

THE CSBridge  
SAGA CONTINUES



# Control Flow Revisited

Chris Piech  
CS Bridge 2020

Starring  
MARK HAMILL · HARRISON FORD · CARRIE FISHER  
BILLY DEE WILLIAMS · ANTHONY DANIELS

Co-starring DAVID PROWSE · KENNY BAKER · PETER MAYHEW · FRANCIS D'ONOZIO

Directed by IRVIN KERSHNER Produced by GARY KURTZ  
LEIGH BRACKETT · LAWRENCE KASDAN GEORGE LUCAS

Executive Producer JOHN WILLIAMS  
Filmed in Panavision® · Colour by Rank Film Laboratories

A Lucasfilm Ltd Production · A Twentieth Century Fox Release

Recorded in DOLBY STEREO®

SOUNDTRACK ON RSO RECORDS & TAPES Read the Sphere paperback

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# Chris Piech

## Teaching at Stanford

CS106A

Programming  
Methodologies

CURRENT

CS106B

Programming  
Abstractions

LAST: FALL 2016

CS109

Probability for Computer  
Scientists

LAST: FALL 2018

CS221

Intro to Artificial  
Intelligence

LAST: SUM 2013



I am a professor in the **AI Lab** at  
Stanford. My focus is on  
education and healthcare!



@chrispiech

Piech and Sahami, CS106A, Stanford University



# Chris Piech



Piech and Sahami, CS106A, Stanford University





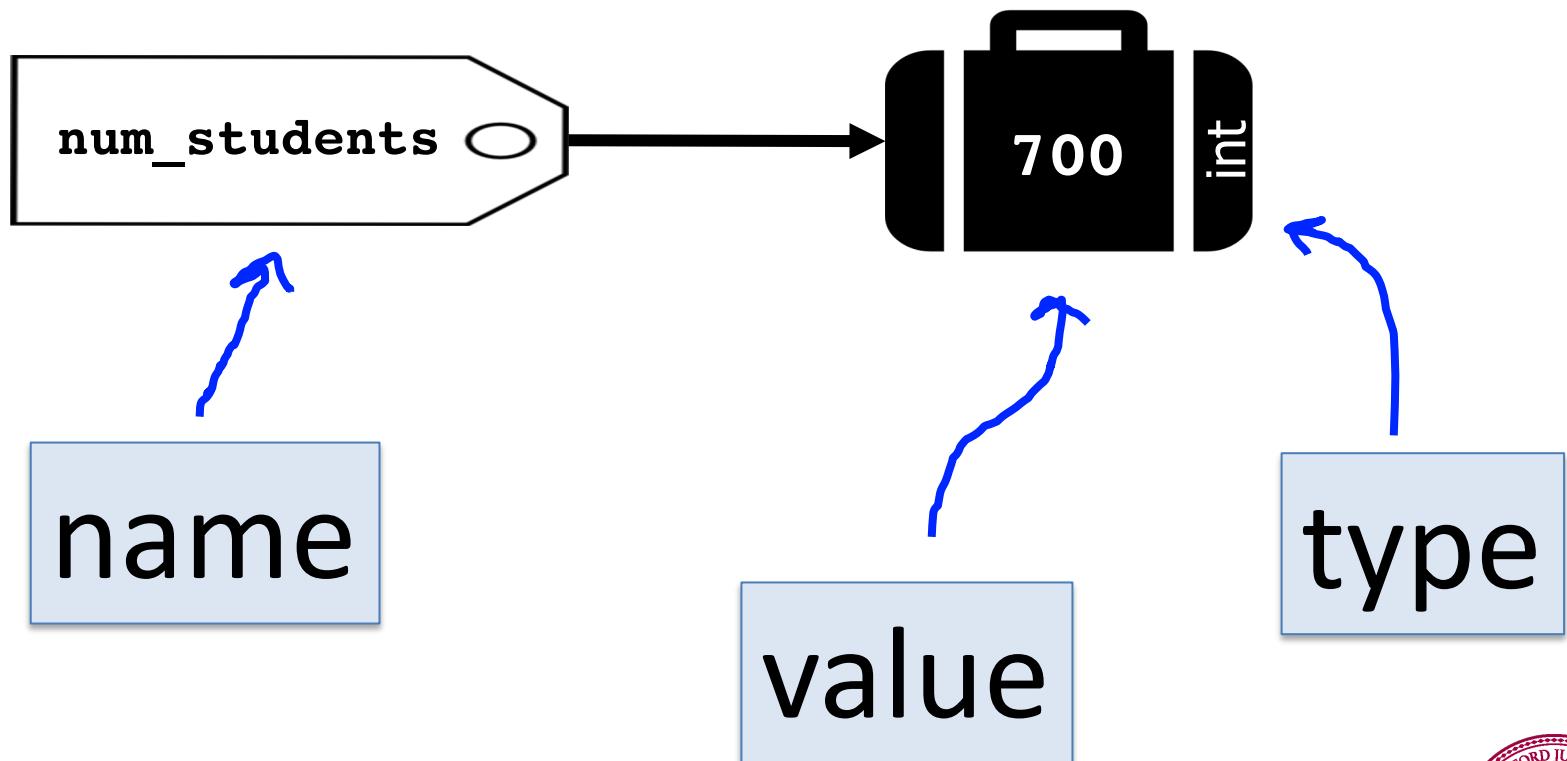
Let's play a game

Truly important concepts

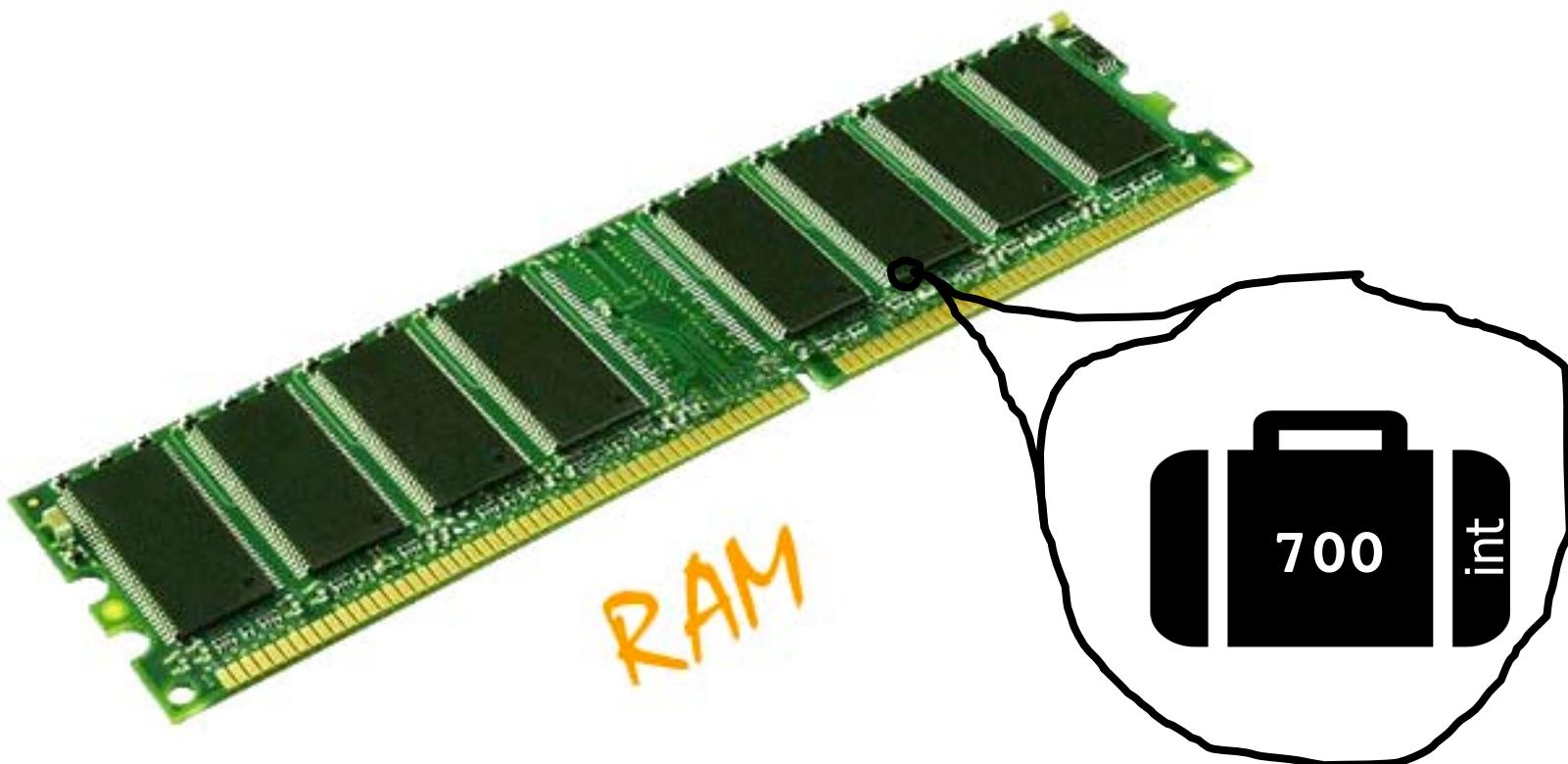
# Review

# Variable Analogy

```
num_students = 700
```



# Teeny Tiny Suitcases



My computer has space for about 2 billion boxes

# Create, Modify, Use

```
# Create a variable, of type int  
# called age with the value 30.  
age = 31
```

```
# Modify age to be one greater.  
age = age + 1
```

```
# Use the value in age (output it)  
print("age is: " + age)
```



# Create, Modify, Use

```
# Create a variable, of type int  
# called age with the value 30.
```

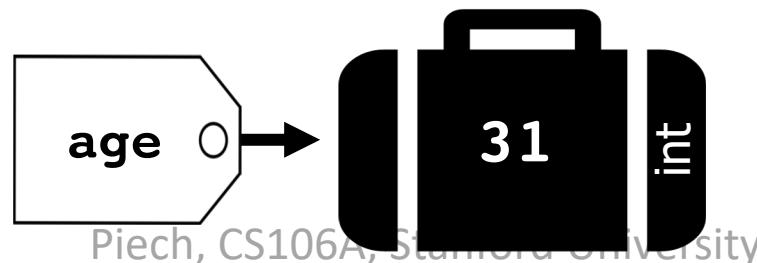
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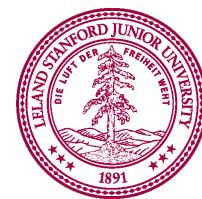
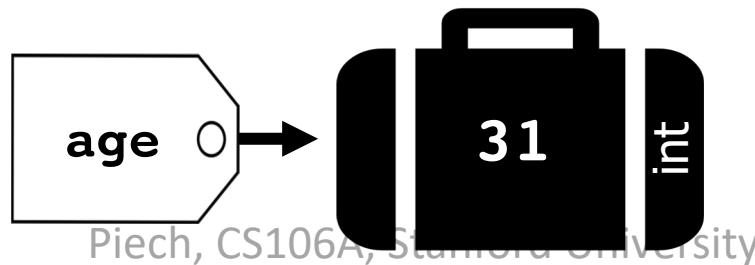
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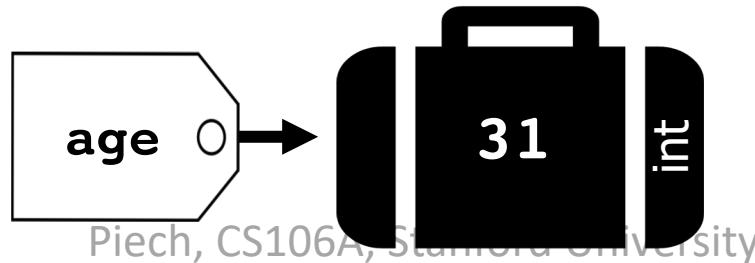


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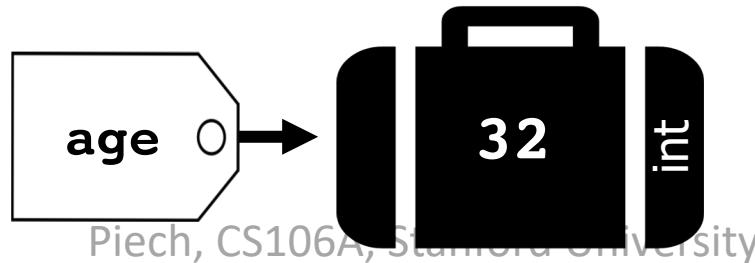


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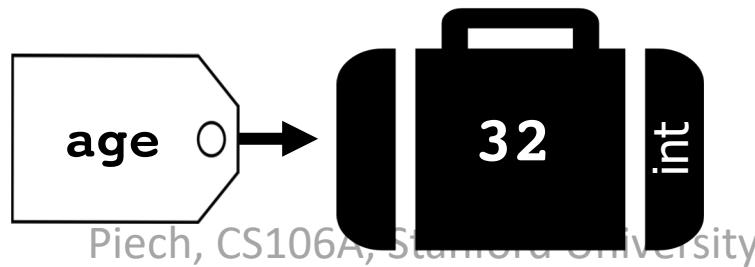


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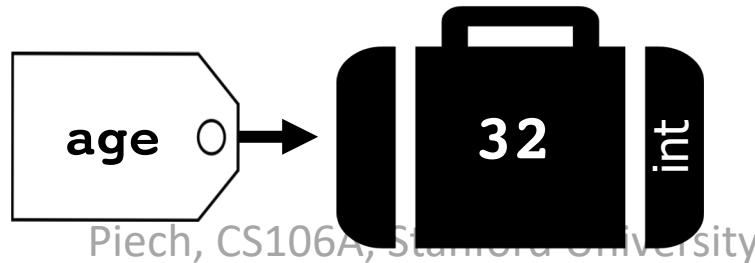


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# Binary Operators

+	Addition	*	Multiplication
-	Subtraction	/	Division

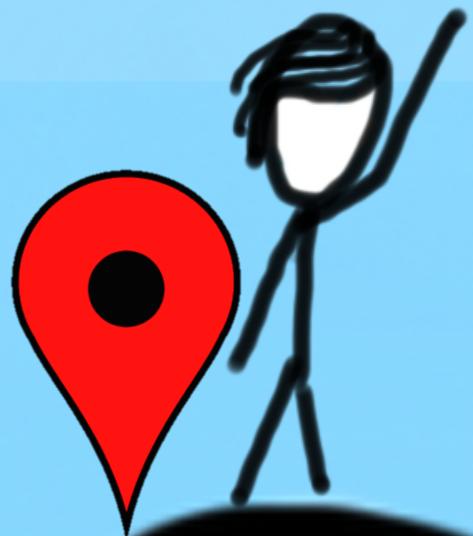
There are others too!

%	Remainder	//	Int Division
**	Exponentiation		

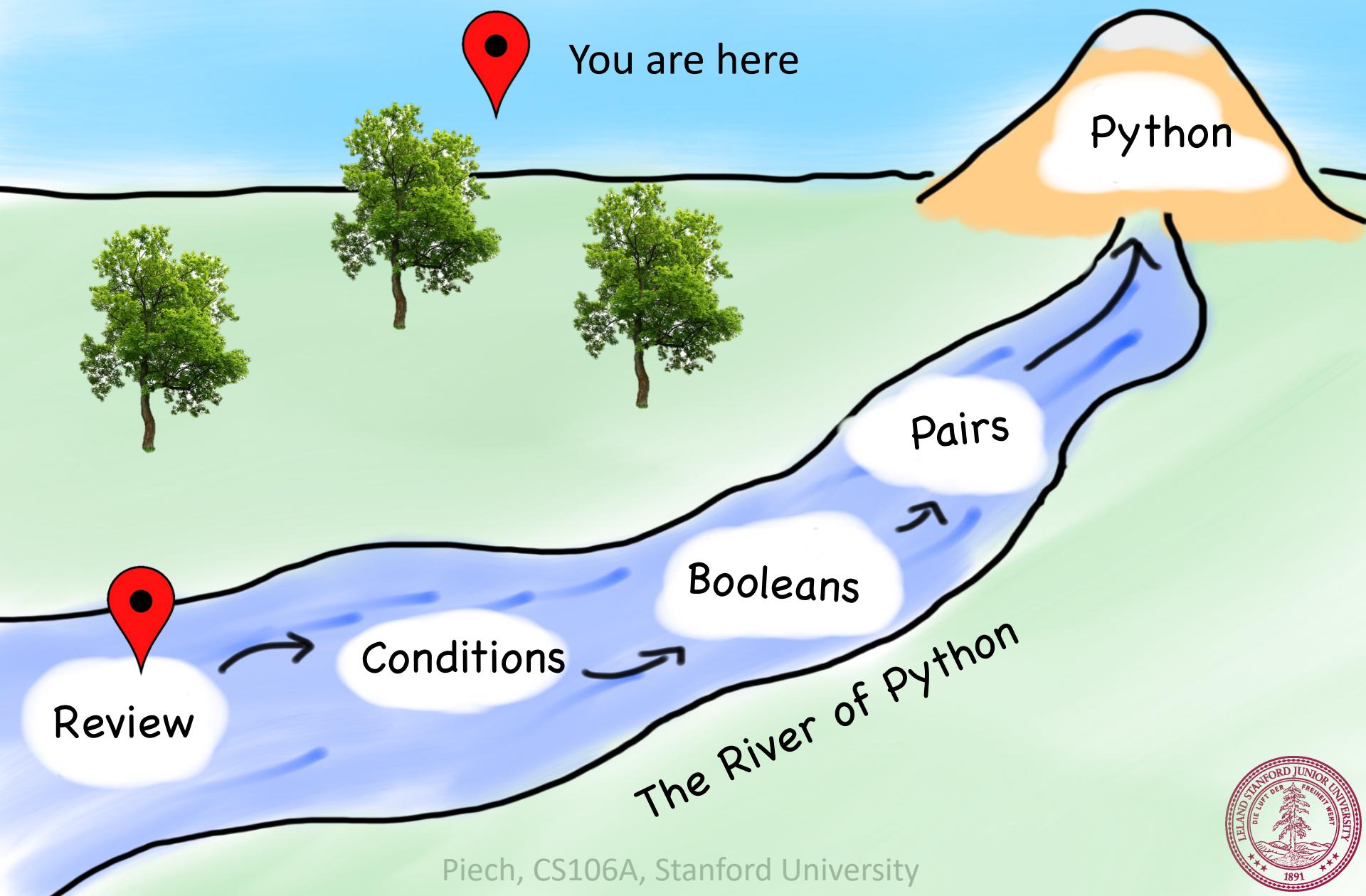


# Today's Goal

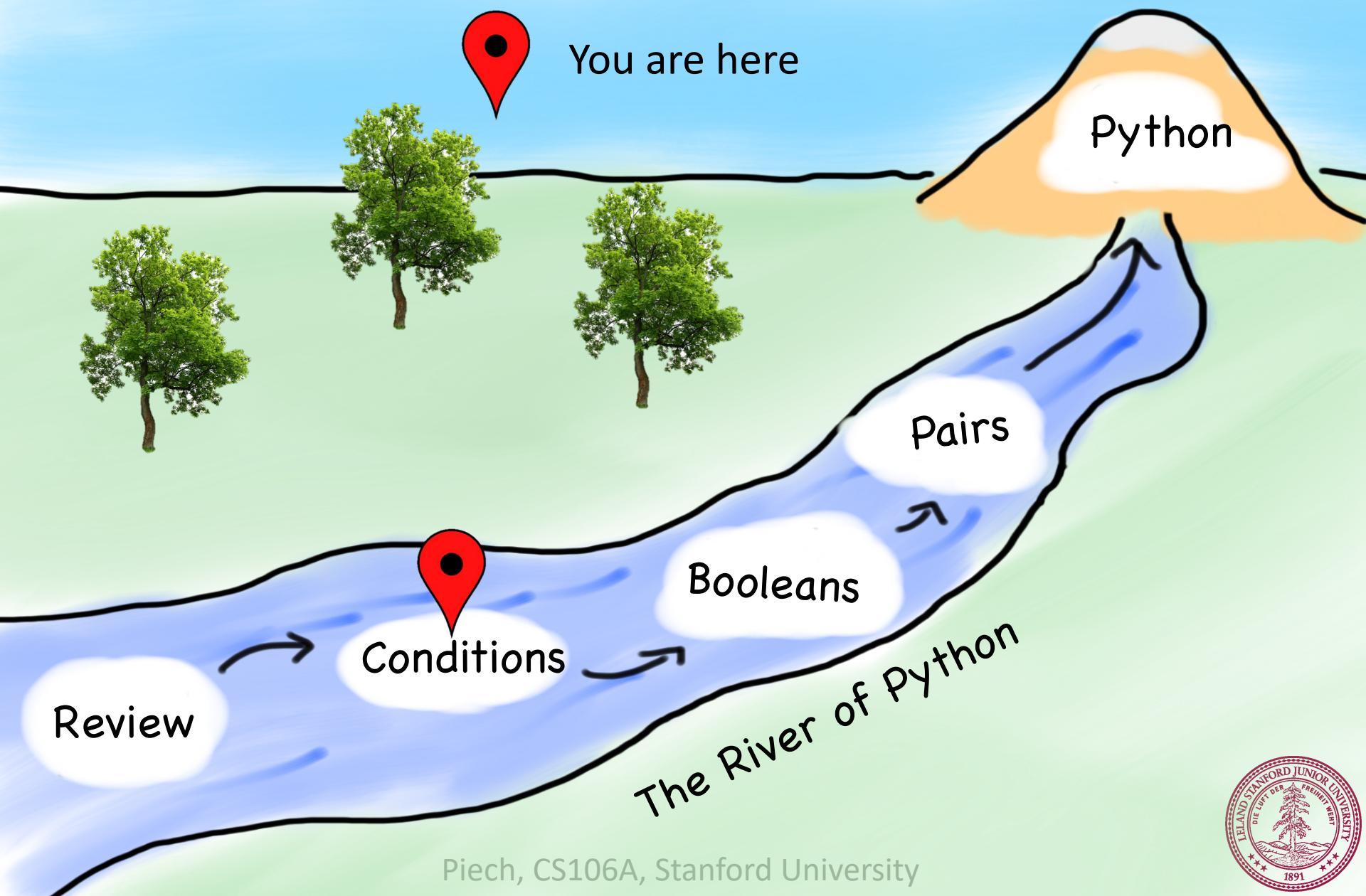
1. Be able to use While and If in Python
2. Combine loops and variables



# Today's Route



# Today's Route



# While Loop in Karel

```
while front_is_clear() :  
    body
```

```
if beepers_present() :  
    body
```



# While Loop Redux

**while** *condition* :  
*body*

**if** *condition* :  
*body*

The condition should be a “boolean” which  
is either **True** or **False**



# Loops in Python



Use **while** and **if** statements  
in Python.

They are the same as in Karel,  
except that the ***test*** can be any  
expression that evaluates to  
**True** or **False**



# Conditions?

Anything that resolves to a “**True**” or  
“**False**” answer is a condition

$$1 < 2$$



# Conditions

Anything that resolves to a “True” or  
“False” answer is a condition

This is a comparison  
operator

$$1 < 2$$

True



# Conditions

Anything that resolves to a “True” or  
“False” answer is a condition

This is a comparison  
operator



```
my_var < 2
```

True



# First Example

```
while 1 < 2 :  
    print("programming is awesome!")  
    print("woot")
```



# First Example

```
while 1 < 2 :  
    print("programming is awesome!")  
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# First Example

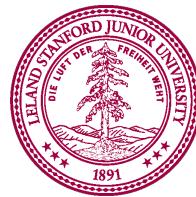
```
while 1 < 2 :  
    print("programming is awesome!")  
    print("woot")
```



# Comparison Operators

Operator	Meaning	Example	Value
<code>==</code>	equals	<code>1 + 1 == 2</code>	True
<code>!=</code>	does not equal	<code>3.2 != 2.5</code>	True
<code>&lt;</code>	less than	<code>10 &lt; 5</code>	False
<code>&gt;</code>	greater than	<code>10 &gt; 5</code>	True
<code>&lt;=</code>	less than or equal to	<code>126 &lt;= 100</code>	False
<code>&gt;=</code>	greater than or equal to	<code>5.0 &gt;= 5.0</code>	True

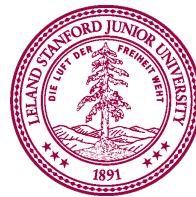
\* All have equal precedence



# Comparison Operators

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<code>&lt;=</code>	less than or equal to	<code>126 &lt;= 100</code>	False
<code>&gt;=</code>	greater than or equal to	<code>5.0 &gt;= 5.0</code>	True

\* All have equal precedence



# = vs ==

In python:



==

Is a comparison  
operator

=

Is used for variable  
assignment



# Comparison Operators

```
if 1 < 2 :  
    print("1 is less than 2")
```

---

```
num = int(input("Enter a number: "))  
if num == 0: This is a condition  
    print("That number is 0")  
else :  
    print("That number is not 0.")
```



# If Else Revisited

```
num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0")

else:
    if num > 0:
        print("Your number is positive")

    else:
        print("Your number is negative")
```



# If Else Revisited

```
num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0 ")

elif num > 0:
    print("Your number is positive")

else:
    print("Your number is negative")
```



# If Else Revisited

```
num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0")
elif num > 0:
    print("Your number is positive")
else:
    print("Your number is negative")
```



# If Else Revisited

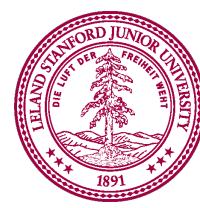
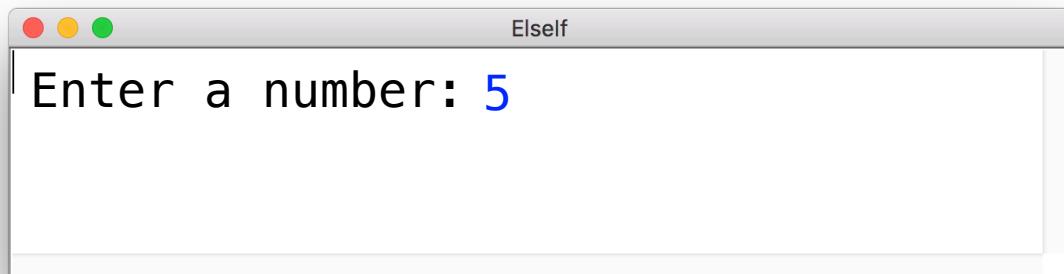
```
num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0")

elif num > 0:
    print("Your number is positive")

else:
    print("Your number is negative")
```

“5”



# If Else Revisited

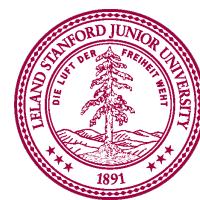
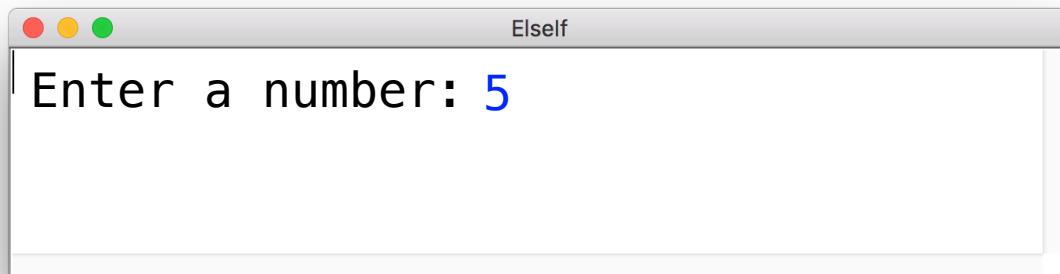
5

```
num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0")

elif num > 0:
    print("Your number is positive")

else:
    print("Your number is negative")
```

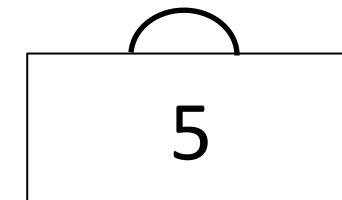
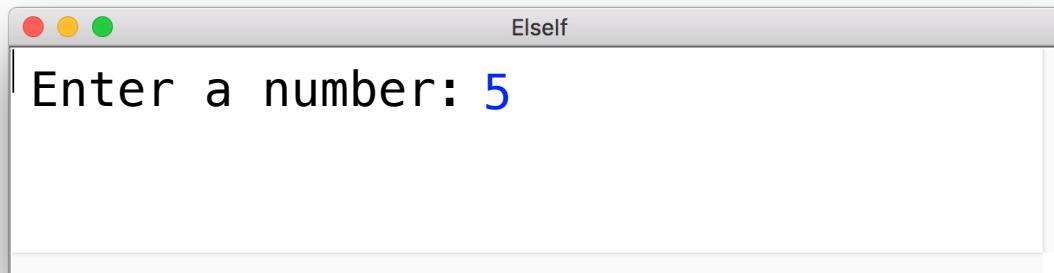


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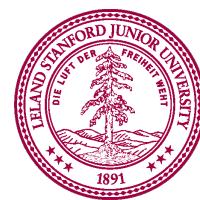
5

```
num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0 ")
elif num > 0:
    print("Your number is positive")
else:
    print("Your number is negative")
```



num



# If Else Revisited

```
num = int(input("Enter a number: "))

if num == 0:

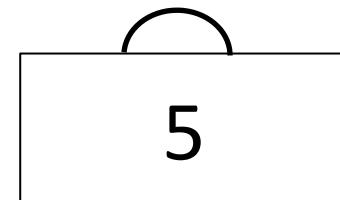
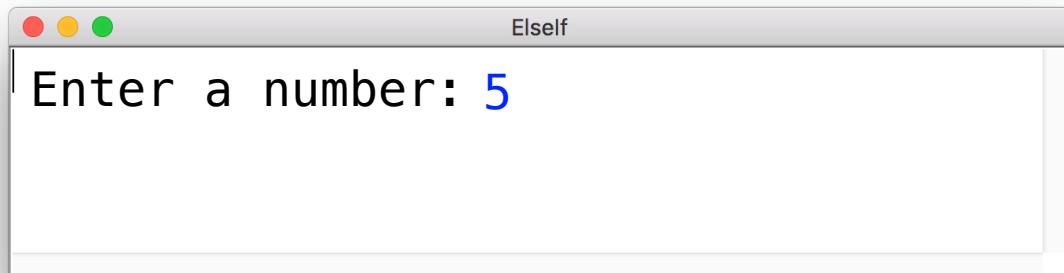
    print("Your number is 0 ")

elif num > 0:

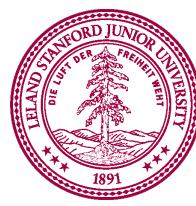
    print("Your number is positive")

else:

    print("Your number is negative")
```



num



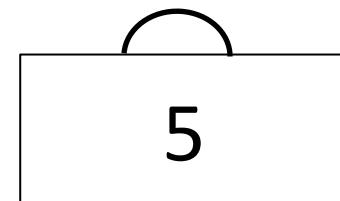
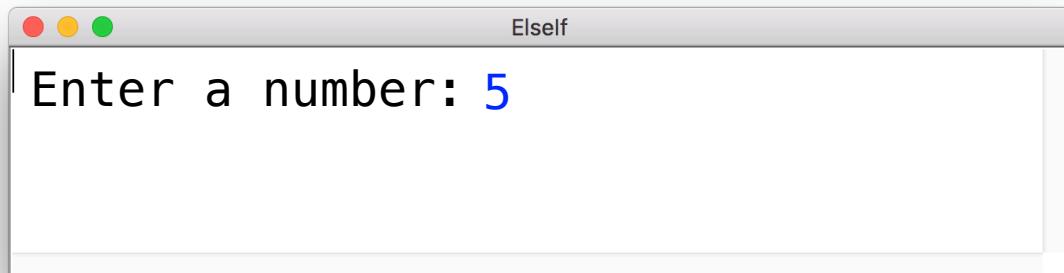
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```
num = int(input("Enter a number: "))

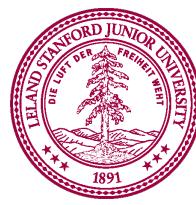
if num == 0:
    print("Your number is 0 ")

elif num > 0:
    print("Your number is positive")

else:
    print("Your number is negative")
```



num

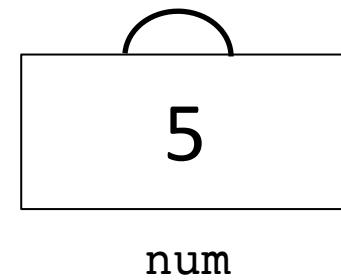
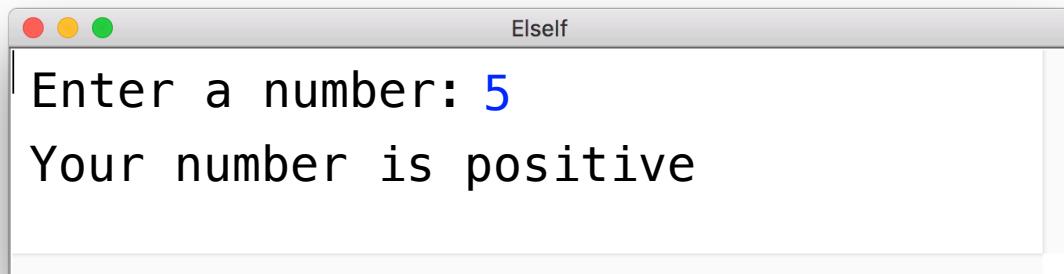


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```
num = int(input("Enter a number: "))

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elif num > 0:
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else:
    print("Your number is negative")
```



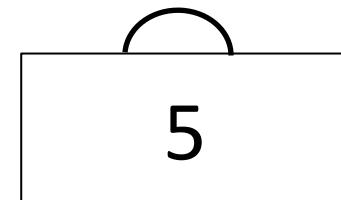
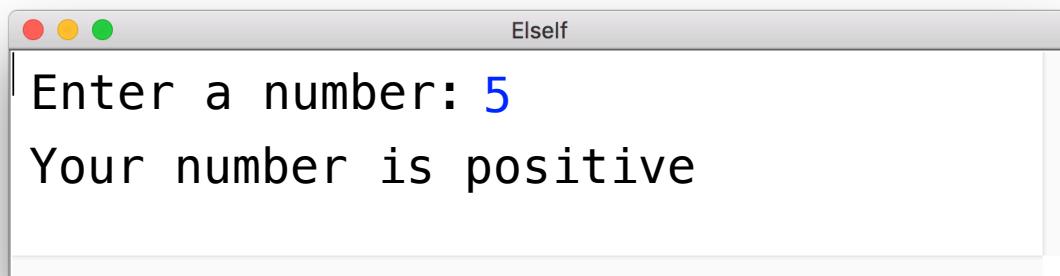
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else:
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```



num



Lets do it again!

# If Else Revisited

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num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0")
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    print("Your number is positive")
else:
    print("Your number is negative")
```



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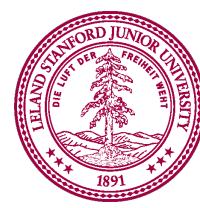
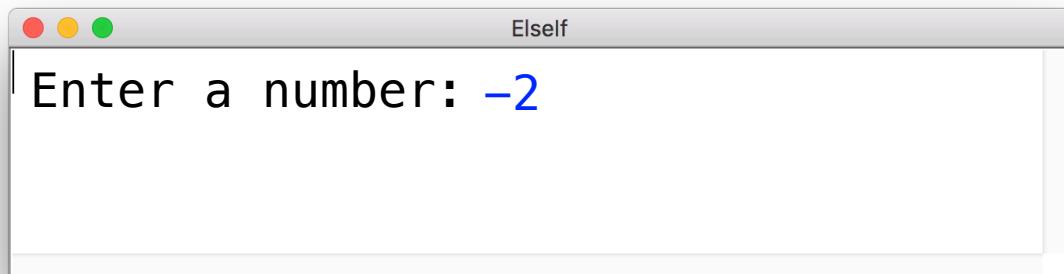
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if num == 0:
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else:
    print("Your number is negative")
```

“-2”



# If Else Revisited

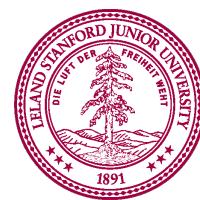
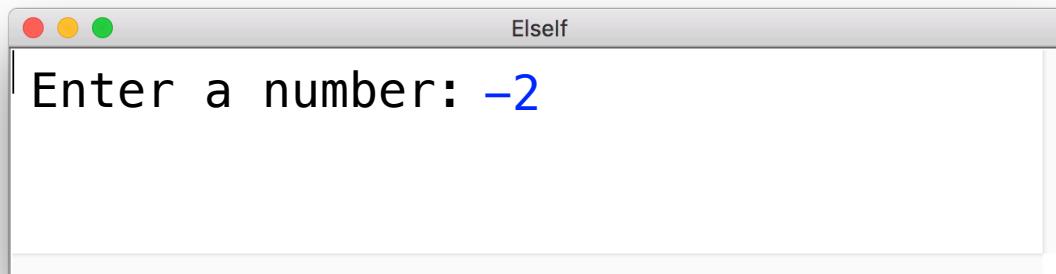
-2

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elif num > 0:
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else:
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```

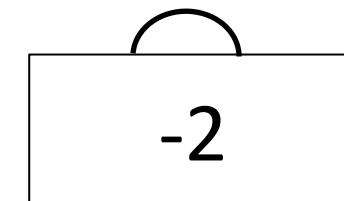
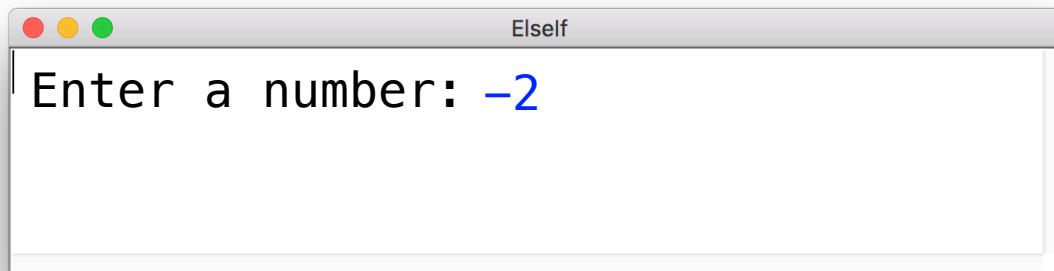


# If Else Revisited

-2

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if num == 0:
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elif num > 0:
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else:
    print("Your number is negative")
```



num



# If Else Revisited

```
num = int(input("Enter a number: "))

if num == 0:

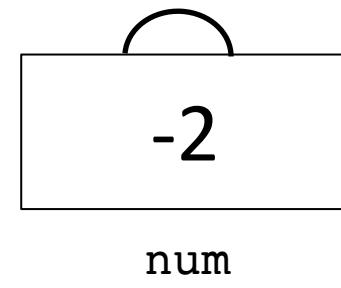
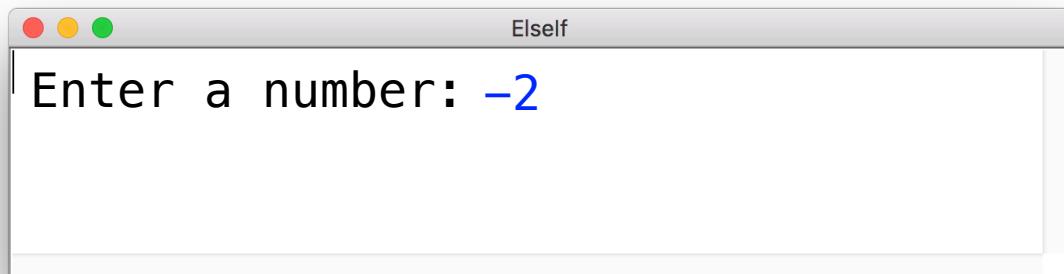
    print("Your number is 0 ")

elif num > 0:

    print("Your number is positive")

else:

    print("Your number is negative")
```



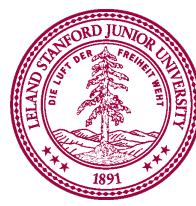
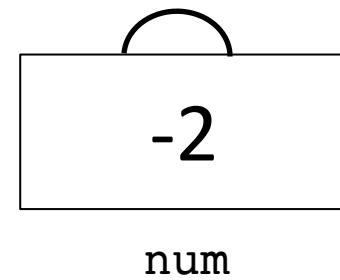
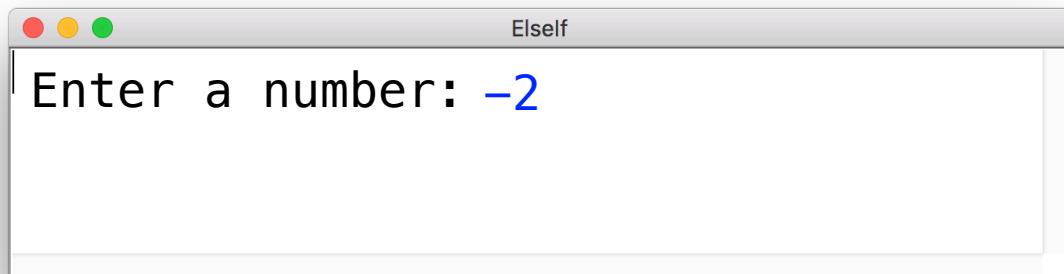
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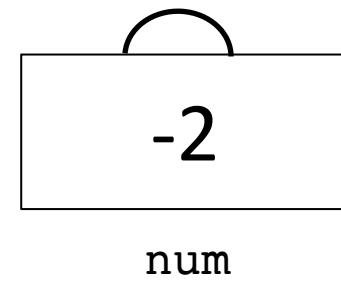
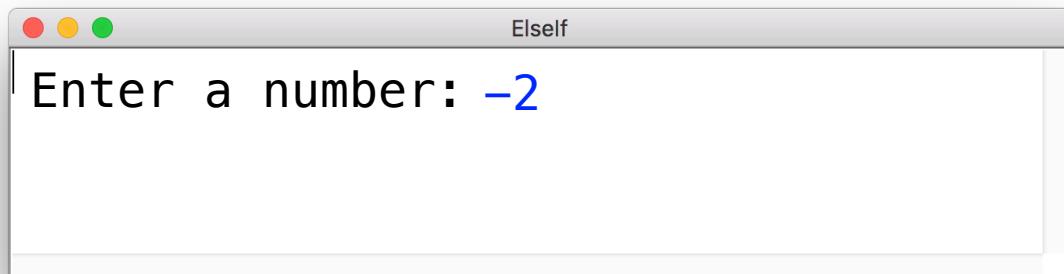
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else:
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# If Else Revisited

```
num = int(input("Enter a number: "))

if num == 0:
    print("Your number is 0")

elif num > 0:
    print("Your number is positive")

else:
    print("Your number is negative")
```

Elself

```
Enter a number: -2
Your number is negative
```

-2  
num



Amazing

# Guess My Number

```
GuessMyNumber
I am thinking of a number between 0 and 99...
Enter a guess: 50
Your guess is too high

Enter a new number: 25
Your guess is too low

Enter a new number: 40
Your guess is too low

Enter a new number: 45
Your guess is too low

Enter a new number: 48
Congrats! The number was: 48
```



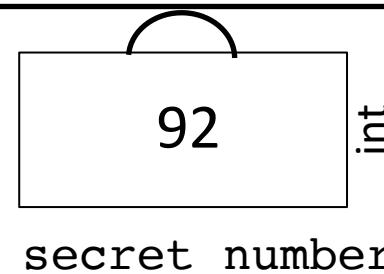
Brace yourself!

# Guess My Number

```
secret_number = random.randint(1, 99)
print("I am thinking of a number between 1 and 99...")
guess = int(input("Enter a guess: "))
# True if guess is not equal to secret number
while guess != secret_number:
    # True if guess is less than secret number
    if guess < secret_number:
        print("Your guess is too low")
    else:
        print("Your guess is too high")

print("") # an empty line
guess = int(input("Enter a new guess: "))

print("Congrats! The number was: " + str(secret_number))
```

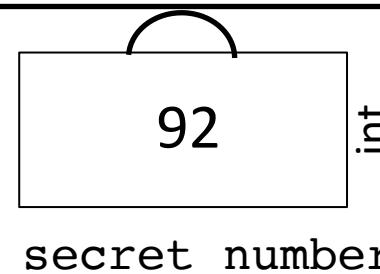


# Guess My Number

```
secret_number = random.randint(1, 99)
print("I am thinking of a number between 1 and 99...")
guess = int(input("Enter a guess: "))
# True if guess is not equal to secret number
while guess != secret_number:
    # True if guess is less than secret number
    if guess < secret_number:
        print("Your guess is too low")
    else:
        print("Your guess is too high")

    print("") # an empty line
    guess = int(input("Enter a new guess: "))

print("Congrats! The number was: " + str(secret_number))
```

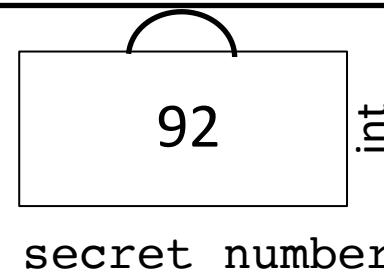
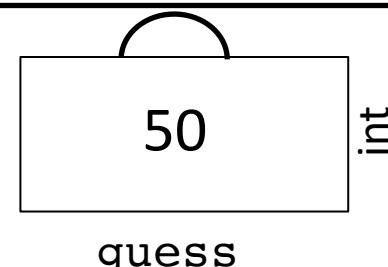


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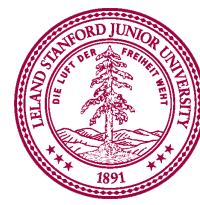
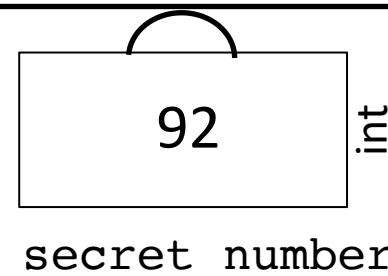
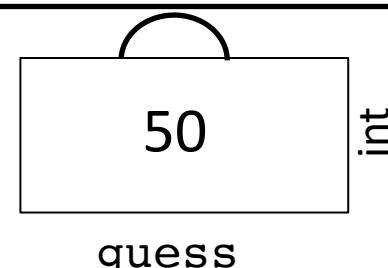


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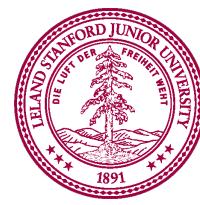
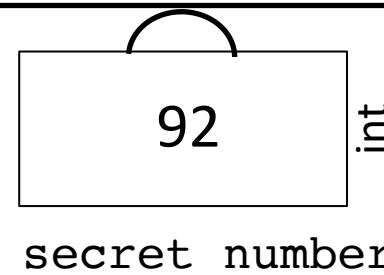
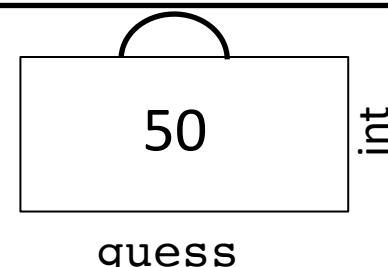


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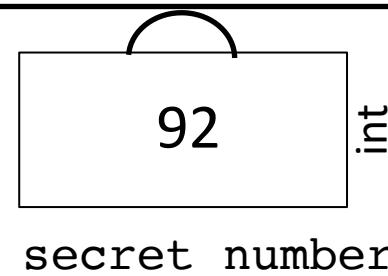
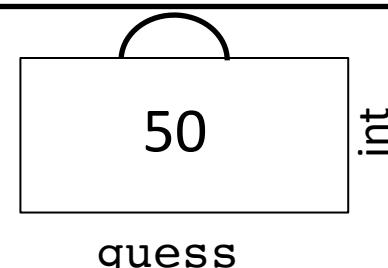


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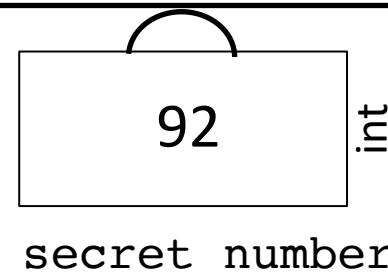
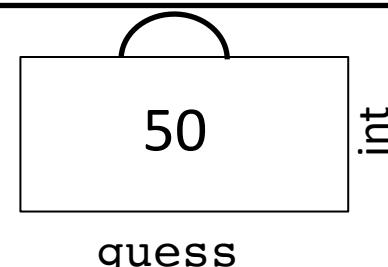


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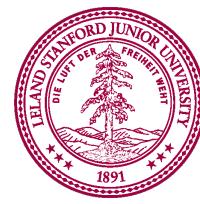
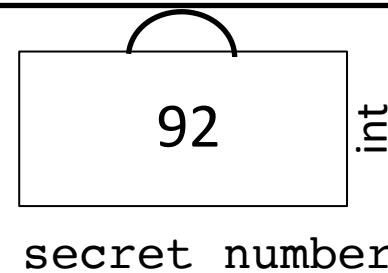
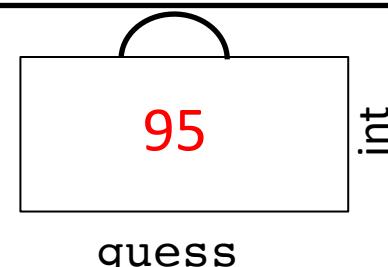


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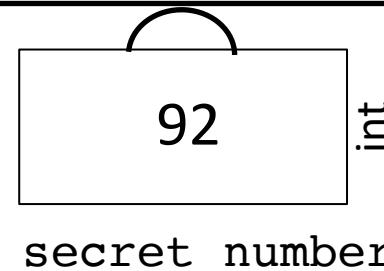
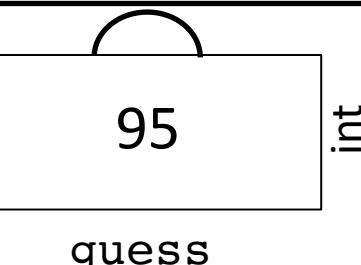


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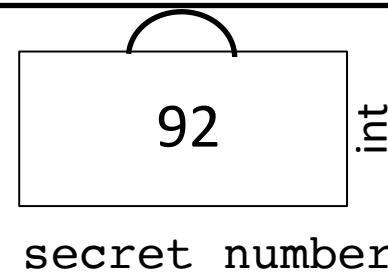
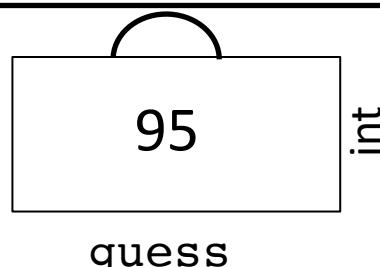


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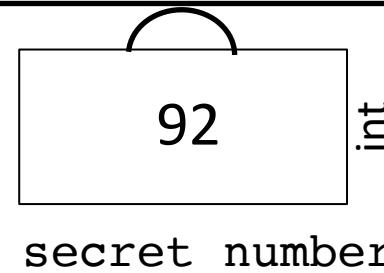
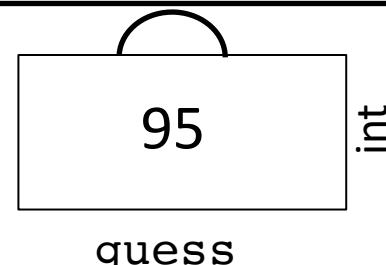


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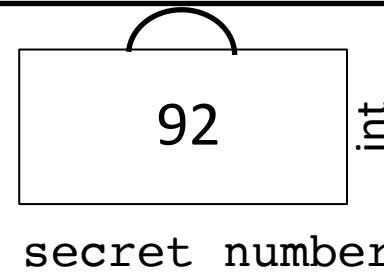
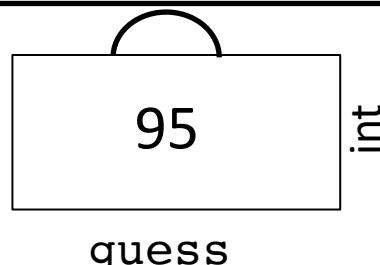


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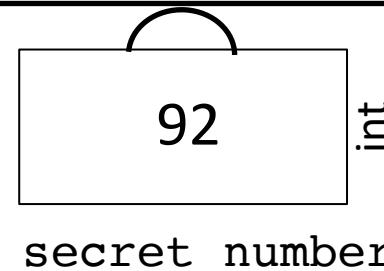
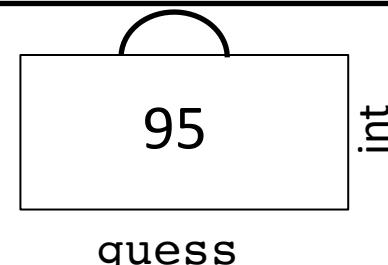


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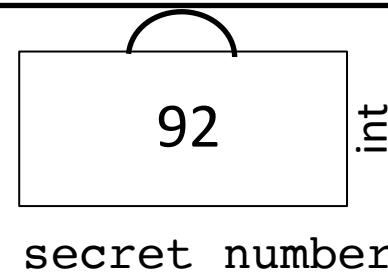
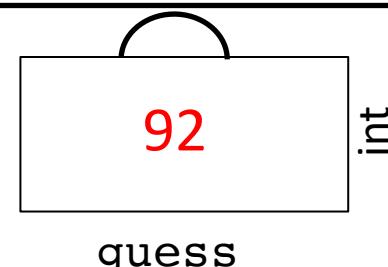


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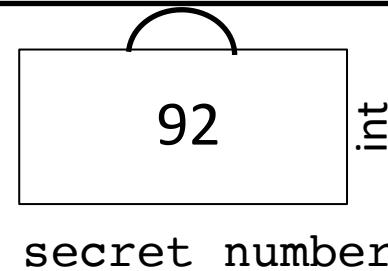
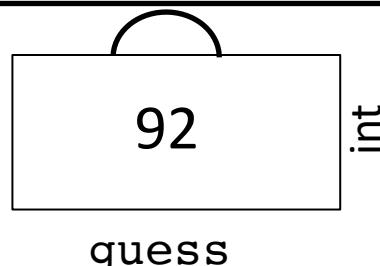


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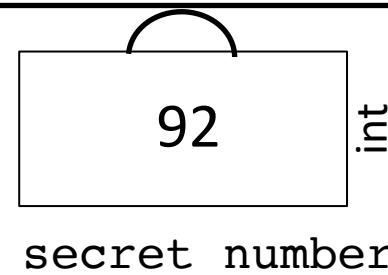
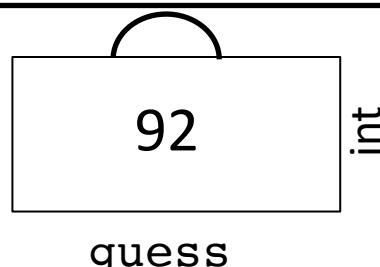


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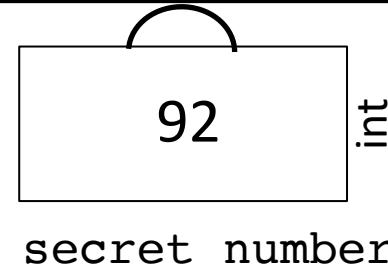
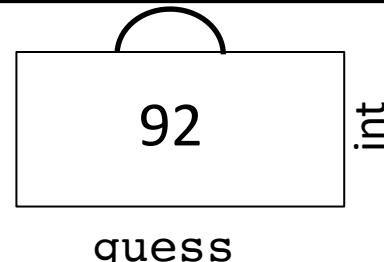


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print("Congrats! The number was: " + str(secret_number))
```



# Conditions in Python



Think about what variables you want to declare before the loop starts!

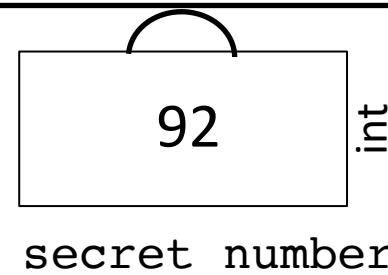
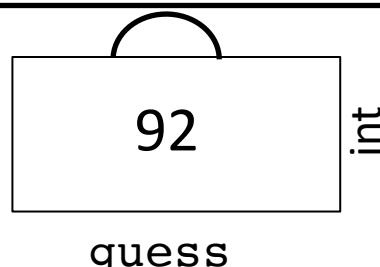


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```

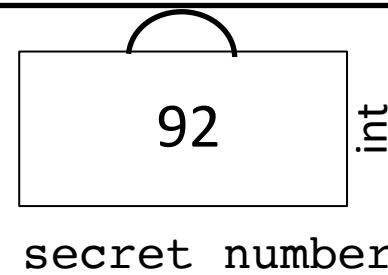
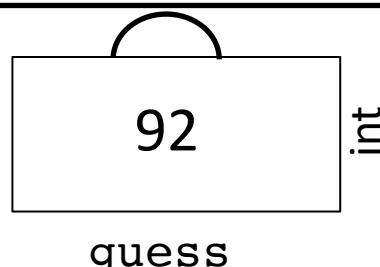


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    guess = int(input("Enter a new guess: "))

print("Congrats! The number was: " + str(secret_number))
```



# Random Integers

```
secret_number = random.randint(1, 99)
```

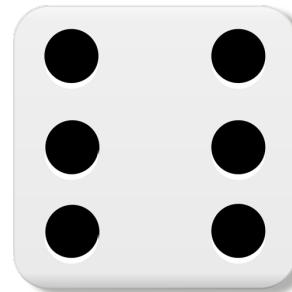
## Minimum value

# Maximum value



# Challenge: Three Sixes in a row

- Write a program that simulates one **dice roll** at a time. Count how many dice rolls until you get **three sixes in a row!**



You rolled a 6

You rolled a 6

You rolled a 3

You rolled a 2

You rolled a 1

You rolled a 4

You rolled a 6

You rolled a 6

You rolled a 6

Number of times rolled = 152





# Example: Sentinel Loops

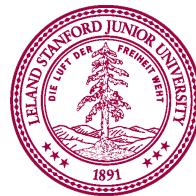
```
def main():
    num_dice_rolls = 0
    # repeat these lines
    dice_value = random.randint(1, 6)
    num_dice_rolls += 1

    print(num_dice_rolls)
```



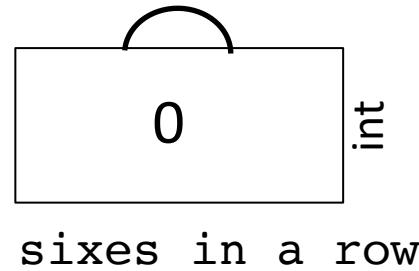
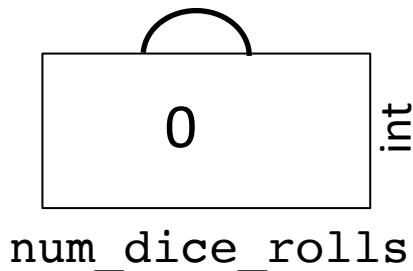
# Example: Sentinel Loops

```
def main():
    num_dice_rolls = 0
    sixes_in_a_row = 0
    while sixes_in_a_row < GOAL_IN_A_ROW:
        dice_value = random.randint(1,6)
        print('You rolled a ' + str(dice_value))
        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
        else:
            sixes_in_a_row = 0
        num_dice_rolls += 1
    print(num_dice_rolls)
```



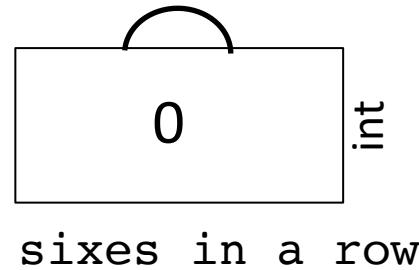
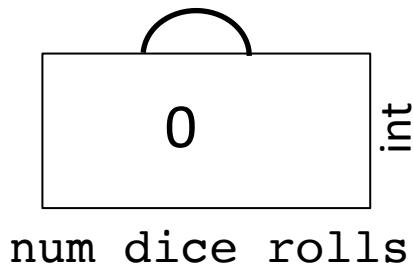
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    while sixes_in_a_row < GOAL_IN_A_ROW:
        dice_value = random.randint(1,6)
        print('You rolled a ' + str(dice_value))
        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
        else:
            sixes_in_a_row = 0
        num_dice_rolls += 1
    print(num_dice_rolls)
```



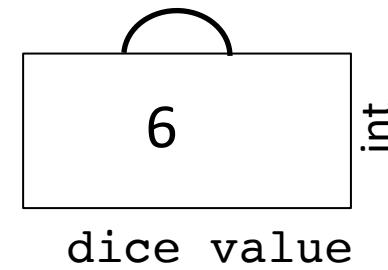
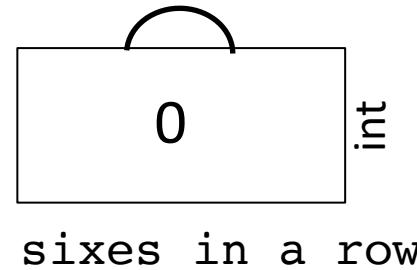
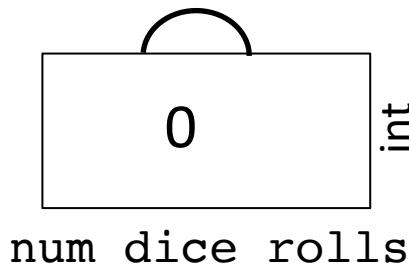
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    print(num_dice_rolls)
```



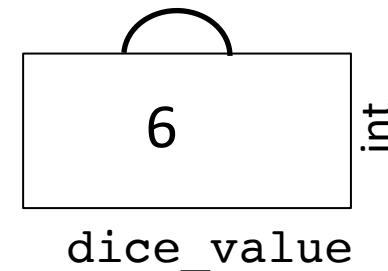
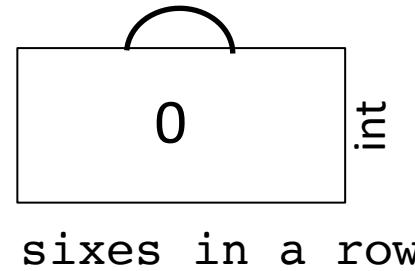
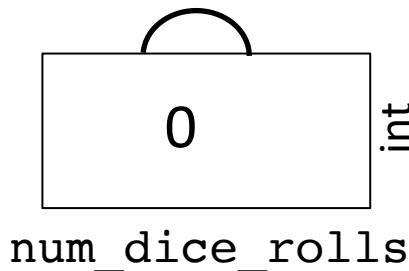
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        num_dice_rolls += 1
    print(num_dice_rolls)
```



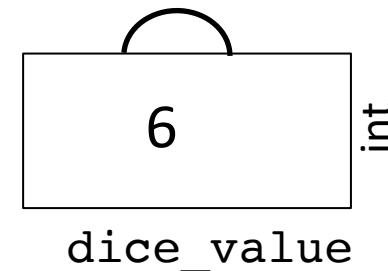
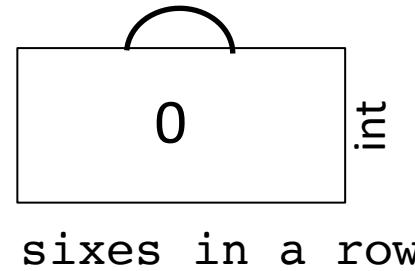
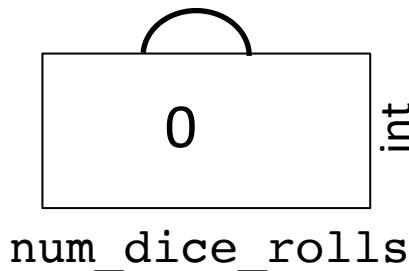
# Example: Sentinel Loops

```
def main():
    num_dice_rolls = 0
    sixes_in_a_row = 0
    while sixes_in_a_row < GOAL_IN_A_ROW:
        dice_value = random.randint(1,6)
        print('You rolled a ' + str(dice_value))
        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
        else:
            sixes_in_a_row = 0
        num_dice_rolls += 1
    print(num_dice_rolls)
```



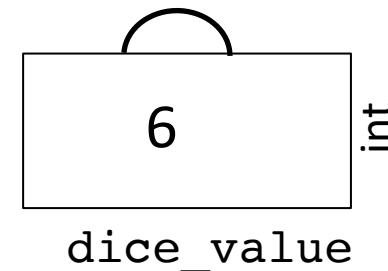
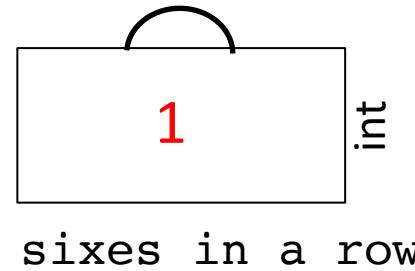
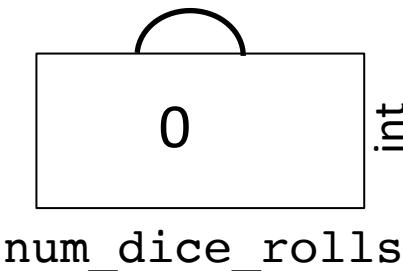
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```



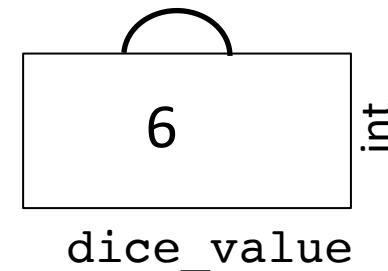
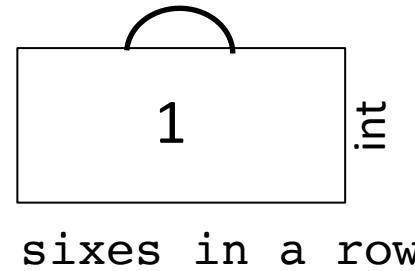
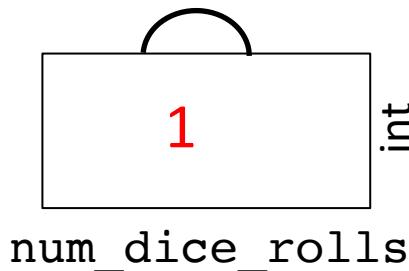
# Example: Sentinel Loops

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        else:
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        num_dice_rolls += 1
    print(num_dice_rolls)
```



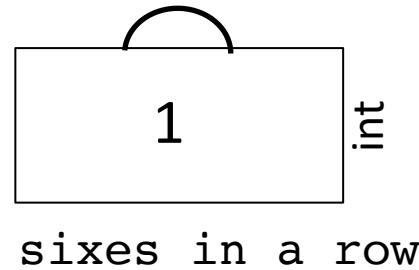
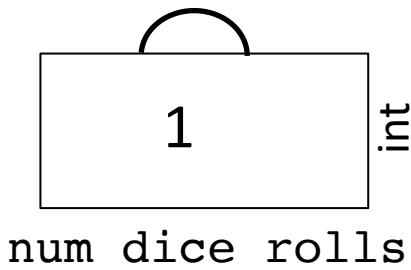
# Example: Sentinel Loops

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    print(num_dice_rolls)
```



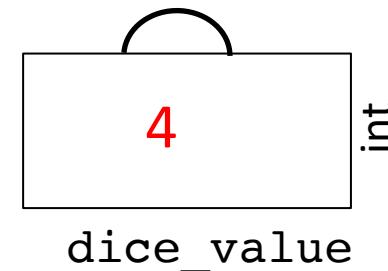
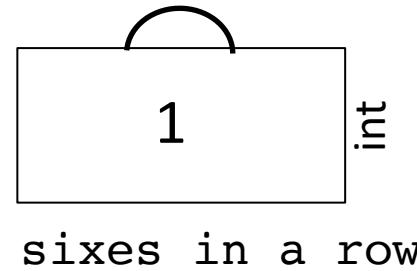
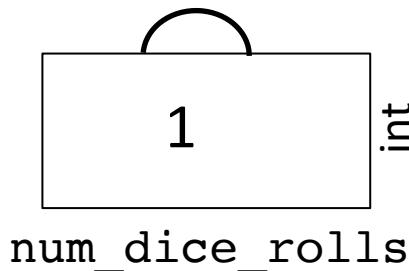
# Example: Sentinel Loops

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        else:
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        num_dice_rolls += 1
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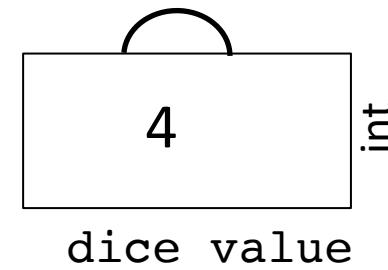
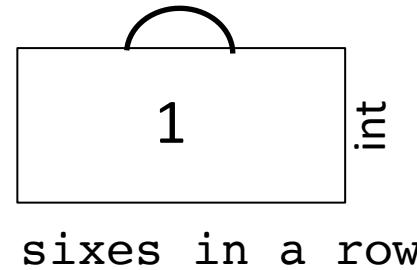
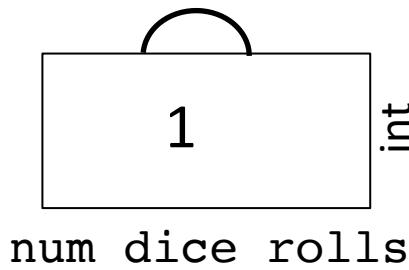
# Example: Sentinel Loops

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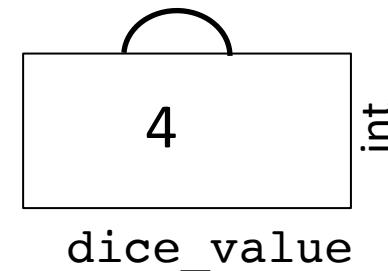
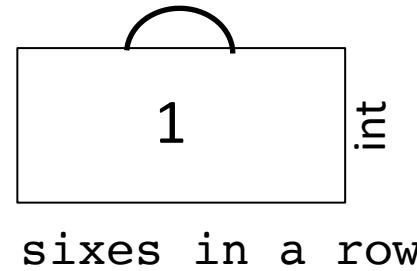
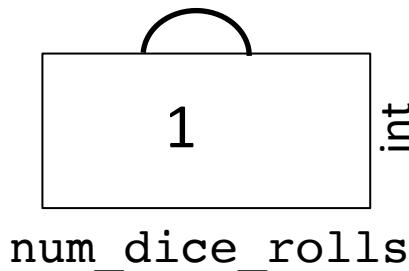
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        print('You rolled a ' + str(dice_value))
        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
        else:
            sixes_in_a_row = 0
        num_dice_rolls += 1
    print(num_dice_rolls)
```



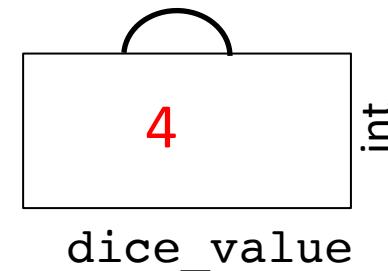
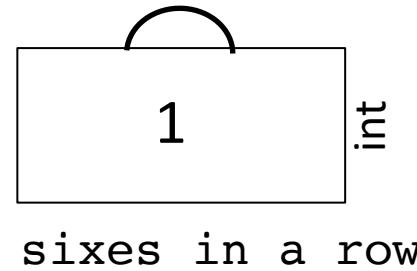
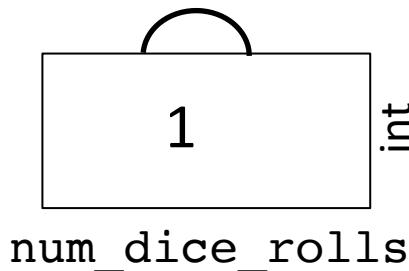
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```



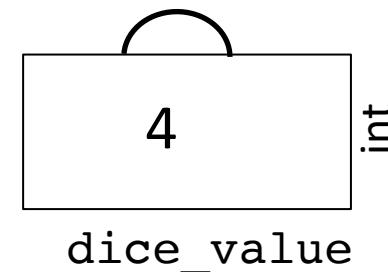
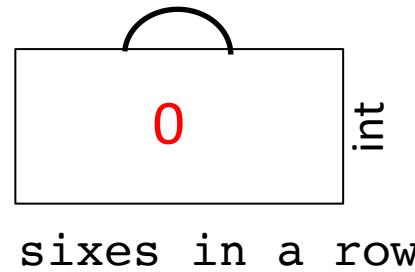
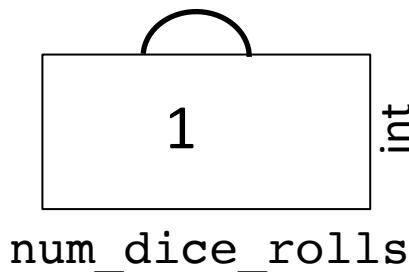
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        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
    else:
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    num_dice_rolls += 1
    print(num_dice_rolls)
```



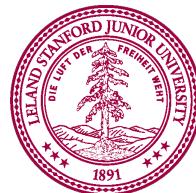
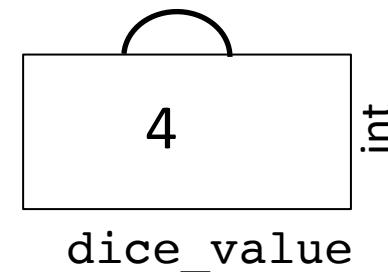
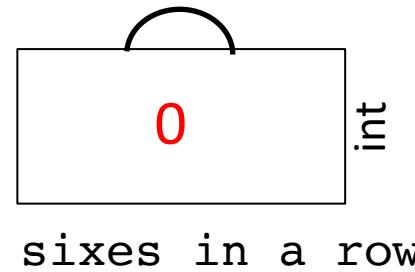
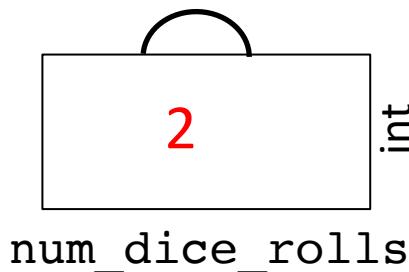
# Example: Sentinel Loops

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        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
        else:
            sixes_in_a_row = 0
        num_dice_rolls += 1
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```



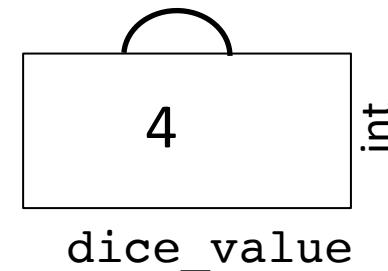
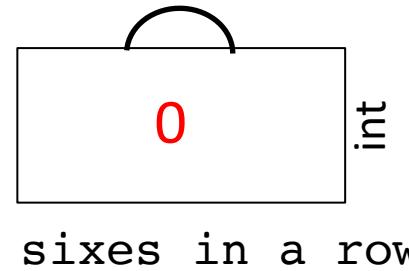
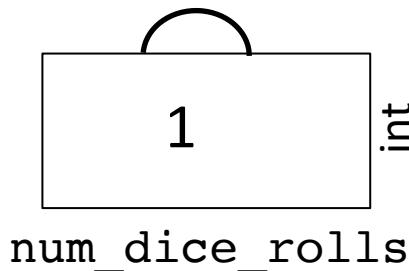
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        print('You rolled a ' + str(dice_value))
        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
        else:
            sixes_in_a_row = 0
            num_dice_rolls += 1
    print(num_dice_rolls)
```



# Example: Sentinel Loops

```
def main():
    num_dice_rolls = 0
    sixes_in_a_row = 0
    while sixes_in_a_row < GOAL_IN_A_ROW:
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        print('You rolled a ' + str(dice_value))
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        else:
            sixes_in_a_row = 0
        num_dice_rolls += 1
    print(num_dice_rolls)
```



# When will it get to this line?

```
def main():
    num_dice_rolls = 0
    sixes_in_a_row = 0
    while sixes_in_a_row < GOAL_IN_A_ROW:
        dice_value = random.randint(1,6)
        print('You rolled a ' + str(dice_value))
        if dice_value == GOAL_VALUE:
            sixes_in_a_row += 1
        else:
            sixes_in_a_row = 0
    num_dice_rolls += 1
    print(num_dice_rolls)
```

num\_dice\_rolls

?

int

sixes\_in\_a\_row

?

int

dice\_value

?

int



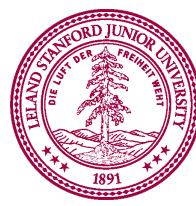
# Logical Operators

In order of precedence:

Operator	Example	Result
not	not (2 == 3)	True
and	(2 == 3) and (-1 < 5)	False
or	(2 == 3) or (-1 < 5)	True

```
num1 = int(input("Enter a positive number: "))
num2 = int(input("Enter another number: "))

if num1 < 0 or num2 < 0:
    print("invalid input")
```



# George Boole



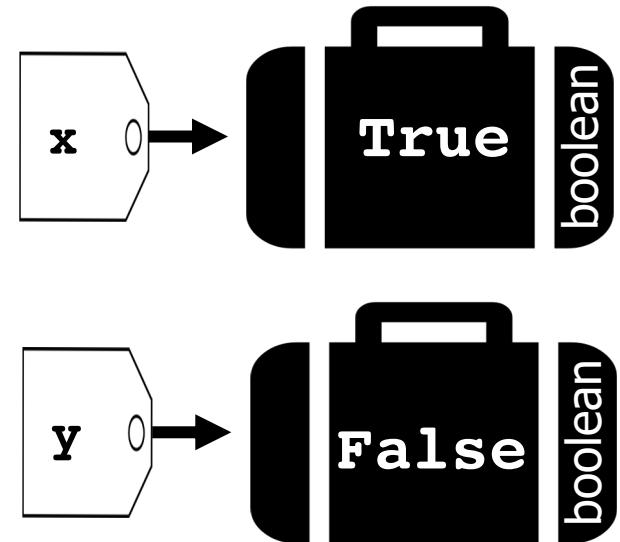
English Mathematician teaching in Ireland 1815 – 1864  
Boole died of being too cool

Piech, CS106A, Stanford University



# Boolean Variables

```
# Store expressions that evaluate to True/False  
x = 1 < 2      # True  
y = 5.0 == 4.0  # False
```



# Boolean Variables

```
# Store expressions that evaluate to True/False
x = 1 < 2      # True
y = 5.0 == 4.0  # False

# Directly set to True/False
is_teaching = True
is_rock_climbing = False
```



# Boolean Variables

```
# Store expressions that evaluate to True/False
x = 1 < 2      # True
y = 5.0 == 4.0  # False

# Directly set to True/False
is_teaching = True
is_rock_climbing = False

play_again = input('Play again? "y" or "n"') == 'y'
if play_again:
    ...
    ...
```



*Please ...*

**NO FOOD OR  
DRINKS**

[FreeSignPrinter.com](#)



Piech, CS106A, Stanford University



\*know your logical precedence

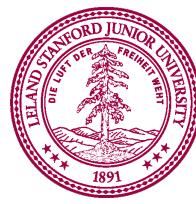


FreeSignPrinter.com

food = **True**

drinks = **True**

is\_allowed = **not food or drinks**



\*know your logical precedence



FreeSignPrinter.com

food = **True**

drinks = **True**

is\_allowed = **not food or drinks**

**False**



\*know your logical precedence



FreeSignPrinter.com

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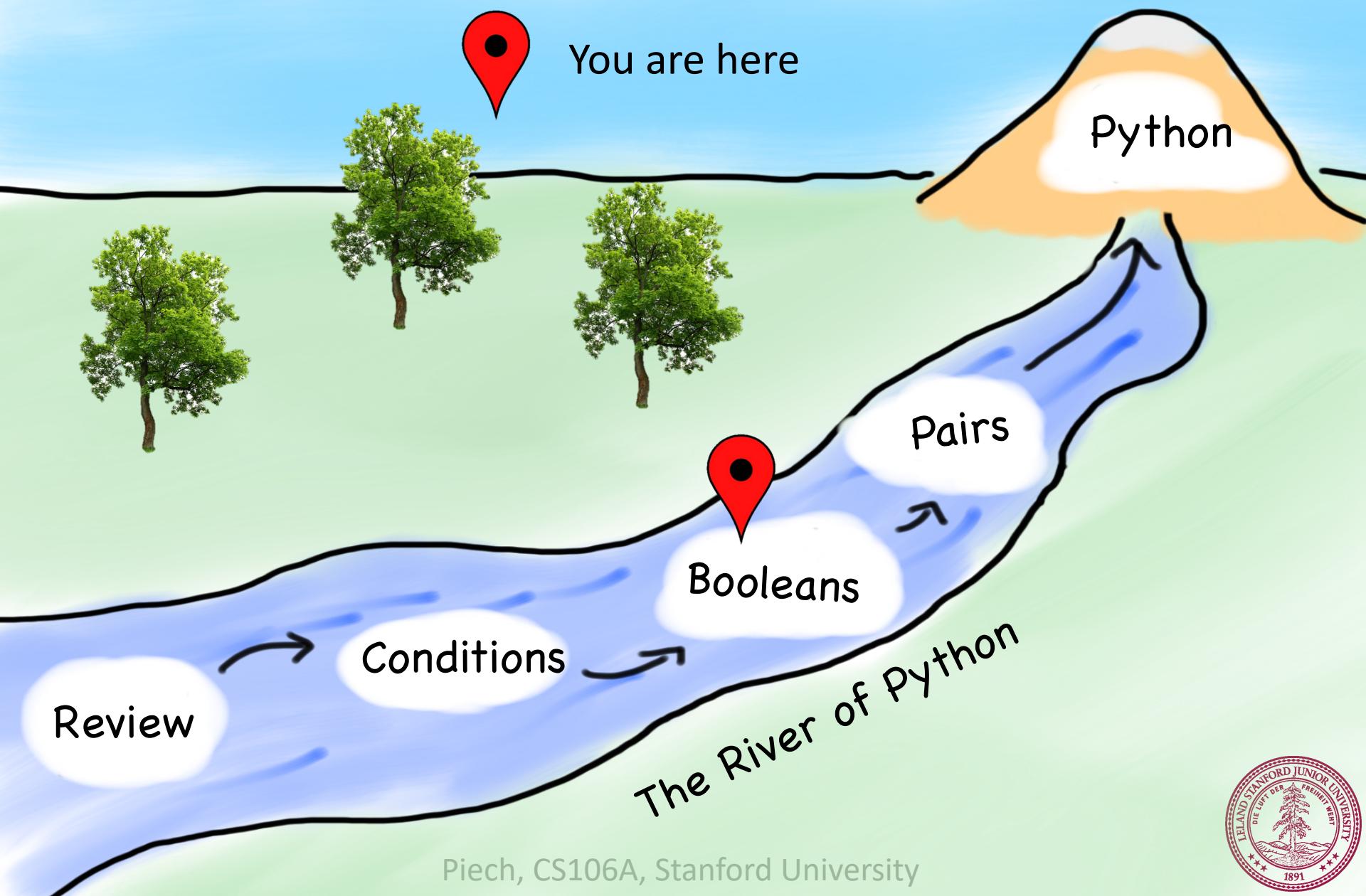
is\_allowed = **not food or drinks**

**False**

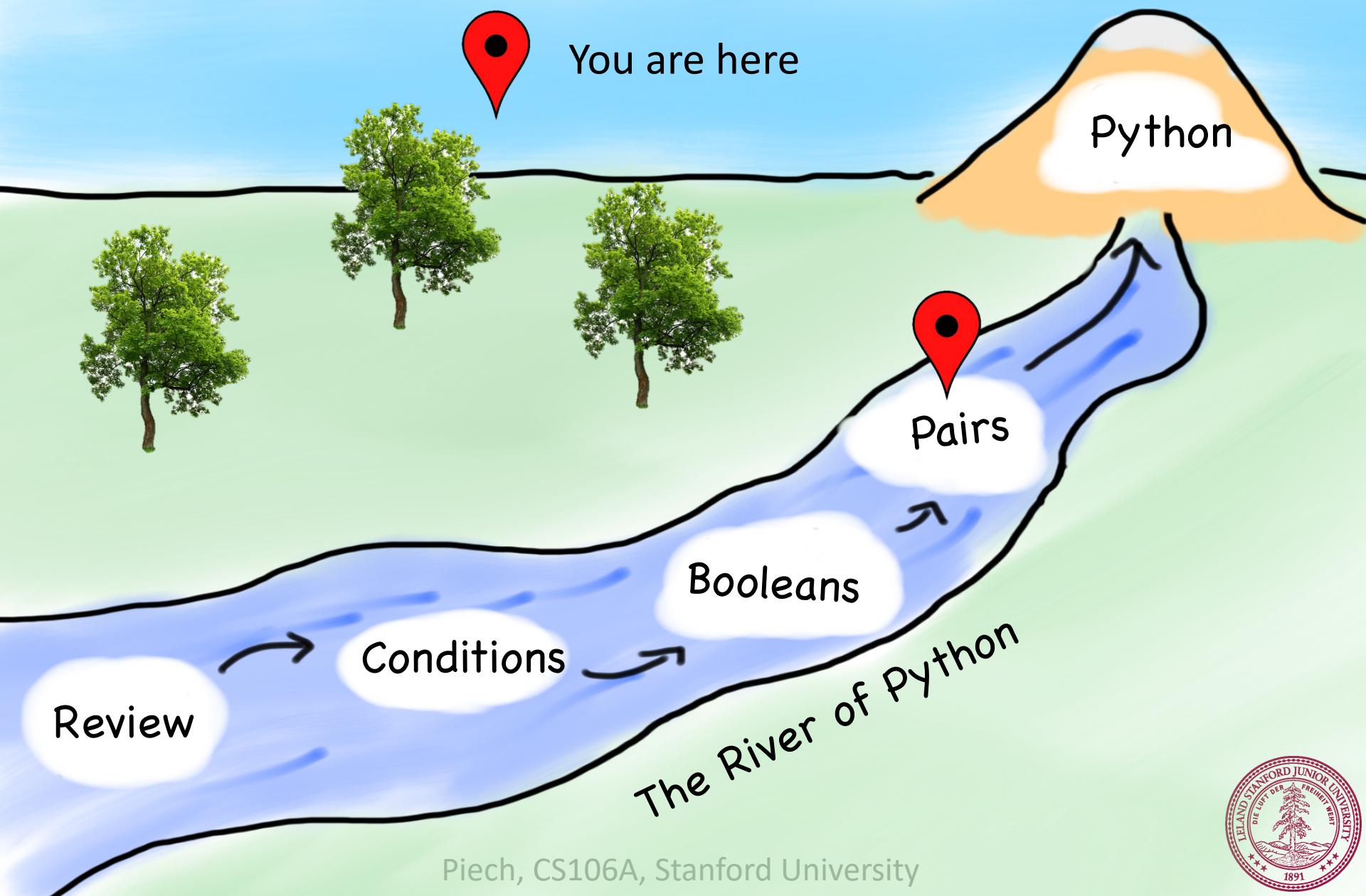
**True**

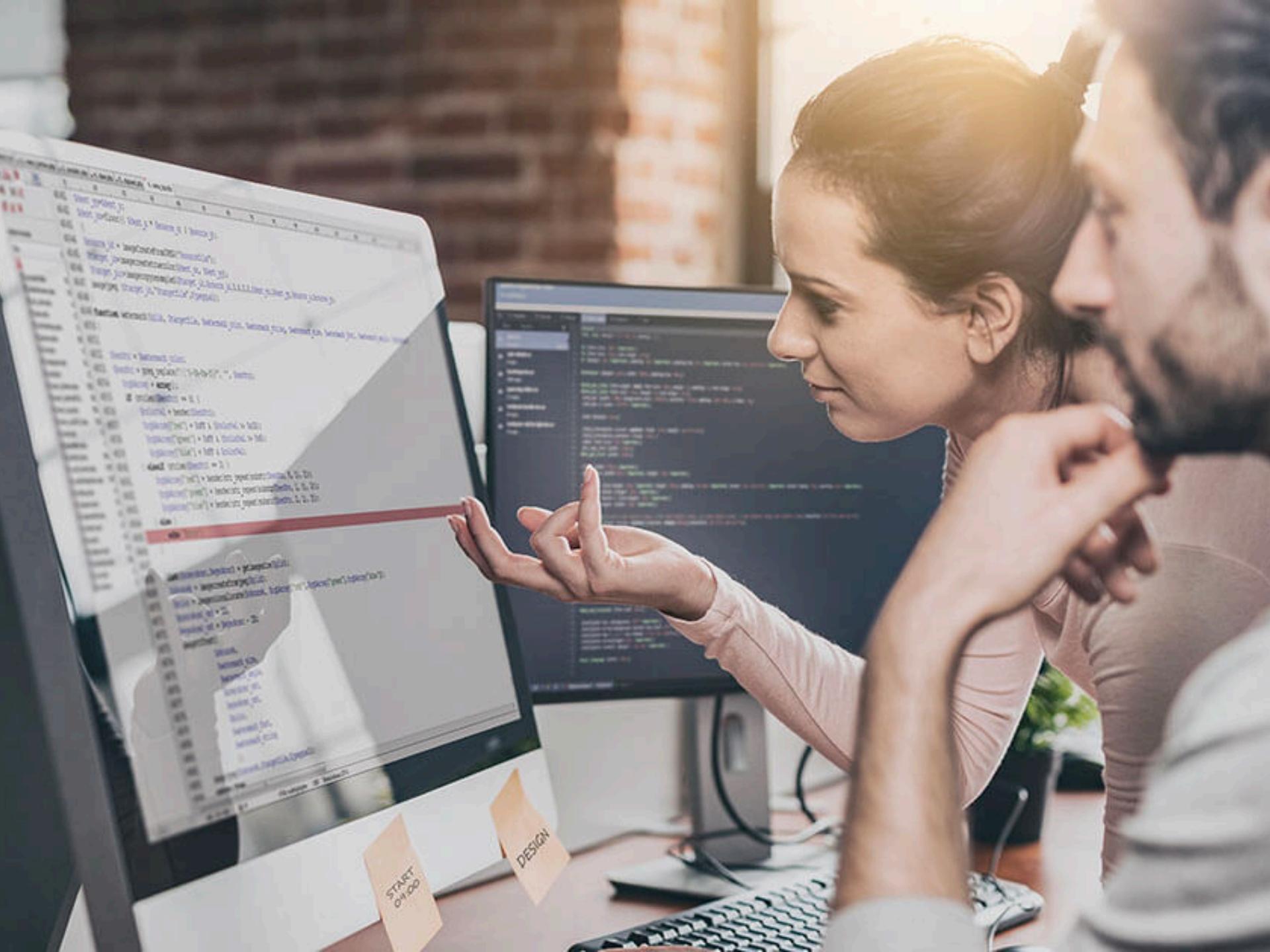


# Today's Route



# Today's Route





# Learning to pair program

The screenshot shows a web-based programming environment. On the left, there is a code editor with the following Python code:

```
1 # happy coding!
2
3 def main():
4     print('hello world')
5
6 if __name__ == '__main__':
7     main()
```

On the right, there is a console area with the following text:

Welcome to PearProgram! This is your console. Click the run button to see your output here.

Below the console, there are three numbered steps with arrows pointing to specific UI elements:

- (1) There are two roles in pair programming: Pilot and Co-Pilot. An arrow points from this text to the "Role: Co-Pilot" button at the top.
- (2) Everyone must understand all the code. Ask a question if you are lost. Feel free to chat as you go! An arrow points from this text to the yellow message icon in the bottom navigation bar.
- (3) Press this button to run your code. An arrow points from this text to the blue run icon in the bottom navigation bar.



Truly important afternoon

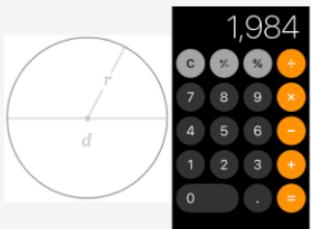
This is hard! Learn a little each day.

# Today's Goal

1. Be able to use While and If in Python
2. Combine loops and variables



## Evening Project [[here](#)]



Area Calculator

[Quickstart](#)

[SL Notes](#)

Variables

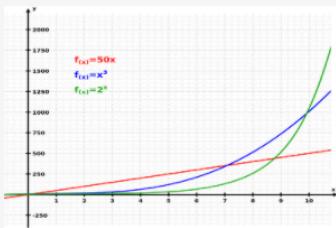


8 Ball

[Section](#)

[SL Notes](#)

Conditionals



Viral Video

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Conditionals



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Conditionals

