CS 456 : Advanced Algorithms

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

Fall 2016 Syllabus

Course Information:

Title:	CS 456 : Advanced Algorithms (3 Credits)
Location:	EB 3140
Time:	T & TR 09:30 – 10:45 a.m.
Course Web site:	http://www.cs.siue.edu/~tgamage/F16/CS456

Contact Information:

Office:	EB 3053
Phone ☎:	650-2407
Email ✉:	tgamage@siue.edu
Web Site ⌂:	http://www.cs.siue.edu/~tgamage
Office Hours:	T & TR 10:50 – 12:20 p.m.
	T & TR 01:50 – 03:00 p.m. *or by appointment*

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

1. to learn and develop algorithmic problem solving skills and put them into practice;
2. to build on the basic skills developed in CS 340;
3. to 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.

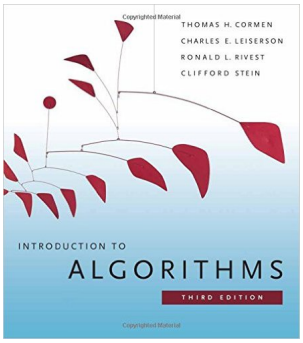
1 Course Prerequisites

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.

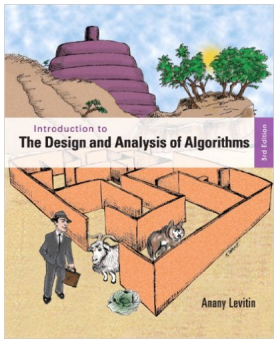
2 Textbook & Resources

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

My lecture notes are based on the numerous textbooks from my personal library and recent literature, and has a **strong mathematical flavor** to them. The presentation slides you find on the course website are from the publisher of **[AL3e]**. You may also find another set of useful and informative slides Professor Kevin Wayne at Princeton graciously let me borrow in my Fall '14 offering (http://www.cs.siue.edu/~tgamage/F14/CS456/).



(a) [CLRS3e]



(b) [AL3e]

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 or rounding the final grade.

Grading Allocation		**BS**	**MS**
Exams		40%	40%
Midterm	15% / 15%		
Final *(comprehensive!!)*	25% / 25%		
Attendance & Scribing		5%	5%
Problem Solving		25%	20%
Programing Projects		30%	27%
Graduate Standing Project		–	8%

Final Letter Grade	
90–100	A
80–89	B
70–79	C
60–69	D
below 60	F

3.1 Exams

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

- **Midterm** : Tuesday October 11^{th} 09:30 – 10:45 a.m.
- **Final** : Wednesday December 14^{th} 08:00 – 09:40 a.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 submissions. Scribe notes serve as a baseline set of complementary notes to you and to your colleagues, hence please do your due diligence to make them readable by others.

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 during the course of the semester. In preparation, I will ask you to research and read about specific algorithmic problems, that you may or may not find on the textbooks. 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** and come fully prepared to the class.

3.4 Programming Projects

You will be given roughly ~3 hands-on programming assignments with a strong 2 weeks deadline. These assignments place a higher emphasis on *empirical validation* over "programming practice". 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 and be sure to provide a Makefile with your submission.

3.5 Graduate Standing Project

Graduate students are required to conduct a mini-research project that is worth 8% of their final grade. Ideally, your topic should be relevant to your current research interest/MS thesis/MS project but approaching it from a theoretical/algorithmic perspective. Important milestones for your project are listed below. All assignments are due at the beginning of class through Moodle.

- Thursday September 08^{th}, 2016 – A one page research proposal and a justification of your proposed research.
- Thursday October 13^{th} 2016 – ~2-3 page research progress summary.
- Thursday November 17^{th} 2016 – Project Presentation slides.
- Thursday December 08^{th} 2016 – Final report.

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

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 your 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 respective 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.

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 assigned work, 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 briefly 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.

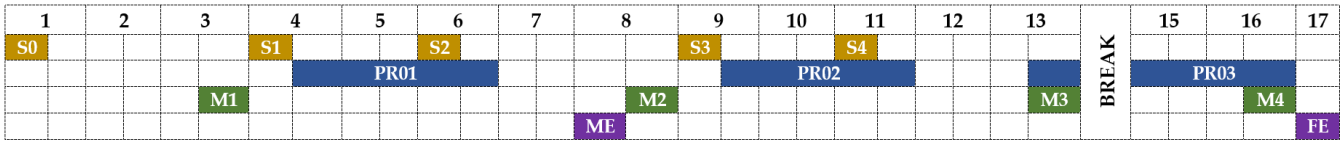
4.3.1 Advice

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.

4.4 Disability Support Services: http://www.siue.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.

4.5 CS456 in a Nutshell



S# – Problem Solving Session
M# – Graduate Standing Project Milestones
PR## – Programming Assignments/Projects
ME – Mid-Term Exam
FE – Final Exam

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. 23, 25	Introduction and Course Overview **Mathematics of Algorithmic Analysis:**	CLRS3e/01	So (take-home)
02	Aug. 30, Sep. 01			
03	Sep. 06, 08			M1 « in
04	Sep. 13, 15	**Greedy Strategy:**	CLRS3e/16	S1 (in-class) PR01 » out
05	Sep. 20, 22			
06	Sep. 27, 29	**Divide-and-Conquer Strategy:**	CLRS3e/04	S2 (in-class) PR01 « in
07	Oct. 04, 06			
08	Oct. 11‡, 13			‡ Midterm Exam M2 « in
09	Oct. 18, 20	**Dynamic Programming:**	CLRS3e/15	S3 (in-class) PR02 » out
10	Oct. 25, 27			
11	Nov. 01, 03	**Network Flow:**	CLRS3e/26	S4 (in-class) PR02 « in
12	Nov. 08, 10	**Randomized & Approximation Algorithms:**	CLRS3e/05,35	
13	Nov. 15, 17	**Algorithmic Intractability:**	CLRS3e/34	M3 « in, PR03 » out
14	Nov. 22, 24	**Thanksgiving Break**		
15	Nov. 29, Dec. 01	*Topic TBA*		
16	Dec. 06, 08	*Topic TBA*		M4 « in, PR03 « in
17	Dec. 14	**Final Exam: 08:00 – 09:40 a.m.**		