Class 1 - Introduction to Programming

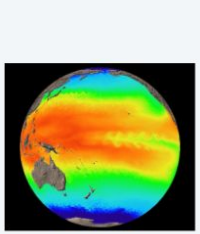
MISE Summer Programming Camp 2023

Why programming?

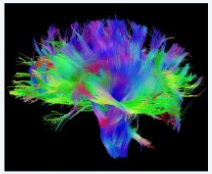
Virtually everything in the modern world has a software (program) component.

Programming is an essential skill in many scientific areas

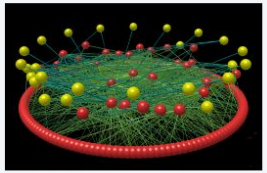
Programming in the Real-World



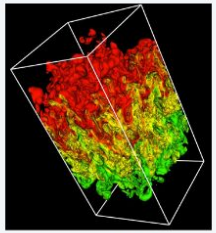
ocean modeling



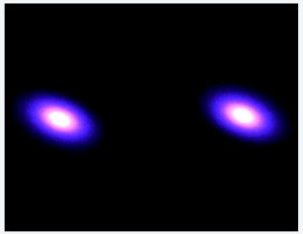
diffusion MRI of brain



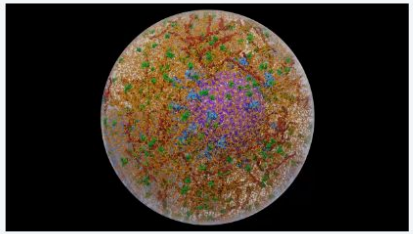
food web in Serengeti



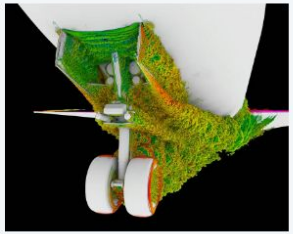
nuclear physics



colliding galaxies



an aerosol droplet containing coronavirus



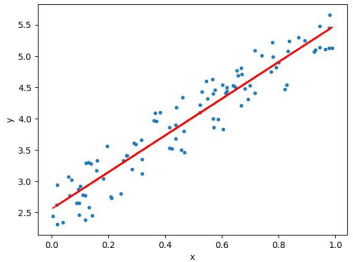
airflow over landing gear

Taken from Princeton COS 126 slides

What will you learn?

1. How to create simple programs

2. How to learn more on your own



Class logistics

piazza

For:

- Announcements
- Questions after class
- Posting class recordings

Homework

- Weekly homeworks out after each class
- Due Friday of the following week
- Posted on the website
- Try to finish homeworks on time, but if you are stuck, ask for help on piazza!
- *Optional* small class project later (early June). You can work in groups for that

Website

https://www.cs.princeton.edu/~pparedes/teaching/mise/summer23/

Please ask questions during class! Send private messages through zoom or unmute yourselves!

What is a program?

Collection of well defined **instructions** that describe a **task**

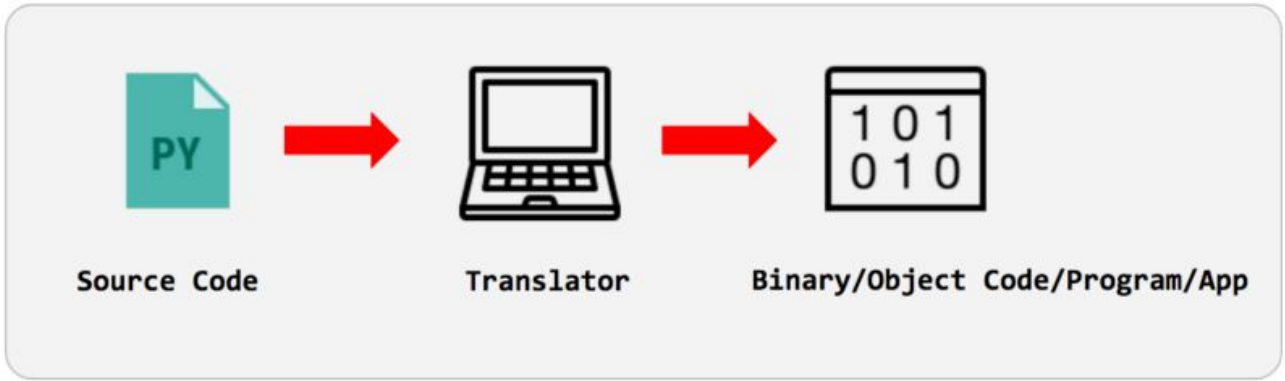
To bake a cake:

1. Combine sugar and butter
2. Beat in eggs
3. Add flour
4. Add milk
5. Bake in oven

How do we tell a computer what to do?

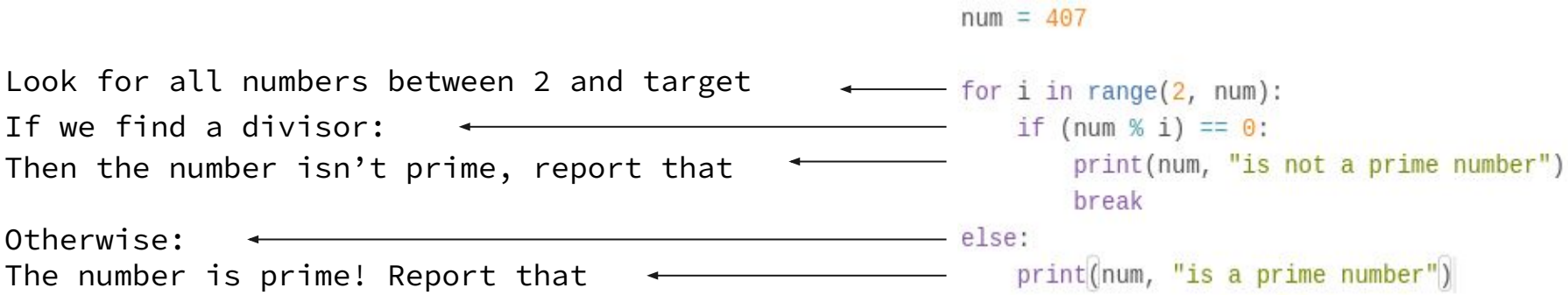
To communicate amongst ourselves we use human languages (for example, English)

To communicate with computers we will use a programming language, namely **Python**

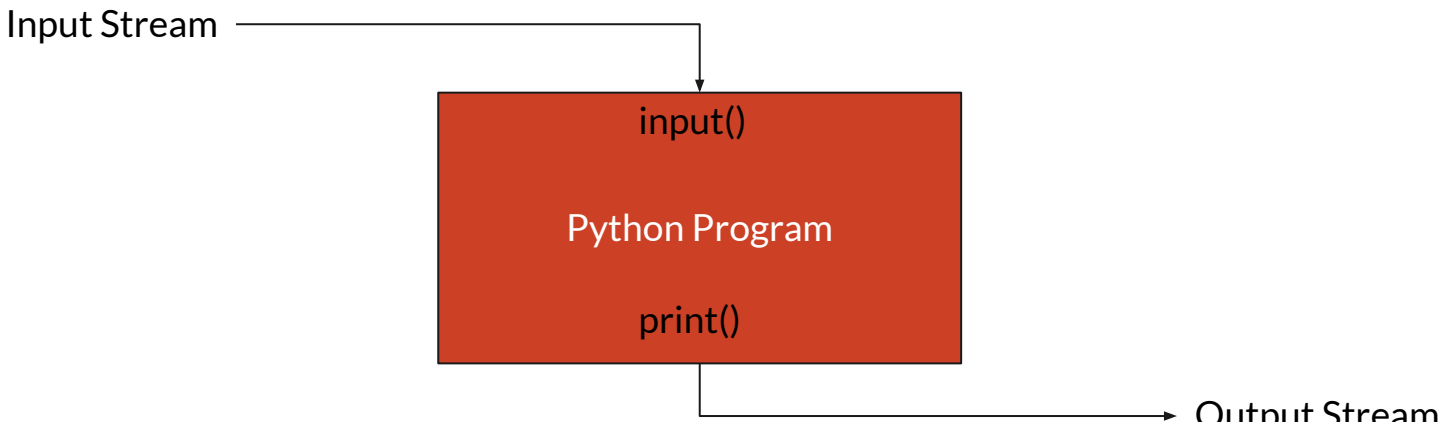


What does a python program look like?

Suppose we want to write a **program** that checks if a number is prime:



Program Abstraction



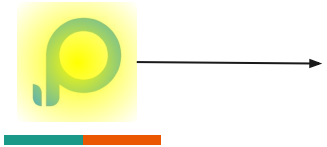
First demo: my first program

Go to: https://www.programiz.com/python-programming/online-compiler/

Learning goals:

1. How to print/read data
2. Python as a calculator
3. What is a variable

```
print("Hello MISE!")

print(input())

a = input()
print("Hello " + a)

a = 5
print(a * 3 - 1 + 4 // 1)
```



itempool.com/mise23/live

Pop Quiz 1:

What is the output of the following program:

```
1  a = "Hello World"
2
3  print("a")
```

What we just learned

- Printing text to the shell
- What is a variable, how to create modify and use one
- Reading input from the user in the shell
- How to use basic math operators

You have to follow the right syntax!

Here is an example of *wrong* code

```
1  a = "Hello World"
2
3  print(a")
```


Produces an error

```
File "<string>", line 3
    print(a")
          ^
SyntaxError: EOL while scanning string literal
```

To fix we need to change line 3

Basic Data Types in Python

- **Integer -** represents integers eg. 2, -20, 9999999
- **Float** - represents decimal numbers eg. 2.0, -3.99, 568.98
- **String -** represents a sequence of characters eg. “Hello”, “#Hi!”, “42”
    - Note the pair of double quotes around the sequence
- **Boolean -** represents true or false values eg. True, False
    - Capitalization is important here!

Second demo: examples with data types

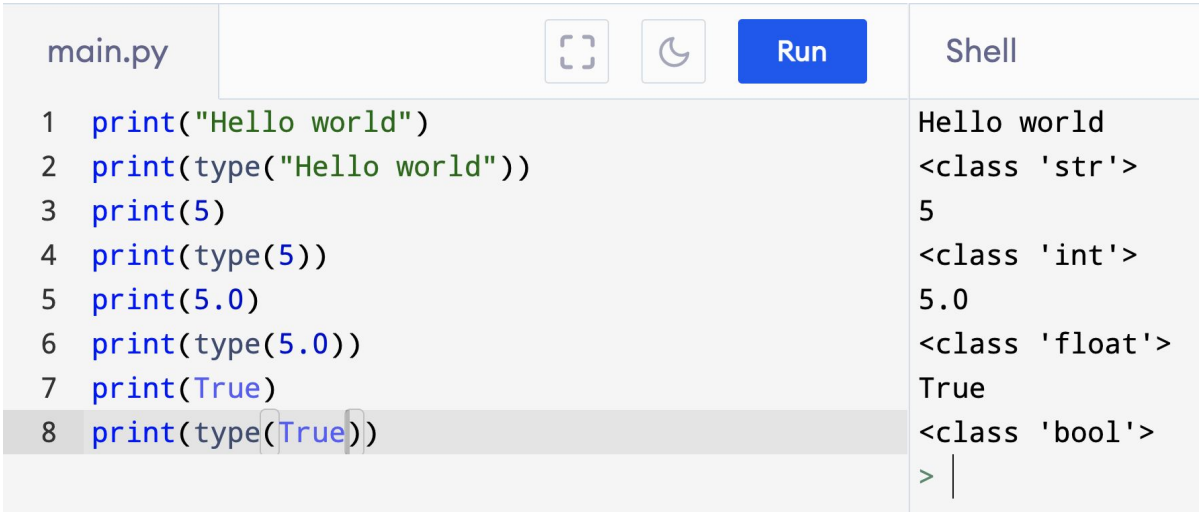
Learning goals:

1. What is a data type
2. How to use strings
3. How to manipulate data types

```
print("5")
print(5)

print("5" + "5")
print(5 + 5)

print(int("5"))
print(int("5") + int("5"))

a = int(input())
print(a + 4)

print(5 / 2)
print(5 // 2)
```

The type() instruction!

If you ever need to know the type of something, you can use the *type()* instruction to do that, like so:



Second demo continued

```
print(2+3*4)  # prints 14, not 20
print(5+4%3)  # prints  6, not 0 (% has same precedence as *, /, and //)
print(2**3*4) # prints 32, not 4096 (** has higher precedence than *, /, //, and %)

print(5-4-3)   # prints -2, not 4 (- associates left-to-right)
print(4**3**2) # prints 262144, not 4096 (** associates right-to-left)
```

Pop Quiz 2:

What is the output of the following program:

```
1  a = 5
2  b = 10
3  print(a / 2)
4  a = 3
5  print(b // 9)
```

Pop Quiz 3:

What is the output of the following program:

```
1  a = "Hello "
2  print(a * 3 + "World!")
```

One more demo: A polite program

Learning goals:

1. Writing a program with a purpose

```
1  name = input()
2
3  print("Welcome to programming, " + name + "!")
```

Pop Quiz 4:

If we run this program and write the number "3" on the terminal, what would be its output?

```
1  n = input()
2  print("Thanks!" * n)
```

One more demo: A polite program now complete

Learning goals:

1. Writing a program with a purpose

```
1  name = input()
2
3  print("Welcome to programming, " + name + "!")
4
5  print("Pick a number:")
6  n = int(input())
7
8  print("Thanks!" * n)
```

Homeworks - Using CodeForces

CODEFORCES

A website where you can submit programs and get immediate feedback

Go to: https://codeforces.com/group/K1Fxw6skwV/contests

What's next?

Homework will be posted on Piazza by tomorrow!

You won't learn anything if you don't try the homeworks

Class 2: Functions and Conditionals

How to create code modules

How to have different outcomes based on the input