Math 460 Course Policies
Spring 2008

Class meets: Mon, Tues, Thurs: 10–10:50 a.m. in KSC 225

One day we will move to another location to play with the programming language perl. Exact day and location to be announced.

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Office: RAC 117

Office hours: Mon., Tues., Thurs., Fri. 11 a.m. – noon

Please come by my office hours whenever you have questions, and even if you don’t have questions. I am also available at other times by appointment.

You are also required to come by my office at one time during the first or second week of the semester. A signup will be passed around the class.


The book is difficult, because the subject is difficult. I will assign reading. Do this reading, if nothing else to get a sense for what you need to have explained. Then, after the lecture, read it again. You should have a better sense about the material then. In addition, it will help to read far ahead to get a sense for what’s coming up. If you don’t read, you will probably get lost.

You should also work through the examples. Unlike calculus, where the examples are merely templates to do your homework, the examples in this book are intended to flesh out the abstract ideas you are reading. The way to read these is to work them out yourself before class, the way you would if these were homework assignments.

Calculator: A calculator is not required for this course, but you are allowed to use one for homework and exams.

Prerequisites: Either Math 360 or Math 221.

It will help to review this material for this class. If you still have your book from that class, good. There will be proofs. You will need to be comfortable with Cantor’s diagonalization proof that the set of real numbers is not countable (though we will review this). Big O notation is also vital.

Email list: An email list will be set up shortly. If you want to join, indicate it on your personal information sheet.

Web page: The official course website is http://math.pepperdine.edu/math460

There are other websites that are relevant to this course. These will be announced in due time, and posted on the course website.

Some simulations are available for Windows at http://www.ics.uci.edu/~savoiu/dem

and for UNIX (JFLAP, written by Susan Rodger is at http://www.cs.duke.edu/~rodger/tools/tools.html).

Objectives: The student should be able:

• To use and understand various methods for describing languages, such as regular expressions and context-free grammars;

• To describe the mechanics of the Turing machine and why it is important to a theoretical understanding of computation;

• To understand and to compose Turing machines, finite-state automata, and pushdown stack automata;

• To relate modern ideas of computation to early 20th century mathematical ideas of effective computability;
• To give examples of functions that cannot be computed, and examples of functions that cannot be computed in reasonable time;

• To translate problems between function computation and language recognition;

**Goals:** The student should develop:

• An understanding of the theoretical foundations of computer science;

• An idea of what can be computed, what cannot be computed, and what cannot be computed in a reasonable amount of time;

• A sense for the relation between different models of computation and what they can and cannot compute;

• An appreciation for the relation between computer science, mathematics, philosophy, and linguistics;

• An ability to adapt to new computational models as they are developing and will continue to develop for the rest of their lives;

• An increased ability to do mathematical proofs.

**Overview**

Is this class a math class or a computer science class? It is required for computer science majors but it has a math numbering in the course catalog. The easy answer is that it is a math class. Students write proofs, not programs (more or less). And yet, the topic is computers. The material for this course is the theoretical foundations of computers, not in their particular form as chunks of silicon and wires, but in terms of what they could be in any physical manifestation. It is a pretty serious part of computer science, as opposed to computer programming. It’s also a rite of passage for all computer science majors, and it’s often viewed as the most difficult course in the curriculum. Not necessarily the one with the most work, but the one that requires the most mental agility and deep thinking.

In the first two weeks or so, I will give an overview of the course, while spending time reviewing material you should have learned in math 220 and math 221 (or math 360). I will especially focus on “Big-O” notation and cardinality of infinite sets.

There are two themes in this course, at first seemingly unrelated: the study of formal languages, and the theory of computation. Formal languages in this context concerns languages of many kinds, from computer languages like C++ to natural languages like Russian, but more generally has to do with what input is considered “valid” (say, in a text field in a form on a web page). The theory of computation deals with the question, “what kind of problem can be solved by a computer, and what cannot be?” As we will see, however, these two topics are closely related and are in fact in some sense equivalent.

We will be working through these themes throughout the course, and see how these are related. Along the way we will see some mind-bending truths about the answers to these questions, and you will be exposed to a few ideas that are at the forefront of computer science, such as artificial intelligence and quantum computing.

**Homework:** Homework will be assigned once a week: homework will be assigned on Monday and due that Thursday. Homework should be turned in at the beginning of class.

Remember that the primary place where learning happens is in the homework, so take the homework seriously. The lowest homework score will be dropped, but you should do your best on all your homework assignments.

If it is appropriate, homework may be emailed, but for security reasons you should not send it in an attachment. Many of the homework assignments will require some drawing of figures and are therefore not suitable for email. If you plan to submit files generated by the simulations listed above, you should check with me and we will make sure the relevant files can be emailed. In short, if I can’t read or access your electronically submitted homework because of a computer compatibility problem, it’s your fault for not checking it out beforehand, not mine.
**Late assignments:** You must give me notice that you are going to turn in an assignment late the class before the assignment is due, or it will not be accepted. You must also have a good reason. These reasons will be treated on a case-by-case basis. When you obtain permission to turn in an assignment late, we will discuss a new due date for that homework.

**Collaboration:** You are encouraged to collaborate on all homework assignments, unless otherwise specified. This means you work on it independently before discussing it with each other, and it means you must thoroughly understand how to do the problem before writing it up. You must write up your answers separately; you cannot turn in one homework for more than one person, nor can you simply include photocopies of other students’ work. There is no limit to the size of a group for collaboration, although 3-5 people tends to be an efficient size.

You should also use these groups to ask questions of each other to better understand the material. If you do not see each other frequently, you should set up a regular time and place to meet to work on assignments. If you do not have a group, talk to me and I can place you in a group. If you do not wish to work in a group, that is your prerogative but this will be a disadvantage to you.

**Comments:** You should include comments about the class at the top of your homework assignments. These comments can be “You go too fast”, “You say ‘um’ too often”, “I like this chapter”, “This is too easy/hard”, “Can we have more applications”, “Everything’s okay”, and so on. You will not be graded on these comments, but they will affect how I teach the class, and may make the class more enjoyable for you.

**Class participation:** You are expected to actively participate in class. Many students view learning as a passive act, where the teacher takes the only active role, and the student simply listens, or at most takes notes. This view is not advisable in this class. Here, you will need to take an active role in learning the material. You are in charge of your education, and you should take responsibility to learn the material as thoroughly as you can. Part of this involves asking questions in class, even questions that may sound “stupid”. A question clearing up a point you do not understand is, by definition, not stupid. Similarly, when I ask the class questions, you should try to answer them, even if you’re not sure of the answer. Your best guess is, by definition, not stupid.

There will also be times when the class will discuss a topic and you are expected to participate in the discussion. Correct answers are irrelevant for the grading of discussion; all that matters is that you participate in some meaningful way.

Class participation will be used to decide borderline cases in the final grade. Remember that since there are 12 grades (counting +’s and –’s), almost everyone in the class will be a borderline case.

**Pre-class preparation:** You are expected to read through the section of the book we are covering before you come to class. If you don’t understand something, write down specific questions you have to ask in class. See above under “text”.

**Attendance:** Attendance is important simply due to the difficulty of the course. Missing one class may have the effect of your not being able to follow any of the classes for the rest of the term. Furthermore, those who do not attend classes will have poor scores on class participation and this will also affect your grade. In short, skip class at your peril.

**Exams:** There will be two midterms, and one final. Each midterm counts for 20% of your grade, the final counts for 30%, and homework counts for 30%. All midterms and the final will be in-class. Test schedules are as follows:

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<thead>
<tr>
<th>Test</th>
<th>Review date</th>
<th>Exam Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm 1</td>
<td>Feb. 7</td>
<td>Feb. 11</td>
</tr>
<tr>
<td>Midterm 2</td>
<td>Mar. 20</td>
<td>Mar. 24</td>
</tr>
<tr>
<td>Final</td>
<td>Apr. 17</td>
<td>Apr. 21</td>
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The final exam grade will substitute for your lowest midterm grade if this is to your advantage. Note that borderline cases will be resolved by class participation, as noted above.

**Grading:** A grade of C indicates an ability to do homework-like problems, and memorization of all techniques and definitions. In order to receive a B, a student must demonstrate a deeper knowledge of the material, being able to apply the course material to new circumstances where applicable. An A student must demonstrate this kind of deep understanding in all of the covered topics, as well as be able to draw new conclusions from known facts in a logical manner, and must also demonstrate persistence and diligence. In the other direction, a grade of D shows only superficial understanding of the material, and shows inconsistency.
to do straightforward problems. An F grade indicates that the student has severe gaps in even superficial understanding of the material in the course.

Although this is the philosophy, grading will be done by counting points received on each problem, as usual. But the difficulty level of the problems will be arranged in order to achieve the above grading scale.

In addition, students may boost their grade by working on an independent project that is suitable to the material. Students interested in doing this should initiate such requests, preferably by suggesting a problem they find interesting and consulting with me to see if it is appropriate for the course.

Christian attitude: Although not part of the grading for this course, you are expected to approach this class with a Christian attitude, being willing to help your fellow classmates to understand the material outside of class, being willing to be corrected by your fellow classmates when you see they are right, but firm in your conviction otherwise, being bold to ask questions without feeling ashamed of looking foolish, encouraging one another in love, being patient with those who are asking questions, and preferring a grasp of the material, which is enduring and becomes part of you, over a grade, which is transient, external, and shallow. You should diligently devote the time you spend on this class as to the Lord. As cheating harms both the cheater and the rest of the class (though in different ways), you should not cheat, nor should you provide temptations for others to cheat.