CS 241: Systems Programming

Lecture 1. Introduction

Fall 2023

Prof. Stephen Checkoway

What is this course about?

Tools for succeeding in computer science

- Unix command line
- Bash scripting
- **Rust programming**
- Building software
- Debugging
- Linters/static analyzers
- Version control
- Collaborative development
- Regular expressions
- Looking things up like a real programmer
- …

What is this course not about?

Learning to program (you already know how to do that!)

You should expect to

Do a lot of programming and debugging!

Learn about tools by reading their documentation and Googling

Read a lot

Work on projects in groups

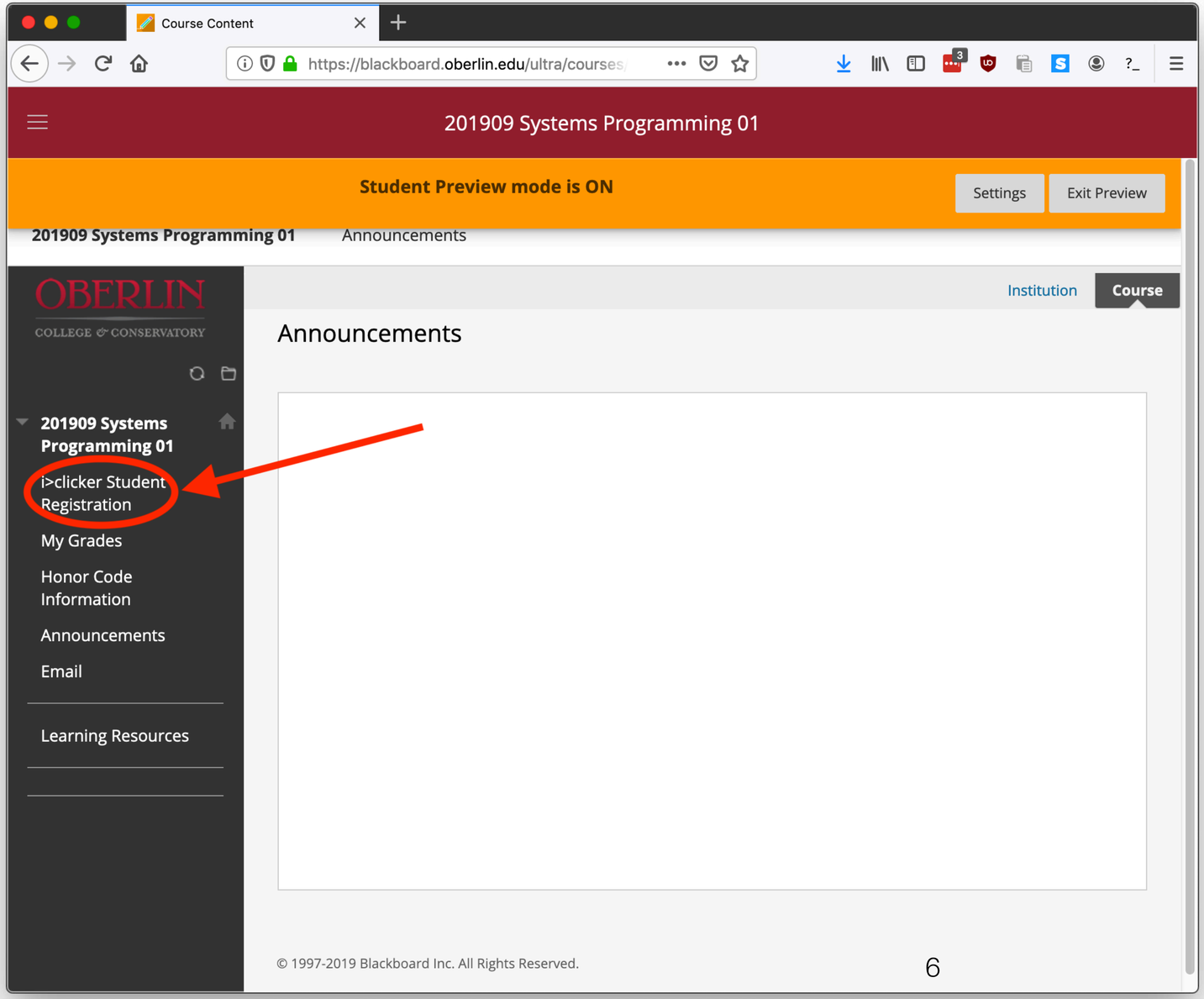
iClickers

Need to have one and register it by Friday's class

Do not borrow them from the Science Library!

http://citadel.sjfc.edu/students/emm00561/e-port/msti260/iclicker.jpg

Register your clicker



Lecture format

Lectures will include

- Lecturing on the topic with some peer instruction (clickers)
- Hands on experience with the day's concepts

Bring a laptop to class or sit next to a classmate who has one

- The science library loans laptops for 4 hours at a time (limited supply)
- There's a loaner program for low-income students (talk to me privately)

Bring your iClicker

Peer instruction

I will pose a multiple-choice question about a concept

Think and choose your answer individually with your clicker

After the time ends, discuss your answers with the people around you, come to consensus, and vote again

After the group vote, you explain why your group voted that way

Why peer instruction?

You get to make sure you're following the material

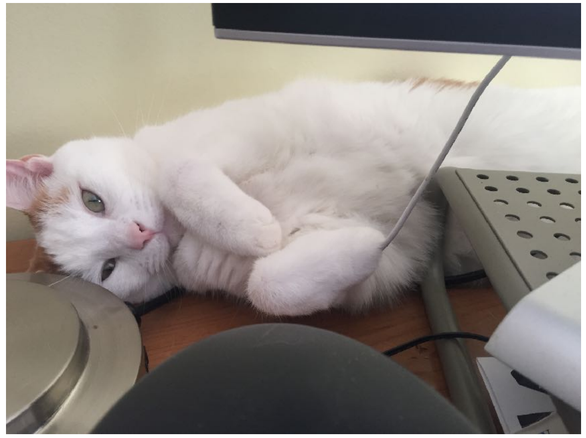
I get immediate feedback about what parts are confusing

It's less boring than lecture

Research shows it promotes more learning than standard lecture

Which cat is cutest?

A. Kirk



B. Spock

C. Bones

D. Equally cute

E. I don't like cats (I'm a monster)

Course website

https://checkoway.net/teaching/cs241/2023-fall/

- Syllabus (there's (a fair bit of) reading for Wednesday!)
- Links to books
- Labs
- Resources
- Ed forum
- Policies
- Office hours

Grading

10% Class participation

75% Homework (6 in total)

15% Final group project

The final project must be completed to pass the course

Late days/missing class

You have 3 late days you can use on any homework

- If you work with a partner (and you should), late work counts against both of your remaining late days

You can choose not to participate in class (including missing class) three times without penalty

You get participation points each day by answering clicker questions, so make sure you answer them all

Final group project

Work in groups of 4 (I'll pick the groups, but you'll get input)

More about this in a few weeks.

You will write a project proposal

You will have a bunch of time to work on it

You will give a short presentation on it at the end of the semester

Everybody is expected to work on all parts of the final; in particular, if you do not show up for the presentation, you will fail the course

Labs

King 137

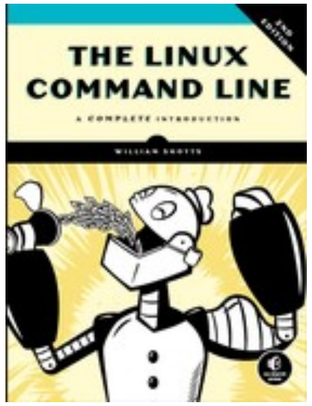
Door code: 8372

See Stephen Mather if you don’t have an account

See Jackie Fortino in the CS office if you add late for 24 hour access

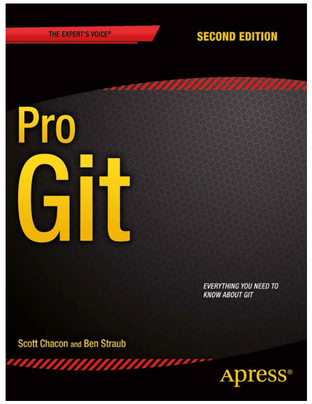
Textbooks

William E. Shotts. *The Linux Command Line*, 2nd edition



Steve Klabnik and Carol Nichols. *The Rust Programming Language*, available online with quizzes

Scott Chacon and Ben Straub. *Pro Git*, 2nd edition



Honor code

Do

- Work in groups of size 2 (or 4 for the project)
- Discuss assignments with others in the class, including on the discussion forum
- Cite sources if using code/ideas from outside class

Do not

- Share your solutions outside your group
- Use someone else's solutions

Labs

Brand new lab assignments for CS 241!

First one (Lab 0) is on Tuesday (it will be short)

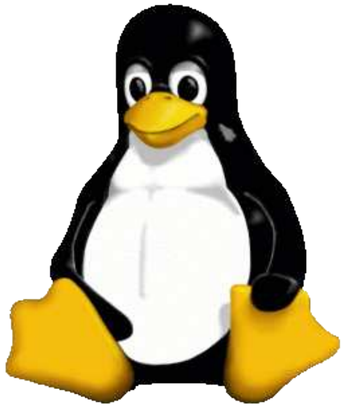
Subsequent labs will be longer (like 150/151 labs) and have code to turn in each week

Final few labs of the semester will be designed to be completed in the lab period

Connecting to mcnulty

Remote server for CS 241: mcnulty.cs.oberlin.edu (named for Kay McNulty)

- Access via ssh
- Accessible from on campus (and in town), but not outside Oberlin



Windows

From a terminal:

Use PuTTY https://putty.org/

```
$ ssh username@mcnulty.cs.oberlin.edu
```

Can't connect to mcnulty?

mcnulty.cs.oberlin.edu isn't reachable outside of Oberlin

occs.cs.oberlin.edu is!

```
$ ssh username@occs.cs.oberlin.edu
$ ssh mcnulty.cs.oberlin.edu
```

Alternatively

```
$ ssh -J user@occs.cs.oberlin.edu user@mcnulty.cs.oberlin.edu
```

Editors

For the Rust portion of the course, we'll be using Visual Studio Code

For the Bash portion of the course, you can use whatever editor you like

- Learning a command-line editor like vim or emacs can be really helpful
- Using VS Code is also an excellent choice

Video Studio Code lets you connect to computers via ssh for remote editing

Why Rust

Traditionally 241 teaches C

C is (essentially) impossible to write correctly

Incorrect C leads to vulnerabilities which can be exploited

C does almost nothing to prevent you from writing unsafe programs

A Python program

```
small_primes = [2, 3, 5, 7, 11, 13, 17, 19, 23]
index = int(input("Enter the index of a small prime: "))
print(f"The small prime at index {index} is {small_primes[index]}")
```

```
$ python small_primes.py
Enter the index of a small prime: 4
The small prime at index 4 is 11
```

What happens if I enter a number that's too large?

```
$ python small_primes.py
Enter the index of a small prime: 10
```

A Python program

```
small_primes = [2, 3, 5, 7, 11, 13, 17, 19, 23]
index = int(input("Enter the index of a small prime: "))
print(f"The small prime at index {index} is {small_primes[index]}")
```

What happens if I enter a number that's too large?

```
$ python small_primes.py
Enter the index of a small prime: 10
Traceback (most recent call last):
  File "/Users/steve/small_primes.py", line 3, in <module>
    print(f"The small prime at index {index} is
{small_primes[index]}")
IndexError: list index out of range
```

A Java program

```
public class SmallPrimes {
    public static void main(String[] args) {
        int[] small_primes = {2, 3, 5, 7, 11, 13, 17, 19, 23};
        System.out.print("Enter the index of a small prime: ");
        System.out.flush();
        int index = Integer.parseInt(System.console().readLine());
        System.out.println("The small prime at index " + index +
                           " is " + small_primes[index]);
    }
}
```

```
$ java SmallPrimes
Enter the index of a small prime: 4
The small prime at index 4 is 11
```

What happens if I enter a number that’s too large?

A Java program

```
public class SmallPrimes {
    public static void main(String[] args) {
        int[] small_primes = {2, 3, 5, 7, 11, 13, 17, 19, 23};
        System.out.print("Enter the index of a small prime: ");
        System.out.flush();
        int index = Integer.parseInt(System.console().readLine());
        System.out.println("The small prime at index " + index +
                           " is " + small_primes[index]);
    }
}
```

What happens if I enter a number that’s too large?

```
$ java SmallPrimes
Enter the index of a small prime: 10
Exception in thread "main" java.lang.ArrayIndexOutOfBoundsException: 10
  at SmallPrimes.main(SmallPrimes.java:7)
```

A C program

```c
#include <stdio.h>
#include <stdlib.h>

int main(void) {
    int small_primes[] = {2, 3, 5, 7, 11, 13, 17, 19, 23};
    printf("Enter the index of a small prime: ");
    fflush(stdout);
    char line[1024];
    fgets(line, sizeof line, stdin);
    int index = atoi(line);
    printf("The small prime at index %d is %d\n", index,
            small_primes[index]);
    return 0;
}
```

A C program

```
$ ./small_primes
Enter the index of a small prime: 4
The small prime at index 4 is 11
```

What happens if I enter a number that’s too large?

```
$ ./small_primes
Enter the index of a small prime: 10
```

A C program

```
$ ./small_primes
Enter the index of a small prime: 4
The small prime at index 4 is 11
```

What happens if I enter a number that's too large?

```
$ ./small_primes
Enter the index of a small prime: 10
The small prime at index 10 is 129070014
```

???

```
$ ./small_primes
Enter the index of a small prime: -7
The small prime at index -7 is 83427584
```

???

For next class

Register your iClicker on Blackboard

Read chapters 1–5 of *The Linux Command Line*

Bring your iClicker and a laptop to class