CS447 : Networks and Data Communications

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

Summer 2022 Syllabus

Course Information:

📖	Title:	CS447 : Networks and Data Communications (3 Credits)
	Location:	*thru* Discord
🕐	Time:	T & R 11:00 – 01:40 p.m.
	Course Website:	http://www.cs.siue.edu/~tgamage/courses/447M22
	Assignment Dropbox:	https://classes.cs.siue.edu/summer-2022

Contact Information:

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📞	Phone:	650-2407
✉	Email:	tgamage@siue.edu
	Web Site:	http://www.cs.siue.edu/~tgamage
📅	Office Hours:	pre-arranged *thru* Discord

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 Online:http://www-net.cs.umass.edu/kurose-ross-ppt-7e/

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

[Supplemental] [SFR3e] Unix Network Programming, Volume 1: The Sockets Networking API, 3nd ed., Stevens, Fenner & Rudoff, Prentice Hall, ISBN: 0131411551
[Supplemental] [BH3e] Beej's Guide to Network Programming, Online: `http://beej.us/guide/bgnet/`
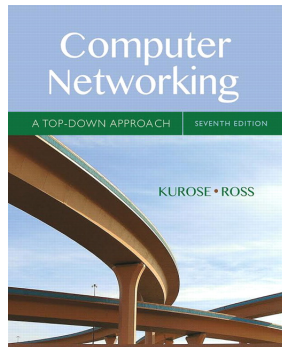
(a) **[KR7e]**
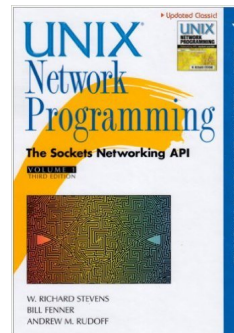
(b) **[SFR3e]**

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 a 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
Exams		40%	35%
Midterm	15% / 13%		
Final *(comprehensive!!)*	25% / 22%		
Attendance & Participation		10%	10%
Wireshark Labs		20%	15%
Programming Projects		30%	25%
Graduate Standing Project		–	15%

Final Letter Grade	
[88 ++	A
[79–88)	B
[70–79)	C
[60–70)	D
– 60)	F

3.1   Exams

- **Midterm** (E1) : <mark>Tuesday June 07th 12:25 – 01:40 p.m.</mark> (75 mins)
- **Final** (FE) : <mark>Thursday June 30th 12:00 – 01:40 p.m.</mark> (100 mins)

3.2   Class Participation

You are expected to **proactively** and **constructively** participate in in-class discussions. This aids your learning and that of your classmates, and provides valuable feedback on the lecture. In preparation, you are expected to read the relevant sections from **KR7e** (*see Tentative Schedule below*). I will try my best to direct you to other relevant resources where 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 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 with a 1 1/2 week deadline. These will be posted on the course website. The programming language is fixed to either C or C++. Additionally, your programs **must** compile and run on typical Unix/Linux setup. Using the zone.cs.siue.edu server to development and testing is highly recommended, as it's a purpose built setup 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 a taxonomy **and** some empirical validation. In other words, your objective is to develop a hypothesis based on your reading and validate it with experimentation. You are free to choose a topic of your choice **relevant** to the theme of this course. Topics that intersects with Cybersecurity are **highly favorable**. Here's a short guide on **How to Read a Paper** : http://ccr.sigcomm.org/online/files/p83-keshavA.pdf.

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. Have a look at the USENIX security symposium proceedings https://www.usenix.org/conference/usenixsecurityXX/technical-sessions (*Replace XX with a 2-digit year (e.g. 19)*) for a quick "*get me up-to-speed*". Here is an excellent sample paper very much in sync with this course: https://www.ndss-symposium.org/ndss-paper/post-quantum-authentication-in-tls-1-3-a-performance-study/.

Important milestones for your project are listed below. All assignments are due at the beginning of class through Blackboard.

- Tuesday May 17th, 2022 – A one page research proposal and a justification of your proposed research.
- Thursday June 09th 2022 – ~2-3 page research progress summary.
- Thursday June 30th 2022 – Final report and in-class Presentation.

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.

I reserve the right to decide which projects meet graduate standing and to lower the grade for any projects that don't at any point during the semester; 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 Classroom Policies

4.1 Attendance Policy

You are expected to attend all live lectures and **proactively** participate in in-class discussions and Q&A. Whenever applicable, lecture recordings and digital scribe notes will be made available to you through Discord. However, it is important for you to pay attention to the live lectures and take your own notes, rather than solely relying on my recorded lectures; recorded videos are not meant to be a substitute for missing classes, and I've had unplanned recording failures in the past.

4.2 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 2022)

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, whether in the classroom, lab, studio, or other academic spaces, students (regardless of vaccination status) shall wear face coverings that fully cover the nose and mouth and practice physical distancing measures to the extent practicable based on the specific classroom capacity and pedagogy. Classroom furniture should not be rearranged, and furniture that has been taped off or covered should not be used.
Students who forget to wear a face covering 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 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 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

At all times, students should engage in recommended health and safety measures, which include:

- Conducting a daily health assessment. If you have **COVID-19 Symptoms**[†], but not yet tested positive, have had COVID-19 close contact exposure, or are COVID-19 diagnosed as presumptive or confirmed positive, contact your health provider or SIUE Health Service at cougarcare@siue.edu or 618-650-2842. More information on reporting procedures is available at https://www.siue.edu/about/announcements/coronavirus/testing-reporting/reporting.shtml?section=students
- Frequent washing or disinfecting of hands.
- Adhere fully to the current face mask and physical distancing rules as articulated in policy: https://www.siue.edu/about/announcements/coronavirus/safety-guidelines-support/face-mask-pick-up.shtml.
- If present, adhere to directional signs and traffic flow patterns in buildings and offices. In many spaces, doors for entering and exiting buildings are designated.

[†]https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html

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 students who missed class due to illness or quarantine catch-up. 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. 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 problem solving and/or exams;
- Collaboratively develop solutions to individual assignments;
- Using materials not allowed during problem solving and exams;
- Using materials not allowed for the programming projects.

You are expected to know and observe the SIUE Student Conduct Code (3C1) and Student Academic Code (3C2) 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
- work/answers that cannot be easily located
- no work
- missing/incorrect units
- compile-time and/or run-time errors

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 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
WS00	WS01	WS02			WS03		
	PR00			PR01	....	PR02	
	M1			M2			M3
				ME			FE

8.1   Tentative Schedule*

*<mark>Subject to adjustment and Change.</mark> 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	May 10, 12	Course Overview, Network Fundamentals Network Performance, **Application Layer:** HTTP, FTP	**KR7e**/01,02	WS00 > out WS00 < in
02	May 17, 19	DNS, SMTP, P2P, Socket Programming **Transport Layer:** Reliable Data Transfer Principles	**KR7e**/02,03	M1 < in, WS01 > out WS01 < in, PR00 > out
03	May 24, 26	Reliable Data Transfer Principles	**KR7e**/03	
04	May 31, June 02	TCP: Flow Control, Congestion Control, UDP **Network Layer:** Routing vs. Forwarding, Routers	**KR7e**/03,04	PR00 < in, WS02 > out WS02 < in, PR01 > out
05	Jun. 07[‡], 09	<mark>**Midterm Exam: Tuesday June 07th 12:25 – 01:40 p.m.**</mark> IPv4 Addressing, DHCP, Subnetting	**KR7e**/04	M2 < in
06	Jun. 14, 16	Routing Protocols, ICMP, IPv6 RIP, OSPF, BGP	**KR7e**/05	PR01 < in, WS03 > out WS03 < in, PR02 > out
07	Jun. 21, 23	**Link Layer:** Error Detection and Correction ALOHA, Slotted ALOHA, CSMA/CD	**KR7e**/06	
08	Jun. 28 Jun. 30	**Network Security** Graduate Presentations, and <mark>**Final Exam: Thursday June 30th 12:00 – 01:40 p.m.**</mark>	**KR7e**/08	PR02 < in M3 < in

[‡]Midterm Exam, [§]Graduate Project: In class presentations