

CSE 4083/5210 Formal Languages and Automata  
Assignment #14  
Due: Fri, 9 Dec 2022

**Reading.** Read Chapter 11 “A Hierarchy of Formal Languages and Automata” and Chapter 12 “Limits of Algorithmic Computations.” There are several pre-recorded lectures pertaining to this assignment. They can be found following the links on the grid of notes, or on the Canvas LMS.

**Assignment.** Do some of the following exercises.

- Section 11.1: Problems 3, 4, 5–10, 11.
- Section 11.2: Problems 1, 3, 5.
- Section 11.3: Problems 2abcde, 3ab.

When giving a grammar be sure to include sample derivations and insightful verbal explanations of the purpose and use of the nonterminals.

- Section 11.4: Problems 1.
- Section 12.1: Problems 2, 3, 5.

We are especially interested in clear exposition and proof technique. (Some solutions sketches are in the back of the book.)

**Submission.** Write up the solutions. You may use pen and paper, plain text, or  $\text{\LaTeX}$ . Produce a PDF document, and submit it on Canvas by the due date before the end of the day.

The due date is for the completed problem set. You should read the material in advance, and start thinking and working on the problems in advance, so that you can ask questions in class.

Collaborating is encouraged; no individual grade for the homework will be used in determining the individual course grade (that’s what the tests are for). Copying just wastes everyone’s time; it is quality that is important not quantity. Copying is not practicing. Of course, some individual may require much more practice than others to achieve the same level of competency on the tests.

**Questions.** If you have questions about how to do the problems, you are welcome to send me e-mail: [ryan@fit.edu](mailto:ryan@fit.edu). Students may be called upon to share and explain their progress on the exercises during class.

**Assessment.** Ultimately the written proofs, your choice of exercises, and your participation in answering and *asking* questions, will influence your course grade.

## Objectives.

1. (§11.1) Explain the difference between recursive and recursively enumerable languages (r.e.) [computable and computably enumerable (c.e.)]
  2. (§11.1) Identify dovetailing technique.
  3. Uncountable sets, diagonalization technique
  4. (§11.2) Describe the type of productions in an unrestricted grammar
  5. (§11.2) Identify the types of languages generated by unrestricted grammars
  6. (§11.3) Describe the type of productions in a context sensitive grammar
  7. (§11.3) Give a sequence of derivations to generate a string using the productions in a context sensitive grammar
  8. (§11.3) Identify the types of languages generated by context-sensitive grammars
  9. (§11.3) Construct a context-sensitive grammar to generate a particular language
  10. (§11.4) Describe the structure and components of the Chomsky hierarchy; [CSL proper subset of REC by diagonalization; HU 1969, Section 8.3, page 117]
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1. (§12.1) Explain the halting problem for Turing machines
  2. (§12.1) Define and identify undecidable problems