CS 330: Discrete Structures
Final except for correcting typos or unforeseeable circumstance

Prof. Xiang-Yang Li
xli@cs.iit.edu, Stuart Building Room 229C, 312-567-5207
Department of Computer Science, Illinois Institute of Technology
Semester: Fall 2015
Class URL: http://www.cs.iit.edu/~xli/cs330/cs330.htm

1 Course Summary

Welcome to CS 330 Discrete Structures. This class has two major thrusts which complement each other nicely: increasing the mathematical sophistication (proofs and logic) and introducing the mathematical foundation of computer science. The emphasis is on understanding the material rather than simply accumulating information.

The class consists of two weekly (standard) lectures and one recitation session (officially called “lab”, Fridays 11:25-12:15, normally administered by the TA) in which students solve problems related to the lectures. Meeting time and locations:

<table>
<thead>
<tr>
<th>Class</th>
<th>Time</th>
<th>Location</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>11:25 am - 12:40 pm</td>
<td>Perlstein Hall 108</td>
<td>Aug 24, 2015 - Dec 05, 2015</td>
</tr>
<tr>
<td>Lab</td>
<td>11:25 am - 12:15 pm</td>
<td>Perlstein Hall 108</td>
<td>Aug 24, 2015 - Dec 05, 2015</td>
</tr>
</tbody>
</table>

The instructor is going to attend some conferences during the semester. Thus there will be some lectures with recitations only, while sometimes normal classes will be held instead of recitations. The exact dates for conference travels will be announced at least a week in advance.

- Labor day, September 7th (Monday, No Class)
- Fall Break Day, October 12th (Monday, No class)
- Thanksgiving break, Nov 25-29 (Wednesday, Friday, No class)
- First Midterm is tentatively scheduled on September 28th (Monday)
- Second exam is tentatively scheduled on October 30th (Friday)
- Final Exam Week, December 7-12. (see IIT calendar for details)

2 Textbook

The required textbooks is

Discrete Mathematics and Its Applications by Kenneth H. Rosen,

The sixth edition would be O.K. for learning, but may not be for assigned homework.
Recommended are

Student’s Solution Guide to Discrete Mathematics and Its Applications by Kenneth H. Rosen,

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These books should be available at the bookstore and on the web. Our library has the textbook on reserve.

3 Current Catalog Descriptions

Introduction to the use of formal mathematical structures to represent problems and computational processes. Topics covered include Boolean algebra, first-order logic, recursive structures, graphs, and abstract language models. Co-requisite: CS 116 or CS 201. (3-0-3)

4 Course Goals

Students should be able to:

1. Illustrate by examples the basic terminology of functions, relations, and sets and demonstrate knowledge of their associated operations.
2. Demonstrate in practical applications the use of basic counting principles of permutations, combinations, inclusion/exclusion principle and the pigeonhole methodology.
3. Calculate probabilities of events and expectations of random variables for problems arising from games of chance.
4. Establish and solve recurrence relations that arise in counting problems including the problem of determining the time complexity of recursively defined algorithms.
5. Model logic statements arising in algorithm correctness and real-life situations and manipulate them using the formal methods of propositional and predicate logic.
6. Outline basic proofs for theorems using the techniques of - direct proofs, proof by counterexample, proof by contraposition, proof by contradiction, mathematical induction.
7. Relate the ideas of mathematical induction to recursion and recursively defined structures.
8. Illustrate by example basic terminology of graph theory and model problems in computer science using graphs and trees.
9. Deduce properties that establish particular graphs as Trees, Planar, Eulerian, and Hamiltonian.
10. Illustrate the application of trees and graphs to data structures.
11. Explain the basic concepts modeling computation including formal machines, languages, finite automata, Turing machines

CS 330 Program Outcomes:

a. An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline.
b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
j. An ability to apply mathematical foundations, algorithmic principles, and computer science

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theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

1. Be prepared to enter a top-ranked graduate program in Computer Science.

5 Getting Help

Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, **students must obtain a letter of accommodation from the Center for Disability Resources** and make an appointment to speak with me as soon as possible. The Center for Disability Resources is located in the Life Sciences Building, room 218, 312-567-5744 or disabilities@iit.edu.

Office hours are **Monday and Wednesday 1-2, in room SB 229C**, or by appointment. For an appointment send e-mail to xli@cs.iit.edu or call 312-567-5207. Please spend a little time trying to understand a homework problem before asking for help.

Some handouts (including this syllabus, homeworks, and some solutions) will be available at [http://www.cs.iit.edu/~xli/cs330/cs330.htm](http://www.cs.iit.edu/~xli/cs330/cs330.htm).

The TA for the class will be Taeho Jung (email: tjung@hawk.iit.edu, office phone number: 312 567 5869) and has office hours Tuesday 1-2 PM and Friday, from the end of the class until 2PM, in room SB 019.

Students are expected to check email every week day of the semester. Clarifications on assignments or other important announcements might be sent by email - and will also be posted on the class webpage and/or blackboard.

We each have roles that will facilitate your understanding of the course material. My role is to aid you by elaborating on the concepts and principles presented in the text, introducing relevant “real world” examples, and being available to answer specific questions.

Your role is to come to lecture prepared. Students are expected to come to class equipped (having studied, with books, online sources, & homework). You are required to have read the assigned chapter before the lecture and to be ready to participate in class discussion. The content of this course will probably require you to re-read certain chapters in order to grasp the concepts covered.

Students are encouraged to ask questions. The only wrong question is an unasked question; if asking that question would have improved your understanding. I will attempt to answer all student questions during lecture except when it is apparent that the student has not read the material or it will significantly affect the pace of the lecture. I am also available during office hours, via telephone, e-mail and by appointment.

6 Grading

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The grading allocation is given below.

- **10 Homeworks (out of 11)**: 30%
- **1st Midterm (open book)**: 15%
- **2nd Midterm (closed book)**: 15%
- **Final exam (closed book)**: 25%
- **10 Quizzes (out of 12)**: 10%
- **Class Participation**: 5%

Tentative schedule of exams: The first midterm will be tentatively scheduled on **September 28th**. The second midterm will be tentatively scheduled on **October 30th**. (Instructors reserve the right to change the exam dates and the exact dates will be announced a week in advance). The final exam will be held as scheduled by the University (see university schedule for the exact date and time).

**Eleven** homeworks will be assigned (typically assigned on Wednesday, and due by midnight of the Wednesday one week or two weeks later, other than exam weeks). You can discuss the problems from homework assignments with other students in the class, but must write the solutions individually. Seek help from me if you are having difficulties with the homework. Except for extraordinary circumstances, homework solutions will be accepted at latest one week late. The penalty for late submission is

- **5%**, for **two days late**, **10%** for **five days late**, and **20%** for **one week late**.

You have to upload the electronic version of your homework solution to blackboard. We only accept PDF files for grading.

Name your solution file by `FirstName-LastName-HWXX-CS330.pdf`. Here `XX` is the number for the homework and `FirstName` and `LastName` are your first name and last name respectively. You also HAVE to include your name and homework number in the cover page of your submission.

The submission time of your homework will purely be based on the time when you successfully uploaded your solution to the blackboard.

Among the eleven homework assignments, only the highest **ten** scores will be used to compute your final grade.

The **first midterm** will be **open-books and closed notes**. Precisely, each student can bring either the sixth or seventh edition of the textbook, printed version only, with no handwritten notes on the book. Electronic versions will not be allowed; however a printout from the textbook (only) of maximum 50 double-sided pages may be used provided it is given to the instructor the lecture before the exam.

The **second midterm** and the **final** will be **closed-books and closed notes**, except for some possible notes distributed by me (photocopied key terms and results). The exams will be strictly individual, and may contain (slightly modified) homework problems. Standard departmental policy regarding academic (dis)honesty applies.

There will be **no** make-up exams, other than the final exam. Exams missed for valid reasons will be replaced by a higher weight of the final. Instructor reserves the right to determine the proper weight reassignment in such a case.
There will be **12 quizzes** (around 5 to 15 minutes each), each Friday (or Monday) other than weeks with exams. Discussion with any students during the quizzes is **not** allowed. Only the highest **TEN** scores among your 12 quizzes will be used when computing the composite score. Typically the quizzes will be given at the end of the class and will cover the material taught in that lecture or previous lecture.

**Attendance (including the recitation) is mandatory and will be reflected in the “class participation” score (valid excuses are required after the third missed class/recitation).** Also, disturbing the class will decrease this score and have negative impact on your grade. Moreover, students will be assigned reading from the textbook to competently discuss in class.

Each score will be scaled by the average of the highest **FIVE** scores in the class. Then a composite score will be computed, and grades assigned almost based on the ranges:

- **A=90-100**,  **B=80-89**,  **C=70-79**,  **D=60-69**,  **E=0-59**.

There is no prescribed curve and you are not competing with each other. Instructor reserves the right to adjust these ranges to deal with significant outliers.

### 7 Class room rules

Each of you is expected to contribute to each class session by arriving on time, being attentive, participating in the class discussion if needed, and being respectful to your instructor and fellow students. Disruptive conversations, eating, sleeping and putting your feet on the furniture are not acceptable behavior in the class environment.

In addition to arriving on time, students are expected to stay the whole class period. Please avoid disrupting fellow students and the instructor by arriving late or leaving early. If a situation arises that consistently causes you to be late or absent, please contact me.

Every electronic device (anything with an on/off button) should be off during the class (exception: disability-helping devices).

### 8 Topics to be covered

- Sets, Functions and relations - sets, set operations, functions, summations, growth of functions, equivalence relations, countable and uncountable sets, examples of algorithm analysis
- Counting Methods permutations, combinations, discrete probability, pigeonhole principle
- Advanced counting inclusion-exclusion, recurrence relations, methods of solving recurrences, examples from computer sciences
- Introductory Logic propositional logic, predicate logic, proof methodologies, examples of algorithm correctness
- Introduction to Graphs - trees, connectivity, Eulerian traversals, minimum spanning tree, planarity, Euler formula, matchings.
- Languages

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