Day 1: Introduction to Programming, Variables, and Basic Operations

July 10th 2023

Goals Today

- class goals / culture, introductions
- what is coding?
- what parts of life use code?
- first program!
  - data types (ints, floats, strings)
- specifics of code – computers aren't that smart!
- environment diagrams
- commenting
- logic problems (words only)

Course Overview, Classroom Policies

- goal of this course is to teach you how to think like a programmer so that you get a sense of a: what coding is and b: how you can learn more in the future
  - think of this as your first two weeks in a journey of your own direction!
- the entire syllabus is posted and I encourage you to read it! we write them with you in mind
  - take note of homework expectations, rules around plagiarism, and how to use office hours
- everyone is welcome in this classroom, and our group culture is something I take very seriously. you are expected to interact with your fellow classmates with respect and inclusion at a level befitting an undergraduate course
  - we will do everything we can to make this a positive space for everyone, but please tell us if you notice something amis

Meet your Instructors!

Haley

- BAs in Cognitive Science and Computer Science (UC Berkeley ‘19)
- Research: how does the brain format information for flexible behavior
- fun CS course: computational biology and genetics

Kei

- BAs in Psychology & Computer Science (Coe College ’20)
- Research: how do people move in a large crowd
- fun CS course: computer graphics

Annika

- BA in Linguistics, Minor in Computer Science (Harvard University ‘21)
- Research: how do babies learn logic and logical language
- fun CS course: natural language processing (NLP)

What is coding? Why do we like coding?

more of a philosophical question than you might think!

Haley: translating a goal you have for a machine into a **language** the machine can understand

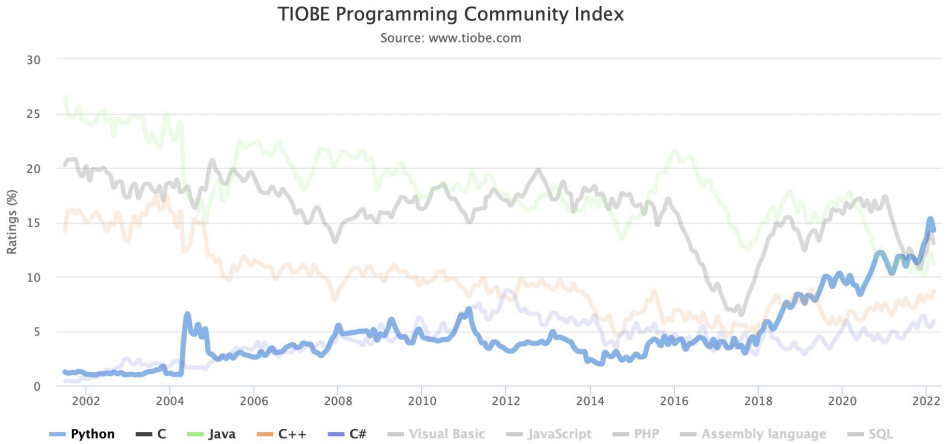
Kei: the process of writing a **program** (= a series of instructions we want a computer to execute to accomplish a task)

Annika: **creating** a set of instructions that control the behavior of a computer program and enable it to perform specific tasks

fun out of task discussion question – what makes something a computer?

Language focus of this course: python

- invented in the netherlands in the early 90s (all code is human produced!)
- named after monty python
- always open sourced: means that the code is available to the public / not private company
- increasingly popular in industry, research, and education!
- code written in human language that is then compiled into code that a computer can act on (1s and 0s)
- used by google from the beginning
- great AI and ML packages!



What parts of your life use code? Group brainstorm!

what have you done today already? what did you do yesterday?

try not to say “phone” or “laptop” (or pick a specific thing if you’re stuck!)

Our first program!

- we write code in an application like “microsoft word” (there are many choices for this) and then ask a computer to run the code for us once we are done writing – imagine writing an essay and then submitting it to a text to speech reader
- this ‘ask to run code’ step we will focus on later in the course – for now, we will use a web based application to make things easier to learn

```
print(“hello world!”)

a = 1

b = 2

print(a + b)
```

```
hello world!

3
```

a and b are called “variables” like you might have experienced in a math class

gray boxes on slides will be code!

Variable (data) types

- variables can contain different types of information
- imagine bank account: needs to know your password and your money balance, different types of information
  - but, all data gets converted behind the scenes into 1s and 0s!
- **int**: integer, numeric type. holds numbers with no decimal points
- **float**: floating point, numeric type. numbers with decimal points (even .0)
- **str**: string, text type. holds any length of characters (which can be numbers!)
- can convert between them when meaningful:
  - int('1')
  - str(93)
  - float(str(3/2))
  - int(3/2)

Example program – calculating final grade

introduction to replit – easier to see code than on a slide

```
# in this file, we will calculate what our goal grade shoudl be
# if we want an A in a class

hw_grade_avg = 87
midterm1_grade = 97
midterm2_grade = 81

# I want to get an A, which means I need an average over the below value
cuttoff_A = 90

# I want to figure out what grade I need for my final to pass the A
# everything else gets averaged together.
final_exam_grade = 0

total_grade = (hw_grade_avg + midterm1_grade + midterm2_grade +
               final_exam_grade) / 4

print(total_grade)
print(total_grade > cuttoff_A)
```

Variable Basics

- all variables in python need to start with a letter or an underscore
- variables cannot contain spaces
  - people use _ (underline) to make multi-word variables, or useCapitalLettersLikeThis
  - there are some common techniques people will use, but preferences also matter
  - you cannot use - a dash character, it must be an underscore
  - **snake case:** variable_like_this
  - **camel case:** variableLikeThis
  - **pascal case:** VariableLikeThis
- variables can contain numbers if they aren't first (**variable1**)
- you should balance being able to understand with not having to type something very long every time
- you cannot use any python keyword as a variable name (more on this later)

Specifics of Code – Computers aren’t very smart

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print(A + b)
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this code will result in an error! any guesses to why?

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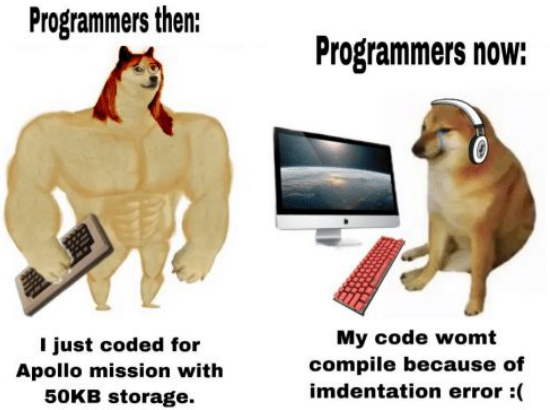

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- **variables are case sensitive!**

Environment Diagrams – tool organizing thoughts

for now, might feel redundant, but when we learn functions and higher order code this will be super helpful for visualizing your code space!

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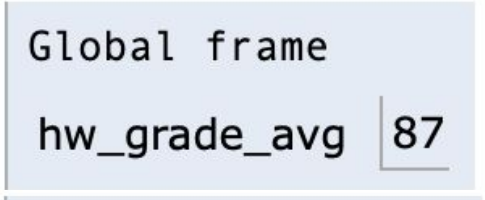
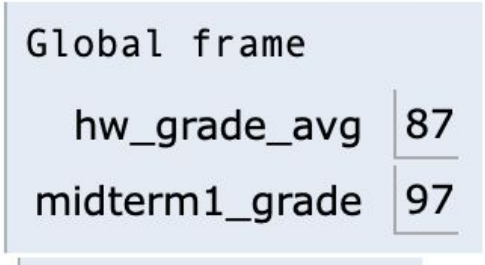
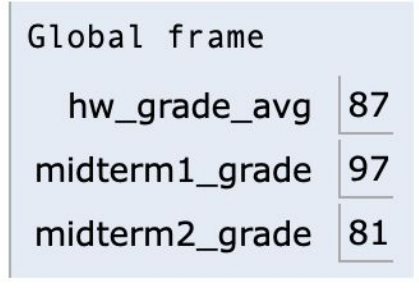
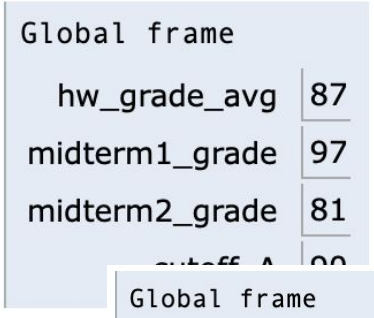
```

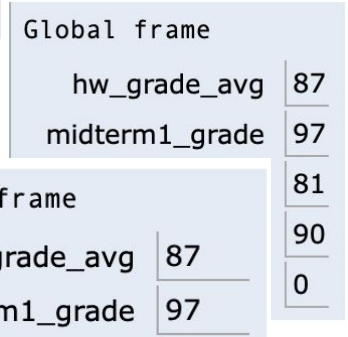
```
66.25
False
```

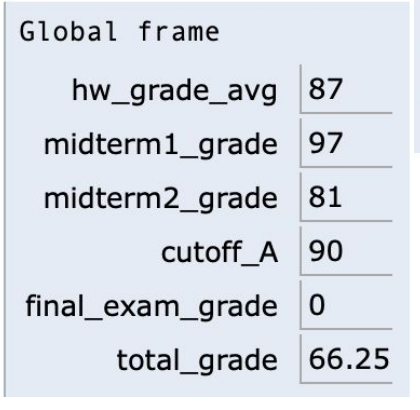












Other tool for success: office hours / your classmates!

- 1-3:30 pm each day in this room
  - office hours are a place to work in groups on assignments, get to talk to your instructors and classmates, and have support as you learn new concepts. we look forward to seeing you!
- 4-5:30 pm each day on zoom
- daily discussion points on canvas
  - use these if you have clarification questions outside of class / office hours
  - students or instructors can reply if they can help or have the same question!

Introduction to logic, logical operators

- values in code can take on **true** and **false** values, which are very important to communicating with computers in any language
  - this type of variable is called a **boolean**
- in python, numbers that are not equal to 0 evaluate to **true**
  - **but 1 and 0 are special numbers which can take the place of true/false**
- to use the values directly, you must type **True** and **False**
  - these are the first examples of special words we will encounter that you should not choose for variable names!
- as we have seen, a single = sign assigns values. double == signs ask “are these things equal?” and will yield a boolean answer!

Introduction to logic, logical operators

- predict: what will the following yield?

```
a = 1

a == 1
```

```
b = 1

a == b
```

```
a == ‘1’
```

```
a == int(‘1’)
```

Introduction to logic, logical operators

```
var = _________

7 + var == var * 2
```

```
num1 = _________

num2 = _________

num1 + 3 == num2
```

working in pairs, for each code block pick one variable assignment which makes the last statement **true** and one which makes it **false**

Logical Operators – Combinations with and/or

or (can also use this symbol |) : true if at least one side is true, else false

and (can also use this symbol &) : true if both sides are true, else false

not: opposite of what follows

can replace these with any true/false statements!

(10 - 5 == 6) | not (3 == 3)

not

x	not x
False	True
True	False

and

x	y	x and y
False	False	False
False	True	False
True	False	False
True	True	True

or

x	y	x or y
False	False	False
False	True	True
True	False	True
True	True	True

Logical Operators and Relations

Relations

- == Equal
- > more than,
- < less than
- <= less or equal
- >= more or equal
- != different (not equal)

Now we can combine logical operands and relations

- not ((3>5) & (2>4))
- (5>3) | (3==(1+2))

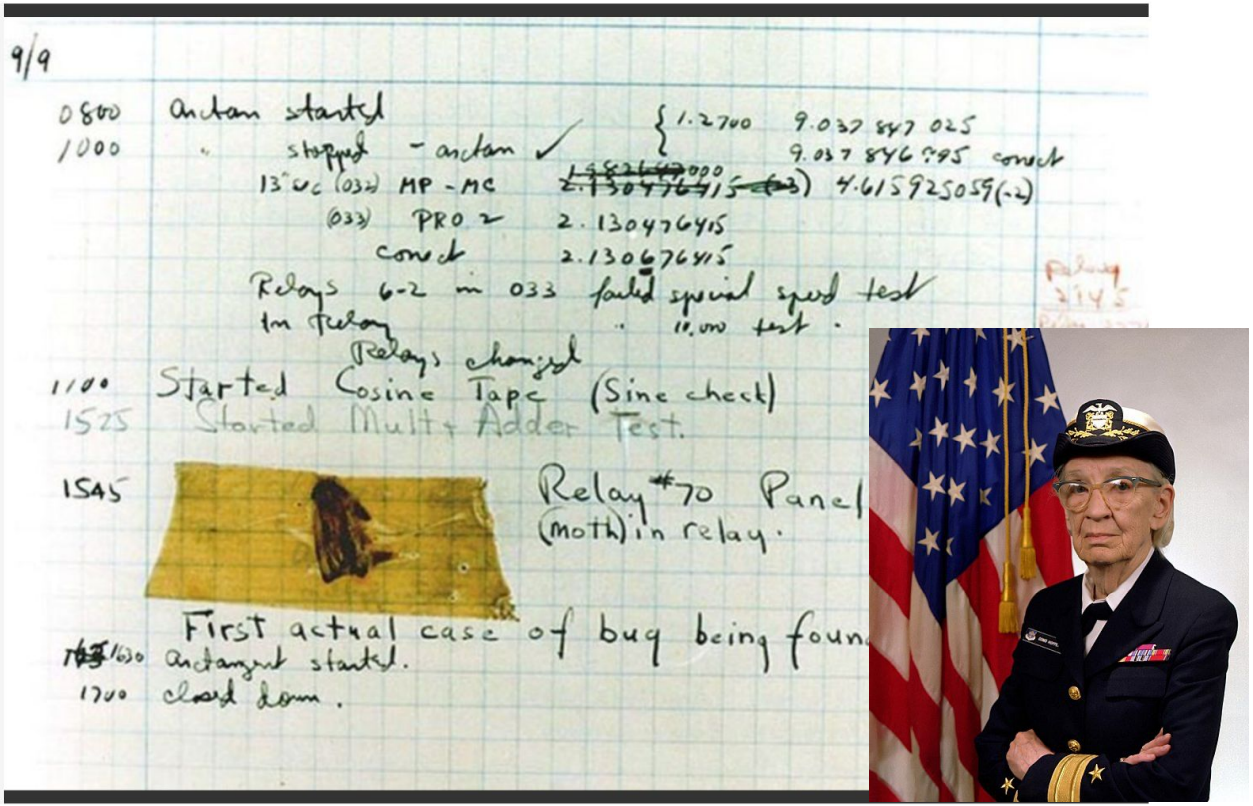
Debugging your code – print statements!

PHOTOGRAPH

Computer Bug

"First actual case of bug being found," according to the brainiacs at Harvard, 1945. The engineers who found the moth were the first to literally "debug" a machine.

> PHOTOGRAPH COURTESY NAVAL SURFACE WARFARE CENTER, DAHLGREN, VIRGINIA



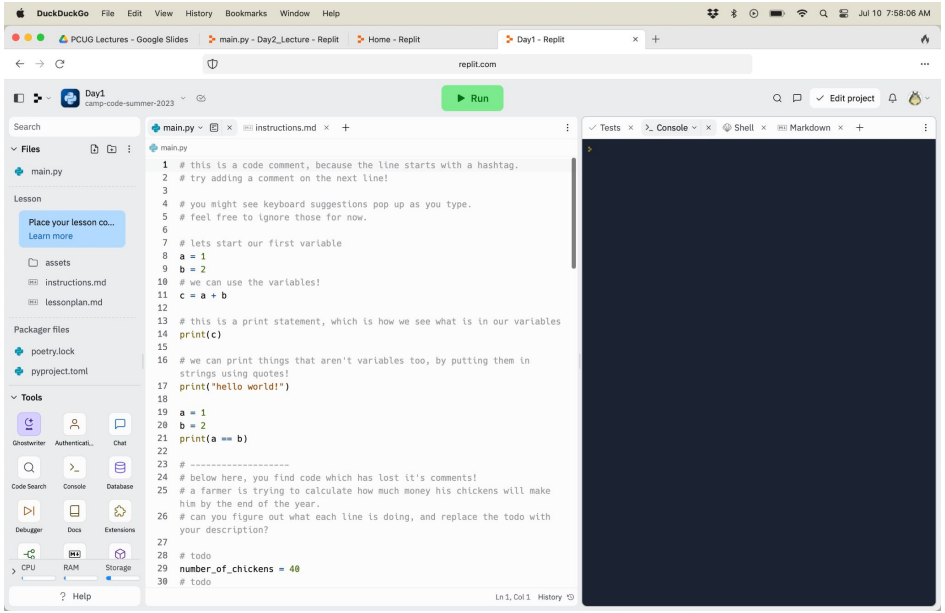
Commenting code – helps to not memorize!

can put comments on their own lines or at the *end* of code lines

```
# check if you are running this code at the scanner
if at_scanner==0:
    # ~~~~~~~~~~~~ PRACTICE: do prac trials and instructions ~~~~~~~~~~~~
    show_instructions(win) # give instructions, calls external function
    win.flip(); htime = core.Clock(); # start a break time before immediately running trials
    while htime.getTime() < timedct['break']: pass
    # start right hand practice
    for ix,row in demo_right.iterrows(): run_trial_prac(win,fixs,row,feedback=True,practice=True,hand='right')
    visual.TextStim(win,text=swtchds,height=.035,pos=[0,.3],wrapWidth=1.2,units='height').draw()
    # now run left hand practice -- they have to press g to start
    win.flip(); wait_for_key('g'); win.flip(); htime = core.Clock();
    while htime.getTime() < timedct['break']: pass
    for ix,row in demo_left.iterrows(): run_trial_prac(win,fixs,row,feedback=True,practice=True,hand='left')
    # have them practice two blocks of real trials
    for BLOCK_NUMBER in range(2):
        HAND = hand_order_prac[BLOCK_NUMBER] # read in what hand they will play main game with
        # show message of how to play game
        visual.TextStim(win,text=(rdymsg if BLOCK_NUMBER==0 else rdymsg2)+hndmsg[HAND],height=.035,pos=[0,.3],wrapWidth=1.2,units='height').draw()
        win.flip(); wait_for_key('g'); win.flip(); htime = core.Clock();
        while htime.getTime() < timedct['break']: pass
        # run a block of practice
        keep_going = run_block_prac(subid,prac_trials.loc[prac_trials.bln==BLOCK_NUMBER],win,fixs,BLOCK_NUMBER,HAND)
        if not keep_going: clean_kill(win) # check nothing went wrong
    # show end practice message
    visual.TextStim(win,text=dneprc,height=.035,pos=[0,.3],wrapWidth=1.2,units='height').draw()
    win.flip(); wait_for_key('g'); clean_kill(win)
```

Homework Goals

- logic problems (words only)
- environment diagram practice
- **sign up for replit: commenting code problem**
  - **bit.ly/replit_brown**
  - **use your brown email to sign up! come to office hours with issues**
  - **on the canvas site, your first assignment will be submitting your username**
- review of course websites: canvas, replit, course homepage



Homework Problem 1: Environment Diagrams with Booleans

In each square, write an env diagram as each line runs. Put print statements in order.

line 0	a = 1
line 1	b = 2
line 2	c = a * 2
line 3	print(c == b)
line 4	b = b * 2
line 5	print(c == b)
line 6	b = “two”
line 7	print(c == b)
line 8	c == a * 2
line 9	c = c ==b
line 10	c == (a == b)
line 11	c = 10

0

4

8

1

5

9

2

6

10

3

7

11

print output:

Homework Problem 2: Logic Practice

Haley: I want anything with chocolate

Annika: I want sorbet OR gelato flavors, but not together

Kei: I want vanilla and one other scoop, but not vanilla alone

What two scoop combination would satisfy all three?

Sorbet: Strawberry, peach, banana, chocolate chip

Gelato: Vanilla, chocolate, oreo, mango

Organize your thoughts: show at least three combinations you try!

Flavor 1	**Flavor 2**	**Haley?**	**Kei?**	**Annika?**
Example: Mango	Example: Mango	Example: FALSE	Example: TRUE	Example: FALSE

Homework Problem 3: Boolean Practice

Boolean 1: True if either variable is larger than 5

Boolean 2: True if either variable is divisible by 5

Boolean 3: True if ONLY one variable is divisible by 5

Boolean 4: True if one variable is divisible by 2, or their sum is divisible by 2, but not both

Goal: Complete the rest of the table using 1 and 0 to indicate if the boolean is true or false.

Variable 1	Variable 2	Bool 1	Bool 2	Bool 3	Bool 4
Example: 5	Example: 1	0 (False)	1 (True)	1	1
1	1				
1	10				
10	10				
3	7				

Homework Problem 4: Logic Challenge 1

You have three jars, one which has oranges, one which has apples, and one which has a mix of both in them. However, their labels have been swapped! You know that no jar can have its correct label. To relabel them, you can reach in and pull out one fruit at a time. What is the worst case for number of jars you need to pick from before you can label all three? What is the best you could do?

Try to use an organizer like this to work through examples! You can try all possible combinations.

	real Apple	real Orange	real Mix
label Apple	no	?	?
label Orange	?	no	?
label Mix	?	?	no

Homework Problem 5: Logic Challenge 2

You visit an island where everyone is a **knight** or a **knave:** knights can only say **true** things, and knaves can only say **false** things. You approach your instructors and they each say one thing:

- Haley: At least one thing is true: Kei is a knave or I am a knight.
- Annika: Haley could claim that I am a knave.
- Kei: Neither Haley nor Annika are knights.

Can you figure out which instructor is a knight and which is a knave? Test by guessing and following the logic! “If [this instructor] is a knight, how does it affect things?”

Questions?

6. Everything in the universe is either a potato or not a potato.