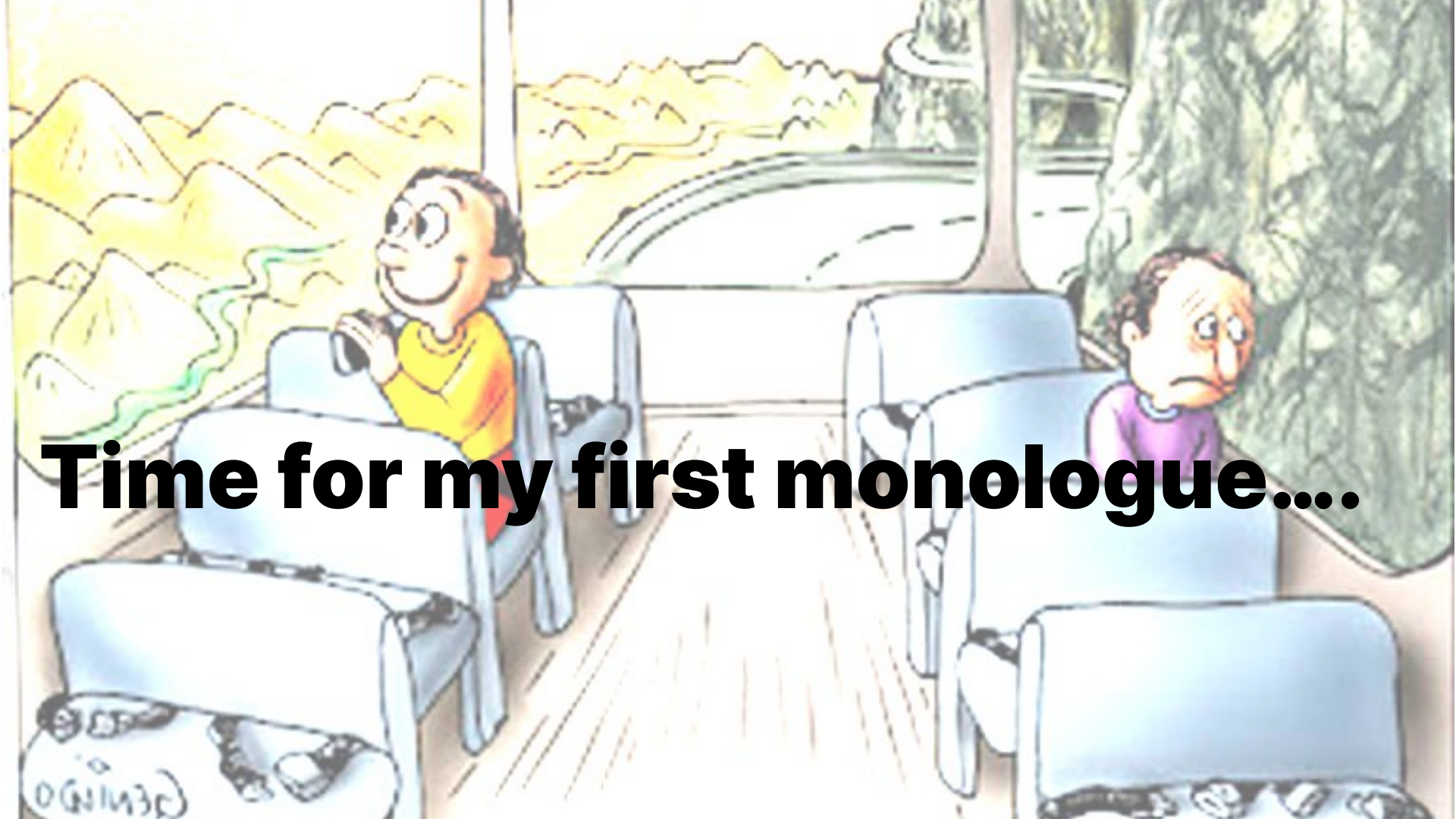
Welcome to HWRS 401/501 aka:

“Tools for Data Handling and Analysis in Water, Weather, & Climate ”


YOU
PEOPLE NOT IN HWRS 401/501
DOING "RESEARCH"


Time for my first monologue....

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts
- An understanding of the overall scientific python data stack

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts
- An understanding of the overall scientific python data stack
- Common data structures for environmental and climate data

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts
- An understanding of the overall scientific python data stack
- Common data structures for environmental and climate data
- How to find & use publicly accessible data

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts
- An understanding of the overall scientific python data stack
- Common data structures for environmental and climate data
- How to find & use publicly accessible data
- How to structure and share reproducible research

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts
- An understanding of the overall scientific python data stack
- Common data structures for environmental and climate data
- How to find & use publicly accessible data
- How to structure and share reproducible research
- The value & process of community and collaboration in data analysis

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts
- An understanding of the overall scientific python data stack
- Common data structures for environmental and climate data
- How to find & use publicly accessible data
- How to structure and share reproducible research
- The value & process of community and collaboration in data analysis
- Considerations for ethical and equitable computing in your research

At a high level, this is what you can expect to learn:

- A rough and basic history of why computing is important in environmental, water, and climate research
- Basic programming skills and concepts
- An understanding of the overall scientific python data stack
- Common data structures for environmental and climate data
- How to find & use publicly accessible data
- How to structure and share reproducible research
- The value & process of community and collaboration in data analysis
- Considerations for ethical and equitable computing in your research
- Who might be collaborators for your future research

Making the case for data science literacy

- We live in unprecedented times in terms of data, compute, and tooling for environmental, climate, and Earth sciences
- I believe that scientists in such fields can use these facts to better understand the Earth system and advance both science and policy
- Taking this approach seriously requires researchers to take computing seriously as an approach to scientific inquiry
- Taking this approach seriously requires researchers to take a critical eye to where their data comes from and understand approaches to discovering errors and/or limitations

Let’s talk about you

- What’s your background?
- What are you interested in?
- What do you already know?
- What do you want to know?
- Do you have cool pets, good recipes, or random thoughts to share with the class?

Let’s talk about me

- You can tell that picture is me by the pixels
- I’m a postdoc working with Laura Condon
- Largely my research interests are focused around hydrologic modeling, machine learning, and understanding how meteorologic data is used in making hydrologic predictions
- I’m also interested in open source science broadly
- Just call me Andrew

Syllabus junk!!!

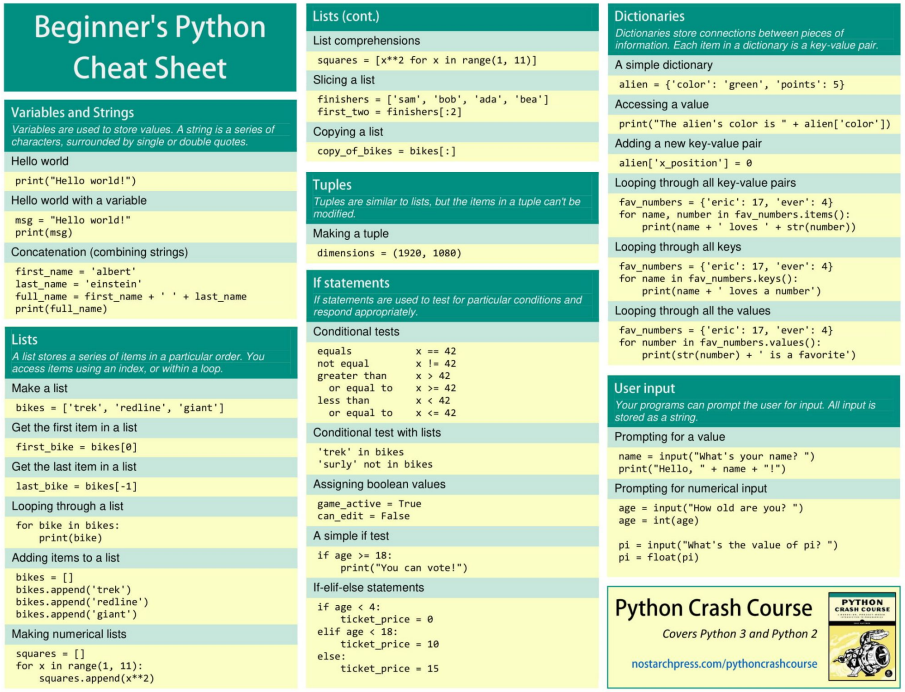
- Yeah, again, it’s 8am - not my choice. What’s your preference for congregation/community?
- We can flip the classroom, I am happy to record lectures and post on youtube or whatever and spend class time on exercises
- Grades will be posted via canvas, but all other materials will be shared via github (to be explained)
- Office hours - I set some but what works for y’all?
    - Mon 2-3pm & Thurs 9:30-10:30am
- I want this to be collaborative - we have a curriculum, but if needs/interests arise let’s respond and adjust!!!

Grading

Item	Grade %
Participation	20
Forecast submissions	40
Cheat Sheets	14
Code review	6
Submitted scripts	12
Forecast evaluation	8

Cheat sheets

- You'll submit one cheat sheet per module
- These are distilled versions of your notes
- Should give something for you to refer back to
- Should give me something to make sure I know ya'll are following along
- Format is free form, can be as simple as organized and formatted bullet points but feel free to go nuts and make infographic, sketches, or whatever



Beginner's Python Cheat Sheet

Variables and Strings

Variables are used to store values. A string is a series of characters, surrounded by single or double quotes.

Hello world

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

Hello world with a variable

```
msg = "Hello world!"
print(msg)
```

Concatenation (combining strings)

```
first_name = 'albert'
last_name = 'einstein'
full_name = first_name + ' ' + last_name
print(full_name)
```

Lists

A list stores a series of items in a particular order. You access items using an index, or within a loop.

Make a list

```
bikes = ['trek', 'redline', 'giant']
```

Get the first item in a list

```
first_bike = bikes[0]
```

Get the last item in a list

```
last_bike = bikes[-1]
```

Looping through a list

```
for bike in bikes:
    print(bike)
```

Adding items to a list

```
bikes = []
bikes.append('trek')
bikes.append('redline')
bikes.append('giant')
```

Making numerical lists

```
squares = []
for x in range(1, 11):
    squares.append(x**2)
```

Lists (cont.)

List comprehensions

```
squares = [x**2 for x in range(1, 11)]
```

Slicing a list

```
finishers = ['sam', 'bob', 'ada', 'bea']
first_two = finishers[:2]
```

Copying a list

```
copy_of_bikes = bikes[:]
```

Tuples

Tuples are similar to lists, but the items in a tuple can't be modified.

Making a tuple

```
dimensions = (1920, 1080)
```

If statements

If statements are used to test for particular conditions and respond appropriately.

Conditional tests

```
equals            x == 42
not equal         x != 42
greater than      x > 42
  or equal to     x >= 42
less than         x < 42
  or equal to     x <= 42
```

Conditional test with lists

```
'trek' in bikes
'surly' not in bikes
```

Assigning boolean values

```
game_active = True
can_edit = False
```

A simple if test

```
if age >= 18:
    print("You can vote!")
```

If-elif-else statements

```
if age < 4:
    ticket_price = 0
elif age < 18:
    ticket_price = 10
else:
    ticket_price = 15
```

Dictionaries

Dictionaries store connections between pieces of information. Each item in a dictionary is a key-value pair.

A simple dictionary

```
alien = {'color': 'green', 'points': 5}
```

Accessing a value

```
print("The alien's color is " + alien['color'])
```

Adding a new key-value pair

```
alien['x_position'] = 0
```

Looping through all key-value pairs

```
fav_numbers = {'eric': 17, 'ever': 4}
for name, number in fav_numbers.items():
    print(name + ' loves ' + str(number))
```

Looping through all keys

```
fav_numbers = {'eric': 17, 'ever': 4}
for name in fav_numbers.keys():
    print(name + ' loves a number')
```

Looping through all the values

```
fav_numbers = {'eric': 17, 'ever': 4}
for number in fav_numbers.values():
    print(str(number) + ' is a favorite')
```

User input

Your programs can prompt the user for input. All input is stored as a string.

Prompting for a value

```
name = input("What's your name? ")
print("Hello, " + name + "!")
```

Prompting for numerical input

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

pi = input("What's the value of pi? ")
pi = float(pi)
```

Python Crash Course

Covers Python 3 and Python 2

nostarchpress.com/pythoncrashcourse

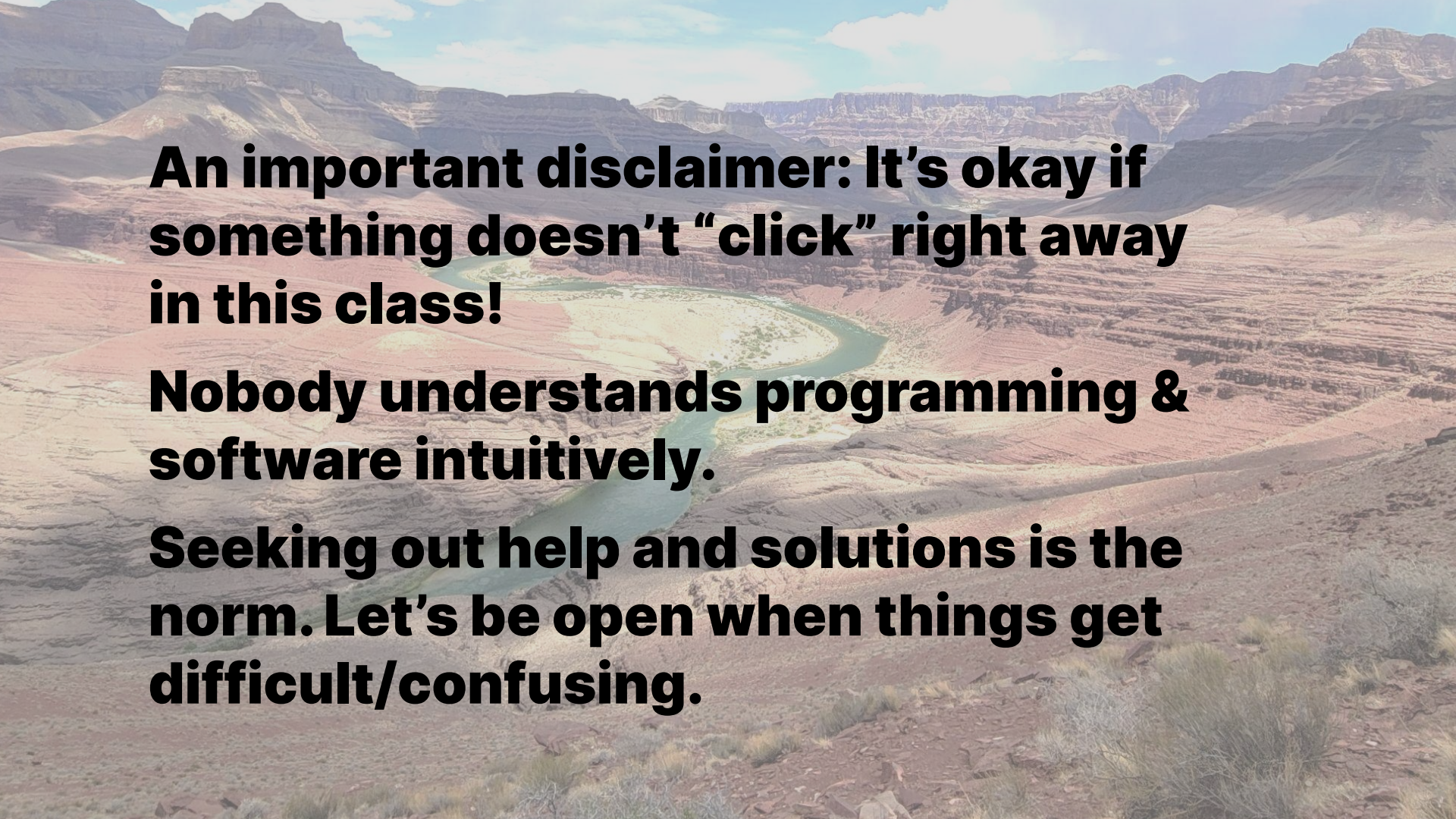
Forecasting on the Verde River

About the Verde

- The 192-mile river begins as springs near Paulden
- 40 miles designated National Wild and Scenic River
  - Riparian oasis surrounded by arid land
  - Supports 50+ threatened or endangered species
  - Critical flyway for migratory birds
- Free-flowing except for 2 dams around mile 137
- Supplies ~40% of the surface water SRP delivers annually to Phoenix for municipal and agricultural use

Verde River Near Camp Verde, AZ *(USGS Gauge 09506000)*

- Each week I'll ask you to produce a 1 week and 2 week forecast of how much water will flow through the Verde river @ Camp Verde
- Specifics of the assignment will be revealed Thursdays and submissions will be due the following Wednesday
- You will not be graded for accuracy of results
- You will be graded for completion and explanation of how you used the methods from the week to produce your forecast
- There will be a competition where I track who has the best forecasts overall. 1st place will receive a 5% grade boost. 2nd and 3rd will receive 3% boosts.
- There might be cool trophies too…



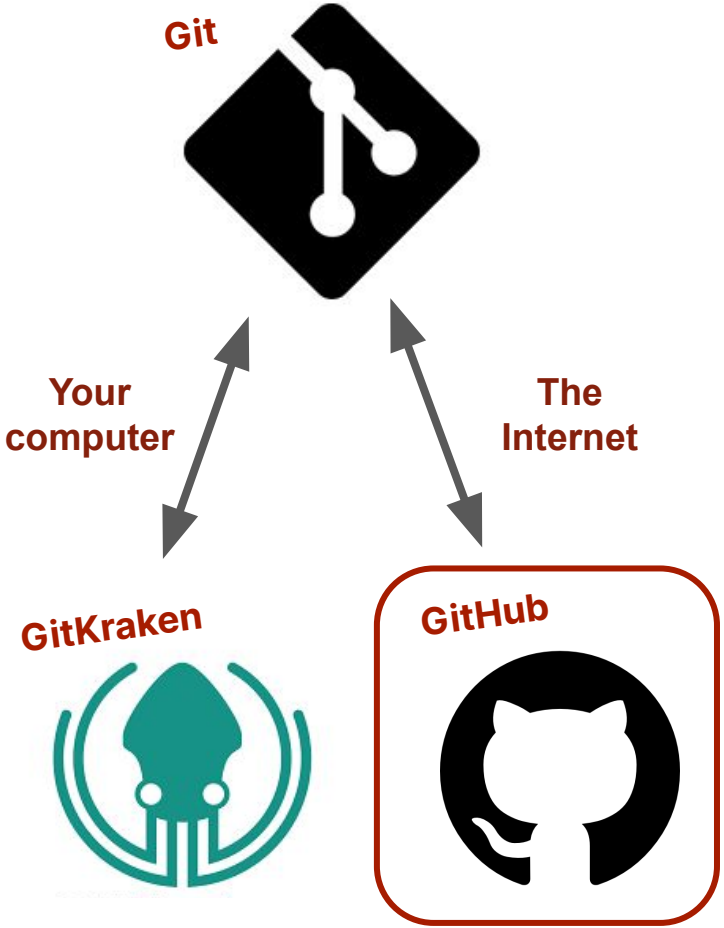
An important disclaimer: It's okay if something doesn't "click" right away in this class!

Nobody understands programming & software intuitively.

Seeking out help and solutions is the norm. Let's be open when things get difficult/confusing.

Let's see how far we can get... Introducing git + GitHub

- Git is software that helps track changes in code/files. Kinda like track changes in word, but on steroids.
- But it's also super f'n hard to use. We'll try to simplify things as much as possible though
- Git is a particular software, but GitHub is a company and web interface built around the software
- We will use GitHub to track assignments and content, as well as help build community
- We will use GitKraken as an app to interact with git and GitHub
- Ignoring how git works for a moment, let's all create a github account.



Let's see how far we can get...
Creating github profiles

- My account is here: https://github.com/arbennett
- The class organization is here: https://github.com/HAS-Tools-Fall2022
- Once you create your account write your username on the board and I will add you to the class
- When you are added, please navigate to the "Discussions" tab and introduce yourself

Let’s see how far we can get…
Installing Git

- Please bear with me… I’m still not going to describe git until next session probably
- But, let’s try to “git” it installed. Go to https://git-scm.com/
- Try to cluster into groups of Windows, MacOS, and (if existing) linux users and walk through steps together

Let's see how far we can get...
Installing python

- Python is a complicated programming ecosystem. We'll dive into it more next class.
- For now, we'll be using the anaconda python ecosystem.
- Let's all try to download it via miniconda: https://docs.conda.io/en/latest/miniconda.html
- Try to cluster into groups of Windows, MacOS, and (if existing) linux users and walk through steps together

Let’s see how far we can get…
Installing GitKraken

- GitKraken just makes git easier to use.
- Let’s all install it from here: https://www.gitkraken.com/
- Once installed let’s log in via our GitHub credentials.
- You should be able to “clone” the class resources at this point
- Depending on time I might return to this later.

Let's see how far we can get...
Installing vscode

- VSCode is a code editor. If you already have something else you know how to use, feel free to stick to it
- Basic download instructions here: https://code.visualstudio.com/
- Once you have it installed, boot things up, and install the python extension. We will probably walk through this together.