Course Description

(From the Course Catalog) A study of the theoretical aspects of computing. Topics covered include formal languages (regular, context-free, and context-sensitive grammars), automata (finite state machines, push-down automata, and Turing machines), limitations of the respective computational models, and unsolvable problems.

Goals

- Explain non-computability and intractability and give examples of problems in each class
- Reduce one problem to another to show its complexity class
- Read and write proofs using mathematical notation appropriate for theory of computation
- Form and answer research questions; present the results in the standard form

Graded Material

- **Journal** – Your journal will be a record of all the non-project work you do during the semester. For homework problems, you will include both the scratch work and the final presentation of your solutions. As you read, you will include entries summarizing the content, working through examples, and listing questions. See pages 3 - 4 for more details.

- **Projects** – There will be two or three traditional programming projects assigned during the semester. In addition to submitting your source code, there will be a written component for each project.

  You will complete a multiple-step mini-research project during the semester. You will select individual topics, and we will meet regularly to discuss your progress. See pages 5 - 6 for more details and due dates.

- **Midterms** – There will be three midterms given during the semester and scheduled at the end of the major units. The tests will be take-home and must be completed in one week without help from anyone but myself. My tentative schedule predicts these tests will occur during the last week of September, October, and November.
• **Final** – The final will be cumulative and will be given in two parts. The take-home portion will be distributed the last week of class and will be due at the time of the final exam (as scheduled by the registrar). The second portion will be oral. We will discuss the format and scheduling of these individual meetings toward the end of the semester.

**Grade Determination**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal</td>
<td>20%</td>
</tr>
<tr>
<td>Programming Projects (collective)</td>
<td>20%</td>
</tr>
<tr>
<td>Research Project</td>
<td>20%</td>
</tr>
<tr>
<td>Midterms (collective)</td>
<td>30%</td>
</tr>
<tr>
<td>Final</td>
<td>10%</td>
</tr>
</tbody>
</table>

Grades will be calculated on the standard scale using pluses and minuses.

**Notes**

- If you have a disability that may affect your participation in this course, please contact me immediately to discuss academic accommodations.

- The dates and percentages on this syllabus are subject to change.

**Summary of Important Dates**

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic Selection</td>
<td>by Friday, September 9</td>
</tr>
<tr>
<td>Topic Presentation</td>
<td>Monday, October 3 through Friday, October 7</td>
</tr>
<tr>
<td>Question Selection</td>
<td>by Friday, October 14</td>
</tr>
<tr>
<td>Peer Review Submission Date</td>
<td>Friday, November 18</td>
</tr>
<tr>
<td>Final Paper Due</td>
<td>Monday, December 12</td>
</tr>
<tr>
<td>Group Presentations</td>
<td>Wednesday December 7 through Monday, December 12</td>
</tr>
</tbody>
</table>
Journals and Homework

The purpose of the journal is to give you a partially structured place to explore the material in this course. In addition to traditional homework problems, you will be given readings, exercises, and questions to complete by a certain date. Your journal should be used to record your progress on all these activities. The following quote from a psychology professor who also uses journal writing summarizes the benefits:

Journal writing can help many students become more productive and more focused thinkers. Research has shown that the regular habit of journal writing can deepen students’ thinking about their course subjects by helping them see that an academic field is an arena for wonder, inquiry, and controversy rather than simply a new body of information. This way of looking at an academic field can make college more interesting, even exciting. The more you see yourself in this course asking questions and questioning answers, the more you will be thinking like a psychologist.¹

Your journal will contain a variety of entries including scratch work for homework problems, final write-ups for homework problems, and responses to readings and other activities. Except in your final problem write-ups, spelling, grammar, and structure are not important in your journal. That is, you should not be concerned whether the writing is effective for another reader. You are writing primarily for yourself.

Homework Problems

The material in this course is best learned through written exercises. In working on these problems, you must think logically, but often creatively. To do well, start each problem set as soon as it is handed out. After you consider various approaches to a problem for a while, you might want to put it down and come back to it a day or two later. The right solution might just jump at you. Above all, do not expect to be able to start the night before an assignment is due!

I strongly encourage, and will occasionally even require you to work with other students. Collaborative work causes you to explain your ideas, which helps other students and increases your own understanding. In addition, describing a solution orally can often illuminate unwarranted assumptions and holes in your arguments.

You are allowed to consult other reference material in addition to your textbook and class notes. However, if you use a reference to derive the answer to a problem, you should give proper credit in your write-up.

You should include the scratch work for homework problems in your journal. Such entries have no prescribed form, but will likely include drawings and a mix of mathematical notation with English words. Messiness, including crossed out sections, is expected and encouraged. When working in groups, be sure your journal contains enough detail that you can re-construct the solution.

On the due date for each problem, you should be prepared to present the solution to each problem. In class, I will select students to share their solutions. You may pass occasionally, but I expect each student to contribute equally over the course of the semester.

¹Engaging Ideas by John C. Bean, pp. 102
Homework Write-Up

After we complete our discussion of each problem, you will produce a final write-up using \LaTeX. In addition to developing your type-setting skills, this activity requires you to give clear and concise explanations of the solutions. Many of these write-ups, especially those toward the beginning of the semester, will be produced in drafts. However, only the final draft should be included in your journal. Please place it close to the corresponding scratch work.

Other Journal Tasks

The other writing tasks in your journal will vary in the amount of structure. In some cases, I will ask you to use a “stream-of-consciousness” approach where you write continuously and simply follow your train of thought. Alternatively, I may give you a sequence of questions that you answer in your journal to help guide you through a more difficult reading. A more structured example would be asking you to write about a difficult concept as though you were explaining it to a roommate.

In many cases, we will use the entries in the next class session. For example, I may ask you to share your entry with the class or with a small group. Alternatively, the entry may have a more implied connection where I simply assume that you gained some preliminary knowledge for a lecture. Regardless of the use, you will gain much more from this course if you come with completed entries.

Procedures

Scratch work for homework problems should be handwritten, as many of the problems require drawings, arrows, and mathematical symbols that cannot be quickly typed. Final homework solutions must be typeset in \LaTeX, but other assignments may be typed or handwritten, whichever is more comfortable.

Because you will have a combination of hand-written and typeset material, you should obtain a three-ring binder to organize your journal. Please keep your journal in the order things were assigned with scratch work for a problem close to the final write-up. Also, please keep your class notes separate from your journal.

Grading

For all journal material, you will be graded based on the number of entries you complete and the quality of a random sampling of the entries. On the homework problem write-up, I expect a correct solution with a clear and succinct presentation. For all other entries, I will not be looking at layout, structure, grammar, or spelling, but rather for evidence that you were seriously thinking about the questions or problems posed. This means that you don’t always have to use the right terms or notation, show mastery of material, or be an encyclopedia of knowledge.
Group Project

This is an overview of the process your group will follow. Further details will be discussed in class as we begin each task.

Research Journal

You should keep notes on all the work you do on the research project. Having such a record demonstrates to me your continued engagement, and it also focuses your work. Anything worth writing down should be in your research journal. I frequently use my own journals to jot down ideas to explore later, to ask questions I don’t know the answer to, or to keep a list of things to do. By re-reading your journal throughout the semester, you will hopefully see your own progress and keep yourself organized.

Bi-Weekly Progress Reports

Every other week, I expect to have a twenty minute meeting with you to discuss your progress on the project. These meetings are your chance to explain what you have done since our last meeting and to ask questions. My purpose is both motivational – you don’t want to come without anything to say – and to act as a guide. I will be able to point you toward useful sources and to offer possible directions when you are stuck on a problem.

Although you are welcome to stop by and talk with me about your project at any time, we will produce a fixed schedule for the semester, and your prompt attendance at these meetings is expected.

Topics

Your first task will be to select a topic. In addition to material in the two text books, the Wikipedia and Mathworld are both good online encyclopedic sources of topics.

I will not allow two people to select the same topic, and requests will be granted in a first come, first serve order. That is, if two people request the same topic, the second will be asked to select another topic.

Once your topic has been approved, you should schedule a meeting with me to discuss how you will proceed. This meeting must occur before Friday, September 9.

Research Question Selection

On Monday, October 3 through Friday, October 7, you will give a 10 to 15 minute presentation on your topic. The goal of this presentation is to give the rest of the class enough background on the topic that it can be discussed effectively. After this presentation, we will talk as a class about possible research questions for the topic. After this discussion, but before Friday, October 14, you and I must agree on the research question you will pursue for the rest of the semester.

Peer Review

On Friday, November 18, you will submit a working draft of your paper to another student in the class. Then, on Monday, November 21, we will use one class session to perform peer reviews of the papers. You should consider the comments carefully and incorporate any changes you deem appropriate.
Annotated Bibliography

As you acquire sources, you will maintain an annotated bibliography including a summary of the source and its significance, as well as an evaluation of the quality in a scholarly sense. This document may contain sources that are not ultimately used in the final document.

Submission

On Monday, December 12, you will submit your paper and the following supporting material:

- Research Journal
- Peer-review document and comments
- Abstract and Title with comments
- Final draft of the paper
- Annotated bibliography

Final Presentation

On Wednesday December 7 through Monday, December 12, you will give a presentation of your research. This presentation will not be simply a summary of your paper, but rather your opportunity to share with the rest of the class the process that occurred as you developed your paper. In effect, you should present an interesting and well-organized version of your research journal along with a summary of your paper.

The class will read each other’s papers and prepare questions.

Grading

As with any technical research, there is a real danger of not having your results by the posted deadline. In the non-classroom setting, this typically means that the results are published later or in a different conference/journal. For this course, however, it is more appropriate to push for closure during the semester. Fortunately, the actual results and conclusions are only a portion of the final written product. In the event that your results are not complete in time, you will write your paper with partial results and/or conjectures.

In class, we will discuss the details of how the projects will be graded.