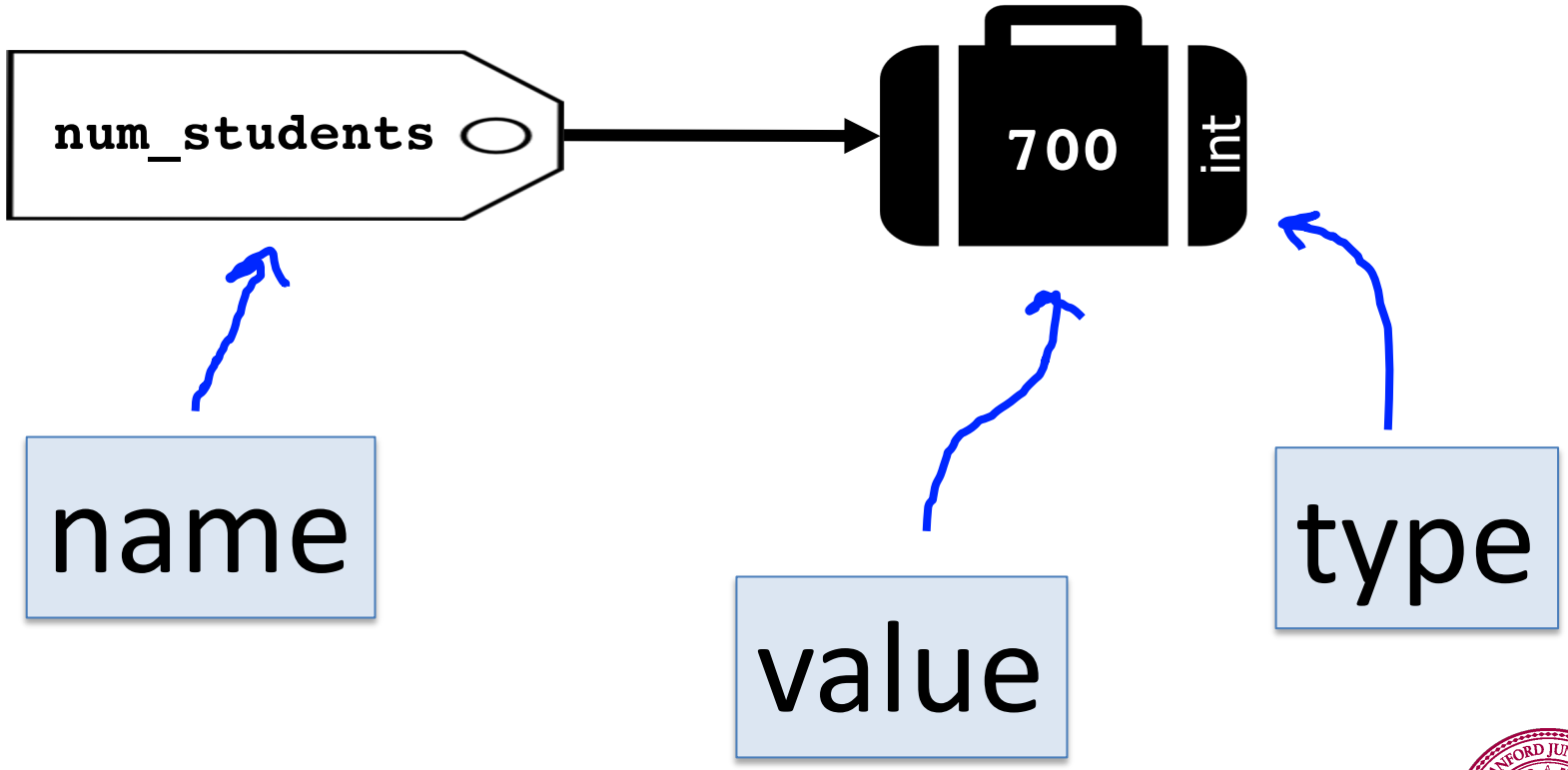
Control Flow Revisited

Chris Piech and Mehran Sahami
Stanford University

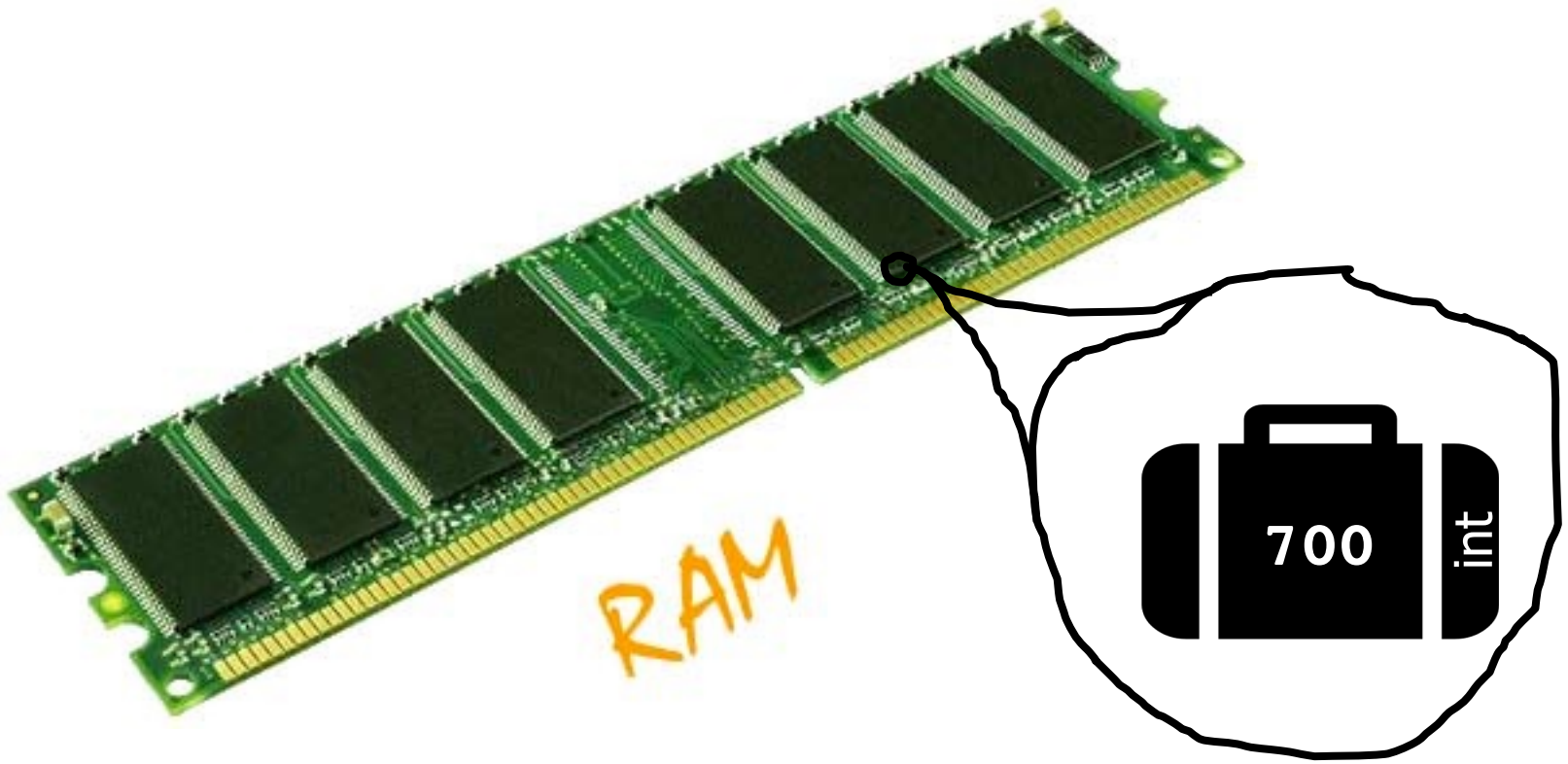
Review

Suitcase Analogy

```
num_students = 700
```



Teeny Tiny Suitcases



My computer has space for about 10 billion suitcases

Create, Modify, Use

```
# Create a variable, of type int
# called age with the value 30.
age = 32

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

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

Create, Modify, Use

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

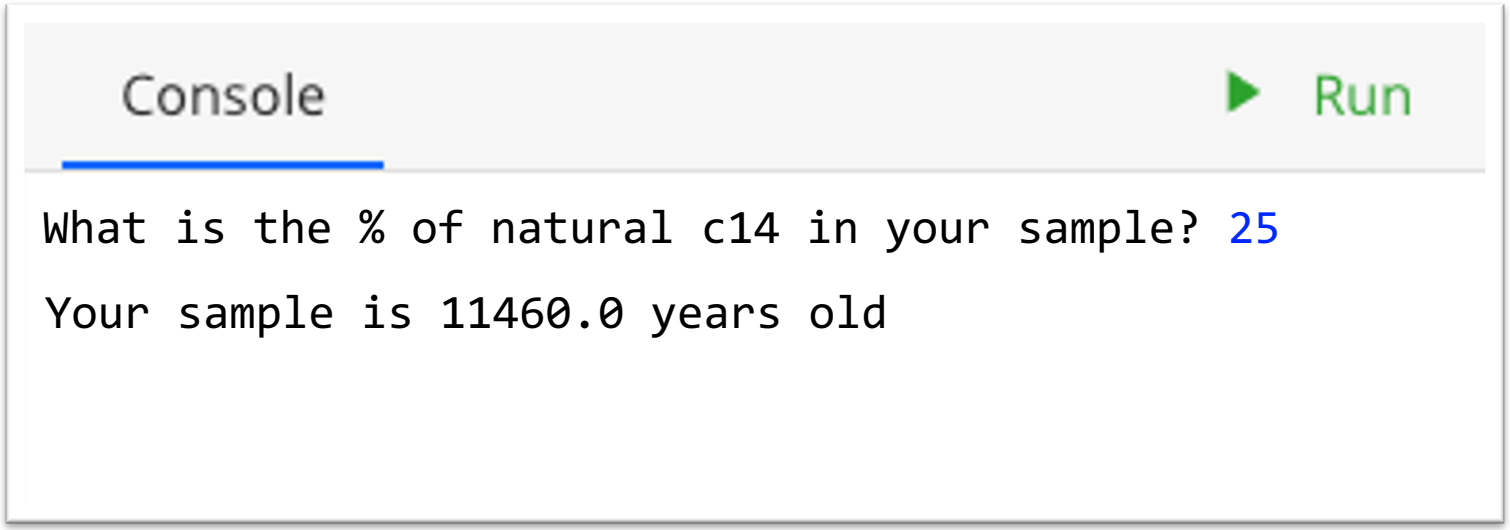
# Use the value in age (output it)
print("age is: ", age)

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


Binary Operators

+	Addition	*	Multiplication
−	Subtraction	/	Division

Cool Example: Carbon Dating



Cool Example: Carbon Dating

C14 = 100%

C14 = 8.8%

Half life constant

% of natural c14

$$\text{age} = K \cdot \log\left(\frac{c14}{100}\right)$$

Cool Example: Carbon Dating

```
K = -8266.64

def main():

    calculate_age_single_sample()


def calculate_age_single_sample():
    # ask the user to enter the percent c14 left in their sample
    pct_left = float(input("% of natural c14: "))
    # calc the age
    age = K * math.log(pct_left / 100)
    # print the result
    print("Sample is " + str(age) + " years old.")
```

* It calculates the age of a C14 sample

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terminal

```
> python carbondate.py
```

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    # print the result
    print("Sample is " + str(age) + " years old.")
```

terminal

```
> python carbondate.py
% of natural c14: 50
```


Cool Example: Carbon Dating

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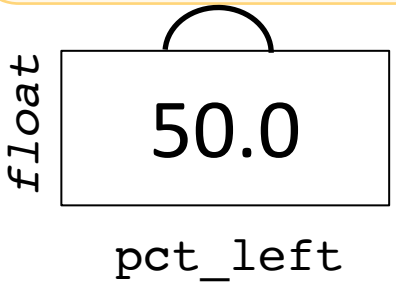

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    age = K * math.log(pct_left / 100)
    # print the result
    print("Sample is " + str(age) + " ye      d.")
```

0.5

terminal

```
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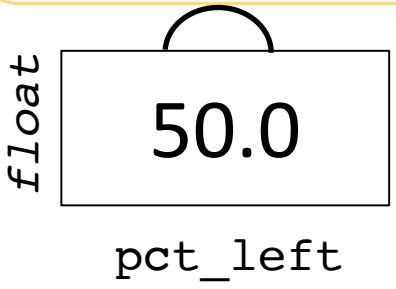
% of natural c14: 50
```



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```

-0.69

terminal

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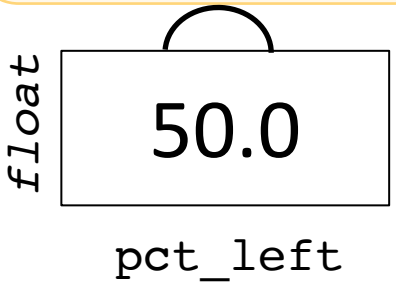

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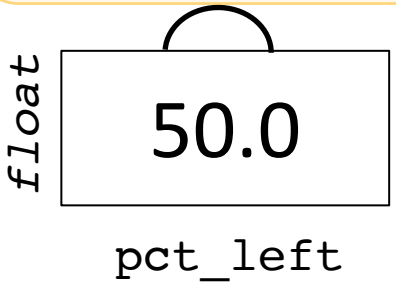
    age = K * math.log(pct_left / 100)
    # print the result
    print("Sample is " + str(age) + " yea")
```

5730.0

terminal

```
> python carbondate.py
% of natural c14: 50
```



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terminal

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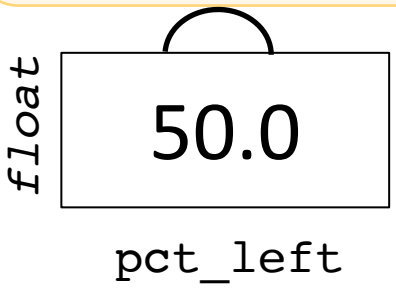

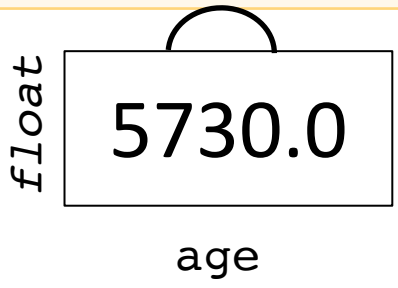

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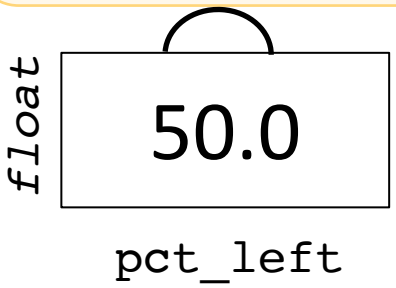
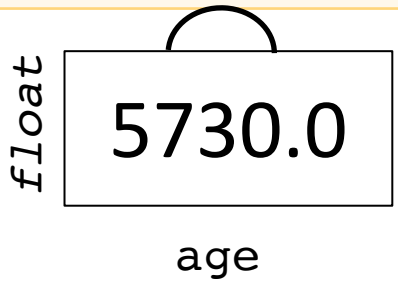
    pct_left = float(input("% of natural c14:"))
    # calc the age
    age = K * math.log(pct_left / 100)
    # print the result
    print("Sample is " + str(age) + " years old.")
```

terminal

```
> python carbondate.py
% of natural c14: 50
Sample is 5730.0 years old
```

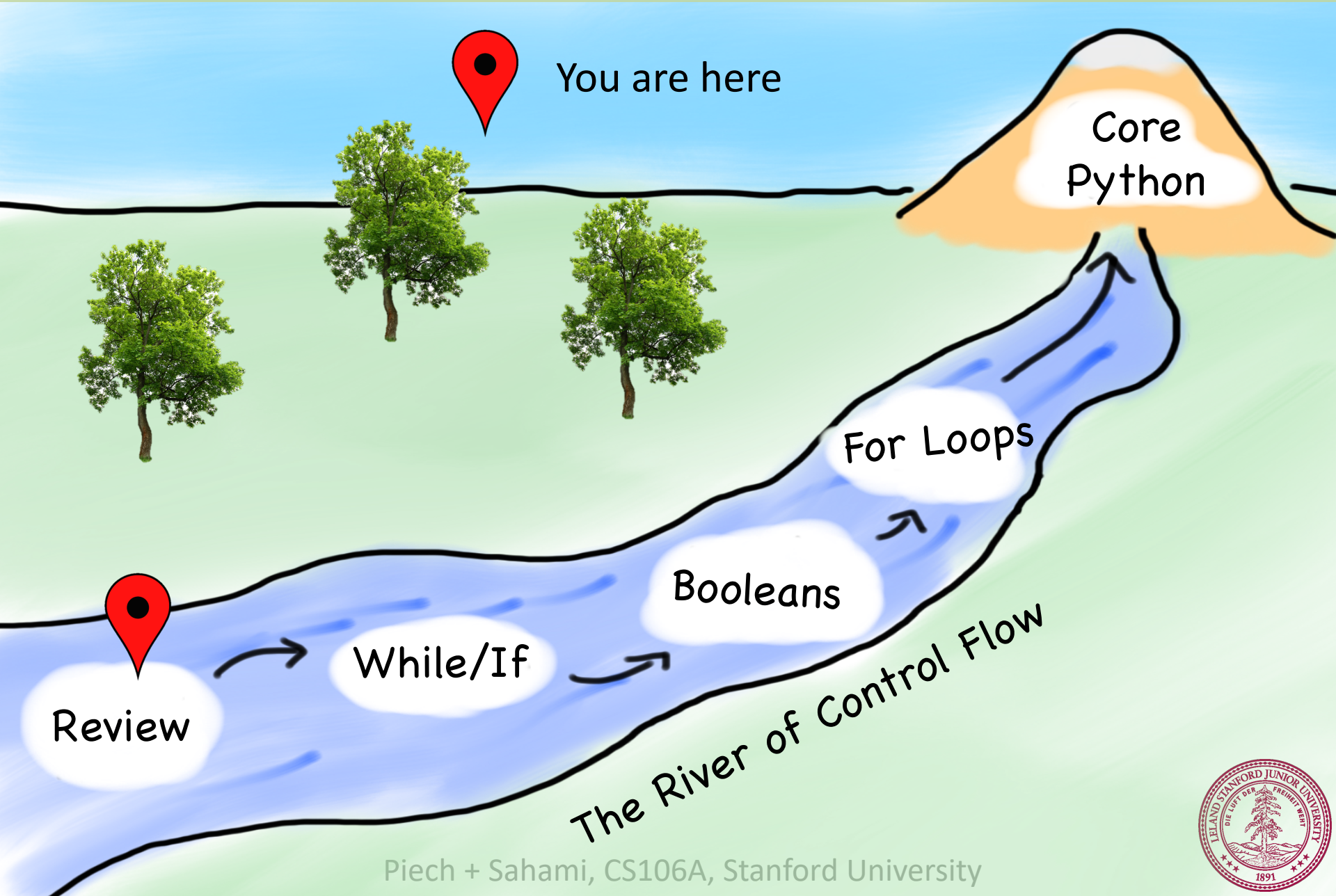




Today's Goal

1. Be able to use For / While / If in Python

Today's Route



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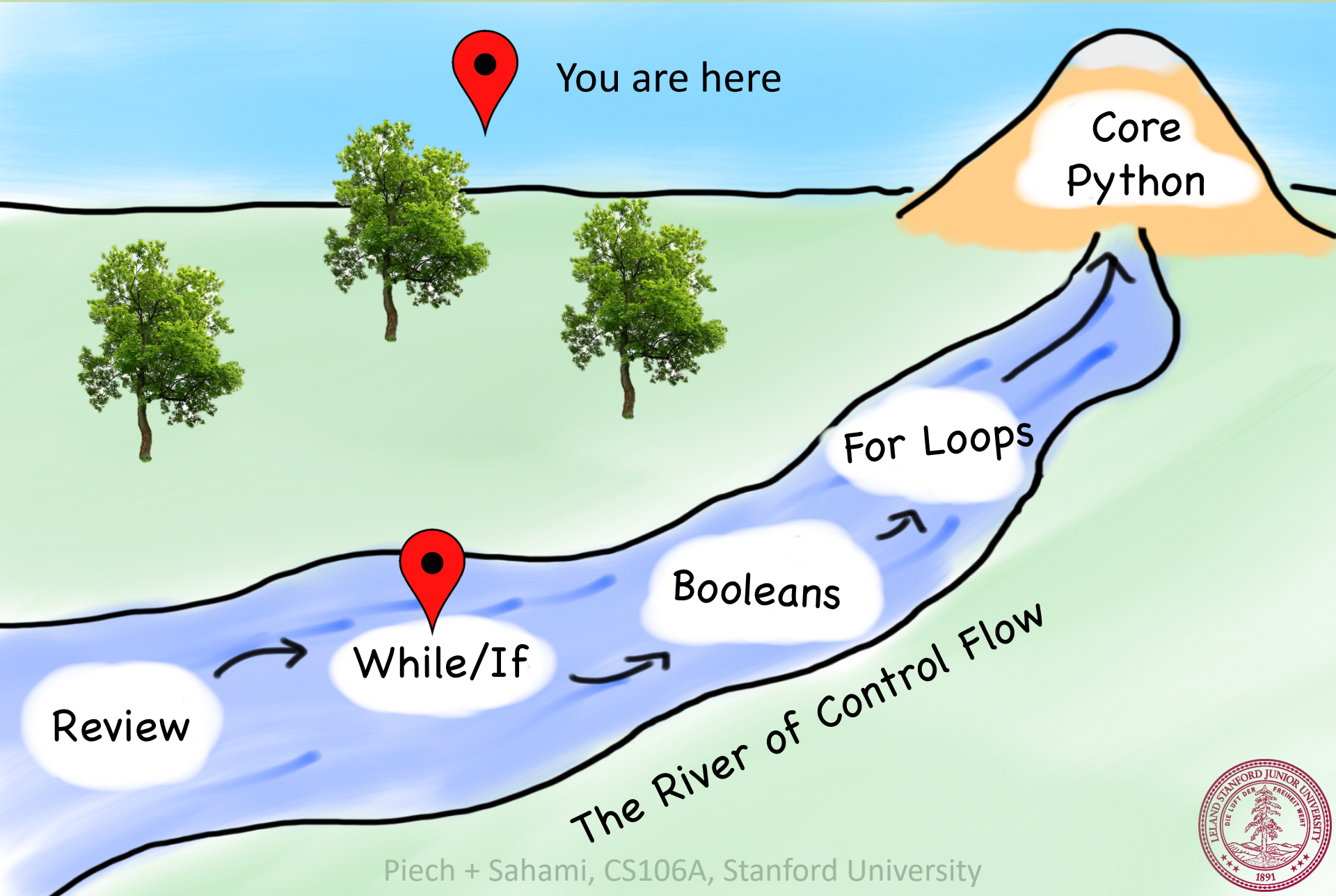

While Loop in Karel

```
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`**

Cool Example: Carbon Dating

```
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def main():

    calculate_age_single_sample()


def calculate_age_single_sample():
    # ask the user to enter the percent c14 left in their sample
    pct_left = float(input("% of natural c14:"))
    # calc the age
    age = K * math.log(pct_left / 100)
    # print the result
    print("Sample is " + str(age) + " years old.")
```

* It calculates the age of a C14 sample

Cool Example: Carbon Dating

Before repeating the body, check if this statement evaluates to True

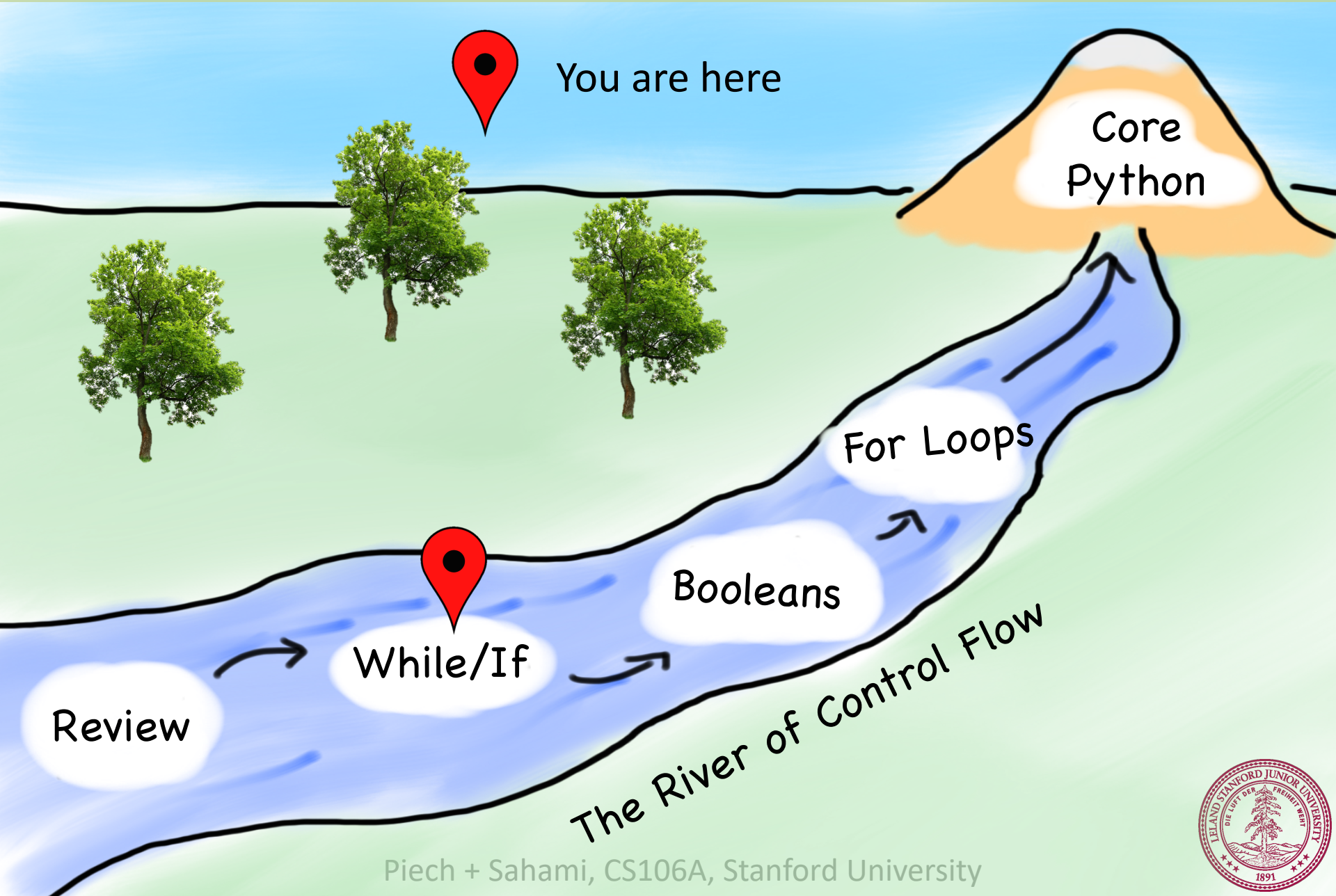
```
K = -8266.64

def main():
    while True:
        calculate_age_single_sample()


def calculate_age_single_sample():
    # ask the user to enter the percent c14 left in their sample
    pct_left = float(input("% of natural c14 in Sample:"))
    # calc the age
    age = K * math.log(pct_left / 100)
    # print the result
    print("Sample is " + str(age) + " years old.")
```

* It calculates the age of a C14 sample

Today's Route



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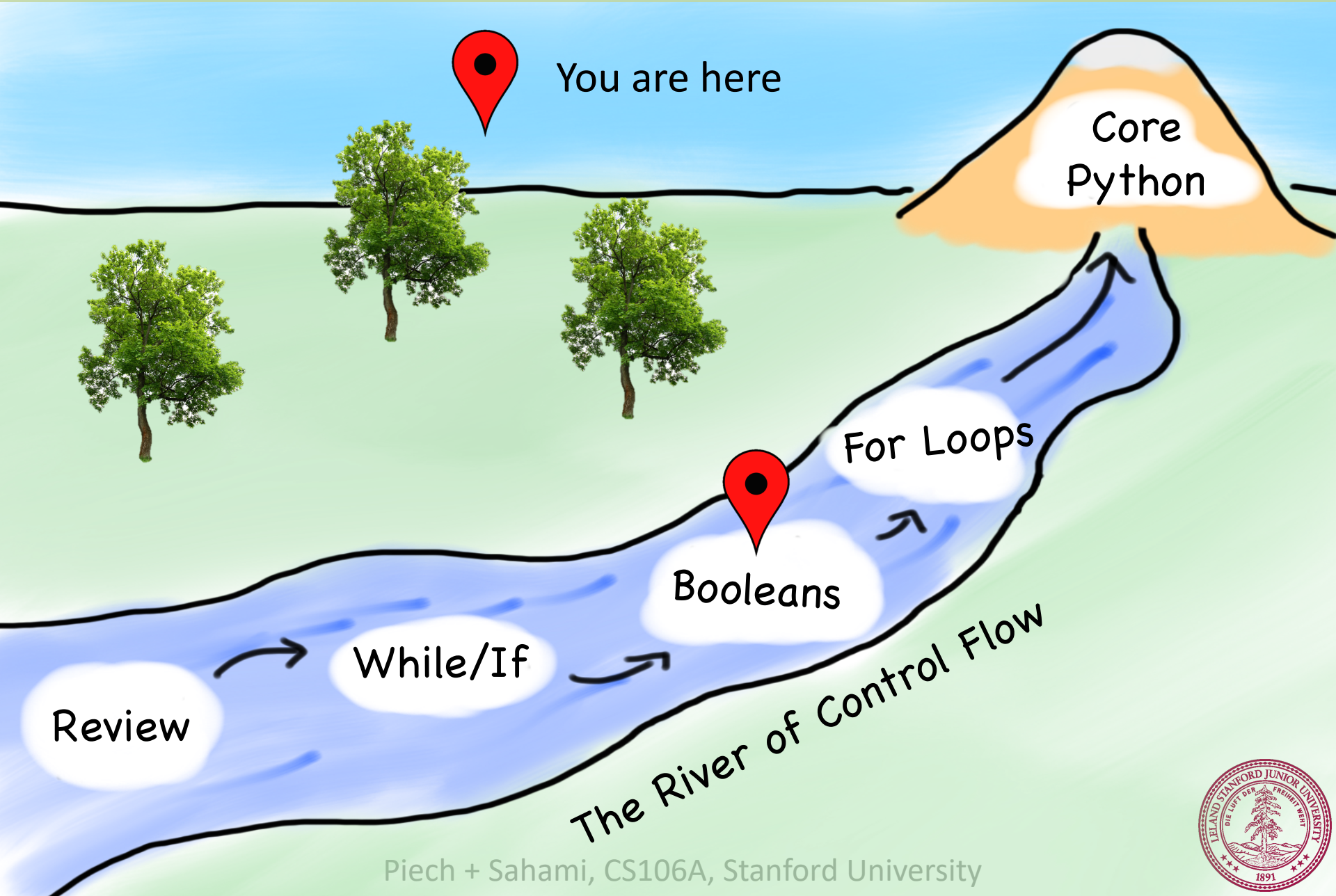

Booleans

front_is_clear()

`True`

Booleans

beyonce_is_great()

```
True
```


Booleans

$1 < 2$

`True`

Comparison Operators

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

* All have equal precedence

Comparison Operators

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>=	greater than or equal to	`5.0 >= 5.0`	`True`

* All have equal precedence

Spot the difference

```
x = 7
```

Sets the value of a variable named x to be 7. Creates the variable if it didn't exist.

```
x == 7
```

Checks if a variable named x has the value 7

Comparison Operators

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

```
num = int(input("Enter a number: "))
if num == 0:
   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:
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```

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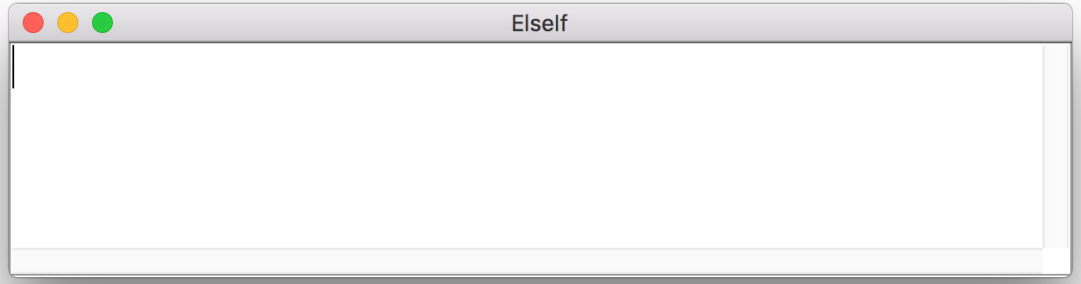

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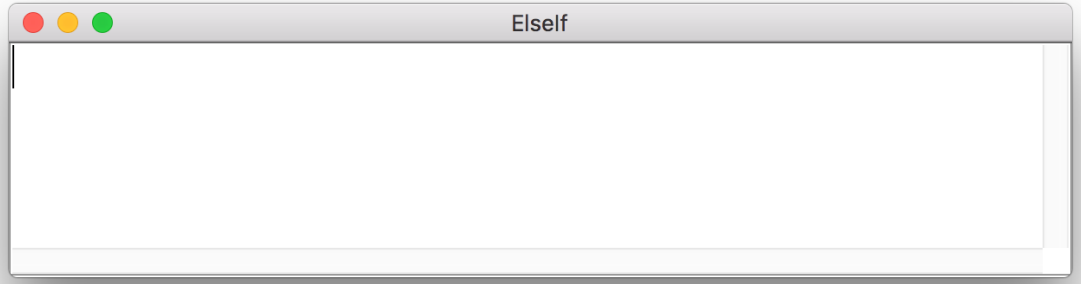
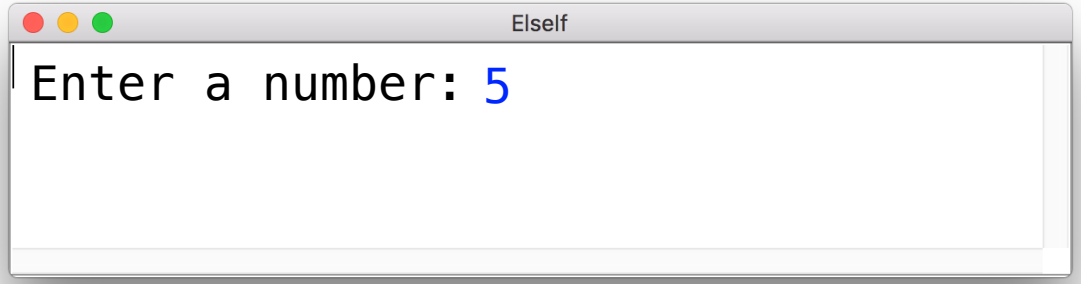


If Else Revisited

"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")
```



If Else Revisited

5

"5"

```
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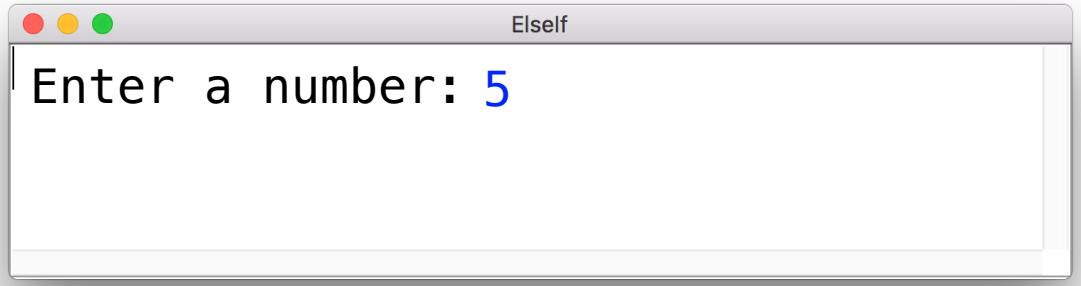

If Else Revisited

5

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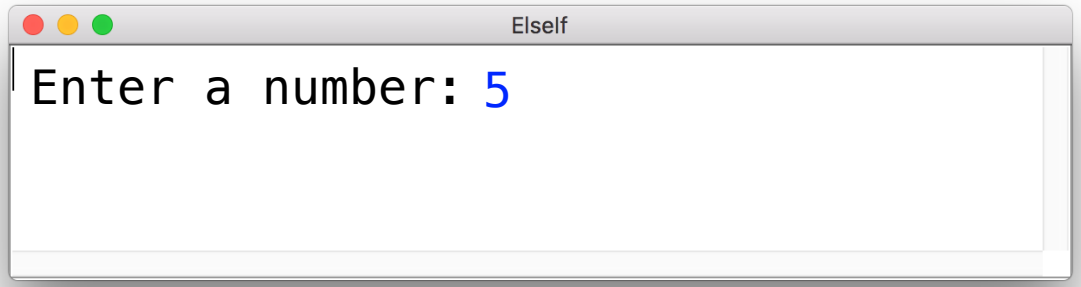

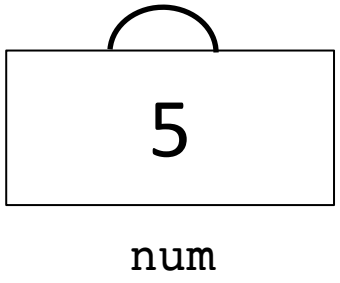

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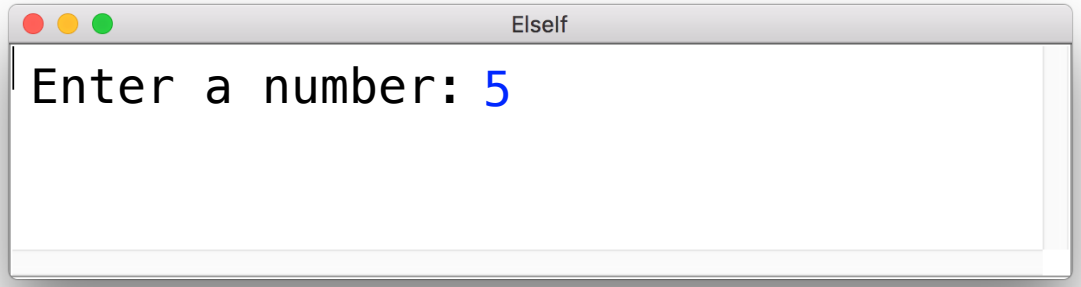

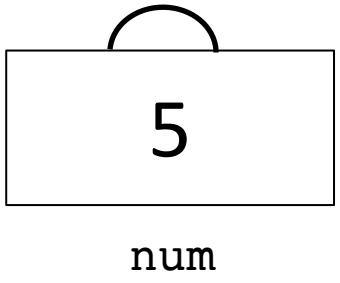

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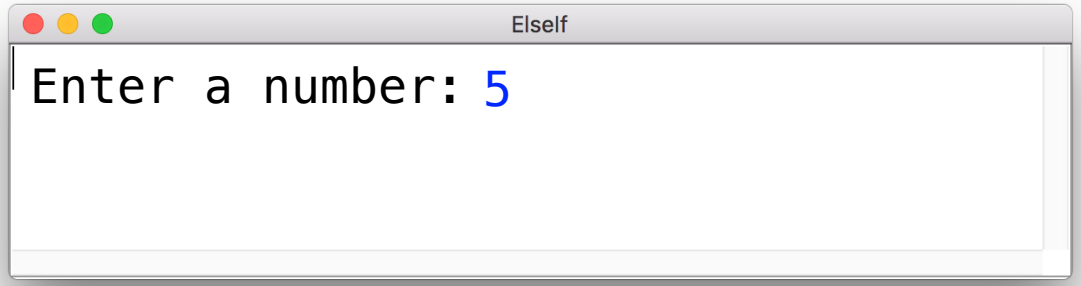

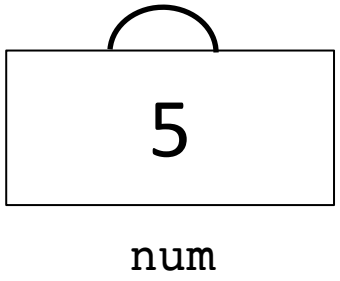

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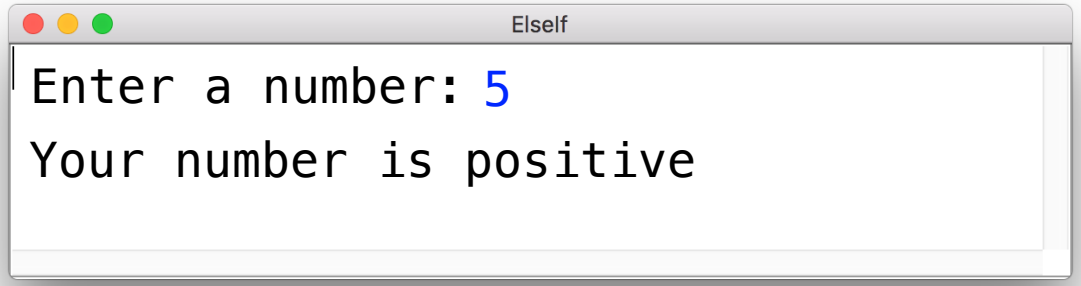

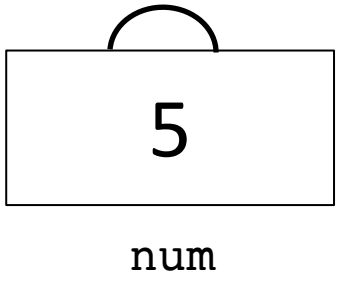

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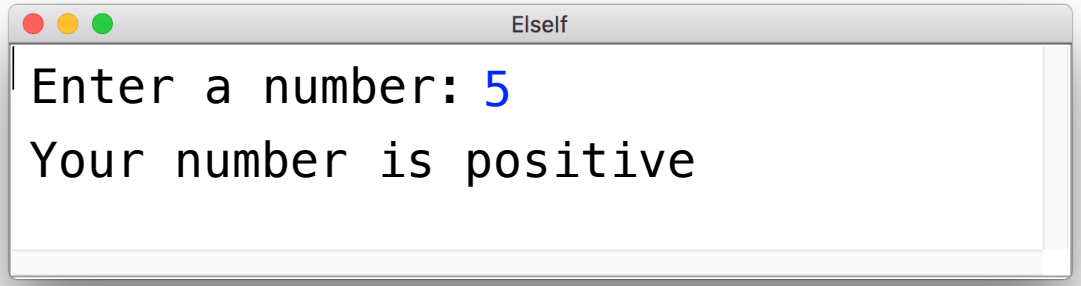
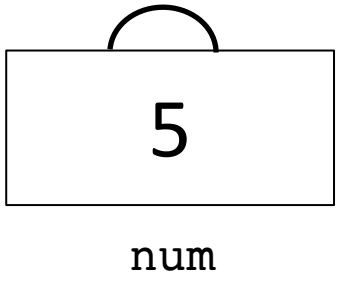




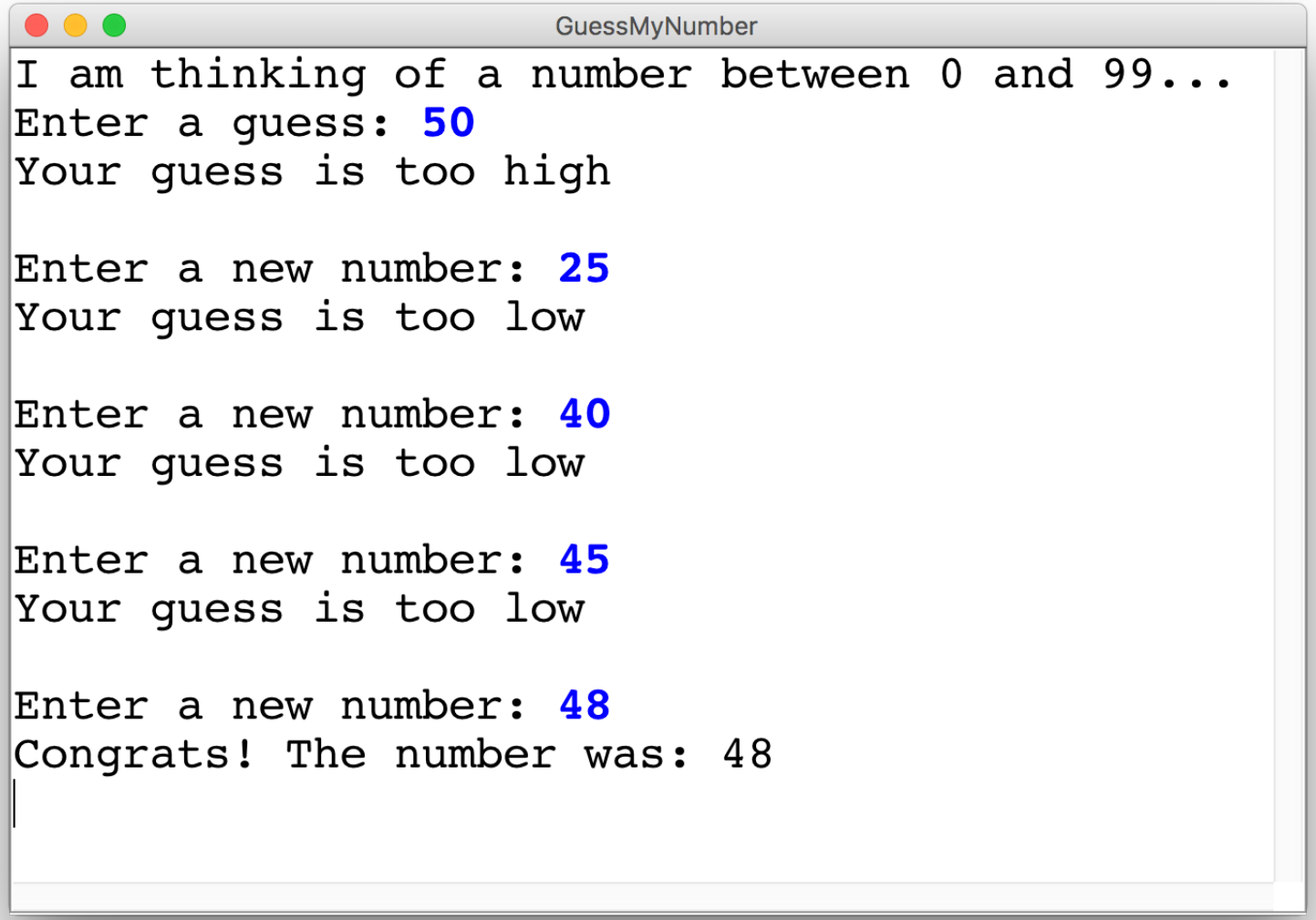
Conditions in Python

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**

Amazing

Guess My Number

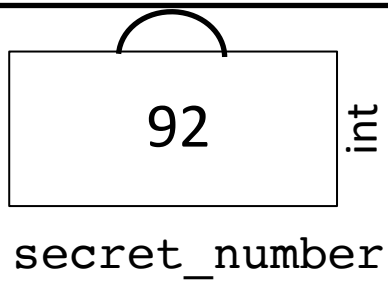


Guess My Number

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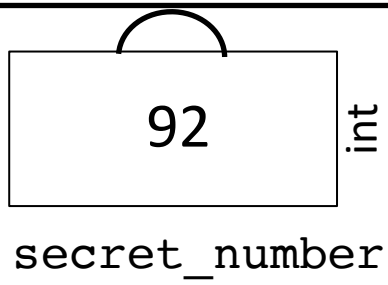
    print("") # an empty line
    guess = int(input("Enter a new guess: "))

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



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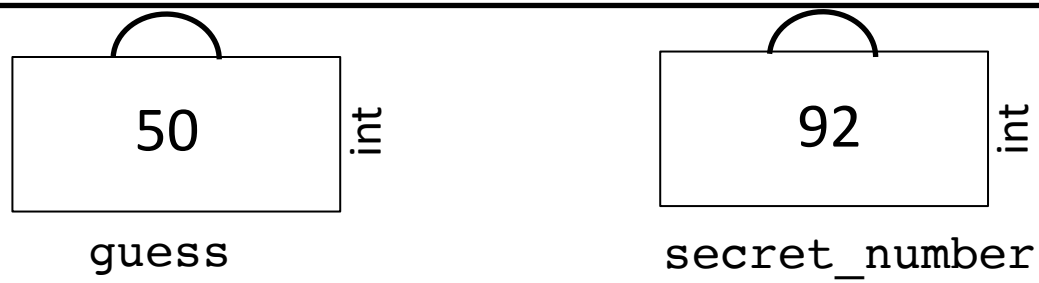

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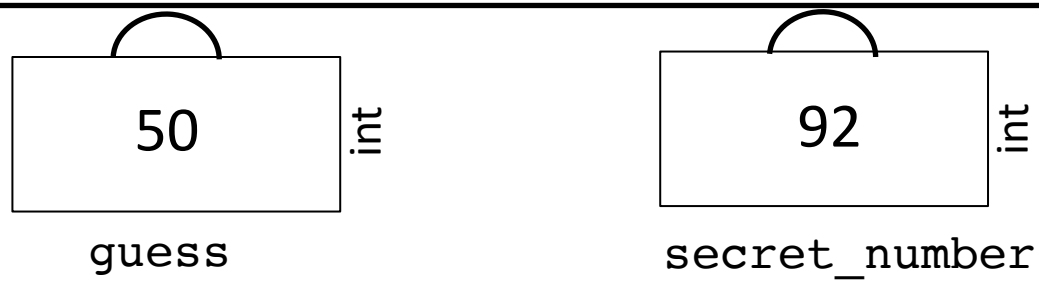

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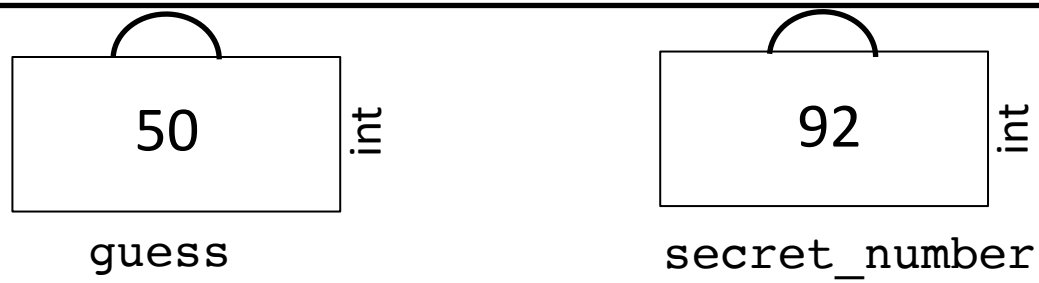

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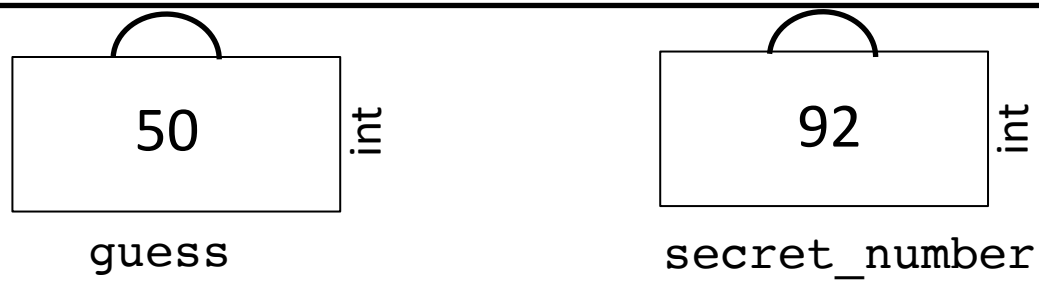

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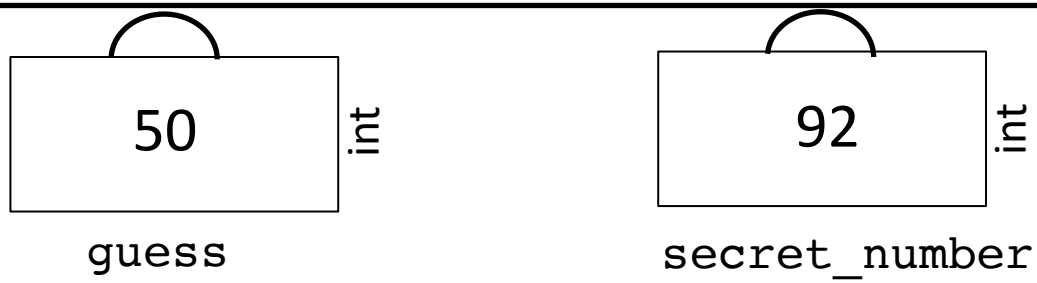

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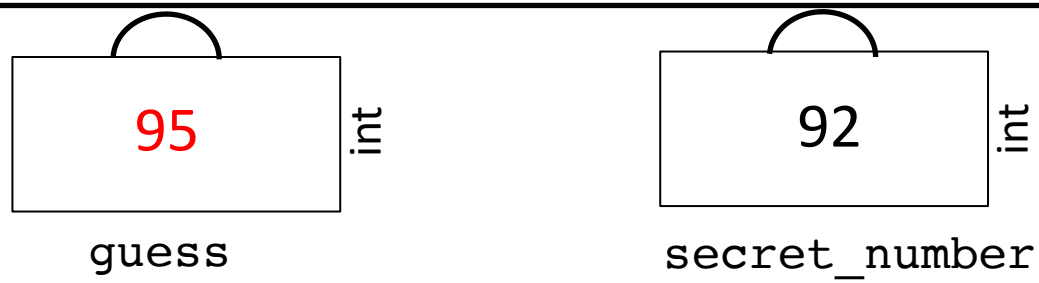

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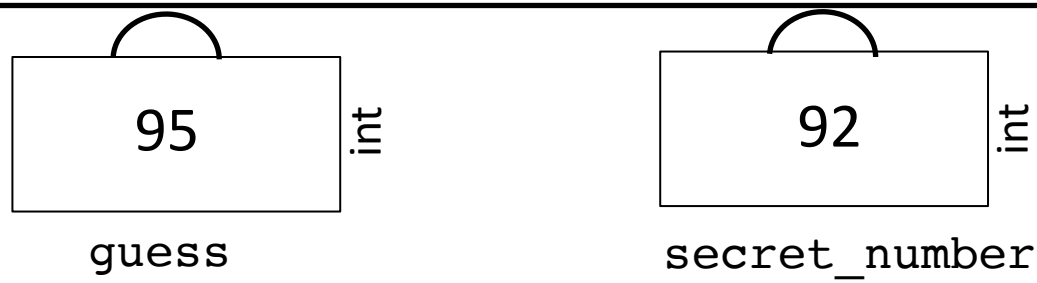

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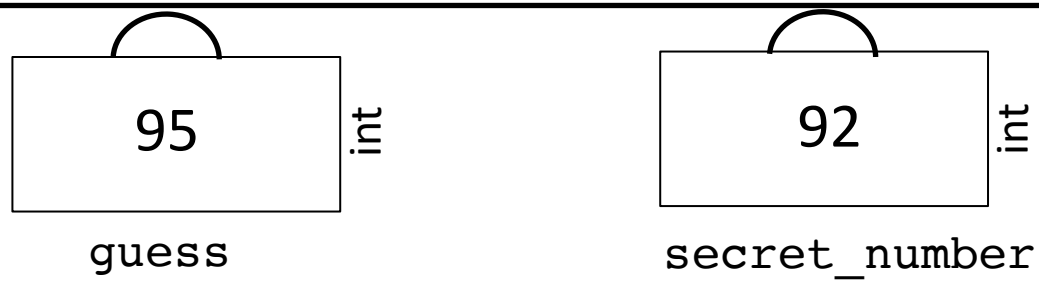

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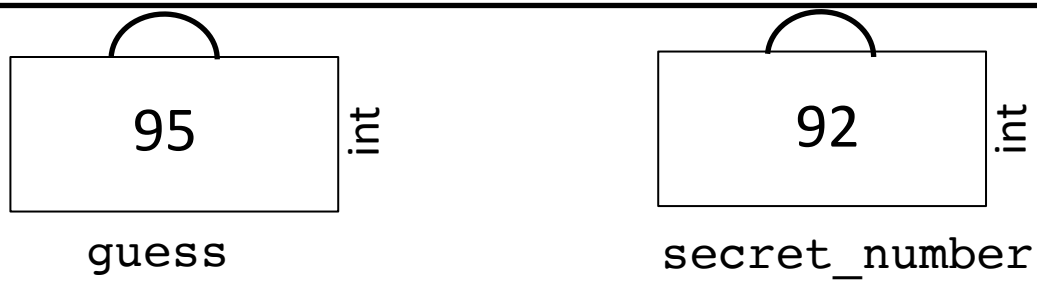

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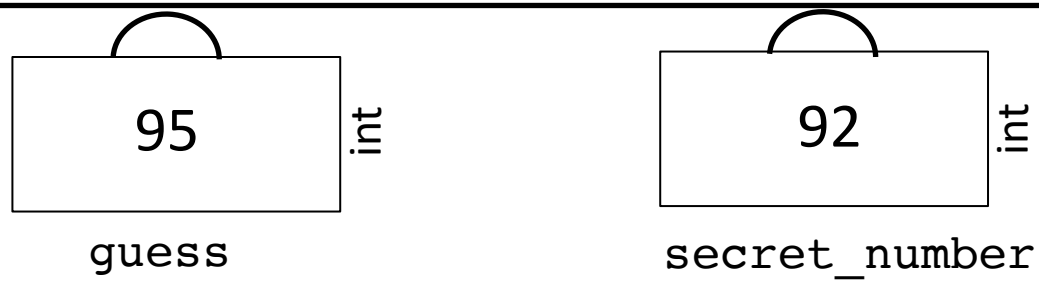

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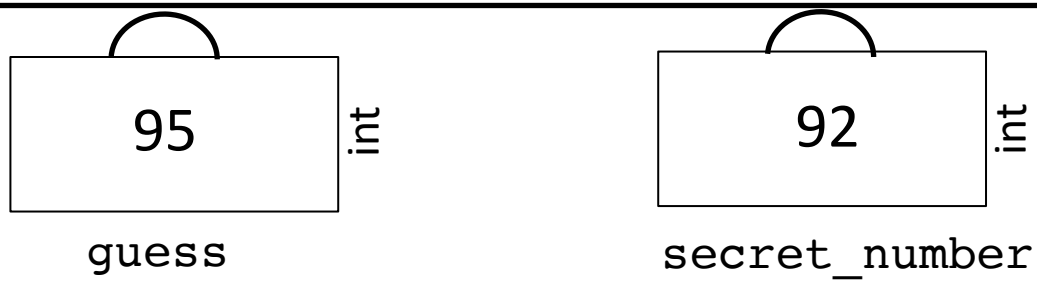

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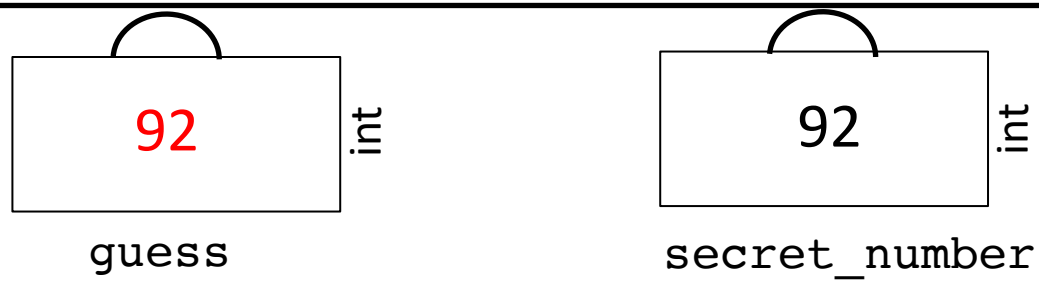

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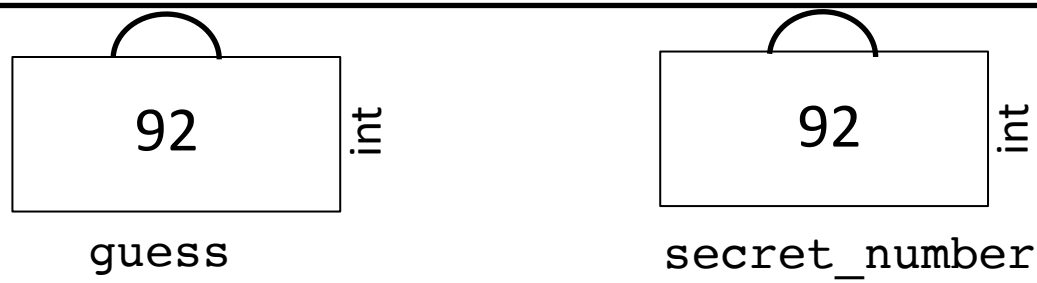

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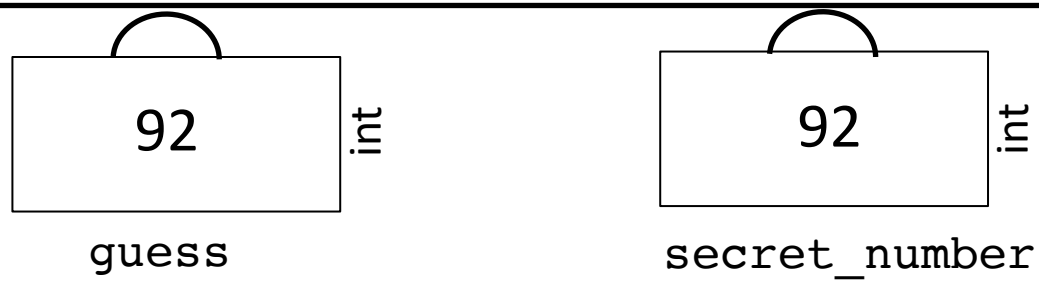

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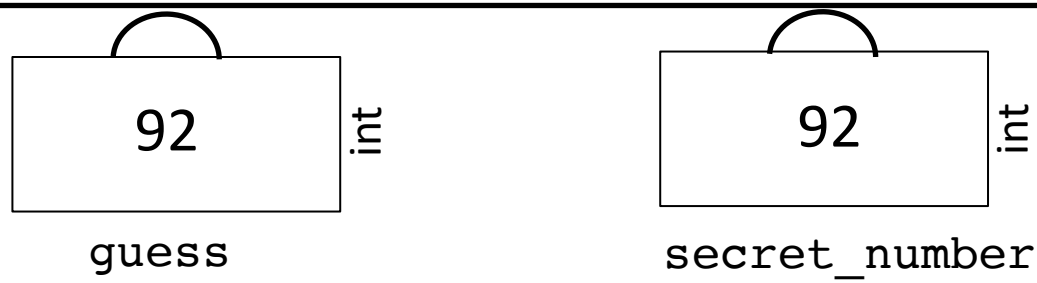


Behind the Scenes

Guess My Number

```
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print("I am thinking of a number between 1 and 99...")
```

```
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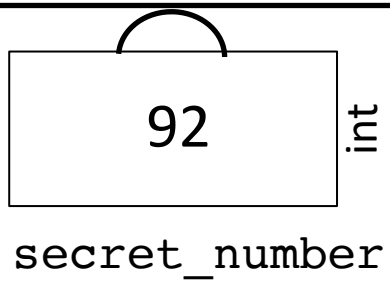
```



Guess My Number

```
secret_number = random.randint(1, 99)
print("I am thinking of a number between 1 and 99...")


while ???:
    # Repeat some stuff???




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...")


while ???:
    # Get a new guess


    # Report high/low




print("Congrats! The number was: " + str(secret_number))
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print("Congrats! The number was: " + str(secret_number))
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secret_number = random.randint(1, 99)
print("I am thinking of a number between 1 and 99...")


while guess != secret_number:
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    guess = int(input("Enter a guess: "))


    # Report high/low


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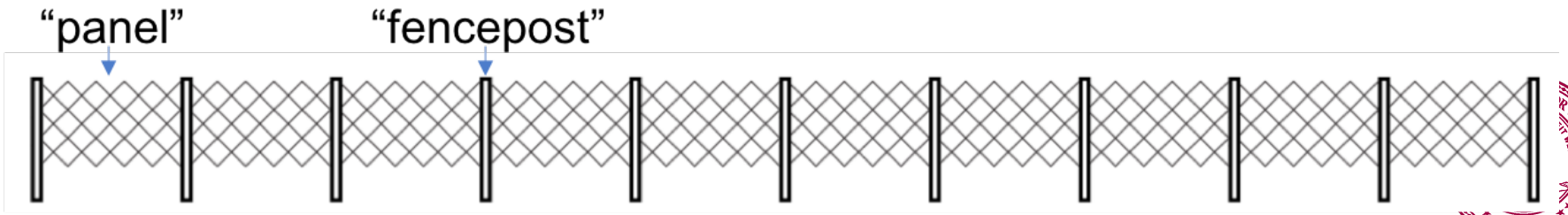

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guess = int(input("Enter a guess: "))

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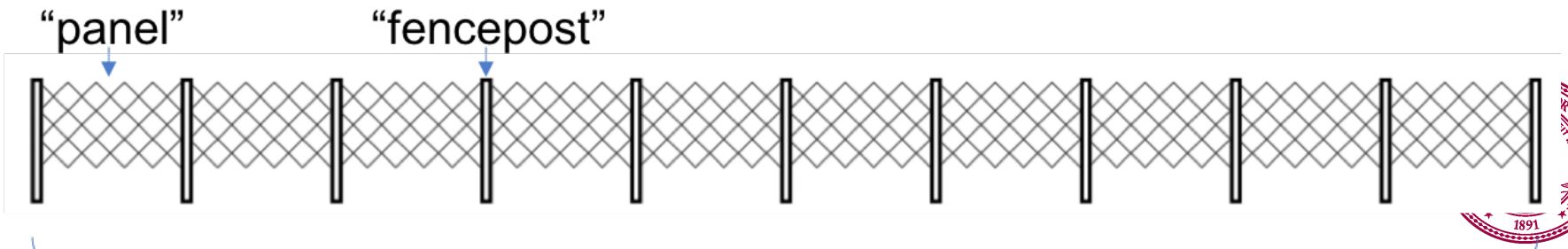

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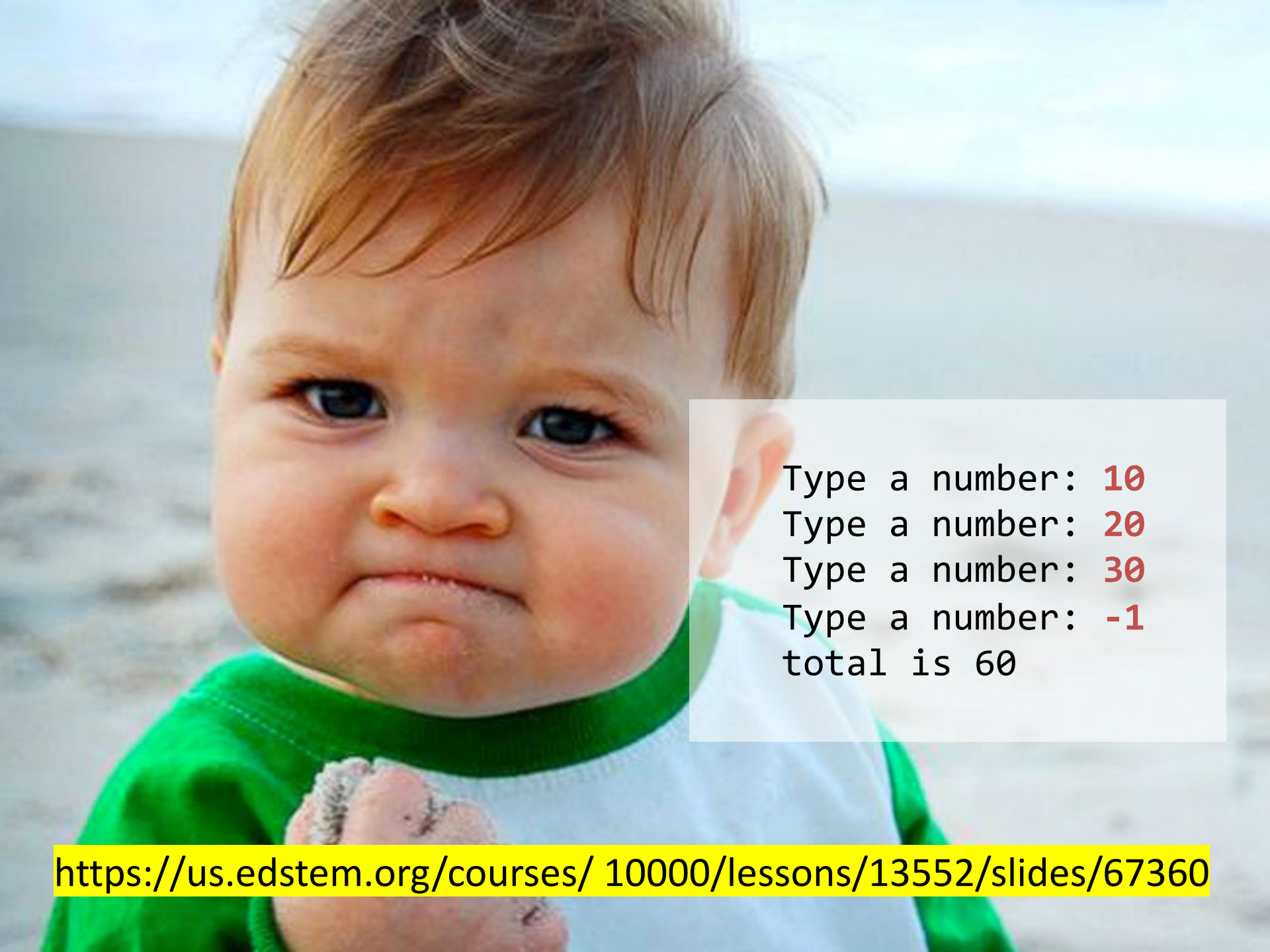
Challenge: Sentinel Loops

- **sentinel**: A value that signals the end of user input.
  - **sentinel loop**: Repeats until a sentinel value is seen.

- Example: Write a program that prompts the user for numbers until the user types -1, then output the total of the numbers.
  - In this case, -1 is the sentinel value.

```
Type a number: 10
Type a number: 20
Type a number: 30
Type a number: -1
total is 60
```


Time to shine



https://us.edstem.org/courses/ 10000/lessons/13552/slides/67360

Example: Sentinel Loops

```
# fencepost problem!
# ask for number - post
# add number to total - fence

total = 0
while num != -1:
    num = int(input("Enter a number: "))
    total += num


print("total is " + total)
```

```
NameError:
name 'num' is not defined
```


Example: Sentinel Loops

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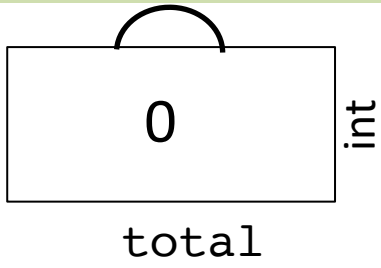


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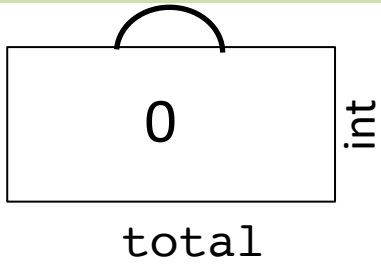


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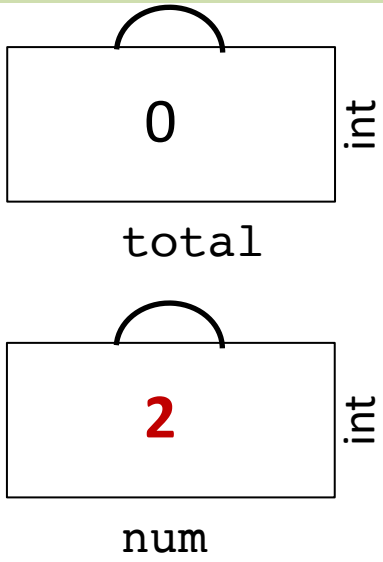


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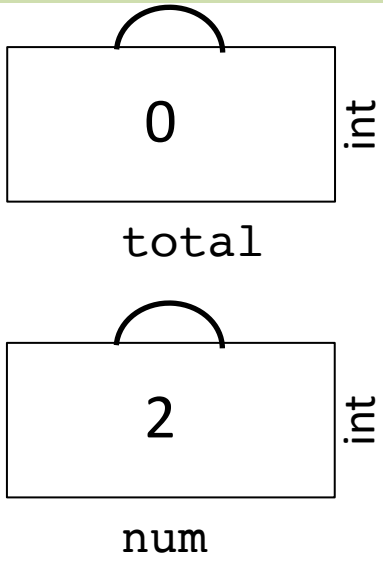


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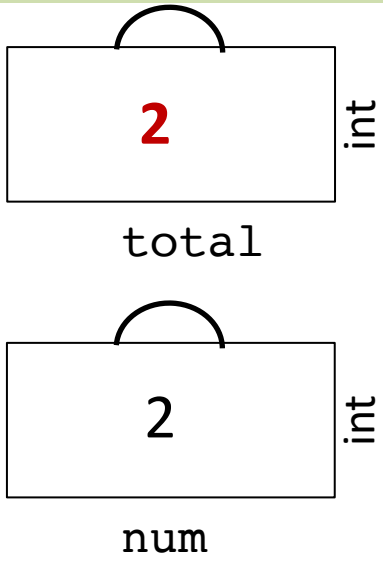


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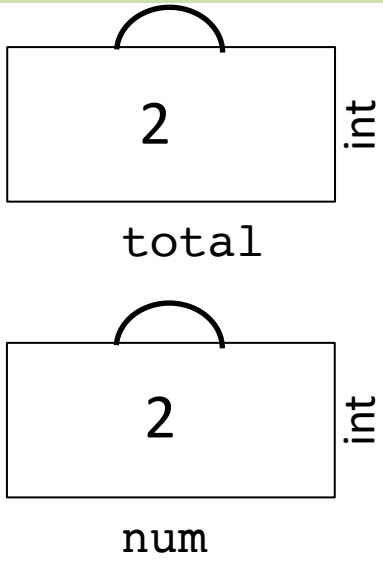


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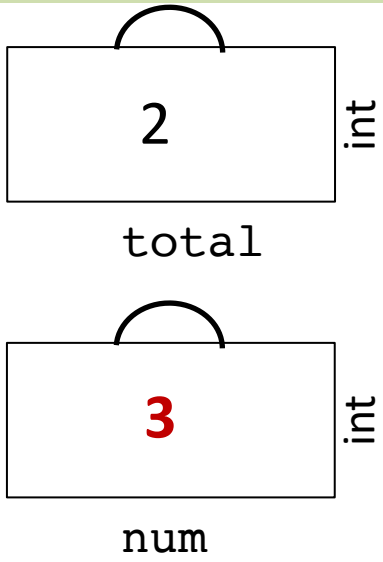


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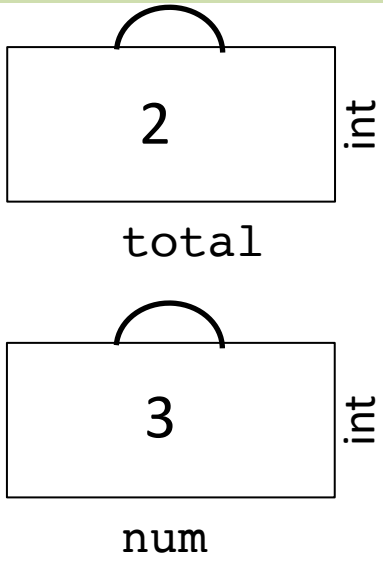


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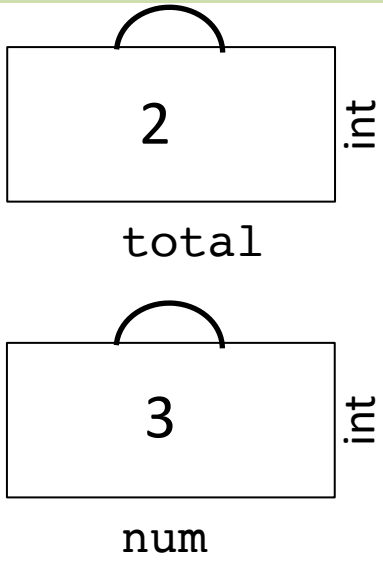
```

Example: Sentinel Loops

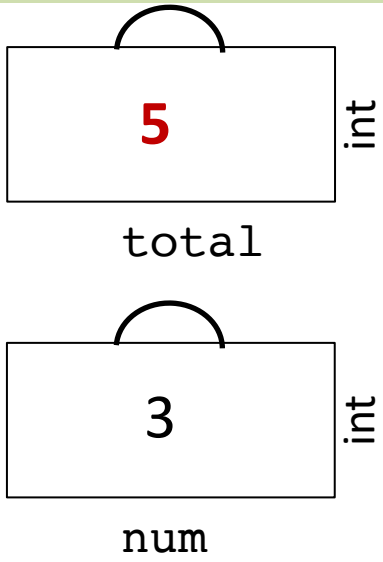



```
# fencepost problem!
# ask for number - post
# add number to total - fence

total = 0
num = int(input("Enter a number: "))
while num != -1:
    total += num
    num = int(input("Enter a number: "))

print("total is " + total)
```

Example: Sentinel Loops

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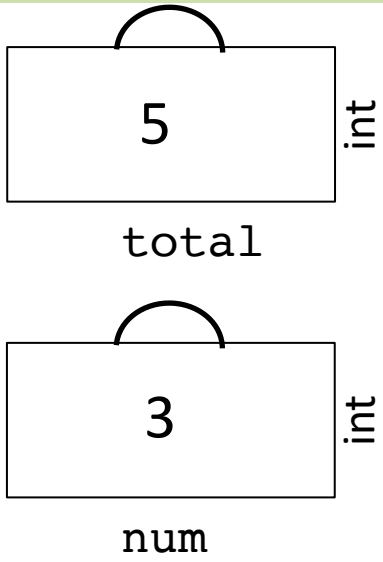
Example: Sentinel Loops

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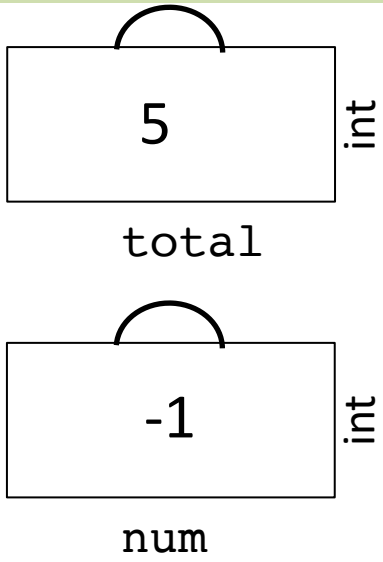
```

Example: Sentinel Loops

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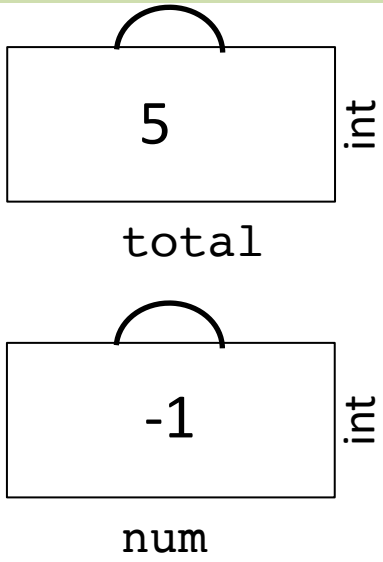
print("total is " + total)
```

Example: Sentinel Loops

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# ask for number - post
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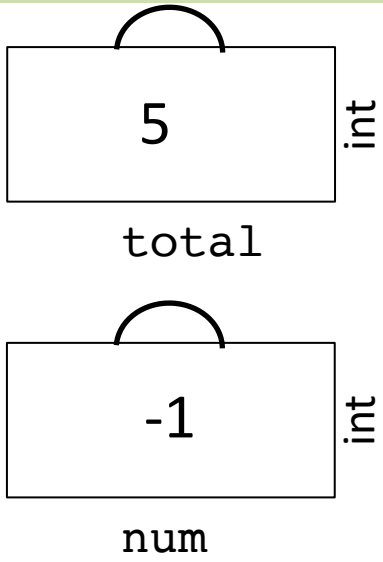
total = 0
num = int(input("Enter a number: "))
while num != -1:
    total += num
    num = int(input("Enter a number: "))

print("total is " + total)
```

Example: Sentinel Loops

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while num != -1:
    total += num
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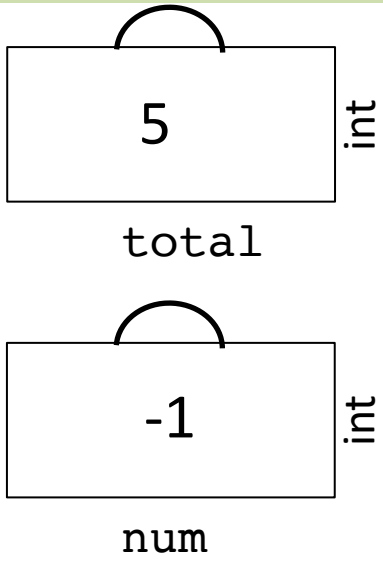
print("total is " + total)
```

Example: Sentinel Loops

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total = 0
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while num != -1:
    total += num
    num = int(input("Enter a number: "))

print("total is " + total)
```

Example: Sentinel Loops

```
# fencepost problem!
# ask for number - post
# add number to total - fence

total = 0
while True:
    num = int(input("Enter a number: "))
    if num == -1:
        break # immediately exits loop
    total += num
print("total is " + total)
```


Example: Sentinel Loops

```
# fencepost problem!
# ask for number - post
# add number to total - fence

total = 0
while True:
    num = int(input("Enter a number: "))
    if num == SENTINEL:
        break # immediately exits loop
    total += num
print("total is " + total)
```


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`

Can "chain" tests

```
# is x between 2 and 10?
2 <= x and x <= 10
```

Precedence Madness

Precedence:

arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
```

https://docs.python.org/3/reference/expressions.html#operator-totalmary

Precedence Madness

Precedence:

arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
5 * 7 >= 3 + 5 * 6 and not False
```

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Precedence Madness

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arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
35 >= 3 + 5 * 6 and not False
```

https://docs.python.org/3/reference/expressions.html#operator-totalmary

Precedence Madness

Precedence:

arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
35 >= 3 + 5 * 6 and not False
35 >= 3 + 30 and not False
```

https://docs.python.org/3/reference/expressions.html#operator-totalmary

Precedence Madness

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arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
35 >= 3 + 5 * 6 and not False
35 >= 3 + 30 and not False
35 >= 33 and not False
```

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Precedence Madness

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arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
35 >= 3 + 5 * 6 and not False
35 >= 3 + 30 and not False
35 >= 33 and not False
True and not False
```

https://docs.python.org/3/reference/expressions.html#operator-totalmary

Precedence Madness

Precedence:

arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
35 >= 3 + 5 * 6 and not False
35 >= 3 + 30 and not False
35 >= 33 and not False
True and not False
True and True
```

https://docs.python.org/3/reference/expressions.html#operator-totalmary

Precedence Madness

Precedence:

arithmetic > comparison > not > and/or

```
5 * 7 >= 3 + 5 * (7 - 1) and not False
35 >= 3 + 5 * 6 and not False
35 >= 3 + 30 and not False
35 >= 33 and not False
True and not False
True and True
True
```

https://docs.python.org/3/reference/expressions.html#operator-totalmary

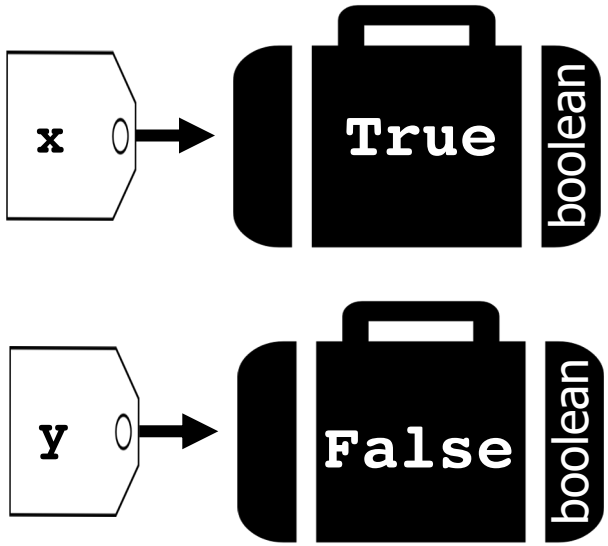
George Boole

English Mathematician teaching in Ireland 1815 – 1864

Boole died of being too cool

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_sheltering = True
is_raining = 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_sheltering = True
is_raining = False

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



```
is_allowed = not food or drinks
```

*know your logical precedence

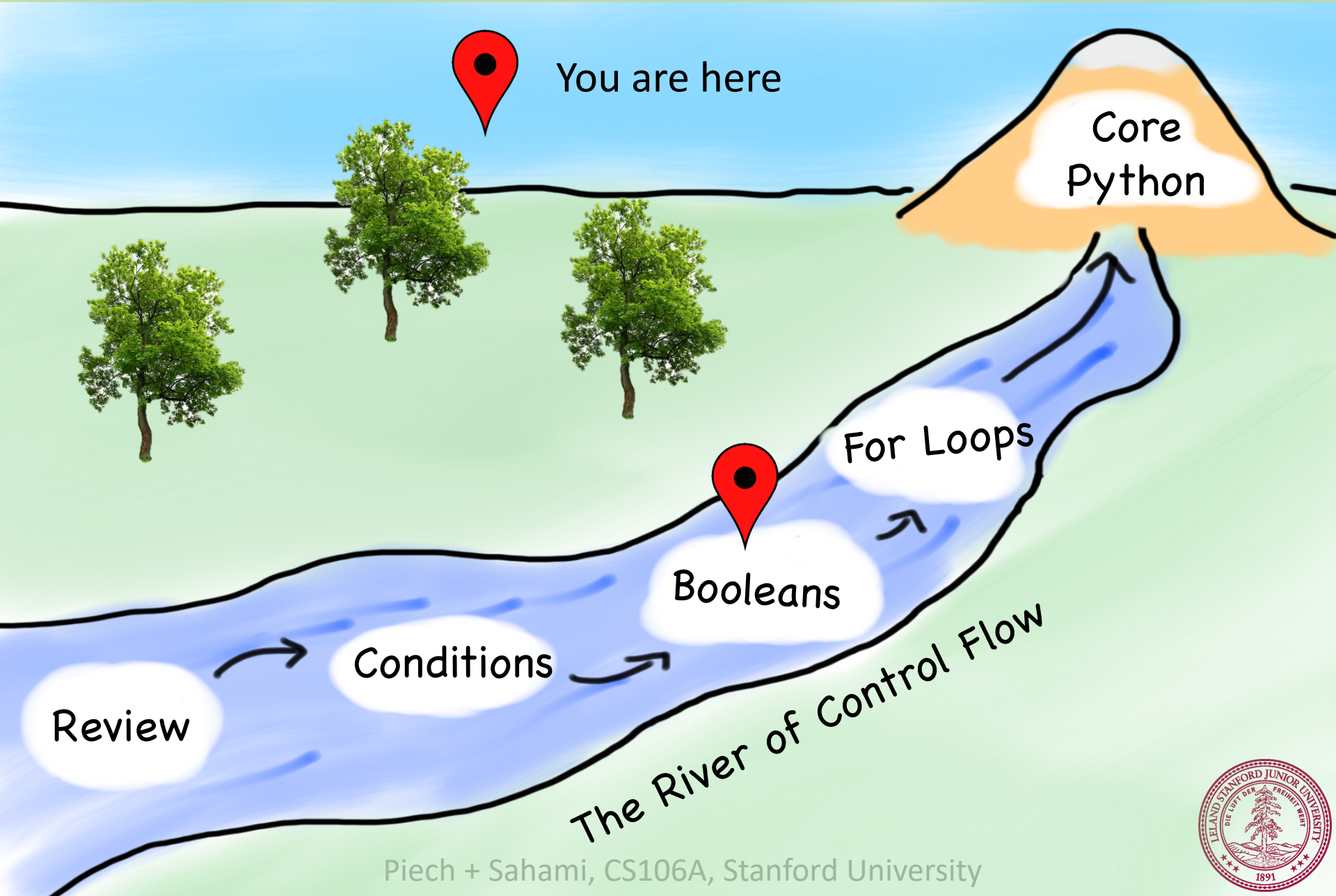

```
is_allowed = not food or drinks
False
```

*know your logical precedence

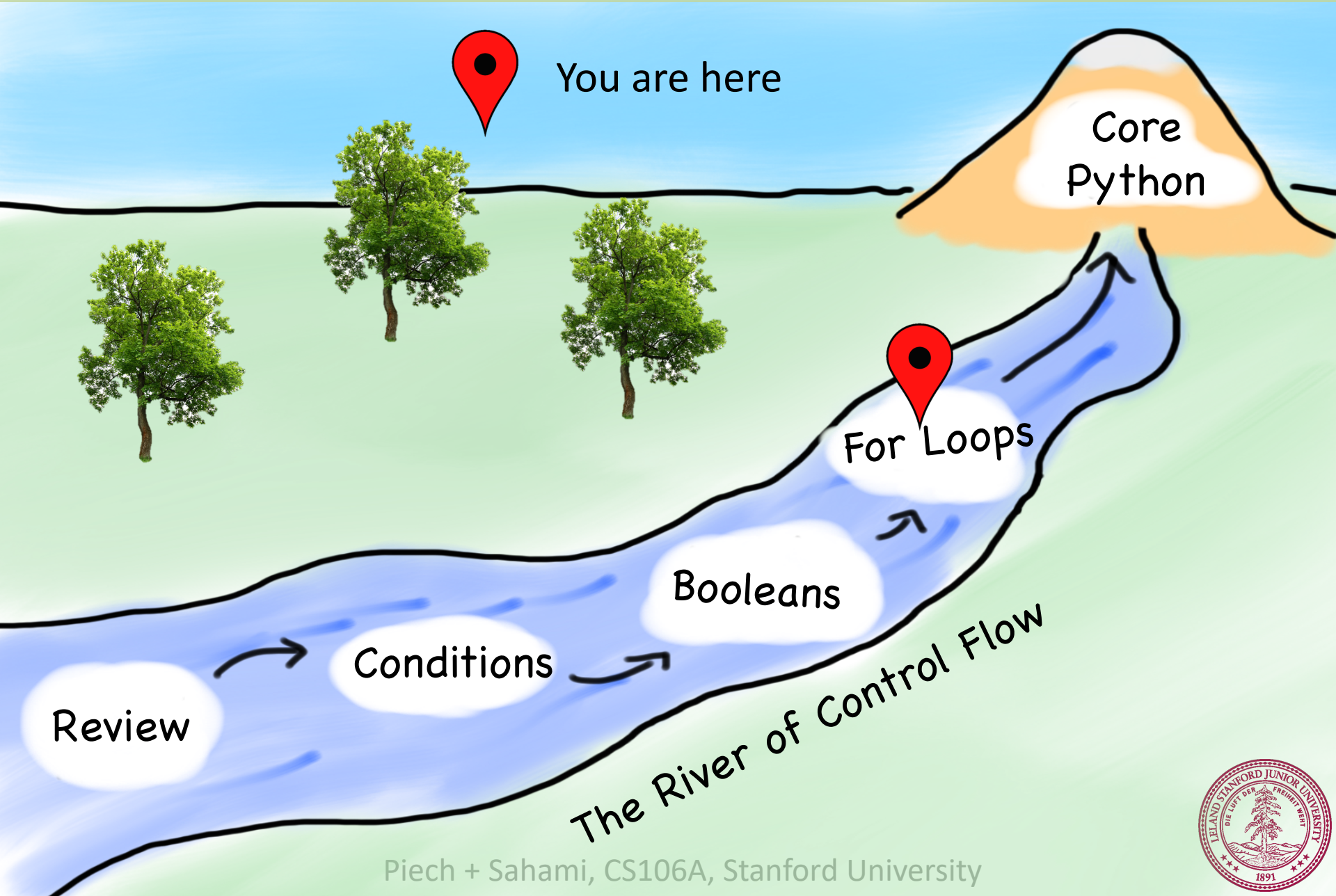

```
is_allowed = not food or drinks
                 False      True
```

*know your logical precedence

Today's Route



Today's Route



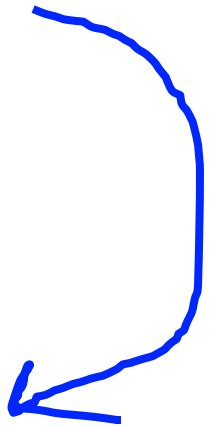
How would you print “Python rocks socks” 100 times

For Loop Redux

```
public void run() :
   for i in range(100):
      print("Python rocks socks!")
```


For Loop Redux

```
for i in range(100):
    print("Python rocks socks!")
```



```
i = 0
while i < 100:
    print("Python rocks socks!")
    i += 1
```

For Loop Redux

Create a counting variable i

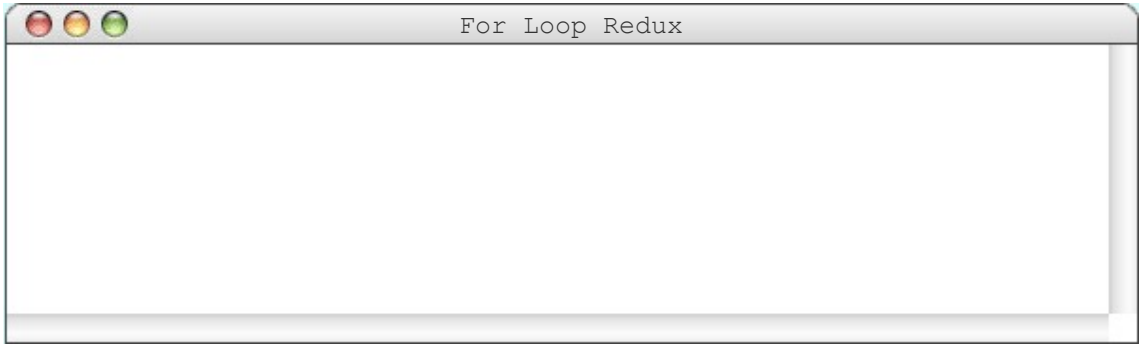
Which takes on the values 0 to 99 one at a time

```
for i in range(100):
    print("Python rocks socks!")
```


For Loop Redux

range(3) -> [0, 1, 2]

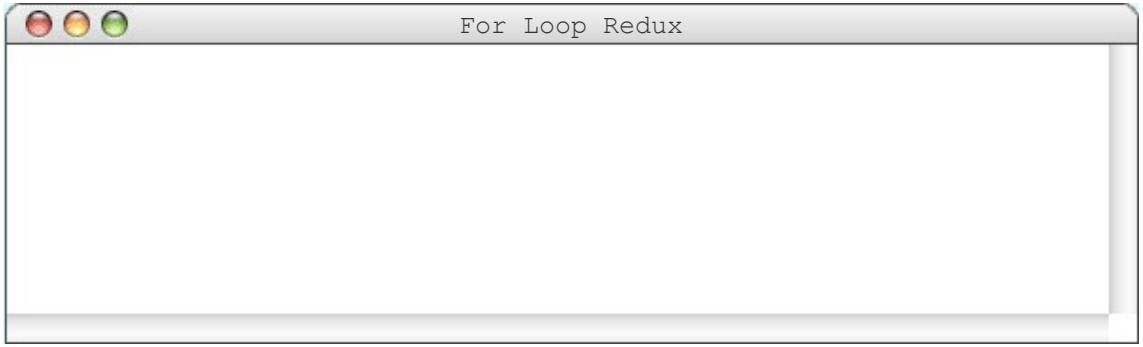
```
for i in range(3):
    print("Python rocks socks!")
```



For Loop Redux

range(3) -> [0, 1, 2]

```
for i in range(3):
    print("Python rocks socks!")
```

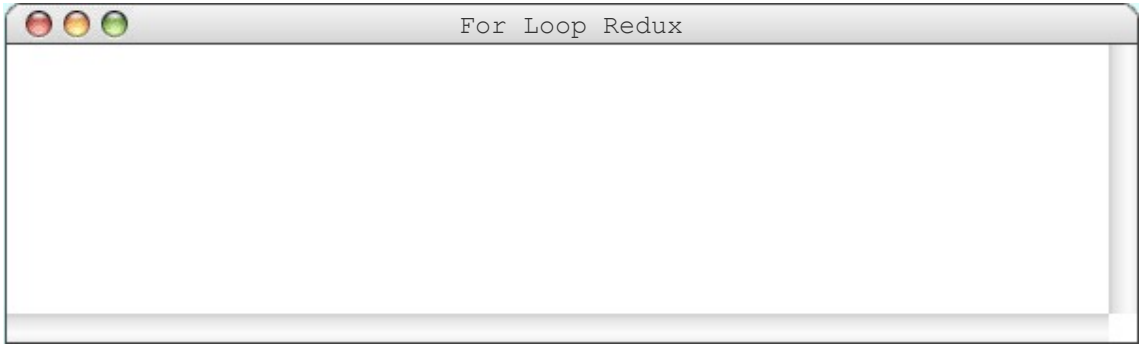


For Loop Redux

i | 0

range(3) -> [0, 1, 2]

```
for i in range(3):
    print("Python rocks socks!")
```



For Loop Redux

i | 0

range(3) -> [0, 1, 2]

```
for i in range(3):
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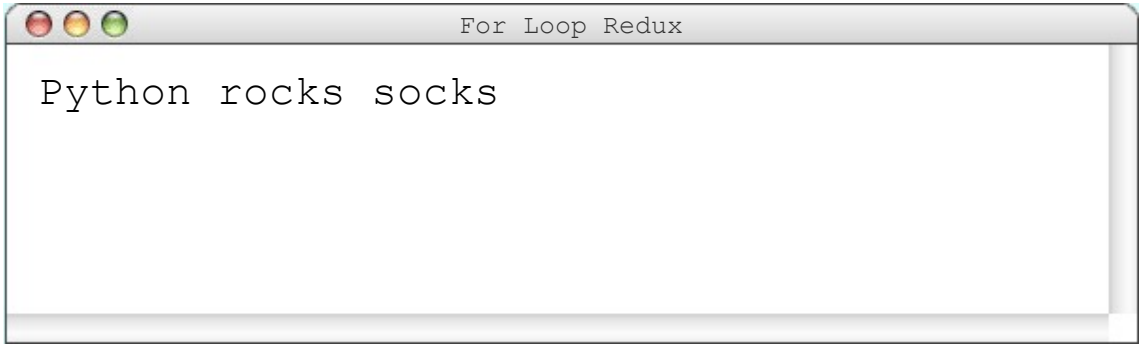
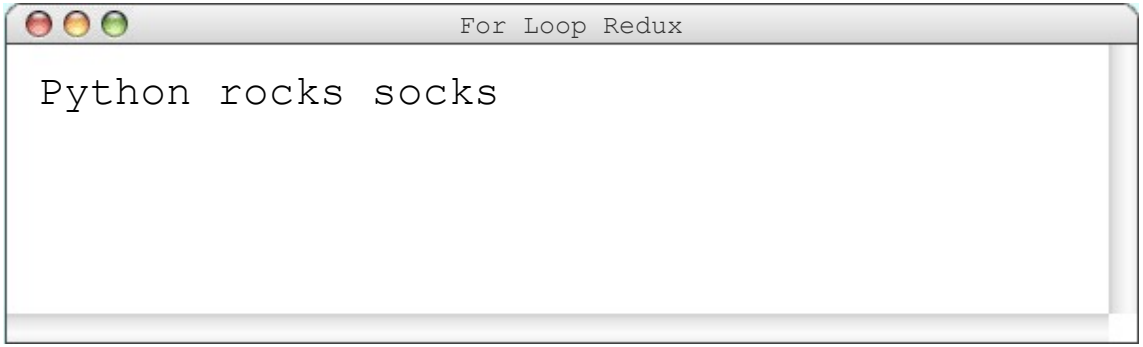


For Loop Redux

i | 0

range(3) -> [0, 1, 2]

```
for i in range(3):
    print("Python rocks socks!")
```

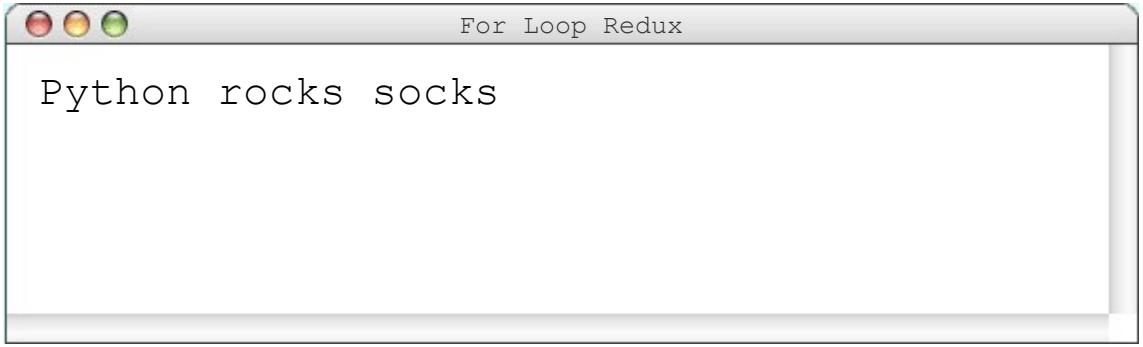


For Loop Redux

i 1

range(3) -> [0, 1, 2]

```
for i in range(3):
    print("Python rocks socks!")
```



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i | 1

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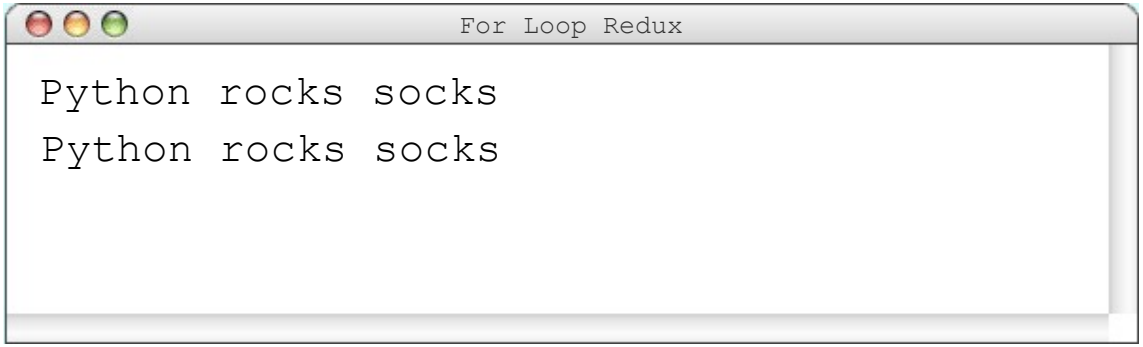

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i | 1

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for i in range(3):
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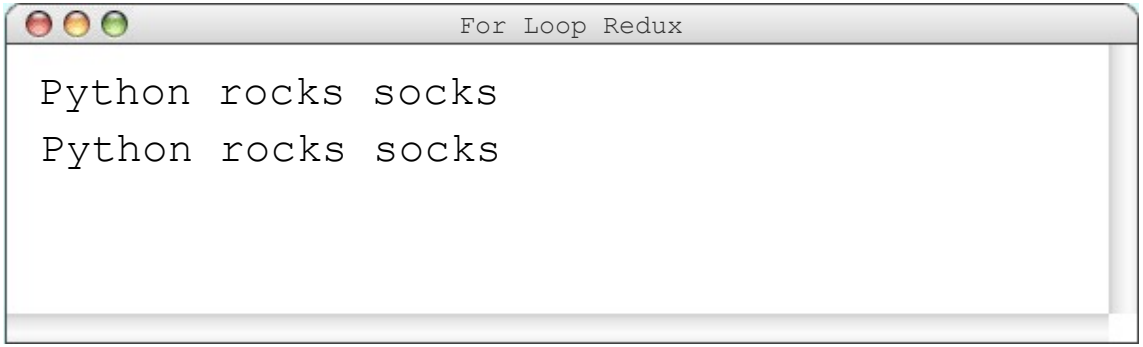
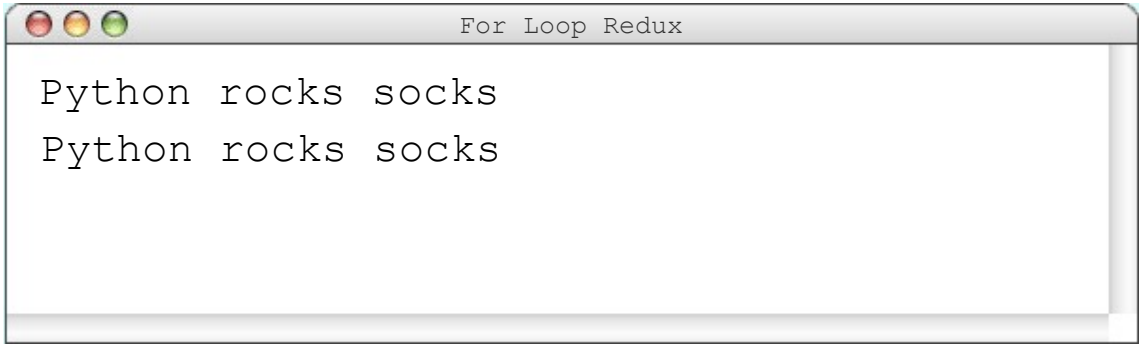


For Loop Redux

i 2

range(3) -> [0, 1, 2]

```
for i in range(3):
    print("Python rocks socks!")
```



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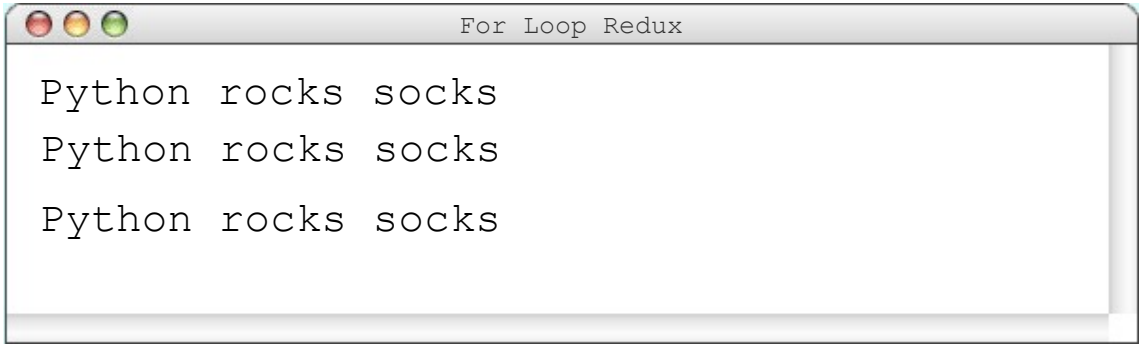

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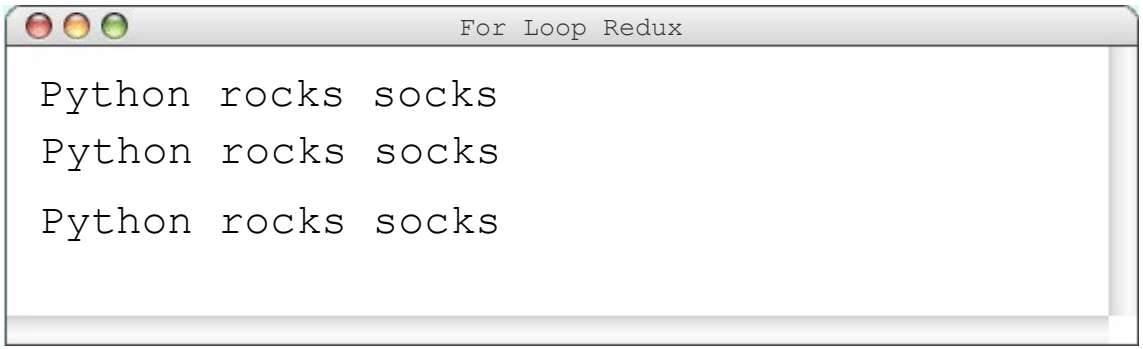
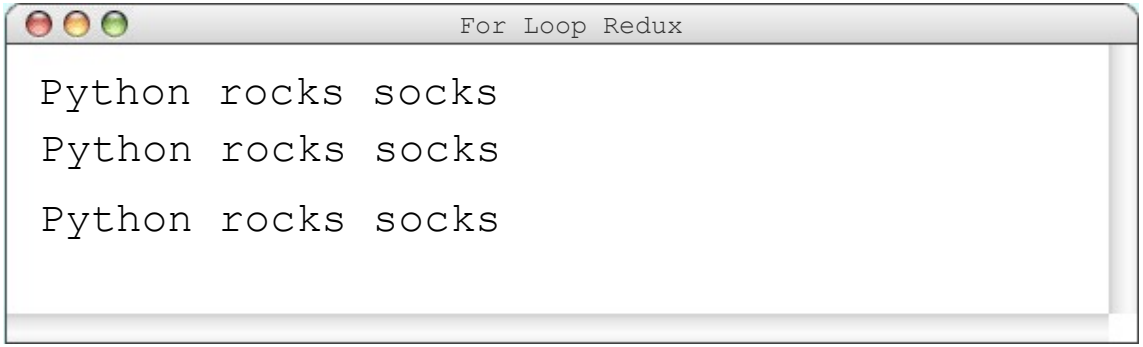


For Loop Redux

i 3

range(3) -> [0, 1, 2]

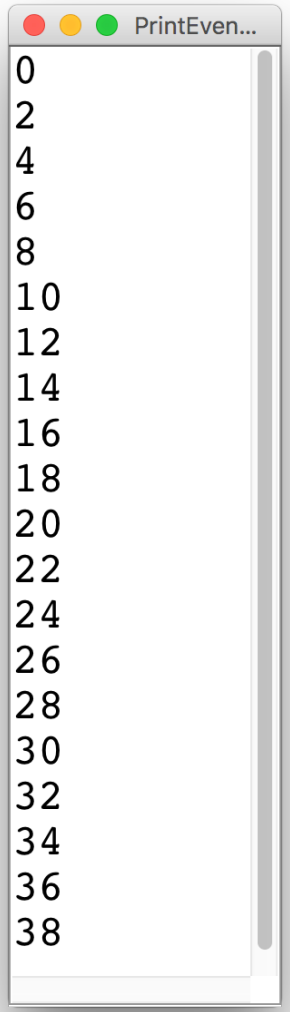
```
for i in range(3):
    print("Python rocks socks!")
```



You can use the for loop variable

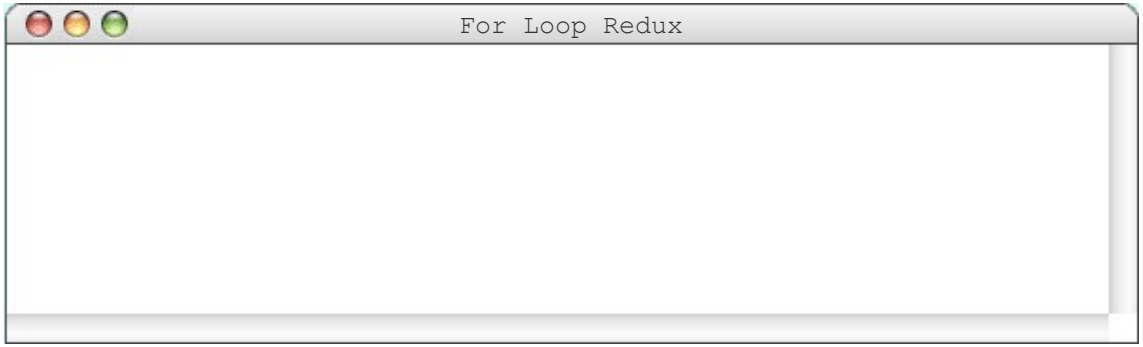
How would you print the first 100 even numbers?

Printing Even Numbers



Printing Even Numbers

```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

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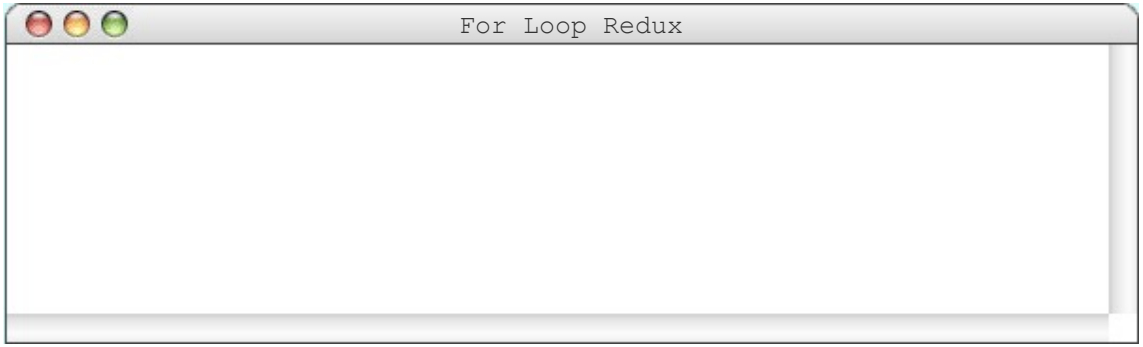
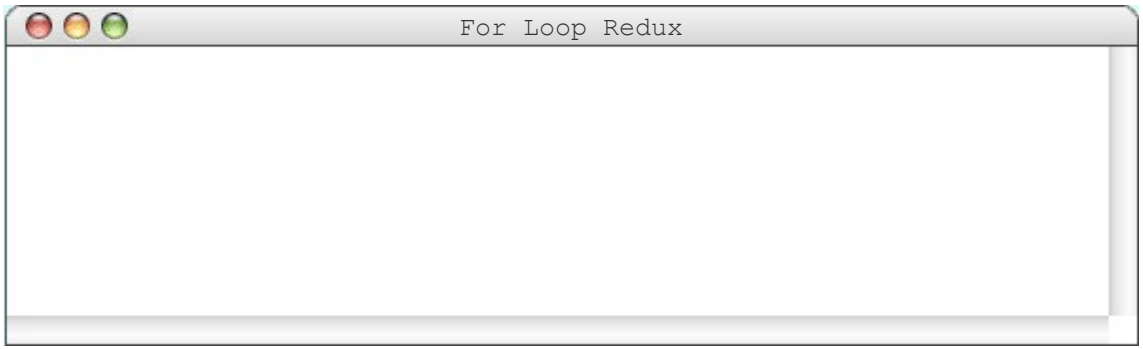


Printing Even Numbers

i	0

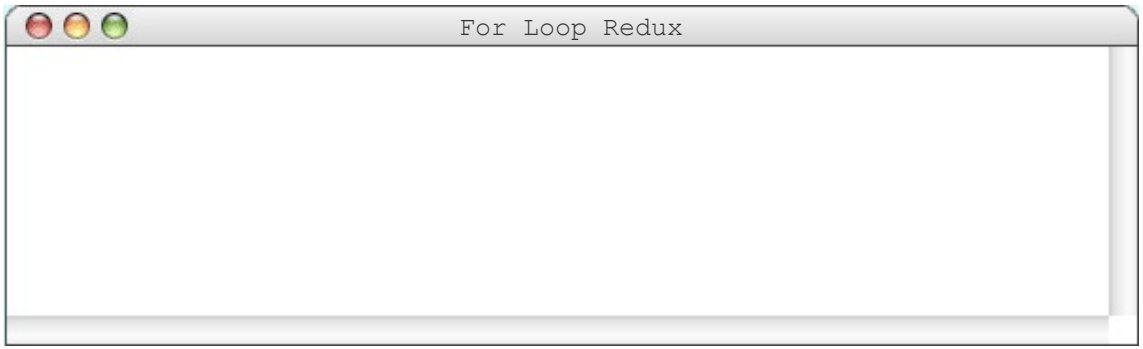
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

i | 0

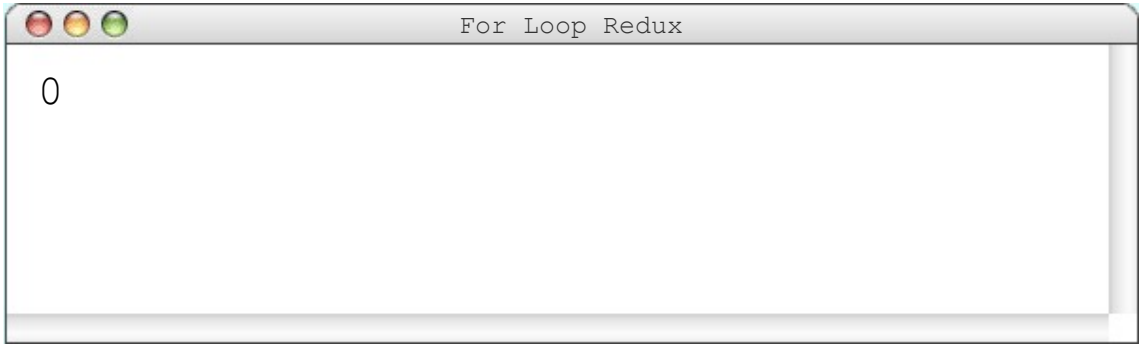
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

i	0

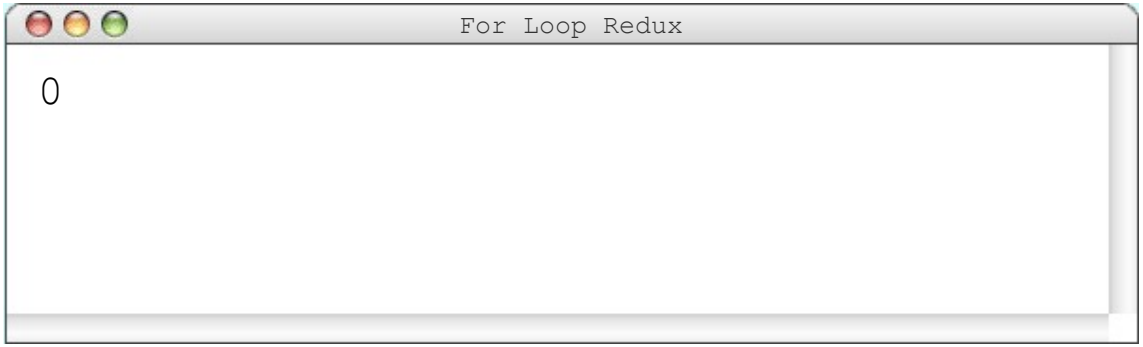
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

i 1

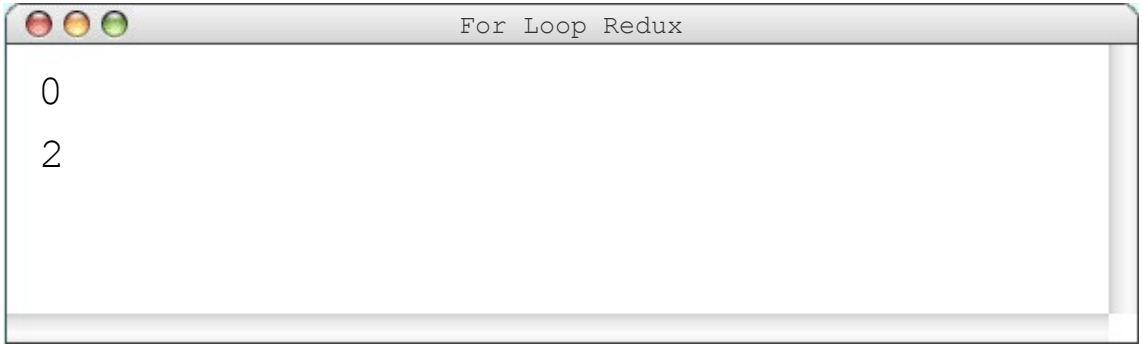
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

i	1

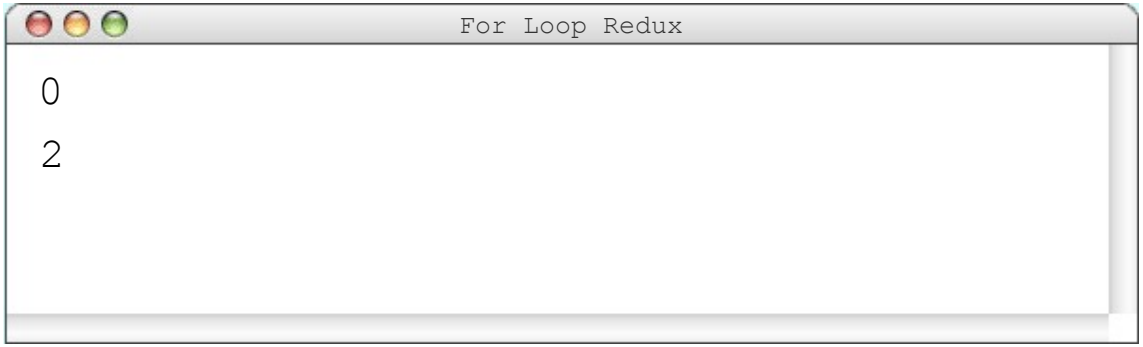
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

i 2

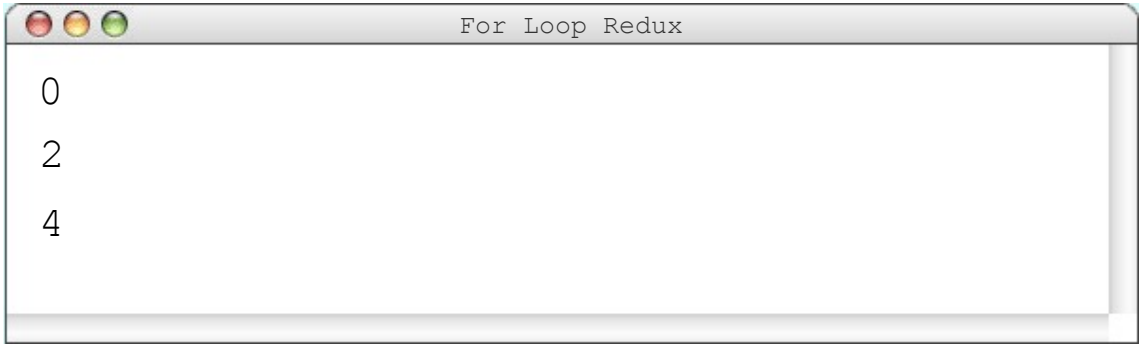
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

i	2

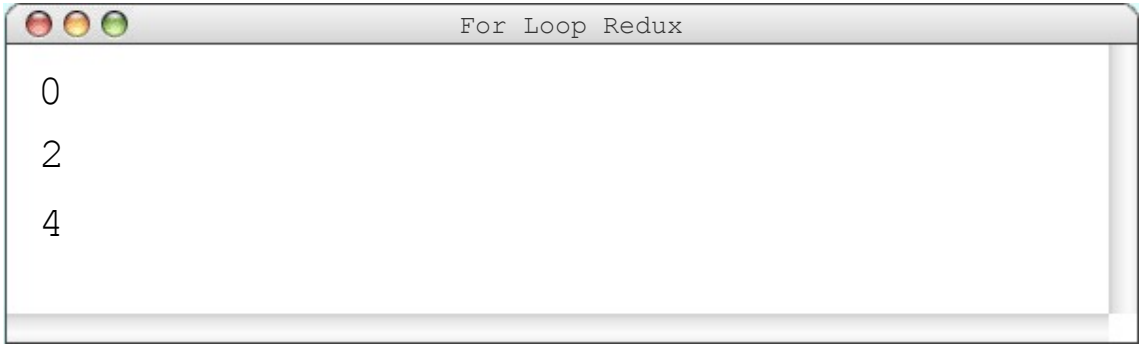
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

i | 3

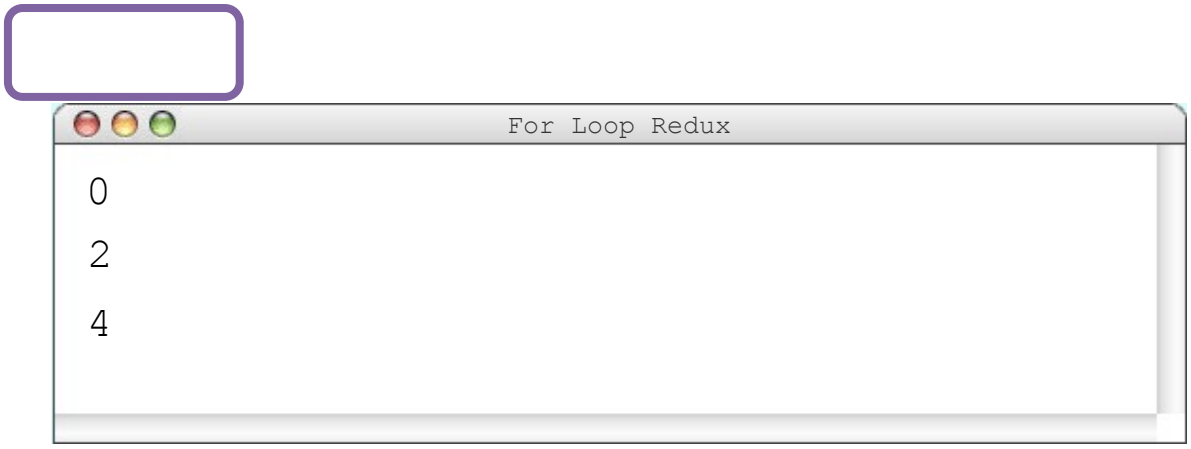
```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

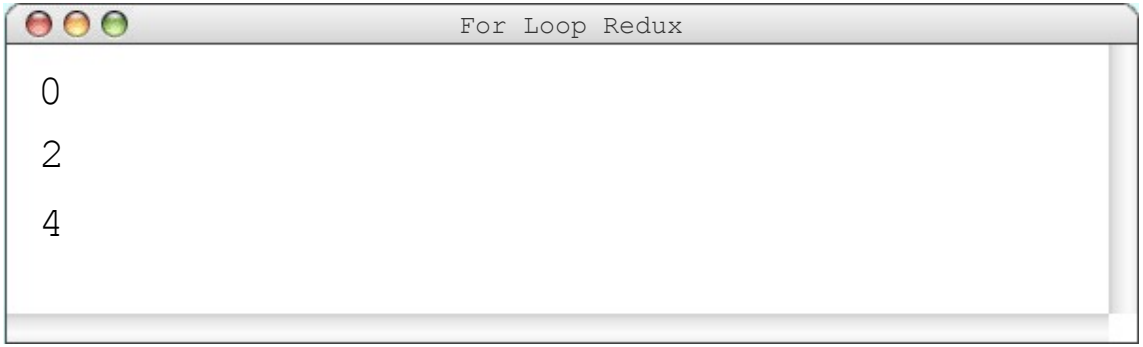
i	3

```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

```
for i in range(3):
    print(i * 2)
```



Printing Even Numbers

```
# our solution
for i in range(3):
    print(i * 2)
```

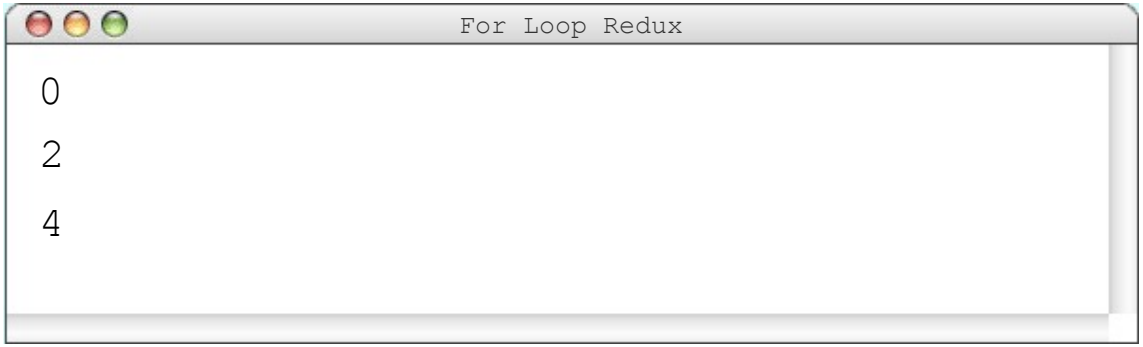
0, 1, 2

```
# equivalently
for i in range(0, 6, 2):
    print(i)
```

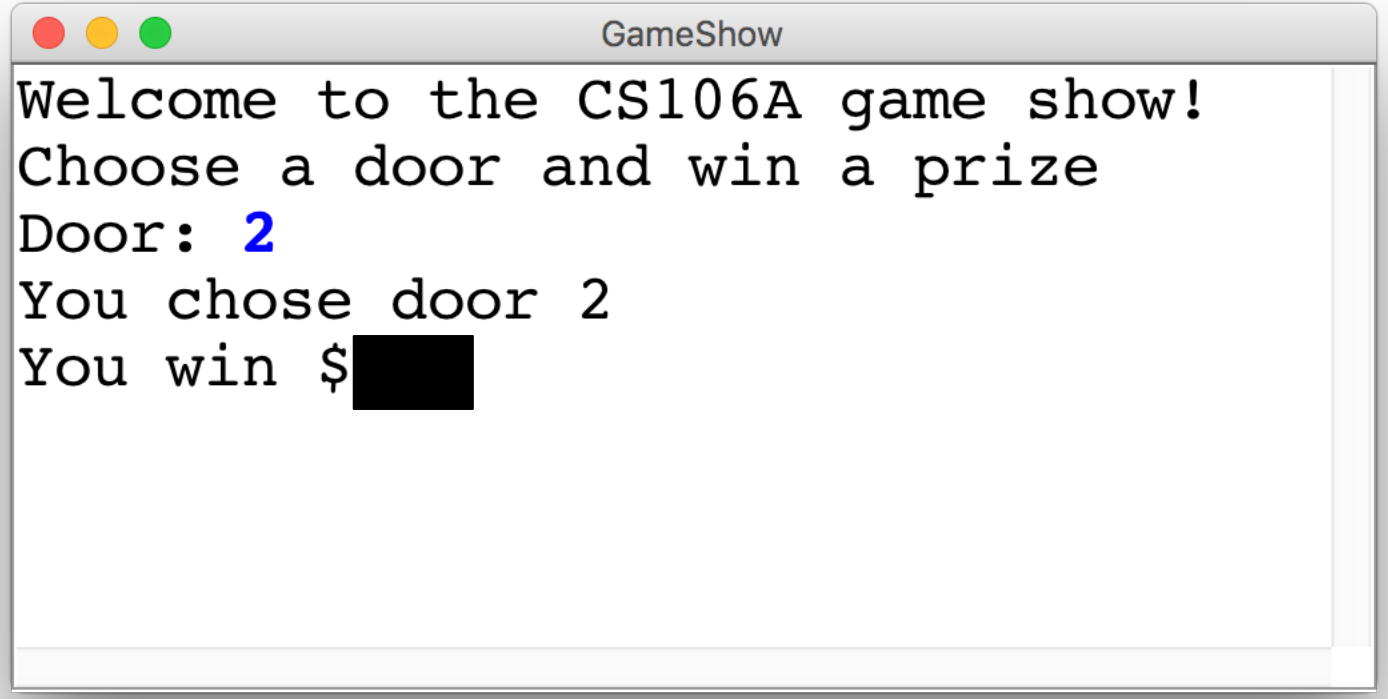
Start at 0

Stop before 6

Skip by 2 each time



Game Show



* To be delivered via amazon gift cards

Choose a Door

```
door = int(input("Door: "))
# while the input is invalid
while door < 1 or door > 3 :
    # tell the user the input was invalid
    print("Invalid door!")
    # ask for a new input
    door = int(input("Door: "))
```

or

and

The Door Logic

```
prize = 4

if door == 1:
   prize = 2 + 9 // 10 * 100

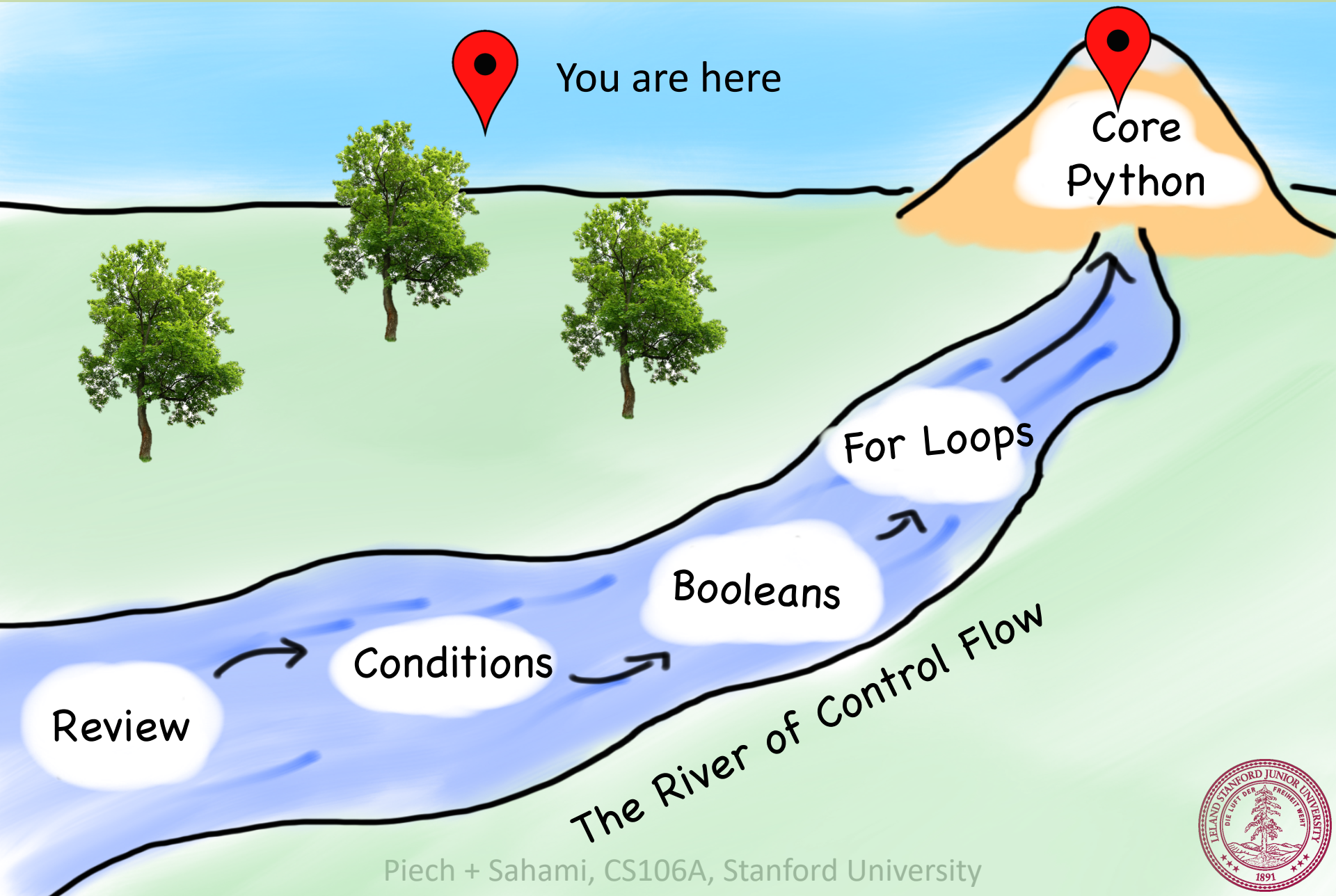
elif door == 2:
   locked = prize % 2 != 0
   if not locked:
      prize += 6

elif door == 3 :
   for i in range(door):
      prize += i
```

That's all

```
def main() :
    for i in range(999999):
        print("You rock!")
        print("See you on Monday")
```


Today's Route



Today's Goal

1. Be able to use For / While / If in Python