Python Programming 101

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Today's class

Prerequisites

- No previous programming experience required
- Lots of slides with `actual code`

Goals

- Teach you to think like a Computer Scientist
- Make you self-sufficient as a Python beginner

Why Python?

Ideal for scripting and rapid prototyping

- General-purpose, high-level language
- Elegant syntax
- Interpreted
- ‘Comes with batteries’ (lots of them!)

Python 2 vs Python 3

There are two Pythons!

- Currently: Python 2.7 and Python 3.6
- Minimal differences for beginners (except `print`)
- ‘Python 2.x is legacy, Python 3.x is the present and future’

Let's install Python!

Download Anaconda from

`https://www.anaconda.com/download/`

Using Python

- (I)Python interpreter
- Scripts

→ Jupyter (previously IPython) Notebooks

Python as a calculator

```
1 + 2     # Addition
3 - 4     # Subtraction
5 * 6     # Multiplication
7 / 8     # Division (integer division in Python 2)
7 // 8    # Integer division
9 ** 10   # Exponentiation
11 % 10   # Modulo
```

Careful with operator precedence!

```
1 + 2 ** 3 * 4
1 + (2**3) * 4
1 + ((2**3) * 4)
((1) + (((2)**(3)) * (4)))  # Don't overdo it! :-)
```

How to think like a Computer Scientist

Thinking like a Computer Scientist

Computer Scientists...

- Use formal languages to denote ideas
- Design things, assembling components into systems
- Observe the behaviour of complex systems, form hypotheses, and test predictions

What's the most important skill
for a Computer Scientist?

Algorithms

- Step-by-step lists of instructions to solve a problem
- Can be represented in a specific notation (programs)
- Can be executed automatically by a computer

Programs

- Sequences of instructions that describes a computation
- Basic instructions include:
  - Input/output
  - Mathematical and logical operations
  - Conditional execution (if-then)
  - Repetition

Let's write an algorithm!

Given a list of numbers, compute
the sum of those divisible by two

Our algorithm… in Python

```
1  def sum_even(numbers):
2      total = 0
3      for number in numbers:
4          if number % 2 == 0:
5              total += number
6      return total
```

```
1  sum_even([0, 1, 1, 2, 3, 5, 8, 13, 21, 34])
2  sum_even(range(101))
```

Variables and operators

Variables

Variables store values of different types:

- booleans are either `True` or `False`
- integers are whole numbers
- floating points are decimal numbers
- strings are sequences of characters
- `None`

```
session = 'Introduction to Python'  # Or use "..."
day = 26
temperature = 21.2
pressure = 7.6e2  # Same as 7.6 * 10**2 = 760
```

Working with variables

```
temp_c = 21.2
temp_f = temp_c * 1.8 + 32
```

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```

Changing type (‘casting’)

```
int('26')
str(21.2)
float('21,2')  # Oops...
```

Operators

- Assignment: `=`
- Comparison: `==`, `!=`, `<`, `<=`, `>`, `>=`
- Mathematical: `+`, `-`, …
- Logical: **`and`**, **`or`**, **`not`**

```
1 + 2
1 < 2
'Lon' + 'don'
'Lon' < 'don'
```

Functions and libraries

Functions

Functions...

- Take input arguments
- Execute statement(s)
- **return** output

```
1 def multiply(a, b):
2     return a * b
3
4 multiply(2, 3)
```

Libraries

Libraries are…

- Reusable collections of code
- Part of the Standard Library
- Distributed through PyPI – the Python Package Index

```
1 import random
2
3 random.randint(1, 100)
```

```
1 from random import randint
2
3 randint(1, 100)
```

Data structures

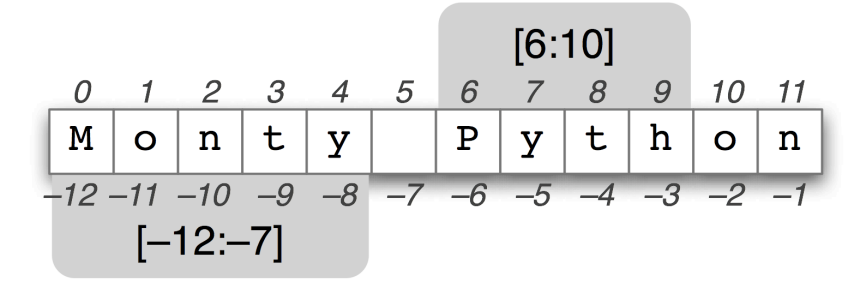
Lists

- Lists are ordered sequences of items (so are strings!)
- Not necessarily of the same type

```
1 a = [0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
2 b = ['I', 'love', 'Python!']
3 a + b
```

Indexing and slicing

```
1 a[0]
2 a[1]
3 a[-2]
4 a[3:]
5 a[:4]
6 a[5:7]
7 a[::2]
```



From *Natural Language Processing with Python*

Dictionaries

- Dictionaries store key-value pairs
- Not necessarily of the same type

```
john = {
    'first_name': 'John',
    'last_name': 'Doe',
    'age': 32
}
john['age']
list(john.keys())
list(john.values())
```

Flow control

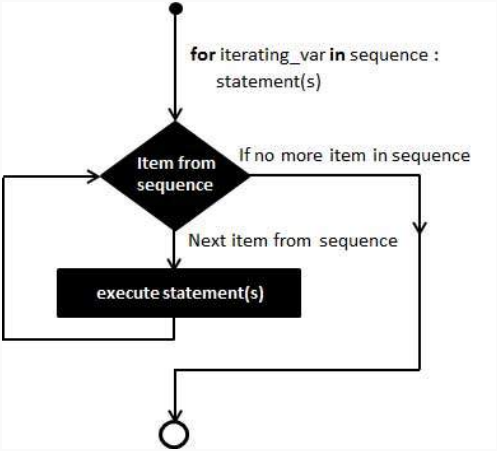
if statements

- One **if** followed by a condition
- Zero or more **elif**s (short for 'else if')
- Optionally a final **else**

```
if x < 0:
    print('x is negative')
elif x == 0:
    print('x is zero')
else:
    print('x is positive')
```

for loops

```
1 for x in range(10):
2     if x == 3:
3         continue
4     elif x == 5:
5         break
6     print(x)
```



From *TutorialsPoint.com*

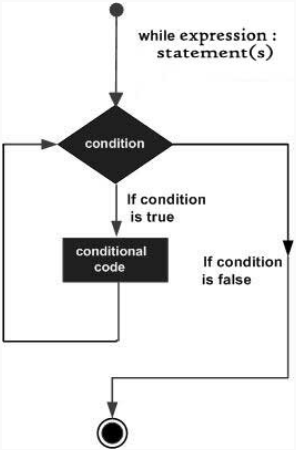
for loops with lists

```
1  a = ['one', 'two', 'three', 'four', 'five']
2
3  for value in a:
4      print(value)
5
6  for index, value in enumerate(a):
7      print('Item {} is "{}"'.format(index, value))
```

while loops

```
1  x = 0
2  while x < 10:
3      x += 1
4      print(x)
```

```
1  x = 0
2  while True:
3      if x == 10:
4          break
5      x += 1
6      print(x)
```



From TutorialsPoint.com

Making coding more enjoyable

Making coding more enjoyable

Write short lines

- Don't pack too much in a single long line
- Clever one-liners don't make you smarter
- Karma: the next person to read your code will hate you

```
def primes(n):
    return set(range(2, n+1)) - \
           set(p*f for p in range(2, int(n**0.5) + 2)
                   for f in range(2, n//p + 1))
```

Making coding more enjoyable

Write short functions

- If it doesn't fit on screen, break it down
- Think in a modular way
- Write reusable code and don't repeat yourself

Making coding more enjoyable

Choose meaningful names

- For both functions and variables
- Make the purpose clear
- The code should be the documentation (but write the documentation too)

Making coding more enjoyable

Rewrite and polish often

- Understand and accept that you will make mistakes
- There is no royal road to coding
- Don’t be afraid of ‘negative lines of code’