Discrete Structures:
CMPSC 102

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Fall 2019
Week 2
What is Docker?

- Using Docker to run Python in a virtual machine.

More about containers?
See: https://www.docker.com/resources/what-container
Virtual Machines
Docker

Virtual Machine
App A
Guest Operating System

Virtual Machine
App B
Guest Operating System

Virtual Machine
App C
Guest Operating System

Hypervisor
Infrastructure
How did you install Docker?

- Find the ToolBox Docker Quickstart Terminal to run
- Or, find the Docker Application to run
- You will be using the terminal window that is opened for your own work

Toolbox Quickstart command, MacOS

```bash
bash --login '/Applications/Docker/Docker Quickstart Terminal.app/Contents/Resources/Scripts/start.sh'
```

Check that Docker is working

```bash
docker run -t hello-world
```

List Docker’s containers

```bash
docker images ls
```
Running Python3 with Docker

```bash
docker run -t python
```

Sample output

```
obonhamcarter$ docker run -t python
Unable to find image 'python:latest' locally
latest: Pulling from library/python
4ae16bd47783: Already exists
bbab4ec87ac4: Already exists
2ea1f7804402: Already exists
96465440c208: Already exists
6ac892e64b94: Already exists
5b3ec9e84adf: Already exists
317202007d7c: Already exists
ba1ee226143f: Already exists
e33fb8e92c2f: Already exists
Digest: sha256:5f980d2673056ca33580979bcfb70c82f70ceccf857b77b740da40701e5d473e
Status: Downloaded newer image for python:latest
Python 3.7.4 (default, Aug 14 2019, 12:09:51)
[GCC 8.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
```
www.python.org

Download python3 if you are using your own hardware
About Python...

- Is an interpreted, object-oriented, high-level programming language with dynamic semantics.
- Excellent for Rapid Application Development thanks to its high-level built-in data structures, combined with dynamic typing and dynamic binding.
- A scripting language for tool-making or automation.
- Used for *quick and dirty* solutions, quick automation, or to connect existing components together from other languages.
Python’s simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance.

Python supports modules and packages, which encourages program modularity and code reuse.

The Python interpreter and the extensive standard library are open source and freely available in all major platforms.
## The 2018 Top Programming Languages

<table>
<thead>
<tr>
<th>Language Rank</th>
<th></th>
<th>Types</th>
<th>Spectrum Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Python</td>
<td><img src="images/network.png" alt="Network" /> <img src="images/computer.png" alt="Computer" /> <img src="images/mobile.png" alt="Mobile" /></td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>2. C++</td>
<td><img src="images/network.png" alt="Network" /> <img src="images/computer.png" alt="Computer" /> <img src="images/desktop.png" alt="Desktop" /></td>
<td>99.7</td>
<td></td>
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<tr>
<td>3. Java</td>
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<td></td>
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<tr>
<td>4. C</td>
<td><img src="images/network.png" alt="Network" /> <img src="images/mobile.png" alt="Mobile" /> <img src="images/desktop.png" alt="Desktop" /></td>
<td>96.7</td>
<td></td>
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<tr>
<td>5. C#</td>
<td><img src="images/network.png" alt="Network" /> <img src="images/desktop.png" alt="Desktop" /></td>
<td>89.4</td>
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<tr>
<td>6. PHP</td>
<td><img src="images/network.png" alt="Network" /> <img src="images/desktop.png" alt="Desktop" /></td>
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<tr>
<td>7. R</td>
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<tr>
<td>8. JavaScript</td>
<td><img src="images/network.png" alt="Network" /> <img src="images/desktop.png" alt="Desktop" /></td>
<td>82.6</td>
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</tr>
<tr>
<td>9. Go</td>
<td><img src="images/network.png" alt="Network" /> <img src="images/desktop.png" alt="Desktop" /></td>
<td>76.4</td>
<td></td>
</tr>
<tr>
<td>10. Assembly</td>
<td><img src="images/desktop.png" alt="Desktop" /></td>
<td>74.1</td>
<td></td>
</tr>
</tbody>
</table>

The 2018 Top Programming Languages

Most Wanted Languages

<table>
<thead>
<tr>
<th>Language</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Python</td>
<td>25.1%</td>
</tr>
<tr>
<td>JavaScript</td>
<td>19.0%</td>
</tr>
<tr>
<td>Go</td>
<td>16.2%</td>
</tr>
<tr>
<td>Kotlin</td>
<td>12.4%</td>
</tr>
<tr>
<td>TypeScript</td>
<td>11.9%</td>
</tr>
<tr>
<td>Java</td>
<td>10.5%</td>
</tr>
<tr>
<td>C++</td>
<td>10.2%</td>
</tr>
<tr>
<td>Rust</td>
<td>8.3%</td>
</tr>
<tr>
<td>C#</td>
<td>8.0%</td>
</tr>
<tr>
<td>Swift</td>
<td>7.7%</td>
</tr>
<tr>
<td>HTML</td>
<td>7.6%</td>
</tr>
<tr>
<td>CSS</td>
<td>7.6%</td>
</tr>
</tbody>
</table>

Most wanted programming languages 2018

https://www.daxx.com/article/python-developer-salary-usa
US High-Paying Python Development Jobs

AVERAGE PYTHON DEVELOPER SALARIES 2018 BY STATE

https://www.daxx.com/article/python-developer-salary-usa
## Average Salaries in Programming

<table>
<thead>
<tr>
<th>Skill</th>
<th>Average salaries</th>
<th>Monthly jobs advertised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Python</td>
<td>US$116,379</td>
<td>6,550</td>
</tr>
<tr>
<td>Ruby</td>
<td>US$115,005</td>
<td>1,080</td>
</tr>
<tr>
<td>Java</td>
<td>US$112,592</td>
<td>10,443</td>
</tr>
<tr>
<td>Perl</td>
<td>US$111,928</td>
<td>1,398</td>
</tr>
<tr>
<td>C++</td>
<td>US$108,123</td>
<td>3,567</td>
</tr>
<tr>
<td>JavaScript</td>
<td>US$103,503</td>
<td>8,764</td>
</tr>
<tr>
<td>C#</td>
<td>US$101,715</td>
<td>4,101</td>
</tr>
<tr>
<td>PHP</td>
<td>US$94,690</td>
<td>1,664</td>
</tr>
<tr>
<td>ASP.NET</td>
<td>US$95,551</td>
<td>1,289</td>
</tr>
<tr>
<td>C</td>
<td>US$95,166</td>
<td>5,639</td>
</tr>
</tbody>
</table>

https://www.daxx.com/article/python-developer-salary-usa
Who Uses Python

Users of Python Programming

- Industrial Light and Magic (George Lucas to create the FX for Star Wars).
- Google
  - Google's very first web-crawling spider was first written in Java 1.0 and was so difficult that they rewrote it into Python.
- Facebook
  - Responsible for multiple services in infrastructure management
- Netflix
  - Used to power data analyses tasks from the server side
- Dropbox
  - Built its API in Python
- And others; Instagram, Spotify, Quora, Reddit
Where can I learn more about the language?

Free online resources

- Think Python First Edition, by Allen B. Downey
  - http://greenteapress.com/wp/think-python/
- A Collection of Tutorials
  - https://wiki.python.org/moin/BeginnersGuide/Programmers
- Interactive Python Tutorial
  - https://www.learnpython.org/
- Host, run, and code Python in the cloud!
  - https://www.pythonanywhere.com/
Install Your Own Python3

- Some trouble to make Python3 work with Docker ToolBox
- Install and use Python3 however you want!
- Get Python3 from the Python Software Foundation
  - https://www.python.org/downloads/

# Python 3: List comprehensions
```python
>>> fruits = ['Banana', 'Apple', 'Lime']
>>> loud_fruits = [fruit.upper() for fruit in fruits]
>>> print(loud_fruits)
['BANANA', 'APPLE', 'LIME']
```

# List and the enumerate function
```python
>>> list(enumerate(fruits))
[(0, 'Banana'), (1, 'Apple'), (2, 'Lime')]
```
Install Your Own Python3

- Download and install the version of Python3 for your OS
- Ask questions if you have trouble installing the program
- Check with the installation material to learn how to launch Python3 from your machine.
Type statements or expressions at prompt:
- `print("Hello, world")`
- `x = 12**2`
- `print(x)`
- `print(x/2)`
- `# bla bla bla...
  (this is a comment: everything after the # is ignored)`
Data types

Note: Use identifiers to help you remember the types!

- Integers, counting numbers
  - num_int = 1

- Floats, decimals
  - num_float = 3.1415

- Strings
  - s_str = "Hello World"

Combining variables in print statements

```python
x_int = 1
print("The integer variable is ", x_int)

num_float = 3.14
print("The float variable is ", num_float)

s_str = "Hello World"
print("The integer is equal to", s_str)
```
<table>
<thead>
<tr>
<th>Mathematical Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 3 + 4  # Addition</td>
</tr>
<tr>
<td>• 3 − 4  # Subtraction</td>
</tr>
<tr>
<td>• 3 * 4  # Multiplication</td>
</tr>
<tr>
<td>• 3/4  # Division ((\frac{3}{4}))</td>
</tr>
<tr>
<td>• 3%4  # Modulus; Returns the remainder from the division</td>
</tr>
<tr>
<td>• 3 * *4  # Powers; raise three to the power of four</td>
</tr>
</tbody>
</table>

- \(= 3 \times 3 \times 3 \times 3\)
- \(= 3^4\)
- \(= \text{pow}(3,4)\)
# Remember each char of a string has own position

```python
s_str = "ABC"
s_str[0] = 'A'
s_str[1] = 'B'
s_str[2] = 'C'
s_str[200] = ??
```

# Another way to iterate
# through a string using its length

```python
for i_int in range(len(s_str)):
    print(s_str[i_int])
```
Examples of working with strings

"hello" + " world"  # concatenation
"hello" * 3  # repetition
"hello"[0]  # indexing
"hello"[-1]  # indexing from end
"hello"[1:4]  # slicing out a subsequence
len("hello")  # determine how many characters, size
"hello" < "jello"  # comparison of ABC order
"e" in "hello"  # True, "e" is found in the string

# General rule:
    single quotes and double quotes are the same
'abc' == "abc"
Characters at the front

```python
line = "python programming is fun"
line.startswith("python") # True
line.startswith(" python") # False. Why is this?
```
**Conditional Statements**

Watch for the white space in the code!

```
if condition:
    statements
else:
    statements
```

```
if a > b:
   print("I'll take a")
else:
   print("I'll take b")
```
if testScore > medianScore:
    print("Above average.")
else:
    if testScore == medianScore:
        print("Average.")
    else:
        print("Below average.")
Conditionals: If statements

An if statement is a programming conditional statement that, if proved true, performs a specific function or task. If the condition is false, then another procedure is performed instead.

```python
num_int = 5  # Assignment of 5 to variable "num_int"
if num_int == 3:  # condition to check
    print("True")  # condition is true
else:  # condition is not true
    print("False")  # num_int, is NOT equal to 3

# make a compressed conditional statement, # no "else" statement necessary
num_int = 4
if num_int == 4: print("True")
```
name_str = "Bill"

if name_str == "Bill":
    print("Hello Bill!")
else:
    print("You are not Bill.")

# Place the name in a string to print
print("Your name is :", name_str)
A for loop is a statement in programming that performs predefined tasks while or until a predetermined condition is met.

```python
# counter program
for i_int in range(10):
    print(" Count is:" ,i_int)
    # Note: you could add some conditional
    # if-statement here to check the value of i_int.

# Iterate through the string's chars
s_str = "hello world"
for i_int in s_str:
    print(i_int)
    # Note: you could add an if-statement here
```
Watch out! Python uses white spaces (spaces and tabs) to define its blocks of code.

Make a source code: `vim nameReader.py`
```python
file = open("names.txt")
for line in file:
    print(" Reading this line: ",line)
    if line.startswith("James"):
        print("** Found the name: ",line)
```

Make a textfile: `vim names.txt`
```
Jane smyth
Betty Davis
John smith
Buffalo Bill
James Bond
```
Find Two Variables in File

Make a source code: `vim findEmail.py`

```python
file = open("emails.txt")
for line in file:
    name, email = line.split(" ","")
    if name == "James Bond":
        print("  ** Found email: ",email)
```

Make a textfile: `vim emails.txt`

```
Jane smyth,smythj@ac.edu
Betty Davis,davisb@ac.edu
John smith,smithj@mum.com
Buffalo Bill,buffalob@prairie.com
James Bond,bondj@magestySecrets.co.uk
```
Find the Summation of Numbers in a File

Make a source code: `vim numberChecker.py`

```python
file = open("numbers.txt")
sum_int = 0
# defined outside of loop to be used inside
# and outside of loop
for num in file:
    n_int = int(num) # convert string to integer
    print(" Reading this number: ",n_int)
    sum_int = sum_int + n_int
print(" ** The summation of the number is :", sum_int)
```

Make a textfile: `vim numbers.txt`

```
1
2
3
4
5
6
```