

# CS 447 : Networks and Data Communications

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Southern Illinois University at Edwardsville

## Spring 2020 Syllabus

### Course Information:

📖 Title:	CS 447 : Networks and Data Communications (3 Credits)
📍 Location:	<del>EB-0140</del> EB 1150
🕒 Time:	M & W 12:00 – 01:15 p.m.
🌐 Course Website:	<a href="http://www.cs.siu.edu/~tgamage/courses/447S20">http://www.cs.siu.edu/~tgamage/courses/447S20</a>
📁 Assignment Dropbox:	<a href="https://classes.cs.siu.edu/spring-2020">https://classes.cs.siu.edu/spring-2020</a>

### Contact Information:

🏠 Office:	EB 3053
☎ Phone:	650-2407
✉ Email:	<a href="mailto:tgamage@siue.edu">tgamage@siue.edu</a>
🌐 Web Site:	<a href="http://www.cs.siu.edu/~tgamage">http://www.cs.siu.edu/~tgamage</a>
🕒 Office Hours:	M & W 01:30 – 03:00 p.m. T 10:00 – 11:00 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) [https://www.acm.org/binaries/content/assets/education/cs2013\\_web\\_final.pdf](https://www.acm.org/binaries/content/assets/education/cs2013_web_final.pdf).

## 1 Course Prerequisites

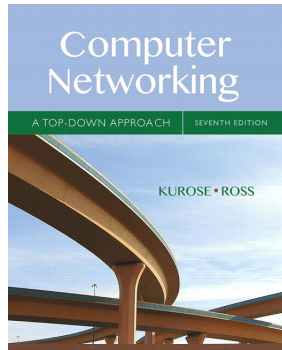
CS340 – Data Structure and Algorithms (**graph theory**), and CS314 – Operating Systems (**system programming**). In addition, fluency and significant experience in structured or imperative programming (e.g. C, C++, Java, Python), and **Unix/Linux** is a **MUST** for the hand-on experiments. If you do 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

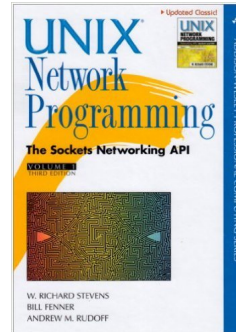
[Required] [PR7e] Computer Networking: A Top-Down Approach 7<sup>th</sup> ed., Kurose and Ross, Pearson, ISBN 0-13-359414-9 Online:<http://www-net.cs.umass.edu/kurose-ross-ppt-7e/>

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

[Supplemental] [BH3e] Beej's Guide to Network Programming, Online: [http://beej.us/guide/bgnet/output/print/bgnet\\_USLetter.pdf](http://beej.us/guide/bgnet/output/print/bgnet_USLetter.pdf)



(a) [PR7e]



(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 PR7e Authors' slides at <http://www-net.cs.umass.edu/kurose-ross-ppt-7e/>. Material I present in class typically have a **strong mathematical flavor** to them.

Students are **required** 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%	90–100	A
Midterm	15% / 13%		80–89	B
Final ( <i>comprehensive!!</i> )	25% / 22%		70–79	C
Attendance & Scribing	5%	5%	60–69	D
Wireshark Labs	25%	20%	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 : Wednesday March 04<sup>th</sup> 12:00 – 01:15 p.m.
- Final : Thursday May 07<sup>th</sup> 10:00 – 11:40 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.

In preparation for each lecture, you are expected to read the relevant sections from [PR7e](#) (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 fully prepared to the class.

Each student is required to submit their scribe notes a **minimum of twice** for the semester, once before the mid-term and once after. 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 pay your due diligence to make them legible.

### 3.3 Wireshark Labs

There will be roughly ~3-4 Wireshark Labs with a 1 week deadline from the day each is assigned. In preparation, each student is expected to download and install Wireshark from the official website <https://www.wireshark.org/>.

### 3.4 Programming Projects

You will be given roughly ~3 hands-on network programming experiments. These will be posted in 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 your programs **must** compile and run on a Unix/Linux machine. It is also advisable to set up a Linux virtual machine that can be used for your programming assignments. Additionally, EB1036 PCs will have a Linux dual-boot option.

### 3.5 Graduate Standing Project

Graduate students are required to conduct a mini-research project that is worth 10% of their final grade. Ideally, this would be a fairly comprehensive literature survey of a topic of your choosing with some empirical validation. Your topic should be relevant to the theme of this course. Important milestones for your project are listed below. All assignments are due at the beginning of class through Moodle.

- Wednesday January 29<sup>th</sup>, 2020 – **M1**: One page research proposal and a justification of your proposed research.
- Wednesday March 04<sup>th</sup> 2020 – **M2**: ~3-4 page intermediate report of your research progress.
- Wednesday April 15<sup>th</sup> 2020 – **M3**: Project presentation slides.
- Wednesday April 29<sup>th</sup> 2020 – **M4**: 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, DSN, IEEE ICDCS, USENIX, etc. Topics in Cybersecurity are **highly favorable**.

A typical graduate level research of this scope would include a bare-minimum 15-20 *highly cited* research papers, ideally culminating a fairly comprehensive literature survey and a taxonomy. Here's a sample for your review: <https://dl.acm.org/citation.cfm?id=3047307>.

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](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 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 Course Requirements and Policies

### 4.1 Attendance Policy

Based on University Class Attendance Policy 1I9: It is the responsibility of students to ascertain the policies of instructors with regard to absence from class, and to make arrangements satisfactory to instructors with regard to missed course work. Failure to attend the first session of a course may result in the student's place in class being assigned to another student. You may be dropped from the course at any time for the following reasons:

- Failure to attend the first scheduled class
- Missing an exam or quiz without an acceptable reason
- Missing more than one week of class or two class sessions

**There will be no opportunities to make up missed exams or quizzes!**

### 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.

### 4.3 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, homeworks, 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.siu.edu/policies>. If you are unsure about what constitutes as plagiarism, check this website: <https://www.siu.edu/education/psychology/plagiarism.shtml>

#### 4.3.1 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.

#### 4.3.2 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.

#### 4.4 Accessible Campus Community & Equitable Student Support: <http://www.siu.edu/access>

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@siu.edu](mailto:myaccess@siu.edu) or by calling 618.650.3726. For more information on policies, procedures, or necessary forms, please visit the ACCESS website at [www.siu.edu/access](http://www.siu.edu/access).

## 5 CS 447 in a Nutshell

1	2	3	4	5	6	7	8	BREAK	10	11	12	13	14	15	16	17	
WS00		WS01				WS02							WS03				
				PR01							PR02				PR03		
		M1							M2				M3			M4	
								ME								FE	

WS## – Wireshark Labs, M# – Graduate Standing Project Milestones, PR## – Programming Projects, ME – Mid-Term, FE – Final

### 5.1 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	Dates	Topics	References	Assignments/Exams
01	Jan. 13, 15	Introduction and Course Overview Fundamentals of Network Communication	PR7e/01	WS00 > out
02	Jan. 20, 22	<b>MLK Day</b> Fundamentals <i>ctd.</i>	PR7e/02	WS00 < in
03	Jan. 27, 29	Network Performance Measurement <b>Application Layer:</b> HTTP, FTP	PR7e/02,03	WS01 > out M1 < in
04	Feb. 03, 05	DNS, SMTP, P2P Socket Programming Tutorial	PR7e/03	WS01 < in PR01 > out
05	Feb. 10, 12	<b>Transport Layer:</b> Mux/Demux Reliable Data Transfer Principles	PR7e/03	
06	Feb. 17, 19	Reliable Data Transfer Principles	PR7e/03	PR01 < in
07	Feb. 24, 26	UDP TCP: Flow Control, Congestion Control <b>Network Layer:</b> Routing vs. Forwarding, Routers	PR7e/04	WS02 > out
08	Mar. 02, 04 <sup>‡</sup>	IPv4 Addressing, DHCP <b>Midterm Exam</b>	PR7e/05	WS02 < in M2 < in
09	Mar. 09 <sup>†</sup> , 11 <sup>†</sup>	<b>Spring Break</b>		
10	Mar. 16, 18	<b>Midterm Review</b> Routing Protocols, RIP, OSPF, BGP	PR7e/05	PR02 > out
11	Mar. 23, 25	ICMP, IPv6, Broadcast and Multicast Routing <b>Link Layer:</b> Error Detection and Correction	PR7e/05/06	
12	Mar. 30, Apr. 01	ALOHA, Slotted ALOHA CSMA, CSMA/CD, Taking Turns	PR7e/06	PR02 < in
13	Apr. 06, 08	ARP, Link Layer Addressing, Ethernet VLANs	PR7e/06	WS03 > out
14	Apr. 13, 15	<b>Network Security:</b> Application Layer Security Transport Layer Security	PR7e/08	WS03 < in PR03 > out, M3 < in
15	Apr. 20 <sup>§</sup> , 22 <sup>§</sup>	Network Layer Security <b>Wireless Networks:</b> CDMA, WiFi	PR7e/07	
16	Apr. 27 <sup>§</sup> , 29 <sup>§</sup>	<i>Topic TBA</i>		PR03 < in, M4 < in
17	May. 07	<b>Final Exam: 10.00 – 11.40 a.m.</b>		

<sup>†</sup>Spring Break, <sup>‡</sup>Midterm Exam, <sup>§</sup>Graduate Project: In class presentations