Week 1: Lecture B

Python, Debugging, and VM Setup

Thursday, August 22, 2024

Reminders

- Be sure to join the course **Canvas** and **Piazza**
  - See links at top of course page
  - http://cs4440.eng.utah.edu

- Finish registering on **PollEverywhere**
  - Account must be `<yourUID>@utah.edu`
  - Location issues should be fixed
  - Sign in at https://pollev.com/cs4440

- Trouble accessing? See me after class!
  - Or email me at: snagy@cs.utah.edu

Reminders: Course Resources

Course website .... wiki, assignments, schedule, slides, office hours

Piazza .... questions, discussion, announcements

PollEverywhere .... lecture participation

Canvas .... quizzes, project submission, course gradebook

Instructor email (snagy@cs.utah.edu) .... administrative issues

Reminders: Weekly Quizzes

- First weekly **Lecture Quiz** released on **Canvas**
  - Submit by **11:59PM this Monday**
  - Late submissions not accepted

- Lecture quizzes released after Tuesday’s lecture
  - Due the following Monday
  - Covers content from both Tuesday + Thursday lectures

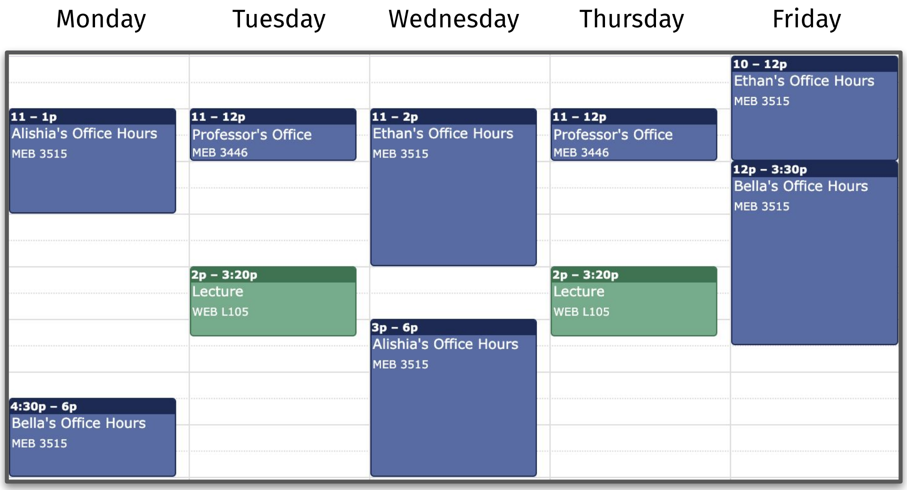
Reminders: PollEverywhere

- **PollEverywhere:** check your UMail for an **account registration** email
  - We'll count today's attendance—let us know of any issues!

- Use your UID@utah.edu when participating
  - Should work automatically if you got the sign-up email

Reminders: Office Hours

- TA office hours (**15 total hours**)
  - First-come/first-serve via **TA Queue**
  - Help with programming projects
- Professor's office hours
  - Help understanding lecture material
  - Administrative or grading issues
- Check the office hours calendar!
  - http://cs4440.eng.utah.edu
  - Cancellations announced via **Piazza**



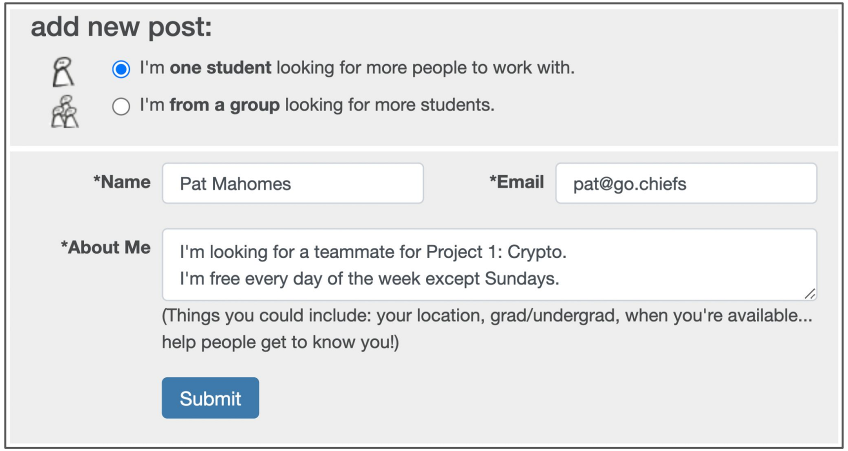
Monday	Tuesday	Wednesday	Thursday	Friday
11 – 1p Alishia's Office Hours MEB 3515	**11 – 12p** Professor's Office MEB 3446	**11 – 2p** Ethan's Office Hours MEB 3515	**11 – 12p** Professor's Office MEB 3446	**10 – 12p** Ethan's Office Hours MEB 3515
4:30p – 6p Bella's Office Hours MEB 3515	**2p – 3:20p** Lecture WEB L105	**3p – 6p** Alishia's Office Hours MEB 3515	**2p – 3:20p** Lecture WEB L105	**12p – 3:30p** Bella's Office Hours MEB 3515

Reminders: Find a Teammate!

- Can work in **teams of up to two**
  - Find teammates on **Piazza**
  - Post on
    Search for Teammates! 12/21/22

- Why work with someone else?
  - Pair programming
  - Divide and conquer
  - Two sets of eyes to solve problems
  - Teaching others helps you learn more

- Yes, you are free to work solo…
  - But we encourage you to team up!



add new post:

● I'm **one student** looking for more people to work with.

○ I'm **from a group** looking for more students.

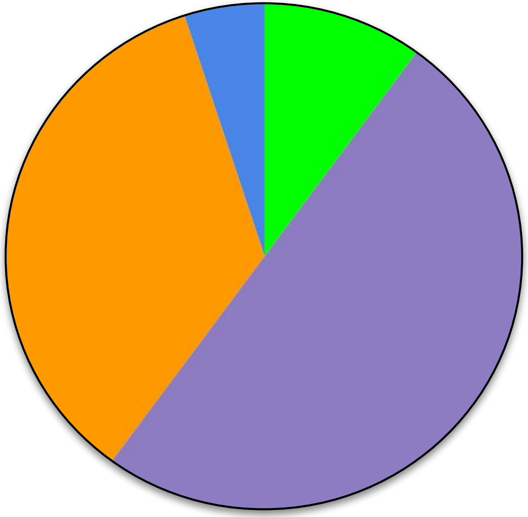
*Name: Pat Mahomes

*Email: pat@go.chiefs

*About Me: I'm looking for a teammate for Project 1: Crypto.
I'm free every day of the week except Sundays.

(Things you could include: your location, grad/undergrad, when you're available... help people get to know you!)

Reminders: Grading Breakdown



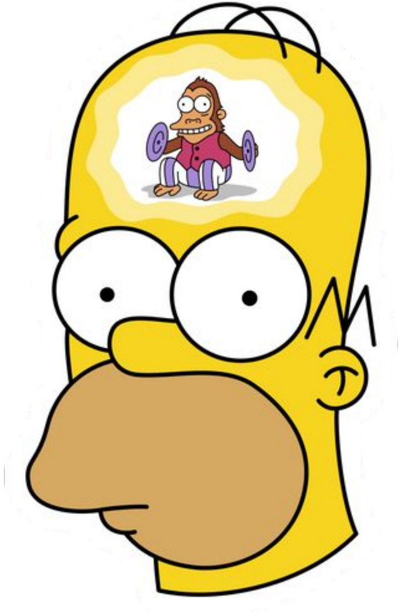
- 🟩 **10%** = weekly solo quizzes based on lectures
- 🟪 **50%** = four Programming Projects (**12.5%** each)
- 🟧 **35%** = Final Exam covering all course material
- 🟦 **5%** = participation during lecture poll exercises

Reminders: Collaboration Policy

- We encourage you to help each other learn!
  - You may give or receive help on key **high-level concepts**
- However, **all code** must only be written by **you or your team**
- Cheating is when you give/receive an **unfair advantage**. Examples:
  - **Distributing your solutions** (e.g., to GitHub, Chegg, CourseHero) = **cheating**
  - **Copying code/solutions** (e.g., from GitHub, Google, another team) = **cheating**
  - **Copying code/solutions from AI tools** (e.g., CoPilot, GPT, Bard, etc.) = **cheating**
- Violations = misconduct sanctions. **Don't jeopardize your degree!**

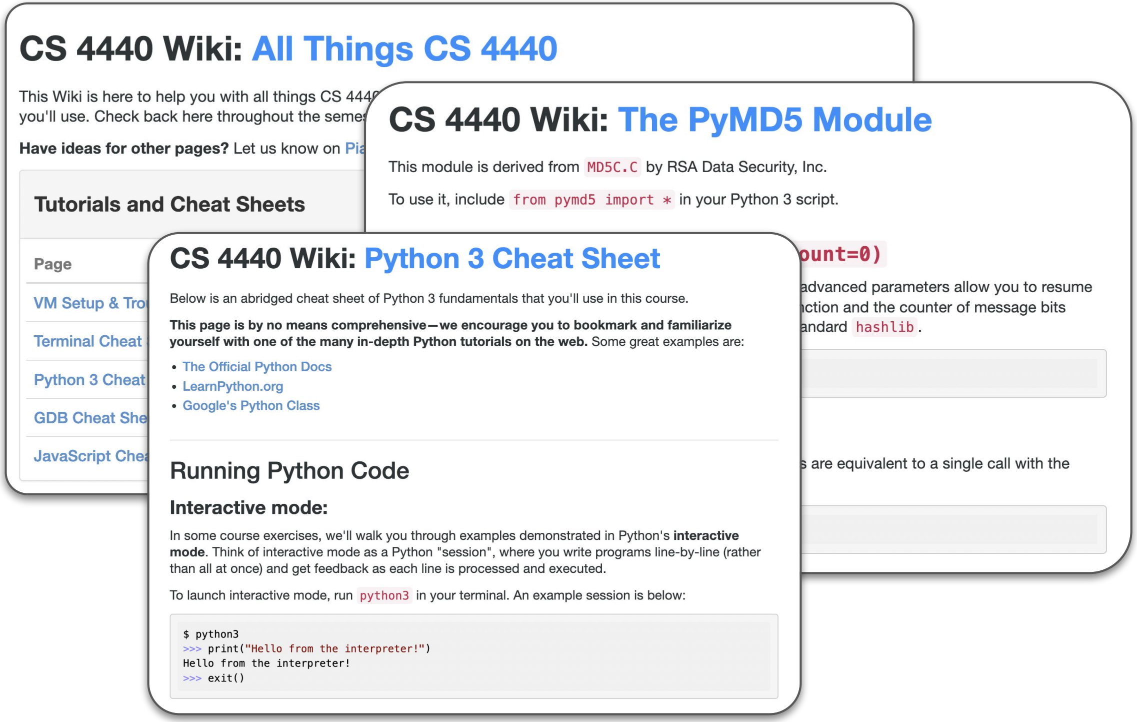
Reminders: Lecture Participation

- **Lecture** participation via PollEverywhere:
  - **Three lecture absences allowed** at zero penalty
  - We'll track these internally—no need to notify us
  - Log-in as **your UMAIL** (e.g., `u8675309@utah.edu`)
- **Online** participation on course Piazza:
  - Make intellectual contributions to help others learn
  - Collaboration policies apply—**don't share your code!**
  - **New for Fall 2024:** top-10 answerers get **5pts extra credit**
- How to **lose** points:
  - Frequently missing class, or not contributing online
  - Engaging in disruptive behavior or violating policies



Announcements: Course Wiki

- Our aim is to lower the overall learning curve
- Resources to help you:
  - Tutorials
  - Cheat Sheets
  - Software documentation
- **Fall 2024: more pages!**
  - HTML, SQL basics
  - Wireshark, Scapy
  - **Coming soon!**



CS 4440 Wiki: All Things CS 4440

This Wiki is here to help you with all things CS 4440 you'll use. Check back here throughout the semes

Have ideas for other pages? Let us know on Pia

Tutorials and Cheat Sheets

Page

VM Setup & Trou

Terminal Cheat

Python 3 Cheat

GDB Cheat She

JavaScript Chea

CS 4440 Wiki: The PyMD5 Module

This module is derived from `MD5C.C` by RSA Data Security, Inc.

To use it, include `from pymd5 import *` in your Python 3 script.

`ount=0)`

advanced parameters allow you to resume nction and the counter of message bits andard `hashlib`.

s are equivalent to a single call with the

CS 4440 Wiki: Python 3 Cheat Sheet

Below is an abridged cheat sheet of Python 3 fundamentals that you'll use in this course.

This page is by no means comprehensive—we encourage you to bookmark and familiarize yourself with one of the many in-depth Python tutorials on the web. Some great examples are:

- The Official Python Docs
- LearnPython.org
- Google's Python Class

Running Python Code

Interactive mode:

In some course exercises, we'll walk you through examples demonstrated in Python's **interactive mode**. Think of interactive mode as a Python "session", where you write programs line-by-line (rather than all at once) and get feedback as each line is processed and executed.

To launch interactive mode, run `python3` in your terminal. An example session is below:

```
$ python3
>>> print("Hello from the interpreter!")
Hello from the interpreter!
>>> exit()
```

Announcements: Course Wiki

- Our aim is to
  overall learni

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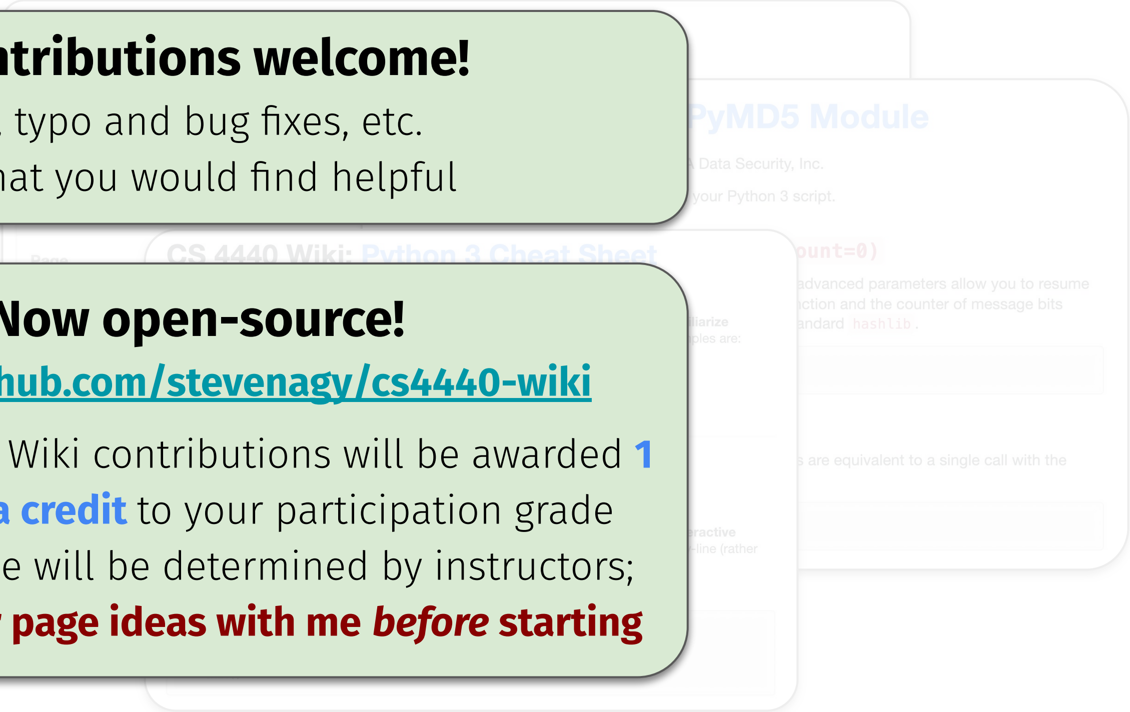


Contributions welcome!

- Page ideas, typo and bug fixes, etc.
- Tutorials that you would find helpful

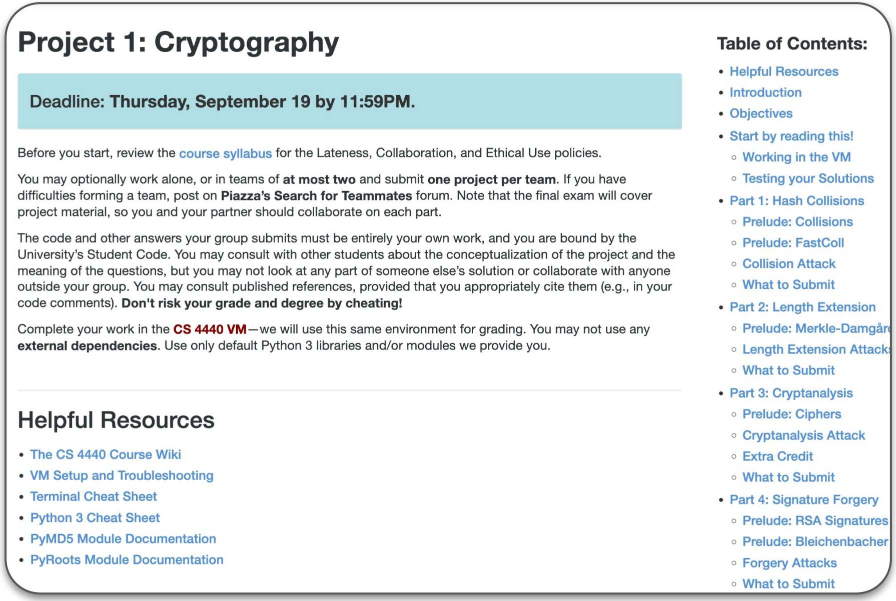
Now open-source!

https://github.com/stevenagy/cs4440-wiki

- Significant Wiki contributions will be awarded **1 point extra credit** to your participation grade
- Significance will be determined by instructors; must **clear page ideas with me *before* starting**

Announcements: Project 1

- **Project 1: Crypto** releasing on **Tuesday, August 27**
  - **Deadline:** Thursday, September 19th by 11:59PM



Project 1: Cryptography

Deadline: **Thursday, September 19 by 11:59PM.**

Before you start, review the course syllabus for the Lateness, Collaboration, and Ethical Use policies.

You may optionally work alone, or in teams of **at most two** and submit **one project per team**. If you have difficulties forming a team, post on **Piazza's Search for Teammates** forum. Note that the final exam will cover project material, so you and your partner should collaborate on each part.

The code and other answers your group submits must be entirely your own work, and you are bound by the University's Student Code. You may consult with other students about the conceptualization of the project and the meaning of the questions, but you may not look at any part of someone else's solution or collaborate with anyone outside your group. You may consult published references, provided that you appropriately cite them (e.g., in your code comments). **Don't risk your grade and degree by cheating!**

Complete your work in the **CS 4440 VM**—we will use this same environment for grading. You may not use any **external dependencies**. Use only default Python 3 libraries and/or modules we provide you.

Helpful Resources

- The CS 4440 Course Wiki
- VM Setup and Troubleshooting
- Terminal Cheat Sheet
- Python 3 Cheat Sheet
- PyMD5 Module Documentation
- PyRoots Module Documentation

Table of Contents:

Announcements: UtahSec

UtahSec Cybersecurity Club

Activities:

-Weekly Capture the flag Competitions

-Cybersecurity Skills Workshop

-Meeting with industry leaders

-Onsite visit to Zions Bank

ARCTIC WOLF

redo

Lucid

ZIONS BANK

Meeting: Every Thursday
Time: 06:00 PM
Location: Meb 3115

DISCORD

Announcements: UtahSec

utahsec

First meeting
TONIGHT @ **6PM**
in **MEB 3115**

Questions?

Last time on CS 4440...

The Security Mindset
Modeling the Attacker
Assessing Risk
Secure Design

Meet the Adversary

"Computer security studies how systems behave in the presence of an **adversary**."

- The adversary…
- a.k.a. the attacker
- a.k.a. the bad guy
- An intelligence that actively tries to cause the system to misbehave.

The Security Mindset

- Thinking like a defender
  - Know what you’re defending, and against whom
  - Weigh benefits vs. costs:
    No system is ever completely secure.
  - Embrace “rational paranoia”

- Thinking like an attacker
  - Understand techniques for circumventing security
  - Look for ways security can break,
    not reasons why it won’t

Thinking as a Defender

- Security policy
  - What are we trying to protect?
  - What properties are we trying to enforce?
- Threat model
  - Who are the attackers? Capabilities? Motivations?
  - What kind of attack are we trying to prevent?
- Risk assessment
  - What are the weaknesses of the system?
  - What will successful attacks cost us?
- How likely?
  - Countermeasures
  - Costs vs. benefits?
  - Technical vs. nontechnical?

The challenge is to think rationally and rigorously about risk.

Rational paranoia.

Threat Models

- Who are our adversaries?
  - Motives?
  - Capabilities?
  - Level of access?
- What kinds of attacks must we prevent?
  - Think like the attacker!
- Limits: kinds of attacks we should ignore?
  - Unrealistic versus unlikely

Security through… obscurity?

Common mistake:

- **???**

Security through... obscurity?

Common mistake:

- Trying to convince yourself the system is secure since attacker won't know *X*

Better approach:

- **???**

Security through... obscurity?

Common mistake:

- Trying to convince yourself the system is secure since attacker won't know *X*

Better approach:

- Limit the assumptions that the security of your system depends upon
- Assume the attacker knows everything but a *small* bit of data (e.g., a key)

Assessing Risk

- Remember: *Rational* paranoia

- What would security breaches cost us?
  - Direct: **???**

Assessing Risk

- Remember: *Rational* paranoia

- What would security breaches cost us?
  - Direct: money, intellectual property, safety
  - Indirect: **???**

Assessing Risk

- Remember: *Rational* paranoia

- What would security breaches cost us?
  - Direct: money, intellectual property, safety
  - Indirect: reputation, future business, well being

- How likely are these costs?
  - Probability of attacks?
  - Probability of success?

Countermeasures

- Technical countermeasures
  - Bug fixes, more crypto, re-architecting, etc.
- Nontechnical countermeasures
  - Law, policy (government, institutional)
  - Procedures, training, auditing, incentives, etc.

Costs of Security

- **No security mechanism is free**

- Direct costs:
  - Design, implementation, enforcement, false positives

- Indirect costs:
  - Lost productivity, added complexity, time to market

- Challenge is to rationally weigh costs vs. risk
  - Human psychology makes reasoning about high cost, low probability events very difficult

Rational Paranoia Exercises

Should you use a **strong password**?

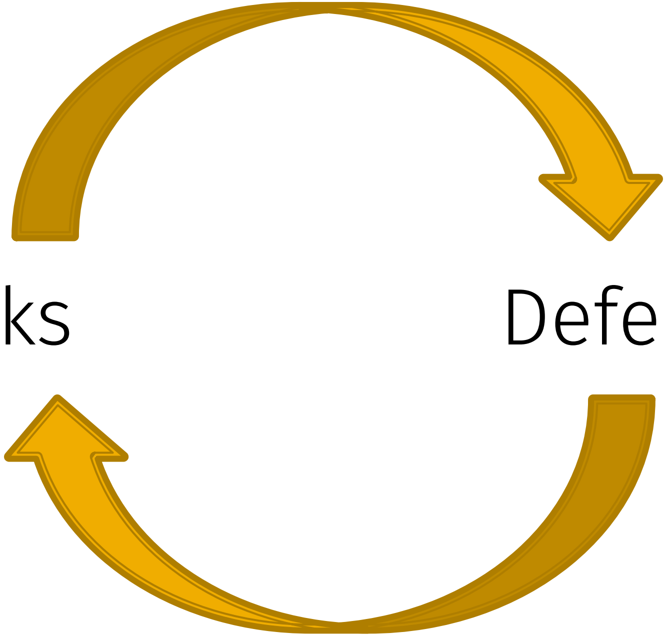
- Assets?
- Adversaries?
- Risk assessment?
- Countermeasures?
- Costs/benefits?

Rational Paranoia Exercises

Using a **credit card** safely?

- Assets?
- Adversaries?
- Risk assessment?
- Countermeasures?
- Costs/benefits?

High-level Approaches



Attacks

Defenses

Questions?

This time on CS 4440…

Intro to Python
Debugging Code
Course VM Setup

Languages and Tools in CS 4440

- Projects cover a few languages and tools:
  - **Project1:** Python 3
  - **Project2:** C/C++, x86, GDB
  - **Project3:** SQL, HTML, JavaScript
  - **Project4:** Python 3, Wireshark

Languages and Tools in CS 4440

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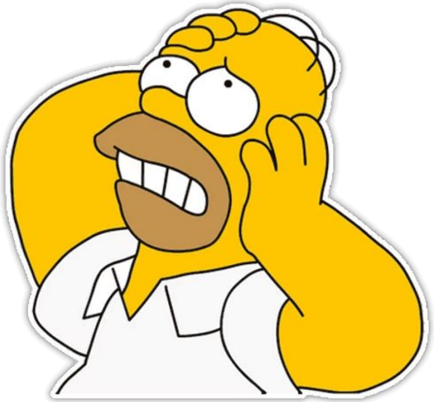
- This may seem daunting—but don't panic!

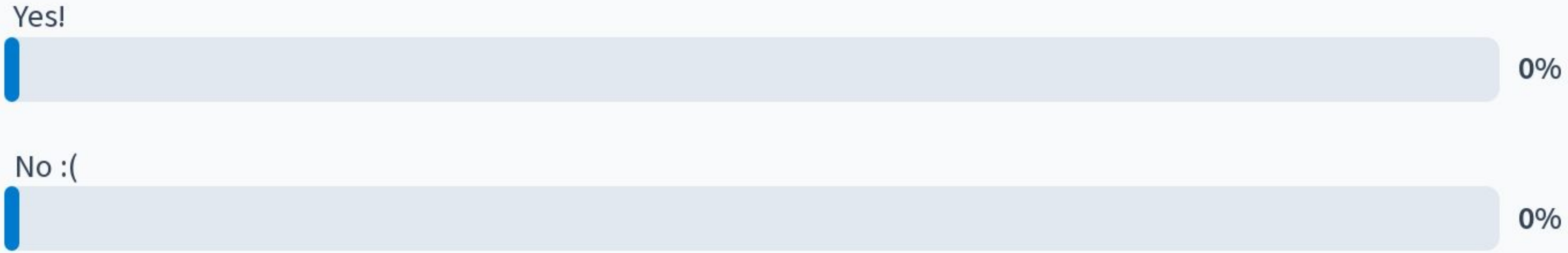


Languages and Tools in CS 4440

- Projects cover a few languages and tools:
  - **Project1:** Python 3
  - **Project2:** C/C++, x86, GDB
  - **Project3:** SQL, HTML, JavaScript
  - **Project4:** Python 3, Wireshark

- This may seem daunting—but don't panic!
  - Only using a **small subset** of their capabilities
  - We'll cover some basics in lecture as we go along
  - We'll post resources for you on the **CS 4440 Wiki**

Have you browsed CS 4440 Wiki yet?

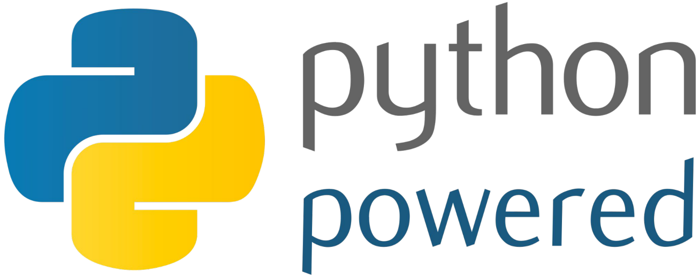


Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

An Intro to Python 3

Python 3

- Primary language for your Projects
  - Though expect to see some others too
- Characteristics:
  - High-level
  - Interpreted
  - Object Oriented
  - Dynamically Typed
  - Lots of indentation



```
print("Hello, world!")
```

Running Python Code

- Interactive mode
  - Launch Python 3 console
  - Enter code line-by-line
  - Executed line-by-line

```
$ python3
>>> print("Hello from the interpreter!")
Hello from the interpreter!
>>> exit()
```

Running Python Code

- Scripting mode
  - Edit your script (e.g., `MyScript.py`)
  - Then call the `python3` binary on it

```
$ cat MyScript.py
#!/usr/bin/python3
print("Hello from scripting mode!")
$ python3 MyScript.py
Hello from scripting mode!
```

Writing Scripts

- You'll be writing relatively simple scripts
  - No need for an IDE
  - IDEs can/will break things

- Recommended text editors:
  - VIM
  - Nano
  - Emacs
  - FeatherPad
  - **Many others—pick one you like!**

```
                :::
  iLE88Dj.  :jD88888Dj:
.LGitE888D.f8GjjjL8888E;
iE   :8888Et.     .G8888.
;i    E888,        ,8888,
      D888,        :8888:
      D888,        :8888:
      D888,        :8888:
      D888,        :8888:
      888W,        :8888:
      W88W,        :8888:
      W88W:        :8888:
      DGGD:        :8888:
                   :8888:
                   :W888:
                   :8888:
                    E888i
                    tW88D
```

Variables

- Can contain alphanumerical characters and some special characters

- Common conventions:
  - Variable names that start with lower-case letters
  - Class names beginning with a capital letter

- Some keywords are **reserved** (cannot be used as variable names)
  - Examples: `and`, `continue`, `break`
  - Python will complain if you use these

- **Dynamically typed:** a variable's **type** is derived from its **value**

Variables

- Types you'll likely see:
  - Integer (`int`)
  - Float (`float`)
  - String (`str`)
  - Boolean (`bool`)
  - Custom classes (e.g., `md5`)

Variables

- Types you'll likely see:
  - Integer (int)
  - Float (float)
  - String (str)
  - Boolean (bool)
  - Custom classes (e.g., md5)

- Variable assignment:
  - Assignment uses the "=" sign

```
>>> x = 5
>>> print(type(x))
<class 'int'>
```

Variables

- Types you'll likely see:
  - Integer (`int`)
  - Float (`float`)
  - String (`str`)
  - Boolean (`bool`)
  - Custom classes (e.g., `md5`)
- Variable assignment:
  - Assignment uses the "=" sign
  - Value changed? **So does type!**

```
>>> x = 5
>>> print(type(x))
<class 'int'>


>>> x = "cs4440"
>>> print(type(x))
<class 'str'>
```

Variables

- Casting:
  - Pick a desired data type
  - “Wrap” your variable in it

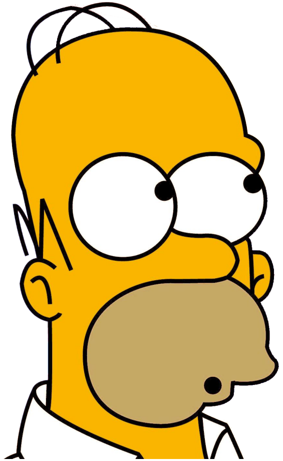
```
>>> x = 5
>>> print(x, type(x))
5 <class 'int'>
```

Variables

- Casting:
    - Pick a desired data type
    - “Wrap” your variable in it
    - **Re-casting** will change type!

```
>>> x = 5
>>> print(x, type(x))
5 <class 'int'>

>>> x = float(x)
>>> print(x, type(x))
5.0 <class float>
```



Strings

- You will use **strings** in many exercises
  - Super flexible to use and manipulate
  - We’ll cover some basic conventions

```
>>> x = "odoyle"
```

Strings

- You will use **strings** in many exercises
  - Super flexible to use and manipulate
  - We’ll cover some basic conventions

- Basic string manipulation:
  - Length

```
>>> x = "odoyle"
>>> print(len(x))
6
```

Strings

- You will use **strings** in many exercises
  - Super flexible to use and manipulate
  - We'll cover some basic conventions

- Basic string manipulation:
  - Length
  - Appending

```
>>> x = "odoyle"
>>> print(len(x))
6


>>> print(x + "rules")
odoylerules
```

Strings

- You will use **strings** in many exercises
  - Super flexible to use and manipulate
  - We’ll cover some basic conventions

- Basic string manipulation:
  - Length
  - Appending
  - Substrings

```
>>> x = "odoyle"
>>> print(len(x))
6


>>> print(x + "rules")
odoylerules


>>> print("odoy" in x)
True
```

Strings

- Other string manipulations:

```
>>> x = "cs4440:fa23"
```

Strings

- Other string manipulations:
  - Splitting by a delimiter

```
>>> x = "cs4440:fa23"
>>> print(x.split(':'))
['cs4440', 'fa23']
```

Strings

- Other string manipulations:
  - Splitting by a delimiter
  - Stripping characters

```
>>> x = "cs4440:fa23"
>>> print(x.split(':')
['cs4440', 'fa23']


>>> print(x.strip(':')
cs4440fa23
```

Strings

- Other string manipulations:
  - Splitting by a delimiter
  - Stripping characters
  - Repeating characters

```
>>> x = "cs4440:fa23"
>>> print(x.split(':')
['cs4440', 'fa23']


>>> print(x.strip(':')
cs4440fa23


>>> print('A'*10)
AAAAAAAAAA
```

Byte Strings

- Sometimes you will work with data as **bytes**
  - In Python, **byte strings** appear as `b'data'`
- Examples:
  - **Encoding** to a byte string

```
>>> x = "cs4440"
>>> x = x.encode(‘utf-8’))
>>> print(x, type(x))
b'cs4440' <class 'bytes'>
```

Byte Strings

- Sometimes you will work with data as **bytes**
  - In Python, **byte strings** appear as b'data'
- Examples:
  - **Encoding** to a byte string
  - **Decoding** a byte string

```
>>> x = "cs4440"
>>> x = x.encode(‘utf-8’))
>>> print(x, type(x))
b'cs4440' <class 'bytes'>


>>> y = x.decode(‘utf-8’))
>>> print(y, type(y))
cs4440 <class 'str'>
```

Byte Strings

- Sometimes you will work with data as **bytes**
  - In Python, **byte strings** appear as `b'data'`
- Examples:
  - **Encoding** to a byte string
  - **Decoding** a byte string
  - Must keep the same codec (e.g., **utf-8**)

```
>>> x = "cs4440"
>>> x = x.encode(‘utf-8’))
>>> print(x, type(x))
b'cs4440' <class 'bytes'>


>>> y = x.decode(‘utf-8’))
>>> print(y, type(y))
cs4440 <class 'str'>
```

Byte Strings

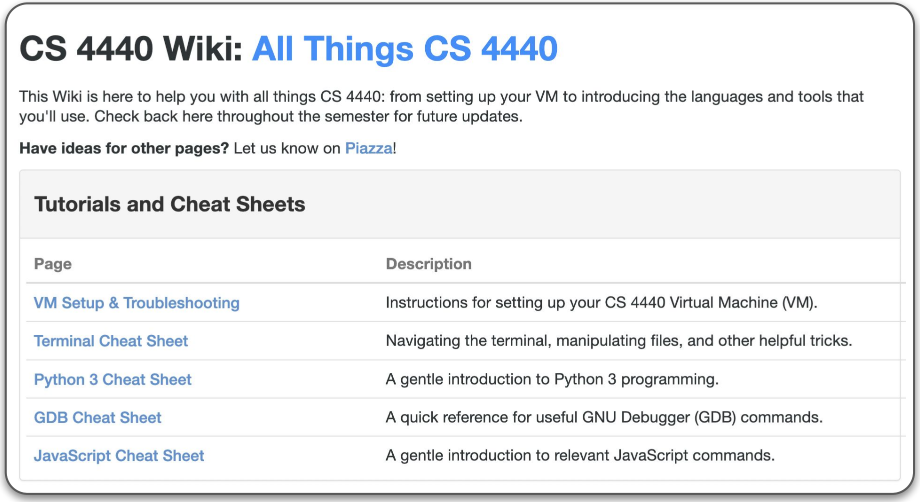
- Sometimes you will work with data as **bytes**
  - In Python, **byte strings** appear as `b'data'`
- Examples:
  - **Encoding** to a byte string
  - **Decoding** a byte string
  - Must keep the same codec (e.g., `utf-8`)
- Conceptually can be a little confusing
  - Functions `print()` and `type()` are your friends!

```
>>> x = "cs4440"
>>> x = x.encode(‘utf-8’))
>>> print(x, type(x))
b'cs4440' <class 'bytes'>

>>> y = x.decode(‘utf-8’))
>>> print(y, type(y))
cs4440 <class 'str'>
```

Other Key Concepts

- A few other concepts to review
  - Check these out in the **CS 4440 Wiki**



CS 4440 Wiki: All Things CS 4440

This Wiki is here to help you with all things CS 4440: from setting up your VM to introducing the languages and tools that you'll use. Check back here throughout the semester for future updates.

Have ideas for other pages? Let us know on Piazza!

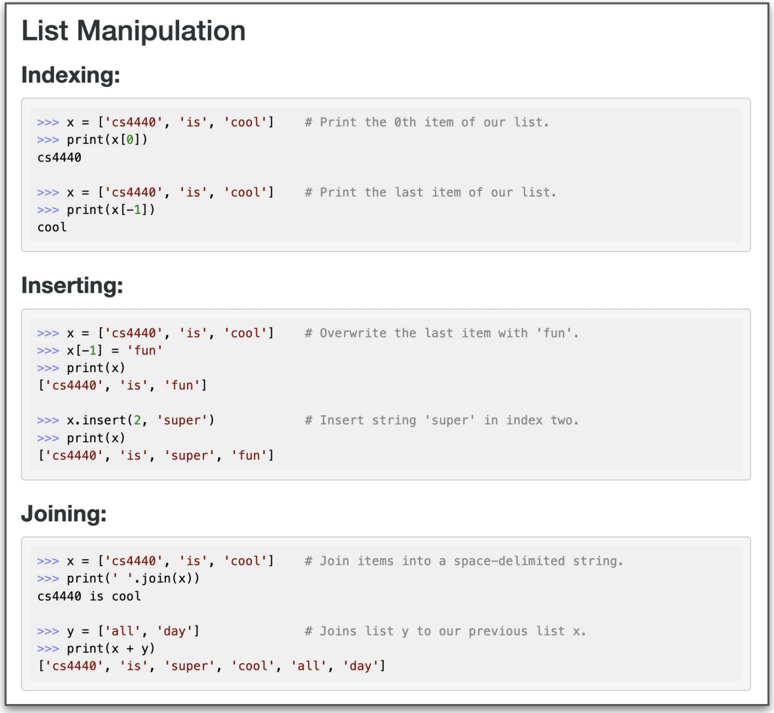
Tutorials and Cheat Sheets

Page	Description
VM Setup & Troubleshooting	Instructions for setting up your CS 4440 Virtual Machine (VM).
Terminal Cheat Sheet	Navigating the terminal, manipulating files, and other helpful tricks.
Python 3 Cheat Sheet	A gentle introduction to Python 3 programming.
GDB Cheat Sheet	A quick reference for useful GNU Debugger (GDB) commands.
JavaScript Cheat Sheet	A gentle introduction to relevant JavaScript commands.

Other Key Concepts

- A few other concepts to review
  - Check these out in the **CS 4440 Wiki**

- Lists
  - Appending
  - Prepending
  - Insert, Remove



List Manipulation

Indexing:

```
>>> x = ['cs4440', 'is', 'cool']    # Print the 0th item of our list.
>>> print(x[0])
cs4440

>>> x = ['cs4440', 'is', 'cool']    # Print the last item of our list.
>>> print(x[-1])
cool
```

Inserting:

```
>>> x = ['cs4440', 'is', 'cool']    # Overwrite the last item with 'fun'.
>>> x[-1] = 'fun'
>>> print(x)
['cs4440', 'is', 'fun']

>>> x.insert(2, 'super')            # Insert string 'super' in index two.
>>> print(x)
['cs4440', 'is', 'super', 'fun']
```

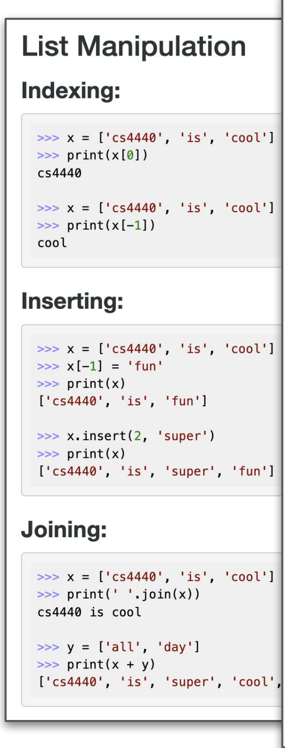
Joining:

```
>>> x = ['cs4440', 'is', 'cool']    # Join items into a space-delimited string.
>>> print(' '.join(x))
cs4440 is cool

>>> y = ['all', 'day']              # Joins list y to our previous list x.
>>> print(x + y)
['cs4440', 'is', 'super', 'cool', 'all', 'day']
```

Other Key Concepts

- A few other concepts to review
  - Check these out in the **CS 4440 Wiki**
- Lists
  - Appending
  - Prepending
  - Insert, Remove
- Control Flow
  - Loops
  - If/Else Statements



List Manipulation

Indexing:

```
>>> x = ['cs4440', 'is', 'cool']
>>> print(x[0])
cs4440

>>> x = ['cs4440', 'is', 'cool']
>>> print(x[-1])
cool
```

Inserting:

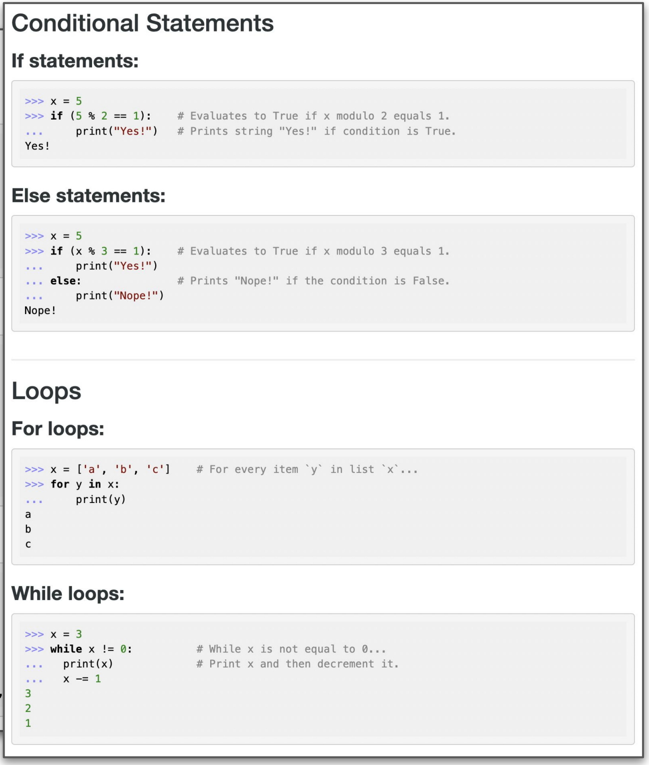
```
>>> x = ['cs4440', 'is', 'cool']
>>> x[-1] = 'fun'
>>> print(x)
['cs4440', 'is', 'fun']

>>> x.insert(2, 'super')
>>> print(x)
['cs4440', 'is', 'super', 'fun']
```

Joining:

```
>>> x = ['cs4440', 'is', 'cool']
>>> print(' '.join(x))
cs4440 is cool

>>> y = ['all', 'day']
>>> print(x + y)
['cs4440', 'is', 'super', 'cool',
```



Conditional Statements

If statements:

```
>>> x = 5
>>> if (5 % 2 == 1):    # Evaluates to True if x modulo 2 equals 1.
...     print("Yes!")   # Prints string "Yes!" if condition is True.
Yes!
```

Else statements:

```
>>> x = 5
>>> if (x % 3 == 1):    # Evaluates to True if x modulo 3 equals 1.
...     print("Yes!")
... else:               # Prints "Nope!" if the condition is False.
...     print("Nope!")
Nope!
```

Loops

For loops:

```
>>> x = ['a', 'b', 'c']    # For every item `y` in list `x`...
>>> for y in x:
...     print(y)
a
b
c
```

While loops:

```
>>> x = 3
>>> while x != 0:          # While x is not equal to 0...
...   print(x)             # Print x and then decrement it.
...   x -= 1
3
2
1
```

Other Key Concepts

- A few other concepts to review
  - Check these out in the **CS 4440 Wiki**
- Lists
  - Appending
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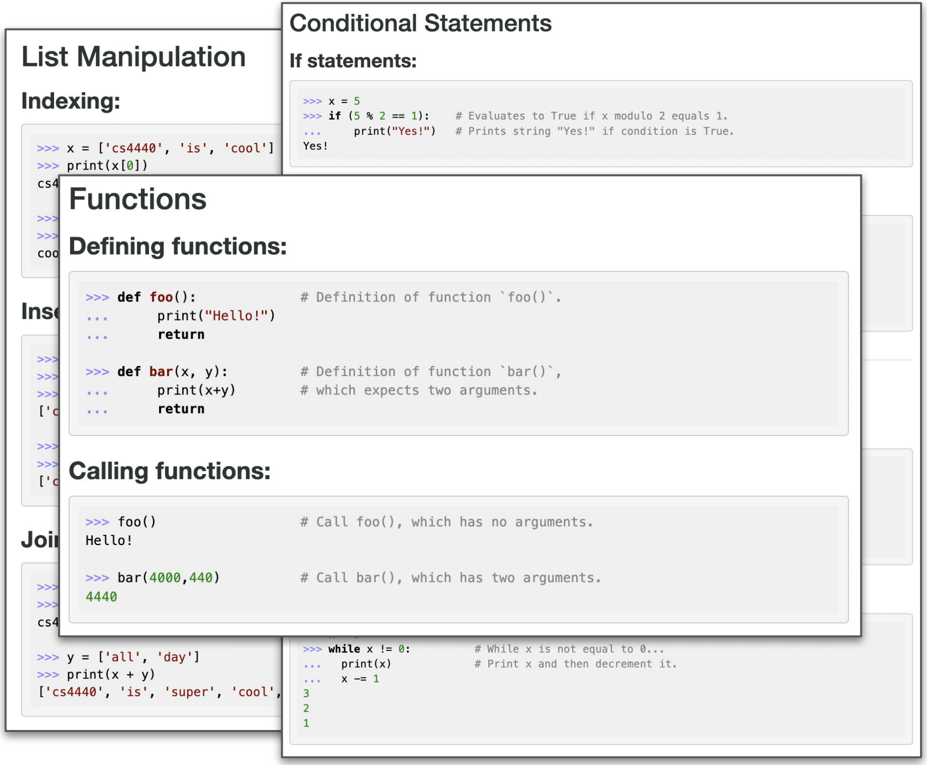
  - Insert, Remove
- Control Flow
  - Loops
  - If/Else Statements
- Functions



List Manipulation

Indexing:

```
>>> x = ['cs4440', 'is', 'cool']
>>> print(x[0])
cs4

>>>
>>>
coo
```

Ins

```
>>>
>>>
>>>
['c

>>>
>>>
['c
```

Joi

```
>>>
>>>
cs4

>>> y = ['all', 'day']
>>> print(x + y)
['cs4440', 'is', 'super', 'cool',
```

Conditional Statements

If statements:

```
>>> x = 5
>>> if (5 % 2 == 1):    # Evaluates to True if x modulo 2 equals 1.
...     print("Yes!")   # Prints string "Yes!" if condition is True.
Yes!
```

```
>>> while x != 0:             # While x is not equal to 0...
...   print(x)                # Print x and then decrement it.
...   x -= 1
3
2
1
```

Functions

Defining functions:

```
>>> def foo():                # Definition of function `foo()`.
...     print("Hello!")
...     return

>>> def bar(x, y):            # Definition of function `bar()`,
...     print(x+y)            # which expects two arguments.
...     return
```

Calling functions:

```
>>> foo()                     # Call foo(), which has no arguments.
Hello!

>>> bar(4000,440)             # Call bar(), which has two arguments.
4440
```

Questions?

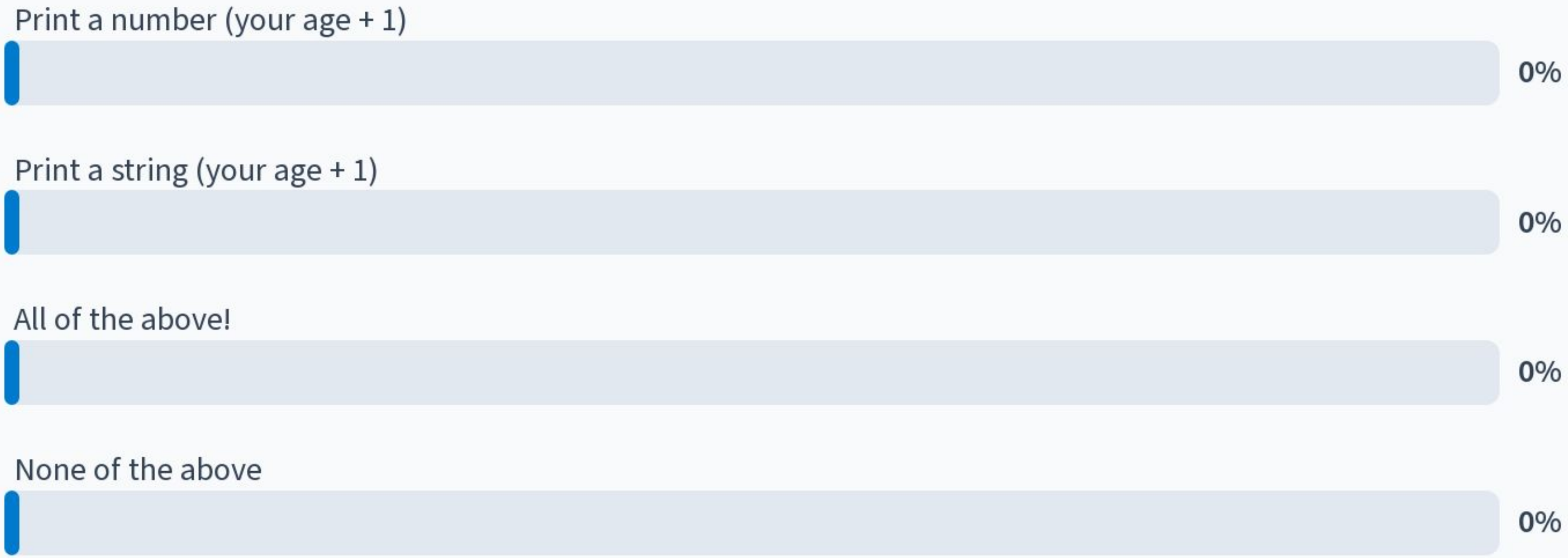
Debugging Your Code

Sample Program

- What will the following code do?

```
age = input("How old are you? ")
next_age = age + 1
print("Next year you will be", next_age)
```

What will the aforementioned code do?



Print a number (your age + 1) 0%

Print a string (your age + 1) 0%

All of the above! 0%

None of the above 0%

Sample Program

- What will the following code do?

```
age =
next_
print                                     age)
```

Where to begin debugging?

- Errors say where the error is!
  - Filename
  - Line number
  - The actual line of code

```
Traceback (most recent call last):
  File "MyScript.py", line 2, in <module>
    next_age = age + 1
TypeError: must be str, not int
```

Where to begin debugging?

- Errors say where the error is!
  - Filename
  - Line number
  - The actual line of code

```
Traceback (most recent call last):
  File "MyScript.py", line 2, in <module>
    next_age = age + 1
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```

Where to begin debugging?

- Errors say where the error is!
  - Filename
  - Line number
  - The actual line of code
- The error's root cause:
  - Program tried "29"+1
  - Strings and numbers are different data types!

```
Traceback (most recent call last):
  File "MyScript.py", line 2, in <module>
    next_age = age + 1
TypeError: must be str, not int
```

Where to begin debugging?

- Errors say where the error is!
  - Filename
  - Line number
  - The actual line of code

```
age = input("How old are you? ")
next_age = int(age) + 1
```

- The error's root cause:
  - Program tried "29"+1
  - Strings and numbers are different data types!
- **The fix:** cast age as an `int`

Debugging is a Process

- **Remember:** `print()` and `type()` are your friend!
  - Insert these, re-run your program, and check output
  - Does the output match what you expect?
  - If not, investigate further and try again!

Debugging is a Process

- **Remember:** `print()` and `type()` are your friend!
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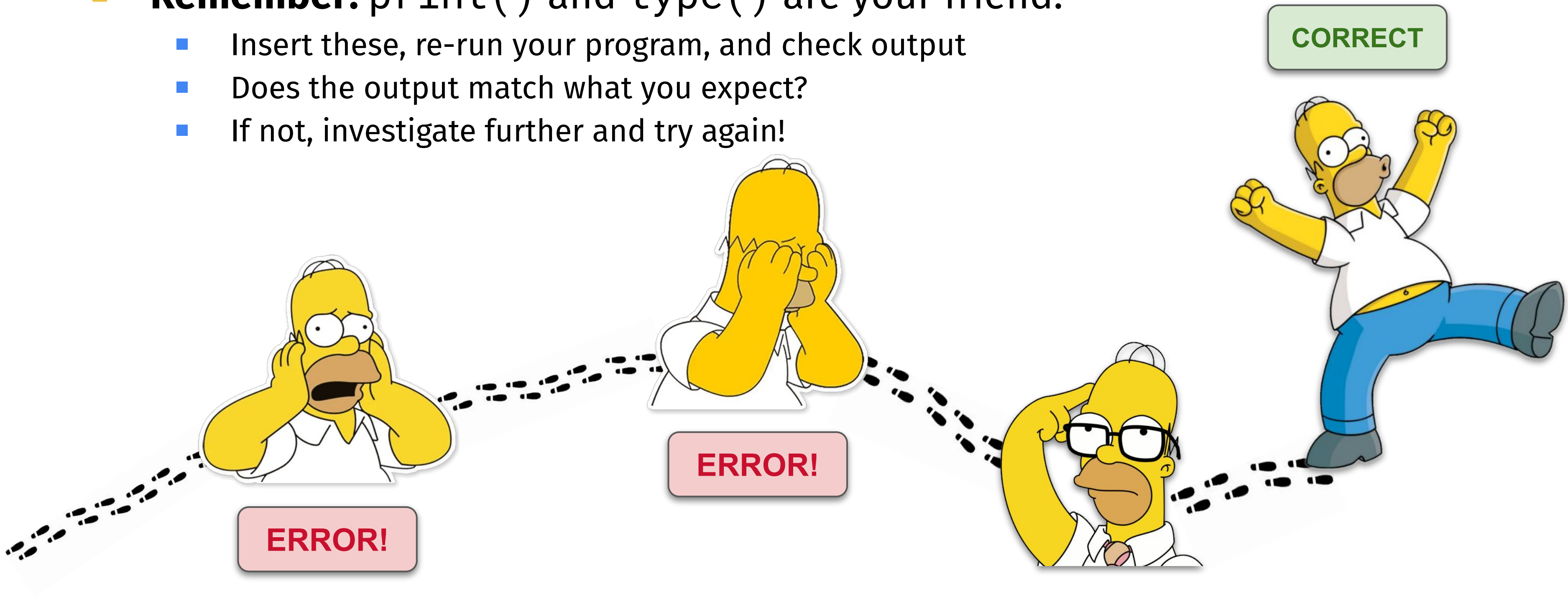
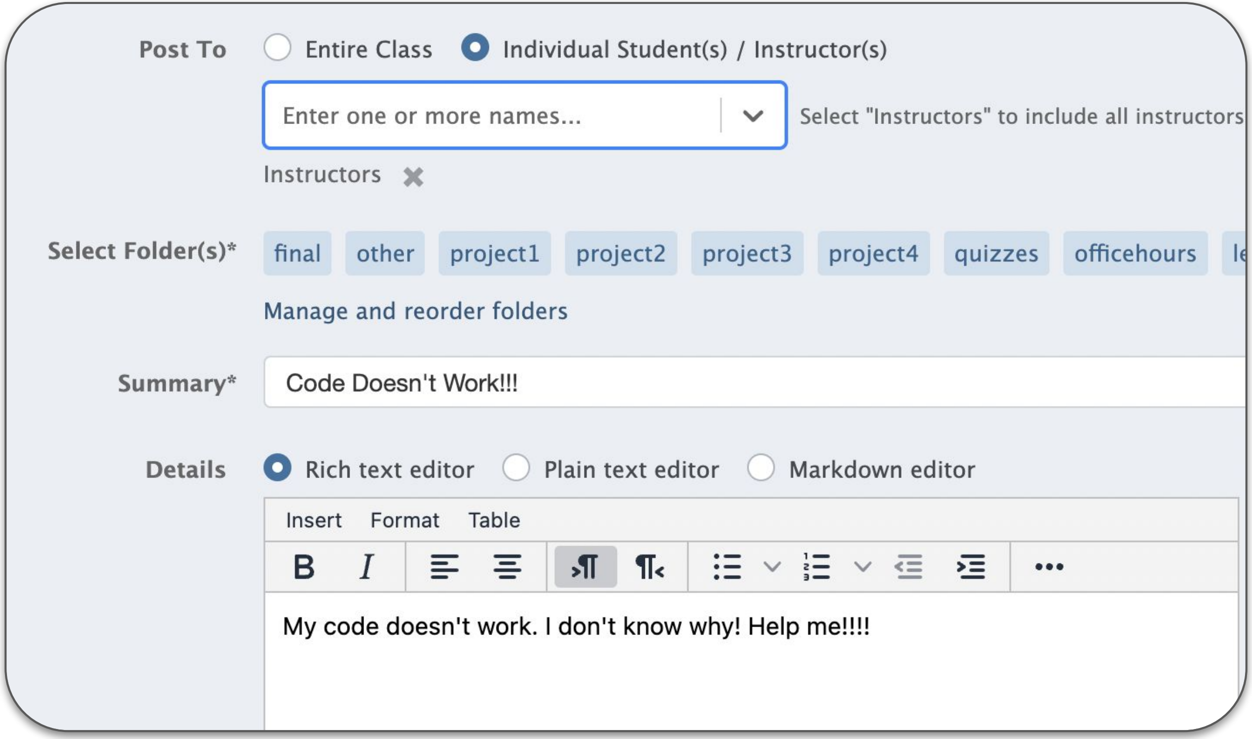


ERROR!

ERROR!

CORRECT

Lazy Debugging



Post To ○ Entire Class ● Individual Student(s) / Instructor(s)

Enter one or more names... Select "Instructors" to include all instructors

Instructors ✖

Select Folder(s)* final other project1 project2 project3 project4 quizzes officehours le

Manage and reorder folders

Summary* Code Doesn't Work!!!

Details ● Rich text editor ○ Plain text editor ○ Markdown editor

My code doesn't work. I don't know why! Help me!!!!

Asking for Help

- **It’s perfectly fine to ask for help**
  - That’s what we / Piazza are here for!

Asking for Help

- **It's perfectly fine to ask for help**
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- Help others help you! **Explain:**
  - What error code are you getting?
  - What do you think it means?
  - What fixes have you tried?
  - What fixes did not work?

Asking for Help

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  - What error code are you getting?
  - What do you think it means?
  - What fixes have you tried?
  - What fixes did not work?

- **Please** try to avoid **"instructor private posts"** about debugging your code
  - We get **a lot** of these near deadlines—it becomes impossible to keep up / help everyone!
  - We may un-private your post if it contains information that's useful for the class 🙂

Questions?

VM Setup

Virtual Machines (VM)

- Why do we use a **VM** in this course?
  - Minor software differences can **break your attacks**
  - We want everyone to have the **same software and OS**
    - Python & Firefox versions, security settings, etc.
  - We'll **grade** everyone using **this Linux VM environment**

Virtual Machines (VM)

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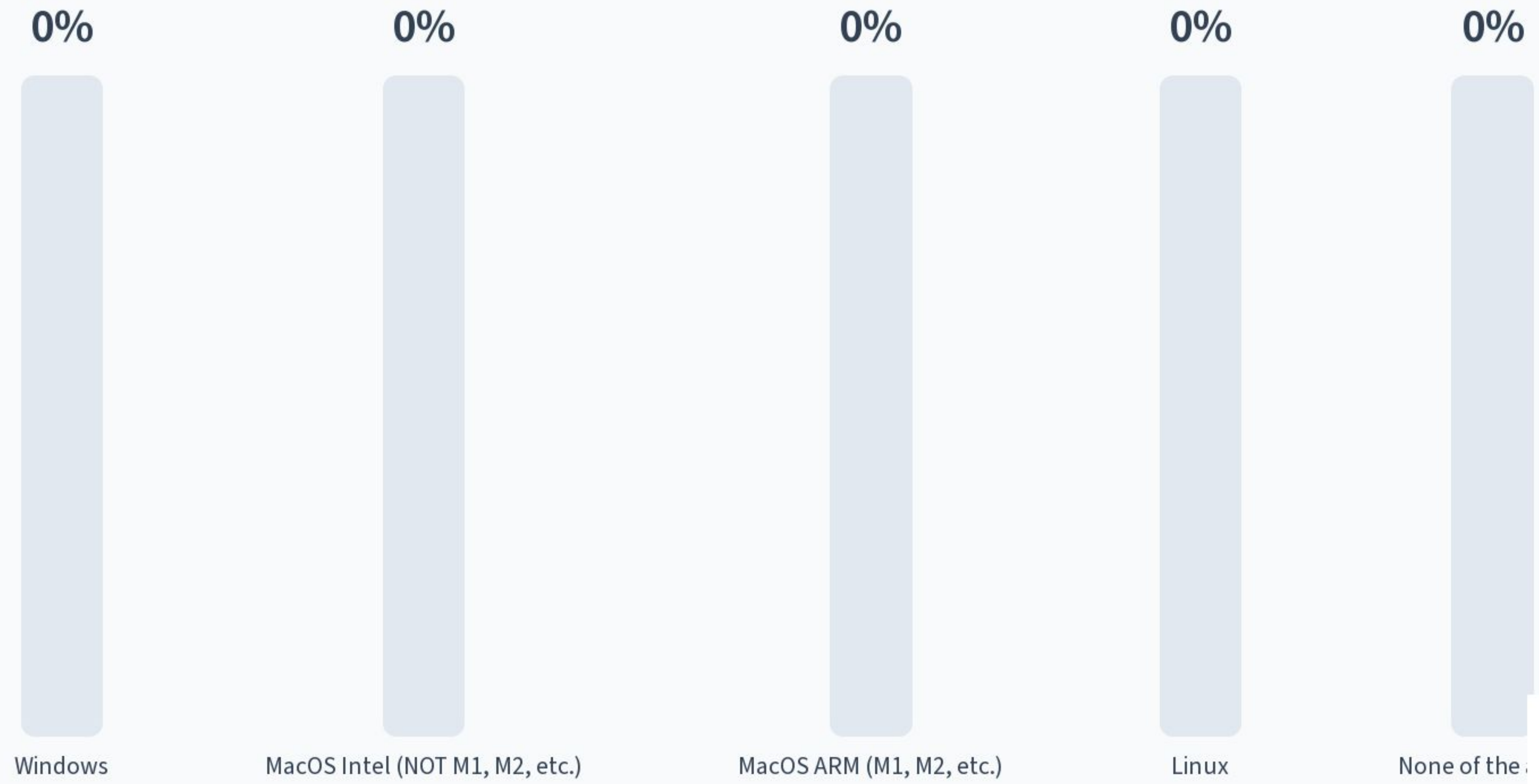
  - Minor software differences can **break your attacks**
  - We want everyone to have the **same software and OS**
    - Python & Firefox versions, security settings, etc.
  - We'll **grade** everyone using **this Linux VM environment**

- **Important:** your computer determines what **VM software** you will use
  - Use **VirtualBox** if:
    - Your laptop is a **Windows-**, **Linux-**, or **Intel-based Mac** (i.e., **NOT** an M1/M2/etc.)
  - Use **UTM** if:
    - Your laptop is an **ARM-based Mac** (i.e., an M1/M2/etc.)

What kind of computer are you using?

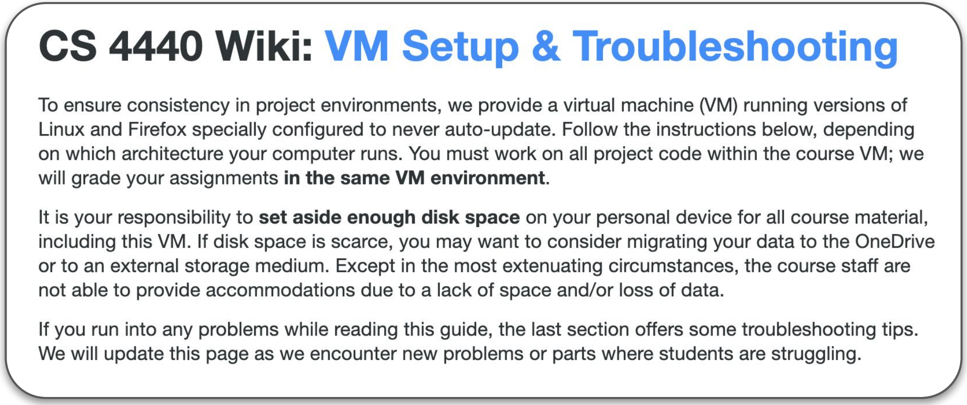


Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

Setup the CS 4440 VM

- Open the **CS 4440 Wiki**
  - See the **VM Setup** page
  - Follow the instructions
  - Once your VM is setup, you are free to leave!
  - In the meantime, feel free to **ask questions**

Course Homepage: **http://cs4440.eng.utah.edu**



CS 4440 Wiki: VM Setup & Troubleshooting

To ensure consistency in project environments, we provide a virtual machine (VM) running versions of Linux and Firefox specially configured to never auto-update. Follow the instructions below, depending on which architecture your computer runs. You must work on all project code within the course VM; we will grade your assignments **in the same VM environment**.

It is your responsibility to **set aside enough disk space** on your personal device for all course material, including this VM. If disk space is scarce, you may want to consider migrating your data to the OneDrive or to an external storage medium. Except in the most extenuating circumstances, the course staff are not able to provide accommodations due to a lack of space and/or loss of data.

If you run into any problems while reading this guide, the last section offers some troubleshooting tips. We will update this page as we encounter new problems or parts where students are struggling.

Next time on CS 4440…

Message integrity (a.k.a. applied cryptography)