

CS 456: Advanced Algorithms

Instructor: Thoshitha Gamage, Ph.D.
Southern Illinois University at Edwardsville

Fall 2015 Syllabus

Course Information:

Title: CS 456: Advanced Algorithms (3 Credits)
Location: EB 0165
Time: T & R 06:00 – 07:15 p.m.
Course Web site: <http://www.cs.siu.edu/~tgamage/F15/CS456>

Contact Information:

Office: EB 3053
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Email ✉: tgamage@siue.edu
Web Site 📄: <http://www.cs.siu.edu/~tgamage>
Office Hours: M & TU 10:00 – 11:30 a.m.
W & TR 01:00 – 02:30 p.m. *or by appointment*

This is an upper level undergraduate class in Algorithms. The primary course objectives are:

1. to learn advanced algorithmic techniques and put them into practice;
2. to build on the basic skills developed in CS 340;
3. learn and apply algorithm complexity and correctness analysis techniques;
4. to develop essential problem solving skills requisite of a computer scientist;
5. to mathematically reason about algorithms and their design; and
6. develop written communication skills within the context of computer science.

By the end of the semester, students are expected to be proficient in algorithmic analysis, complexity analysis, and correctness analysis of computer programs.

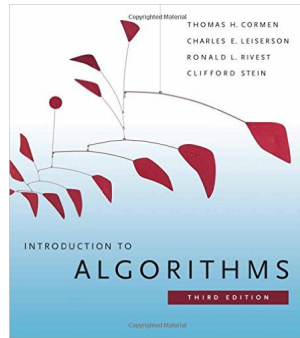
1 Course Prerequisites

CS340 (Data Structure and Algorithms) or the instructor's permission. Also *fluency and significant experience* in programming (C++, Java, Python, etc.) and Unix/Linux will be essential. If you do not meet these prerequisites, you **MUST** come and talk with me the first week of class. I reserve the right to drop you from the course if it becomes obvious that you do not meet the prerequisites.

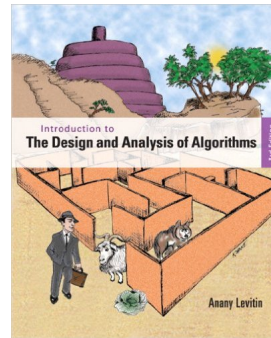
2 Textbook & Resources

[Required] **[CLRS3e]** *Introduction to Algorithms*, 3rd ed., Corman et al., MIT Press, ISBN: 978-0262033848
[Supplemental] **[AL3e]** *Introduction to the Design and Analysis of Algorithms*, 3rd ed., Anany Levitin, Pearson, ISBN: 978-0132316811

The presentation slides you find on the course website are the ones for **[AL3e]** from the publisher. You may also find another set of useful and informative slides Professor Kevin Wayne at Princeton graciously let me borrow on my previous offering from last Fall at <http://www.cs.siu.edu/~tgamage/F14/CS456/>. My lecture notes are based on



(a) [CLRS3e]



(b) [AL3e]

the numerous textbooks from my personal library and recent literature, and has a **strong mathematical flavor** to them.

I may ask you to research and read about specific algorithmic problems as a precursor to an in-class discussion that you may or may not find on the textbook. I will try my best to direct you to relevant resources where applicable, but I am fully expecting you to **take the responsibility of your own learning**.

3 Assigned Work and Tentative Grading Policy

The following grade allocation breakdown is **tentative**, and may change during the semester. Unless the circumstances change, I am **NOT** planning on curving the final grade.

Grading Allocation		BS	MS	Final Letter Grade	
Exams		50%	40%	90–100	A
Midterm	20% / 15%			80–89	B
Final (<i>comprehensive!!</i>)	30% / 25%			70–79	C
Attendance & Scribing		5%	5%	60–69	D
Problem Solving		15%	15%	below 60	F
Programing Projects		30%	25%		
Graduate Standing Project		–	15%		

3.1 Exams

All exams and quizzes will be held in the lecture room.

- **Midterm** : Tuesday October 13th 06.00 – 07.15 p.m.
- **Final** : Tuesday December 15th 06.30 – 08.10 p.m.

3.2 Class Participation

You are expected to **proactively** participate in in-class discussions. This aids your learning and that of your classmates, and provides valuable feedback on the lecture. Constructive and proactive participation in in-class discussions and scribing accounts for 5% of your final grade. I, therefore, expect you to attend each and every class. Each student is **required** to submit their scribe notes at least **two** times during the course of the semester. Scribe notes are due through *Moodle* within **48 hours** after the lecture. Only the top two scribe submissions (based on Moodle timestamp) will be counted as valid.

Scribe notes serve as a baseline set of complementary notes to you and your colleagues, hence please do your due diligence to make them readable. Students are also **required** to check the course website and the SIUE email account regularly for any important updates.

3.3 Problem Solving

There will be roughly ~3-4 in-class problem solving sessions. In preparation, students are **required** to read the relevant section(s) from the textbook and be familiar with the type of problems that will be discussed/solved in class. I plan to upload an outline a list of problems/topics related to the discussion at least 12 hours (hopefully 24 hours) before the lecture on the course website, so you can prepare accordingly.

3.4 Programming Projects

You will be given roughly ~3 hands-on programming assignments with a 2 weeks deadline. These assignments place a higher emphasis on empirical validation over “*practicing programming*”. Specifics of these assignments will be posted on the course website. I will give you the option to choose a language of your choice for programming (though C++, Java, or Python is recommended) but the development platform is fixed to Unix/Linux. You **must** make sure your code compiles and runs on any typical **Linux** system.

3.5 Graduate Standing Project

Graduate students are required to conduct a mini-research project that is worth 15% of the final grade. Ideally, your topic should be relevant to your current research interest/MS thesis/MS project but approaching it from a theoretical perspective. Some topics of interest to the instructor are category theory, topological combinatorics, model checking, communicating sequential processes, invariants-based correctness proofs, formal verification/Program Semantics/Hoare logic, and Bisimulation.

- Tuesday September 29th, 2015 - The title of the your research project. Due at the beginning of class.
- Thursday October 29th 2015 - A one page research progress summary. Due at the beginning of class.
- Thursday November 19th 2015 - Project Presentation slides. Due through Moodle by the end of the day.
- Thursday December 10th 2015 - Final report. Due at the beginning of class.

Places to look for a research topic includes (but not limited to) IEEE FOCS, ACM STOC, ISAAC, SODA, IEEE S&P, ACM CCS, SOCG, IEEE CCC, ACM PODC, IEEE IPDPS, CSF, etc. Implementations and empirical evaluations **very strongly favorable** over other types of projects.

A typical graduate level research of this scope would include a bare-minimum 20-25 *highly cited* research papers. I reserve the right to decide which projects meet graduate standing and lower the grade for those who don't, thus make sure to clearly exchange your research ideas with me and clarify your doubts about my expectations **early** in the semester.

You are to present your research to the class at the conclusion of your research during weeks 15 and 16. In addition, you are required to produce an IEEE conference style minimum 8-page paper of your research. A template can be found at http://www.ieee.org/conferences_events/conferences/publishing/templates.html. You are **highly encouraged** to produce your report using Latex.

In addition, graduate students may have additional mandatory questions in exams. Accordingly, graduate students will be graded on separate scale. Please refer Section 3 for the scale.

4 Course Requirements and Policies

4.1 Attendance Policy

For unforeseen circumstances, there will be times when you are unable to attend the lecture. Thus, I allow you to miss at most 2 classes for the semester without any penalties. Medical emergencies are outside this “absentee allowance”, but should be accompanied by proper documented proof of medical services. For planned absences, assignments should be turned in before the absence, rather than after. I reserve the right to lower the grade of any student who is markedly deficient in attendance and/or in in-class participation. If you miss a class, it is *your* responsibility to find out what happened and to collect any material that was handed out in the class.

4.2 Late Policy

Unless otherwise noted or announced in-class, any leftover questions from in-class problem solving sessions are due within a week at the beginning of the next immediate class. Programming assignments typically have a 2 week deadline. Assignments may be turned within 48 hours *grace period* after the deadline with a 20% late penalty. No assignment is accepted beyond that.

4.3 Responsible Learning Policy

I expect *you* to *own* your degree of success in this class *and*, I expect you to contribute to the success of others. Examples:

- Read outside the class on your own in preparation for each lecture, jot down any questions you encounter on your reading (strongly encouraged), and bring those to the class as discussion points;
- Be respectful of the learning environment. Refrain from activities that may disturb the flow of the lecture or the environment;
 - Do not engage in disruptive “*little talk*” while I am conducting the lecture; if you have a concern, raise your hand and grab my attention. be respectful of your colleagues time and desire to learn.
 - Put your cell phones to vibrate mode and refrain from using your computers for casual web browsing. Take full advantage of the opportunity to learn.
- Cooperate with other students and to share your knowledge during in-class discussions. Respect the differences in learning and understanding of each other. Seek ways of taking advantage of those differences;
- If another student is confused, help him or her out without disturbing the class;
- I enjoy engaging in technical conversations with students with the goal of helping them create an accurate understanding of course material. Participating in such conversations is very favorable for your class participation grade;
- If I am systematically doing something that inhibits your learning, tell me;
- Engage in *proactive learning*: speak up when you don’t understand, question assumptions, relate course material to your experience outside class, seek out additional experience and reading related to the class. You must *construct* your understanding of the material;
- If a lecture point is unclear, ask questions and ask me to repeat what I said, preferably in class, during office hours, or by e-mail. You are probably not alone in your confusion;
- Promptly review feedback you receive from me or other students to actively clarify the feedback if the material is still unclear and to incorporate the feedback in your future work;
- Spend adequate time on the course. Adequate time includes getting enough rest so that time you spend on course tasks is well-spent time. Adequate time includes proofreading and reviewing your assignments before you hand them in;
- Have high expectations of yourself: set goals for yourself and try to do your very best. Consciously think about the balance between what you do to earn a grade and what you do to learn (If I’m doing something that puts these in opposition to each other, please let me know.); and,
- Check your SIUE assigned student email and the course website regularly for important class announcements.

IMPORTANT: I strongly discourage you from getting into discussions with me about grades and how you can get a better one. This includes emailing me about possible ways to “bump” your grade. Such requests only mean one thing; that you have already fallen behind on your own expectations.

4.4 Academic Dishonesty: <http://www.siue.edu/policies> (3C1 & 3C2)

Do your own work. Your exams, homeworks, and programming projects are subject to the academic honor code. **DO NOT CHEAT IN ANY WAY: DO YOUR OWN WORK!** Following activities will be considered academic dishonesty:

- Submitting work (such as homework assignments projects, and code) done by somebody else (this includes any human/electronic sources (such as web sites));
- Watching and copying your neighbors’ solutions during quizzes and/or exams;
- Using materials not allowed during quizzes and exams;

- Using materials not allowed for the programming projects.

It is quite acceptable to ask others things like “Have you come across this particular issue/error/exception before?,” and even having them briefly look at your stack trace and/or its code. To have them spend hours helping develop or seriously rearrange your program’s logic, on the other hand, is not acceptable. And, of course, it is unacceptable for two or more people to collaboratively develop the solutions to assignments. If you are tempted to collaborate on such assignments, **DON’T!!**.

I expect you to know and observe the [SIUE Student Conduct Code \(3C1\)](#) and [Student Academic Code \(3C2\)](#). Copying of other students’ work, working together on individual assignments, plagiarism of published sources and other forms of academic dishonesty will result in zero credit on the assignment for all students involved and a lower grade in the class. A second offense (across the University) will result in an automatic **F** in the course and exposes the violator to University sanctions up to and including expulsion. All offenses will be reported to Student Affairs.

4.4.1 Advice

- a Don’t wait until the last minute to do homework or projects. Labs get busy, computers break down, and people get sick. These are not sufficient excuses for an extension.
- b Save early; save often!
- c Contact me if you are confused. Don’t wait for office hours; send an email.

4.5 Disability Support Services: <http://www.siu.edu/dss>

Any student inquiring about academic accommodations because of a disability should contact Disability Support Services so that appropriate and reasonable accommodative services can be determined and recommended. Disability Support Services is located in Student Success Center, Room 1270. Their phone number is 650-3726 and their email is disabilitysupport@siue.edu.

5 Tentative Schedule*

*Subject to adjustment and change. I reserve the right to change topics or add an item of related interest. All changes will be announced in class.

Week	Dates	Topics	References	Assignments/Exams
01	Aug. 25, 27	Introduction and Course Overview Algorithmic Analysis, Strategies, and Math Review	CLRS3e/01	
02	Sep. 01, 03	Greedy Strategy:	CLRS3e/16	HW01
03	Sep. 08, 10		CLRS3e/16	
04	Sep. 15, 17	Divide-and-Conquer Strategy:	CLRS3e/04	PR01
05	Sep. 22, 24		CLRS3e/04	
06	Sep. 29, Oct. 01	Dynamic Programming:	CLRS3e/15	HW02
07	Oct. 06, 08		CLRS3e/15	
08	Oct. 13 [‡] , 15	Network Flow:	CLRS3e/26	[‡] Midterm Exam
09	Oct. 20, 22		CLRS3e/26	
10	Oct. 27, 29	Randomized & Approximation Algorithms:	CLRS3e/05	PR02
11	Nov. 03, 05		CLRS3e/05,35	
12	Nov. 10, 12	Algorithmic Intractability:	CLRS3e/34	HW03
13	Nov. 17, 19	Security and Number Theory:	CLRS3e/34, 31	
14	Nov. 24, 26	Thanksgiving Break		
15	Dec. 01, 03	Topic TBA		PR03
16	Dec. 08, 10	Topic TBA		
17	Dec. 15	Final Exam: 06:30 – 08:10 p.m.		

PSXX – Problem Solving #XX
MS PR – MS Research Project