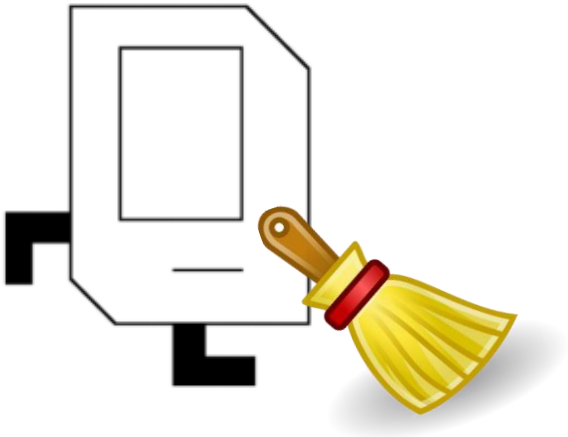
Control Flow Revisited

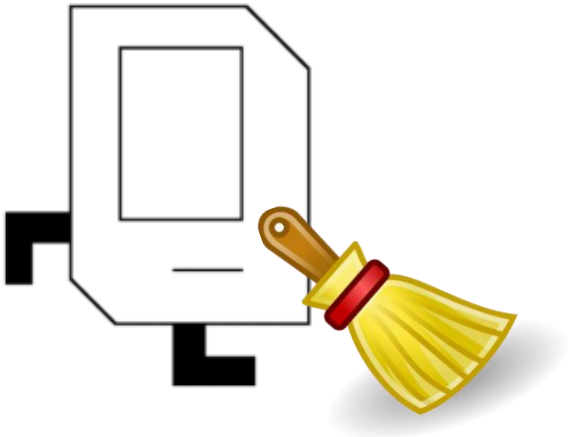
CS106A, Stanford University

Housekeeping



- Assignment #1 due today
  - How long did you spend on it?
- Assignment #2 goes out today
  - It is due at 12:15pm on Friday, April 15th (one week)
- Invitation to participate in a study of learning introductory computing
  - Watch “Diary Study invitation” video on Canvas

Housekeeping II



- Extra office hours on Sundays from 3-5pm on Zoom
  - Details in post of Ed discussion Forum
- If you are comfortable doing so, please let us know your preferred name and your preferred pronouns
  - Also, if you can provide an audio recording of the pronunciation of your name
  - You can provide this information at the website: https://cs198.stanford.edu/profile

Review

Statement Block

- A *block* (also called a *suite*) in Python is defined by a set of lines of code indented by (at least) the same amount
  - A block ends when the next line is indented less than the line before it
- Example:

```
main():
    move_to_wall()
    for i in range(3):
        turn_left()
    move()

def move_to_wall():
    while front_is_clear():
        move()
```


Statement Block

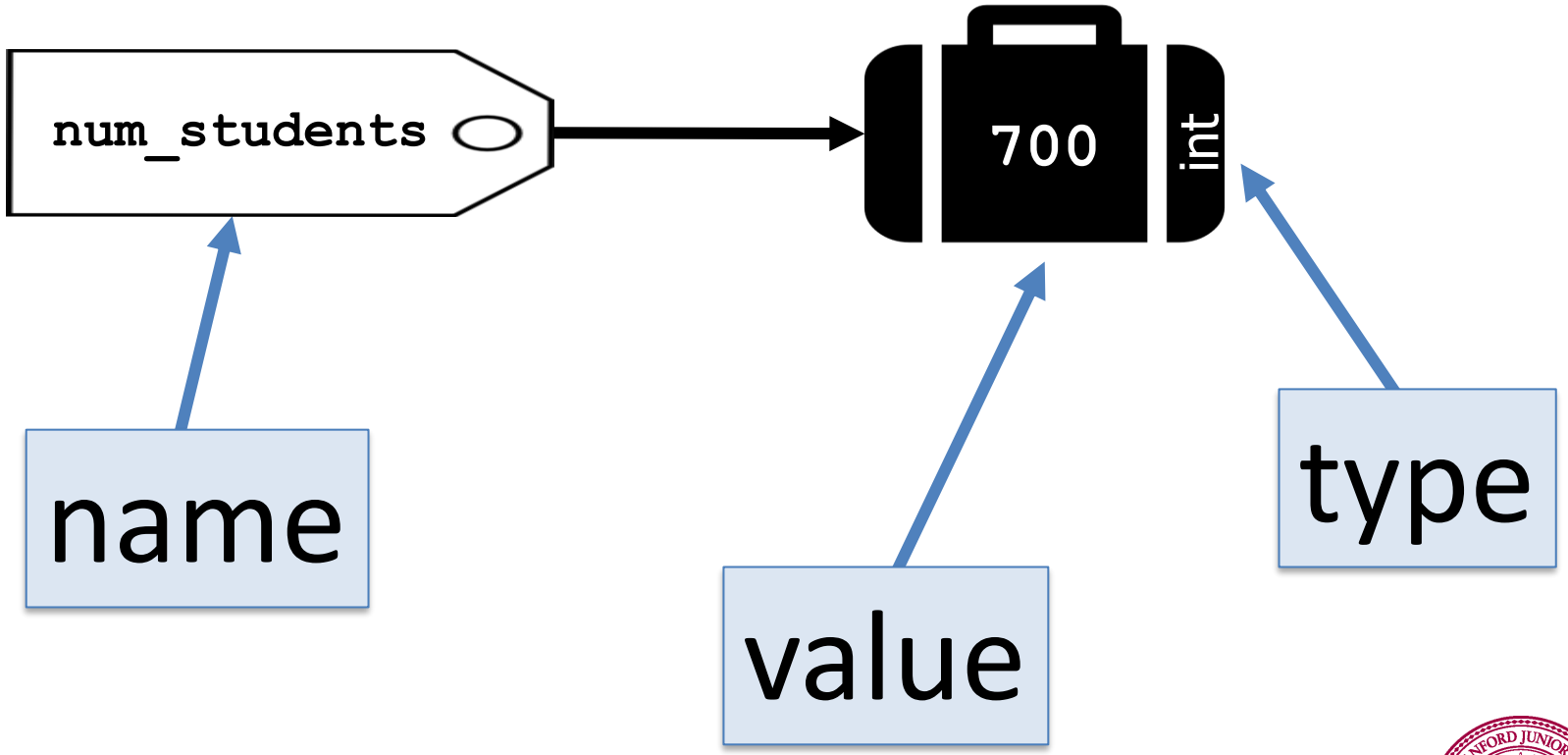
- A *block* (also called a *suite*) in Python is defined by a set of lines of code indented by (at least) the same amount
  - A block ends when the next line is indented less than the line before it
- Example:

```
main():
    move_to_wall()
    for i in range(3):
        turn_left()
    move()

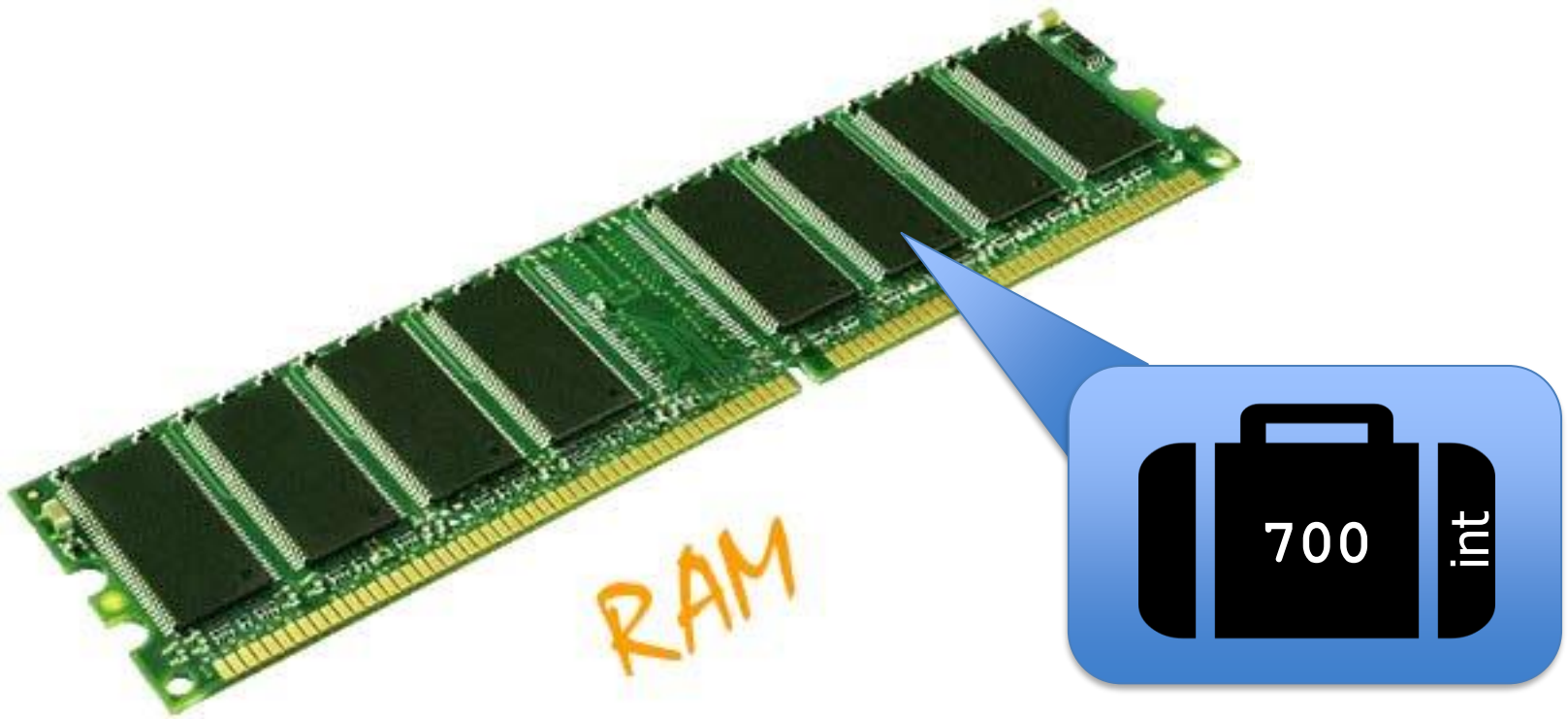
def move_to_wall():
    while front_is_clear():
        move()
```


Suitcase Analogy

```
num_students = 700
```



Teeny Tiny Suitcases



Your computer has space for millions of suitcases!

Create, Modify, Use

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

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

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

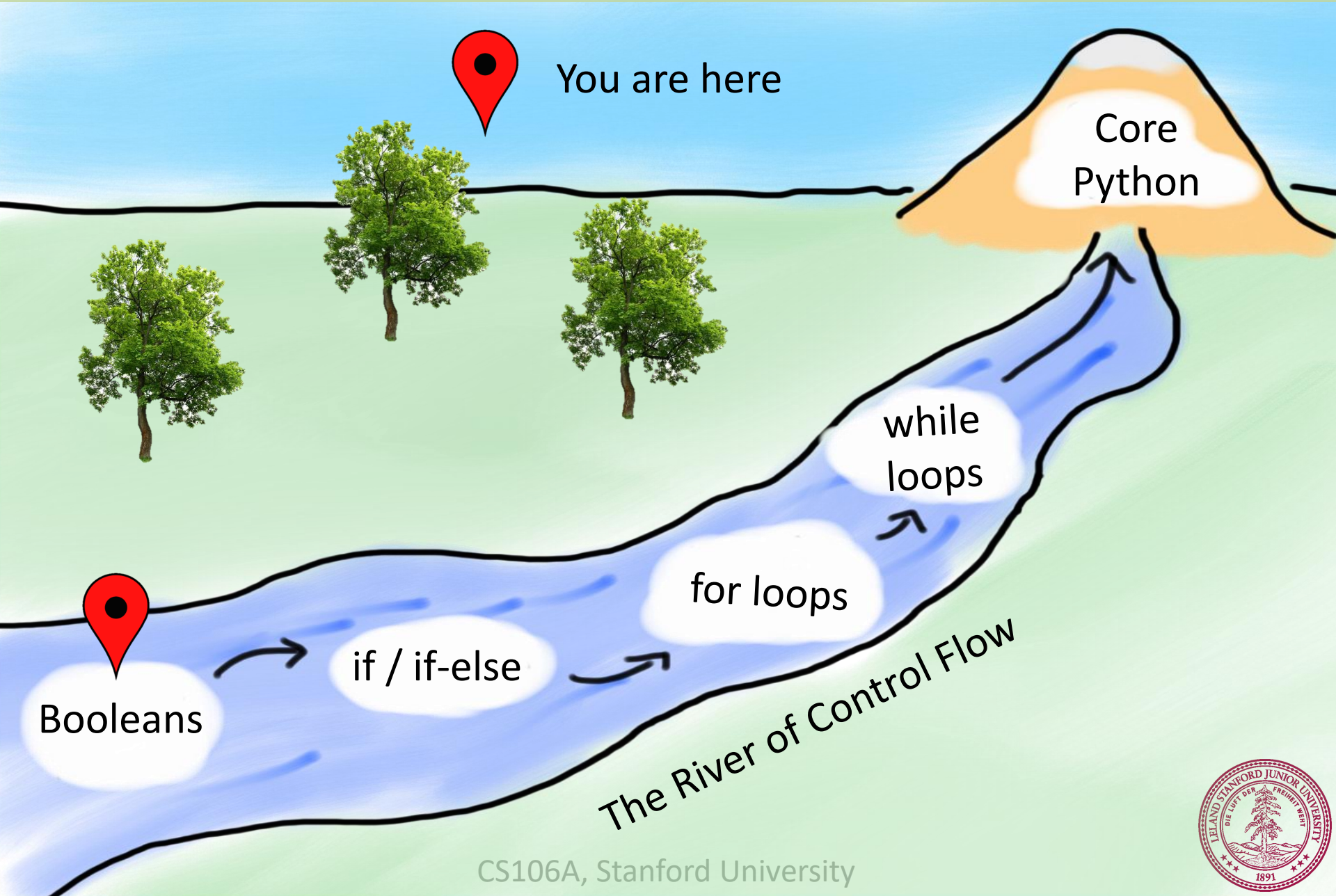
Recall, Arithmetic Operators

+	Addition
–	Subtraction
*	Multiplication
/	Division

Today's Goal

1. Learn about Boolean variables
2. Use For / While / If statements in Python

Today's Route



George Boole

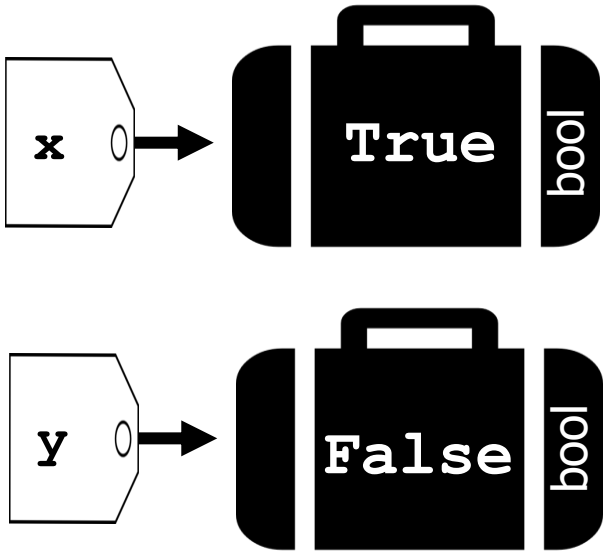
English Mathematician teaching in Ireland 1815 – 1864
Boole died of being too cool (literally)!

Boolean Variables

- Boolean variables only have values **`True`** or **`False`**

```
x = True
y = False
```

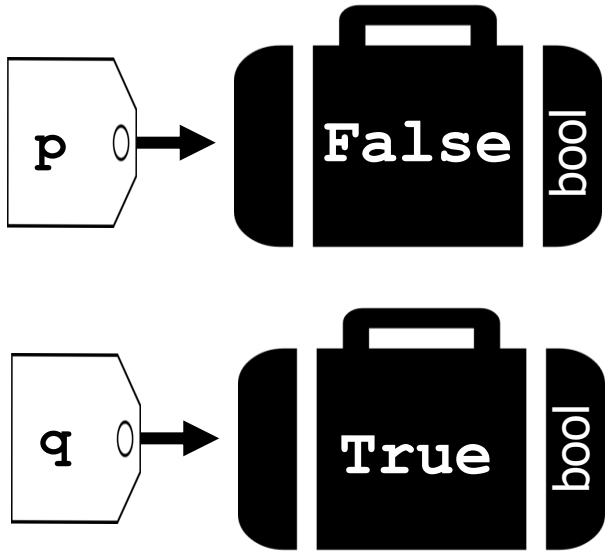
- Represent logical values
- Type is called **bool** in python



Boolean Variables

- Can also set value of Boolean variable by comparison
  - This is called a Boolean expression

```
p = 5.0 < 4.0
q = 2 > 1
```



Comparison Operators

Operator	Meaning	Example	Value
==	equals	`(1 + 1) == 2`	`True`
!=	not equals	`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`

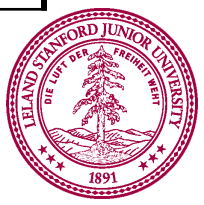
All have comparisons have equal precedence

Logical Operators

In order of precedence (assuming **`p`** and **`q`** are Boolean values):

Operator	Meaning
`not`	if **`p`** is **`True`** then **`not p`** is **`False`**, and vice versa
`and`	**`p and q`** is only **`True`** if **`p`** and **`q`** are both **`True`**. So, it is **`False`** when either **`p`** or **`q`** are **`False`**.
`or`	**`p or q`** is **`True`** if either **`p`** or **`q`** (or both) are **`True`**. So, it is only **`False`** when both **`p`** and **`q`** are **`False`**

Operator	Example	Result
`not`	**`not (2 > 3)`**	**`True`**
`and`	**`(2 == 3) and (-1 < 5)`**	**`False`**
`or`	**`(4 == 5) or (7 >= 3)`**	**`True`**



Logical Operators

- What if we want to determine that a variable **`x`** does not have a value of either 1 or 2?
- Might write something like how it sounds in English:

```
p = (x != 1) or (x != 2)
```

  - That's a bug! **`p`** will always be **`True`**
- Really, want to say:

```
p = (x != 1) and (x != 2)
```

- Bonus: you can chain tests for a range, like in algebra!

```
p = (2 <= x <= 10)
```

  - Same thing as:

```
p = (2 <= x) and (x <= 10)
```


Short Circuit Evaluation

- Python stops evaluating a Boolean expression as soon as it knows the answer
- Consider:

```
p = (5 > 3) or (4 <= 2)
```

- The test `(4 <= 2)` is not performed!

- Example of useful case:

```
p = (x != 0) and ((y % x) == 0)
```

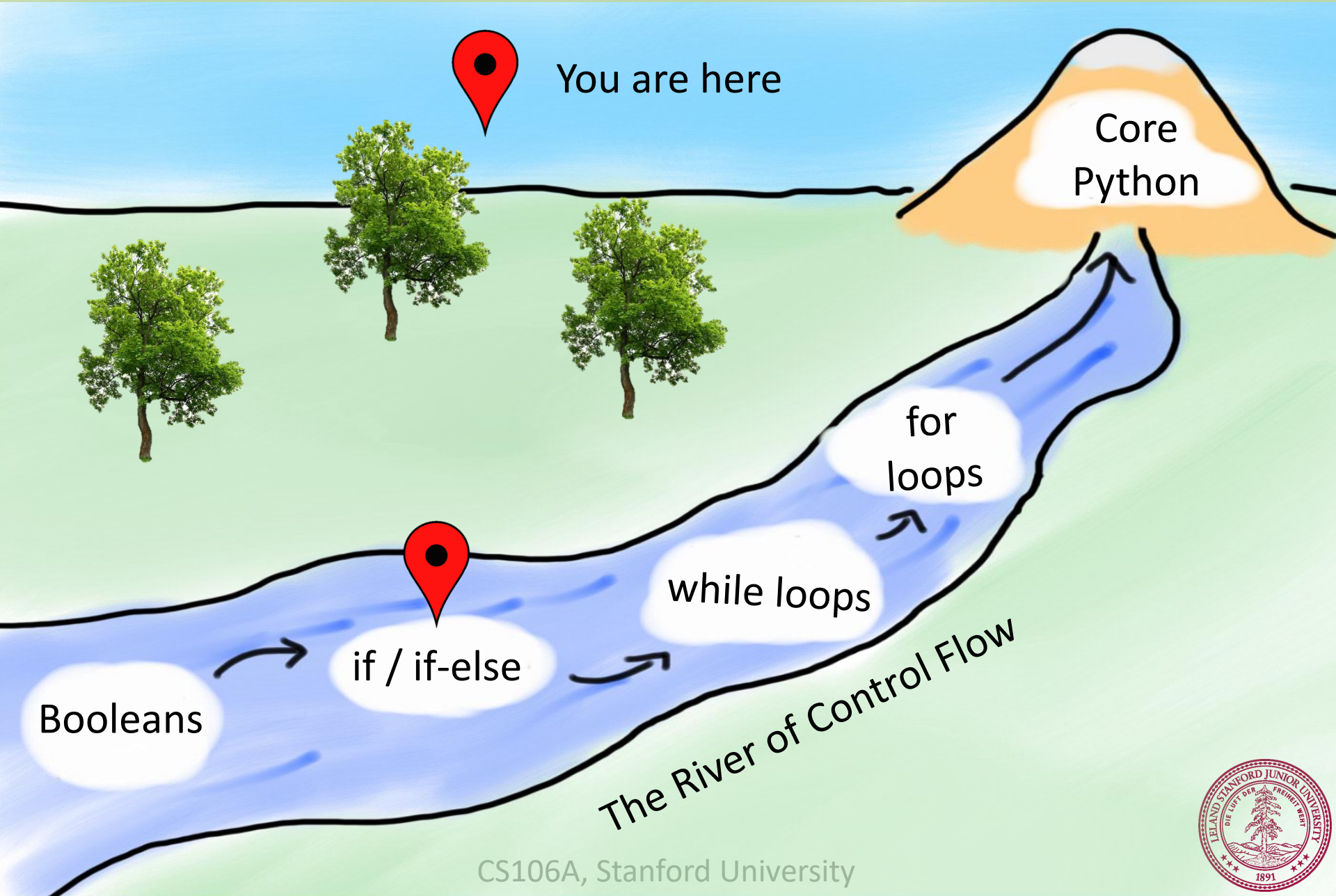
  - Avoid division by 0 error, since `((y % x) == 0)` is not performed when `x` is 0
    - To compute remainder (`%`), Python needs to do division


Please ...
NO FOOD OR
DRINKS
FreeSignPrinter.com


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


```
is_allowed = (not food) or drinks
```

Today's Route



`if` statements, revisited


```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number:
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number: 8
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number: 8
```

`if` statements, revisited


```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number: 8
8 is less than 10
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number: 8
8 is less than 10
Beat Cal!
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number:
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number: 15
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number: 15
```

`if` statements, revisited

Any Boolean expression or variable

```
if condition:
    statements                    # note indenting
    (block)
```

```
x = int(input("Enter a number: "))
if x < 10:
    print(x, "is less than 10")
print("Beat Cal!")
```

```
Enter a number: 15
Beat Cal!
```

Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number:
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 3
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 3
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 3
3 is positive
```

Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 3
3 is positive
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 3
3 is positive
I like to stay positive
```

Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 3
3 is positive
I like to stay positive
Thank you
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number:
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 12
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 12
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 12
12 is positive
```

Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 12
12 is positive
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 12
12 is positive
12 is greater than 5
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 12
12 is positive
12 is greater than 5
I like to stay positive
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: 12
12 is positive
12 is greater than 5
I like to stay positive
Thank you
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number:
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: -2
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: -2
```


Nested `if` statements

```
x = int(input("Enter a number: "))
if x > 0:
    print(x, "is positive")
    if x > 5:
        print(x, "is greater than 5")
    print("I like to stay positive")
print("Thank you")
```

```
Enter a number: -2
Thank you
```


if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number:
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 4
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 4
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 4
4 is even
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 4
4 is even
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number:
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 11
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 11
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 11
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 11
11 is odd
```

if-else statement

Any Boolean expression or variable

```
if condition:
    statements (block)      # condition True
else:
    statements (block)      # condition False
```

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
    print(num, "is even")
else:
    print(num, "is odd")
    print("and so are you!")
```

```
Enter a number: 11
11 is odd
and so are you!
```

Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```


Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

```
Enter a number:
```


Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

```
Enter a number: 6
```


Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

```
Enter a number: 6
```


Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

```
Enter a number: 6
```


Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

```
Enter a number: 6
```


Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

```
Enter a number: 6
6 is positive
```


Nested `if-else` statements

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

```
Enter a number: 6
6 is positive
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
else:
    if num > 0:
        print(num, "is positive")
    else:
        print(num, "is negative")
```

→ `elif num > 0:`

Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number:
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number: -2
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number: -2
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number: -2
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number: -2
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

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


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

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


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number:
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number: 0
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number: 0
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

```
Enter a number: 0
Zero is my hero!
```


Bring me the `elif`

```
num = int(input("Enter a number: "))
if num == 0:
    print("Zero is my hero!")
elif num > 0:
    print(num, "is positive")
else:
    print(num, "is negative")
```

Done!

```
Enter a number: 0
Zero is my hero!
```


It works for grades too!

```
grade = int(input("Enter a score: "))
if grade >= 90:
    print("A")
elif grade >= 80:
    print("B")
elif grade >= 70:
    print("C")
else:
    print("Keep trying!")
```


It works for grades too!

```
grade = int(input("Enter a score: "))
if grade >= 90:
    print("A")
elif grade >= 80:
    print("B")
elif grade >= 70:
    print("C")
else:
    print("Keep trying!")
```

```
Enter a score:
```


It works for grades too!

```
grade = int(input("Enter a score: "))
if grade >= 90:
    print("A")
elif grade >= 80:
    print("B")
elif grade >= 70:
    print("C")
else:
    print("Keep trying!")
```

```
Enter a score: 82
```


It works for grades too!

```
grade = int(input("Enter a score: "))
if grade >= 90:
    print("A")
elif grade >= 80:
    print("B")
elif grade >= 70:
    print("C")
else:
    print("Keep trying!")
```

```
Enter a score: 82
```


It works for grades too!

```
grade = int(input("Enter a score: "))
if grade >= 90:
    print("A")
elif grade >= 80:
    print("B")
elif grade >= 70:
    print("C")
else:
    print("Keep trying!")
```

```
Enter a score: 82
```


It works for grades too!

```
grade = int(input("Enter a score: "))
if grade >= 90:
    print("A")
elif grade >= 80:
    print("B")
elif grade >= 70:
    print("C")
else:
    print("Keep trying!")
```

```
Enter a score: 82
B
```

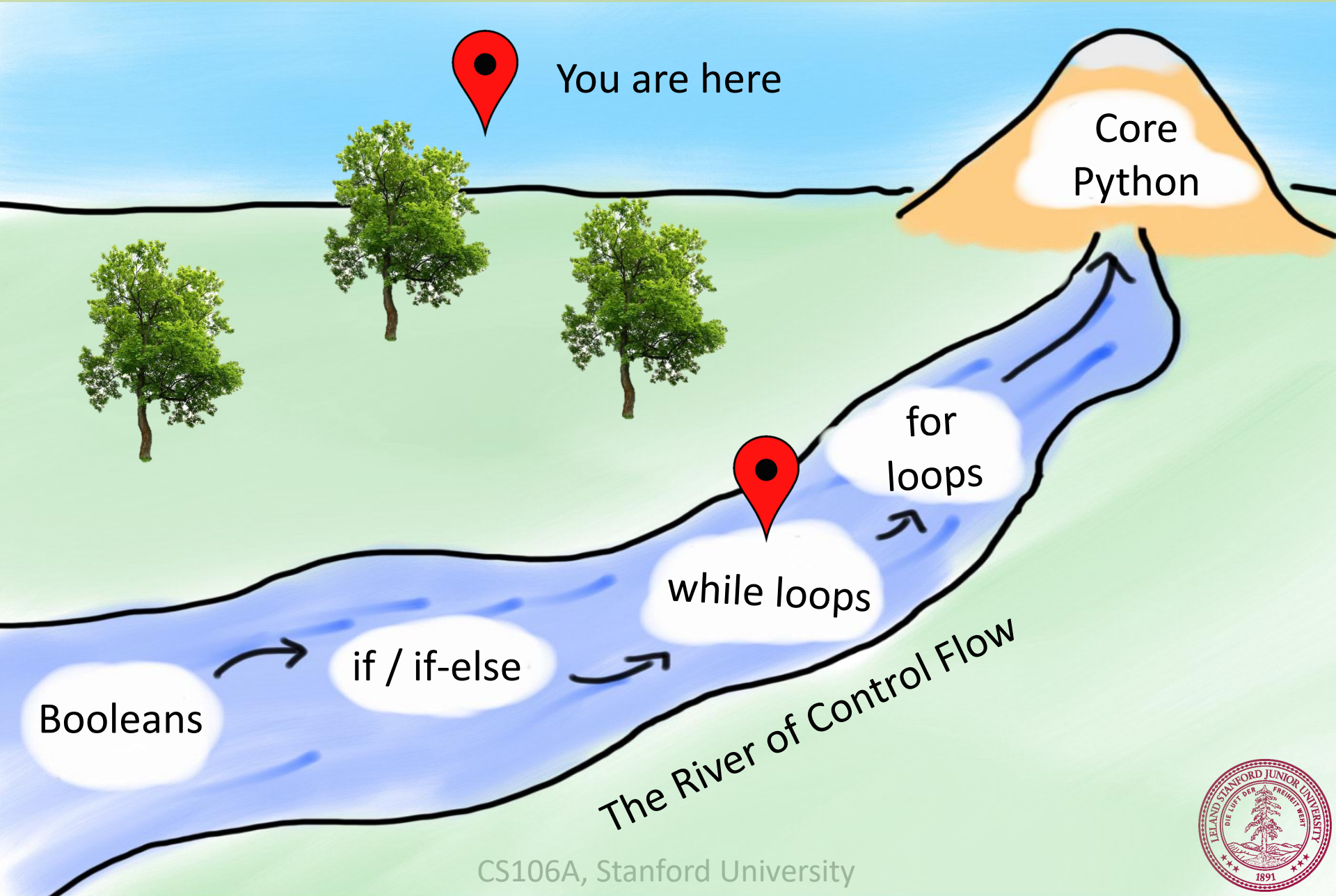

It works for grades too!

```
grade = int(input("Enter a score: "))
if grade >= 90:
    print("A")
elif grade >= 80:
    print("B")
elif grade >= 70:
    print("C")
else:
    print("Keep trying!")
```

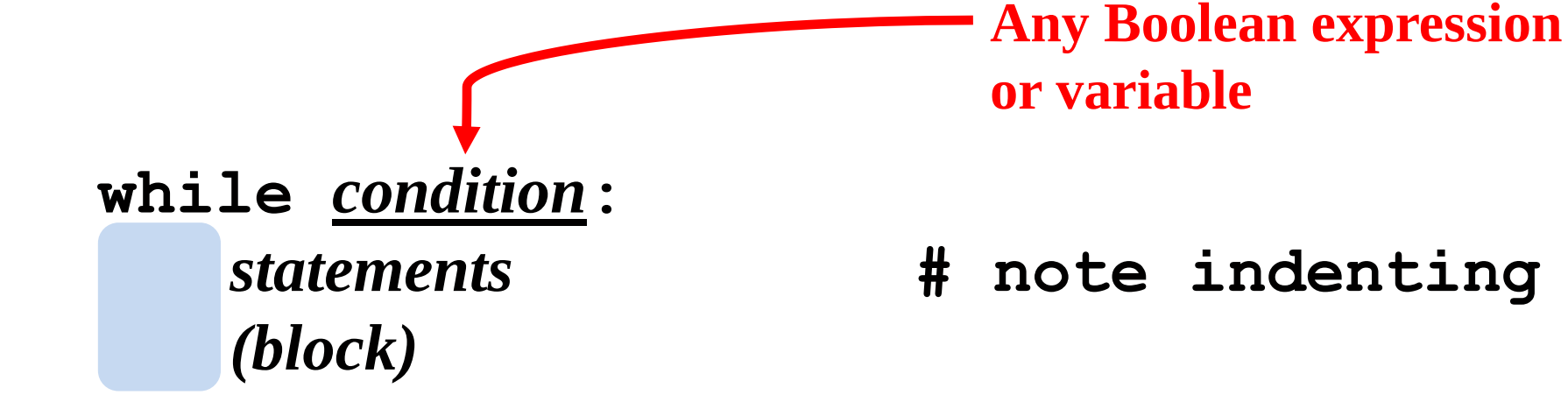
```
Enter a score: 82
B
```


Amazing!

Today's Route



`while` loop




```
x = 10
while x > 1:
    x /= 2
    print(x)
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

`while` loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
```

`while` loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
```

`while` loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
```

`while` loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
```

`while` loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
1.25
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
1.25
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
1.25
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
1.25
0.625
```

while loop

Any Boolean expression or variable

```
while condition:
    statements                    # note indenting
    (block)
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

```
5.0
2.5
1.25
0.625
```

`while` loop

Any Boolean expression or variable

```
while condition:
    statements
    (block)                    # note indenting
```

```
x = 10
while x > 1:
    x /= 2
    print(x)
```

Done!

```
5.0
2.5
1.25
0.625
```

Conditions in Python

You can use **if**, **if-else**, and **while** statements in Python.

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

A Loop-and-a-Half?

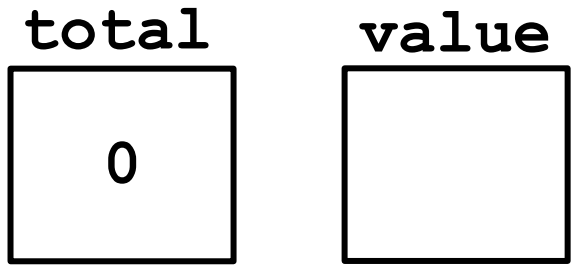
```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```


A Loop-and-a-Half?

```
SENTINEL = -1

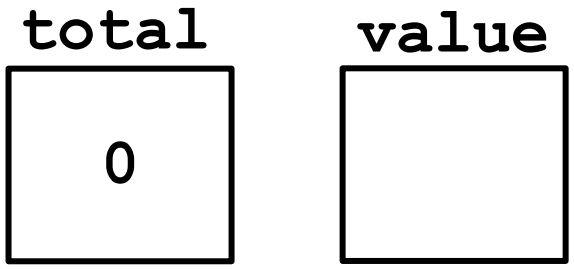
def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```



A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

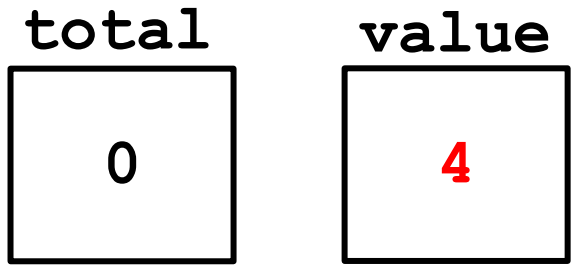



```
Value?
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

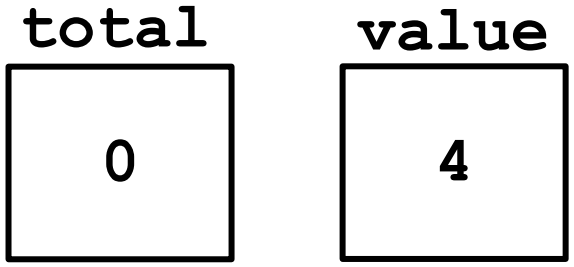



```
Value? 4
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

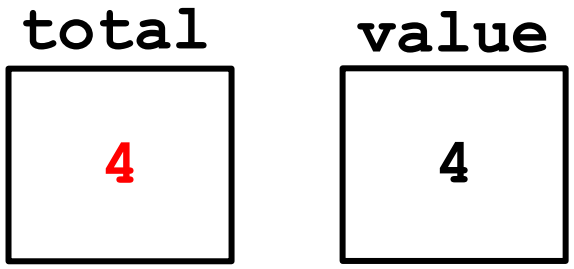



```
Value? 4
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

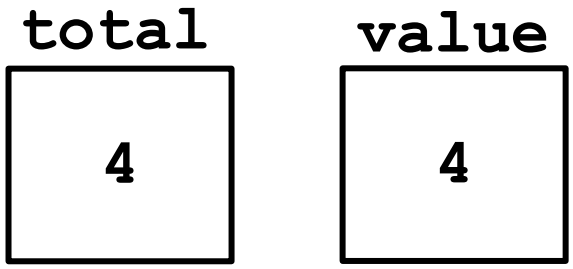



```
Value? 4
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

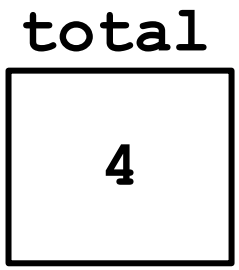


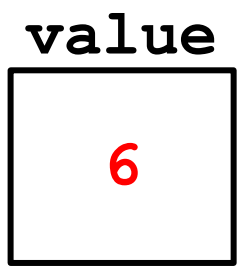

```
Value? 4
Value?
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```



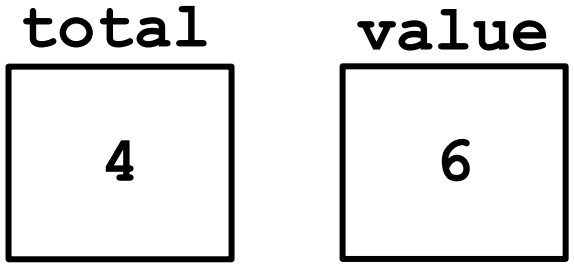



```
Value? 4
Value? 6
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

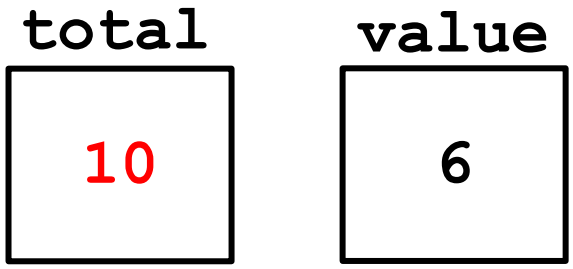



```
Value? 4
Value? 6
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

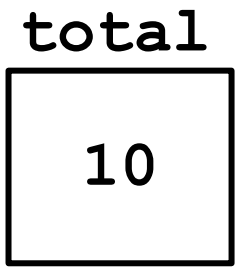


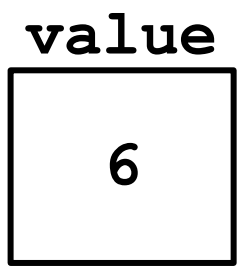

```
Value? 4
Value? 6
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```



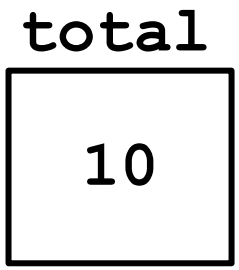


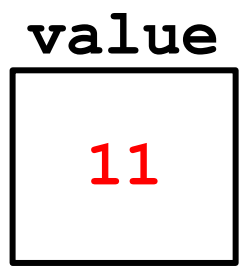

```
Value? 4
Value? 6
Value?
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```



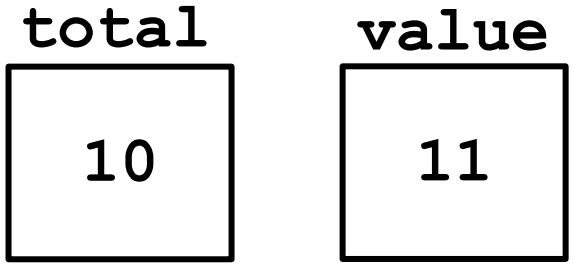



```
Value? 4
Value? 6
Value? 11
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

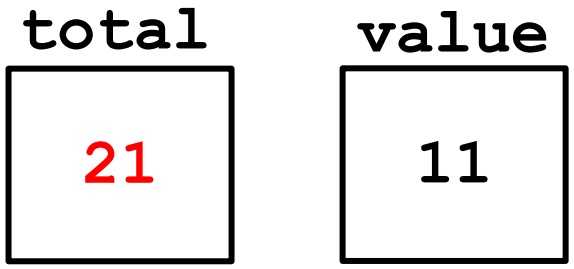



```
Value? 4
Value? 6
Value? 11
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

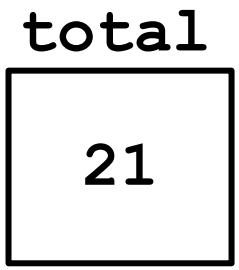


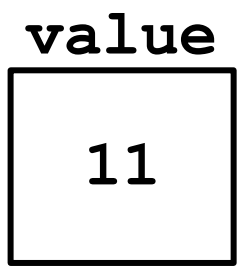

```
Value? 4
Value? 6
Value? 11
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```



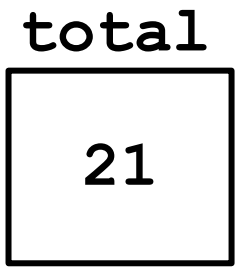


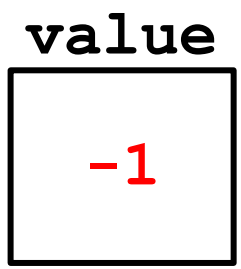

```
Value? 4
Value? 6
Value? 11
Value?
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```



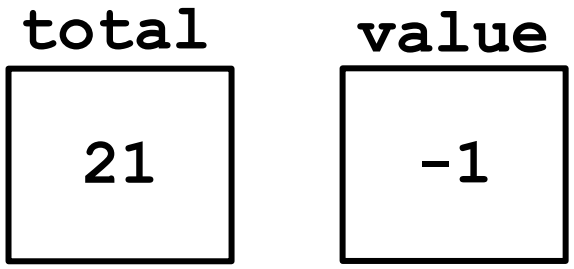



```
Value? 4
Value? 6
Value? 11
Value? -1
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

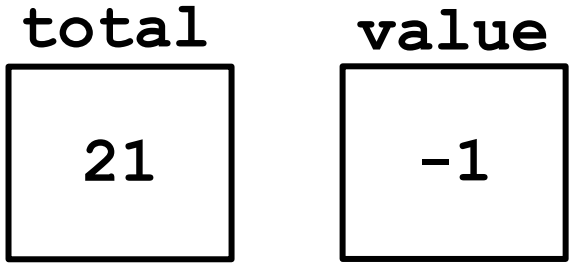



```
Value? 4
Value? 6
Value? 11
Value? -1
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

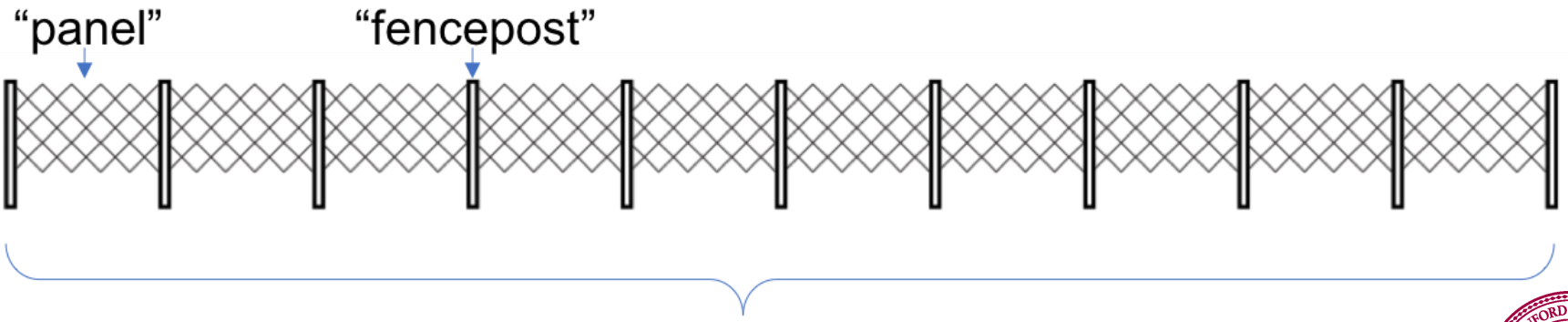



```
Value? 4
Value? 6
Value? 11
Value? -1
Total = 21
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```



A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    value = int(input("Value? "))
    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```


A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0

    while value != SENTINEL:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```

```
UnboundLocalError: local variable 'value'
referenced before assignment
```


A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0

    while True:
        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```


A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:

        total += value
        value = int(input("Value? "))
    print("Total = " + str(total))
```


A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        total += value

    print("Total = " + str(total))
```


A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))


        total += value
    print("Total = " + str(total))
```


A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```


A Loop-and-a-Half?

```
SENTINEL = -1

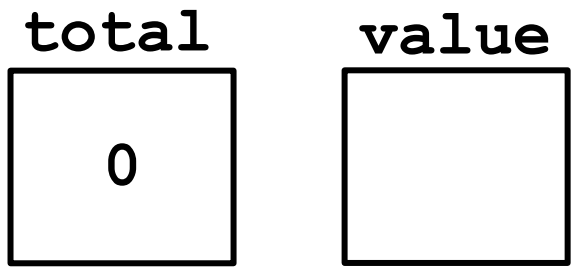
def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```

Immediately break out of current loop

A Loop-and-a-Half?

```
SENTINEL = -1

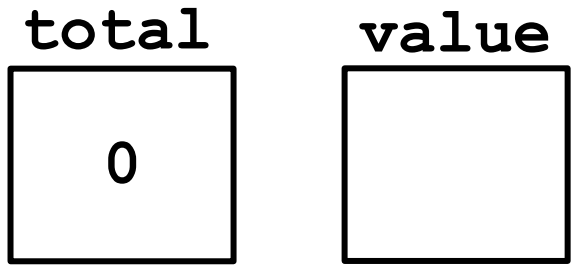
def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



A Loop-and-a-Half?

```
SENTINEL = -1

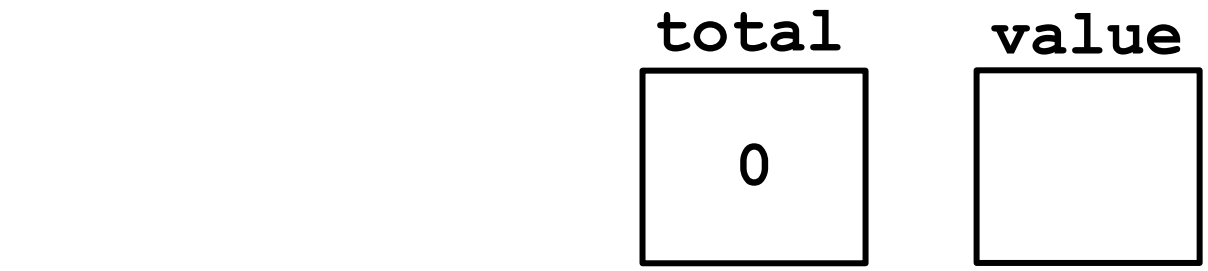
def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```




```
Value?
```

A Loop-and-a-Half?

```
SENTINEL = -1

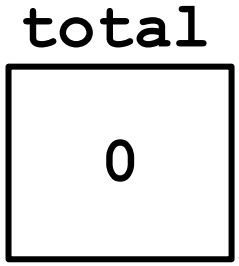
def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```

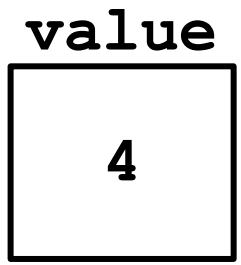

```
Value? 4
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



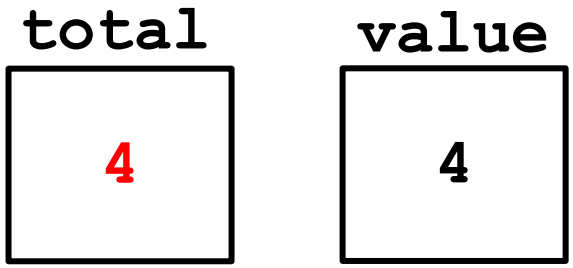



```
Value? 4
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```

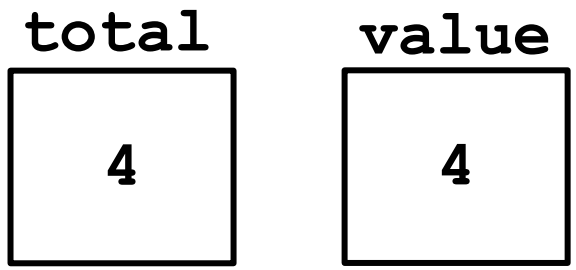



```
Value? 4
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```




```
Value? 4
```

A Loop-and-a-Half?

```
SENTINEL = -1

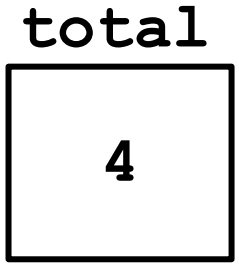
def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```

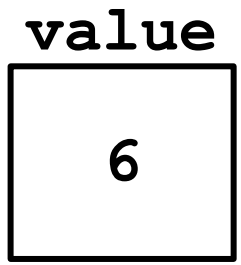

```
Value? 4
Value? 6
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



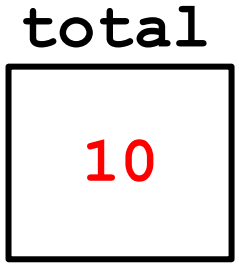


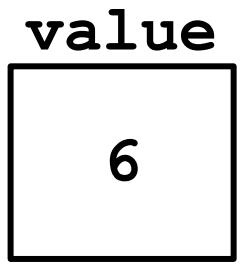

```
Value? 4
Value? 6
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



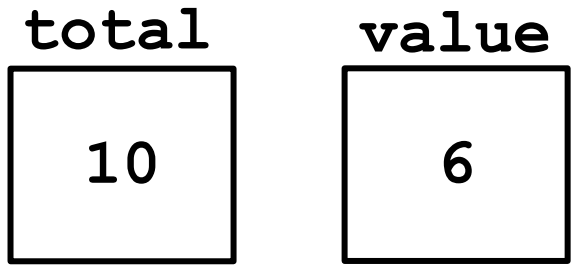



```
Value? 4
Value? 6
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```

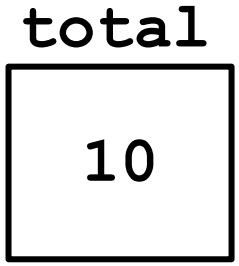


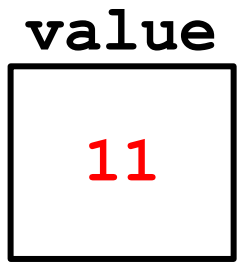

```
Value? 4
Value? 6
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



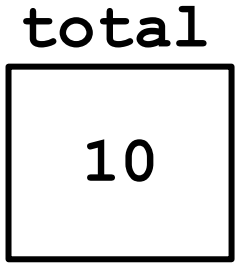


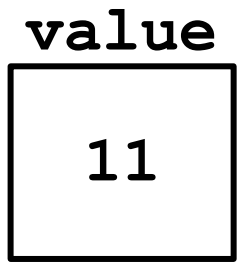

```
Value? 4
Value? 6
Value? 11
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



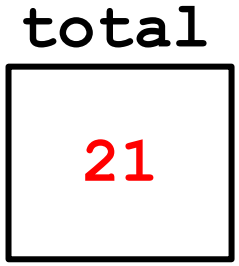


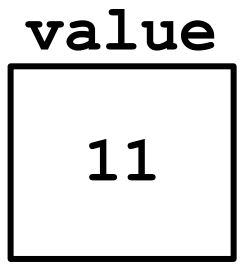

```
Value? 4
Value? 6
Value? 11
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



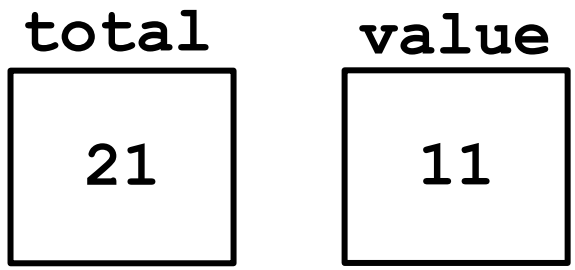



```
Value? 4
Value? 6
Value? 11
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```

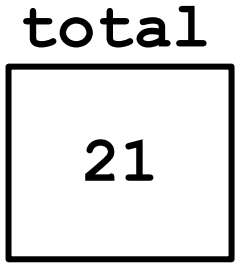


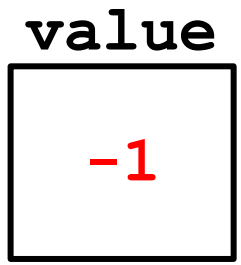

```
Value? 4
Value? 6
Value? 11
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



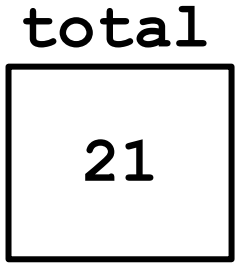


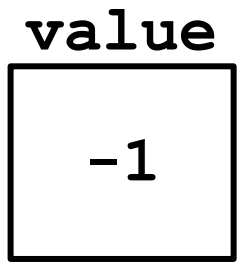

```
Value? 4
Value? 6
Value? 11
Value? -1
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



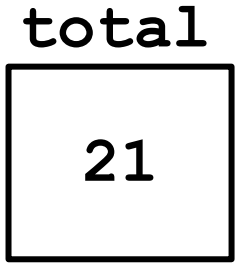


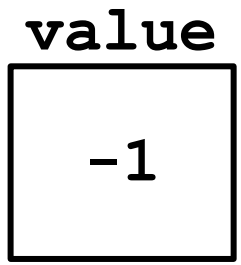

```
Value? 4
Value? 6
Value? 11
Value? -1
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



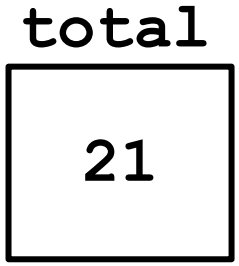


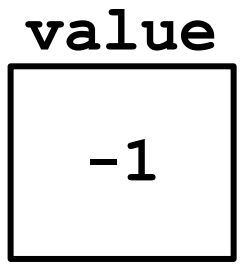

```
Value? 4
Value? 6
Value? 11
Value? -1
```

A Loop-and-a-Half?

```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```



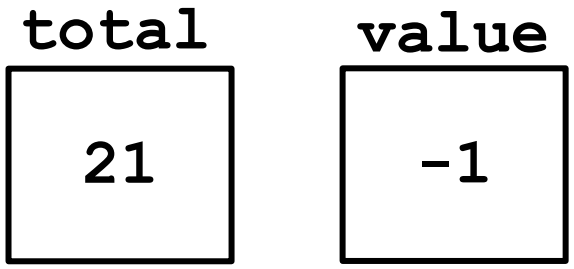



```
Value? 4
Value? 6
Value? 11
Value? -1
Total = 21
```

A Loop-and-a-Half?

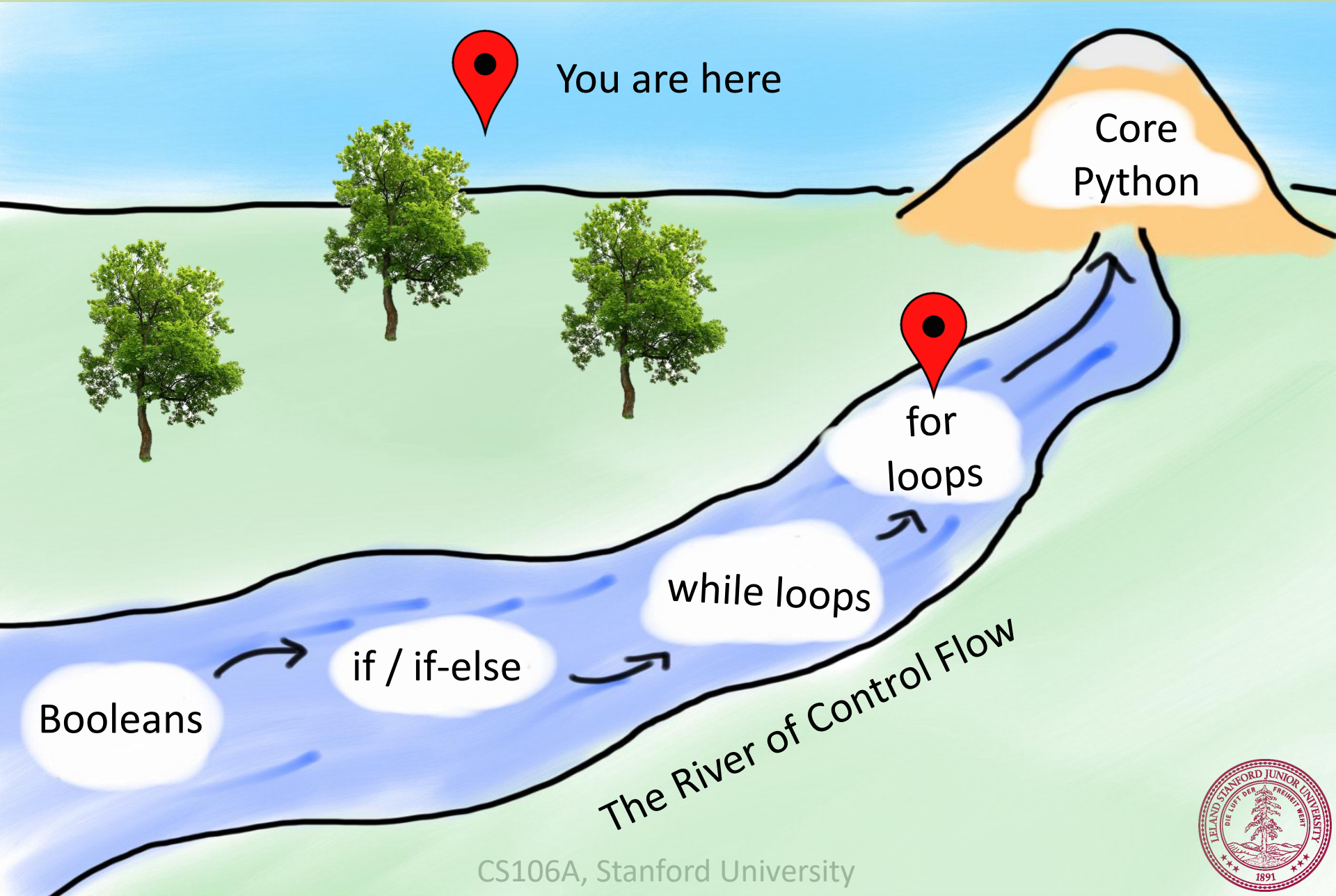
```
SENTINEL = -1

def main():
    total = 0
    while True:
        value = int(input("Value? "))
        if value == SENTINEL:
            break
        total += value
    print("Total = " + str(total))
```




```
Value? 4
Value? 6
Value? 11
Value? -1
Total = 21
```

Today's Route



`for` loop


```
for i in range(count):
    statements                  # note indenting
    (block)
```

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

`for` loop

This is called an *index* variable.
Can have any variable name.

```
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (`count` – 1)

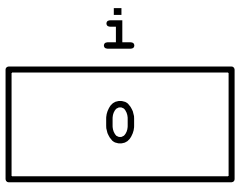
`for` loop

This is called an *index* variable.
Can have any variable name.

```
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (`count` – 1)



`for` loop

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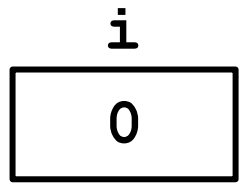
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (`count` – 1)




```
0
```

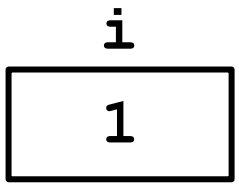
`for` loop

This is called an *index* variable.
Can have any variable name.

```
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (`count` – 1)



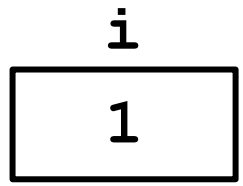
for loop

This is called an *index* variable.
Can have any variable name.

```
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (count – 1)




```
0
1
```

for loop

This is called an *index* variable.
Can have any variable name.

```
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (count – 1)

i

2

```
0
1
```

for loop

This is called an *index* variable.
Can have any variable name.

```
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (`count` – 1)

i

2

```
0
1
2
```

`for` loop

This is called an *index* variable.
Can have any variable name.

```
for i in range(count):
    statements                    # note indenting
    (block)
```

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

Index starts counting from 0
Counts up to (`count` – 1)

Done!

i

2

```
0
1
2
```

Write a program to print
“Python rocks my socks” 100 times

`for` loop redux

`i` starts at 0, counts up to 99 (inclusive)

```
def main():
    for i in range(100):
        print("Python rocks my socks")
```


`for` loop redux

`i` starts at 0, counts up to 99 (inclusive)

```
def main():
    for i in range(100):
        print("Python rocks my socks")
```

Can think of it like this:

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


`for` loops – the advanced course!

```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*
Stops counting before *end*
Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```

`for` loops – the advanced course!

```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*
Stops counting before *end*
Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```

i

1

`for` loops – the advanced course!

```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*
Stops counting before *end*
Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```

i

1

```
1
```

`for` loops – the advanced course!

```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*
Stops counting before *end*
Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```

i
3

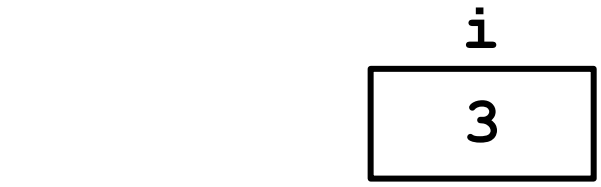
```
1
```

`for` loops – the advanced course!

```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*
Stops counting before *end*
Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```




```
1
3
```

`for` loops – the advanced course!

```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*
Stops counting before *end*
Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```

i

5

```
1
3
```

`for` loops – the advanced course!

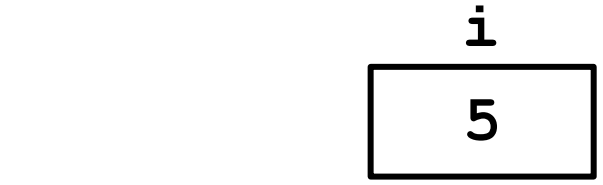
```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*

Stops counting before *end*

Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```




```
1
3
5
```

`for` loops – the advanced course!

```
for i in range(start,end,step):
    statements
    (block)
```

Starts counting at *start*
Stops counting before *end*
Each iteration, add *step* to counter

```
for i in range(1,7,2):
    print(i)
```

Done!

i
5

```
1
3
5
```

Putting it all together: guessnumber.py

Today's Goal

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


Have a good weekend!