

Dimensions of Excellence in Research

Department of Computer Sciences
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The Department of Computer Sciences at the Florida Institute of Technology has a in stake in the development of individuals capable of conducting computing research. The aim of this document is to outline the level of research accomplishment the department expects of students, and it is a guide to be used when judging the appropriateness and quality of student research.

Categories and Subject Descriptors: A.m [General]: Miscellaneous; I.7.2 [Document and Text Processing]: Document Preparation—*standards*

General Terms: Research, Objectives, Dimensions, Levels

Additional Key Words and Phrases: Originality, Student Development, Connection to Existing Work, Problem Difficulty, Impact, Exposition, Proof of Skill

1. THE OBJECTIVES OF RESEARCH

The meaning of the word “research” changes, depending on the context in which the term is used. Within the department several levels of research are recognized.

—Undergraduate research:

This phrase, as used by organizations like Council on Undergraduate Research, typically refers to activities that are far closer to “project work” than basic research: for example, the redoing of classic studies under slightly different experimental conditions, in ways that usually yield unsurprising results.

—Master’s research:

This phrase, when used in the computer sciences, typically refers to a project that recapitulates known work, and advances the state of the art by a relatively small amount.

—Ph.D. research:

This phrase, when used in the computer sciences, typically refers to an endeavor that involves a substantial element of original work, including a convincing demonstration that the work is original. This demonstration ideally involves a careful review of known literature on the problem under attack.

2. DIMENSION OF RESEARCH

There are several dimensions along which research can be measured.

- (1) Originality
- (2) Student development
- (3) Connection to existing work
- (4) Problem difficulty
- (5) Impact
- (6) Exposition
- (7) Proof of skill

DIMENSION 1 ORIGINALITY. *All research must exhibit some degree of originality.*

Original contributions can be made in concepts, models, proofs, methodology, synthesis, applications, or implementations. Undergraduate research most often contributes in the development of original applications and implementations. At the Ph.D. level, the primary original contributions will most often be in the

Professor Cem Kaner wrote the initial version of this document for his students. The department has edited his version to create a standard for the department.

development of concepts, models, and proofs. Master's level research originality is frequently in methodology, synthesis, and applications. A synthesis of ideas, with literature review, may be sufficient for a Master's thesis but is seldom sufficient for a Ph.D. dissertation, which must be accompanied with more, for example, experiments that tie the ideas together in useful and theoretically interesting ways.

DIMENSION 2 STUDENT DEVELOPMENT. *The student must be able to design her own research program.*

The advisor should listen carefully, ask questions, provide references, and sometimes point out errors. At the undergraduate level, the advisor may need to clearly define the scope of the research topic. At the master's level, the problem scope may be somewhat ambiguous. But at Ph.D. level, the definition and refinement of the topic must be fully left to the student.

Especially at the Ph.D. level, it is common for students to make false starts and learn from their mistakes. The faculty member who tries to rescue the student from unproductive paths prevents this learning. As a result, the student will probably make these errors later in their career, at greater cost to themselves.

DIMENSION 3 CONNECTION TO EXISTING WORK. *The student must understand their contributions within the context of existing work.*

The student must understand their contributions within the context of existing work and make the connection of the work to its context clear to others.

A student must be able to find, read, and understand the literature that relates to the research topic. As the level of research increases from undergraduate to Ph.D. level the required mastery of existing work increases proportionally. For research that has applied aspects, you should search out and cite relevant work from both, academic and practitioners literature.

Plagiarism (intentional or unintentional) is flatly unacceptable. The reuse of academic or practitioner research without attribution is unacceptability. Students are expected to know and understand the standards without needing supervision. If you are not familiar with academic customs and expectations regarding intellectual integrity, find out [Jones 2001].

DIMENSION 4 PROBLEM DIFFICULTY. *A research problem must be of substantial difficulty such that significant time and effort are required in producing and describing its solution.*

A reasonable undergraduate-level research problem may be solvable in one term of sustained work. A talented and motivated master's student should be able to complete a thesis in two terms. To write an acceptable doctoral dissertation may require two or more years of dedicated effort.

A problem can be unusually challenging for several reasons. If getting over the problem difficulty requires you to develop and use skills that are considered important in computing, your work will be accepted even though it shows less progress than would be expected in a problem area that is less difficult.

DIMENSION 5 IMPACT. *The research must have some effect or influence.*

The impact of the research may be in theoretical advancements that theorists will use, methodology advancement that researchers will use, solution techniques to practical problems in ways that practitioners will use, or implementation techniques and algorithms of general utility.

DIMENSION 6 EXPOSITION. *The writing must be sufficiently clear and organized so that fellow students and faculty can readily understand it.*

Quality in writing and presentation is required and expected at every level. If you cannot communicate in the language of the University where you study (here, English), your work will rarely be acceptable, even if it is brilliant. This is your problem, not the Department's. Build time in your schedule to practice your language skills (if you need the practice) otherwise, your project schedule is at high risk. Faculty/student and committee/student agreements are much less certain if your language skills are weak. There will simply be too many opportunities for confusion. Faculty guidance is a challenge if you find it hard to communicate with the faculty member.

Even the best writers can benefit from the study of writing skills. There are several excellent references on exposition that can be recommended [Dupré 1995; Strunk Jr. and White 1999; Zobel 2004].

DIMENSION 7 PROOF OF SKILL. *The research must prove that the student is able to accomplish a wide range of tasks.*

The research should demonstrate that the student mastered some skills. These may be algorithmic, mathematical, modeling, empirical, grants-manship, software engineering process, or software construction skills.

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