Computing Research Association Committee on the Status of Women in Computing Research

Career Mentoring Workshops

Research Mentoring

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Sharing Information

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Building Communities

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Effecting Organizational Change

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CRA-W

Committee on the Status of Women in Computing Research

CRA-W aims to take positive action to increase the number and success of women in computing research and higher education through its four areas of activity:

Research Mentoring

Providing hands-on research experiences and mentoring programs that guide, support, and encourage women in computing.

- Best Practices in Recruiting and Retaining Women in Computer Science and Engineering
- Career Mentoring Workshops
- Collaborative Research Experiences for Women
- Distributed Mentoring Project

Information Sharing

Collecting, analyzing, and disseminating information about and for women in computing.

- Careers Booklet
- CRA-W Online
- CSE Ph.D. Database
- "Expanding the Pipeline" Column

Community Building

Fostering professional networking, collaboration, and recognition of women in computing.

- Award Nominations
- Coalition of Women in Computing
- CRA-W/Lucent Technologies Distinguished Lecture Series
- Systers Academia

Effecting Organizational Change

Educating and influencing organizations on issues, policies, and procedures to promote the full participation of women in computing.

- Government Affairs
- Senior Leadership Development Workshop

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Career Mentoring Workshops

Guidance for graduate students, new Ph.Ds, and professionals at all levels

Coordinator • Francine Berman, *University of California, San Diego*
Editor • Ann Redelfs, *San Diego Supercomputer Center*

Contents

4 • Preface

5 • Building a Research Career
Francine Berman, *University of California, San Diego*

15 • Getting a Job
Francine Berman, *University of California, San Diego*

25 • Obtaining Federal Funding
Caroline Wardle, *National Science Foundation*

31 • Networking
Janice Cuny, *University of Oregon*

37 • Tenure
Mary Jane Irwin, *Pennsylvania State University*

43 • Perspective From the Smaller Schools
Sheila Castañeda, *Clarke College*

47 • Time Management and Family Issues
Janice Cuny, *University of Oregon*

Preface

This publication is the culmination of a decade of information provided at the highly successful CRA-W Career Mentoring Workshops. In 1991, the Computing Research Association (www.cra.org) established a subcommittee to address the problems of attracting and retaining women in computer science and engineering. The resulting CRA Committee on the Status of Women in Computing Research (www.cra.org/craw), CRA-W, has developed a number of highly successful programs. One of the most effective programs sponsored by CRA-W has been a series of Career Mentoring Workshops focused on providing critical information and mentoring to students and professional women at all levels in computer science and engineering.

The workshops have been held at every Federated Computing Research Conference (www.acm.org/sigs/conferences/fcrc) since 1993 and at a selection of other conferences. A CRA-W Career Mentoring Workshop is typically structured as a set of panels and social events that provide the participants information critical to success in the workplace and ample opportunity to network with senior women and workshop attendees. The panelists at the workshops include prominent senior women from academia, funding agencies, the national laboratories, and industry, who speak expertly on a variety of subjects from "getting a job" to "obtaining funding" to "time management."

The chapters herein are based on information provided at a number of workshops. These chapters were written to summarize much of the information presented at the workshops, and to provide mentoring to the community beyond the workshops themselves. Raw workshop transcripts are also available on the Web: cra.org/Activities/craw/mentorWrkshp/transcripts.

At the last Career Mentoring Workshop (www.cra.org/Activities/craw/projects/researchMentoring/mentorWrkshp), the participants were challenged to take the useful advice and ideas they gained at the workshop and to use it to improve the professional research climate at their home institutions. We hope that you, the reader, will accept the same challenge, and that this information will be not only be helpful to you, but that you will find a way to use it to mentor and support others in your own environment.

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Let us hear from you:

As you make use of the information in this publication or experience successes not defined in these pages, we invite you to provide input to this publication by submitting your insights to the CRA-W Career Mentoring Workshops Web site: www.cra.org/Activities/craw/projects/researchMentoring/comments.html.

Building a Research Career

Francine Berman, *University of California, San Diego*

Workshops held in 1993, 1994, 1995, 1999

Participants
Ruzena Bajcsy, National Science Foundation
Anita Borg, Institute for Women in Technology
Anne Condon, University of British Columbia
Jeanne Ferrante, University of California, San Diego
Leah Jamieson, Purdue University
Nancy Leveson, MIT
Vijaya Ramachandran, University of Texas at Austin
Barbara Simons, IBM
Mary Vernon, University of Wisconsin

1. INTRODUCTION

"The joy of research must be found in doing because every other harvest is uncertain." [*T. Smith*]

"If you want to make important discoveries, work on important problems." [*P.B. Medawar*]

This chapter is a compendium of two excellent CRA-W panels and my own experience doing research. There is a wide variation in the level of the advice given here, from guidelines for pre-tenure researchers developing their first professional research programs to tips that will be relevant throughout your career. As the quotes above indicate, conducting the research is at least as much a part of the experience as your research results. The research experience can stretch you intellectually, professionally, and emotionally, and a satisfying research career can be well worth the effort and commitment it takes to succeed.

1.1 Why Go Into Research?

Computer science and computer engineering are very exciting fields. There are many opportunities for innovation, creating new technology, and designing and developing new research prototypes and products, in areas ranging from the most mathematical and theoretical to the most experimental. Researchers are members in a community of scholars and innovators. The computing research community contributes much that is important and valuable to society, and a career as a computer science researcher can be enormously and personally satisfying.

Researchers are as different as the research they do but certain attributes seem to help promote research success. It helps to be:

- curious about the whys and hows of things
- persevering in your approach
- an independent thinker and worker
- creative
- disciplined and focused when you need to be.

In this chapter, we discuss practical strategies for building a research career as well as the art of doing research.

2. DOING RESEARCH

Your goal as a researcher is to investigate a problem with the goal of developing a solution that advances the state of knowledge about that problem. The choice of the research problem, the way you attack it, the way you communicate your results to your community, and the way you leverage individual research efforts to build a body of work all contribute to your success as a researcher. The following subsections describe different aspects of doing research in more detail.

2.1 Choosing a Research Problem

The choice of a research area and research problems is fundamentally your own. You should choose an area and problems about which you feel the most excited, interested, and creative. You will spend a lot of time thinking about your research and you want to engage the very best of your creative abilities over a long enough period to thoroughly understand the problem, and come up with innovative and successful solution strategies.

2.1.1 Work on Important Problems

The more important the problem, the more important your results will be. Good work that is considered too "incremental" or focuses on a problem that few people care about may not provide you the leverage in your research community you'll need at career transitions (first job, tenure, promotion to full professor, etc.).

The first problems you work on will probably be a collaboration between you and your thesis advisor or other faculty or students at your graduate institution. As you mature professionally, it will be important for you to develop a sense of what problems to work on and where the next problem will come from. Although some researchers have a natural feel for this, everyone else has learned this along the way so don't feel that you are not cut out for research if you do not know what to do next.

2.1.2 New Problems Can Come from Anywhere

A theoretician in the research community began to think about geometric algorithms when he had to move a piano into an upper-level apartment. A high-performance computing researcher developed strategies for implementing distributed applications based on her observations of how drivers deal with freeway traffic. Your first problems on your own may come out of the "future directions" of your thesis or out of research papers you have read doing your thesis research. You can pick up new problems reading the literature, going to conferences and noting the areas of interest to your community, talking to colleagues, preparing for the courses you teach, and working with students. Many times you'll start addressing one problem and become interested in an offshoot of that problem which leads you to still another problem. Solving problems that somehow hang together or attack a particular theme can help in establishing you as a researcher with an identifiable body of work.

One possible approach to choosing problems is to look for the "hot areas" in your field. This approach has both pluses and minuses. Most research communities have hot areas that change reasonably frequently. Hot areas are often motivated by current issues of practical importance. Making a contribution in such areas is not only worthwhile but can provide you with additional research visibility. If the area is new,

you may be able to come up with a significant result fairly quickly if many of the fundamental questions have not been widely researched. However such areas can also be high risk. The more popular an area is, the more people may be working in the area and the same result may be discovered independently by several groups of people. If you are not tied into your research community, you may not know that other people have come up with the same result until you see it published at a conference or in a journal. If you work in a hot area, make sure you know the other people working in the area and are in touch with them so that you are aware of new results.

2.1.3 Finally, Know the Literature

Read widely on your problem and in your area so that you can recognize what is new and what has been done previously. Read widely outside your area if you can because often the same problem may be addressed in different research communities. The more techniques you have in your research arsenal, the more techniques you will be able to apply to any given problem and the more you will improve your chances for success.

2.2 The "Mechanics" of Doing Research

Professional researchers know a lot about the "mechanics" of doing research. The following is a partial list of research skills that experienced researchers have found helpful in developing an effective research program.

2.2.1 Set Aside Big Blocks of Uninterrupted Time to Think Creatively on a Regular Basis

Your brain is a muscle and it must be exercised to stay in top shape. Many researchers find it critically important to have uninterrupted time to work out research ideas. Although for many researchers, good ideas come at a variety of times (on the drive home, in the shower, at the office), the time to work through such ideas is critical to the development of research results. It is easy to get distracted by small jobs, unimportant problems, or e-mail during your research time. You must make this time a priority if you want to develop your research program.

2.2.2 Know When to Work More Deeply, When to Work More Broadly, and When to Put Things Aside

You'll need to develop a feel for when to push through on a problem, when to step back and consider your work in a broader context, and when to give things a rest. This is true both "locally" in terms of the time you spend considering different solution strategies for a particular problem, as well as for the time you give to the problem or the area itself. If things are not panning out for an excessive amount of time, it may be time to move on. It may be that your skills and your problem-solving approach is much better suited to a different problem or even a different area. It's often good to talk to a trusted mentor or colleague if you're at this point so you can get some perspective.

Note that research is an uncertain profession. You will regularly work on things that don't pan out at the time but that turn out to be useful in completely different situations. Probably the only guarantee is that your work will almost never be "linear"—progressing from problem to result in a direct and straightforward fashion.

2.2.3 Start with Problems Rather than Solutions

The idea is to study the problem and understand it thoroughly without restricting your solution approach. Some researchers have had considerable success with particular solution techniques, but the assumption that the techniques you know best will fit all the problems that you are interested in can limit you unnecessarily.

2.2.4 Question Assumptions

One approach to investigating new solutions is to question the underlying assumptions of your problem. Do you need to assume that k is even or that messages are queued in FIFO (first in first out) order? You may find an innovative way of looking at the problem if you don't take the same path as everyone else.

2.2.5 Break the Problem into Manageable Pieces That Will Fit into a Whole

One way to attack a problem is to break it into "pieces" and to try to solve each of the pieces. This approach has the benefit of building a successful solution from smaller solutions. Sometimes you may have a sense of what the next step is but not the step after that. Having a sense of what the pieces are can help provide a context in which to determine your strategy farther down the line.

Note also that decomposing your research problem is an iterative process and that it may be necessary to re-evaluate the big picture frequently with collaborators, graduate students, colleagues, and others. Things that appear to be show-stoppers initially might not be so bad as you get into the problem and things that you thought might be simple may turn out not to be. Keep an up-to-date perspective on the big picture of your research.

2.2.6 Know What it Means to Solve Your Problem and be Able to Demonstrate this to Other Researchers

Have a clear idea about what it means to demonstrate that you have solved your problem. Theoreticians may use theorems and proofs, and experimentalists may show comparative studies or simulations. Know what it means to your community to demonstrate and you have done something and make sure that that is part of your solution approach.

2.2.7 Have Long-term and Short-term Research Goals

Have a sense of the big picture and where the problem you're working on fits within it. Your ultimate research goal is to develop a body of work that represents your talents and skills as a researcher and contributes to the body of knowledge in computer science and/or computer engineering. In the near term, you are probably working to solve pieces of one or more problems. Develop a strategy that leverages your immediate research goals into a long-term approach to research. Keep your goals in mind when you prioritize your time and effort at the day-to-day, week-to-week, month-to-month, and year-to-year levels.

2.2.8 Promote Your Work

No matter how important your results are, no one will know about them if you don't publish them and present them to your colleagues. Professional research consists of the investigation of problems and the communication of results. In the next subsection, we will talk about several strategies for publishing your work, but whatever strategy you choose to take, your success as a researcher depends on your ability to communicate your work.

When you talk about your work, be realistically upbeat about it. Excessive modesty ("This isn't very important.") or excessive arrogance gives the wrong message about you as a researcher and distracts your audience from your results. Put your results into context but allow yourself to feel good about them—this is new work and as such is a real contribution to computer science.

2.3 Publicizing Your Work

Your main means of communicating your work to others, as well as building your research community, is to publish. Researchers often form a strategy for what and when to publish, taking into account how much should go into each paper, where it should be sent, when the work might be mature enough to publish, and how a publication will fit into their career plan. The following subsections synthesize some of the common issues around publishing for researchers.

2.3.1 Where to Publish

Most people will tell you to publish in the best professional journals and conferences in your area. There are many good reasons for this—your work will reach the most relevant audience, the quality of your publishing choices will be noted at career transitions or if you apply for a job elsewhere, and you do your good work justice by publishing it in good places. If you don't know where the good places to publish are in your research community, ask someone who would know and whose advice you trust.

Conversely, avoid publication choices that may be discounted by your professional community—these may include private journals with low readership, poorly refereed conferences, etc. Although workshops are not considered as good a place to publish as top-quality conferences or journals, they are often attended by the best people in your field, so you may want to publish in selected workshops, but possibly not your very best or most mature work. (In fact, people often use workshops to get feedback for new ideas and/or immature work.). Note that technical magazines are typically not considered as prestigious as good archival research journals (although they often have much broader audiences). *IEEE Computer* and *ACM Communications* are widely read and highly competitive and may be considered an exception to this rule.

The importance of journals, workshops, and conferences will vary from area to area. In some areas, conferences are considered much more competitive and prestigious than journals; in other areas, journals are considered more prestigious. Some workshops are considered to be as important as good conferences. Make sure you know what publications are considered the best quality by your research community when you are considering where to send your papers.

By the way, in almost all areas concurrent submissions (sending the same paper to two conferences and/or workshops simultaneously or to two journals simultaneously) is considered unethical. Program committees, reviewers, and editors will generally automatically reject any work that they believe is being submitted elsewhere or is very close to work that has already been published. It is reasonable, however, to expand one or more conference papers into a journal submission. There should be more results in such papers than in their constituent parts.

2.3.2 What to Publish

What constitutes a publication varies a lot from field to field and even from problem to problem. Your thesis advisor or other faculty can help you in determining what should go in your first publications which will most likely be the ideas in your thesis. For most students, there are two to three separable and publishable pieces of work within their thesis.

You can also study the conference proceedings and journals in your area to get a good idea of what constitutes a publishable result. In general, you want to publish one or more good new ideas that you have worked out or substantiated and put into context. Seek to publish the most innovative of your ideas but also the ideas most in need of feedback. Submit these to workshop or a rigorously refereed conference and use the feedback to improve your work. Over time you will develop a feel for what is publishable and what is not.

By the way, your colleagues and reviewers will always appreciate more in each paper rather than less. Although the quantity of publications in your resume does count at career transitions, the quality counts more. Always publishing immature work or the "least publishable unit" will get you more publications but not earn the respect of your colleagues who will be asked to write letters evaluating your work at tenure time. Just as you will actively seek to investigate important problems, you should seek to write important papers that introduce good new ideas and do a comprehensive treatment of them. Strive to get a "best paper" award with your papers rather than just to be accepted. It will help you to be a better researcher and earn you respect in the eyes of your colleagues.

2.3.3 What do Referees Look for?

Most referees like papers that are written well, articulately describe one or more interesting ideas, and provide credible substantiation for the importance of the ideas. The quality of your writing is important. Your paper needs to describe to the referees why both the problem and your solution are important. At the same time, don't oversell your work. Many referees are likely to rank a paper higher that describes a solution and its limitations than a paper that purports to have fully solved a problem and hasn't. Beware of using too many buzzwords. Your goal should be to articulately, carefully, and thoughtfully describe your problem and solution in a way that communicates to the referees the importance and quality of your work. Write a paper that you as a reviewer would consider excellent. Use classic papers in your area and "best papers" in conferences as a guide for what is good writing. Here are a few tips on style:

Make your paper both readable and interesting.

Reviewers are more likely to put unreadable, difficult papers aside to be picked up "later" and are less likely to review them well.

Don't try to snow people.

Take time and care to make your ideas understandable. The people who have really significant contributions to make do their very best to explain them in the simplest way possible.

Don't make up terminology or use non-standard notation.

If conventional notation will do. Don't make up new terms for old ideas. Use conventional terminology.

Use both math notation and English to describe your ideas.

This helps your reviewers understand what you are doing. Use examples liberally as well.

Make sure your paper is well organized.

Start with an introduction that sets the context, and describes the problem and solution. Follow with a more detailed description of the solution and your results. Provide some kind of summary or conclusion. Use examples to give readers a feel for what you're talking about.

Include a related work section in your paper.

Referees always look to see if the authors have read/surveyed the literature sufficiently. It is important that you do a good job of identifying references relevant to your paper and describing their relation to your results. Although you want to strive for conciseness, too much related work is better than too little.

Use critical reviews to your advantage.

If you send a paper to a conference and several reviewers point out the same thing, listen to them. They are giving you real insight on your writing and your results. Although it may not feel that way at the time, it's often much more helpful to you in the long run to get and use real criticism for your work than it is for people to just say, "Good work!" Note that from time to time, you may get reviews that seem overly nasty or personal. Ignore the nasty part, get what you can from the review, and move on—try not to take such reviews too much to heart.

Be generous in determining co-authors.

Many researchers err on the side of inclusion rather than exclusion when determining who should be a co-author. There is very little downside to including people who have participated in some way in the work as co-authors. In contrast, there is considerable downside to having people think that they participated in the research and are not being given proper credit. If someone helped but did not participate enough to be a co-author, put acknowledgements in your paper and include their name. Everyone appreciates thanks.

2.3.4 Ordering of Authors

Ordering of authors varies widely between areas and between researchers and even for particular papers. Many researchers use a default alphabetical ordering. Other researchers try to determine who is largely responsible for the work and order authors accordingly. Many senior researchers generally put students or junior people's names first and their own name last. Use the ordering policy that seems reasonable to you and will be understood by people in your area. Note that at tenure time, university committees sometimes want an explanation of how much you contributed to a paper, and they may care about who is first author in non-alphabetical papers. Check with your department so that you're sure that you understand what is expected.

2.3.5 Other Ways of Publicizing Your Work

You can communicate your results in ways other than publications. Develop a habit of giving talks on your work at institutions other than your own. This is a great way to get exposure and feedback for your work, and to develop relationships with colleagues in your field. If you're going to be in the area anyway, it doesn't cost much for an institution to invite you to give a talk, so you can use your travel to conferences, meetings, etc. as leverage for building your research reputation. Researchers often do a "tenure tour" (giving talks at institutions where prominent people in your research area work) the year before they are up for tenure so that potential letter writers will be "fresh" and knowledgeable about their work.

You may also want to keep a mailing list of colleagues who are interested in your work. Send them your publications as you produce them, and generally keep in contact with them on research topics. Note that they may not always read these papers but it doesn't hurt to have your work pass their desk. (Note that in this case, sending the paper rather than just a URL may help in getting them to read it.)

Finally, don't neglect publicizing your work within your own department and at your own university. The more your colleagues know about what you do, the better they can represent you to other researchers, potential students, etc. Knowing about your successes and your research will help your chair, the dean, and other administrators when it comes to promotion, support issues, etc.

2.4 Developing a Coherent Research Plan

Research is not just about individual papers or results, it is about developing a track record. Your work should build into a body that makes a significant contribution to one or more areas and identifies your research skills and interests.

Most researchers start in the area of their thesis work. This is a good starting point as it is an area where you have real expertise, have made real contributions, and have initial research strength. Build from this strength. Take the opportunity after your thesis to address problems you encountered doing your thesis research. You can also take the opportunity to apply the techniques you used to move into related fields. This initial work will provide you with a good base from which to build your research.

Why does building a track record in a timely fashion matter? Academics are evaluated by senior people in their area at tenure time who compare them to the best people in their area at their career level. Having a solid record of accomplishments in a well-defined research area will allow you to gain visibility and make a favorable impression. Concentrating on a main area before tenure and having a solid record of accomplishments will help you build a successful tenure case. The following sections focus primarily on building a research career before tenure.

2.4.1 Developing a Research Area

It is initially a good idea to work in the area of your thesis, but most researchers do not spend their entire career in their thesis area. At some point, you will want to branch into related or different areas. The good reason for this is that it keeps you interested, it keeps your skills as a researcher sharp, and it's hard to make a very broad impact on research if you are always working on the same set of problems. That being said, the issue for pre-tenure researchers is when to shift into other areas. Your focus pre-tenure is to establish yourself in an area for which there are identifiable senior people and for which you have made clear contributions. This does not have to be your thesis area, but if it's not, you will need time to establish yourself.

Many researchers shift or expand into new areas either early in their tenure process or late, when they have established themselves in an area already. One strategy for branching out early is to work in your thesis area as well as related or other areas that are interesting to you post-thesis. Make sure that at least one of the areas in which you work can be considered your "main" research area by your colleagues at tenure time. Note that it is not the same to have one good publication in each of k areas vs. having k good publications in one area. In the former case, senior people in the various areas may feel that they have insufficient data to evaluate you so that none of the communities you work in may consider you tenurable, In the latter case, you have built a body of work that is more visible and identifiable to the senior people in an area and they may feel more comfortable evaluating you for tenure.

2.4.2 Working in Controversial Areas before Tenure

You may consider whether to work in a controversial area before tenure. In such areas, you may generate work that is both very much appreciated (and/or thought to be very important) by some researchers and very much condemned (and/or thought to be inconsequential) by others. If you choose to do this pre-tenure, you may run the risk of negative letters from researchers that may be difficult for your case (see the tenure chapter for more discussion of this process). On the other hand, your department may have other researchers in this area and an understanding that the work is valuable but controversial. Get good advice from your mentors on working in a controversial area. You may

choose to work in such areas as a secondary or tertiary area and move into the area more fully post-tenure. However if you are absolutely confident that what you are doing is really terrific, and the problems engage you above all else, go for it. Research is all about risks and sometimes the best choice for your may also be the most risky.

2.4.3 Collaborating before Tenure

For many of us, one of the joys of research is collaboration. Research is often a social process where the synthesis of individual research perspectives can become more than a sum of its parts. Your collaborators will know you well and will understand and appreciate your results. The process of collaboration can be fun and immensely satisfying.

Throughout their careers, most researchers collaborate with a variety of people senior to them, at their level, and people junior to them, including students. In any given collaboration, the role of each person and the amount contributed to the research by each of them varies. Your role in collaborative research is one of the things in which your tenure committee will be very interested. Note that other researchers in the community will sometimes identify and/or give credit to the most senior collaborator on joint work. This can work against more junior collaborators who may actually have performed a considerable part or provided the fundamental vision for the joint work. (This can be especially true with your thesis advisor so you may want to avoid having a substantive part of your research be joint work with your advisor.) When collaborating with colleagues, be clear about who will develop the software, who will write the paper, who will be first author, who will present the results, etc. You can ensure that your work is given proper credit by having some singly authored papers, a variety of research collaborations, and collaborations in which you are the senior collaborator.

2.5 Good Research Practices

The process of doing research involves not just you but students, collaborators, colleagues, and others in your community. Since you are in it for the long haul, it makes sense to develop good research practices that not only contribute to your experience as a researcher but make you a researcher who is respected by others. Here are some things to keep in mind:

2.5.1 Be a Good Colleague

For most of us, research is a fun and social activity as well as an intellectually challenging activity. Be a good colleague. Value your colleagues' time and ideas as you would your own. Seek out good people to work with and nurture your relationships with them. Helping others to succeed as people will no doubt be helping you. Give of your time and your expertise to your students, your department, and your research community when you can. Don't focus on the trivial, the petty, or fads. As a researcher, you'll be a role model for a great many people. Be a good one.

2.5.2 Use Other Activities as an Opportunity to Enhance Your Research

Rather than a distraction from research, teaching and other activities can often be used to enhance your research. Oftentimes, researchers will weave their teaching commitments and research together. If you have the opportunity to teach a grad course or a topics course, you can use it to stay current with the research in your area, and also to interest grad students in your research. Teachers often note that you never quite know a topic as well as when you have to teach it. Teaching even classic material can give you ideas about techniques or relevant work for the problems you are working on as well as interest students in working with you.

Also, use any opportunity you can to think creatively. You may get good ideas from describing your work to a colleague on a university committee, or even your family. You can get good ideas from reading all kinds of literature and thinking about connections between what you're reading and your research. Lots of researchers get good ideas from looking at solutions to real-life problems, connecting freeway traffic to network problems, waiting in line to queuing theory, etc.

2.5.3 Celebrate Your Accomplishments

Academics generally don't get immediate rewards for doing good work. Recognition typically comes as a result of a long track record. Even for specific stellar results, it may be a substantial delay between the time you write up the solution and the time that you present your work or are recognized by your colleagues. Impart to your students and yourself a sense of accomplishment when you've completed a project. By the time you get community recognition, you will probably have moved on. Don't wait until a paper has been accepted or rejected. Celebrate the fact you finished the paper and submitted it. If you and your students have worked hard on a project and it's finished, celebrate. You deserve it.

2.5.4 Find/Create a Supportive Environment

Infrastructure is critical to many research activities. Experimentalists may need adequate numbers of personnel, large-scale computational platforms, and complex software environments in which to conduct their work. Inter-disciplinary researchers may need sophisticated collaboration environments in which to make progress. In order to work well, you will need to find or create enough resources to conduct your research. Often this means attracting sufficient grant money, but you may need resources that you may only be able to get from your department or university—space, furniture, network connectivity, administrative support, etc. Think carefully about your infrastructure strategy. Your success is in your university's best interest and it may be possible to partner with your university in building and maintaining your research program, depending on how tight resources are. In some cases, it is possible for the researcher to receive some of the university overheads or other kinds of support to help build the infrastructure they need.

2.6 Working with Students

For most academic researchers, much of your research career will be spent mentoring and advising students at all levels. It is extremely rewarding to see a graduate student evolve from a novice to a professional researcher and to see them take their place within the research community. After you have been a researcher for a while, you may even have "grand-students" (students of your graduated students)! Your relationship with your students is an important component of their present and future success as researchers. Good research advisors find a way to help their students mature as researchers, find and solve their own problems, and learn the mechanics of doing research and participating in a professional research community. You will need to consider how to support your students during the period in which they are working with you—intellectually, emotionally, and financially. The following are some tips in mentoring and working with graduate students.

2.6.1 Find Good Students

If you teach graduate classes and/or seminars, you have a terrific opportunity to find and assess students who may work with you on research problems. Many faculty pick the best and most interested students and ask them if they would like to follow up and do an independent study on a research problem of mutual interest. This allows

both the faculty member and the student to "try out" a research relationship before they make a more formal commitment to be advisor and advisee.

You can also give general talks in seminars in your department and see who comes. One approach is to send out a general note to graduate students advertising your talk and letting them know that you have research slots in your group or research funding available. Interested students may come to the talk and approach you afterwards about working together.

Another approach is to offer to fund new students in the program or prospective students who have applied to your program. If someone has expressed an interest in a research area you work in, you can offer them a position as research assistant (RA) for one or more years even before the student has arrived on campus. This is a high risk/high benefit approach which can work out very well or not so well. Some of the risk may be mitigated by offering a promising new student a one-year RA with an option for further work, should both of you agree that you enjoy working with each other; however, this is also a higher risk for the student.

2.6.2 Develop Good Students

Working with students is not just a lot of work for the students, it is also a lot of work for you because you are essentially training them in the art of doing research. Initially, you will spend a lot of time introducing an area or investigating a new area with a student, getting a feel for their skills and their abilities, and developing a working relationship with them. At some point, you will have a publishable result and you will work with them to show them how to write a technical paper and to edit their work. You will also probably work with them preparing and giving talks and evaluating what's going on in your shared research community. Working with students is rewarding all along the way but especially as the student becomes more senior and interacts more as a colleague and a collaborator than as an advisee.

Most students come to graduate school without a clear idea of what it takes to do research or be a researcher. One of the ways you can help them learn more about the mechanics of research is to give clear guidance and good feedback to your advisees. Teach them how to analyze a problem and where to look for answers. Teach them how to communicate with other researchers—good writing and speaking will be critical skills for your students no matter what they end up doing. It is very gratifying to see students who started not knowing much about research get jobs and be successful as professional computer scientists.

Note that as with any relationship, your research relationship with your advisees will ebb and flow. Many students find the process of finding a thesis topic difficult as that is their first real "hands-on" experience with the uncertainty of research. Some advisors provide the research problem and the student is tasked with developing a successful solution strategy; some advisors encourage the student to think through the process of finding the problem as well as the solution. Whatever your approach, or the approach taken by most researchers in your community, many students have a particularly difficult time during this period and need additional support. Meeting with the student regularly, finding a small concrete goal to focus on, and letting the student know that all researchers have periods of uncertainty can help a lot.

When students are ready to graduate, you need to help them think beyond their thesis. What areas are they interested in branching out in and what problems do they want to work on? What problems that come out of their thesis do they plan to work on and what problems are you free to work on with other students? What are their career goals? You can help them greatly during this period by assisting them to get a good start in their professional career.

2.6.3 Support Your Students

It is much easier for students to focus on research if they do not have an outside job. If it is possible for you to support your students, or help them find fellowships of their own, do so. Providing your student with focused time and space within your research group gives them a context in which to do good work and can be extremely important to the creative process. If you don't have funding, you might be able to help your student get a fellowship or a teaching assistantship—all of those help the student stay in the department while doing their research. Know that if a student works at a job outside of the university, it will probably take longer and they may not be as well-connected to their research community as students who are working doing research within the department.

You can support your students in other ways. Nominate your students for fellowships and awards if you think they are good candidates. There are several national fellowships and internship programs sponsored by funding agencies (e.g. NASA and NSF) or industry (e.g. IBM and ATT) that distinguish good students while they are in graduate school. Being awarded one of these fellowships or internships can help your students both financially as well as providing important professional contacts that will help them after grad school. Your support is critical in order for them to be nominated for such fellowships. Finally, support your students in your department. They will appreciate your efforts and it will help them have confidence in their abilities as well.

2.6.4 Encourage Your Students to Publish

When your students graduate and enter the job market, the number and quality of their research publications will be more or less of an issue for most jobs. For academic jobs, it will be critical that your student has some record of research productivity. Encourage them to publish throughout their graduate career and not just during their last year.

The great majority of student publications are co-authored with their advisors. Most advisors feel that they have contributed substantively to the work through their guidance, support, collaboration, writing, and editing, and that they should be a co-author on a student paper. There may also be cases in which advisors feel that it is more appropriate for students to publish certain results as a singly-authored paper or with other researchers. You will have your own ideas on what is appropriate on this. It is also useful to talk to other researchers you trust or to look around and see what other researchers in your community are doing in cases where it is not clear what to do.

2.6.5 Promote Your Students

The best thing you can do for your students is to give them a good start in their professional life. Help your students develop professional contacts and establish a professional network. Tell your colleagues about their good work. Credit them in your talks and your papers for their ideas and their research. Nominate them for awards, program committees, etc. Tell funding agency managers about their work. Be a resource to them in finding a job, and in succeeding at their jobs. It is immensely rewarding to see successful researchers in the field who have been former students and who are now mentoring and developing new researchers themselves.

2.7 Research Funding

For many researchers, achieving an adequate level of research funding is critical to their success. Research funding is used to support students and staff, to travel to professional meetings and conferences, and to obtain equipment necessary for research. For some researchers in some areas, part of the process of doing collaborative research includes writing or being included in proposals with their colleagues. If obtaining funding is important to support your research or important for interacting in your research community, you will need to become good at it.

There is a whole chapter on obtaining funding in this publication. In this section, we will briefly focus on the more "cultural" aspects of obtaining funding.

2.7.1 Recognize That Different Funding Agencies Have Different Cultures and Different Means of Assessing Your Work

The process of applying for, attaining, and reporting on the results of funding varies widely between different agencies. In computer science, researchers typically apply to DARPA/DoD, NSF, DOE, NIH, and NASA for funding. Each of these agencies have very different organizational structures that have a real impact in how proposals are solicited and evaluated, and how funding is allocated. For example, NSF currently uses peer panels to initially evaluate proposals whereas DARPA evaluation is focused around the program manager. There may also be very different expectations about what happens after funding is awarded and even what funding can be awarded for. NSF requires annual reports but does not generally focus on "deliverables" whereas these are an important part of DARPA contracts. Have a good feel for the culture and organization before you apply to a specific agency. The best way to do this is to ask people who are funded by that agency what the experience is like.

2.7.2 Know the Difference Between an Contract and a Grant

Although you conduct the same kind of research for both, the constraints imposed by contracts and grants are very different. A grant provides you funding to investigate a problem or a promising solution with generally no expectation for concrete deliverables. Grants allow some freedom to follow the direction of the research during the granting period, but the funding itself may be very restricted to particular categories (e.g. salaries for technical participants, travel, equipment). Contracts are much more focused on the "products" of the research and allow less variance. In addition, the reporting requirements may be more stringent, however funds can often be spent on "infrastructure"—administrative staff, meals with visiting colleagues—which are not generally allowed with grants.

2.7.3 Read the RFP or BAA Closely

The RFP ("Request for Proposals") or BAA ("Broad Area Announcement") contains the description of the program and what the evaluators of the proposals will be looking for. Read this carefully. Don't just read the title of the program and write what you want. Your proposal will be evaluated on the criteria provided in the RFP or BAA and it is critical that you provide enough information to be able to evaluate the work based on those criteria.

2.7.4 Be Clear About Your Goals

In some areas, it is easy to get caught up in the acquisition of funding. Be clear about your goals—what is the right size group and funding for your research? If you are just starting out, you might focus on winning an NSF CAREER grant or building a relationship with program managers in the funding agencies who focus on your area. Build your funding program as you build your research and let your research drive your funding rather than the other way around initially.

Note that many very prominent experimental and systems researchers have large research programs that require huge amounts of support. Obtaining research funding can become a full-time job for such programs but the size of a large group also affords a researcher the opportunity to put forward a big vision. The overhead of a big research program is large—multiple grants and contracts are required with considerable management responsibilities, expectations for reporting and interaction with the funding agencies, and large-scale responsibilities for direction, promotion of the research results, and publishing. The responsibilities and scale of the research is large but the potential impact is also large.

3. INDUSTRIAL RESEARCH

Many industrial research activities are the same as academic research activities. Industrial researchers write papers and publish them in their area's technical conferences and journals, serve on program committees and panels, make professional contacts, and review papers. Many companies have summer or other programs with universities in which researchers supervise and mentor students. Some companies have sabbatical programs in which industrial researchers can visit universities or other institutions for a prolonged visit and take a long-term view of what they are doing. There are also differences between academic and industrial research. The following subsections briefly focus on some of them.

3.1 Research Relationships

Researchers who have had both positions in industry and in academia advise that you have a fundamentally different relationship with your colleagues in academia than you do in industry. In academia, most researchers primarily work with their students where they are "project lead" and perhaps with a small number of departmental colleagues. In industry, many researchers work as part of a team where everyone is on the same footing.

Most people who join a company initially join as part of a group. The expectation is that the researcher will be a good team member of a project which may or may not be directly in the area you've been working. Researchers are expected to initially "pay their dues" doing work on the project for which they were hired. After establishing their credibility, project members develop more independence within the company and can go on and propose research projects to the company. Successful project members may be tapped as research managers. In contrast, as soon as you join an academic department, you are assumed to be an independent researcher. You set your own direction, goals, and agenda and you are responsible for your own research program. You enter as a research manager.

Note also, that the "infrastructure" of your research program varies as well. In industry, it is important to develop company contacts and support within the company. In effect, the company is your "funding agency" and needs to understand and appreciate what you do. Researchers in academia can rely on some infrastructure from the department but most of their research funding must come from outside contracts and granting agencies.

3.2 Changing Fields

Many industrial researchers feel that it is easier to change fields within a company than in an academic department. The company allows the researcher the time to start up a new field and an environment of project colleagues that affords the researcher the opportunity to learn a new field and contribute. There may be hundreds or thousands of employees at the company and many projects so it may be easy to move within the company. In an academic department, the "startup" for a new area counts toward your next career transition (tenure, promotion to full professor). You must time moving into a new area and in particular, develop a strategy so that you have enough time to mature in a new area and so that letters reviewing you as a researcher at career transitions are positive.

3.3 Which is Harder?

Some researchers who have worked in both industry and academia claim that academia is harder. They say that there is more to do as an academic researcher and that it is easier to strike a balance between research and other activities as an industrial researcher. Other industrial researchers claim that the influence of management and the ultimate product orientation of industry make their jobs less stable than for tenured academic researchers.

Note that it may be easier for industrial researchers to move between companies than it is for academic researchers to move between academic departments. Companies may also have an advantage in dealing with "two- body" problems as they may have hundreds or thousands of employees rather than tens.

3.4 Industrial Project Management

In most venues, success provides the ability to rise in the hierarchy of the institution. Many successful industrial researchers are given opportunities to lead and manage projects of their own. The experience of these managers varies widely. Some managers say that for some projects, they conducted essentially no research themselves. Some managers feel like they do a considerable amount of research on their projects. The advice of these researchers is to look at a management opportunity very carefully to get a clear idea of how much research is required and to consider who will be working for you, how well defined the tasks are, and how much scope there will be for research.

3.5 Switching from Industry to Academia

It's generally considered to be more difficult to switch from industry to academia than from academia to industry. Researchers who have made the switch stress the importance of keeping an academic profile and maintaining an academic resume. The idea is to do all of the same things the professors at your career level are doing in your research community: publishing papers, serving on program committees and leadership positions in your community, etc. All of this is much easier if your company rewards it. For some companies, having prominent researchers is important and they will give you a lot of latitude with respect to building your academic credentials. For other companies, such activities are considered secondary to activities that support the product development of the company. As with academia, it is probably easiest to move very early in the game, i.e. within a few years of attaining your Ph.D. or if you are a very prominent senior person within your community. In between those two extremes, it is more difficult.

4. "INTERRUPTIONS" AND LIFE AFTER RESEARCH

Your research career is just that, your career. It is not your life, although at times it feels that way, seems that way, or even is that way. Most researchers go through standard creative cycles which are interrupted from time to time by a variety of professional and personal events. The good news is that the research skills you are developing can be used at any time. Getting back into research from an absence is a bit more difficult if your research requires a considerable amount of infrastructure (such as experimental research for example) or if your absence from it is prolonged. Be realistic. Life happens, and most of it is much more important than research! Here are a few research "interruptions" and a brief discussion of their potential impact with respect on your research career.

4.1 Sabbaticals

Sabbaticals can be a great boost to a research career. The opportunity to go to a different place without the usual responsibilities and to be exposed to new people and new ideas is often rejuvenating. Many researchers take the opportunity to learn a new field or do a longer-term writing project on sabbatical. They also give researchers the breathing room to "empty their stacks" of work that have been piling up. If you have a large research program or considerable infrastructure at your home institution, you will have to make arrangements for supervision and maintenance of your group. Sometimes students may travel with you on sabbatical, but this is less practical for administrative or technical staff. However most researchers consider the opportunity to take a sabbatical well worth the extra effort in arranging it.

Researchers say that the return from a sabbatical is like a "professional Monday morning" after a "research vacation" so plan in advance to make this transition as smooth as possible. While you were away, some things in the department will have changed and you may have missed getting to know some potential students. If you plan ahead, it is possible to minimize the down sides and enjoy the positive experience that getting away can be.

4.2 Moving/Changing Positions

Moving to a new place and a new position can be an exciting change. New colleagues, new students, and a new department will influence your work and can provide a good source of new ideas. However, moving often has a real (immediate) cost on your research productivity. You will have to deal with issues around dismantling or leaving infrastructure (equipment and people) from your old institution and how best to set up a good environment at your new institution. At the same time you will be putting together a new life with your family in the new place as well and that takes time and energy. Both personal and professional startup can be time consuming and will no doubt slow your immediate research productivity. It will take some time to get back up to speed and settle into/create your new environment, so keep your expectations reasonable.

4.3 Having Children

For many of us, having children is a peak life event. It's one of the very most important experiences you will ever have so give it your full attention. Some pregnant researchers work until they're on their way

to the hospital; some stop some time before that. Many new parents find that it is difficult both physically and psychologically to get back into a very creative research mode for the first few months or even the first year after the birth of their baby. Be realistic about priorities during this period. You may decide to go into "maintenance mode" with respect to your research around the time your baby is born and until your family can re-integrate around its new member and stabilize. If you are pre-tenure, some universities acknowledge that this is a special time and allow the primary caregiver to stop their tenure clock for a period. You may also want to arrange for a lighter teaching load with you chair during this time, or perhaps take a leave to keep your stresses at a realistic level.

4.4 Life Events

Everyone has both expected and unexpected life events that interrupt our everyday lives. Divorce, marriage, serious illness, death, or issues with aging parents or children. can change your focus for a considerable amount of time. Be realistic about your priorities. Give yourself the time and space in your professional career to deal with difficult issues When it's time to get back to your research, it will be there for you.

4.5 Life After Research

Unlike ballet or baseball, researchers can do productive hands-on research for many, many years. For more senior researchers, it may be the case that it becomes time to take on new challenges at some point. Senior researchers sometimes evolve out of a direct research mode to take on administrative positions (chair, dean, etc.), policy positions in government, or industry positions. A productive research career is an important prerequisite for these positions, but the new challenges of these positions also allow the researcher to grow as a professional.

5. EPILOGUE

Research can be an extremely rewarding and satisfying career. Facing, managing, and eventually overcoming uncertainty is a powerful experience, as knowing that you have contributed something to the body of knowledge in your discipline that no one has ever known before. Research is both an art and a science: It requires you to know your subject and to know yourself, to have knowledge of the mechanics of solving a problem, as well as a feel for what is promising and what is not. For many people, the experience of conducting research provides an opportunity to grow not only as a researcher, but as a person, in a deep and substantive way, and is well worth the commitment and effort.

Getting a Job

Francine Berman, *University of California, San Diego*

Workshops held in 1993, 1994, 1996, 1999

Participants
Faith Fich, University of Toronto
Eileen Kraemer, University of Georgia
Jill Mesirov, Whitehead Institute
Toni Pitassi, University of Pittsburgh
Barbara Ryder, Rutgers University
Jennifer Schopf, Northwestern University
Valerie Taylor, Northwestern University

1. RESEARCH OPTIONS AFTER GRAD SCHOOL

This chapter is a compendium of several excellent CRA-W panels on "Getting a Job." The panels were generally composed of senior researchers who had considerable experience with interviewing candidates for a job, and new faculty who had recently been successful on the job market. The panels focused primarily on academic jobs, touching on postdocs and industrial jobs as well. The following sections provide a comprehensive discussion on the process of getting a job based on the information offered in the panels as well as my own experience on both sides of the job market.

2. POSTDOCS

A postdoctoral fellowship (postdoc) gives you an opportunity to "upgrade"—to work at a more prestigious university than the one you graduated from, or work with a well-known person in your area. Alternatively, you may also take a postdoc to work in a related or different area without the responsibilities and pressures of a faculty position. If you can secure a postdoc at a prestigious school or with a famous advisor, you have instant leverage the next time you go out on the job market. Moreover, you have time to generate additional publications for your vita and perhaps write some grants to fund your professional activities.

Start looking for a postdoc the year before graduation. Typically the funding cycle is to secure a commitment sometime in the Fall or Winter with your prospective postdoc advisor. The advisor will need to find funding for you or perhaps apply for additional funding. Alternatively, you can apply to NSF or other agencies for a postdoctoral fellowship. This enables you to bring funding with you to the institution of your choice. Finally, researchers will advertise for postdocs through their professional contacts or through mailing lists such as Systers. Such advertisements may come at any time, and not just in the Fall. The typical time period for a postdoc is two years with one-year postdocs and three-year postdocs also possible.

However you are funded for a postdoc, think carefully about who you will postdoc with and with what institution they are associated. Talk with your prospective new advisor and perhaps their grad students and/or other postdocs and be clear about their expectations—some advisors will consider you a "free agent" while others will expect you to work on specific projects. Knowing up front what to expect will help you get the most out of the experience.

3. PURSUING A CAREER IN ACADEMIA

For Ph.D.s interested in research, academia affords attractive benefits: flexibility in schedule and workload, autonomy in what and how you conduct research, opportunities to work with students, and continuously challenging work. Note that professors at research colleges and universities are typically required to do much more than research: they teach courses, mentor graduate and undergraduate students, serve on departmental, university, and national committees, and write grants and research publications. The more senior you become, the more you are likely to participate in advisory committees and national service as well. This in turn impacts your research career—it keeps you busy, provides a connection with a wider professional community, and gives you an opportunity to impact science on a larger scale. In addition, many professors also consult with industry.

This section and the next give detailed information about applying for a faculty position at a college or university in which research is a substantive part of your job. In Section 5, we briefly describe how industrial research positions differ and discuss the process of applying for a research position in industry.

3.1 Your Vita

Your curriculum vitae (a.k.a. c.v. or vita) is your academic résumé. It should be written in an academic style if you are applying for a faculty position or postdoc at an academic institution.

What is considered "good" on a vita will vary from institution to institution and from person to person, but it is important to consider what recruitment committees (or potential advisors) think is important when developing your vita. Graduate students have a tendency to think, "Having a great thesis is what's really important." A good thesis is definitely a critical element of your vita, but it is not the only one. In evaluating your vita, recruitment committees will look at the following factors:

- What school you come from
- Your research area
- How famous your thesis advisor is
- How good your thesis is
- The number and quality of your publications
- Your letters of recommendation
- Any special awards, fellowships, professional service
- Are you a target of opportunity?)

Spend time developing a good vita from your first years in graduate school. Apply for special fellowships and awards, impress your advisor, publish your results, and give talks at conferences. Nurture a set of letter writers who will be credible to your recruitment committees and

who will have strong, positive things to say about you. (Note that some institutions may value letters from academics more than letters from industry unless the letter writer is world famous.) Make sure your thesis is both strong scientifically and communicates your problem and solution in a clear, compelling manner.

When you are ready to go out on the job market, you want your vita and application letter to reflect your hard work. Identify what aspect of computer science you specialize in at the beginning of both your letter and your vita. Make sure your vita is clear, easy to read, and has no spelling errors. Check with new faculty in your department and/or successful grad students for examples of a good vita and model yours after it. Note that although there are many, many interesting things about you, only the professionally oriented things should go on your vita. In most cases, it is appropriate to exclude hobbies, marital status, outside activities, etc. from your c.v.

In the following subsections, we expand a bit on the factors of importance to recruitment committees.

3.1.1 School and Advisor

All other things being equal, coming from a top school with a well-known advisor who supports you can definitely give you an edge. People will be impressed to find out that you are from a top 10-ranked institution and that Professor X is your advisor. There are trade-offs, however. Professor X may compare you to his/her other students—a fairly competitive group. Having Professor X will make you stand out but a mediocre reference letter will make you a less desirable candidate.

If you're reading this pre-grad school, go to the best known graduate school among the graduate schools that satisfy all your other criteria. This will improve your chances on the job market when you graduate. When picking an advisor, choose someone who is respected in the area in which you feel the most creative and interested. Look for an advisor who is well known, matches your professional style, and has a good track record with students. Try hard to impress that advisor. Your goal is to do a strong thesis and get a strong letter of recommendation—essential factors in getting a job.

3.1.2 Research Productivity

Recruitment committees are very interested in your research productivity. Conference and journal publications indicate that your professional community is impressed with the quality of your results. Do not wait until you are done with your thesis to begin writing papers. Publish your work along the way as it matures and build a professional community. (Note that technical reports are not considered publications by most universities.) Give talks at conferences and network with other people in your field. Getting a job is often the result of personal contacts made in an informal setting when you can share your research ideas in more depth. The frequency of publications, number of publications, and the conferences you publish in are area-dependent so you should be talking with your advisor and other people in your area about a good strategy. In some areas, graduate students publish a half-dozen papers or more in order to be competitive.

Your vita should include refereed publications (conference and journal), any book chapters, technical reports, and submitted publications. It should also include references to any invited talks or workshop presentations you have given.

3.1.3 Awards, Fellowships

Awards, special fellowships, and internships will help distinguish your vita from those of other applicants. They indicate to recruitment committees that you are already accomplished. You can apply to many of these programs in your first year of graduate school (e.g. the NSF Fellowships). You should also look carefully at fellowships sponsored by industry (e.g., AT&T, IBM) as well as government organizations (NASA, etc.). Not only do these fellowships provide you with independent funding throughout your graduate career, but often they provide you with opportunities to widen your network and to establish ties with potential future employers.

Many of these fellowships are competitive. Talk to your advisor and others in your department to determine which fellowships you might apply or be nominated for and what your best strategy is. You may apply for some fellowships multiple years.

3.1.4 Target of Opportunity

Although in many places affirmative action is now against the law, there are schools that endeavor to improve the diversity of their faculty by putting aside special funds to attract qualified members of underrepresented groups. In such cases, it is helpful to be a "target of opportunity," i.e., a member of an underrepresented group that the university is trying to hire. Typically, the criteria applied to hiring underrepresented minorities is the same as it is for everyone else. The difference is that the position may be supported by special funds put aside for this purpose. In this case, being a qualified applicant from an under-represented group may help you get a job. However, there are also occasions when qualified representatives from underrepresented minorities suffer because of their group association—as most of us know.

3.1.5 Letters of Recommendation

Many places have a two-phase process where the department receives applications and solicits letters of recommendation from the candidates in whom they have an interest. Other places ask candidates to send recommendation letters along with their application. Typically, for a junior position (assistant professor), three to five letters are requested. Postdocs may be asked for no letters, or up to three letters, depending on the situation.

It is critical that your letters be strong, positive letters. The letters should show you at your best and indicate your technical strength and suitability for the position. Your letter writers may compare you to other students at your institution, other students they have had, and/or other people in your area at your level. One way to try to determine if your letter writers will be supportive is to ask them if they would feel comfortable writing a strong letter (rather than just a letter) on your behalf. It is far better to know that a prospective writer is uncomfortable writing a strong letter than to have a weak letter go out to the places you are applying to.

Your advisor or another trusted faculty member can help you determine a set of letter writers who will write the strongest letters on your behalf. You may even have them ask for you. Letters can come from anyone who is well respected by the research community. They need not be confined to professors at your university. The best letters are strong letters from the most famous people in your research community (academic or non-academic). Next best are typically academic letters. Another source of letters—although not as highly regarded as the latter two—are industry people not well known in the research community. Note that if your job search goes poorly, you may want to reconsider who your letter writers are for the next time around.

Once you have determined your set of letter writers, send them your c.v. and other supplementary material to assist them. Even if they know your work well, they may not be aware that you were awarded a fellowship or that you won a "best paper" award at an important technical conference in your area. Access to specific information helps your letter writers write the strongest possible letters.

3.2 The Job Application

The job application consists of a cover letter, a vita, a brief (one- to three-page) research summary, and possibly a teaching statement. The cover letter should state clearly what job you are applying for, what your area is, your advisor and institution, and indicate the area of your research. Your vita should include the elements discussed in the previous subsections. The research summary is a one- to three-page description of the work you have done, what you have accomplished, and how you view your research. This summary gives people a feel for the kind of problems you like to work on, and what you are good at. Note that your research summary will be read potentially by all faculty—not just those who are in your field of expertise.

The teaching statement should be one page. In that statement, you should discuss your experience, what kind of courses you can teach and have taught, innovative ideas that you've had that you've used in the courses that you've taught, and perhaps your teaching philosophy. If you haven't taught and you've only been a teaching assistant (TA), you may still choose to include a teaching statement which talks about your experience as a TA.

It is very important that all these materials be well-written, clear, and concise. Get help doing this and look at other people's materials when you formulate yours. Make sure everything reflects the style (academic or industrial) of the place where you are applying. Use a spell checker.

3.3 Deciding Where to Apply

Academic positions and postdocs are often advertised in journals such as IEEE Computer and CACM and on the Web. You may also apply to institutions that are not currently advertising positions. Send your vita with your cover letter and your research summary to the prospective institution. You may want to keep a file on where you sent applications, when you sent them, and notes on follow-up.

Apply to any place you would consider going. There are many reasons to apply for a job at a particular institution—professional considerations, geographical considerations, quality of life considerations, or family considerations. All of them are good reasons to apply. Apply to institutions both "up" and "down" the rankings from where you think you are best matched. Apply to institutions where you think there is something interesting going on in your research area. Sending an application is nearly free and implies no commitment on anyone's part. If there's any chance that you may be interested in an institution, apply. Be open-minded. You may find that you are a good fit with a department you had never thought you would like, and not be as good a fit with a department you assumed would be a good place for you, so apply broadly.

Note that each institution will have expectations for their faculty. For some institutions, it is assumed that faculty will be heavily involved in research and will become national leaders in their research areas. At other institutions, it is assumed that faculty will spend a considerable amount of teaching and interacting with undergraduate students. Be aware of the expectations of different institutions to which you apply. This will help you focus your applications. In fact, you may want to have slightly different versions of your application packet, emphasizing different things about you depending upon the focus of the department.

3.4 The Selection Process

When a university receives your letter, they will add it to a growing pile of applications. The recruiting committee, recruiting chair, department chair, and/or other faculty will look at the letters that have been received. Letters of reference will be requested for some of these applications. A small set of candidates will be asked to come for an interview based on these letters. At this point, your goal is to be asked to come for an interview. Therefore it is important to be in the set of applicants for which letters are requested, and for those letters to be positive.

The more you have strengthened your vita, the better position you will be in to get the attention of the recruitment committee. From the university's perspective, nothing will happen for candidates for whom letters have not been requested, so you definitely don't want to be in this group. Sometimes, you can encourage the process by getting in touch with someone on the faculty of the institution you have applied to (or having your advisor or another faculty member get in touch with them) and inquiring as to the status of your application. This may prod the process if the person who has been contacted can encourage the department to request letters for you or request letters on the department's behalf. This is where your good work at networking and your visibility from presenting papers at conferences pays off.

After your letters have been received at an institution, there will be a lot of discussion. At this point the department must decide which of the qualified candidates will be asked to interview. Typically the department will ask for letters on many candidates but only interview a handful of them. Who the department ultimately chooses to interview is a function of who applies, departmental needs, opinions of the department's faculty members and research groups, politics, and a variety of other things. It may be helpful to have a local faculty champion at an institution at this point. It helps to have impressed the people in your area by your vita or perhaps in person when you have met them at a conference, but there's not much you can actively do at this point.

3.5 The Interview

The interview is a major step. Once an institution asks you to come interview, you have a real chance at the position. If you are asked to interview, the ball is now in your court. The best thing you can do is to be really prepared and try to relax. Before you get to the interview, check out the institution on the Web, get some sense of the kind of research that is done there and the strengths of the department. Prepare a really polished interview talk (more on this later). Talk to your advisor and other faculty members and get a sense of the department. Ask the department for some literature on the institution and look at it. Knowledge is power, and the more you know before you get there, the more prepared you will be at the interview, and the better able you will be to ask and answer the right questions.

The typical interview day is long, exhausting, and fun. Get a good night's sleep and be prepared for a lot of meetings. Generally you will start off the day with breakfast with your host. After that, you will have meetings with faculty members, undergraduate and/or graduate students, staff, and possibly the dean. These meetings will typically last between 30 and 60 minutes. Note that you may request to see specific people or groups during your interview. You may want to talk with graduate students, systems staff, and particular faculty members. These people can give you different perspectives and can help you get the "feel" of a place.

A very important part of the day will be your talk—which may or may not be attended by the people you would like most to be there. Typically, you will be meeting people and "on" from breakfast through dinner. It's tiring but it can be exhilarating as well. You want to get through the day relaxed and at the top of your form. You really have several goals here. You would like the department to be interested in offering you a job, and you want to get a clear enough impression of the department to determine whether you would like working there. Here are some tips that will help.

3.5.1 The Talk

At many places, the talk will be the single most important part of your interview. You are communicating many things during your talk: that your research is addressing an important problem with an innovative solution, that you can communicate well, that you would be a good addition to the research and instructional climate of the department, and that you are a person who would fit in well with the style of the department. Your talk should be rehearsed and polished. Develop your talk with your advisor and research group. Give your talk in front of (possibly different) audiences at least twice (and probably more) before you give it during an interview. The talk should be clear and in the genre of your research area (hand-written slides, PowerPoint, videos, whatever people in your research area typically do). Note that if you use something other than overhead slides, inform your hosts in advance so that they will have the proper equipment and make sure that you have a backup. If your talk is the time the department discovers that the LCD projector is not working and you have no backup slides, it can really throw off the interview.

The talk itself should convince your audience that you have tackled an important problem and devised an innovative solution. You really are targeting two audiences here: first you want everyone to understand what the problem is that you are addressing and that your solution is important, and second, you want the specialists in your research area to be impressed. Make your problem and solution generally interesting to people not in your area, and provide a good overview of the solution. You must also provide enough detail to convince specialists in or close to your area that your approach is innovative, credible scientifically, and a research contribution. Appealing to both specialists and non-specialists in the same talk takes practice.

3.5.2 Interviews with Faculty

During your visit you will interview with a number of faculty in the department. During these interviews, you want to make a good impression and get a good feel for the people in the department, its political and social structure, and the interests of the faculty. Be prepared to have a one-minute, five-minute, and 15-minute description of your research. Have a future direction for your research. Faculty will want to know not only what you've done but what you plan to work on in the future.

Have some questions in mind based on your Web research on the faculty and their interests as well as other things you want to know (What is the teaching load? How are the students? Do faculty members usually work on joint projects or independently?) Ask several people the important questions; you'll get a much better feel for what's really going on. Also, don't forget to ask faculty about their research—you should know what interests your potential future colleagues most, and most faculty will appreciate the opportunity to talk about their work.

3.5.3 Interview with the Chair

During your interview with the chair, you want to get a feel for the vision of the department. You may also touch on more practical details—rank, salary, startup package, etc. Be prepared with some idea of what you'd like—teaching preferences, equipment, initial course reduction or committee reduction, RA money, and/or summer support while you are writing your first grants. Note that in many places the startup package comes from the institution rather than the department; it is in both your and the department's best interests for you to start well endowed.

3.5.4 Interview with the Dean

At many places, you may meet with the dean—who may have more or less influence over the department's decision to hire you. You might want to ask the dean what his/her vision for the department is—how much he/she sees it growing, in what areas, etc. The dean may also control your startup package so impressing upon him/her that you need resources may not be a bad idea.

3.5.5 Interview with Students

The students will tell you what's really going on: how the department works, who holds the power, etc. You can also get a good sense of what caliber the students are as you will probably be meeting with the best students in the department, and/or students in your area. Asking them how they choose an advisor will give you insight into how competitive it may be to attract strong graduate and/or undergraduate students to work with you on your research.

3.5.6 Interviewing the Department

Don't forget that you are interviewing the department while they are interviewing you. Ask hard questions and listen to the answers. Try to pick up some information about the social and political structure. What is the situation for tenure? In some schools, junior people are hired with the intention that if they perform well, they will be able to get tenure. In some schools, tenure may be awarded to only a fraction of the junior people that perform well, or as the result of an "open" search in which junior people compete with candidates from outside the institution. How much power do the chair and the senior faculty have? Do you feel that you would be happy working in this environment? Try to get as much information as you can while you interview. It is often useful to write yourself some notes when you get back to your hotel room. These notes can be invaluable after multiple interviews when you are trying to remember specifics about a particular institution.

Look interested in the job or at least look as though you would seriously consider the job. You won't really know if this is the best place you've interviewed until after you've gone, so maximizing your chances of getting a job at this particular institution is a reasonable thing to do. In addition, if university A offers you a job, you can let university B know your deadline and perhaps hasten the process at university B. Having a job offer can provide leverage for additional offers at places more desirable to you, and multiple offers can help you improve your offer from the place you'd like to work.

3.5.7 Social Events/Meals

Don't forget that you are still interviewing during meals. Even though it is a more relaxed and informal social situation, everything will count towards the final decision. Avoid anything that won't work in an interview or a professional situation: telling off-color stories, getting drunk, being too personal, etc.

3.5.8 Special Interview Issues

For each person, there are real-life issues that are important in the decision-making process. For many people, these include the impact of the move on a partner or on children. We briefly discuss these below.

The "two-body" problem.

If you and your partner are both looking for jobs and it affects whether you would be interested in a job from the institution at which you are interviewing, you may want to share this with the department at some point. Some people share this in the initial letter and some don't share this information until after they have received an offer. The decision of when to share this information varies widely from place to place and from person to person. Some candidates mention their "two-body problem" when things look like they are going well during the interview. The department or institution may be able to help connect your partner with relevant people in their area. If your partner needs an academic job, the department may only have limited influence, however.

There are also creative ways for you and your partner to deal with the two-body problem. You may decide to focus the job search on cities in which there are a number of institutions and companies (San Francisco Bay Area, Chicago, New York, etc.). Some couples have approached departments about sharing a single position. Some couples find good jobs in geographically distinct locations and "commute." Although institutions are becoming more sensitive to the difficulties of working partners, solving the two-body problem still requires considerable flexibility and presents a real challenge to many couples.

Children and other real-life issues.

If you want information on childcare or schools, you may want to ask about this during the interview. Ask someone who seems sympathetic to these issues, and ask them after you have established an impression of yourself as a researcher, which is their primary reason for interviewing you. This is true in general for other real-life issues as well during the interview. Although there is a lot more to you than your research interests, and indeed you will most likely make your decision about where to go based on a whole spectrum of things, the department is hiring you in a professional capacity and needs to have an impression of you in that context first. Note that departments often allow a second visit (sometimes called the "househunting visit") after they have made an offer. This is a great time to check out some of the real-life concerns that are important to you.

Finally, it is illegal for the department to ask you about your marital status or whether you have children, but it may come up in conversation anyway at a meal or by someone who isn't clear about the law. If you don't want to discuss these issues, you may want to plan ahead what you might say so that you can gracefully deal with this.

3.5.9 Dress for Success

Times have changed since the book "Dress for Success" came out and researchers as a group tolerate a pretty wide variation in appearance. Basically, you want your prospective colleagues to remember your technical abilities and not your clothes. Wear what you are comfortable and confident in to the interview and try to stay reasonably within the mainstream. Most female interviewees wear some kind of suit (skirt or pants).

Very heavy makeup, very short skirts, very high heels, and formal attire are generally considered unusual. Most male interviewees wear pants and a sports jacket or a suit with or without a tie. In either case, the goal is to look professional and to feel confident, rather than to wear any particular kind of clothing. You'll probably be walking and may be outside part of the time so make sure your shoes are comfortable and your "look" can survive a long day.

3.6 Post Interview

It is good manners to thank your host and anyone else who has spent time or effort on your visit. Departments generally try to be on their best behavior during interviews and will have spent considerable time and effort meeting with you and arranging your visit. Thanks to faculty, staff, and hosts is generally much appreciated. An e-mail to your host, the department chair, the secretary who arranged things for you, and anyone else who spent time or effort on your interview or whom you particularly connected with is considered appropriate.

After the interview, don't spend too much time worrying about whether you will get an offer. The department's final selection process is often highly volatile. At some point in the department's interview process (usually after everyone has been interviewed but sometimes before), there will be discussions about who will get an offer. The quality of your interview is just one factor in how this goes. There may also be political issues: whose "turn" is it to add to their research area, what areas the dean or the department wants to hire in, which candidates appeared more desirable to a greater cross-section of research groups, who the department thinks they can get, whether political conditions have changed so that the faculty position you interviewed for is no longer available, whether it makes more sense for the department not to hire any of the candidates who have interviewed and to wait until next year and do the search again, etc. You will probably not know what's going on at this point, although you may want to stay in contact with your host or the department chair to get a sense of when you might know, and you certainly will want to let the department know if you have received an offer from another institution or have other hard constraints.

3.7 The Offer

With any luck at all, after this "black box" process has gone on, you will receive an offer. Once you receive an offer from the place where you want to work, you will have to negotiate the terms of your job. What you can negotiate for depends on the institution and the department. You may be able to negotiate for:

- salary
- rank
- start date
- summer salary
- equipment
- research assistants
- travel allowance
- startup money
- "signing bonus"
- lab space
- home loan assistance
- house-hunting trip
- moving expenses
- course reduction
- committee reduction

Note that at some institutions, you may negotiate to come in at a higher salary or at a higher rank (which often implies a higher salary). As a rule, you want to get the best salary offer you can, and at the least what other people with your qualifications would get. When negotiating for rank, consider the time to tenure. Being brought in at a higher

rank may force you to come up for tenure sooner, so make sure that the time frame associated with your rank works for you.

In conjunction with negotiating your salary, ask for at least the first year's summer salary. When you first get to your institution, you will probably not have a grant—the usual source of summer salary. If you write a grant your first year, you still may miss the first year's summer salary depending on when the grant starts being funded and whether you get it. Negotiating for summer salary for the first year or so can help give you a good start on your research career.

In addition, grants usually provide for travel—which will be critical for you in building your research community and eventually your tenure case. (You'll start building your tenure case as an assistant professor from the first, just as you started building your vita from your first years as a graduate student.) Since you probably won't have a grant the first year or so, you should also negotiate for a travel allowance so you can go to professional meetings in your area.

For your first year it is a good idea to negotiate your workload so that you are not overwhelmed at the beginning. Negotiate a reduction in teaching load and committee work. If you can negotiate for support for research assistants, do so; this will help you attract graduate students and get your research started. (Note that support for teaching assistants (TAs) is not as helpful for you since TAs are required to target their activities to the course they are supporting rather than to research.)

Ask for the equipment configuration that will allow for your best working environment. (Of course, you are much more likely to get a good workstation setup than a supercomputer!) If there's certain hardware or software you need for your research, ask for it. Think about both your work and home offices. You should also discuss laboratory and desk space. You will get an office, but where will your students sit? The department may organize itself so that each research area or particular research projects have a lab. At many places, your future colleagues can be helpful in determining your offer package.

Often the department is willing to help you with moving expenses and/or home loan assistance. Note that at many schools, the funding for new faculty and existing faculty come out of separate "pots." By getting a better package, you are probably not taking resources away from your future colleagues. Once you are there, limited or few institutional resources may be available to you. You will compete with other researchers for money from funding agencies to support your research, and you may compete with your new colleagues for space, students, discretionary funds, etc. Now is the best time to think hard about what you need to work well and to ask for it.

Finally, it is not rude to negotiate your offer. At most places, you are expected to do this. If you ask for additional resources, they will not revoke the job offer. At some point, the department will have offered what it can and you must decide if you are happy with it. At this point, it's up to you.

4. DO'S AND DON'TS WHEN SEARCHING FOR A JOB

The following is a compilation of advice from the CRA-W Career Mentoring Workshop panels on "Getting a Job":

4.1 Do's

Volunteer to be the graduate student representative on the recruiting committee at your institution.

This is an invaluable opportunity to learn how the recruiting process works from the inside. You will probably find the discussion once the applicants leave to be surprising.

Attend recruiting talks.

Get a sense of what works well and poorly with an audience. Note how different applicants deal with questions.

Follow the academic year.

Apply for academic jobs November - January. Interviews will be held from January on, with most falling in February and March. You should receive your offers for most places March - June.

Prepare your portfolio.

Include copies of a couple of your best papers with your application. Make sure that your Web site is up-to-date.

Show your application packet to your advisor and other faculty members before you send it.

If your department has just hired someone or if another graduate student has just gotten a job, ask to take a look at their packets and consider modeling yours after theirs.

Keep track of and follow-up on your applications.

Record when and where you sent out your packets. Hold on to letters confirming the receipt of your packets. If you do not hear from a school, call them and ask about your application. Make sure that your applications did indeed get sent out. Keep track of any notifications you get about problems concerning your packet. If a school requests letters of recommendation, mark it down in your records. Record all exchanges with the school—phone conversations, e-mail inquiries, faxes. You will minimize any erroneous delays in the processing of your application if you are organized. If the school sends you notification that they have not received your letters of recommendation, remind your letter writers or their secretaries about it. Don't alienate secretaries. They can definitely help smooth the process.

Use any available resources for your job search.

There are several comprehensive Web sites that are loaded with job openings that universities post. They are organized in different ways: how many available positions, school rank, location. Use a search engine to find "computer science faculty positions." Or look at the Web pages of computer research organizations like ACM, IEEE, and CRA. Word of mouth is also a good way to get information about job openings.

Leverage relationships with faculty in the department to which you are applying.

Well-placed questions can often provide you with good information and sometimes prod the process a bit.

Apply to lots of schools.

Apply for positions that you consider up in rankings from where you belong and down in rankings from where you belong. An initial interview at a school where you do not really think you will go will help immensely as a practice interview. Also, you might be surprised to find some schools you visit are more appealing than you would have thought. Postage is relatively cheap, and you might get an interview or an offer at a school where you never dreamed you could go.

Dress appropriately for your interview.

People should remember what you had to say and not what you

wore.

Think through beforehand how you will describe your research.

You should know the answers to the following questions:

- Can you describe your research?
- What is the most important contribution of your research?
- What will you work on next?
- Where do you see research in your field going in the next five or 10 years?
- How does your research fit within this department?
- What courses would you like to teach?\

Focus your talk.

Give a clear problem statement and the motivations for your work. Talk about related work and discuss future directions. Conclude with a strong summary review of what you've done on one slide so that people who leave the talk can come away with a good idea of what you do.

Adjust your talk to your audience.

Tailor your talk to the institution where you will be interviewing. You may want to have a version of your talk that works better at a more teaching-oriented institution and a version of your talk that works well at a more research-oriented institution. If you're interviewing at an undergraduate school or a school where undergraduate teaching is of primary importance, you may be asked to prepare an undergraduate lecture rather than a research talk.

Polish your talk.

Practice your talk until it's the very best talk you can give. Any materials you have should be of high quality. Any videos you use should appear professional.

Be flexible.

You will be given a schedule but additional people may want to talk with you or people may not be able to make appointments. Thirty-minute appointments often go longer and the schedule gets shifted. The department will worry about who you see when, but you will need to adapt to your evolving schedule throughout the day.

Network.

View the whole process as an opportunity to meet people and to show off your work. Every person you talk to and every institution you visit becomes a part of your professional network. Even if you don't end up going there or even getting an offer, you will find your interactions with the people you meet while interviewing to be invaluable in your research career.

Use good judgment in discussions with future colleagues.

You may want to avoid politically or socially charged discussions during the interview. Your job is to develop potential allies, rather than potential detractors.

Take care of your health.

Being on the road can be stressful. Eat well, try to take a run or a swim, or use the health club if you can. You'll interview better if you feel good while you're traveling.

Accept the job you want.

Consider everything—how you fit in, whether you want to live in that city, what your quality of life will be like. Go to the place that feels the best to you.

4.2 Don'ts

Don't refrain from contacting a school just because it is not advertising.

Advertising deadlines and institutional deadlines are not always in sync.

Don't be afraid to contact schools that you have yet to hear from.

Once you get some offers you might run into a problem with deadlines. One school might give you a deadline by which to respond. But you might not have yet heard from the school you prefer. Don't let it slide. Call the department chair of the school you prefer and say, "Hello, Dr. X. I interviewed at your university in February and I have received some offers from other schools with deadlines within the next two weeks. I wanted to let you know that I am still interested in your university. Do you know when you will be making a decision?" This should generate some kind of response from the department. Deadlines are often flexible as well; if a deadline is closing in and you are still anxiously awaiting another school's response, call and ask for an extension on the deadline. Of course, when you have made a firm decision and have accepted an offer, you should inform all other schools of your choice.

Don't mail out your packets too early or too late.

Mail your packets out within a month or so of the deadline advertised, usually in late December or early January.

Don't let your talk run too long.

Most talks are 50-55 minutes, although you should check with your host about their institution's expectation. Even if there are some technical difficulties or a lot of questions, people will expect you to speak for just under an hour. Structure your talk so that you can add or delete things (and not just at the end) depending on the time. Wear a watch. Don't meet the time deadline by flipping slides and talking faster.

Don't be indifferent if you are asked, "What would you like to teach?"

Have some ideas about the courses for which you would be best suited. You can also use this as an opportunity to determine how classes are assigned to faculty. Are certain classes "owned" by particular faculty? Do faculty members trade off teaching certain classes?

Don't make faculty feel that they are wasting their time.

They asked you to interview and you agreed to come. The department has spent considerable time, effort, and funds on your interview. Even if it is becoming clear that this is the last place on Earth you would want to be employed, these people will still be part of your research community. Be gracious, behave professionally, and don't alienate anyone.

Don't complain about your situation.

It appears unprofessional and petty to complain about fellow students, your advisor, previous interviews, etc. You will make the strongest impression by acting professionally rather than complaining.

5. AFTER YOU'VE GOT THE JOB

Congratulations! You have been through a long and arduous process and you have accepted an offer you like from a place you'd like to go. What do you do when you get there? The following brief subsections should get you started and on track for the first year or so.

5.1 Establishing Yourself as a Researcher

Just as you focused on getting a job from your first days as a grad student, you should focus on your tenure case from your first days as an assistant professor. Get a realistic picture of what it takes to get tenure at your institution. What kind of publication record is expected? What is the relative balance of research, teaching, service, and grants for successful tenure cases? Figure out what your university values and focus on building your tenure file in those areas.

To establish yourself as a researcher, you need to do two things: perform good research, and communicate your work to your professional community. One focus of your first year should be to develop a research program. Spend some time thinking about the problems you want to work on beyond your thesis and develop a strategy for attracting students to work with you on these problems. Talk with your former advisor or other trusted colleagues about research directions and strategies. (Note that in many places, you will need to demonstrate at tenure time that you can work independently of your former advisor so spend some time focusing on a research thrust that is not collaborative work with your advisor.) At tenure time, it will be important for you to demonstrate that you have a research track record in a well-defined research area in computer science.

A good way to attract students is to give graduate classes in your area of expertise. "Core courses" allow you the opportunity to come in contact with a wide variety of students. "Topics courses" allow you to focus on more advanced problems with students who are interested in the field. Both kinds of courses provide a good opportunity for meeting and evaluating potential students. You should also consider joining or starting a regular research seminar in your area. The formats of these seminars differ from place to place, but they typically provide a way to build a research group in a particular area and keep up on the latest results.

Attracting students will help you conduct your research; going to conferences, meetings, and giving talks will help you communicate your research. There are several important reasons for doing this. At tenure time, your institution will ask for letters that review your work from the prominent people in your area. It is important that these people know what you have done and have positive things to say about it. When you go to conferences and meetings and give talks about your work, you are educating your colleagues about what you do. In addition, the better known you are in your research community, the more likely other opportunities will be open to you: program committees, funding, policy groups, etc. Although most assistant professors do minimal national service activities before tenure, requests to be on program committees, participation on NSF panels or in professional organizations, etc. are important opportunities and should be seriously considered. Being known to the prominent people in your area who are doing these activities (and who will probably be asked for letters about your research) can help you through the next transition. Note that networking with your colleagues early on can generally improve the letters your colleagues will send, and will provide a long history with which your colleagues can better describe the maturation of your work.

Since the permanent record of your research is your papers, you will want to start writing papers your first year. This is the time to get the papers from your thesis out of the way. You may not want to work on them as your research focus changes and you begin to move on. The other thing you should do in your first year is to write a grant proposal. The NSF has programs for new faculty and you should apply to that. Apply for a NSF Career Grant. Having your own money to support your research and your students is critical in most areas and you will want to start on this in the fall of your first year.

5.2 Establishing Yourself in the Department

Now that you have joined your department, you will become part of the departmental group dynamic. Get a good picture of the power structure in your department before you jump in. You will need to figure out who the reasonable people are, who the powerful people are, and how faculty members interact with each other. You will need to determine where you fit in to the political spectrum.

It will be helpful if you can establish a relationship with someone in your department who can mentor you. Basically, you need information about what your best strategy for tenure might be and how to deal with a multitude of day-to-day issues. Look for reasonable people in your department, and listen to what they say about the department dynamic. Develop good relationships with these people. Overall, your aim is to develop a collegial and professional interaction with all of your colleagues.

Don't forget to put effort into developing good relationships with secretaries, administrative staff, and systems people. These people make the department run smoothly and their support can be incredibly valuable to you. Besides, it's the right thing to do.

Your first year is going to be challenging. You will be starting in a new place, teaching courses, serving on committees, writing grants and papers, establishing your research, and developing relationships with colleagues, staff and students. Don't volunteer for everything. You may want to demonstrate that you're a team player and volunteer for specific things, but don't go overboard. Everyone will understand that you need to pace yourself.

5.3 Teaching

As a university professor you will be asked to teach. Your teaching load may vary accordingly to your institution, career level, and negotiated offer. Have a realistic notion of how important teaching is at your institution. In many research institutions, good teaching is encouraged but not necessarily rewarded at promotion time. Conversely, poor teaching may make career transitions to the next level more difficult.

Whatever your situation, do the best job you can in your courses. Your students deserve it and being well prepared can also help you with your research. You will need to prioritize all of the things that are expected of you: research, teaching, committee work, etc. Be realistic about how to prioritize your time based on what you want the outcome to be.

If you can teach courses in your area, that will help your research. You may also want to minimize the number of new courses you teach per year. Consider carefully the mix of graduate and undergraduate, area and out-of-area, core and specialty courses you want to teach.

When you teach, be especially well prepared the first few weeks of class. Once you have established your credibility with the students, you will find the situation is easier.

5.4 Having a Real Life

Although almost nothing in your professional life will encourage you to have a real life, do it anyway. Nurture your real life. Do it for yourself and your family and your friends. Do it for your research. Research is a creative process and you need to have the resources to do your job. Your real life provides time for you to regroup and refresh. It is important for you and it is also the best strategy for improving your professional life. You might be surprised to know how many of your professional colleagues run marathons, lead Brownie troops, sing in rock groups, raft down the Colorado River, etc.

Have friends who are not computer scientists. Have friends who are not academics. There is a whole world of people out there and all of them have important things to offer you. Moreover, having a real-life perspective will help you deal with the ebbs and flows of your professional life.

Which brings us to a controversial point: be discreet about your real life. You may be at the top of your form on Monday because you spent the weekend reading and resting, but until they know you well (and sometimes even after that), your colleagues may not consider that nearly as credible as if you spent the weekend writing a paper. Learn when to share that you are leaving work to take your son to Indian Guides and when it works better for you to say that you are leaving for an off-campus meeting. Each department and each group of people is different about this. Be sensitive about what you need to do to convince your colleagues that you are both serious and credible. But don't let it stop you from having a real life.

6. PURSUING A CAREER IN INDUSTRY

Although there are many similarities between pursuing a career in academia and pursuing one in industry, there are many differences as well. In industry, there is a wide spectrum between research and development (R&D), and between marketing and sales. We touch very briefly on careers in industry here.

6.1 Careers in Industrial Development

The main goal of a development group is to produce some kind of product. Many people find great satisfaction in being part of the development of a "finished product" and seeing the direct utility of their work. Knowing that the product you helped develop may be used by millions of customers can be extremely rewarding. However because the work is product-driven, development jobs can be stressful. Schedules are tight, and the company may realize an immediate loss or problem when deadlines are not met. There can be enormous repercussions if you have promised a client a product and you cannot deliver on time. On the other hand, meeting deadlines can yield big pay-offs in terms of money and advancement. If you do a great job in a development group, considerable opportunities may become available to you. A career in development often means taking big risks for big payoffs.

Your work with a development group may be either very well defined and/or described entirely by someone else. In addition, the focus of your work may change depending on your position in the development group and how high up in the company's hierarchy you are. If you are a new member, however, it is likely that someone else will tell you what to work on with more or less input from you.

6.2 Careers in Industrial Research

Research in industry is quite different from development. There are actually only a few "basic research" jobs in industry. Many of the larger companies have research labs (AT&T, IBM, Microsoft, etc.) but many of the positions are not entry-level, and in general the number of opportunities in this area is small compared to academia. More common in industry are interdisciplinary jobs on the interface between engineering and computer science, or between computer science and mathematics. These jobs often require excellent communication skills—both verbal and written. If you are working with somebody with a different technical background than you, it is incumbent upon you to be able to communicate information in a concise and understandable manner.

Applied research jobs are positions that exist in nominal development groups. Applied research can mean many things. It might mean your research will progress in a particular application area, like product development or software. Or perhaps the research will focus on hardware development areas.

One issue to keep in mind if you are interested in research positions in industry is the ultimate goal of industrial vs. academic research environments. In industry, the profits of the company support the research that the company performs. This means that when times are good, the company can expand its research efforts and support more basic and undirected research. When times are bad, the research group may be the first group to be considered for cuts. If you work in an industrial research group, be clear as to what the company's long-range goals are, what the marketing and development strategies are, and how what you are doing relates to them.

6.3 Academia vs. Industry: A Discussion

In industry, there is a much broader range of opportunities, as well as many more jobs as compared to academia. Moreover, you do not need to work in an industrial research group to do research. A lot of research is accomplished in development groups despite a lack of freedom in determining the problems. Industry also provides geographic flexibility. If you are restricted to a particular geographic area or are faced with a two-body problem, industrial jobs may provide more opportunities than academic positions. In addition, industrial jobs typically carry higher salaries, stock options, bonuses, and other tangible rewards for good work.

On the other hand, academia provides a different flexibility. R&D in industry is restricted to the progress of the company; what you choose to work on in academia is something that you determine. In an academic job, you will determine your research goals, your daily work schedule, when you work, where you work, and with whom you work. Academics can often choose their teaching schedules, students, and summer activities to support their research efforts. Academics have the freedom to go to conferences, take sabbaticals, and visit other places as part of their work. In addition, tenure provides long-term job security.

Teaching is generally a required part of academic jobs. Mentoring students and teaching courses is an important part of the job and can be time-intensive. In industry, you often do not have regular contact with students. Although helping students get "up to speed" may not contribute directly to your research effort in academia, interactions with students can raise new issues, force you to look at different viewpoints, and keep you current with your field. In many industrial positions, you have to make a conscious effort to keep current in your field, keep abreast of the literature, and generally know what's going on. In academia, keeping current is more or less part of the job.

6.4 Interviewing with an Industrial Research Group

The objective of an interview in an industrial research group is the same as that of the academic interview: to find out if you would be happy with the job. You must decide if the company's goals and your research interests are compatible.

There are several important matters to discuss with your interviewer and the people you meet throughout the day. Find out about the distribution between applied and undirected research at the company. Often it is not obvious unless the company is huge. How is research directed in the group in which you are interested? Decide if you need a position that provides some flexibility in research, or if you are content with some external guidance.

More to the point, ask to whom you will have to report and how you will be evaluated. You want to see if you can fit in within the group. Does the group comprise many individual efforts, or does everyone work together? How does the manager view the group's goals in relation to the company's goals? What development groups in the company will your group interact with? What resources will you be provided? What kind of hardware and software will you use? All of this information will give you a feel for the rules of the group.

You also should get a sense of your career options within the company. Find out what the career paths are and what the salary levels are. Perhaps you are interested in research management—how is the hierarchy organized? Some companies have administrative, management, and purely scientific career paths, and some do not. You want to be sure you will be happy with how your salary will scale as well.

You should also be clear about the company's policy on publications. Some companies do not allow you to publish for fear of revealing company secrets. Some companies will however encourage you to publish a lot. Some will even provide travel support so that you can give talks and get involved in professional activities within the research community. This is important because you may need or want to maintain connectivity to the your professional research community. Find out how far the company is willing to go to support you in these ventures. Finally, try to meet with your future colleagues in a less formal setting if possible. You want to make sure you are comfortable with them as a group.

6.5 On the Job

The best way to survive and to succeed is to do great work. As in academia, it is easy to get side-tracked in industry by volunteering to do more projects, or to get too heavily involved in work that digresses from your own. If you see something that needs to be done and you can convince others that it is important, do it. That kind of initiative can be very well rewarded. Analogous to choosing a departmental mentor, you should also seek a good industrial mentor. Seek someone who can guide you technically and with whom you can get along. Stay in tune with what is going on in the company as well as what is going on in the research community outside.

Finally, be careful of social relationships within the company and your group. Dating colleagues or your manager is a high-risk proposition. There are many examples of both long-term partnerships that began as working relationships, and of relationships that soured a professional environment. Such relationships are often tougher for the junior person, so use good judgment.

7. EPILOGUE

The best advice in looking for a job is to know as much as you can about the process. Knowledge is power, and knowing how candidates will be selected for a job, the manner in which they will be evaluated, and the potential promise and pitfalls of the jobs you apply for can help a great deal. With this in mind, you can optimize your chances to find a job that is both rewarding and satisfying.

Obtaining Federal Funding

Caroline Wardle, *National Science Foundation*

Workshops held in 1993, 1994, 1999

Participants
James Cassatt, National Institutes of Health
Marina Chen, Boston University
Frederica Darema, National Science Foundation
Susan Eggers, University of Washington
Helen Gigley, Naval Research Laboratory
Helen Gill, DARPA
Mary Jane Irwin, Pennsylvania State University

1. INTRODUCTION

The following sections provide a guide to the art and science of writing competitive proposals for federal funding. While this guide may provide valuable information for proposal writing in general, it was prepared with research proposals in mind, not educational proposals.

Federal agencies such as the National Science Foundation (NSF) and the National Institutes of Health (NIH) have traditionally provided support for research funding in the form of grants, where money is transferred to the grantee institution and there is no substantial involvement between the agency and the grantee. In contrast the Defense Advanced Projects Research Agency (DARPA) traditionally uses contracts to provide research support and with this type of funding mechanism, there is a great deal of DARPA involvement during the project performance period. This guide discusses issues relevant primarily to the grant mechanism, although the contract mechanism is addressed briefly.

2. INSTITUTIONAL ENVIRONMENT

When writing proposals, you need to take into account your institutional environment. If you're in a major doctoral institution with a one course per semester responsibility, you must be successful in obtaining research funding. If you're in a liberal arts college or comprehensive university that do not offer doctoral degrees, where you may be teaching three courses per semester, you will have very little extra time to do research. It does not mean that it's impossible, but you may have to do different sorts of research, or less quantity, or collaborate with people at other institutions. A teaching-oriented institution may also encourage you to look for funding to support innovative curriculum development, rather than research. If you are teaching at an institution with a large proportion of minority students, there may be special programs that you can take advantage of.

3. SUBMISSION STRATEGY

3.1 Communicating with Your Program Manager

First you must choose to which funding agency or organization you will submit your proposal. Once you have identified the agency that funds your type of research, you should find the program manager within the agency whose program best matches your research focus and scope. Carefully read through the program announcement or description and talk with the program manager to make sure that there is a good fit. If the program manager likes your work, but it does not fit exactly in her funding area, she will often be able to make suggestions that will steer you in a slightly different direction more in line with what she is able to fund. She can also suggest other programs and organizations for you to contact that may be helpful in your research endeavors.

Sometimes a proposal will overlap more than one program or organization. In this case, you may need to discuss your project with several program managers to determine to which program you should submit your proposal.

You can see why getting to know the program manager who funds your type of research is an important activity. Many program managers go to conferences to evaluate the research being presented and to meet the researchers. So if you are attending a conference and see your program manager there, use this opportunity to introduce yourself. In the best case the program manager will have read your work, but don't count on this, and have ready an explanation of what you do. She may sit down with you right there and then and talk. If she is too busy at the conference don't be worried, take it in stride. Ask for her business card and contact her after she gets back to Washington. If you do not have an opportunity to see your program manager face to face, then contact her by telephone or by e-mail.

Remember, when you have the opportunity to explain your research to a program manager, you must get across very concisely and very coherently the problem you are solving, why it is important, and how you plan to attack the problem. You may not have much time to do this, so decide what you're going to say and practice it beforehand.

3.2 Type of Proposal

3.2.1 One proposal or many?

There are good reasons for submitting several proposals and probably trying more than one funding organization. The first is that not all funding sources fund everything you will need. Industry tends to give equipment, and the federal government likes to support faculty and students (it also supports equipment acquisition of course). The second is that there are many more good proposals submitted than there is money available, so not all of your proposals will be funded.

A good model is to write a core technical text on which you can base several proposals, each of which is sent to a different source. For example, you send one proposal to the National Science Foundation asking for research assistant salaries and your summer salary, and one to Sun Microsystems asking for workstations, notifying each about the other proposal. It's the same research project, but you're asking for different types of support. As another example, in the core text you might have different subprojects, each doing a separate part of the work, perhaps each with a different focus. You could submit some of the subprojects to the NSF and then different ones to the Office of

Naval Research (ONR). But remember, always notify each agency about the other proposals.

It saves you time to submit several proposals as described above, rather than to craft several new proposals from scratch. (Frankly, in the beginning of your career, you might not have enough research ideas to craft several separate proposals.) From the funding agency's viewpoint, they want to get good researchers into their programs, and they want to fund viable research. So they are usually happy to share funding with another agency.

3.2.2 Single or multiple investigators?

Should you be the sole principal investigator (PI) on a proposal or collaborate with others on a group proposal? Some organizations have sources of funding strictly for one PI, e.g., the NSF CAREER awards for junior faculty. Other organizations have sources of funding channeled in the direction of collaborative, multidisciplinary projects that will have several investigators, be more complex, will ask for more money, and will extend over a number of years. So the answer is yes, you should participate in writing both individual and group proposals, emphasizing the approach that makes most sense for you, taking into account how far along you are in academia and how broad your research interests are.

3.3 Institutional Commitment

To succeed in your research endeavors, your need your institution to be committed to your research project. This commitment may take the form of adequate laboratory space for your research, basic equipment to get you started, or release time from teaching. Funding agencies often require some level of cost- sharing, either in cash or in kind. You need to discuss this with your department chair or your dean, so make sure you keep them up to date with what you are doing. Your proposal will require a senior institutional representative to sign that the university agrees to the amount and form of cost-sharing, as well as other financial agreements in the proposal.

4. PROPOSAL PREPARATION

4.1 When to Start Writing

Start the proposal-writing process early. If the proposals are due in October or November, start gathering your thoughts in June. It takes a long time to focus fuzzy, new ideas into a concrete, credible proposal. It is also a good idea at this time to discuss your ideas with senior colleagues. Even experienced proposal writers typically take two to three months to write a proposal. It's not merely a matter of writing things down; you're trying to find a problem, come up with a good solution, and explain it well. It will take you several iterations to get it right. You're new at this so you want to leave yourself enough time to craft a good proposal.

Allow sufficient time for your administration to read through your proposal and sign off on the institution's commitment. Your administration cannot sign off in 24 hours. Allow yourself at least a week for the administration to check budgets, determine sources of cost-sharing, and take care of required paperwork.

4.2 What to Ask For

In writing your proposal, you need to determine what you want to ask for in support. Do you want summer salary for yourself? Do you want to buy equipment? Do you need a powerful workstation? Do you need a robotic arm? How much do you need to travel to a major academic conference? Do you want to support undergraduates, graduates, or postdocs?

Let us say you need equipment, as most people do nowadays. Does your university have a base of equipment already? When it hired you did it give you a workstation for your desk? Or do you have one that three faculty share? If you don't have the equipment infrastructure you need for your research, that's the first thing you should ask for in your proposal.

4.3 Defining the Research Project

One of the first sections in a proposal is a discussion of the problem you plan to solve. You should make it very clear that it is a problem worth solving. This is important even if you're working in a field where no one doubts that the problem is important.

In thinking about a research project, you've got to find a problem, an idea, something that's exciting to you. If the problem is new to you, survey the literature. Find out what other people are doing, and what has already been done. You have to show your credibility, that you know what else has been done. Contact some of the major investigators that you find perhaps through that literature search. Perhaps you'll bump into them at a conference. Ask some friends if they know them.

Discuss your ideas with your colleagues and ask for their feedback. This is a good brainstorming way of getting your ideas going. And very important, don't wait until you get funded, get started on that project. If you need equipment then get started on some of the theory behind the project. Do that literature research. It looks a lot better on your proposal if you can show that you've done some preliminary work even if it's just some of the very basics.

Before you start writing, read through some successful proposals in your area. Contact the program manager of the funding organization and ask how to obtain copies of successful proposals. For example, if you do experimental work, read a proposal in experimental work, so you can see what kinds of things they talk about, how much space they devote to the various sections, how they hone their arguments and so forth.

And lastly, many program managers like to see your vision of where you're going with this research. So if you have that future view, include it in your proposal.

4.4 Your Unique Contribution

Why are you the best person to do this research? One way of demonstrating this is to talk about how you are qualified to carry out this work. You should discuss your track record, show some of your previous work that leads up to it, which may, of course, mean your thesis. Basically you need to show that you have the skills, the background, and the experience to do it.

Are you extending somebody else's work? Are you doing a problem with different techniques or are you designing new techniques? Say why your contribution is unique. What are other people doing in the area, either directly in your area or related to it? This demonstrates that you've done your literature research, that you're familiar with what's going on.

Is your project technically feasible? A proposal that neither the reviewers nor the program managers think is technically feasible will not succeed. So show that your proposed work is feasible with the resources you are asking for and the resources you indicate that you have at your university.

4.5 The Research Plan

Describe at a fairly high level how you plan to address the problem. Be concise but give sufficient detail for the reviewer to understand exactly what you are proposing to do. Provide enough information to indicate that what you are proposing to do will actually work. If you do experimental work, put in some preliminary data. If you do theory, sketch out partial proofs. If you develop algorithms, include some algorithmic design.

4.6 Budget

Present a carefully justified and realistic budget. Nothing irritates reviewers more than unrealistically high budgets. For equipment get the best discounted prices you can and use these discounted prices in your budget. If there is something unusual in your budget or perhaps something very expensive don't try to hide it. Come up front and say why this item is necessary for you to do your research. It may be expensive but if it's a one-of-a-kind there will be no discount.

Do not exceed the program budgetary guidelines. Talk to your program manager about what can be included in your budget and what is excessive. It varies from program to program. Some programs, like theoretical computer science programs, have very tight constraints. Other programs that are more experimental in nature have much looser requirements and will provide more categories of support such as graduate students or multiple computers.

4.7 Reviewer Names

While NIH has standing study sections to review proposals, NSF uses different groups of reviewers in each competition. Thus at NSF, it is standard procedure with a research proposal to list names of people that you think are qualified to evaluate your proposal. When making suggestions, don't leave out a whole school of thought, but if you would rather the program manager avoid someone, say so. There may be some people who you do not feel comfortable with as reviewers because you have some personality conflicts with them, or you think they are biased against you or your work. It's up to the program manager to take note of this or otherwise. But they will usually honor your request and choose names from those that you have suggested as reviewers, as well as some additional names.

The reviews are usually not blind—the reviewers know who you are. They receive your full proposal containing everything that you submitted. In contrast, you usually receive anonymous reviews with the names of the reviewers removed. At NIH a roster of the study section members is sent to the investigator along with the reviews. At NSF, such rosters are not revealed to the investigators.

DARPA sends you neither copies of reviews nor any information on the reviewers. You will receive a letter from the manager describing the status of your proposal. You may then, if you wish, request a "briefing" with the program manager, either by telephone or in person.

4.8 Proposal Documents

Each federal agency has its own set of rules and regulations concerning the format of a proposal together with special forms that must be submitted with each proposal. Required forms usually include cover sheets identifying the program, the investigators and their institutions, budget sheets, current and prior awards forms, institutional disclosure forms, and more. Your institution should have a sponsored research office that probably has these forms and can help you fill them out. They are an important resource and should also be able to point you in the direction of appropriate programs for your research interests.

You are usually asked to supply biographical sketches of all investigators on the proposal. Read your program announcement carefully because it will very often specify a maximum number of pages for each vitae. Also check the agency guidelines before including appendices. NSF, for example, does not allow appendices to be included with a proposal.

There are usually very tight guidelines on proposal lengths. Agencies are trying to reduce paperwork to reduce the burden on reviewers. NSF and NIH impose page limits on various parts of your project description and will return your proposal unreviewed if it exceeds these limits.

5. PROPOSAL PRESENTATION HINTS

All the reviewers and program managers are scientists or engineers used to reading scientific literature, so write in the scientific style.

Present your ideas clearly and succinctly and write to the reviewers. It is important for a reviewer to understand what you're doing right at the beginning. Most programs require you to provide a project summary or abstract outlining the problem, your research plan, and expected outcomes. This is the reviewers' introduction to your project, so you should put considerable thought and effort into writing it well.

A good proposal is readable, well written, well organized, and grammatically correct. Organize your proposal to permit skimming. Many reviewers will read the abstract to see what you're doing, then they'll look at your paragraph headings and probably look in detail at particular sections that catch their eye. Use paragraph headings either underlined or in boldface type so people can see what you're doing.

It's also important to get feedback on your proposal before you send it to the funding organization. Show the proposal to someone on your faculty, someone who has written successful proposals. Or ask someone who has served as a reviewer for a funding agency to assess your proposal and give you comments on improving it. Allow sufficient time for making changes to your proposal as a result of these collegial reviews.

6. PROPOSAL REVIEW PROCESS

What happens after you submit your proposal? Assuming that it meets the page and formatting requirements of the agency, at NSF and DARPA it will be sent to the program you indicated for review, and at NIH it will be sent to the appropriate study section for review.

There are two sorts of reviews, mail review or panel review. Mail review was once used a great deal by NSF for research proposals, but now panel review is more commonly used. DARPA also uses panel review. Mail review means that copies of your proposal will be sent out to several people in your research area. Each reviewer will provide a written review of the proposal together with a rating. At NIH, it is usual for proposals to be reviewed only at study section meetings.

NSF draws its reviewers from academic communities, industry, foundations, professional societies, and government laboratories and agencies; NIH draws primarily from academic communities; and DARPA draws primarily from industry, government laboratories, and agencies. Reviewers are chosen based on their scientific, and educational expertise.

Panel review is often used to speed up the review process and goes hand in hand with a program with a deadline. A deadline is a specified date by which you must submit your proposal. All the proposals are then collected together and a panel of outside experts is brought together to review all the proposals at once. It sometimes happens that

panel members are unable to adequately review a proposal because its research area is outside their own areas of expertise. In this case, the program manager will send the proposal to additional reviewers for a mail review.

So when the reviews are done, whether by mail or panel, they will be examined by the program manager and some action will be taken. Most of the time the program managers agree with the reviewers' recommendations but sometimes they will disagree. There are usually far more highly rated proposals than there is money to fund. So the program managers have to decide which of these can be recommended for funding.

For programs awarding grants (NSF and NIH), you will receive copies of the reviewers' comments with the reviewers' names removed. Reviewers are charged with safeguarding the confidentiality of proposals and are asked not to copy, quote, or otherwise use material from any proposal. At DARPA, where the mode of funding is through contracts, you will not see the reviews but can request a briefing with the program manager.

You should expect it to take several months from when you mail in your proposal to when you hear whether you've received an award or not. It's perfectly all right if you haven't heard anything for a while to inquire as to the status of your proposal.

It is very interesting and informative to understand the review process, and it will really help you write better proposals. So talk to your program manager and volunteer to be a reviewer.

7. EVALUATION CRITERIA

It is important to learn the evaluation criteria of the organization to which you are sending your proposal. For example, in 1997 NSF moved from using four criteria to using the following two criteria:

Criterion 1: *What is the intellectual merit of the proposed activity?*

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

Criterion 2: *What are the broader impacts of the proposed activity?*

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

In addition to these base criteria, individual NSF programs may have additional criteria that are described in the program announcements. Be sure to read the current announcement carefully.

Other agencies also have specific review criteria. These can be obtained from the program officer or from the agency Web site.

8. SUCCESSES AND FAILURES

The four possible actions following your submitting a proposal to a federal agency are: an award, withdrawal of the proposal, return of the proposal, or a declination. Let's look at each of these.

1. Award—this is what we are all hoping for, that you are successful and receive an award.
2. Withdrawal of the proposal—your proposal can be withdrawn by your institution any time before the final decision has been made. This would happen if you left the university for example.
3. Return of the proposal without review —a funding agency will return a proposal that is inappropriate for the program, or that exceeds the specified page limits, or that arrives after the program deadline. For example, a proposal concerning development of building architecture that had been sent to a computer architecture research program would be returned to the submitting institution.
4. Declined or non-fundable—this means that your proposal will not be funded. If this happens, do not be discouraged. Everyone has proposals rejected. There is not enough money for this not to happen. So the first thing you should do is damage control on your spirits.

   Second, treat the declination as a learning experience and look carefully at the reviewers' comments. If you don't understand what they've written then contact your program manager and ask her to explain the reviews to you. Always take the reviews very seriously. If the reviewers complain about something or misunderstand something you have written, then re-write that part of your proposal. Unless the feedback indicates otherwise, revise your proposal taking into consideration the reviewers' comments and resubmit in the next competition.

9. FEDERAL FUNDING SOURCES

Different funding agencies have different rules, different budgets, and different priorities. Individual programs within agencies may have different rules, different budgets, and different priorities, so read the program announcements carefully.

Federal programs, rules, and procedures change over time, so check with the agency to which you will be submitting your proposal for their current information. This information can usually be found on the agencies' Web sites.

10. FREQUENTLY ASKED QUESTIONS

10.1 Can You Submit the Same Proposal to Different Programs in the Same Agency or to Different Agencies?

In general the answer is –no-. NSF does not allow you to submit the same proposal to more than one program in the Foundation, and any related proposals submitted to other agencies must be disclosed in your proposal. However certain Directorates within NSF may impose stricter rules, e.g., the Biological Sciences Directorate does not accept proposals that have already been submitted to NIH.

NIH does not stop you from submitting your proposal to another agency, but it does want to know about it. It is illegal to accept federal money for the same project from two sources.

10.2 What Happens if You Have an Award at One University and You Accept a Position at Another University? Can You Take the Award With You to the New University?

It depends on the type of award. Some of them you can take with you as long as both universities agree to the transfer, and your new university agrees to assume any cost-sharing and financial obligations that were part of the award requirements. Except for fellowships, the award is made to the university and most times the university will let you take the award with you. If your current university does not agree, and the funding agency determines that it does not make scientific sense for the project to continue without you, then the award will be taken back from your current university when you leave.

10.3 What are the Percentages or Proportion of Proposals That are Funded? How Big are the Awards and How Long Do They Last?

The average success rate at NSF is between 28% and 30%, the success rate being the ratio of the number of proposals that are funded divided by the total number of proposals received. NSF's average annual award is just over $100,000 with most projects being funded for 2-3 years. At NIH, the success rates vary depending on the particular Institute. In the National Institute of General Medical Sciences (NIGMS) the success ratio is 35% to 38%, the average award size is around $250,000 (total costs), and most projects are funded for 4 years. DARPA's success rate varies from 10% to 20%, with awards ranging from $220,000 to more than $1 million, with durations of 3-5 years.

10.4 What Should I Do if My Proposal is Turned Down?

Keep trying. It's a very competitive process. If the average success rate is 30% that means that 70% of proposals that are received are turned down. It doesn't mean that those 70% are poor proposals. A large number of them have probably been evaluated as fundable. There is just not enough money to fund all good proposals.

Each agency also has a number of priorities such as national initiatives, geographic diversity, balancing awards to new faculty versus experienced faculty, or funding small institutions as well as large institutions. So even though there may be a set of proposals that have received excellent technical reviews, when deciding upon whom to fund, other priorities must also be taken into account.

So if your proposal is turned down, look at the reviews and try again. Don't be too discouraged if you are not successful the first time.

10.5 Are Budgets Ever Negotiated?

Yes, budgets are frequently negotiated, more often down than up. For example, a program manager may only have enough money left to fund graduate students, not equipment. You should accept the reduced budget and look elsewhere for equipment support. You may decide to go back to your university and explain the situation to them. Sometimes they can come up with additional funds. The university negotiation is up to you; the program manager will not get involved with that.

Would they make that reduced funding contingent on your getting such funds from elsewhere? It's up to the program manager, but probably not.

10.6 How do you Know What to Put Down for Salary?

There's a strict algorithm for that. If you're on a nine-month academic appointment, each month of support is one-ninth of your gross salary. If you're on a 12-month appointment, you use one-twelfth.

10.7 What if You are Graduating and Don't Yet Have a Job, So You Don't Know What Your Salary Will Be?

For most programs, it is the institution you work for that submits the proposal on your behalf, and an award is made to the institution, not to you. So when you are hired by the institution you'll know from the letter they send you what your salary is going to be, and that's what you fill in. You can't submit a proposal until you have the university appointment.

10.8 Is Cost-sharing Always Required in NSF Proposals?

NSF's policy on cost-sharing changed in 1999. Cost-sharing is not required in NSF proposals unless explicitly stated in the program announcement. Programs supporting equipment acquisition usually require a significant level of cost-sharing. However, additional cost-sharing by the institution is no longer allowed to be taken into account in the review process.

How can I find out about issues relating to indirect costs? The best source is your institutional sponsored research office (sometimes called the grants and contracts office). In addition, each funding agency publishes a document that provides all the details related to budgets, including indirect costs. Look for these documents on the Web.

10.9 What are the Most Frequent Causes of a Proposal Receiving a Poor Review Even if the Research Ideas are Good?

A very common reason is poor presentation of your ideas, so that it is unclear to the reviewers what research you are proposing to do or how you are proposing to do it. The guidelines presented here have been designed to help you write well-organized proposals that present your ideas clearly and succinctly.

Another common reason is failure to address all of the components of the program. For example, if you submit a pure research proposal to the NSF CAREER program and omit an educational component, then the reviewers will downgrade your proposal since the program requires you to address the integration of research and education.

The most common reason for faring poorly in an equipment request is failing to justify the need for the equipment.

11. EPILOGUE

The pursuit of funding for research requires an understanding of the goals of the funding agencies. See the full transcripts from this CRA-W Career Mentoring Workshop on "Obtaining Federal Funding" at www.cra.org/Activities/craw/projects/researchMentoring/mentorWrkshp for more detailed information. Also, consult with the appropriate representatives of funding agencies for more information before you write your proposal.

Networking

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Workshops held in 1993, 1994, 1999

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1. INTRODUCTION

Networking is making professional connections and using them wisely. Networking makes you and your research known. It's clearly important. Networking opens doors by connecting you to the person who controls something (resources or information) that you need. It can connect you either because you know that person already or because you both know someone in common who can introduce or recommend you. A number of panelists from the CRA-W Career Mentoring Workshops on networking gave examples:

EXAMPLE. When I was a graduate student, my brother got married in Seattle. I really like the department at the University of Washington, so I invited myself for a visit. I knew a faculty member there and I sent him e-mail saying, "I'm going to be in town. Can I come and give a talk?" While I was there, I met another faculty member who was working in an area related to mine. She listened to my talk, and unbeknownst to me, made a conscious decision to help me. She came and gave a talk at my university. She read a copy of my first grant proposal and gave me good advice. Later when she was chair of a program committee, she invited me to be a member. At that meeting, I met someone else who asked me to be on another program committee. So she helped me make contacts.

EXAMPLE. When I was an undergraduate, I did a work term in Japan. One day my boss asked me to do a demo on the spur of the moment for two visitors. I'd watched him do it before, so I said, "Sure." One of the visitors was from the University of Toronto. I told him that I was interested in grad school and give him my business card. Some months later I got a package inviting me to do graduate work at the University of Toronto.

EXAMPLE. I was trained in architecture, but soon after graduating, I realized that there were a lot of problems that I couldn't solve with architectural solutions alone. Their solutions required interaction between the architecture and compiler optimizations or code scheduling. So I decided to start doing research in compilers. I didn't know anyone in the compiler area, but I went to PLDI (Programming Language Design and Implementation), which is one of the main compiler conferences. A grad school friend of mine was there. He spent the next two and a half days introducing me to everyone. When he was done, I knew all of the key players, and some of the not so key players. I knew what they were working on and, more importantly, they knew me. I got very good technical-cal advice from these people. The first time I had a compiler paper rejected, they gave me concrete advice about my style: I was writing like an architect, not like a compiler writer. They advised me about the form of the paper and the kinds of things I should talk about and the arguments I should make and where I should put emphasis. One of them later asked me to be on the program committee for PLDI.

EXAMPLE. Someone at a conference pointed out one of the ONR program managers who funds research in my area. I went up to him and said, "I'm about to send out several funding proposals, and I'd like to explain to my work to you to see if you're interested." He said, "Fine. Let's talk." He could have said, "No, I don't really fund that area. Why don't you talk to so-and-so." In that case, I would have talked to so-and-so. He could have said, "I am busy now." And then I would have said to him, "Well, why don't we talk after this session? Or over lunch tomorrow? Or later on in the day? Or at the break?" In other words, I would have tried to pin him down to a specific time and obligate him. If he still waffled out of it, I would have thought maybe he just doesn't want to talk to me and my time would be better spent talking to someone else. I tried to talk to him alone so that I wasn't competing with other people for his attention. Eventually, I talked to him. I had five projects going at the time, and I explained them all to him with very succinct summaries that I had prepared ahead of time. He said, "O.K. I like that one. Send me a proposal." And he funded it. Now that he funds me, I make a point to see him every year. I tell him what I have done over the course of the year and show him our new results.

EXAMPLE. I used to give talks in local schools about how to make mathematics and computer science fun for students in grades 4 - 8. Someone in the Education Department at my university heard about it and suggested my name as a speaker for the International Congress for Mathematics Educators, a meeting attended by three thou-sand people. Six months before the meeting, one of the four plenary speakers backed out and I got scheduled in his place. I had to write a paper, and while doing that, I began to realize that what I was doing in those classrooms probably wasn't the best investment of my time. I was trying to convey mathematics to children in a way that would make it exciting but because I was only there for an hour and a half, the impact wasn't going to last. So I started looking at electronic games. And as a result of this person who had heard about my talks and lobbied for me to speak at the conference, I've spent the last two years of my life in a new research area. It's been one of the most exciting things that I've ever gotten involved in.

After deciding to work on educational/multimedia stuff, I needed to find some video game or electronic game developers who would work with me. I wanted to develop real products that had high quality graphics and animation and storylines and characters and sound and so on. It costs a million dollars to do one. I wanted to do several. I didn't know any game developers, so I started asking people for leads. Nothing panned out and eventually I decided to try Microsoft even though they don't do games. I called an old academic friend who knew people at Microsoft and he set up a meeting for me. He even

drove me there.We met with guys in their edutainment section and they told me, "We don't do games." But they did suggest another company, and right now I'm working with that other company on our second product.

EXAMPLE. When I was a graduate student, I met every month with a group of women graduate students in computer science and electrical engineering. We talked about all sorts of things. Now they've all graduated and gone to other institutions but we still network. We've learned from each other's experiences about interviews, about writing grants, about all the steps along the way. It wasn't something that we intended, but it has grown into a valuable set of connections.

EXAMPLE. Networking helps with some of the more mundane aspects of our jobs, too. I had a connection with a senior woman who gave me a copy of her successful NSF proposal so that I had an example to look at the first time I wrote a proposal. Another senior woman suggested that I become an ACM lecturer. I didn't even know what that was, but the three years that I spent as an ACM lecturer really taught me how to think on my feet, how to give a cogent talk, and how to think about how well a talk was coming over from my audience's point of view.

EXAMPLE. One of my students' research was not quite ready to submit to a conference, so she presented it at a workshop associated with the conference. These are often very good things to attend. They're informal and there's usually more time for your work to be discussed. My student met faculty and students from other research groups at MIT and Stanford. She got to know their work and they got to know her work. Afterwards they exchanged papers, software, etc. As a result one of her letters of recommendation came from MIT and she's now doing a post-doc at Stanford.

EXAMPLE. Two years ago, I was a guide on a kayaking trip on the California coast. One of the men on trip mentioned that he worked for X (major computer company). "Oh," I said "What do you do for X?" And the answer was, "I manage it." He was the CEO! A year later when I was raising money for the Grace Hopper Celebration, I called him up and left a message with his secretary saying that I was an old kayaking buddy and I'd like some advice about a conference that I was running and maybe he could call me back. Sure enough, two days later, "Hi. How are you? Been kayaking lately?" And we got a significant contribution for the Celebration.

Networking opens doors for you. It can:

- Help you get letters of recommendation.When you go up for tenure, you'll need letters from people outside your department. If the people who are asked for letters have known you and respected your work over a period of time, they'll be able to write stronger letters.
- Make it easier to get job interviews. Much of the screening of candidates for job interviews goes on informally at conferences. Faculty from departments with openings contact potential recruits, including graduate students who are a few years from graduating.
- Get you invitations to give talks. Giving talks at other universities is also a good way to network further.
- Help you get funding. In agencies that do not use peer review, program directors make the decision themselves; it helps if they know you and respect your work before they get your proposal. In agencies that do use peer review, reviewers are often explicitly asked to comment on the proposer and their work.
- Get you invitations to join program committees. These are usually formed by the committee chair with the advice of people who he/she knows.
- Give you an edge on getting papers accepted. Reviewers evaluate papers on their content, and the process, in general, is quite fair. However, if they know the author and like her/his past work, they start off with positive expectation; it's a small factor but it can make a difference.
- Supply you with great advice. You'll met people who have been in similar situations and they'll have all sorts of helpful suggestions.
- Provide feedback on your research. Most of the time when you network, you'll have technical discussions that can give you invaluable feedback. People will find pitfalls in what you're doing, alerting you to potential problems sooner rather than later. They may expose you to biases in the community that you can then address when pitching your work. Technical discussions may give you new ideas or a different perspective. They can also give you encouragement.

Lots of women, however, are not comfortable with the idea of networking. Some worry that they aren't good at it, but networking doesn't really require much more than being prepared and being sociable. Other women are concerned that it isn't fair: Should someone get an interview at IBM just because their advisor knew who to talk to? Regardless of whether or not it's fair, it is how things work. People who make hiring decisions, for example, will value a recommendation from somebody they know and trust. Some women worry that networking uses people. However, most people are happy to do small professional favors for you and you'll be able to return those favors, if not to that person directly, then to someone else.

The idea of networking may make you nervous (although you're probably already doing a lot more of it than you realize). It can be scary, but do it anyway. The better prepared you are, the easier it will be. The next three sections will help you get better prepared.

2. WITH WHOM SHOULD YOU NETWORK?

The easy answer is everybody, but the most important groups are:

2.1 Established Researchers in Your Field

These are the people that are going to be asked to write your promotion letters. They are not going to ask your cohorts, your colleagues, or people with the same length of time in your career. They're going to ask the big guns. It's a good idea to make sure they know you. Not just know you because they read your paper, but also because they have met you. They know your approach to research. They have heard you dis-cuss your ideas. They have a general sense of your intelligence and your capability. Get to know these people and keep in touch with them throughout your career.

2.2 Funding Program Directors

As mentioned above, it helps if your program directors are pre-disposed to liking you and your work. In addition, many agencies have special, targeted pro-grams from time to time. If your program director knows your work, he/she may point out relevant opportunities.

2.3 People Who Could Hire You

Networking may help you get your foot in the door for an interview. If you already know someone at an organization, they might be your host, for example. It can make you more relaxed.

2.4 People Who Can Give You Good Technical Advice

Obviously this includes people in your area but it also includes people in other areas. Talking to somebody who is naive about your field and asks you questions about it can change your perspective.

2.5 Your Contemporaries

People grow up. One day your contemporaries are going to be established researchers. Keep in touch with them now. Be aware of people both above and below you: the undergraduate you were mean to today could be your program manager in ten years. There are things you can do with your contemporaries right now. You can trade software or workloads, leveraging off each other to get your research programs started more quickly. You can trade lecture note or test questions. Graduate students or new faculty will often take the time to read papers that senior researchers won't, so you can get good technical advice from them. Include people from outside your immediate research area as well. You may be able to meet other people through them and you never know what directions your research will take in the future. Even purely social connections are good, since having a person that you like to talk with can make a conference seem more welcoming.

Networking has a snowball effect: as you get to know people, you'll meet the people they know and your resource tree will expand.

Most networking takes place at conferences where we, the professional and technical community, meet on a yearly basis. The next section focuses on networking at conferences. Section 4 covers advice on what to do outside of conferences, and Section 5 covers negative aspects of networking (there aren't many). To conclude, Section 6 introduces the "Young Girls' Network."

3. WHAT TO DO AT CONFERENCES

It's essential to go to conferences and workshops. Make it a point to start going as soon as you have some research to talk about. Go to the best conferences in your area, even if you're not presenting a paper. Don't overlook small conferences and workshops either. If you're having trouble getting your papers accepted at the large, prestigious conferences, it can help to start in the smaller, less prestigious conferences and workshops. There the talks will often be longer and there will be more time for interesting discussions. In the smaller venues, the participants may also make time for social activities—like hikes—which give you a chance to get to know others in a more relaxed, informal setting.

This section describes how to prepare to network at a conference or workshop—including tips on making contacts once you are at the event.

3.1 Know Whom You Want to Meet and What You Want to Talk to Them About

Know beforehand who you want to talk to. Write their names down. Often conferences are busy places and it is easy to get distracted. People will come up and snare you and you may lose sight of the fact that you wanted to talk to a specific person. If you miss an opportunity, you'll have to go home and wait for another year to roll around.

Know what you want to talk to them about, as well. Read their papers and check out their Web pages so that you'll have comments to keep the conversation moving.

3.2 Know What the People You Want to Meet Look Like

If you're going to find people, you'll need to know what they look like. Check their Web pages for pictures beforehand. If they've published in IEEE journals, you can look for their pictures at the end of their papers. Ask your friends or your advisor to point them out. You should know what all the important people in your field look like. If you don't, you may miss an opportunity: you may, for example, idly chat with someone in an elevator only to find later that you should have been introducing yourself to them.

3.3 Prepare a Brief Description of Your Work

The only thing you're sure to have control over in a technical conversation is what you say about your work. You'll do a much better job if you've thought ahead of time about how you're going to describe it. You want to deliver is a crisp, intelligent, few words explaining what problem you're solving, why that problem is important, and why your solution separates you from the rest of the pack. You'll want a brief description because in most cases, you won't have much time and you can't afford to go rambling on and on. Get right to the point. The purpose is not just to get across to them what you're doing, but also to impress them with what you're doing and how you're doing it. You should have three-sentence, five-minute, and 15-minute descriptions of your research ready because the person you're talking to may or may not be in your area and you don't know exactly how long you're going to have his/her attention. You can go on for as long as the person is still asking questions. Most people will want one of the shorter versions, but occasionally some one really interested in your area will want the longer version.

Remember that when you're talking, you're acting to some extent. It's a presentation. Practice. Close your office door and talk to yourself. Talk to your friends.

3.4 Ask a Question During a Talk

If you're sitting at a talk and you have a question, no matter how stupid you think it is, stand up and walk to the microphone and ask it. Chances are, there are a dozen or two other people in the audience who have the same question and it's not stupid at all. You don't get to meet anyone this way but everyone in the room sees you and hears your name and hears your intelligent question. (If it gives you any consolation, it's far easier to ask the question than to answer it.)

3.5 Introduce Yourself to the Speaker After the Talk

If you can't bring yourself to ask a question during the talk, introduce yourself to the speaker afterwards. Go up and say "I liked your talk," or "I had a question." It might give you a chance for a more in-depth conversation. Try to clarify something that you didn't understand, or explain a different slant that you have, or describe a related research result of yours or explain how you might be able to extend the work. This is a good time for pigeon-holing that particular individual. (Of course, there may be other people doing the same thing, but it's still a good opportunity.)

3.6 Engage in Hall Talk

Most of the technical talk goes on at conferences while some poor soul is giving their paper. Everyone is out in the hall, jabbering away. Join them. You, too, can do that.

3.7 Follow Your Personal Style

Even without realizing it, most of you already do quite a bit of networking. Continue to be sociable and friendly to the people you meet. Talk to them in a way that is natural and comfortable for you.

3.8 Use Your Contacts to Get New Contacts

Get your friends to introduce you to people you don't know. Get your advisor to introduce you. Your advisor is probably an established researcher who knows everyone. Have them introduce you. (Don't assume that they'll do it on their own.) Join your advisor if he/she's talking to a group of people. Don't do it so often that you're a pest, but once or twice a conference is O.K.

Don't forget to pass it on. Make an effort to introduce your friends to each other.

3.9 Make Lunch and Dinner Plans

Everyone at these conferences has at least two meals a day in public, and they might as well eat them with you. If you see somebody in the evening standing around the lobby of the hotel looking hungry, you can go up to them and say, "Do you have dinner plans?" If you walk into the lunch room and you haven't made a plan ahead of time, don't sit down at an empty table. Sit down at a half full or three quarters full table and introduce yourself to the people around. Meals can be particularly good, since you're sitting in one spot. You don't have to worry about people looking over their salads for somebody more important to talk to. They're stuck with you for the duration. But be a little bit careful. If you want to go to a lunch and get involved in a technical discussion, the worst thing to do is sit next to people who are already deeply into a technical discussion, because they're probably not going to break to talk to you. They might ignore you and continue talking to each other. That's a wasted opportunity. So, pick a table where people are talking socially.

3.10 Talk to People You Meet by Chance

Start up a conversation with someone who happens to sit next to you. Talk to the people on either side of you or in front of you or in back of you. If you're at a session, make a comment on the last talk or ask about something that you didn't understand. What did you like about the talk? What you didn't you like? It's also O.K. to just introduce yourself. Talk to whoever you sit next to on a conference bus or stand next to in line.

3.11 Talk to People Who Happen to Come up to You

Don't always be so on the lookout that you miss what is right in front of your face.

3.12 Talk to People About Their Lives as Well as Their Works

When you met people professionally, you should talk about their work. Generally, people enjoy that. But it's also good to get to know them at multiple levels. Don't ask prying questions, but, if somebody mentions their spouse or their kids or their hobby, follow-up on it. Be interested.

3.13 Offer to Help Out When You Can

Don't look just for connections that can help you, but also for connections that would enable you to help somebody else. Try to bring people together who could help each other or tell somebody about a paper they might be interested in. This builds ties with people.

Volunteer. You might want to introduce yourself to a well-known editor in your field, for example, by volunteering to be a referee. A current editor reported:

> If you introduce yourself to me and tell me that you are willing to referee papers for my journal, I am much more likely to remember you than if you tell me, "That's a nice dress."

You don't want to spend too time much on service, but a limited amount can be to your advantage. Making a good impression on a senior editor in your field can be a significant reward. The same editor said:

> One of the reasons that I am an editor now is that the people who appointed me knew that I had done a responsible job on various reviewing I'd done for them in the past.

3.14 Don't Hang Around with Your Graduate Student Friends

You already know them. Wean yourself away from them. Meet other people. That is, after all, why you're there.

3.15 Don't Interrupt Heavy or Private Conversations

You can tell by someone's body language whether or not you should interrupt their conversation. If you get a sense that it's a private conversation—if, for example, they're whispering or if they're huddled—don't interrupt. You'll get much better receptions if you're sensitive to the situation.

3.16 Get Involved in Activities Targeted for Women

Often conferences have some activity targeted at women: a lunch, a birds-of-the-feather session, a panel, etc. Attend these events. Many women take mentoring seriously, and you can get to know them. Get on the "Systers-Academia" mailing list (see the CRA-W Web pages at www.cra.org/Activities/craw/projects/communityBuilding/sys-aca.html.)

3.17 Don't Just Stand There—Speak!

You may feel uncomfortable initiating a conversation. The easiest way—assuming you've read the person's papers or gone to their talk—is to compliment their work and talk technical. "I just read your paper and I enjoyed it and I was wondering if you could tell me a little bit more?" Or "Have you done anything further on it?" Have specific questions ready. There's not a researcher alive that doesn't want to talk about his or her research ad nauseam. It's a safe, guaranteed topic. You can also ask people if they know of anyone else who's working in on your topic. That way, when you run into them, you can say "So-and-so told me that you're working on this." That's a natural way to start up a conversation. Use your ready-to-go descriptions of your work.

3.18 Write it Down

Once you've talked to someone, you'll want to follow up on your conversation, but don't assume that you'll remember what it was that you were supposed to do. Write it down. Many conferences publish the names and e-mail addresses of attendees. When you meet somebody, make a note next to their name on your address list as to what the follow up should be. If they've promised to get back to you with something, write that down too: write it on your list and write it on the back of one of your business cards to give to them. If a technical idea comes up in a conversation, write that down as well because it is freshest in your mind when you have just talked about it. If someone

asks you a technical question that you can't answer, write it down so that later you can e-mail them and say, "That was a good question; it's made me think. Here's a possible answer." Or "Here's a step in the right direction. Do you want to work on it together?" If you've written a paper that's related to something you talked about, send them the paper or e-mail them and write "It was nice to meet you. We talked about my work and here's a Web address where you can and download my latest paper." Ask for copies of their papers. Read them, don't just get them. Send back comments. If you have questions, you can ask them at the next conference. Don't trust any of this to your memory.

3.19 Do Joint Work Together

You can do collaborative work with people. This is especially true of people on your own level. If you're talking to someone and find that you have mutual interests, suggest a joint project.

3.20 Invite Them to Give a Talk at Your University

A good way to get to know people better is to invite them to give a talk at your institution. That way you'll have lots of time to talk to them. As a graduate student, you probably can't do this but you can get your advisor to do it for you. If you invite your peers to talk at your university, they might well return the invitation.

3.21 Ask to Give a Talk at Their University

You can ask people if you can come and give a talk at their university when you're in the area. This is especially useful if it's a place where there are senior researchers in your area. You'll know that they've heard your talk and you'll spend a whole day getting to know them and their students.

3.22 See The Same People Again

There are lots of new people to meet at every conference, but it also helps to follow up with the same people, building longer term, stronger relationships.

4. WHAT TO DO WHEN YOU'RE NOT AT A CONFERENCE

There are some things that you can do without leaving home.

4.1 Talk to People in Your Own Organization

Get to know people around your university. Get to know researchers in other departments as well as nonresearchers around campus. There are lots of ways that people in your own organization can help you and you can help them. It's good to get to know them.

4.2 Send Preprints

Circulate preprints of your papers to people that you think would be interested, including well-known people in your field. If someone is working on a related problem and you cited their work, send them a copy of the paper. You should realize that some people will ignore your preprints, but you won't make any enemies by circulating them, and you might create a community of interest for your work.

4.3 Meet With Visitors to Your Department

You should meet visitors to your department—seminar speakers, postdocs, people who are on sabbatical, students of people on sabbatical, etc.—and try to keep in touch with them afterwards.

4.4 Visit Program Directors

You don't have to wait to run into program directors from the funding agencies; you can go and visit them. Most of them are more than happy to talk to young researchers.

4.5 Use E-mail

We've already mentioned follow-up e-mails but you can also e-mail someone cold. You can ask for copies of papers that you can't find. If you've read a paper, you can send the author questions about it (but make sure that you've read the whole thing). E-mail can be a good way to pave the way to meeting someone in person.

Remember, though, that senior faculty receive lots of e-mail. Don't over do it. Realize too, that you might not get a response. If not, don't feel bad and don't get angry. It's probably just that you hit them at the wrong time. Sometimes it's better not to ask the senior researcher the question. Instead, send the e-mail to all of the authors and a student may respond. That's fine. You get your answer and now you have a budding relationship with that student.

4.6 Ask For Help When You Can Use It

Most people are glad to have the opportunity to do something for somebody else, as long as it's not too big of an imposition. You have to gauge this. Be clear on what the person could do for you. One panelist described an example:

> At one point, when I had my master's degree, I wanted to get a programming job. We were new to the area and I didn't know anyone. I called organizations and found the right person to target. Then I sent them a letter with my resume and said, "I'm going to call you on Thursday, May 10th and talk to you about this." Then I'd call them. In the letter, I'd been very explicit about what I wanted from them, which was either to find out if they had job opportunities for me or find out if they knew of somebody who did. I contacted some of the big employers, with technical slants that I thought might want to hire me directly, but I also contacted the sales organizations for computer manufacturers, because their customers might have wanted to hire me. In fact, that's how it worked out. Someone at Burroughs said they were working on a contract with a group at the university and that group had openings. I ended up with the job and everybody benefited, and the guy at Burroughs got to do something for somebody he wanted to make a sale to.

5. WHEN IT DOESN'T GO AS PLANNED

Very few women reported any negative outcomes to their attempts at networking. One panelist did report that she'd once been rebuffed in trying to meet a very well-known and influential person. She'd kept her eyes open, made her move just as planned, and he'd been absolutely horrible to her. She reported that this was a devastating experience that took her quite a while to get over. While this could happen, the overwhelming consensus was that it was extremely rare. It's really unlikely that you'll encounter such a person. If you do, realize that it's probably more of a commentary on their social skills than on you; write it off and move on.

Another complaint was that men had sometimes mistaken women's intentions. Again, this didn't seem to be a particularly common problem. The consensus was that you were much less likely to run into harassment issues at computer science conferences than in other communities. There was some discussion:

I've met one or two that were inappropriate. The first time this happened to me at a conference, I was a graduate student and I was kind of flattered and kind of disgusted and I said, "You know that's really very sweet, but..." and he kept making the same offer all weekend, all week. It was more of a problem for me early in my career. I wasn't quite sure what was going on in a guy's mind. Was he coming on to me or was I just imagining things? And a few times I ignored my discomfort and ended up having to be much more uncomfortable by explicitly stating, "No." I learned to pay a lot of attention to those signals and to give off my own signals. I started mentioning my husband all the time. I've found that to be very effective.

Once I was at a conference and ran into a grad student who had graduated from my institution. I thought he was a friend. I invited him into my hotel room and I would suggest that you never do that.

The first thing to do when somebody makes an inappropriate suggestion is say "No." It's not up to you to protect his or her feelings. They are not complementing you. A sexual offer, a proposition, is simply inappropriate. Recognize that you have the right to determine what you do and you don't have to be nice and polite at all times, especially if you're not comfortable. Say "No" firmly and politely. If that's not effective, say it loudly enough for others to hear.

6. EPILOGUE

We've all heard of the "Old Boy's Network." You should be part of the "Young Girls' Network." "Young," in this case is intended to modify "network." We're not young girls, but we are part of a women's network that is young. Our network hasn't been around very long, but it is effective. Panelists spoke of getting jobs, grants, and invitations to speak all because of women who knew them and their work. Many women take mentoring seriously. When you need to know something, ask one of them. If you are interested in a job at some specific place, send a senior women there e-mail and ask about it. Likewise, if you see an application at your institution from a woman, follow it up; at least make sure that people read the folder. Make sure that women whom you hear give good talks get invited for colloquia at your department. Call a woman you've met at an institution you'd like to visit and say, "Hi, I'm going to be in the area, I'd like to give a talk." When you hear a woman or meet a woman who impresses you, tell other people about her. Talk her up. Help other women to get well connected, too.

Finally, don't expect to establish connections overnight. They come slowly. Don't give up. Keep the contacts up. Build ongoing relationships that will last your professional life.

Tenure

Mary Jane Irwin, *University of Pennsylvania*

Workshops held in 1993, 1994, 1995, 1996, 1999

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1. THE PROCESS

Tenure, as defined by Webster, is the "status granted after a trial period to a teacher protecting him from summary dismissal." (Apparently, Webster doesn't use gender-neutral language.) At many universities, tenure and promotion from assistant to associate professor go hand-in-hand. The tenure "clock" is usually a six-year clock (although it can vary from an eight-year clock to two five-year trial periods). For schools with a six-year clock, the official tenure review process actually begins near the end of the fifth year, but you should start thinking about it from Day One. There is nothing more daunting than the realization that you should have been aware of each step of this very changeable process instead of considering it only as your tenure approaches steadily in the last year.

First, make sure you understand the tenure process and rules at your institution. All universities have very detailed documents outlining their criteria for promotion and tenure and detailing the process; these are the written rules. Many universities also have additional college level and/or department level guidelines that elaborate a bit more on aspects that are important to that particular college and/or department. You need to make sure you have read all of these guidelines and understand them. These guidelines will give you a fair idea about what your university is seeking in its tenure candidates, and what you will need to achieve to get tenured. Take advantage of university-wide sources of information. Often, universities will run tenure panels/workshops, and, of course, they will have many accompanying hand outs. If the written guidelines are unclear, talk to your department head or some other person who is qualified to explain them. It also helps to know as many of the unwritten rules as you can. A mentor can help here. Find out what the expectations are; they can vary a lot from institution to institution. Find out how much research counts, and how it is evaluated. Find out how much teaching and service count. Don't rely on information about another department in your university; not only can departments vary greatly from institution to institution but they can vary within the same institution. Your department head and the senior faculty in your department are the people who are going to make the decision at the department level—usually the most important level. Talk to the senior faculty in your department and find out what their criteria are.

Some time at the end of your fifth year, you will submit your promotion and tenure dossier, usually consisting of your curriculum vitae (cv) and a personal statement. What you have accomplished goes into your cv—more on this shortly. The personal statement is typically a one- to three-page statement of your view of your research, teaching, and service endeavors, how your various contributions integrate, and how they are relevant to the computer science and engineering community. This is your vision statement; don't underestimate its importance. It is usually the first thing read by promotion and tenure committees and sets the stage for their reading of the rest of your dossier. Don't leave the crafting of it until a week before your dossier is due. Draft it in your first year and then edit it as your research, teaching, and service evolve. And remember that, other than your department committee, the people on the various committees are not experts in your field. Describe your contributions in well-educated layperson's terms. If possible, look at the personal statements of previous successful candidates. Letters of recommendation, solicited and collected by your department, are added to your dossier after you have submitted it.

There are usually several levels to your tenure evaluation during year six. It starts with the department promotion and tenure committee—a committee made up of tenured senior faculty that are elected or partly elected and partly appointed. This committee reviews your dossier and writes a letter that is added to the dossier recommending your case (or not) for tenure outlining the reasons why (or why not). Your case is also reviewed by your department head whose evaluative letter is added to the dossier. This is then usually followed by a similar process at the college level consisting of a review of your case by a college-level committee consisting of tenured senior faculty from the various departments in the college. Your college's dean also reviews your case. At each of these steps an evaluative letter is written and added to the dossier so that reviewers at later stages have access to the letters from earlier stages. Eventually, your case works its way up to the university level where another committee consisting of tenured senior faculty from across the university reviews your case. They make a final additional written recommendation to the university provost and/or president. It is possible (even likely) that the different committees focus on different aspects of your dossier—your department on your research and teaching contributions, your college on your teaching and your department's view of your research, and the university on your teaching and your college's view of your research. Each level is also able to contrast your case against a larger and larger pool of sixth-year cases from across the institution. Also note that the committee at each level is less and less likely to be familiar with your particular area of research and teaching. Again, think about this when you write your personal statement.

Your case for tenure could be stopped at any of these stages – the department, the college, or the university – by a negative recommendation. Some universities require that the case go through all stages (even for cases with negative recommendations at the department level) before the final decision is reached and the candidate is informed. It is usually rare to see a negative decision at a lower level (e.g., department) reversed at a higher level, although the opposite can and does occur.

2. THE CRITERIA AND BUILDING A DOSSIER

Tenure is evaluated based on your contributions in teaching, research, and service. The importance and relative weight of these depends on your university; know the rules at your institution, in your college and in your department. The following are standard criteria for tenure evaluation at a research-focused institution.

2.1 Teaching

The teaching portion of the dossier normally consists of a list of the courses you have taught, evaluations of your teaching from both students and faculty, an indication of your yearly academic advising responsibilities, and a list of the students you have supervised (e.g., B.S. honors, M.S., and Ph.D. research advisees). New courses developed and/or new ways of teaching existing courses may also be included. Teaching evaluations can consist of in-class student evaluations, peer evaluations by fellow faculty, evaluations of teaching from exit interviews of graduating seniors, and teaching evaluations from questionnaires sent to alumni.

Be aware that good teaching is very important, even in primarily research-focused institutions. You will become more effective as a teacher—and improve your dossier—if you take teaching seriously and work to improve yourself. Consider your philosophy about teaching. What are you trying to do when you teach a course? What is important to you? You need to think about your goals and purposes in teaching and to be able to articulate these in your personal statement. Show your commitment to teaching by being aware of issues broader than the scope of a particular course.

2.1.1 Classroom Instruction

You should try to teach a variety of courses—but not too many. Teaching a variety of courses will demonstrate confidence in different aspects of teaching. Choose a few courses that you are comfortable with and are interested in and ask the department head to give you those courses. You don't want too many courses, though; teaching new courses from scratch will inevitably overwhelm you and result in poorer evaluations compared to those you would receive after teaching a course for the second or third time. Review committees look for improvements in in-class teaching evaluations with second and third offerings of the same course and they understand that good in-class evaluations are harder to get in low-level undergraduate courses compared to advanced graduate courses.

Also, don't get pigeon-holed into teaching huge, beginning classes all the time. Evaluations from large classes are almost always worse than those from smaller classes. Appeal to the department head if you are assigned to beginning classes all the time. Ask to teach upper division or smaller classes. Of course, you don't want to teach these classes exclusively; teach large classes, too, so they know you're versatile. Your review committees need to know that—at the very least—you can do an adequate job of teaching on all three levels: beginning courses, upper division courses, and graduate level classes.

Develop your own course if possible. Developing your own course, whether it is an undergraduate or a graduate course, will indicate to the evaluating committees that you are committed to teaching. Developing special projects—like a programming project or a software engineering project—for your students takes even more time and shows even more commitment.

Build on the work of others. You don't have to teach every course completely from scratch. Talk to people who have taught the class before. You can get copies of the materials and the syllabus for the class and work from those. Check for material on the Web; often PowerPoint slides are available that you can revise/augment.

Get feedback. After the class, ask for criticisms from the students. Don't feel defensive about it. Students will usually give earnest critiques of your performance. When you are accessible to your students, provide help, and are interested in them, your student evaluations will improve. Ask good teachers to visit your class. Be aware that few college professors have experience with learning how to be an educator, although they spend much of their careers as one, so try to find people who have reputations as good teachers and ask them to critique your class. Your university may have a faculty development office, or other similar resources to help you improve your teaching. Videotape your class and have someone from this office or a mentor review the tape with you.

Offer to teach an advanced graduate course in your research area. If scheduling of such a course proves to be impossible, offer to teach a one-credit reading course as an overload. Do this in your first year as a way of attracting graduate students to your research program. You can arrange a reading course so that it's not too much work for you. Collect all the recent research papers in your area you wish you had time to read. Have each of the students in the class choose one to present. Present the first one yourself to set the tone for the type of presentation you want the students to give. Require everyone to read every paper—one way to enforce this is to require everyone to ask at least one question in class about each paper. When the class is over you have a group of students up to speed in your research area and eager to work with you (not to mention finally having found the impetus to read all those papers).

2.1.2 Graduate Student Advising

Supervision of graduate dissertations is an important element of your dossier. Work to attract good graduate students. Graduate students are a great resource. They can help with your research and your research productivity. Also, when the university evaluates you for tenure, they will inevitably ask: Has she worked with graduate students? How many Ph.D. students has she produced? Where are those students now? Of course, if you do not start working with Ph.D. students early on in your tenure process, chances are that the students you do have will not be producing work early enough to affect your evaluation. After all, it takes about five years for a graduate student to complete a Ph.D. So work with M.S. students as well. Just beware that masters students require more organization on your part because they are going to complete their degrees in two years. You need to have a clear idea of what you want your masters students to accomplish in that short time frame. Also be aware that weak students can take a lot more of your time and effort than good students. Its better to say "no" than to take on a student that you suspect can't do the work.

Of course, advising students, even the good ones, takes an enormous amount of time. You are the one that provides both the intellectual and emotional support for the student. Sometimes doing research for a Ph.D. can isolate students; you need to encourage them periodically to continue. Aside from the satisfaction you get from helping these students, the students you advise and work with reflect your efficacy in mentoring and teaching.

2.2 Research and Scholarship

The research portion of the dossier normally consists of a list of your publications, external grants and contracts, creative accomplishments (major software and hardware systems—artifacts—developed and their impact), papers presented at professional meetings, participation in

seminars and workshops, invited talks, professional honors, awards, etc. At research (and most teaching) institutions, there is just no way to get around having to have a good research record. Being able to describe your research contributions succinctly and in general terms in your personal statement is very important.

Have a comprehensive plan of research. It is very hard to make an impact when you are jumping around between different areas; publishing a few papers in several areas means you won't be well known in any. Your publications must be relevant to your overall plan of research. And this plan of research should be reflected in your personal statement. Produce quality work that is relevant to your statement. Keep in mind that the quantity of published works is far less an issue than is the quality of the work. It is unlikely that an evaluator will have read every one of your papers. Your evaluator will, however, have read a select few of your papers. Make sure your work is coherent and has sufficient impact. Weed out any junk; resist the temptation to engage in too much LPU (least publishable unit). You have failed to make a good impression if the only paper that is read happens to be your worst, or if it contains a minor result, or if it is not clearly faithful to your stated research purpose.

Be aware that if you pursue interdisciplinary research areas you may be faced with greater difficulty in getting tenure than would someone in a more traditional field. Some research inherently requires collaboration with people outside the department. Unfortunately, this means you have to work harder to get people to know you, because you're covering more ground. You need the support of people from each field involved. You might consider playing it safe by pursuing interdisciplinary research after you have earned tenure at a university.

2.2.1 Research Publications

Publications consist of your refereed journal papers, refereed conference proceedings papers, books and parts of books, and nonrefereed publications. Journal publications are important. Although there are some departments that understand the value and importance of conference publications, journal publications are a staple to making your research known. And college-level committees almost never appreciate the importance of conference proceedings publications because, in many disciplines, essentially all papers submitted to a conference are accepted (even though classified as refereed conferences). Some institutions distinguish between conference submission that are fully refereed (i.e., full papers are submitted) and those that are refereed by abstract. Be careful about keeping track of which is which because there may be people on the upper-level review committees that know, for instance, that a particular conference is refereed by abstract; if you fail to correctly classify your papers they may start to wonder about other papers you have listed. Also included in the dossier are letters of acceptance for manuscripts or papers that have been accepted for publication.

Make sure your journal papers are in as highly ranked journals as possible, i.e., any journal published by the ACM or IEEE is usually considered a top-rated journal. There are many journals that are not considered quality outlets. Put your best work in the best journals in your area. Some departments even maintain a ranked lists of the journals in their area. If there isn't such a ranking system in your department, there are several ways that you can find out which journals are the most important. Look over the authors of papers in a journal; do you recognize them? Are they the people in your field that you respect? More important than the absolute ranking of the journal is how your department perceives its importance. Ask people in your department about which journals are important to them. Also ask your potential letter writers. Your letter writers will note in their recommendation that you published in a top journal if you follow their suggestions. Sometimes your research will fall short of excellent. Everyone has papers like that—papers with good, but not great, results. Consider submitting them to second-tier journals or conferences. And sometimes your papers will be rejected. Read and reread the reviews. If the paper can be salvaged, revise and resubmit making sure you address all reviewers' concerns. Nothing is more irritating to a reviewer than to get another paper from an author with the same problems they complained about the first time around.

If possible, don't put all of your best papers in the same journal. There may be problems with delays and turn-around times; also—depending on the journal—the paper might get published between six months and two years after submission. And tenure review committees can get suspicious if all of your publications are in the same outlet. Remember, though that there are people that want to help you. Do not be afraid to tell the editor that you are up for tenure in a year and you would like a quick response to your submission.

Find the right mix of journal and refereed conference publications. Get an idea of how many of each you are expected to do. The department head should be able to tell you this. There is some amount of flexibility in this as well; if you feel that you need eight journal papers and you only have six, you have not necessarily diminished your chance at getting tenure. It just means you have to have a few more conference papers, or you have to have a strong teaching performance, or you have to have that additional external funding. And some tenure cases can be made on the outstanding contributions of a single journal paper (although that is the exception, not the rule).

Also consider the differences between journals and refereed conference proceedings. Areas of computer science and engineering tend to be fast moving; the problem with journals is that it takes longer to get an article published. Conferences, in contrast, publish more timely material. And you get to go and present your work in person, giving you additional visibility in your research community. Many conferences in computer science and engineering are very competitive and very highly respected by your immediate community. You will find out quickly (and sometimes painfully) which ones are highly valued. Include the acceptance rates of your refereed conference proceedings publications in your dossier. Just remember, journals are considered more scholarly by most scientists and engineers. Consider a strategy of extending and revising a conference publication and submitting it to a journal. Most journals will not accept a conference paper that has not been extensively extended and revised.

Electronic journals are becoming increasingly popular and important. The problem with electronic journals is that at the higher levels of your tenure evaluation consist of people who may not be familiar with the idea of electronic journals. Deans probably will not understand; other faculty might not understand. If you have published in an electronic journal you will need to make a strong case about the journal's legitimacy. Show that the review process of the electronic journal is the same as the process for the conventional, respected journal.

How about a paper with multiple authors? The problem with extensive collaboration is that it is difficult to determine how much you contributed to the paper. Of course, if your collaborators are students, most people will understand that you probably contributed greatly to the paper. In fact, co-authored papers with graduate students are a positive indication of your ability to supervise and mentor graduate students. If you decide to make the statement that you are the major contributor to a paper by listing yourself as first author, it is crucial that you are justified in saying so, and that you are not slighting your

coauthors. You do not want a former collaborator killing your chances for tenure by announcing that you were not the major contributor to a work in which you have claimed first authorship. Some disciplines (and researchers) automatically list authors in alphabetical order, although that tends not to be the norm in computer science and engineering.

Collaboration in research is engaging and fun; however, depending on area you might also want to have some single-authored publications. In some areas, such as in theory, you need to establish yourself as someone who is capable of researching independently. Experimental research, by contrast, is most often done in teams, where multiple-authored papers are the norm. In either case, beware of continuing to coauthor papers with your Ph.D. research advisor.

2.2.2 Funding

Another important area is research funding. Keep track of all proposals and grants that were submitted, funded, are in progress, or are completed. Receiving funding from a peer-reviewed funding agency, like the NSF, makes a strong statement about your work. Your peers have deemed your research of sufficient quality to qualify for a limited pool of research funding (for which they are probably also competing). Certainly you should consider applying for an NSF CAREER award in the summer after your first year on the faculty. CAREER proposals contain both a research and a teaching section; you have to demonstrate contributions in both areas.

Especially if your department is in a college of engineering, some funding from industry is desirable. Your department head often has a pool of money given by industry friends of the department that can get you started in that direction. Some agencies tend to only support groups of researchers or well-established researchers (e.g., DARPA) so be careful about putting too much effort in that direction unless there is some reasonable chance for pay-off. The May issue of CRA's quarterly newsletter, *Computing Research News* (you'll automatically receive a copy if your department is a member of CRA; if it's not, it should be) contains a list of all relevant federal funding agencies giving contact names, phone numbers, and e-mail addresses. Don't be afraid to call a program manager to ask them if your research is appropriate to submit to their program. NSF program managers, in particular, are especially helpful. The same warnings given about collaboration in publications holds true for research funding. Try for a mix of individual and group-funded research projects.

For the pre-promotion and tenure candidate it is also important to keep track of proposals that were submitted but not funded because it shows an activity profile. It is better to have tried and not gotten funded than to never have tried at all. Having a proposal declined can be a painful experience. Read the reviews carefully. Call the program manager for guidance. Based on this input, revise and resubmit.

2.2.3 Creative Accomplishments

You may be involved in research that requires the development of artifacts (e.g., a VLSI chip, simulation system, network, software system, robot). Unlike lab apparatus of other disciplines, computational artifacts embody the idea as well as being a means to observe or measure it. Thus, if you are involved in experimental research that requires the building of artifacts, their impact will need to be evaluated as well. Examples of impact might include the number of downloads of a piece of software, the number of users, the number of hits on a Web page, and, of course, statements about their impact from your letter writers. Think about how the community will best evaluate your artifacts and build this into your experiments from the start. Just remember, popularity is not equivalent to impact. And be aware that such research usually has a longer lead-time (from idea to output) than more theoretical work. Make sure the time span from idea to measurable output for your research is less than six years! Another factor to be considered is that experimental research is usually more expensive in terms of personnel (number of graduate students and staff needed to do the work) and infrastructure (equipment and lab space). These two factors—time to output and cost—often make extensive experimental research too risky for pre-tenure faculty.

2.3 Service

The service portion of the dossier normally consists of a list of the department, college, and university level committees you have served on and a list of your external service activities (service to the profession through professional societies, service to your community, etc.). Find out how important service is and resist the temptation to become involved in more service than is healthy for your tenure case. Usually, service is not important compared to research and teaching. A typical formula at a research institution might be 45% research, 45% teaching, 10% service.

There is very little opportunity for pre-tenure level faculty to participate at the college and university level. Most of your service at your institution will be on department committees. Try to have at least one leadership position (i.e., committee chair). Department service that benefits students is also usually considered good service for junior faculty (e.g., serving as faculty advisor of a student ACM or IEEE chapter). You should also have a record of contributing to university programs at home and abroad. You will probably be involved with efforts to increase the number of women in computer science and engineering; these are outreach activities that count. Contributing to other programs that enhance equal opportunity and cultural diversity also counts.

Service to your profession, typically through service in a professional society activity (e.g., conference or technical committee) is important for two reasons. Such activities count as service to the profession and they are a way to meet and, hopefully, impress people who might eventually be writing letters of recommendation. Work your way up to serving on important committees. The best way to do this is to let some friendly senior person in your field know that you would like to serve. But don't shoot for program chair as your first position. Volunteer to be local arrangements chair (or something similar) and do a really good job. Then work your way up to a position on the program committee. Senior people in computer science are often overburdened with program committee and editorship responsibilities. They simply have too much to do. If they encounter a talented, responsible, and reliable junior person who says "I'd like to do this" they will probably respond with delight and work to make sure the junior person gets the position. Becoming an associate editor for a journal toward the end of the pre-tenure period will indicate to your evaluating committee that you are a capable member of the academic community. So do a good, prompt job of reviewing papers for journals to suitably impress those editors-in-chief.

Service to governmental agencies is also very important. Participation on an NSF panel or workshop counts as service. Service to the public also counts. Delivering career booklets to the local high schools and talking to girls about how interesting it is to be a computer scientist or engineer are good ways to participate.

Choose service with your tenure process in mind. Moderate your volunteerism and choose to serve on committees that help you with the tenure process. For instance, serving on a graduate recruiting com-

mittee will avail you access to the students' folders—invaluable information for targeting students to work with you. Or serve as colloquium chair; as chair you can bring speakers to campus to give you visibility as well as helping you to make a future contact.

Learn quickly when and how to say no. This might seem simplistic or obvious, but it is a critical point. Women in particular need to say "no" because women are frequently asked to take on service projects, despite the dubious benefit of some service to your eventual promotion and tenure. You need to establish yourself as a good citizen of the department, but you do not want either your research or your teaching to suffer greatly. Get involved, but not in over your head. Say no nicely—"I'll really like to do that, but for now my first priority has to be getting promoted and tenured." People should understand.

3. HOW TO BUILD A STRONG CASE

Ask to see the CVs and the personal statements of successful cases. Anyone who has received tenure will proud of it. (It would actually be more informative if you can get the unsuccessful ones, but these are understandably more difficult to procure.) If some senior faculty member in your department happens to have served on the college and/or university committee, go and talk to them. Ask them to look over a draft of your dossier (be prepared to follow their suggestions). Also keep in mind that expectations change over time. Finding out what the expectations are in your first year and assuming those expectations will hold for another five years is folly. Keep informed about what the department, college, university needs or wants. The target may be moving.

3.1 Constructing a Complete Dossier

One thing to be aware of during the tenure process is that you are evaluated by information you provide in your dossier that should be a fair representation of your years at the institution. It is often difficult to reconstruct the activities you participated in in your first year if you wait until your fifth year to start working on your dossier. So practice good record keeping. Start a file into which you put a note about activities that might be used to construct your dossier. When in doubt, file it. You can always toss it out later if it proves to be an activity that will not be recorded in your dossier.

Keep track of your successes. Most universities have a teaching award. Being nominated for such an award, even if you don't win it, is an honor. Make sure it gets recorded in your dossier. If you spend a lot of time working on some course development, write it up and put it in your file. Not only should you keep track of successes in terms of what you did, but also keep track of students who are successful. In your sixth year your department head might write to these students and ask, "Can you give me a supporting letter saying this professor was particularly influential in your education?" Letters from students whom you have made a great impact upon carry a lot of weight. Start a "kudos" file containing electronic mail from students whose praise your teaching talents.

3.2 External Letters of Recommendations

External letters of recommendation from senior people in your research area are an extremely important part of your tenure case. In such letters, people primarily evaluate your research contributions. They also are asked to discuss the impact of your research on the field. They need to be able to say that you have made a significant contribution to a particular area. Create your target list of six to ten people to ask for letters of recommendation; do this right away - don't wait until year six. Revise your list yearly. It should contain mostly people at the full professor rank from institutions considered to be at or above the rank of your home institution. A few names can be from industrial research lab researchers. Try for at least one name from outside North America. Some universities disallow letters from collaborators; think about this when you start on a collaborative project. If you have collaborated with all of the senior people in your immediate research area, there will be no authoritative people to write letters attesting to your research contributions.

Whether your department allows you to choose people to ask for letters or your department seeks out these people on its own, you can cultivate good letters proactively. Attend conferences and workshops. Get involved. Give as many research presentations as you can. Volunteer to serve as your department colloquium chair. As colloquium chair you can invite likely letter candidates to your university to give a talk. Not only will you will have the opportunity to spend the day with them and to show them your vision of research, you might also be able to wrangle an invitation to give a colloquium at their institution. If you have produced a paper that you think is relevant to work that somebody else has done, send that person a copy. Don't flood these people with a deluge of your work; choose key works and send those only.

You also need to be visible and known to the people in the top departments. Try to give a talk at each of the top ten departments in your discipline within your first three years. (By year five it's almost too late.) Don't be reticent about calling them up and saying "I'm going to be in town on this date to attend this conference; and I'd be happy to come by and give a colloquium at your department." Few people are comfortable doing this at first, but it is a crucial opportunity for you to create. Soon you will be invited to give talks. Not only will your increased visibility help establish you in the field so that you get strong letters of recommendation, it could also help you get funding for your research.

A good time to network is at your job interviews; do not decline them lightly. Go to universities and make a good impression. When you are asked to interview, the universities and researchers are focusing on you. This is a great opportunity to network and prime potential letter writers. Ask questions about their work, or about a talk they gave.

3.3 Internal Evaluations

Official written evaluations, which are common to all universities, are a part of your dossier. At many institutions the yearly or bi-yearly review letters become part of the dossier. If there is no procedure for written evaluations at your university, ask your department head for written feedback. Getting your evaluations in writing is important. It is very easy to sit down with your department head to talk about your progress informally, but your department head might not be as aggressive in explaining the bad—as well as the good—points of your performance. Or you might only hear what you want to hear. You need a written critique to read, understand, and take to heart, uncluttered by the periphery considerations that might sabotage a casual encounter.

When you get your written feedback, expect some candid criticism. No one likes being criticized, but taking this criticism productively is essential in improving your case. You might be tempted to just put the review aside because criticism hurts. At some point you need pull the review out and study it. Outline ways that you will overcome each weak point. Set some reasonable goals for yourself and make sure you deliver. Future committees have access to earlier reviews and know what points you needed to work on. If you haven't addressed the

weaknesses enumerated in the critique, the committees will consider this a negative.

All universities have some way of evaluating the efficacy of your teaching. This evaluation usually manifests itself as an in-class written survey or questionnaire. Those results are compiled and added to your dossier. The department level committee is responsible for extracting a sampling of comments from these results. And often senior faculty or your department head come in and evaluate your teaching. They write up a form that is included in your dossier in the form of a peer review.

4. ASKING FOR HELP AND ADVICE

Your journey through the tenure forest can benefit greatly from the right advice. Don't be afraid to ask for help. First and foremost, stay on good terms with your department head. You will have to depend on them for guidance and help. But they can't really serve as a mentor as they are also your boss. So, don't hesitate to also rely on senior faculty for information and feedback. Getting feedback regularly is crucial to staying on track successfully. Senior faculty can review your grant proposals before you submit them, they can introduce you to people in the field, they can alert you to the intricacies of your particular institution, they can clue you into the "power structure" in your college, etc. If you can't find a senior faculty in your own department to serve as a mentor, look for someone in the same college. It's a bonus if your mentor is also a woman, but don't count on this, as there are so few senior women in computer science and engineering (and there may be none at your institution).

Don't go out of your way to alienate senior faculty in your department. You don't have to be best friends with everyone in the department. Just remember those senior faculty sit on the various tenure review committees.

5. TENURE MODELS

5.1 Model 1: Low Expectations

Be aware of what you can expect from your university. MIT, Harvard, Stanford, and some other institutions are universities where a substantial number of very good people do not receive tenure. This is not necessarily wrong or bad; these universities simply use a model in which a relatively small fraction of tenure-track assistant professors are expected to get tenure. They believe this model builds the kind of institution that they want.

Failing to receive tenure at such an institution is not, in itself, a death career breaker. These people who are denied tenure are often promoted at other outstanding universities and do exceptionally well for the rest of their careers. However, this model obviously has some negative impact on the climate for junior faculty. Despite this, there are several excellent reasons to accept a position at such a university. Working at one of these universities might be particularly advantageous if an important person in your field is there.

5.2 Model 2: High Expectations

The second model is that each person hired into a tenure-track position is expected to get tenure as long as they meet the requirements of the university. This is a more common model that universities in the United States and Canada follow. The tenure track process is a little shorter—and thus, harder.

6. EPILOGUE

Although keeping track of all these suggestions might seem overwhelming, it is a reasonable task if you start early and stay organized. Get all the help you need—copies of guidelines, advice from your department head and colleagues, etc. Stay positive. The worst thing you can do is think you're doomed to fail from the start. Try to keep some balance in your life. An understanding and supportive partner can be an enormous help. Work hard, maintain a healthy personal life, and you can do it.

Perspective from the Smaller Schools

Sheila Castañeda, *Clarke College*

Workshops held in 1995, 1996, 1999

1. A CAREER AT A SMALL COLLEGE OR UNIVERSITY

A career in education at a small college or university has many of the same components and issues that working at a large research university has, but there are some differences that can make this type of position either very appealing or the wrong choice for you.

Many of these institutions are based on the liberal arts, and some may have a religious background. Those of us who work at these types of institutions still have all the pressures of time and commitment, along with the same teaching, promotion, and tenure issues that are addressed in other chapters in this series, but perhaps from a different perspective. Often we are talking about a difference in scale, but at other times the emphasis is quite different.

1.1 Promotion and Tenure

The main mission of most small institutions is teaching—not the 'publish or perish' emphasis you may find at larger institution. At my institution, when one applies for promotion or tenure, we are evaluated on the following categories for approximately the corresponding percentages:

Teaching 50%

Professional Development 30%

Service 20%

The reality is that teaching is a 100%-time job, and the rest of the 50% fits in on top of the 100%. We are evaluated on many of the important aspects of teaching that are commonly required at any institution: being organized, creating an atmosphere in the classroom that is conducive to learning, and incorporating new materials into the courses. The expectation is for exceptional teaching skills and dedication since this is the main emphasis of our positions.

Professional development is an umbrella phrase that includes issues like publishing, advanced study, doing research, going to conferences, organizing workshops and conferences, and all of the other activities that we do to keep ourselves current and involved in computing.

In addition to teaching and professional development, service is often a very important part of a small college, especially perhaps those liberal arts institutions that have evolved from a religious background. Service can be divided into three categories: service to the department, service to the college as a whole, and service to the community.

Service to the department can include things like chairing the department, being on subcommittees within the department, recruiting new students, acting as an academic advisor, serving as a student club advisor, or being responsible for the student cooperative education experiences. The list could go on to include many other tasks that need to be taken care of within the department. Often some of these tasks are taken care of by support staff at a larger institution, but these support personnel may not be available at the smaller school.

Service for the college would include committee membership, representing the department during college functions (e.g. Admissions Open House, Development Showcase), or participating in other college events and activities.

Community service means providing leadership and sharing your expertise, perhaps in a civic capacity, as an educational resource for grade or high schools, or with one's church. It might include things like acting as a liaison to one of the local high schools, talking to the Scout explorer groups, or serving as an expert source for the local newspaper or television station.

1.2 Teaching

While all of these promotion and tenure issues are important, the most important issue is teaching. We can all identify with the importance of having an advisor we could work with while in graduate school. It may be just as important to have a mentor when you start teaching. Find out who is a good teacher and see if you can convince that person to help you. It may be a very informal process. You may just take her to lunch or dinner and ask about the accepted practices at your institution, find out if you should really be going to all those meetings and functions you hear about, or ask about important practices within the classroom.

Teaching at a small institution is different from teaching at a research institution. You may have to teach more classes. Typically a semester load is teaching four classes, 12 contact hours. If you are lucky, it may be only two or three different class preparations, but it could mean four different sets of preparations. That is a lot of work: four sets of assignments, four sets of programs to grade, four sets of exams. You may not have teaching assistants who can staff office hours, answer student questions, or help with grading. However, after you get to know the undergraduate students within the department, you may be able to utilize some of them to help you with the routine kinds of tasks you have for your coursework. This may include grading programs, conducting help sessions, or assisting in closed labs. But it is important that you train them well and let them know exactly what is expected of them.

In addition to the issue of the number of class preparations, you may not have as much choice in what you teach. Perhaps your specialty is in AI, but an operating systems course, a CS1 course, or a computer architecture course needs to be taught and you may have to teach it. So an implied requirement at a smaller institution is to main-

tain a wide breadth of interest—to keep up to date with all areas of computer science. That can be a challenge while still trying to stay informed about the latest developments in your area of specialization.

In a larger institution there may be several classes dealing with your specialty and you may be able to teach some of them. But in a smaller institution, there may not be room in the curriculum for several classes, or even one class in your specialization. For instance, let's suppose your specialty is in neural nets—at a large institution you may be able to have a class or two dedicated to neural nets. But at a small institution, the curriculum may only have room for a general AI class. You may be able to spend a little more time than normal on neural nets, but not to the extent of what you would like. Often in a smaller institution, the curricula contain the breadth but not necessarily the depth you might find at a larger institution—especially in subfields within the discipline. You may be able to get around this by offering a special topics class or a symposium dealing with a particular subfield, but that may not happen consistently.

Another issue to be considered is the frequency with which classes are offered. Because enrollments are smaller, most classes aren't offered every semester, so you may not teach a particular course but once every three semesters. By that time often there is a new set of hardware or software installed, new developments in the field have emerged, and the old textbook is outdated. So teaching that course again takes a lot of work. Your foothold keeps slipping. You should try to schedule these types of classes so they are staggered, so you don't have more than one of them every semester.

However, there are also many positive aspects to teaching at a smaller institution. We have a real opportunity to be interested in many different areas of computer science—to not stay so tightly focused on just one subfield. Because of smaller class sizes we can get to know our students personally. We can keep track of when students may be having problems in a class and can suggest something that may help them before it is too late to salvage that particular class or even their career in computing. We will probably teach them in several courses within their college career, so we can understand their interests and goals, their individual strengths and weaknesses. We can influence them in their career choices—whether that may be to continue their studies in graduate school or to help them take advantage of their particular strengths in an applied area.

1.3 Research

With so much of our effort spent in teaching classes, and additional work that needs to be committed to professional development and service, finding the time to do research is usually the biggest issue. Summer is probably the biggest block of time that most of us find to devote to some sort of research. That research may be in your thesis area or other area of interest, but it may quite possibly be focused on your teaching. Its primary emphasis many be on how to improve a class you teach: learning about new developments in the area, developing new projects or labs, attending workshops or conferences dealing with the topic, or other activities that will improve your teaching and classes.

Release time is another related issue. Many institutions may not regularly provide for release time during the academic year, so the only way you may be able to get it is through grants, which of course implies needing more time to spend on developing proposals and all the related activities that go along with them.

One of the hardest aspects about doing research is that you will probably be the only person at your institution with your interests. If you want to bounce ideas off of someone or have a particular problem or question, you won't have anyone to turn to at your home institution, so a feeling of isolation is sometimes a fact of life. That is why it is so important to cultivate interdisciplinary contacts within your own institution and to develop contacts and collaboration among colleagues from other institutions who may be in similar situations. These contacts may be very helpful in writing grants, developing new coursework, or just helping to provide new ideas for exam questions or class assignments.

To expand your circle of professional contacts, you should attend conferences and organizations from your research disciplines. There are also those organizations that are dedicated to teaching, such as ACM's SIG on Computer Science Education, and there are organizations specifically for those of us from smaller institutions (Midwest Instruction and Computing Symposium, the regional sessions of Consortium for Computing in Small Colleges). People who attend these symposia and conferences often propose innovative solutions to the same kinds of situations and problems that we may experience in our own classrooms.

Another problem you may encounter when doing your own research is that there may be fewer institutional resources available. There may be fewer support staff in the grants office, hardware availability may be inadequate, travel funds may be limited, the computer staff may be less experienced in a variety of software and hardware platforms, and even the availability of clerical staff may be an issue. You may find that you have to pursue these kinds of resources through grants or other funding sources. Even matching funds may be an issue. A fifty thousand dollar match for a grant may be a problem at a smaller institution but may not be as much of an issue at a larger institution where more funds are available.

You may also have to be creative in getting help with your research. At a large institution you may have research assistants (RAs) available, but since most smaller institutions don't have graduate students, you won't have RAs. However, you could get your undergraduate students involved. There is an emphasis for undergraduate research now by organizations such as the National Science Foundation or Computer Research Association, so you may be able to get funding from these sources. This is a win-win situation, giving you help with your research and providing your students with a valuable experience and an example of what graduate school may involve.

1.4 Service

There may be many ways of providing service within your department since often support staff are not as available as in larger institutions and you may be working more closely with your students. Students may seek you out for special projects or advice in solving academic, career and personal problems.

One of the aspects of serving on college-wide committees that can be very satisfying is working with colleagues from many different disciplines. The opportunity to have a larger view of your institution can be very rewarding and may allow you to have a wider influence than solely within your own department—especially as a junior faculty member. You may have many opportunities to serve on committees, since often computer-savvy people are sought out to provide added expertise to the membership.

2. EPILOGUE

If you choose a career teaching at a smaller institution, you will have to work just as hard as your counterparts at larger institutions but often without the recognition or support they enjoy. However, having the opportunity to focus on teaching, working closely with your students, having a wide experience with many aspects of computing, and interacting with colleagues from many disciplines can be very rewarding.

If you are going to choose a career at a smaller institution you have to love teaching and enjoy a smaller environment. You may think of yourself as a teacher who happens to be a computer scientist rather than a computer scientist who is teaching.

Time Management and Family Issues

Janice Cuny, *University of Oregon*

Workshops held in 1993, 1994, 1999

Participants
Francine Berman, University of California, San Diego
Carla Brodley, Purdue University
Laurie Dillon, Michigan State University
Joan Francioni, Winona State University
Leah Jamieson, Purdue University
Judith Klavans, Columbia University
Andrea LaPaugh, Princeton University
Mary Vernon, University of Wisconsin

1. TIME MANAGEMENT AND FAMILY ISSUES

This chapter collects the advice of a number of women who have participated in CRA-W panels on time management and balancing a career with a family. Perhaps more than in other panels, the discussions were illustrated with personal anecdotes. Some of the flavor of those conversations has been preserved in this text with direct quotes from panelists and participants (indicated by indenting).

It is clear from their comments that women at all stages of their careers—from novice faculty members to eminently successful senior women—struggle with the substantial demands that compete for their time.

> When I showed up for my first faculty job, my orientation was "Here's your key. Here's your secretary." That was it. I really didn't know what I was doing and I spent a lot of time trying to figure out things like, Who do you talk to if something is wrong with your computer? And how come when you ask them to do something, they don't do it right away? It took quite a bit of time.
>
> In my first two years, course preparation took a lot of time because I had a new course every single semester. Also I was writing grants. (I was not successful in the very beginning and I have a drawer of rejected grants to show it. And then one year everything worked and now I have too many.) I finished publishing papers out of my thesis. I started some new research. I did my own programming because I didn't have any graduate students to work with. In the first year, I gave two talks at conferences and one workshop talk. I spent time looking for people I could collaborate with, students and faculty in the department as well as faculty at other institutions.
>
> I am in my fourth year, and my time is a little different. I have a fairly large research group. I have funding from a lot of different agencies. I'm on program committees but I don't do more than two a year because they're very time consuming. I typically go to about three conferences but now my graduate students are giving the talks, which actually requires more work on my part trying to get them ready. I still try to go around and give talks, particularly since I'm up for tenure and I want to hit up people for letters. I'm on two editorial boards. These came in years three and four and it's unusual to be on them so young but my field is nice to young faculty and tries to bring them onto program committees and editorial boards.
>
> Getting tenure is hard, and certainly there is no pressure quite analogous to it in the sense that if you screw up you'll lose your job. But the need to manage your time continues after tenure because your responsibilities increase. There are some things that have to get done and someone has to do them, but in good conscience most of us have to say they shouldn't done by assistant professors. That means tenured professors should carry more of the service load.
>
> As a tenured associate professor, I teach two classes and only one per semester. Now I have the luxury of having them be mostly repeats except for, of course, my research course, which is quite dynamic and changes. My committee work includes the graduate committee and I am chair of the faculty search committee.
>
> I'm a full professor and the demands on my time are quite different than when I was an assistant professor. Now I supervise six Ph.D. students, manage grants/contracts from ARPA, NSF, Motorola, AT&T, and Kodak, and I am director of the E.E. graduate program. I teach only one course per year. I'm on the editorial board of two journals, and the program committees for two conferences and two workshops. I chair three committees: one at the university level and two for the IEEE Signal Processing Society. I am a member of the IEEE Signal Processing Society Advisory Committee and an IEEE CS Distinguished Visitor (Lecturer).

Thus, it's not simply a matter of hanging on until you're tenured. Time management is a skill you'll need to cultivate throughout your career. Being a faculty member is time consuming at any stage in your career.

> Panelist 1: Last semester I spent on average about 70-75 hours a week working, away from my two young kids. I ended up with a daughter who wouldn't talk to me any more. I talked to my chair about this and he gave me the impression that this is normal and that I should expect to have to put in this many hours if I want to get tenure. I want to know whether this is normal.
>
> Panelist 2: I really only work 40 to 45 hours a week most weeks. There are probably about four weeks a year that are outliers where I work 60 or even more because there's an important deadline. But I usually only work two or three nights a week. I have time to do things like volunteer at my son's school teaching phonics for one morning a couple of hours a week. And I go swimming once a week and I try to walk to work for exercise.
>
> Panelist 3: I think I put in, in an average week, probably 60. There are weeks where I put in more than that and there are weeks when I'm completely burned out and I put in a lot less. You could put an infinite amount of time into this job; there's always more to do. For me personally though, if I had to choose between this job and the rest of my life, I'd choose the rest of my life.
>
> Panelist 4: I think at this point I work about 50 hours a week, most weeks. There are times when something really has to go out

and I will work a fair amount more than that by getting up earlier in the morning so my family is not aware of it. I'll get up as early as 4:00am when I'm working on something that really has to be done. When I was an assistant professor, I think it was more typical that I worked between 55-60 hours a week. If I look honestly at what I did then and what I do now, I get more done now in 50 hours than I used to get done in 60.

This chapter presents a compendium of strategies for time management. No single approach worked for all women and most seemed to employ a variety of strategies that changed over time as they adapted to new and different demands. There was enormous individual variation.

2. TIME MANAGEMENT: STRATEGIES AND TIPS

It's easy to get overwhelmed by the rush of day-to-day demands and lose sight of your really important objectives. When asked to report what she did on a random day, one panelist came up with the schedule below. This is clearly a busy person but how much of her day was spent on really important matters? How much of her professional activity furthered her career in any significant way? It's not enough to be busy and work hard.

> The interesting thing about this day is that while not every day includes exactly the same activities, a lot of my days generally look like this. I worked pretty hard, continuously from 7:00 in the morning until 11:00 at night and yet there's nothing professionally useful that I've done this day except teach. The rest of the work related things were necessary but they don't add up to anything. None of them advanced my career in any real way.
>
> | | |
> |---|---|
> | 7:00-8:00am | Finish midterm exam (My husband takes care of the kids in the morning so that I can home early.) |
> | 8:00-9:00am | Finish lecture |
> | 9:00-9:30am | Answer e-mail (I didn't get through it all.) |
> | 9:30-11:00am | Class |
> | 11:00-12:30pm | Office hours; Write letter of recommendation |
> | 12:00-12:30pm | Meet with grad student |
> | 1:30-2:00pm | Work on NSF review; Make travel arrangements |
> | 2:00-3:30pm | Class (This class was a teaching overload that I volunteered for!) |
> | 3:30-5:00pm | Faculty meeting |
> | 5:00-5:30pm | Get younger son's Valentines printed off at Kinkos |
> | 5:45-7:15pm | Attend older son's basketball game |
> | 7:30-8:00pm | Dinner |
> | 8:00-9:30pm | Kid's homework; Drive to sport practices; Address Valentines; Kid's bedtime |
> | 10:00-11:00pm | Work on letter of recommendation and student evaluations |

To avoid having such busy but ultimately unproductive days, you'll have to make deliberate and careful choices about where to spend your time and energy. There are only three basic options:you can do fewer things, you can do them faster, or you can enjoy them more. The remainder of this chapter includes a list of strategies. It's divided into general tips and tips for making it work with children.

2.1 General Tips

The panelists gave 13 general strategies, to help them effectively balance their personal and professional lives.

2.1.1 Know Your Long-term and Short-term Goals

To be able to make choices, you'll need to have clear long-term and short-term goals. Spend some time at the beginning of each quarter evaluating and revising these goals. What do you want to accomplish this year? This quarter? This week? Successful time management involves making decisions based on an understanding of your goals.

2.1.2 Prioritize

Most time management books stress the importance of prioritizing. Make a to-do list and classify everything on it. In light of your goals and other commitments, consciously decide whether each item is "must do," "should do," and simply not that important.

> I keep my highest priority list on the whiteboard in my office so that I see it constantly. Each item has a deadline next to it. Everything that makes it onto my board gets done and almost always on time but many things never make it that far. Those things I keep on a separate list and they don't always get done.
>
> To-do lists are depressing. Often I work an entire day, only to end up with more things on my list than when I started. To avoid feeling overwhelmed, I sometimes go for "completions," going all the way down to something relatively unimportant, just to find something that I can finish. It gives me a sense of progress.
>
> I get a lot more done now than I did as a new professor and I do it simply by selecting what I'm doing. There are some basic decisions. For example, it's much better to have one paper of high quality than two papers at second-rate conferences, even though it may be appealing to have two papers. It's better to put in the one and a half times as much work and have the one good paper than to put in twice as much work and have the two average papers. And there really are a lot of explicit decisions that have to do with trading off time verses quality and which things you are going to do and which things you are not going to do.

2.1.3 Learn to Say "No"

This is by far the most important single thing that you can do. You'll be asked to do many worth-while things by students, colleagues, and friends. You can't possibly do them all. Know your limitations. You'll have to say "no" and you'll have to say it often. The key is selectivity. Evaluate each request in terms of your goals. Is this task going to have an appreciable impact on achieving my goals? Is it worth doing? Do I have the time to do it well? Am I going to enjoy doing it? If you can't answer "yes" to these questions, you probably shouldn't be doing it.

It's often really hard to say "no," but practice. Learn to say it nicely: "I'm sorry, I'm trying to limit new commitments so that I can really focus on research this quarter." Or "I can't review another paper right now but I know of some other potential reviewers." Or "Thanks for asking me but I'm already on a program committee this year and can't do two." Or "That sounds like a really interesting post-tenure project."

> This is the end of my fourth year, and I've had to teach six different classes so far. I finally told my chair "No, I can't teach another new course because it requires too much additional prep time. I have to spend time on my research." I told him I'd be happy to teach additional new courses after I had tenure.

Avoid saying "yes" when you mean "no."

> I find it hard to say no to something far in the future. If you ask me to do something this week or next week, I'll probably say "no." But ask me to do something in six months, I'll say "yes," every time. It always seems like I should be able to fit one more thing in a six-month period. If you're tempted to say "yes" to something, don't answer right away. Ask for some time to think it over and evaluate it off-line.

Beware of volunteering. Over-commitment comes not only from things you're told to do or asked to do but also from things you volunteer to do. Resist the urge to volunteer for tasks that are not high priority for you, even if that means there are long, awkward silences while everyone sits around waiting for someone else to step forward, and even if it means something worthwhile doesn't get done.

Finally, make sure that anything you do decide to do, you do really well. It's much better to do a few things well than to be so over committed that you do a sloppy job.

2.1.4 Make a Schedule

Successful people are often good at scheduling. Most of the panelists described carefully thought out daily, weekly, and even quarterly schedules. This means they periodically spend time scheduling. "What do I have to get done today? What do I have to get done this week? What bigger projects am I trying to get done and when am I trying to get them done by?"

> A week is an amount of time that is fairly easy for me to focus on. If on Monday morning, I sort through everything that has to get done in that week, at least I know that I'm not going to let something slip that is really critical. "Am I giving a test this week?" for example. It would be good for me to pay attention to that.
>
> First thing every day, I spend 5 or 10 minutes deciding what I'm going to do. I write down a list and then I just march through it in order. Once I have the list, I don't waste any more time deciding what to do next. When I've finished something, I move on to the next thing. I make sure that the list is marginally doable in a day so at the end, I feel like I've accomplished something.
>
> My schedules are particularly important because of my childcare arrangements: I don't have the luxury of saying "I've got a lot of work to do to do this week, so I'll just work 14 hours a day instead of 9." My time is really constrained.

It often takes a fair amount of time to find schedules that are personally comfortable and function well.

> I hate having fully scheduled days, so I try to trade off. Each quarter I pick one or two days a week that I don't schedule at all. It gives me time to focus big blocks of time on projects without interruptions and, if I have to schedule anything out side of work—like a doctor's appointment—I always know when I'll be free.
>
> I schedule all my meetings for Tuesday through Thursday and that leaves me Fridays and Mondays days to do research and to really be left alone.
>
> I work well in crisis mode and so I deliberately schedule crises. If I have a paper that's due, for example, I decide how much time its worth and then I back up from the deadline that amount of time and that's when I start the paper. This creates an enormous amount of tension in my life but it means that I don't end up wasting inordinate amounts of time on last little touches that might not make much of a difference anyway. This is not an approach that would work for everyone.
>
> I found that my personal style as a student/mother just didn't work when I became a professor. I was always the kind of person to save the best for last, get the worst things over with quickly. If I had an unpleasant task to do, I would start on it right away and get it done. This strategy didn't work as a professor. I've had to become much more demand driven. If I start on routine tasks too early I spend too much time on them. It's better, as was mentioned, to back them up against a deadline. If I have to prepare an exam that shouldn't take more than an afternoon, I wait until the afternoon before. That's a stressful way to work, but I get it done and I don't waste time making it unnecessarily perfect.
>
> I am definitely priority driven. On the other hand, I hate working under pressure. These two things sound like they contradict each other, and in some sense they do. But there are some kinds of pressure that I simply can't live with. I could not make up a test the afternoon before it had to be done because I would be nuts; instead, I just work very hard at deciding how much time I'm going to allow and make sure that it gets done in that amount of time so that other things can fall into place. I work by schedules.
>
> I either want to teach first thing in the morning or I want to teach at lunch. Teaching first thing in the morning forces me to be efficient because I prepare the night before and I don't want to lose sleep. If I teach at lunch time, it stops me from spending too much time at social lunches.
>
> I try to avoid social lunches as well, eating my lunch at my desk or exercising instead but I realize that I may be missing out on some of the networking that happens with my colleagues. As a compromise, I generally go out once week with people from the department.
>
> I always schedule office hours after a lecture because you can't do anything then anyway and the students are going to want to talk to you. So you might as well make that part of your official office hours, particularly if the university has requirements about how many office hours you should have.
>
> I don't see all my graduate students on one day. A lot of people do but I don't because each meeting with a graduate student requires some work out of me. For example, I might have to read a conference paper or a proposal draft. That creates a huge time crunch the day before because I never do things until the last minute. So I need to have my meetings with graduate students spread out over the week.
>
> I never schedule anything after 4:30 in the afternoon because I want to be home.
>
> My children go to bed every night exactly at 8, period. They are in bed, the lights are off. I'm very strict about that. And that's because I often need that hour and a half or two hours to work at night.
>
> If you are married and have children and you and your spouse are both working, you need to have some kind of protocol for who gets extra time to work and when. It's best to work that out in some way that is not tension creating.

Know how long things take.

To make a realistic schedule, you have to have good time estimates. It's hard to do this at the beginning but it's an invaluable skill, developed through experience. As you go through the process of making a test, for example, determine how long it takes. Can you see a way to use less time in the future? Eventually you'll get a good sense of timing and then you'll be able to manage your time better.

Avoid fragmented time.

Don't have 30 minutes between appointments, that's too much time to waste but not enough time to really get into anything. Back appointments up to one another. That will insure that they end on time.

Know when something is good enough.

Don't insist that everything you do is perfect or even that everything is your best effort. If you spend the extra amount of time needed to get that last 10%, you might invest a lot of time without seeing that much of an improvement in quality. Teaching consumes a lot of time. Lecture preparation time can vary dramatically and students can be quite demanding.

> A new lecture takes me from two to 20 hours to develop, depending on the difficulty of the material. If it's an undergraduate course, two to four hours might be enough, but if it's in my research area and I thought to myself, "I really want to know how hidden Markov models work this year so I'm going to put it on the syllabus to force myself to do it" then it could take me 20 hours or more. If it's a course I taught before, it doesn't take me very long because of the preparation that went into the first time. I have slides and behind them I have notes to tell myself what I was thinking about when I was doing that or to explain the little bits of math that I don't think I can recreate on my own. I'm not very good on the fly—I need to really have everything spelled out.
>
> This year I taught two courses, compiler construction for graduate students and discrete math for undergraduates. The compiler course took over my life. It had been a long time since I'd taught it so I started pretty much from scratch. I spent 6 or 7 hours on every lecture and some times much more. On the other hand, I'd taught the discrete math course many times before and I had extensive notes and lots of worked out examples, so I'd spend about 45 minutes per lecture.
>
> The first time you teach a course it takes an incredible amount of time. Once you've taught it a few times, the time demand goes down of course. It also depends on the area. Discrete math is the obvious example. I've taught it a few times too and the subject matter never changes, so its much easier the second or third time. On the other hand, programming languages change all the time and no matter how many times I've taught the comparative programming languages course, it always takes an incredible amount of time.
>
> I don't allow students to drop-in. I always tell them I'm available by appointment through e-mail and I honor that. I always do see them. But I also tell them, do not drop by. I'm very serious about it and nobody drops by without an e-mail appointment. I do really well on the availability question on the course evaluations, so I think you can be pretty strict about your time.
>
> I've always had trouble getting students to show up during office hours. Now I have very few regularly scheduled office hours and I make sure that I'm accessible to the students for individual appointments.

It's rare that anyone gets ahead of schedule.

> Once, right before I left town, I had my students finish a paper ahead of schedule. When I got back, I noticed a Federal Express bill and asked them why they had Fed Exed it when it was done early. It turned out that they didn't know that you could mail a submission in by regular mail because they had never seen me do it.

If you're late, sometimes, you can get a two or three day extension, particularly for something like a conference paper submission. It's good to check this out in advance, obviously. Also, check whether you have to have it on someone's desk by the deadline or just in the mail. It's important to know which deadlines can slip and which can't. Proposals for programs, for example, typically have rigid deadlines.

Be sure to put your life in your schedule, too.

> My husband and I have lunch together four times a week. It's one of the very few times that we can spend any time together and relax and just enjoy being together. This is almost a religious commitment: we do it because it's really necessary for both of us.
>
> As a faculty member you do a lot of things but you don't really get much time for professional development. When do you learn new things or catch up on your reading to keep yourself abreast of things? I schedule in professional development time. My husband came up with the idea; he gives himself every other Friday in order to insure that he is doing well and growing as a researcher.
>
> I need to schedule in time to exercise or I may not get to it.
>
> Any single day for me has this hour at night where I'm either reading a book or watching TV. I need that; I'll trade sleep for it. It's an important aspect of my quality of life; I need to be able to read novels and watch TV.

2.1.5 Be Organized

Organization pays off. Disorganization wastes time that you probably don't have.

> Organization does make a difference. My personal scheme is that I'm organized at a macro level. If I'm working on eight different projects, there will be eight distinct places in my office where each of those projects is, and I can find them immediately. I don't waste time looking for the relevant pieces of paper. I have the materials for any given project together. Within that stack, I'll organize it as needed. If I'm not working on it right now, I don't take time to put every paper in its place. When I get down to working on that project, I put the papers in their place and then I can work on it efficiently.
>
> Efficiency is important. I open my mail to the extent that I open the envelope and separate the recyclable part inside from the non-recyclable envelope, but for a lot of mail I don't spend any time looking at it.

The good news is that disorganization is not necessarily genetic. You can consciously decide to become more organized.

> I was the least organized person in the world and I was constantly lamenting the fact that I lost so much time to it. Then about two years ago, I did one of these panels and another panelist said "Last summer, I became organized." This was a total shocker. One could become organized. For me it's still a continuing struggle, but every little bit of organization that I've achieved has made a difference.

One way to become more organized and efficient is to eliminate wasted time. Start looking for your worst time sinks.

> I found that I wasted a lot of time on really ridiculous little things: looking for my car in the afternoon, looking for it at the airport, locating my keys. Now I have a parking algorithm that I can reverse to locate the car quickly. I also have a designated place for my keys in my office. These are trivial things but the time I've saved adds up.
>
> I try really hard not to chat in the hallway.
>
> I was so disorganized once I landed at an airport and had no idea where the conference was or what hotel I was staying at. Now I keep a folder for each trip with tickets, hotel reservations, registration forms, and information on how to get there from the airport. I just pick it up as I walk out the door and I'm all set. It saves time.
>
> I try to make meetings for less time than I think they're really going to take in the hope that it will make me and the other members more efficient. I always make sure there's an end point, particularly if it's a meeting with people that like to go on and on and on.
>
> I try to make meetings productive by preparing for them. I have an agenda. I have specific questions to ask.
>
> One thing that floored me when I started this job was how many decisions I had to make every day, big and small. I spent a ridiculous amount of time debating on whether I should do this or not. Should I be on this program committee? Was it going to be fun? Was this other program committee going to ask me to be on that one? Should I wait for that one? I've had to learn to just make a decision quickly and move on.
>
> I try not to reinvent the wheel at every opportunity. When I teach a course, I borrow materials—lecture notes, syllabi, transparencies, test questions—from friends. The Web is a good source of material and inspiration.

2.1.6 Be Sensitive to Your Most Productive and Unproductive Times

Most people have times of the day when they are more effective and times when they are less effective. These times can change. You should be sensitive to them and schedule the things that need the hardest thinking for your best times.

> There are really productive times of my day where I'm good at working on research and thinking hard, and there are times where I'm totally wasted and there's no reason for me to be trying to do anything. It used to be that my best research was done between 11 p.m. and 2 a.m. And now, forget it. I'm asleep or comatose during those times. The time when I work best now is really early in the morning. So I protect that time and reserve it for research.
>
> When when I first started working, I would carry my backpack full of proposal-related material home every night and I wouldn't get anything done because I don't work well in the evening. There is no way in the world I'm going to write a good proposal starting at 8 or 9 in the evening. I can grade papers in the evening, I can make up homework, I can even prepare classes in the evening. I can't do proposals. It took me several years to figure that out but eventually I started carrying home papers to grade.

2.1.7 Delegate

This is an important strategy. You can delegate things both in your professional life and in your personal life.

Graduate Students

New faculty often overlook their graduate students as a source of support. Part of your job, though, is to train them: they need to learn how to teach, review papers, write proposals, and author papers. You can help them and help yourself by letting them get involved in these activities. Give them lots of responsibility. Your teaching assistants, for example, can help with drafts of homework projects or exams, they can write up solutions to problems, and they can grade. They can have office hours. Graduate students can write sections of grants proposals and papers, they can proofread materials, and they can help review papers.

> I have my students see the TA first for anything I consider boring like coding problems or regrade requests (which I make them do in writing because it discourages them). I want to see them for conceptually interesting problems about the material.
>
> I have my grad students learn the word processor I use so that if we co-author a paper together, they can get all the format issues resolved and make the camera-ready copy.
>
> I have something that my students call calendar torture. When we've agreed that they need to do something like write the first chapter of their thesis or finish a conference paper, I pull out my calendar and I say, well, when do you think you could have that done by? And I let them pick a date and they know that once they've picked that date, it has to be done then. Usually, I try to move them back a little—is it really going to take you three weeks to write that? How about two? And they'll usually agree and get it done on time. I also make them have prioritized lists. The more efficient your graduate students are, the better your time goes. It's important to translate your time management skills over to them so that they can be more productive.

Undergraduates

Many departments have graders in addition to teaching assistants. Often these students can keep track of grades, assist in making up solution sheets, etc. Sometimes they can monitor labs and help with office hours. They can be supervised to some extent by a grad student.

> I have always had work study students as office assistants. They are very inexpensive to me—most of their salary is paid by the university—and some of them are really competent. They file, xerox, copy class hand outs, find references in the library, help keep my office organized, etc. Some have even done mailings and designed posters for me.

Secretaries and Staff

Be incredibly nice to these people; if they want to, they can save you repeatedly.

> I didn't have time to proofread my final before I left town this week, so I read it on the plane and called back to one of the secretaries asking her to change the first question and run off a new copy. Once I was supposed to host a faculty candidate but I went out of town the week before, forgetting to make up his schedule of faculty interviews. When I got back on the day he was to arrive, I panicked only to find that one of the secretaries had taken care of it for me.
>
> I routinely bring the secretaries and our system staff chocolate.

In terms of your personal life, you can delegate many things too. If you have children, it really helps to have a partner who is involved in their care.

> I have three kids and my husband does lots of the childcare. Initially, though, it was hard for me to let him have responsibility: I felt that I, Super Mom, should be the one to take them to the doctor's, get their hair cut, buy their clothes, etc. It turns out that my spouse can do all of these things really well.

2.1.8 Trade Time for Money

This is another form of delegating. Hire someone to do the things you don't like to do. Hire someone to clean the house or take care of your garden or plow the driveway or mow the lawn or paint the bedroom. Value your time. Hire someone to do as many of the little tasks that you don't like as possible. If you love to cook, obviously cook. If you don't love to cook, eat out.

> My favorite rule of time management, which I invented myself, is that up to $20 an hour I buy time above $20 an hour I sell time. There is an immediate corollary to this: I have never in my life taught an overload course and I have never in my life taught a course during the summer. One of the rules of the game is to avoid letting yourself be exploited by teaching part-time in any way.
>
> I wanted to offer a variation on the trade money for time idea, and that's to reduce your work hours. I did it recently. Just cut down one day a week. It doesn't give me more time with my son, but it gives me more time for other things that intrude on life like doctor's appointments and taking snow tires off the car.
>
> This also applies to entertaining. My idea of entertaining used to be that took a day and a half and you went shopping and you cooked and cleaned the house, and everything was very elegant. I never had time for it. Now I've learned that I can buy dinner, from pizza to take-out sushi. It turns out people don't mind: they would rather spend some time talking with you than eating home-cooked food.

2.1.9 Stay Focused

Pay attention to what you are doing, don't get distracted. You'll have to do a lot of very different things during a day; learn to context switch fast. Avoid thrashing: you start working on a paper that's due and then think "What am I going to say in class this afternoon?" so you switch to class preparation and then think "I've got a committee meeting in a half hour" and switch to planning that. In the end you don't accomplish anything.

2.1.10 Find a Place to Escape or Hide

Find places where you can go and work undisturbed. Often, that's not your office. Set up a home office or find a cubby hole in the library, but get away.

> The tip I give all of our new faculty is to set up a home office. I work at home for several hours every morning. By the time I get to my office, I've already accomplished a lot and interruptions don't bother me as much. In real crisis mode I intentionally ignore everything [unessential]. I don't answer my e-mail. I look at the subject line, and if it looks critical, I look at it; otherwise, I ignore it.

2.1.11 Be Aware of E-mail

E-mail is a huge time sink. Try turning off notifications and restrict your reading to certain times of the day. Respond immediately if possible and, if not, file it in an appropriate place. Don't keep rereading the same e-mail.

> I have an e-mail file in each directory. Since the directories correspond more-or-less to the different projects that I work on, I can always easily find everything relevant. When I read a message for the first time, I either answer it immediately or route it to the appropriate directory.
>
> Contrary to the advice already given, I read my e-mail periodically all day long. I particularly like to read it while drinking coffee or having lunch at my desk.
>
> Every once and a while I get overwhelmed. I had 2,500 messages at one point recently and I just took the whole file, compressed it and started over. If I ever need to look at those e-mail messages again, I know where to find them.

2.1.12 Don't Confuse Hard Work with Hard Thinking

It's not just enough to work hard. Nobody's going to reward you for working hard. In the end, people don't care how many hours you put in. They care about the quality of your research and the quality of your teaching. So you really have to know what is important and put your best effort into that.

2.1.13 Maintain a Balance

This is not a career to do if you're not having a good time. It's a very consuming job and there are much easier ways to make a living. Most faculty members really love their job but to do that over a long period of time, you have to maintain a balance. Remember that your job is not you. Keep things in balance.Take breaks. Do things for yourself. You'll need a real life. You'll need lots of time to work but you'll also need time to rest, time to exercise, and time for your family and friends. Having a fulfilling outside life will make you more creative and productive as a computer scientist.

> I need at least 7 to 7-1/2 hours of sleep and work is not worth feeling yucky so I always try to get enough sleep.
>
> I find that if I exercise I actually get that time back. If I exercise for an hour during the day, I'm much more energetic, much more awake at night, and I get more done than if I don't exercise.
>
> When I first started working, I never took vacations. After our kids started daycare though, we found that all of the daycare centers in our area closed for the last two weeks in August. At first we just worked through this, juggling the kids. Nobody got much done and we were totally stressed by the effort. Then we gave in and planned family vacations for August. We had great times and came back rested and rejuvenated. By the end of September, I'd have done more than if I'd worked straight through.
>
> I've found that unless I make very specific vacation plans, it never happens. If I leave it at "I'll take off some time this summer," all of a sudden, it's the end of the summer and I haven't taken any time off. I try now to commit myself by buying plane tickets.
>
> From the very beginning of my career, I believed in vacations and took usually three weeks in he summer all together. On the other hand, I work some weekends in the summer to make up for it. My husband is Australian and you can't exactly go to Australia for a week, so we end up taking long vacations.

2.2 Making it Work with Kids

Balancing a career and a family puts even more pressure on your time.

2.2.1 Accept that Parenting Takes Time

You look at your colleagues who have no kids or have stay-at-home partners and they get to work 19 hours a day. You won't get to do that. Parenting does take time away from your career.

> When you are having a baby, don't expect to do a lot in the first year. Even if somebody takes care of the baby a lot, you'll still be getting back to normal and you'll still be sleep deprived. It's usually not the most creative time, so give yourself a break and assume that you're going to have some sort of slow down the year that you have the baby.
>
> I didn't have that experience. I didn't lose creative time after the birth of my son. I guess it doesn't hurt to prepare by reducing your responsibilities if you can but I've heard from many women that some of their most intellectually creative times were immediately after having a baby. So don't be too depressed at the thought of losing a lot of time after having a baby.
>
> I didn't follow the normal tenure path schedule. I started out the regular tenure track and found it unbearable. We had four women in our department but I was the only one with children. The men had wives at home for the most part taking care of their children. They just did not understand the commitment to family. I wanted to volunteer in the schools and be there for sporting events and school plays. By my third year, I was ready to resign but the dean proposed a half-time tenure track position which extended the time to tenure. I have half the teaching load but that's really the only concession. Service is so vaguely defined that it's not clear what half-time is. My research I feel I do full time. I work about 40 hours a week for half pay; basically I used the money to buy time. It was worth it to me and I feel very balanced as a faculty member doing it this way. I see the other faculty members working at a frenzied pace all around me and I feel that I am a little bit slower and that sometimes that makes me feel inferior. Other times it makes me think everyone else is nuts.
>
> Often we focus on the difficulties of dealing with very young children but your parenting responsibilities and time commitment are the same for older children. My kids are now 11 and 13. I still put tremendous amounts of time into volunteering at their schools and going to all of their sports events, and helping them with their homework. I feel I put a lot of creative energy into them and it's been great.

At the same time that you notice your colleagues working nonstop, you'll also notice the stay-at-home moms who are doing a zillion things with their kids. Having a career takes times away from parenting.

> One year, my mom sent my kids plastic shrink wrap for Easter eggs, plastic sleeves decorated with really tacky cartoon characters. My kids loved them. And they were easy. You put the sleeve around the egg, drop it in boiling water, and presto, it shrink wraps and you're done. We brought the eggs over to my stay-at-home-mom neighbor's house. Her kids had gone out in the woods collecting roots for homemade dyes for their Easter eggs, pasting small leaves and flowers on them for patterns—very neat. It's hard in such situations not to feel inadequate.

Be aware you that you are neither a totally focused computer scientist, nor a full-time mom. You're something in between. Be aware that there will be many trade offs, but there will be terrific rewards as well.

2.2.2 Focus on the Important Things

Invest your time wisely, just as you would at your job. Focus on the things that you or your partner or your kids feel are important, and forget the rest.

> When my kids were younger, I'd make cupcakes for their birthdays for school. These wouldn't be just cupcakes. These would be productions—one year they were decorated with little snowmen with scarves and hats. Around third grade, my daughter balked. She didn't want anything for school. Why not? Because "None of the other kids had to bring in those homemade things," was how she put it. So the cupcakes, while well-intentioned, were a total waste of my time. I didn't particularly enjoy making them and she didn't appreciate it all. On the other hand, I love making Halloween costumes, so whether they like it or not, I do Halloween costumes.
>
> I volunteer to work at my kid's school but I always try to choose activities that are visible to my child—like going with the class on a field trip or going to school to help with the jogathon—rather than signing up for things—like grading homework papers for the teacher—that my children don't really appreciate.

2.2.3 Get Great Daycare

Spend the time and energy to find a daycare situation that you're really happy with. You don't want to be at work worrying about whether or not the kids are in a suboptimal place. You'll want to know that they are safe, happy, and doing creative things.

> When the kids were little we had a daycare that was so wonderful that the kids were sometimes bummed out that they had to leave. It was really nice for me that I knew they were so well cared for.
>
> I got up to talk about nannies or it "pays to pay." You are all going to have careers that pay well and the chances are that you are also going to have a spouse who has a career that pays reasonably well. The most important thing you can do is pay for time that you want to spend in ways that are important to you. For me the most effective way to do that has been to pay to have a nanny. It's not the best solution for everyone necessarily but—I know that my husband would agree with me—the best thing we ever did was hire a nanny who also has housekeeping duties. Just pay well. Put energy into the relationship because this is an employee and a semi-member of your family; it does take time to manage the person and to have a good relationship. Spend time picking the right person. It is an incredible boon. Right now we are both at a conference and we are happy because we know that our kids really love our nanny and they're having a good time while we are away. Of course we have bribes like whenever we go away they can each rent a video game and a video and have a trip to Jimmy's where they can buy junk food. (It also pays to bribe.) The bottom line is that a nanny is a wonderful solution. It's really cost effective and if you put an effort into finding the right person your life is 100 times better.
>
> My husband and I split the day. One of us takes the kids to daycare or school, and the other one picks them up. That way, we each have half the day open and the kids spend less time in daycare than they might otherwise.

2.2.4 Get Lots of Help

Get your spouse or partner involved. Get advice from stay-at-home moms: they always know what the best camps are or who the best teachers are.

I arranged car pools whenever possible. That way, if something came up, I could easily trade off driving responsibilities.

When the kids were too old for daycare, we advertised in the university paper for a sitter who would be at home when they got home. This worked well. We had very qualified college students who had cars. They drove the kids to practices or lessons. They let the kids have friends over. They baked cookies with them.

The kids can help too. We made family chores into family activities. For instance, we all do the grocery shopping together. My kids are getting a little old for that now, but up until now we've done it together. You've got to get your grocery shopping done and it's time that you spend with your kids. We fold clothes together every Sunday night in front of the TV set. The kids also help with yard work and they love to help cook. They feel like they've accomplished something. I try to take advantage of that to get things done and spend time with my kids.

2.2.5 Reduce Teaching Loads When You Need to

Your family will demand more or less attention at various times and you should avail yourself of any options that you might have when the demand is particularly high. Many universities offer parental leaves or extensions to the tenure clock. More informally, some departments will lighten your teaching or committee loads after a baby. Some universities offer "family leave" for emergency situations. In some cases it's not considered good form to extend tenure, and in other places it's acceptable. Find out what the culture of your university is. Take advantage of your options.

My tenure clock was not extended and you should not expect to get it extended but you should ask. I am the only woman on my faculty. In my entire school, with seven departments, there are only five women. They didn't know what to do when I got pregnant; I was the first one who had a baby. I taught class 10 days later. Don't do that.

You should ask for relief from teaching and to stop the tenure clock. Go for it. I made the mistake of not asking. I'm up for tenure in a year and I think that I'll be successful but there is no reason to go through what I did, this is adverse time management. Make things as good for yourself as you can. Everybody wants you to succeed.

I interviewed this year and I'm old enough that I need to have children sometime in the near future. So after I got offers, this was an important negotiation point for me. I told people that I knew I was going to have a baby and that it was going to affect my productivity and that I wanted guarantees that my tenure clock would be frozen. At the university where I am now, four women had gone ahead of me and had children and had gotten tenure, so the chairman there was very understanding. It was no problem, a non-issue. At one of the other schools that I was seriously considering, they had never had a woman faculty member come up through the tenure process and they certainly never had a woman have a baby. When I told them that it was important to me, they went to the dean who said that I would have to take a leave of absence for at least one semester to get my tenure clock frozen. I told them that I couldn't come under those circumstances and so they went back to the dean and they reduced the time but I still would have had to take a leave of absence for a month. I do recommend that you wait until you have an offer before you enter into that negotiation process.

At one point, my son was going through a lot of problems and I had to take a leave. It's important to understand that these things happen and it's okay.

I also have had two children, one before getting tenure and one after. I think the current way things are set up—what you need to go through to manage both your professional life and your personal life after you have children within the academic environment—is pretty draconian. I think it can be done and it can be very satisfying but many of us are working to change the policies. Certainly one of the things that has been mentioned is trying to negotiate—whether it's before you get to an institution or after you are there—for teaching load reductions.

2.2.6 Maintain a Sense of Humor

Keep in mind that with kids, even the best laid plans don't always work.

We lived in Massachusetts for a long time and I'd send the kids off to school and 10 minutes later they'd walk back in and say, "snow day." What do you do with three kids on a snow day as you're rushing out the door to teach a class?

I have a nanny who is responsible from being there from 8:30 am until 5:30 pm. So I don't have any problems when my kids are sick but when my nanny is sick, my husband and I have this horrible negotiation process of who has to cancel which meetings. But she doesn't get sick very frequently, thank goodness.

Many things that appear to be crises now will make entertaining stories in a few years.

3. EPILOGUE: PERSONAL HARMONY

Be careful not to put your career first. If you do, it will take all of your time and energy and they'll be nothing left for whatever is second.

Everyone searches for harmony in their lives and everyone has to find their own balance. There aren't any simple answers. The tips we've discussed are just that, tips that have worked for some women in some situations. Each of us has to decide on where to put our time and energy. Be true to yourself in making those decisions. And, if things are not working out, don't to be afraid to make changes. Put aside time to really think about your important decisions in a focused way.

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