Systems Programming

CS222

Who am I?

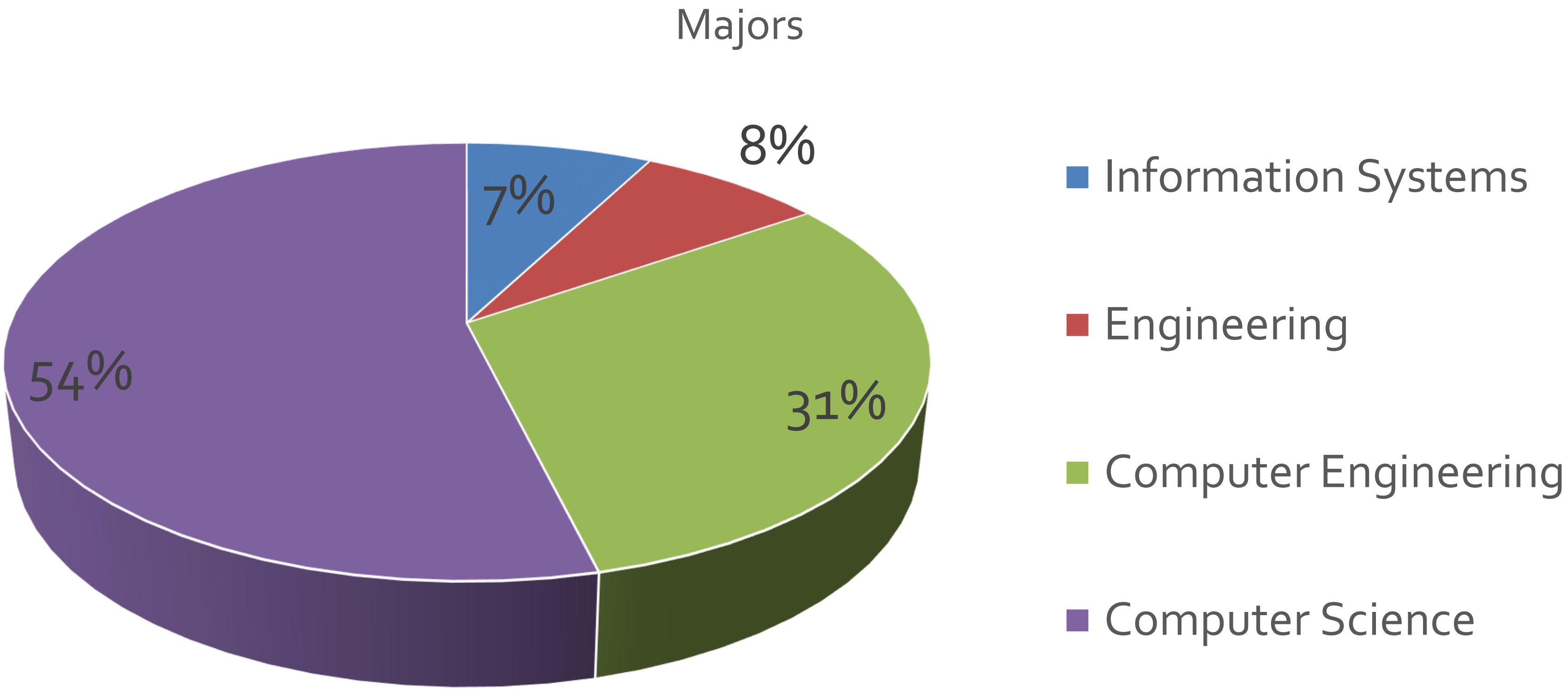
- Dr. Barry Wittman
- Not Dr. Barry Whitman
- Education:
  - PhD and MS in Computer Science, Purdue University
  - BS in Computer Science, Morehouse College
- Hobbies:
  - Reading, writing
  - Enjoying ethnic cuisine
  - DJing
  - Lockpicking

How can you reach me?

- **E-mail:** wittmanb@etown.edu
- **Office:** Esbenshade 284B
- **Phone:** (717) 361-4761
- **Office hours:** **MWF** 11:00am – 12:00pm
  MWF 2:00 – 3:20pm
  T 1:00 – 3:00pm
  And by appointment
- **Website:**

  http://users.etown.edu/w/wittmanb/

Who are you?



- A couple of regular Engineers?

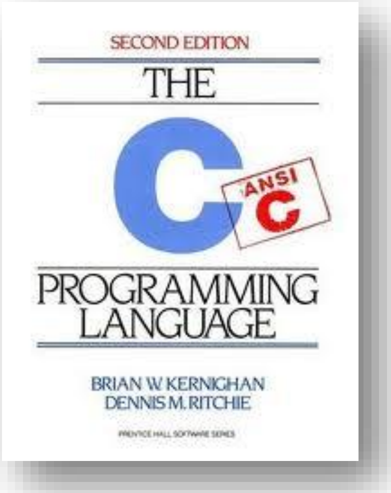
Why are we here?

- What’s the purpose of this class?
- What do you want to get out of it?
- Do you want to be here?

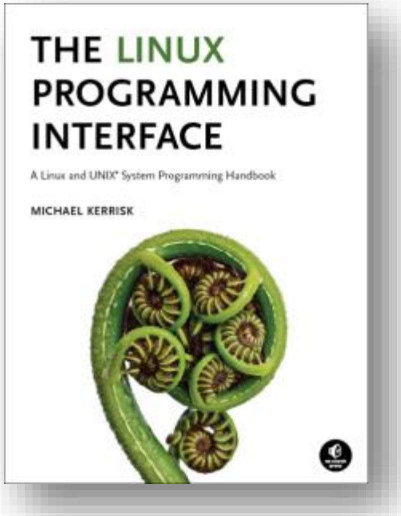
Course Overview

Textbooks

- Brian W. Kernighan and Dennis M. Ritchie
- ***The C Programming Language***
- 2nd Edition, 1988, Prentice Hall
- ISBN-10: 0131103628
- ISBN-13: 978-0131103627
- **Required textbook**
- The book that every serious computer scientist must have a copy of



Textbooks


THE LINUX PROGRAMMING INTERFACE
A Linux and UNIX® System Programming Handbook
MICHAEL KERRISK

- Michael Kerrisk
- ***The Linux Programming Interface***
- First Edition, 2010, No Starch Press
- ISBN-10: 1593272200
- ISBN-13: 978-1593272203
- Amazing book that you'll want to keep in your bag of tricks for all your future Linux hacking
- **Optional textbook**

You have to read the book

- You are expected to read the material before class
- If you're not prepared, you will be asked to leave
  - You will forfeit the opportunity to take quizzes
  - Much more importantly, you will forfeit the education you have paid around **$100 per class meeting** to get

Course focuses

- C expertise
  - Another language in your tool belt
- Linux proficiency
- Command line tools
- Loving your inner geek

More information

- For more information, visit the webpage: `http://users.etown.edu/w/wittmanb/cs222`
- The webpage will contain:
  - The most current schedule
  - Notes available for download
  - Reminders about projects and exams
  - Syllabus (you can request a printed copy if you like)
  - Detailed policies and guidelines
- Piazza will allow for discussion and questions about projects: `https://piazza.com/etown/spring2018/cs222/`

Projects

Six projects

- 36% of your grade will be six equally weighted projects
- Each will focus on a different major area from the course:
  - Basic math and I/O
  - Bitwise operations
  - String manipulation
  - Memory allocation
  - Dynamic data structures
  - Socket communication
- You will work on each project in two-person teams

Teams

- All projects are done in teams of two
- You may pick your partners
  - But you have to have a different partner for each project!
  - Use the Groups tab under the People section on the Canvas page for CS222 to form teams
- I will copy assignments from the leader's class Canvas account

Turning in projects

- Projects must be turned in by zipping them and uploading them to leader’s Canvas **before** the deadline
- Do **not** put projects in your public directories
- Late projects will not be accepted
  - Exception: Each team will have 3 grace days
  - You can use these grace days together or separately as extensions for your projects
  - You must inform me **before** the deadline that you are going to use grace days
  - If two people in a team don't have the same number of grace days, the number of days they will have available will be the **maximum** of those remaining for either teammate

Labs

In-class Programming Exercises

Labs

- 15% of your grade will be based around programming labs
- Labs are usually on Friday
  - But one is Wednesday and another is Thursday
- Approximately one hour of class will be devoted to each lab
- Each lab will focus on the solution of a problem
- Work should be done individually, but the goal is to learn, and I will help everyone

Quizzes

Pop Quizzes

- 5% of your grade will be pop quizzes
- These quizzes will be based on material covered in the previous one or two lectures
- They will be graded leniently
- They are useful for these reasons:
    1. Informing me of your understanding
    2. Feedback to you about your understanding
    3. Easy points for you
    4. Attendance

Exams

Exams

- There will be two equally weighted in-class exams totaling 30% of your final grade
  - **Exam 1:** 02/19/2018
  - **Exam 2:** 04/04/2018
- The final exam will be worth another 14% of your grade
  - **Final:** 11:00am – 2:00pm
    5/08/2018 (Section A)
    11:00am – 2:00pm
    5/07/2018 (Section B)

Course Schedule

Tentative schedule

Week	Starting	Topics	K & R	Linux	Notes
1	01/15/18	Introduction	1	1	
2	01/22/18	Data representation	2	11	
3	01/29/18	Control flow	2, 3	2, 3	Project 1
4	02/05/18	Functions	4	6	
5	02/12/18	Arrays and Strings	4, 5		Project 2
6	02/19/18	Pointers	5		Exam 1
7	02/26/18	Memory allocation	5	7	Project 3
	03/05/18	Spring Break			
8	03/12/18	Software engineering		8, 10	
9	03/19/18	Structs	6		Project 4
10	03/26/18	Advanced structs	6		
11	04/02/18	Files and streams	7	4	Exam 2
12	04/09/18	File systems		5, 13, 14, 15	Project 5
13	04/16/18	Networking	5	56, 57, 58, 59	
14	04/23/18	C++		Notes	
15	04/30/18	Review		All	Project 6

Project schedule

Project 1:	**6%**	Tentatively due **02/02/2018**
Project 2:	**6%**	Tentatively due **02/16/2018**
Project 3:	**6%**	Tentatively due **03/02/2018**
Project 4:	**6%**	Tentatively due **03/23/2018**
Project 5:	**6%**	Tentatively due **04/13/2018**
Project 6:	**6%**	Tentatively due **05/04/2018**

Policies

Grading breakdown

36%

- Six projects
- Equally weighted

15%

- In-class labs

5%

- Quizzes

30%

- Two equally weighted midterm exams

14%

- Final exam

Grading scale

A	93-100	B-	80-82	D+	67-69
A-	90-92	C+	77-79	D	63-66
B+	87-89	C	73-76	D-	60-62
B	83-86	C-	70-72	F	0-59

Attendance

- You are expected to attend class
- You are expected to have read the material we are going to cover **before** class
- Missed quizzes cannot be made up
- Exams and labs must be made up **before** the scheduled time, for excused absences

R-E-S-P-E-C-T

- I hate having a slide like this
- I ask for respect for your classmates and for me
- You are smart enough to figure out what that means
- A few specific points:
  - Silence communication devices
  - **Don’t use the computers in class unless specifically told to**
  - No food or drink in the lab

Computer usage

- We will be doing a lot of work on the computers together
- However, students are always tempted to surf the Internet, etc.
- Research shows that it is nearly impossible to do two things at the same time (e.g. use Facebook and listen to a lecture)
- For your own good, I will enforce this by taking 1% of your final grade every time I catch you using your computer for anything other than course exercises

Academic dishonesty

- Don’t cheat
- **First offense:**
  - I will give you a zero for the assignment, then lower your final letter grade for the course by one full grade
- **Second offense:**
  - I will fail you for the course and try to kick you out of Elizabethtown College
- Refer to the Student Handbook for the official policy
- Ask me if you have questions or concerns
- **You are not allowed to look at another student's code, except for group members in group projects (and after the project is turned in)**
- **I will use tools that automatically test code for similarity**

Disability

Elizabethtown College welcomes otherwise qualified students with disabilities to participate in all of its courses, programs, services, and activities. If you have a documented disability and would like to request accommodations in order to access course material, activities, or requirements, please contact the Director of Disability Services, Lynne Davies, by phone (361-1227) or e-mail daviesl@etown.edu. If your documentation meets the college's documentation guidelines, you will be given a letter from Disability Services for each of your professors. Students experiencing certain documented temporary conditions, such as post-concussive symptoms, may also qualify for temporary academic accommodations and adjustments. As early as possible in the semester, set up an appointment to meet with me, the instructor, to discuss the academic adjustments specified in your accommodations letter as they pertain to my class.

History of Unix, Linux, and C

What does UNIX even mean?

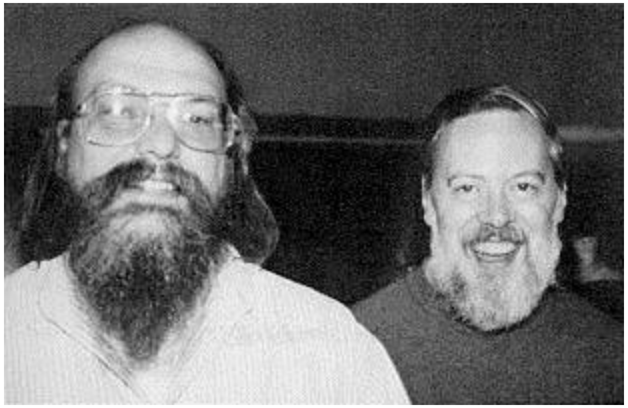
- It was originally called **Unics** (**UN**iplexed **I**nformation and **C**omputing **S**ervice)
  - A pun on another OS, Multics (**MULT**iplexed **I**nformation and **C**omputer **S**ervices)
  - After it starting supporting multiple simultaneous users, it was renamed Unix
- So, it doesn't stand for anything anymore (sort of like CERN...)

What is Unix?

- It's a standard for operating systems based on a long, complex history with many companies and innovators
- The Open Group has the trademark on the term "UNIX," and you're only allowed to call your OS Unix if it meets their Single UNIX Specification
- Linux and FreeBSD and other free implementations of Unix do **not** meet this specification

Development

- Ken Thompson started working on Unix in 1969 at Bell Laboratories, a division of AT&T
- It was written in assembly language for the PDP-7 and PDP-11 minicomputers
  - Made by Digital Equipment Corporation (DEC), a giant of that era that was bought by Compaq (which was bought by HP)
- Meanwhile, Dennis Ritchie developed the C programming language
- It was mature enough in 1973 that most of Unix could be implemented in it
- This connection has established C as the pre-eminent systems programming language



Distribution

- Unix was originally only used within AT&T
- Because AT&T has a monopoly on telephone service, they were not allowed to sell software
- They started giving Unix to universities for a distribution fee
- While spending a year at Berkeley, Thompson worked on BSD (Berkeley Software Distribution), a version of Unix that was widely used in academia
- AT&T's monopoly broke up, allowing them to sell Unix, eventually leading to the famous System V Unix in 1983

Ports

- System V was used as the basis of Unix systems on lots of different kinds of hardware
    - Sun: SunOS and Solaris
    - DEC: Ultrix and OSF/1 (which became HP Tru64 UNIX)
    - IBM: AIX
    - HP: HP-UX,
    - Apple: NeXTStep, A/UX
    - Intel: XENIX

GNU

- Richard Stallman (RMS) is the father of open source software
- He started in the GNU (GNU's Not Unix) project in 1984
  - This created the GPL (GNU Public License)
- The focus is on the ability to run, copy, and improve software
- Lots of useful programming tools that have been incorporated into Linux came out of GNU:
  - **`emacs`**
  - **`gcc`**
  - **`bash`**
  - The glibc

Linux

- Linus Torvalds started working in 1991 to make a Unix kernel to run on an Intel 386
- He put Linus's Unix (Linux) under the GNU GPL
- The BSD distributions also gave rise to free BSD implementations (notably FreeBSD), but their usage is much less widespread than Linux
- Linux kernel version numbers are ***x.y.z*** where ***x*** is a major version, ***y*** is a minor version, and ***z*** is a minor revision
  - Current stable release is 4.14.13

Test out Logging into Linux

Upcoming

Next time…

- C basics
- Lab 1
- Please read K&R Chapter 1 and LPI Chapter 1

Reminders

- Read K&R Chapter 1 and LPI Chapter 1
- Form your teams for Project 1
- Consider dual-booting Linux on your machine if you don't have it already
  - Another option is running Linux inside of Virtual Box
- Lab 1 is Friday