

CS447 : Networks and Data Communications

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

Spring 2023 (*sec. 02*) Syllabus

Course Information:

📖 Title:	CS447 : Networks and Data Communications (3 Credits)
📍 Location:	SE 1230
🕒 Time:	M & W 01:30 – 02:45 p.m.
🌐 Course Website:	http://www.cs.siu.edu/~tgamage/courses/447S23
📁 Assignment Dropbox:	https://classes.cs.siu.edu/spring-2023

Contact Information:

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✉ Email:	tgamage@siue.edu
🌐 Web Site:	http://www.cs.siu.edu/~tgamage
🕒 Office Hours:	M & W 09:30 – 11:30 a.m. <i>or by appointment</i>

This is an upper-level undergraduate introduction to computer networks with the following learning objectives:

1. to gain a fundamental understanding of how modern communication networks and their underlying mechanisms work;
2. to become proficient in the TCP/IP protocol suite and in applied networking – network programming, diagnosis, basic penetration testing, network engineering, performance analysis – through hands-on activities;
3. to kick-start cybersecurity education.
4. to facilitate a learning environment to strengthen participants' *theoretical* and *empirical* knowledge; and
5. to improve participants' critical thinking, reading, and writing skills;

By the end of the semester, students are expected to be proficient in networking programming with insight into underlying network mechanisms. The content of this course is influenced by and was developed in accordance with the IEEE/ACM Computer Science Curriculum Guidelines (2013)*.

1 Course Prerequisites

CS340 – Data Structure and Algorithms (**graph theory**), and CS314 – Operating Systems (**system programming**). In addition, fluency and significant experience in C or C++, and a basic familiarity with **Unix/Linux** is a **MUST** for the hand-on experiments. If you do not meet these prerequisites, talk to the instructor immediately within the first week of classes. I reserve the right to drop participants from the course that do not meet these minimum prerequisites.

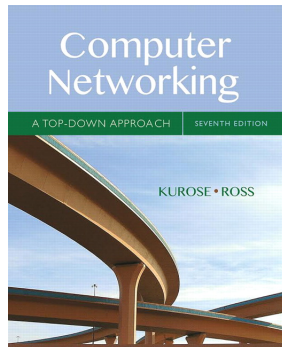
2 Textbook & Resources

[Required] [KR7e] Computer Networking: A Top-Down Approach 7th ed., Kurose and Ross, Pearson, ISBN 0-13-359414-9

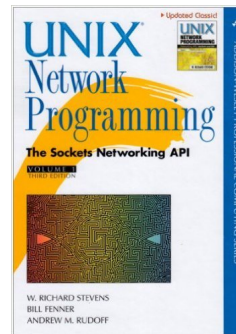
*https://www.acm.org/binaries/content/assets/education/cs2013_web_final.pdf

[Supplemental] [SFR3e] Unix Network Programming, Volume 1: The Sockets Networking API, 3rd ed., Stevens, Fenner & Rudoff, Prentice Hall, ISBN: 0131411551

[Supplemental] [BH3e] Beej’s Guide to Network Programming, Online: <http://beej.us/guide/bgnet/>



(a) [KR7e]



(b) [SFR3e]

My lecture notes are based on numerous textbooks from my personal library and recent literature. A complementary set of publisher provided lecture slides can be found on the course website. You can also find KR7e Authors’ slides at https://gaia.cs.umass.edu/kurose_ross/ppt.php among other useful resources. I tend to favor an engineering/mathematical approach to my classroom explanations.

Students are **expected** to regularly check the course website and their SIUE email account for any important course related updates.

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	Final Letter Grade	
Exams	40%	35%	[88 ++	A
Midterm	15% / 13%		[79–88)	B
Final (<i>comprehensive!!</i>)	25% / 22%		[70–79)	C
Participation (<i>including Attendance</i>)	10%	10%	[60–70)	D
Wireshark Labs	20%	15%	– 60)	F
Programming Projects	30%	25%		
Graduate Standing Project	–	15%		

3.1 Exams

- Midterm (E1) : Wednesday March 01st 01:30 – 02:45 p.m. (75 mins)
- Final (FE) : Wednesday May 03rd 12:00 – 01:40 p.m. (100 mins)

3.2 Class Participation

You are expected to attend all live lectures and **proactively** participate in in-class discussions and Q&A. When applicable recorded video lectures and instructor scribe notes will be made available. However, such material are not meant as a substitute for missing classes, thus, pay attention during live lectures and take your own notes. Constructive and proactive participation in in-class discussions accounts for 10% of your final grade.

In general, you are expected to read the relevant sections from the reference textbook(s) in preparation for each lecture (*see Tentative Schedule below*). I will try my best to direct you to other relevant resources wherever applicable,

but I fully expect you to **take the responsibility of your own learning** and come to the class as much prepared as you can.

3.3 Wireshark Labs

~3.5 Wireshark Labs (Wo-W3) with a one week deadline from the day it was assigned. In preparation, you are expected to download and install Wireshark on your personal computer from the official website <https://www.wireshark.org/>.

3.4 Programming Projects

3 hands-on network programming experiments (Po-P2) with a 2 week deadline. These will be posted on the course website. The programming language is fixed to either C or C++, **AND**, your programs **must** compile and run on typical Unix/Linux setup. Using the zone.cs.siu.edu server to development and testing is highly recommended, as it's a purpose built environment for this class.

3.5 Graduate Standing Project

Graduate students are required to conduct a mini-research project that is worth 15% of their final grade. A typical graduate level research of this scope would include a fairly comprehensive literature survey that refers a minimum 15-20 *highly cited* research papers, culminating to some empirical validation. In other words, your objective is to develop a hypothesis based on your readings and see if you can validate your hypothesis (*hence, scientific method*). You are free to choose a topic of your choice **relevant** to the theme of this course. 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, DSN, IEEE ICDCS, USENIX, etc. Here's a short guide on **How to Read a Paper** : <http://ccr.sigcomm.org/online/files/p83-keshavA.pdf>. Here's a good sample literature review: <https://dl.acm.org/citation.cfm?id=3047307>.

Important milestones for your project are listed below. All assignments are due at the beginning of class through Moodle. You will present your research to the class during weeks 15 and 16, and produce an IEEE conference style minimum 8-page paper as the final report. 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.

- Monday January 23rd, 2023 – A one page research proposal and a justification of your proposed research. (M1)
- Wednesday March 15th 2023 – A near complete literature review along with a rough empirical validation plan. (M2)
- Wednesday April 26th 2023 – Final report. (M4)

While not mandatory, graduate students are highly encouraged to regularly meet and update the instructor on their research progress. I reserve the right to decide which projects meet graduate standing and lower the grade for those who don't; hence, make sure to clearly exchange your research ideas with me, find out about my expectations, and set yourself up for success **early** in the semester.

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 Late Policy

Unless otherwise noted or announced in-class, all deadlines are hard deadlines and assignments are due at the beginning of class on the due date. Assignments may be turned within 48 hours *grace period* after the deadline (except any final projects) with a 20% late penalty. No assignment is accepted beyond this grace period. Graduate project milestones do not have any grace periods.

5 COVID-19 Pandemic Policies Related to Classroom Instruction (Spring 2023)

5.1 Health and Safety

The measures outlined below are required and any student who does not comply may be in violation of the *COVID-19 People-Focused Health and Safety Policy*, as well as the University's *Student Code of Conduct*.

The full text of the *COVID-19 People-Focused Health and Safety Policy* can be found here: <https://www.siue.edu/policies/Covid.shtml>

5.2 Classrooms, Labs, Studios, and Other Academic Spaces

Under current University policy, SIUE will only require masking in campus healthcare settings. See, <https://www.siue.edu/about/announcements/coronavirus/safety-guidelines-support/index.shtml>.

Individual faculty of record may determine that masking will be required in their classrooms and are asked to communicate accordingly with students. Face masks may be required in other campus sites following guidance from governing regulatory agencies.

- Students who forget to wear a face covering when masking is required will be reminded of their obligation to comply with SIUE's *COVID-19 People-Focused Health and Safety Policy* and temporarily asked to leave the class until they are able to conform to the policy. Students who forget or lose their face coverings when masking is required may be able to obtain replacements from a friend, a faculty member, or a nearby departmental office. Face coverings are also available for purchase in the Cougar Store (MUC).
- Students who refuse to wear a face covering when masking is required will be asked to leave the classroom and referred to the Dean of Students for non-compliance with community health and safety protocols. Repeated non-compliance may result in disciplinary actions, including the student being administratively dropped from an on-ground/face-to-face course or courses without refund if no alternative course format is available.
- If a student has a documented health condition which makes wearing a face covering medically intolerable, that student should contact ACCESS to explore options with the understanding that ACCESS will not grant accommodations which excuse the need for a face covering while on campus or in the classroom. ACCESS will work with qualifying individuals to find reasonable alternatives, whenever such solutions are available. Please call or contact the ACCESS Office via email to schedule an online appointment to discuss potential alternatives. ACCESS office (Student Success Center, Room 1203, 618-650-3726, and myaccess@siue.edu).

5.3 General Health Measures

Students and employees are expected to review the [siue.edu/coronavirus](https://www.siue.edu/about/announcements/coronavirus/) website (<https://www.siue.edu/about/announcements/coronavirus/>) to better understand prevention strategies and safety expectations.

- Students and employees are expected to maintain healthy hygiene practices.
- Students and employees are expected to follow COVID-related guidelines and directions.
- Students and employees are expected to conduct a daily health self-assessment and isolate themselves if COVID-related symptoms are present. COVID-related symptoms include:

<ul style="list-style-type: none"> – Fever (100.4 degrees or above) or chills – Cough – Shortness of breath or difficulty breathing – Fatigue – Muscle or body aches – Headache 	<ul style="list-style-type: none"> – New loss of taste or smell – Sore throat – Congestion or runny nose – Nausea or vomiting – Diarrhea
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5.4 Academic Integrity

Students are reminded that the expectations and academic standards outlined in the Student Academic Code (3C2) apply to all courses, field experiences and educational experiences at the University, regardless of modality or location. The full text of the policy can be found here: <https://www.siue.edu/policies/3c2.shtml>.

5.5 Recordings of Class Content

Faculty recordings of lectures and/or other course materials are meant to facilitate student learning and to help facilitate a student catching up who has missed class due to illness or quarantine. As such, students are reminded that the recording, as well as replicating or sharing of any course content and/or course materials without the express permission of the instructor of record, is not permitted, and may be considered a violation of the University's Student Conduct Code (3C1), linked here: <https://www.siue.edu/policies/3c1.shtml>.

5.6 Potential for Changes in Course Schedule or Modality

As the COVID-19 pandemic continues, there remains a possibility that planned classroom activities will need to be adjusted. Depending on circumstances and following state-issued recommendations, potential changes include alterations to distancing requirements, course modality (e.g., transition from face-to-face to online, hybrid, or hy-flex, mask wearing, in-course activities, etc). These changes would be implemented to ensure the successful completion of the course while preserving health and safety. In these cases, students may be provided with an addendum to the class syllabus that will supersede the original version. If the course schedule or modifications significantly alter expectations, a new syllabus will be issued.

6 Responsible Learning Policy

There is a no tolerance policy with regards to cheating. **Anyone caught cheating will fail the course.** Do your own work. Your exams, homework, and programming projects are subject to the academic honor code. You are expected to know and observe the [SIUE Student Conduct Code \(3C1\)](http://www.siue.edu/policies) and [Student Academic Code \(3C2\)](http://www.siue.edu/policies) found at <http://www.siue.edu/policies>. If you are unsure about what constitutes as plagiarism, check this website: <https://www.siue.edu/education/psychology/plagiarism.shtml>.

6.1 Online Repositories

If you intend to keep any project source code in online repositories, ensure those repositories are **private** and **only accessible to you**. By making source code publicly available to others, you might be involuntarily participating in plagiarism.

6.1.1 Advice

This course will require a substantial amount of time reading and solving problems outside of class time. It is imperative that you keep up with the assigned reading and other tasks as much as possible. If you do not, it will be very difficult to be successful in this course.

Know the information, how to approach the problem/solution, and present it in a clear and organized manner. On exams and in programming projects, you are attempting to demonstrate understanding of concepts and the ability to solve problems. If I have to try to determine **how** you came up with your answer, then you will **not** receive full credit.

The following conditions are subject to loss of some or all credit for a given problem:

- Illegible work/answers
- missing/incorrect units
- work/answers that cannot be easily located
- compile-time and/or run-time errors
- no work

Solutions which clearly demonstrate understanding of the material, but have a minor error may receive partial credit. The final score for such problems is at the discretion of the grader and/or the instructor.

- 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 a Discord DM or an email.
- d. 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.

7 Accessible Campus Community & Equitable Student Support

Students needing accommodations because of medical diagnosis or major life impairment will need to register with Accessible Campus Community & Equitable Student Support (ACCESS) and complete an intake process before accommodations will be given. Students who believe they have a diagnosis but do not have documentation should contact ACCESS for assistance and/or appropriate referral. The ACCESS office is located in the Student Success Center, Room 1270. You can also reach the office by e-mail at myaccess@siue.edu or by calling 618.650.3726. For more information on policies, procedures, or necessary forms, please visit the ACCESS website at www.siue.edu/access.

8 CS447 in a Nutshell

1	2	3	4	5	6	7	8		10	11	12	13	14	15	16	
W0		W1				W2					W3					
	MLK			P0				BREAK	P1			P2				
		M1							M2						M4	
							E1									FE

W# – Wireshark Labs, P# – Programming Projects, M# – Graduate Project Milestones, E1 – Mid-Term Exam, FE – Final Exam

8.1 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	Topics	References	Assignments/Exams
01	Introduction and Course Overview Network Performance Measurement	KR7e/1.1–1.8	Wo > out
02	MLK Day Introduction to Socket Programming	KR7e/2.7	Wo < in, W1 > out
03	Application Layer: Application Developer's view Application Layer Protocols: SMTP, HTTP, DNS	KR7e/2.1–2.4	M1 < in W1 < in
04	P2P Transport Layer: Reliable Data Transfer Principles	KR7e/2.5, 3.1–3.2	Po > out
05	Reliable Data Transfer Principles <i>ctd.</i>	KR7e/3.4–3.5	
06	TCP: Flow Control, Congestion Control, UDP	KR7e/3.6–3.7, 3.3	Po < in
07	Network Layer: Forwarding Protocols (IPv4, IPv6) Subnet Addressing & Management	KR7e/4.1–4.3	W2 > out
08	Mid Term: Wednesday March 01st 01:30 – 02:45 p.m.		W2 < in
09	Spring Break		
10	Routing Protocols (RIP, OSPF, BGP)	KR7e/5.1–5.4	P1 > out M2 < in
11	DHCP, ICMP Software Defined Networks	KR7e/4.3.2, 5.6, 5.5	
12	Link Layer: Error Detection and Correction	KR7e/6.2	P1 < in, W3 > out
13	ALOHA, Slotted ALOHA CSMA/CD, Taking Turns Protocols	KR7e/6.3	W3 < in, P2 > out
14	ARP, Link Layer Addressing Ethernet, VLANs	KR7e/6.4	
15	Network Security: Fundamentals TLS/SSL	KR7e/8.2–8.6	P2 < in
16	Topic TBA (Project Presentations)		M4 < in
17	Final Exam: Wednesday May 03rd 12:00 – 01:40 p.m.		