上海科技大学
ShanghaiTech University

SI100B Introduction to Information Science and Technology (**Python Programming**)

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School of Information Science and Technology
ShanghaiTech University

Instructor for programming

- Instructor: 张海鹏 Haipeng Zhang
- Research
  - Data mining, finding insights from data
  - Fintech, applying technology to solve problems in finance

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张海鹏

上海科技大学 ShanghaiTech University

- 研究方向：数据挖掘（金融数据、电商数据、社交媒体数据），金融科技
- 教育背景
  - 2009-2014 美国印第安纳大学 计算机科学 博士
  - 2007.8-2007.12 香港科技大学 计算机科学 交换生
  - 2005-2009 南京大学 软件工程 学士
- 工作、实习经历
  - 2018-至今 上海科技大学信息科学与技术学院 助理教授，研究员，博导
  - 2015-2018 中国金融期货交易所 博士后研究员
  - 2014-2015 IBM中国研究院 研究科学家
  - 2013.6-9 三星研究院（硅谷） 移动数据挖掘
  - 2013.2-5 微软研究院（剑桥） 社交媒体数据挖掘
  - 2012.5-8 eBay研究院（硅谷） 电子商务数据挖掘
  - 2010.6-8 国立情报学研究所（东京） 推荐系统研究

Instructor for signal processing

- Instructor: 娄鑫 Xin Lou
- Research
  - Integrated Circuits for Computer Vision
  - Digital VLSI

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Email: louxin@shanghaitech.edu.cn

Web: https://sist.shanghaitech.edu.cn/2018/0502/c2739a24281/page.htm

娄鑫

- 研究方向：智能视觉芯片，超大规模数字集成电路
- 教育背景
  - 2012-2016 新加坡南洋理工大学 电子工程 博士
  - 2010-2012 瑞典皇家工学院 片上系统设计 硕士
  - 2006-2010 浙江大学 电子信息技术及仪器 学士
- 工作、实习经历
  - 2017-至今 上海科技大学信息科学与技术学院 助理教授，研究员，博导
  - 2016.4-2017.2 新加坡南洋理工大学 研究科学家

Instructor for electronics

- Instructor: 梁俊睿 Junrui Liang
- Research
  - Self-powered Internet of Things 自供能物联网
  - Power electronics 电力电子
  - Mechatronics 机电一体化

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Web: http://metal.shanghaitech.edu.cn

梁俊睿

- 研究方向：自供能物联网，电力电子，机电一体化
- 教育背景
  - 2007-2010 香港中文大学 The Chinese University of Hong Kong 香港中文大学 机械与自动化工程 博士
  - 2004-2007 上海交通大学 SHANGHAI JIAO TONG UNIVERSITY 上海交通大学 精密仪器与机械 硕士
  - 2000-2004 上海交通大学 SHANGHAI JIAO TONG UNIVERSITY 上海交通大学 仪器科学与技术 学士
- 工作、实习经历
  - 2013-至今 上海科技大学 ShanghaiTech University 上海科技大学 信息科学与技术学院 助理教授，研究员，博导
  - 2015-2016 Berkeley UNIVERSITY OF CALIFORNIA 美国加州大学伯克利分校 访问学者者
  - 2013 CityU 香港城市大學 City University of Hong Kong 香港城市大学 博士后研究员
  - 2010-2012 香港中文大学 The Chinese University of Hong Kong 香港中文大学 博士后研究员

SI100B

- 24 lectures on Wed&Fri, for the first 12 weeks
  - **1. Python programming (PP)**, 8 lectures, **20%** of the total score
  - **2. Signal processing (SP)**, 8 lectures, **20%**,
  - **3. Electrical and electronic technologies (EE)**, 8 lectures, **20%**
- Project (PJ) during the last 4 weeks
  - Choose 1 from 4 projects, each one with a different focus: programming, signal processing, electronics
  - **39%**, details to be announced later in the semester
- Miscellaneous
  - **1%** for one logistics assignment on Academic Integrity
  - For PP, SP, EE, and PJ, each may include bonus scores up to 10% of the score for the corresponding part. E.g PP may take up to 22% of the total score
  - Additional points (up to 3%) may be given to students with good answers on Piazza, details to be announced.

Python Programming

- Goals
  - Learn Python as a computational and engineering tool.
  - Be successful in science, engineering, business, and other professions.
- Reference: www.python.org, **Python 3.7**
  - The Python Tutorial
  - The Python Language Reference, **core** syntax and semantics
  - The Python Standard Library, **exact** syntax and semantics
  - The Python HOWTOs, guide for specific tasks
  - *Learning Python* (《Python学习手册》), *5th Edition,* Mark Lutz
- Slides, discussions, assignments, announcements on Piazza:
  - https://piazza.com/shanghaitech.edu.cn/fall2020/si100b/
  - Register using your real Chinese names and ShanghaiTech emails.
  - Check Piazza and email daily. Don't miss out important messages.
- General course information on course website https://si100b.org/
- Gradescope: www.gradescope.com (register with entry code **9D7J7V**), for submitting some paper&pen (non-programming) assignments and we will publish your scores on it.

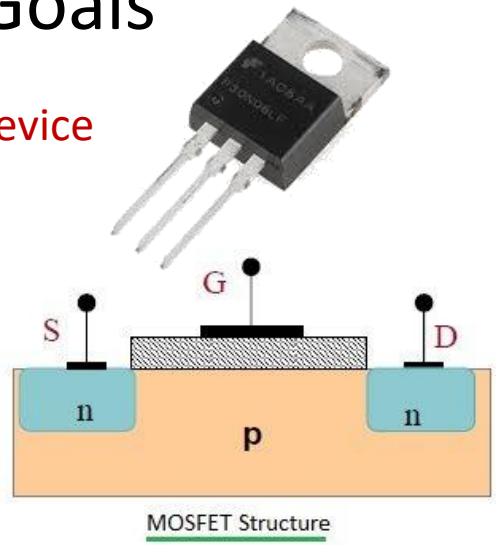
Signal Processing

- Goals
  - To provide an introduction to signal and signal processing
  - Familiarize the students with signal processing using MATLAB
- Reference books
  - Richard G. Lyons, Understanding Digital Signal Processing
  - Alan V. Oppenheim and Ronald W. Schafer, Discrete-Time Signal Processing, 3rd Edition
  - Sanjit K. Mitra, Digital Signal Processing: A Computer-Based Approach, 4th edition

Electronics

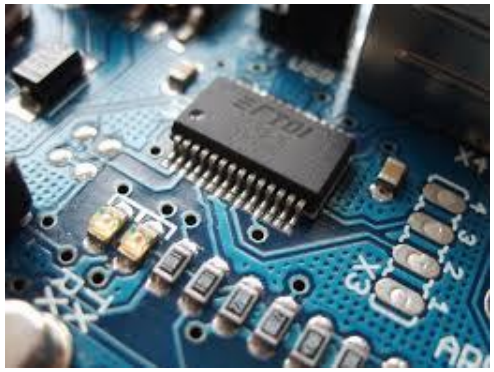
- Goals

Device

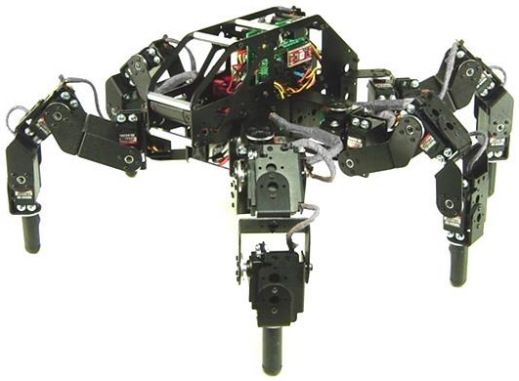


MOSFET Structure

Circuit



System



- Reference books
  - Sarah Harris, David Harris, *Digital Design and Computer Architecture. ARM Edition*, Morgan Kaufmann, 2015, ISBN 978-0-12-800056-4. (电子版https://b-ok.as/book/2716132/efaeba?regionChanged)

Programming Arrangement

- 8 lectures

Lecture	Content
1	Intro to course, computer basics, environment setup, basics about print, comments, and control flow
2	Variables (some on standard data types: numbers, string, list, tuple, dict), Expressions (some about operators), Statements
3	More on operators; condition, program structure
4	Loop, functions
5	Exception handling, file operations, modules, class and objects
5	Class and inheritance
7	NumPy, Pandas
8	Web crawler and data analysis example

- 2 programming assignments
  - HW1 30%, HW2 40%
  - Announce on Piazza
- Quizzes (30%), in class

PP Arrangement

- TAs for programming part
  - 刁子豪, diaozh@shanghaitech.edu.cn
  - 高子淇, gaozq@shanghaitech.edu.cn
  - 邱龙田, qiult@shanghaitech.edu.cn
  - 徐鸿图, xuht1@shanghaitech.edu.cn
  - 吴大千, wudq1@shanghaitech.edu.cn
  - 郭恺豪, guokh@shanghaitech.edu.cn
- Related inquiries
  - Google, StackOverflow
  - Ask on Piazza
  - Email, put **SI100B** in titles
- TA office hours
  - Time and location TBD
- TA tutorials
  - 1-1.5 hours each week
  - Time and location, vote on the slot, via Piazza

Academic Integrity

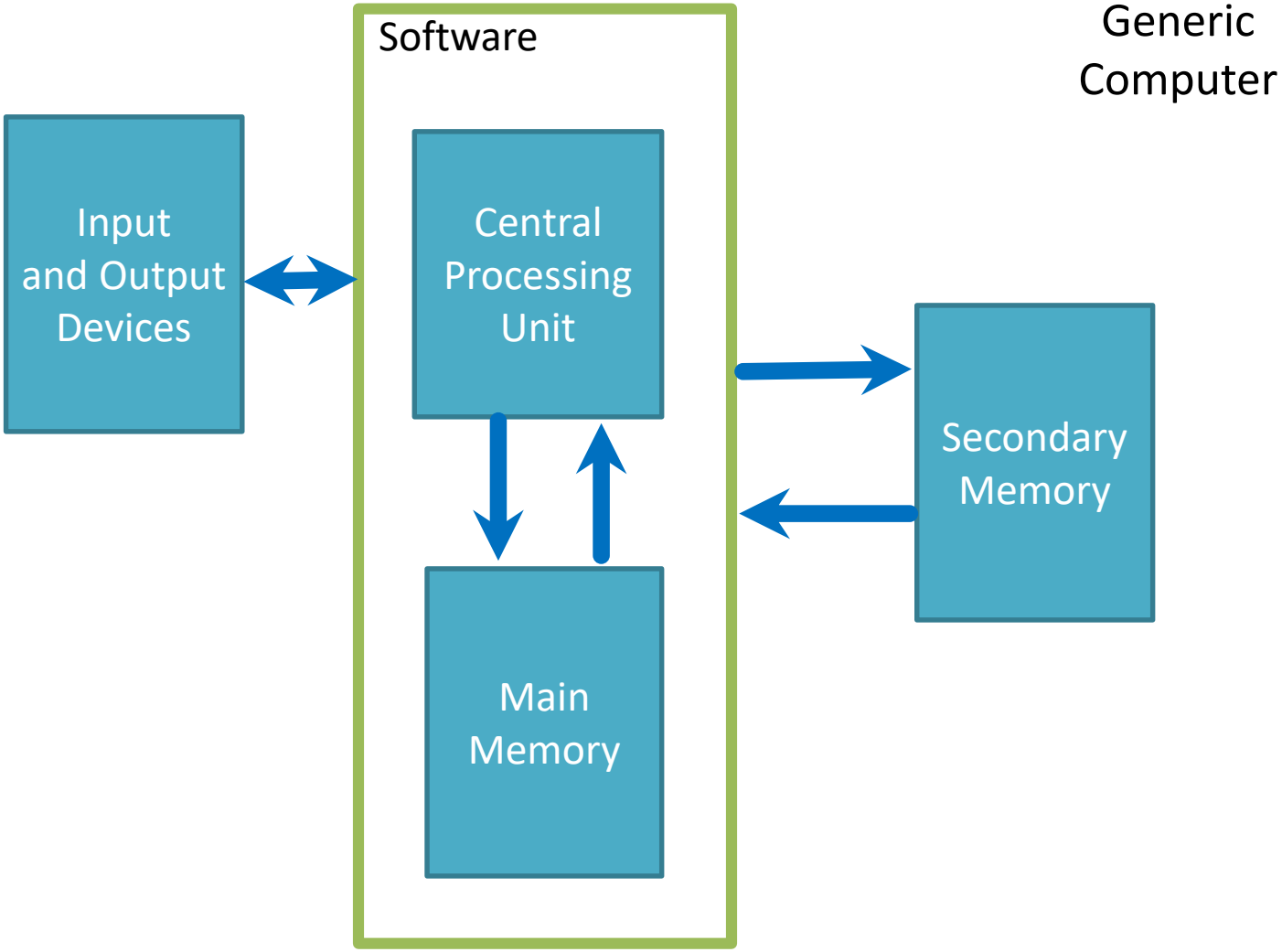
- The university code on academic integrity
  - http://openinfo.shanghaitech.edu.cn/xswyhxgzdjjy/list.htm
- Academic integrity policy for SI100B
  - https://si100b.org/resource-policy/#policies
- We **DON'T** tolerate academic misconducts
  - X 抄袭他人代码，抄袭网络源代码(Github, CSDN等)
  - X 反编译别人的编译后文件(.pyc)
  - X 散布源代码
  - X 帮助或者寻求别人帮助修改代码问题(debug)
  - X 代他人签到

  - 不允许提供抄袭，保护好自己的代码
  - 鼓励讨论，仅限于算法层面，不允许讨论与借鉴实现细节

Learning Objectives

- How a program runs on a basic computer
- What is Python
- How to get Python
- Run a Python program
- Basics about print and comments
- Basic control flow

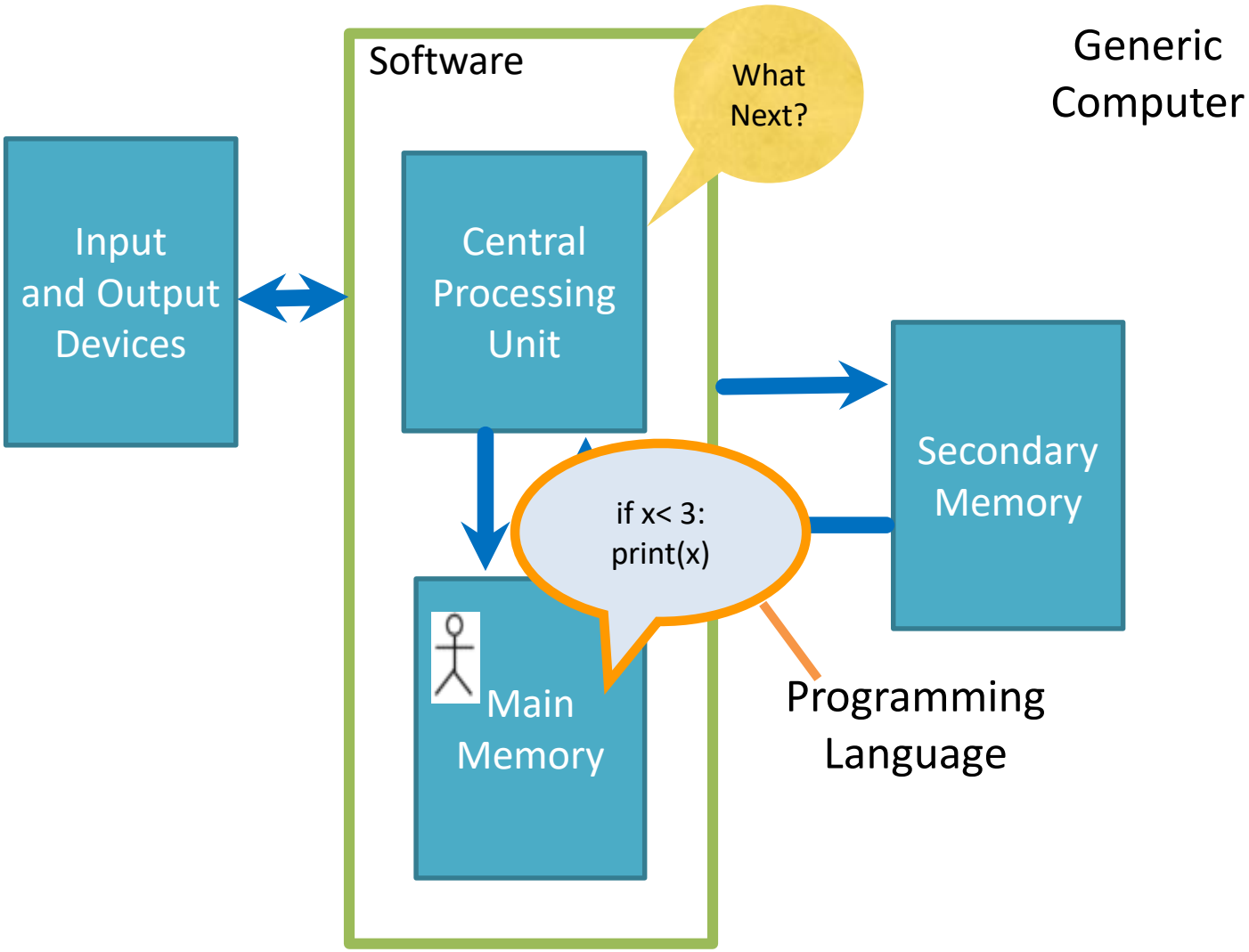
A basic computer



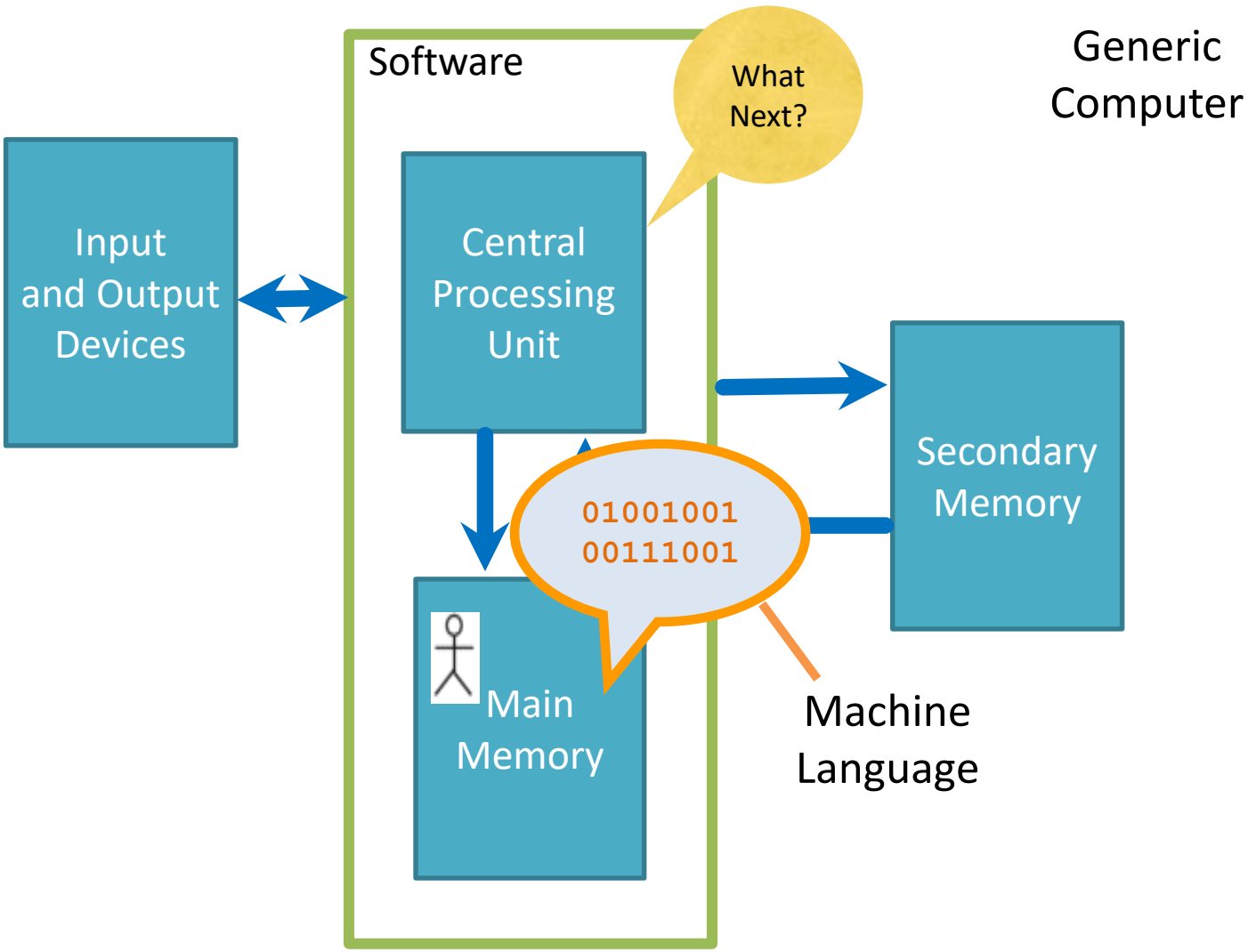
Definitions

- Central Processing Unit: Runs the Program - Executing simple instructions (add, multiply, etc), one by one.
- Input Devices: Keyboard, Mouse, Touch Screen
- Output Devices: Screen, Speakers, Printer, DVD Burner
- Main Memory: Fast small temporary storage - lost on reboot
- Secondary Memory: Slower large permanent storage - lasts until deleted - disk drive / memory stick

How a program runs on a basic computer



How a program runs on a basic computer

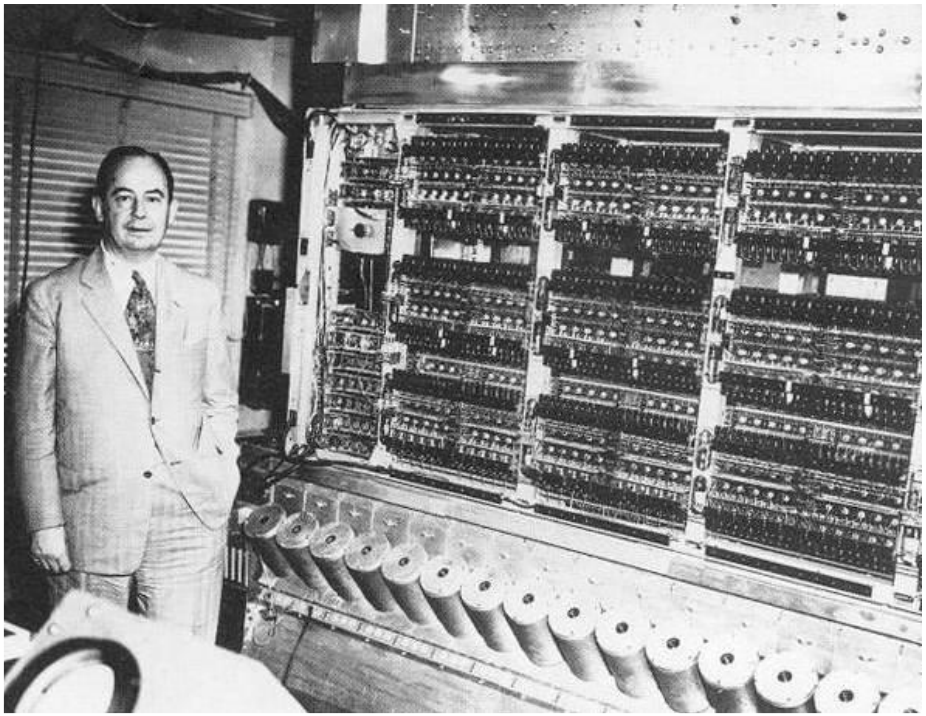


Basic Computer Architecture

- A very simple computer (RaspberryPi)

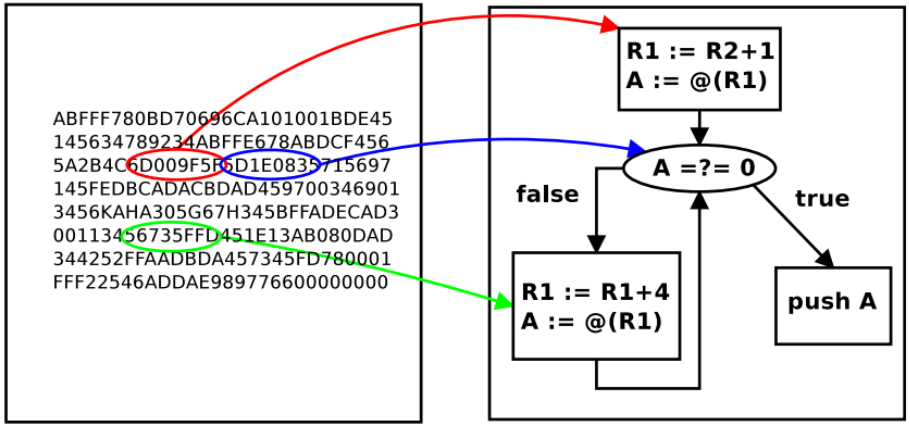
A brief history of programming languages

- In the late 1940s, the stored-program computer invented by John von Neumann, programs written in machine language, {0,1}+



A brief history of programming languages

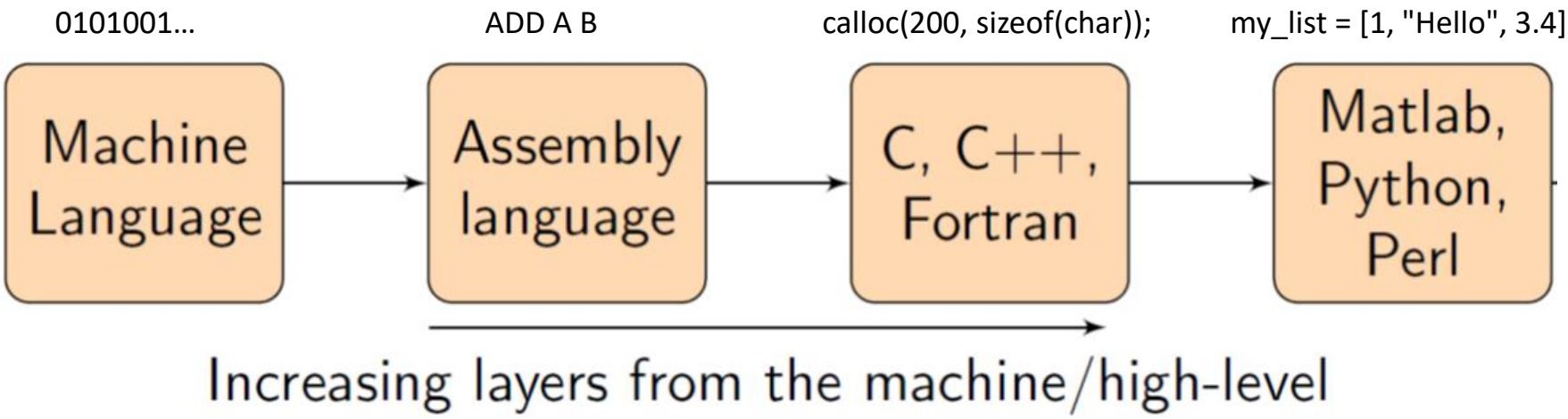
- Assembly language: in 1949 numeric codes were replaced by symbolic forms
  - Mov R, 2 (R=2)
- Assembler: translate assembly language into corresponding machine language.



- FORTRAN language and its compiler: between 1954 and 1957, developed by IBM

Programming Languages

- Far from hardware, more human-friendly.



How to pick a language?

- **Meet your application requirements**
  - **Must it be efficient?**
  - **Easy to understand**
  - **Easy to write (time, size of programs)**
  - **Easy to debug, maintain, and prevent errors**
  - **Plenty of support**

Why Python?

- ✓ **Efficiency**
  - **efficient for programmers to write programs**
  - **but Python programs themselves are not efficient**
- ✓ **Easy to learn**
- ✓ **Active user community**
- ✓ **Lots of handy packages**
- ✓ **Lots of open source projects**

And as a bonus

- Once you learn how to code in one programming language it will be easier to learn another programming language, and another, and another…
- C#, Java, C++, Perl…

A brief history

- Invented by Guido van Rossum, started in 1989
  - "'hobby' programming project that would keep him occupied during the week around Christmas"
  - Top 5 popular programming languages
  - Ver 3.0 in 2008, limited backward compatibility


Life is short, use Python
人生苦短
我用python

Growing popularity

- Among top 5 by popularity

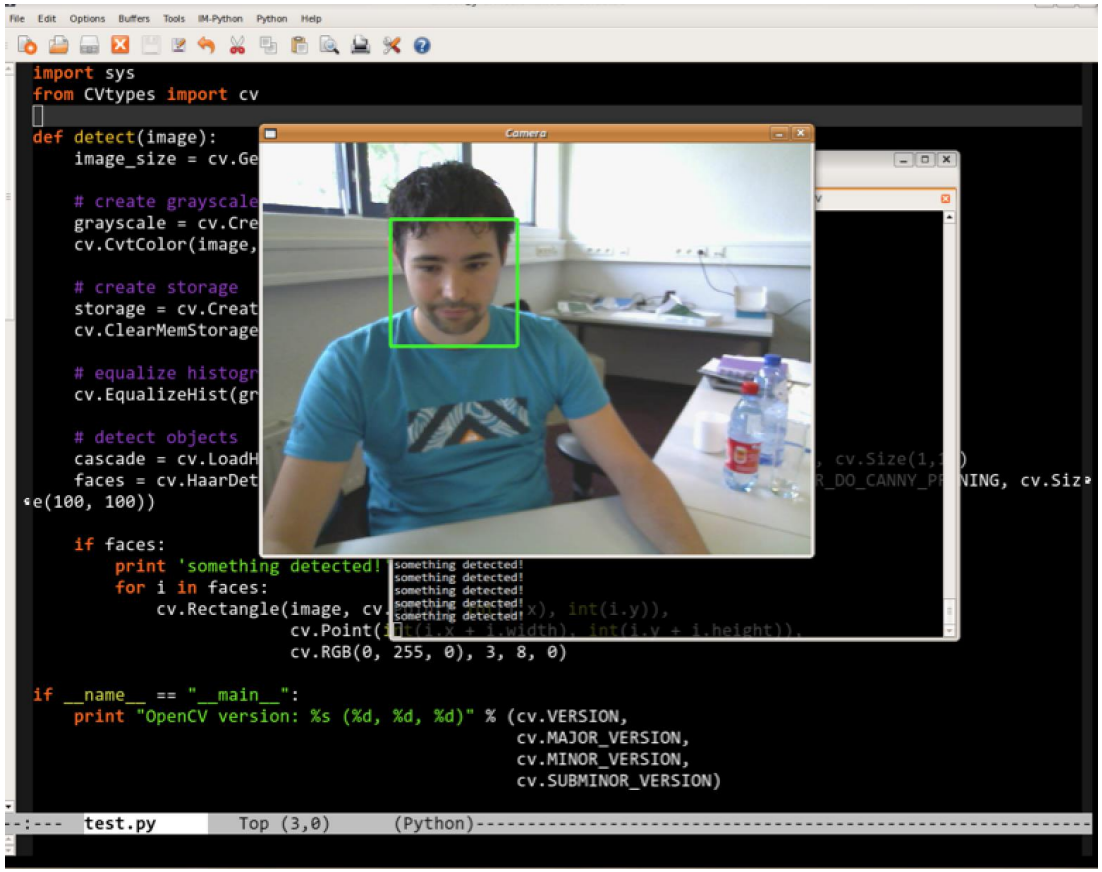
Aug 2020	Aug 2019	Change	Programming Language	Ratings	Change
1	2	↑	C	16.98%	+1.83%
2	1	↓	Java	14.43%	-1.60%
3	3		Python	9.69%	-0.33%
4	4		C++	6.84%	+0.78%
5	5		C#	4.68%	+0.83%
6	6		Visual Basic	4.66%	+0.97%
7	7		JavaScript	2.87%	+0.62%
8	20	⇈	R	2.79%	+1.97%
9	8	↓	PHP	2.24%	+0.17%
10	10		SQL	1.46%	-0.17%

https://www.tiobe.com/tiobe-index/

Who use Python?

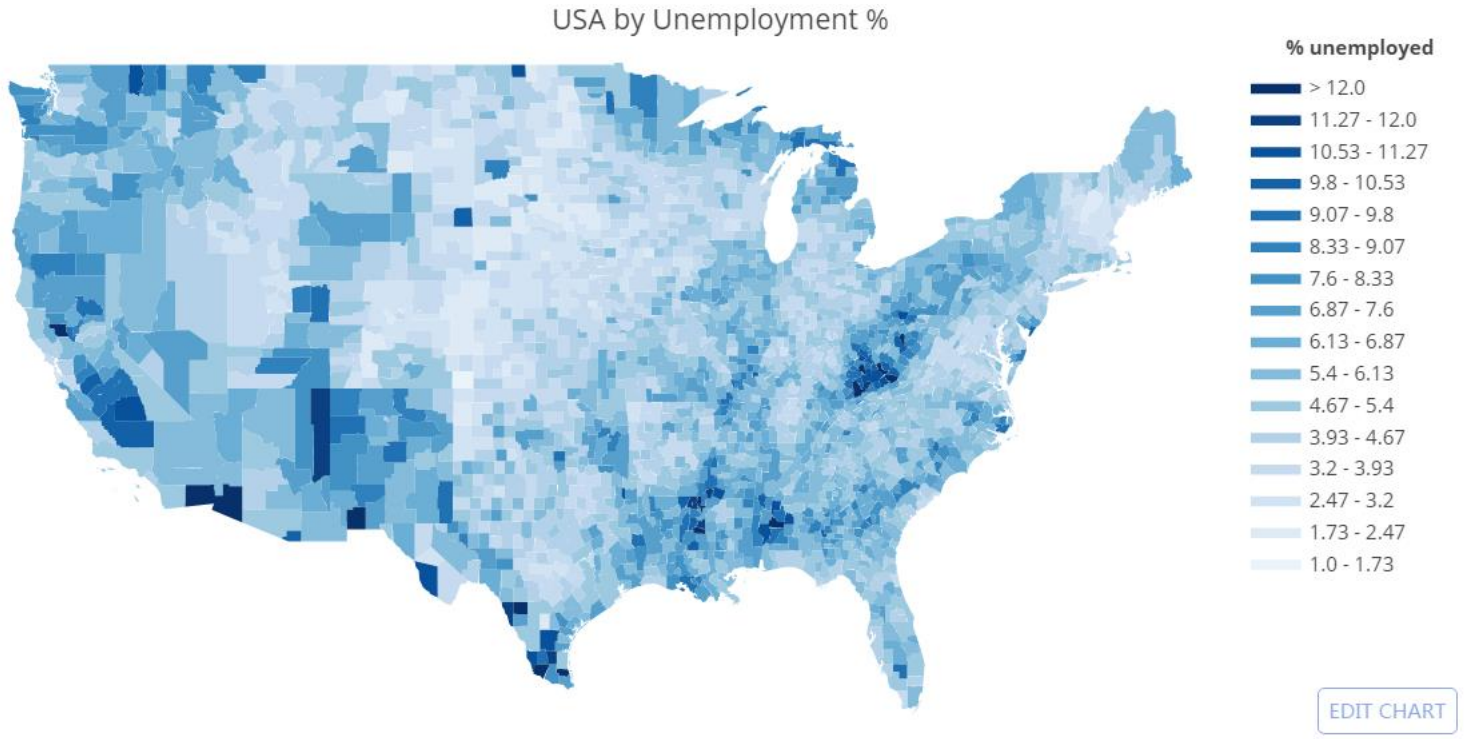
What can Python do?

- Face recognition with OpenCV library



What can Python do?

- Interactive visualizations and data analysis, https://plot.ly



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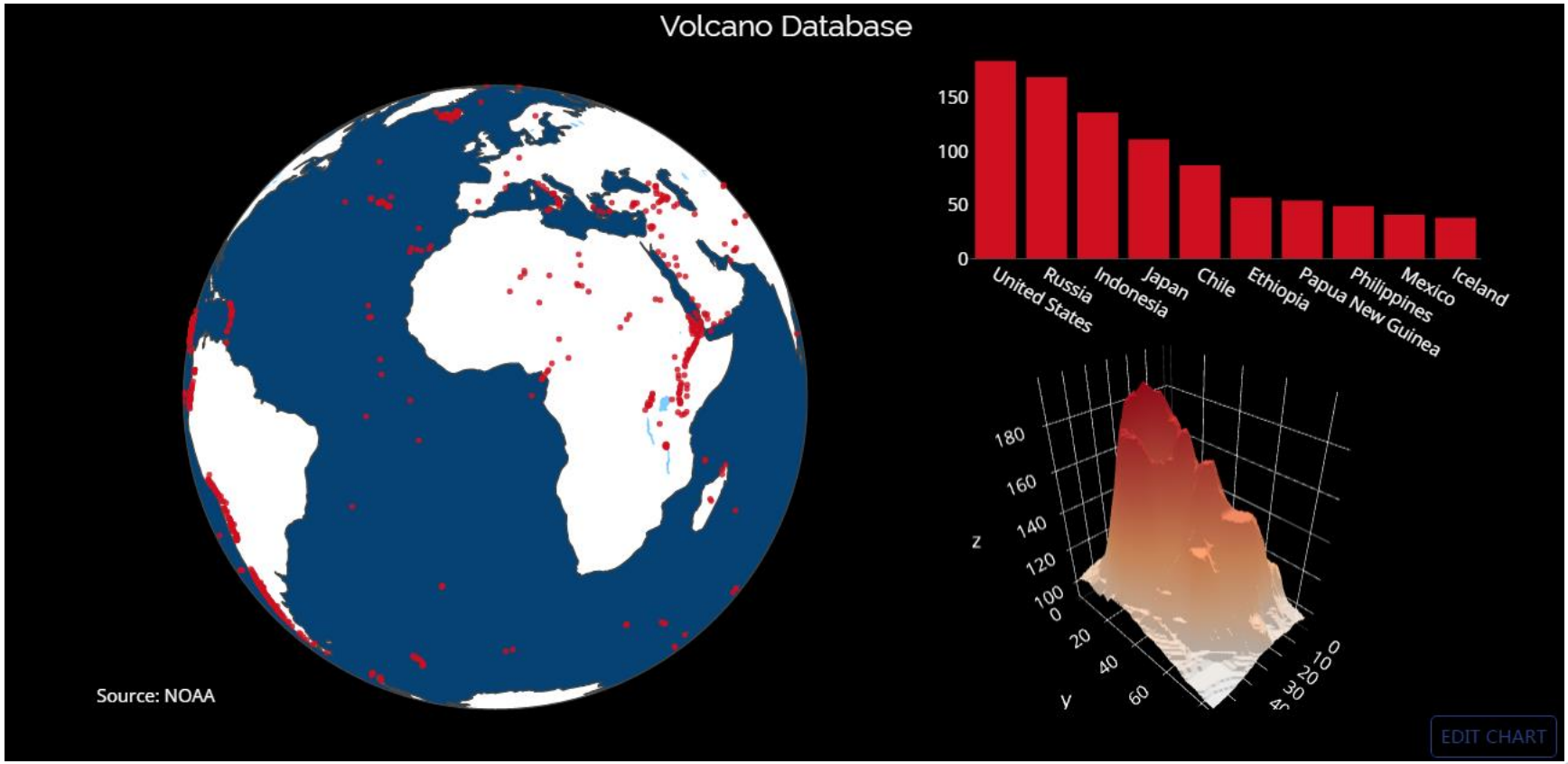


What can Python do?

- Quantitative trading
  - https://uqer.io, write strategies and back-test them

```python
import pandas as pd
import numpy as np
from sklearn.svm import SVC
import CAL
start = '2013-01-01'                        # 回测起始时间
end = '2014-01-01'                          # 回测结束时间
benchmark = 'HS300'                         # 策略参考标准
universe = set_universe('HS300')  # 证券池，支持股票和基金
capital_base = 100000                       # 起始资金
freq = 'd'                                  # 策略类型，'d'表示日间策略使用
refresh_rate = 20                           # 调仓频率，表示执行handle_da

trainperiod='-3M'#训练周期3个月
factor=['LFLO','NetProfitGrowRate']#选2个因子
cal = CAL.Calendar('China.SSE')#创建日历



def initialize(account):                    # 初始化虚拟账户状态
    pass

def handle_data(account):                   # 每个交易日的买入卖出指令
    preday=cal.advanceDate(account.current_date,trainperiod)
```

- A story about Bitcoin arbitrage system in 2014
  - http://daily.zhihu.com/story/4831821

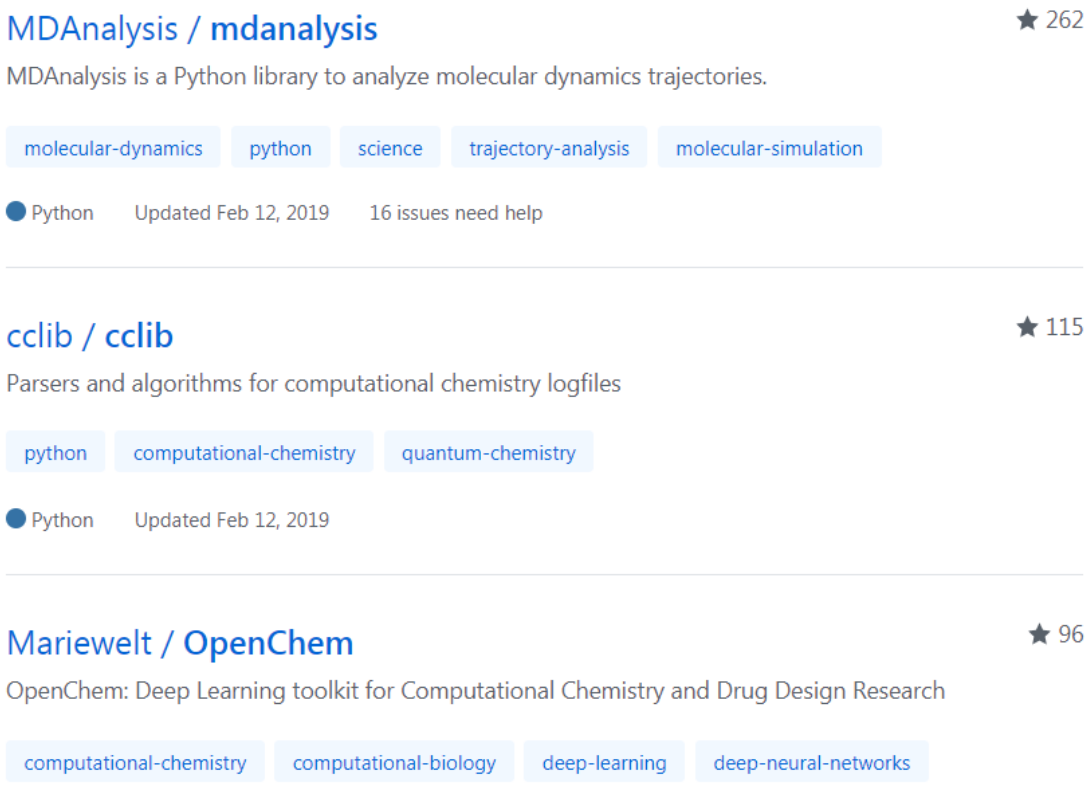
What can Python do?

- Computational biology, bioinformatics
  - combines biology, computer science, information engineering, mathematics and statistics to analyze and interpret biological data
  - https://biopython.org, computations on gene sequences

What can Python do?

- Computational chemistry
  - uses methods of theoretical chemistry, incorporated into efficient computer programs, to calculate the structures and properties of molecules and solids.

Some active projects on **Github**



What can Python do?

- 2017 Nobel Prize in Physics
  - for decisive contributions to the LIGO detector and the observation of **gravitational waves**
  - https://gwpy.github.io/ , tools and methods for studying data from gravitational-wave detectors

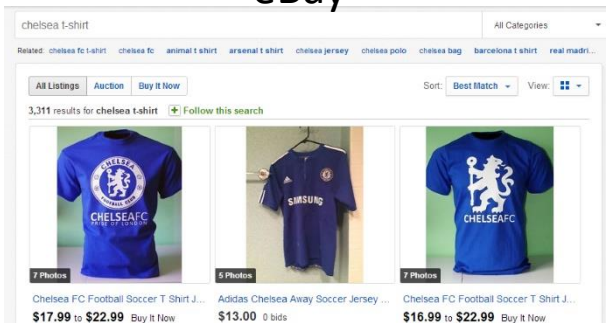
What can Python do?

- Crawling web data
  - Beautifulsoup, Scrapy
  - E.g. Get rent price from 链家 and analyze the price trend
- Statistics, scientific computing
  - statistics, numpy, scipy, pandas
- Natural language processing
  - NLTK, Jieba; to understand human language
- Machine learning/ Deep learning
  - SKLearn, Tensorflow, Pytorch

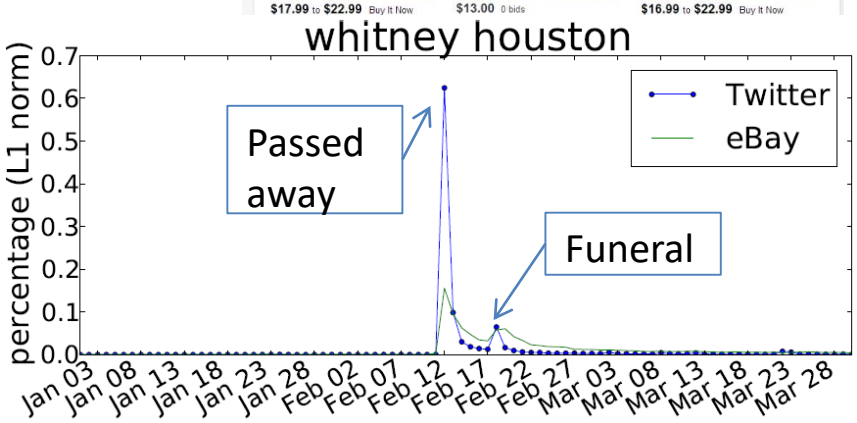
Social media data mining and e-commerce campaign

Twitter

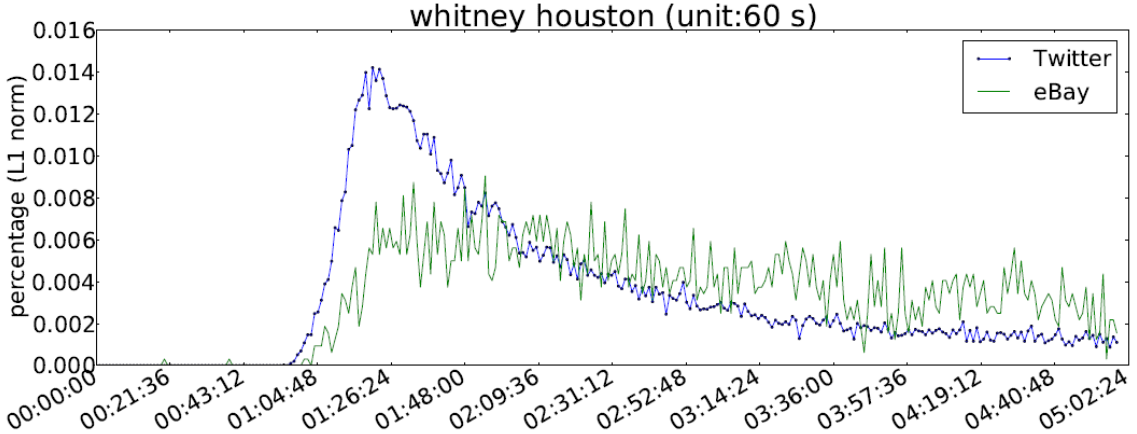
eBay



correlations

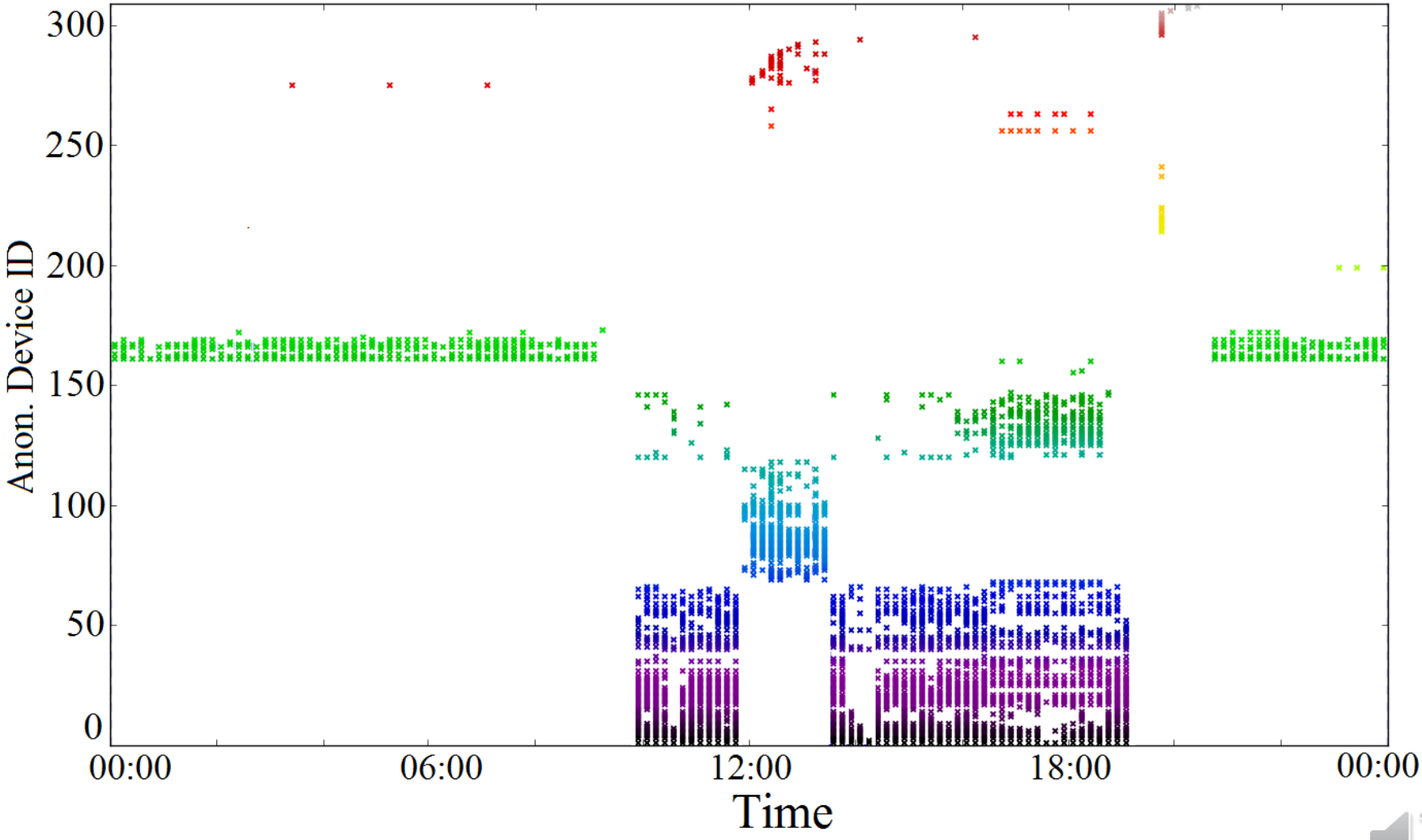


lags
(4.8 hours)



Mining mobile user behaviors

- WiFi device ID discovered by a phone, in a day



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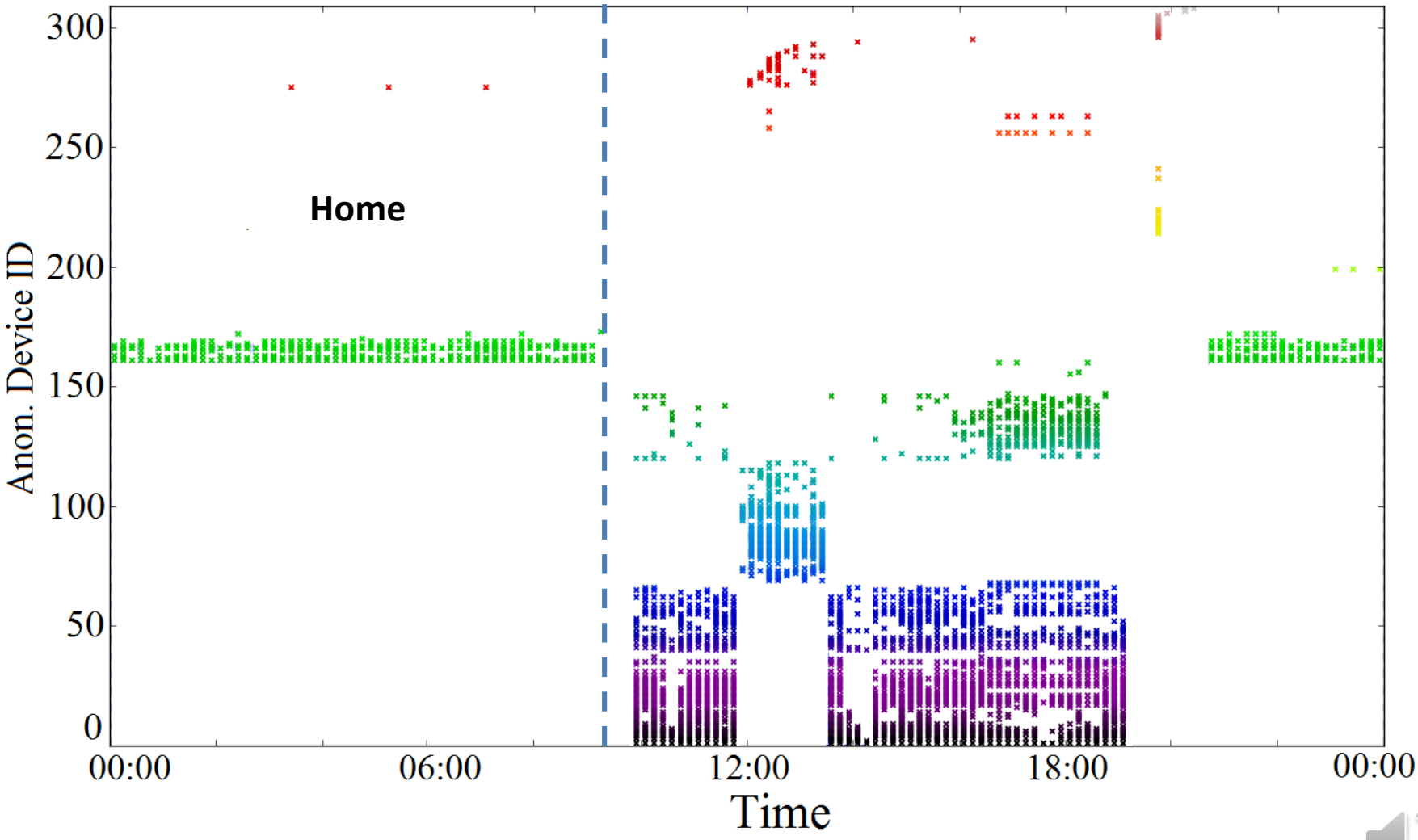

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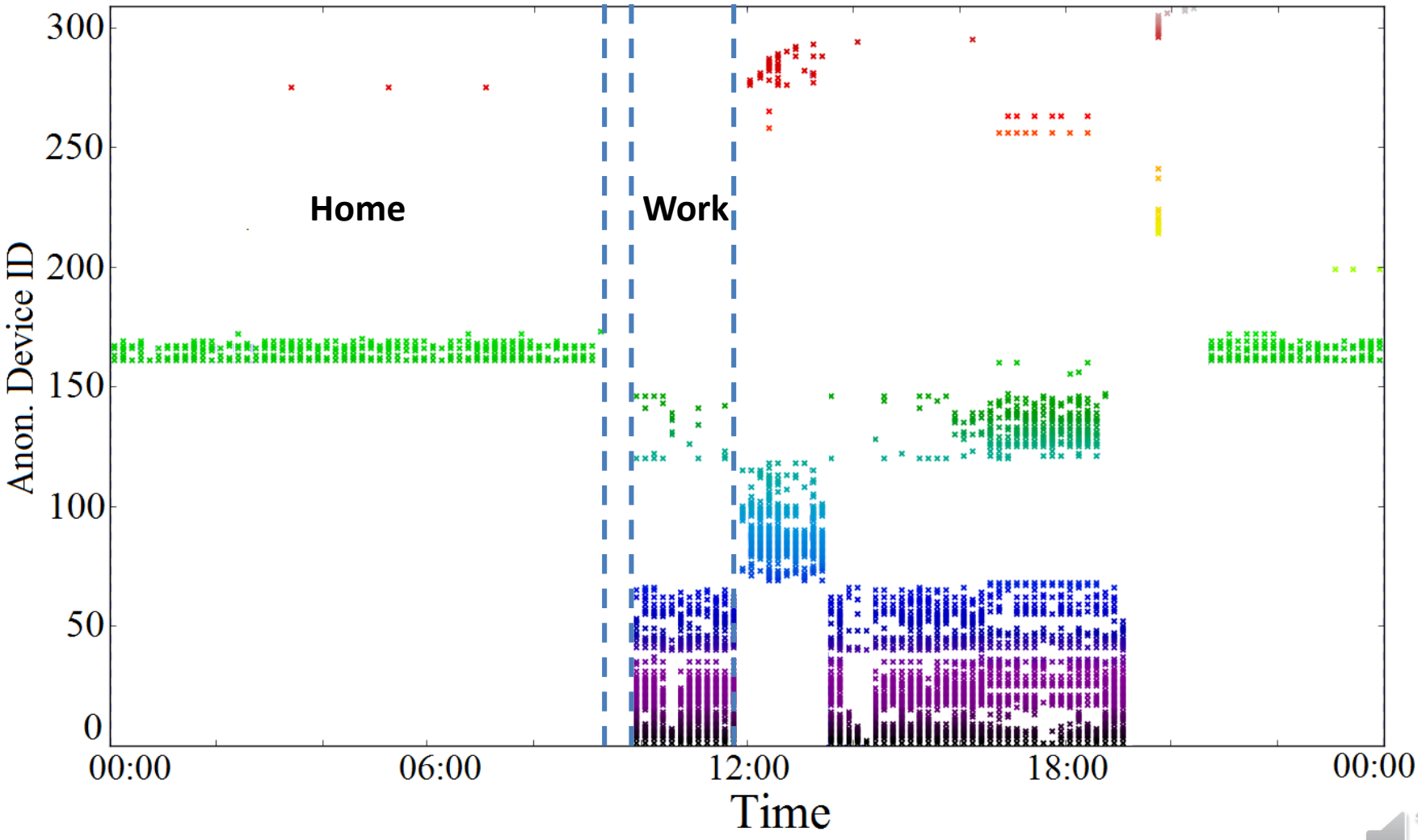

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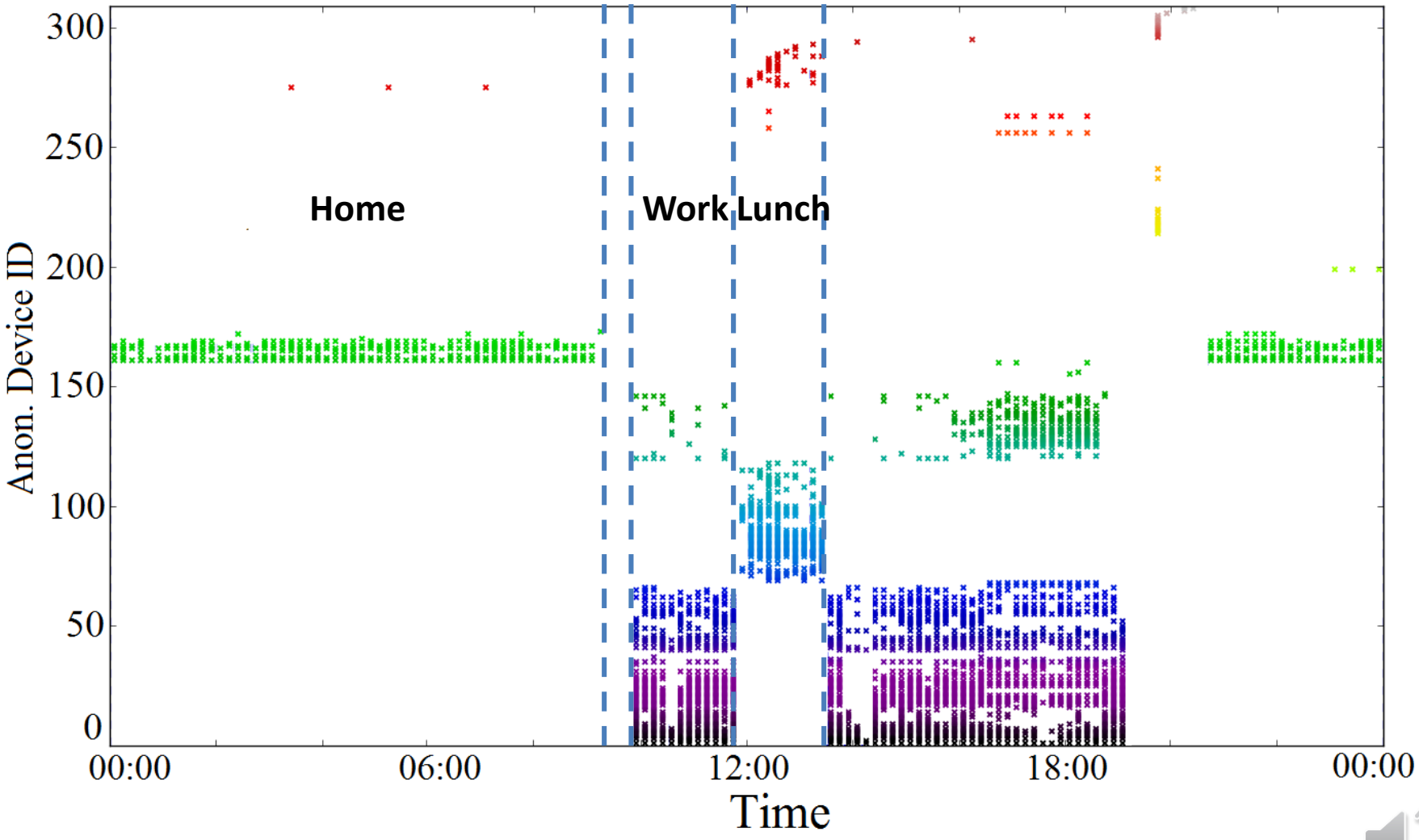

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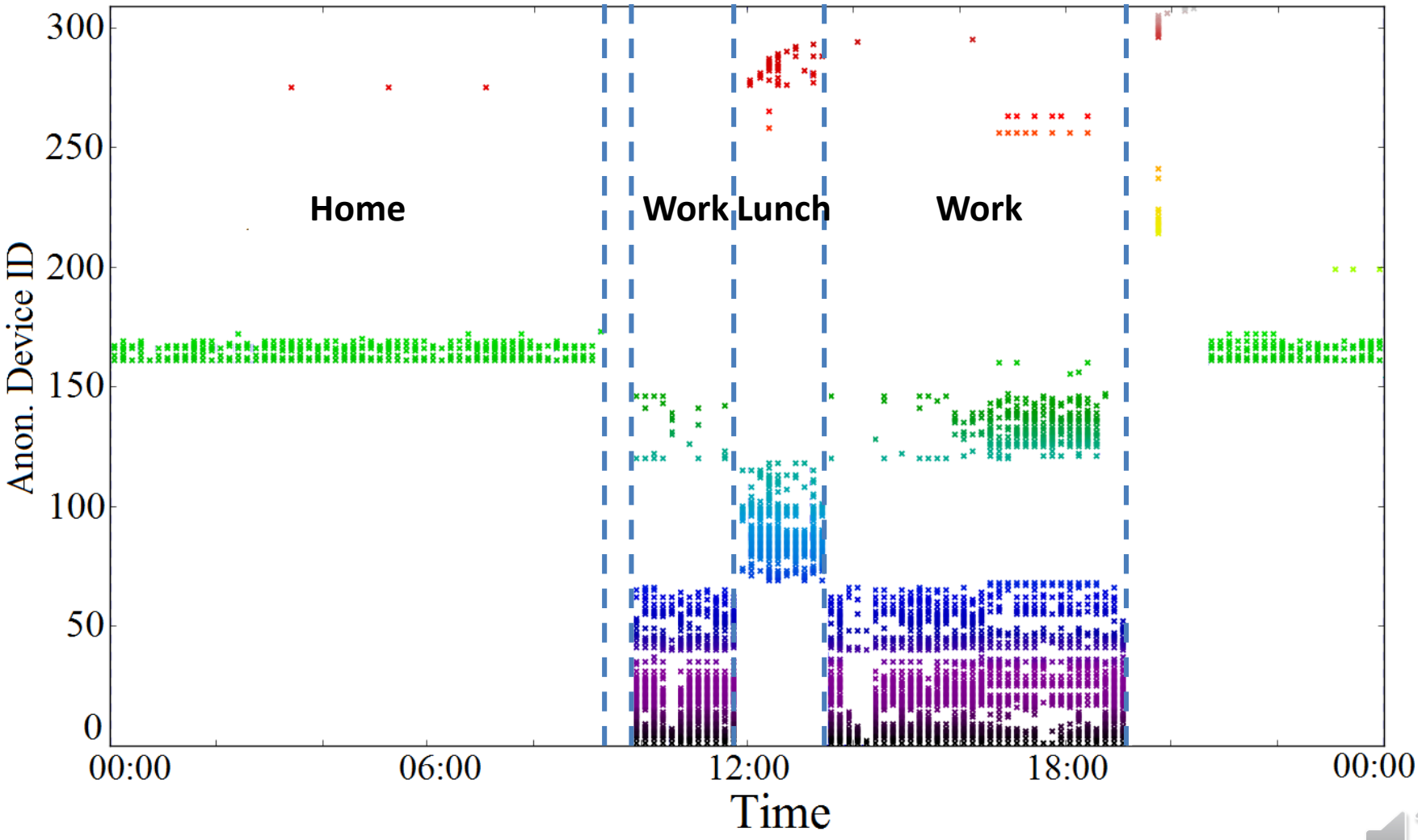

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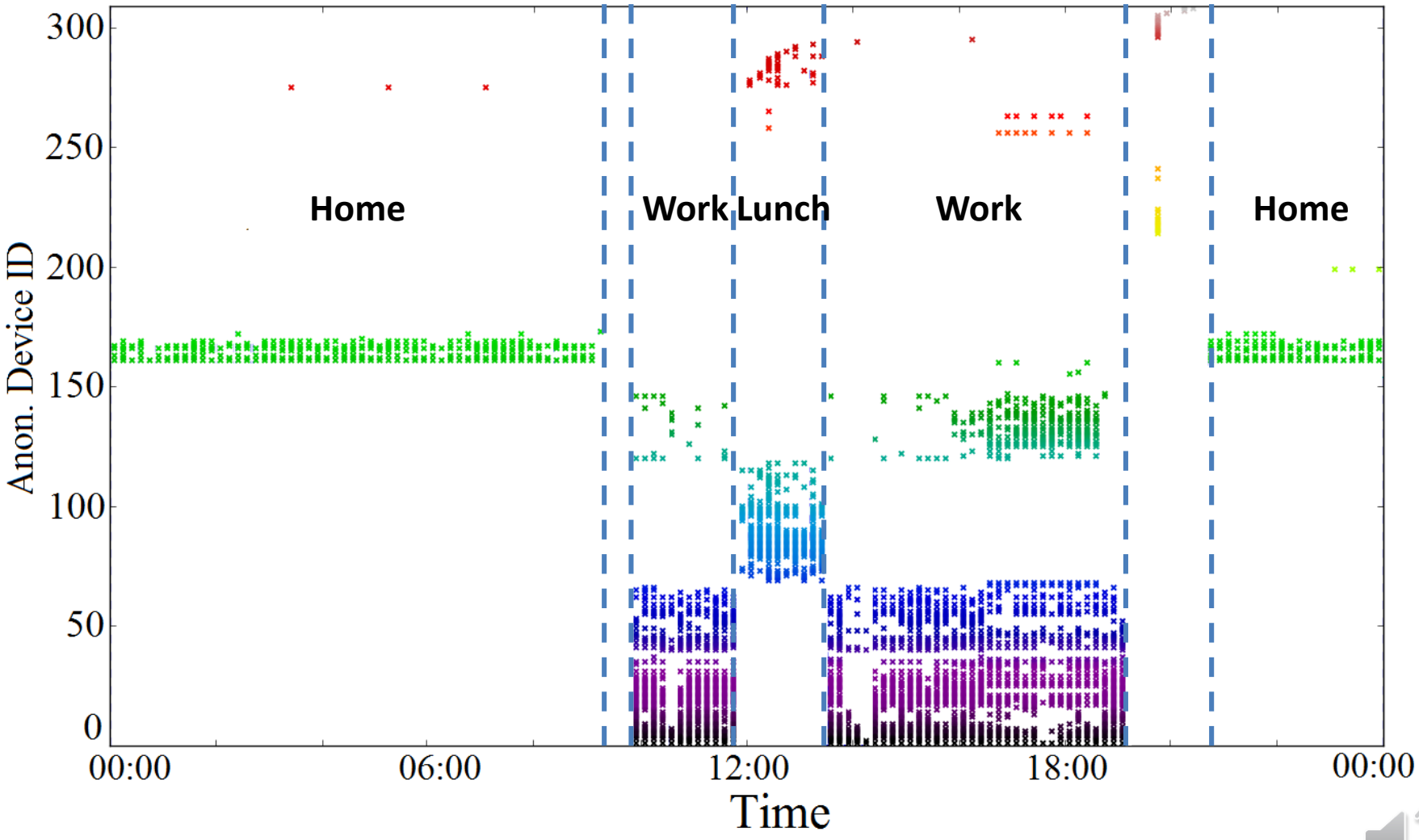
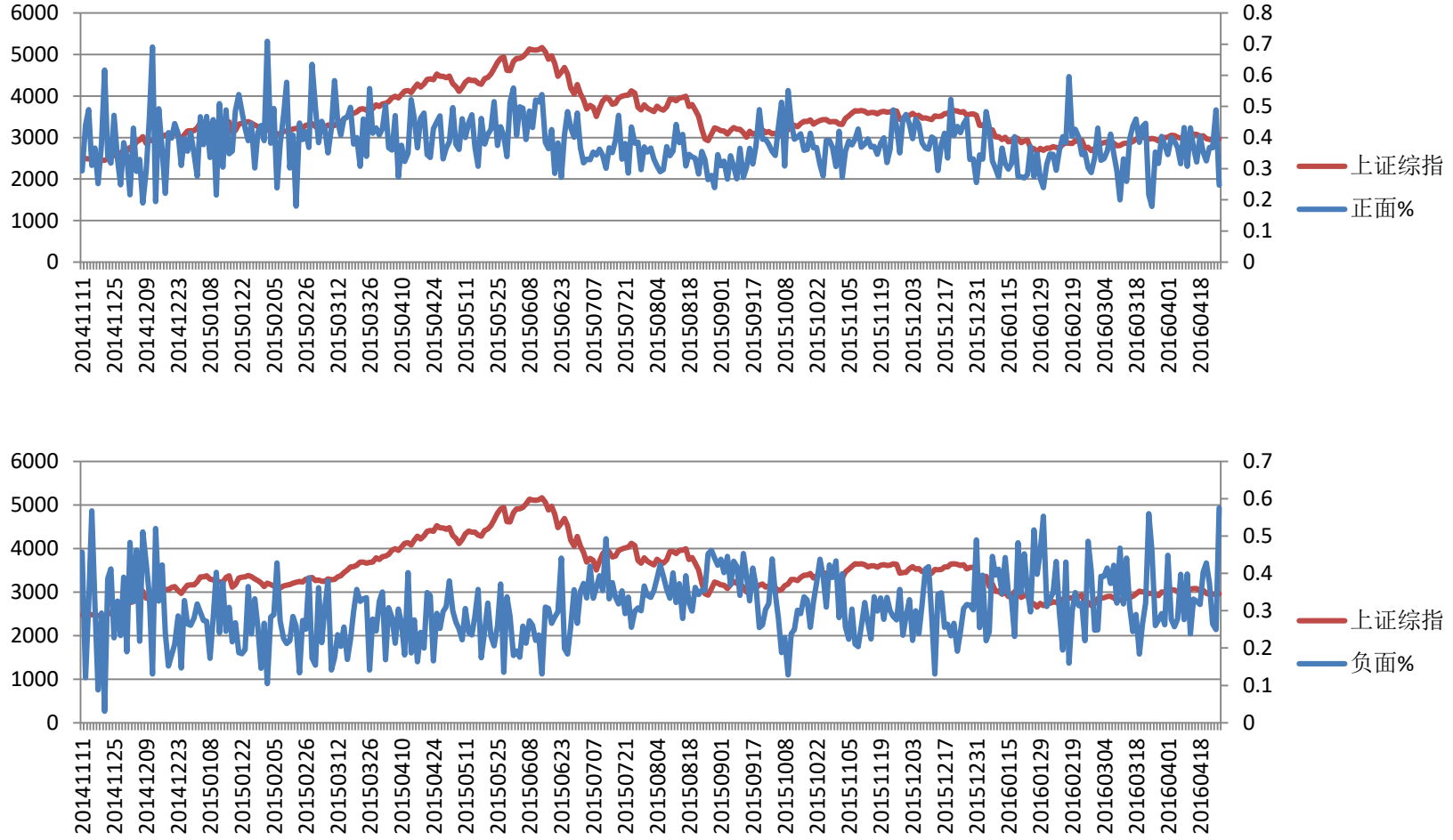


Social media and stock market

Positive/negative social media sentiment and the stock market



How to get Python

- **Option 1**, install Anaconda
  - Includes core Python environment, IDE (Integrated Development Environment). All in one.
  - Data science and visualization packages
  - Easy to manage (add, remove, update) packages
  - **Python 3.7** version for this course. **Anaconda3 version 2018.12**
  - https://www.anaconda.com/products/individual

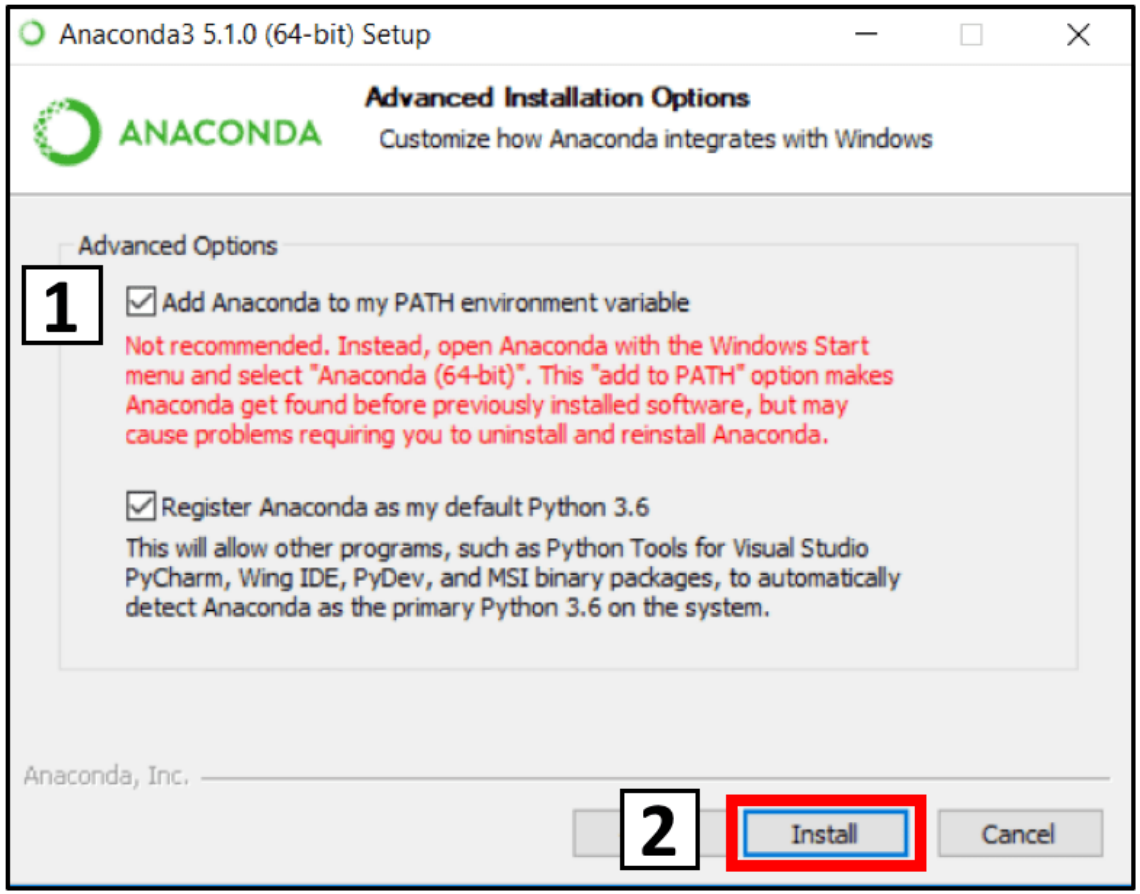
How to get Python

- For Windows
  - Check your Windows bit, 64bit or 32bit, most often 64bit.

  - Download and install 64bit or 32bit Anaconda accordingly
    - https://repo.anaconda.com/archive/Anaconda3-2018.12-Windows-x86_64.exe 64bit
    - https://repo.anaconda.com/archive/Anaconda3-2018.12-Windows-x86.exe 32bit

How to get Python

- Recommend you check the first box



How to get Python

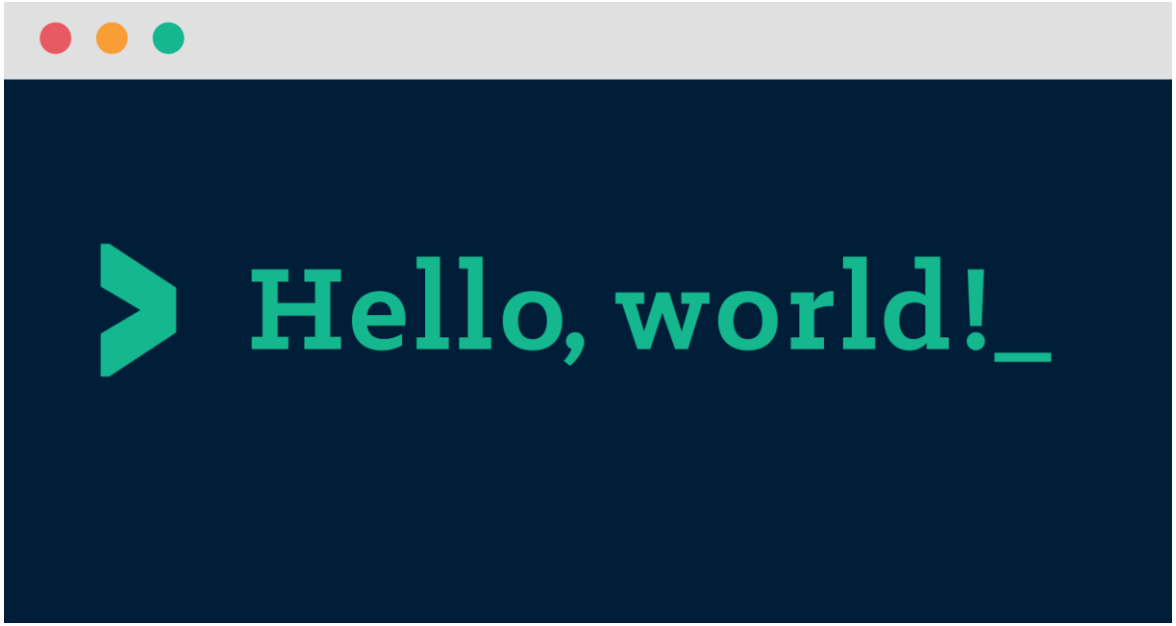
- For Mac OS
  - https://repo.anaconda.com/archive/Anaconda3-2018.12-MacOSX-x86_64.pkg
- For Linux
  - https://www.anaconda.com/distribution/#linux
  - Install according to your operation system bit and CPU (x86 or Power8/9)
- After installation
  - Try the **Spyder** IDE, included in Anaconda
  - Or in Anaconda Prompt/command line/terminal, enter Python (depending on whether you have added Anaconda to your system path during installation)

How to get Python

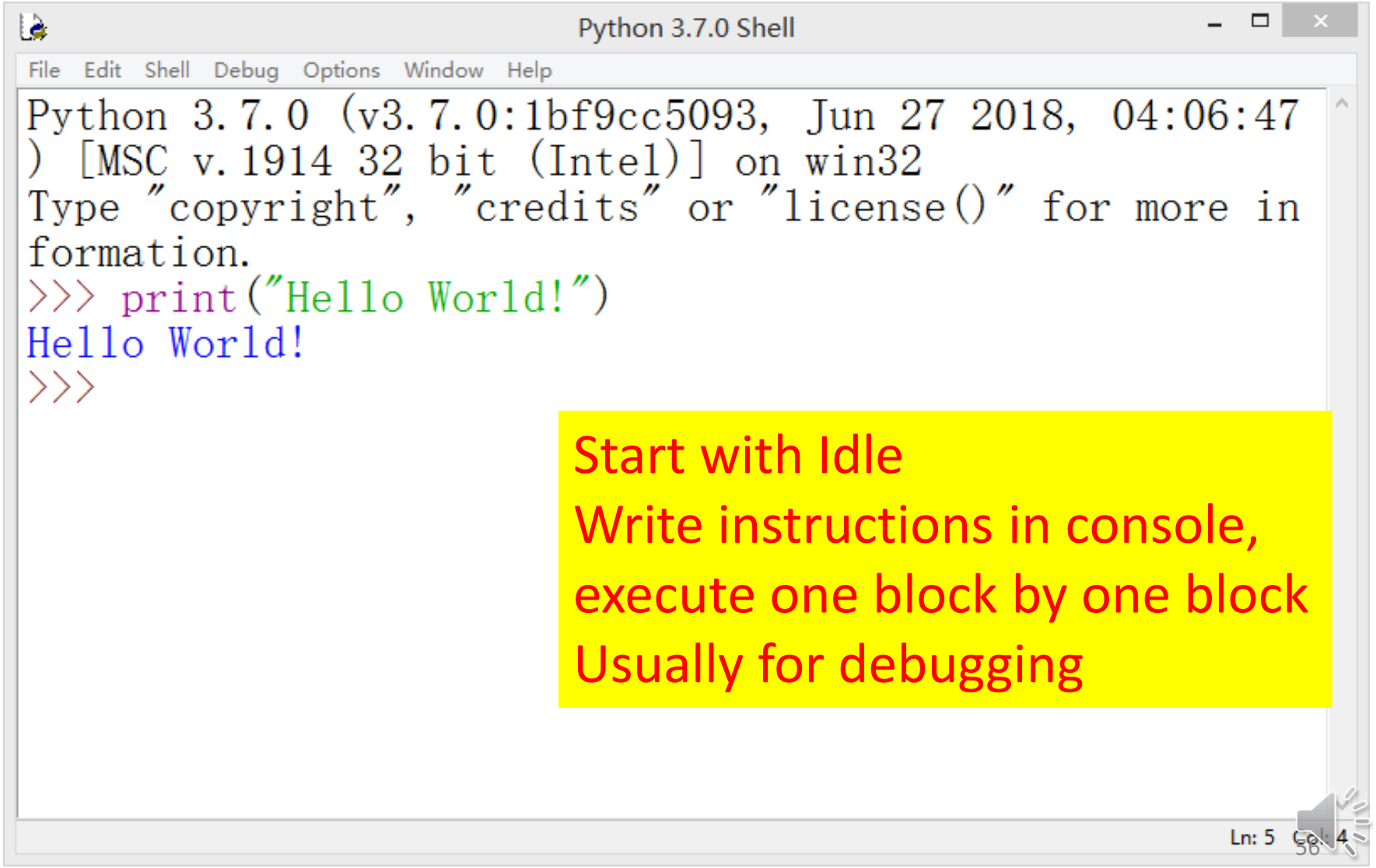
- **Option 2**, install Python from python.org
  - Download python 3.7.1 at www.python.org/downloads
  - 32bit/64bit, Windows, Linux/UNIX, Mac OSX depends on your computer
  - Run python or idle in Windows
  - Type in python3 or python on Linux or Mac OSX
  - Two programming modes in Python
    - Interactive
    - Batch

How do I know I installed everything correctly?

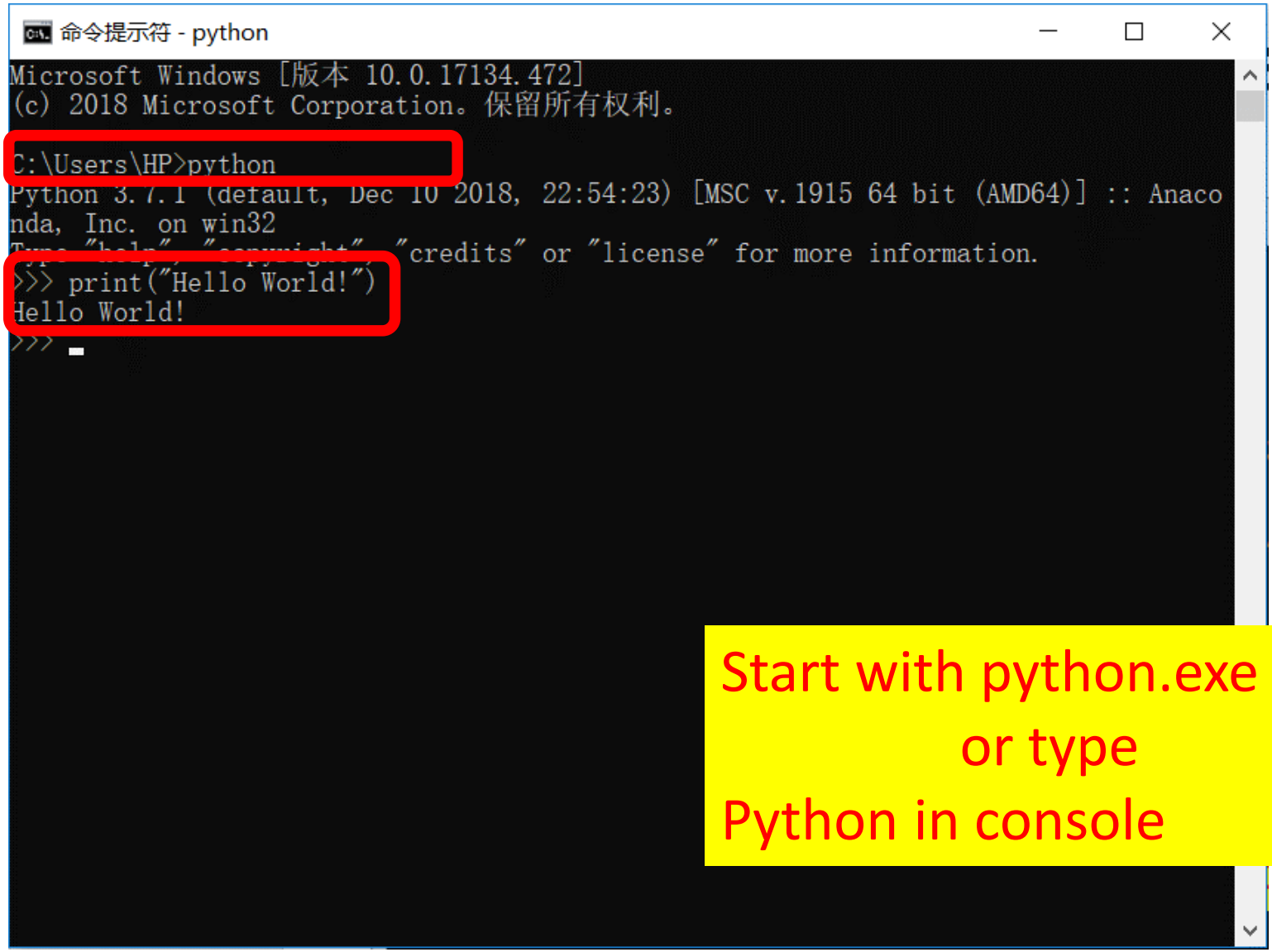
- A tradition among programmers
  - always test installation by writing the same program



Step 1: Interactive programming



Step 1: Interactive programming



Step 2: Batch programming

Comment starts with #

```
#hello.py

print("Hello World!")
print("Hello World!!")
```

Write instructions in a file hello.py, execute the file by

python hello.py

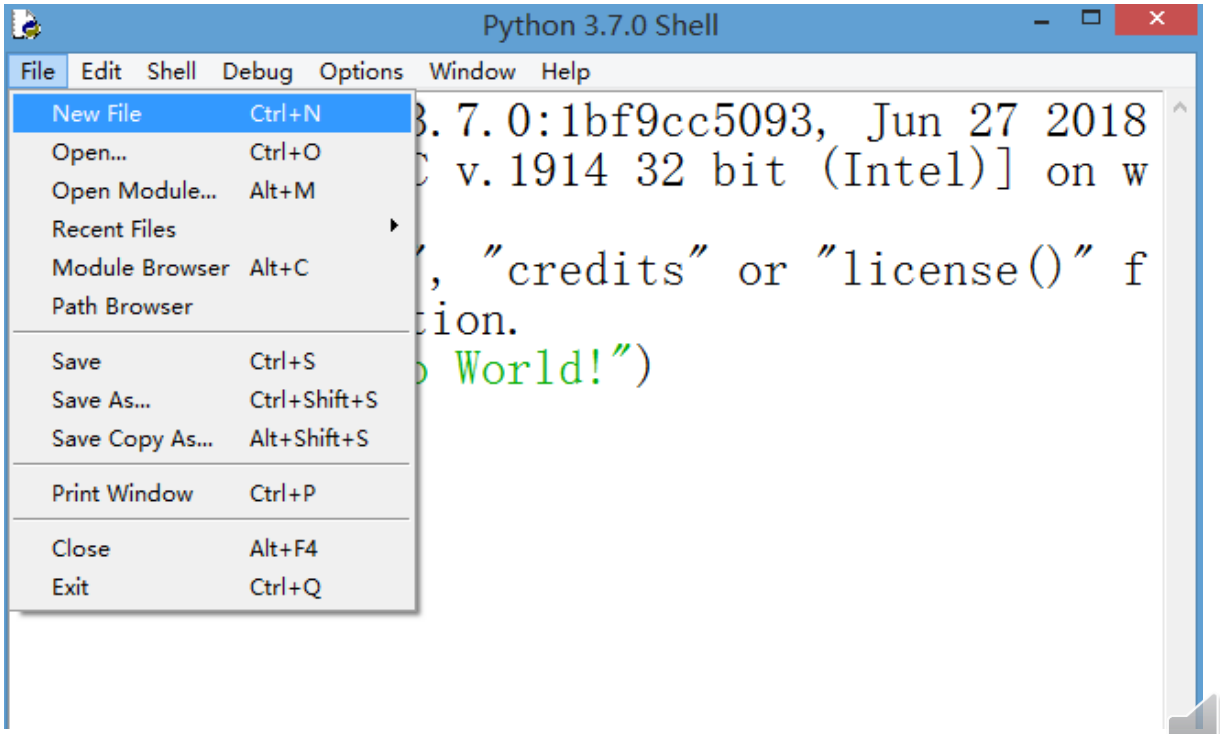
Step 2: Batch programming

In IDLE:

1. “File”==>“New File” create a file,

2. write your python program

3. save file as hello.py



Step 2: Batch programming

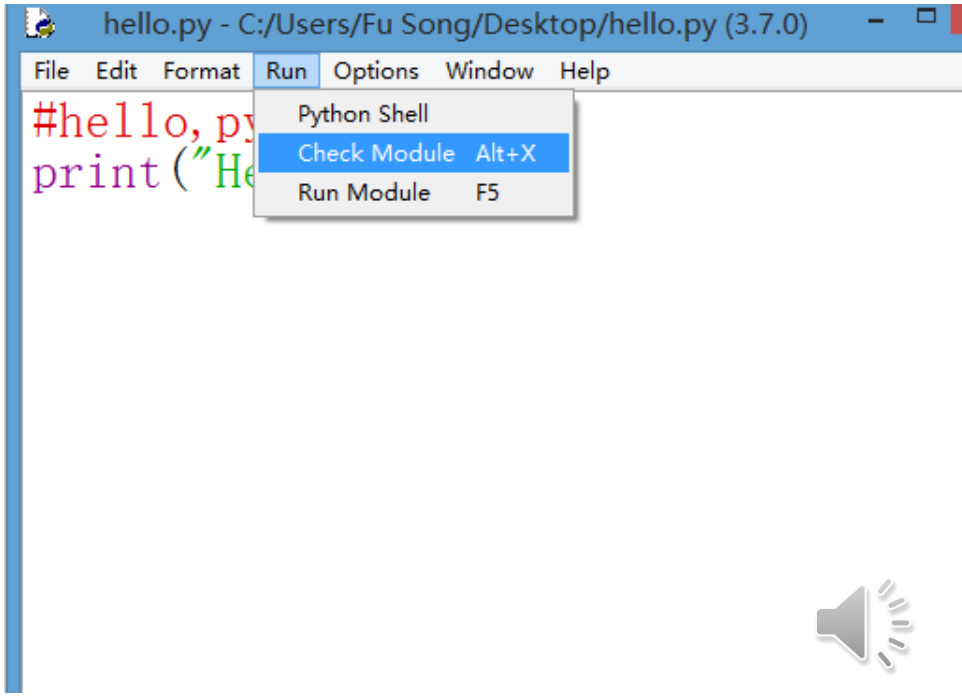
In IDLE:

1. **“File”==>“New File” create a file,**
2. **write your python program**
3. **save file as filename.py**
4. **“Run”==>”Check Module”**

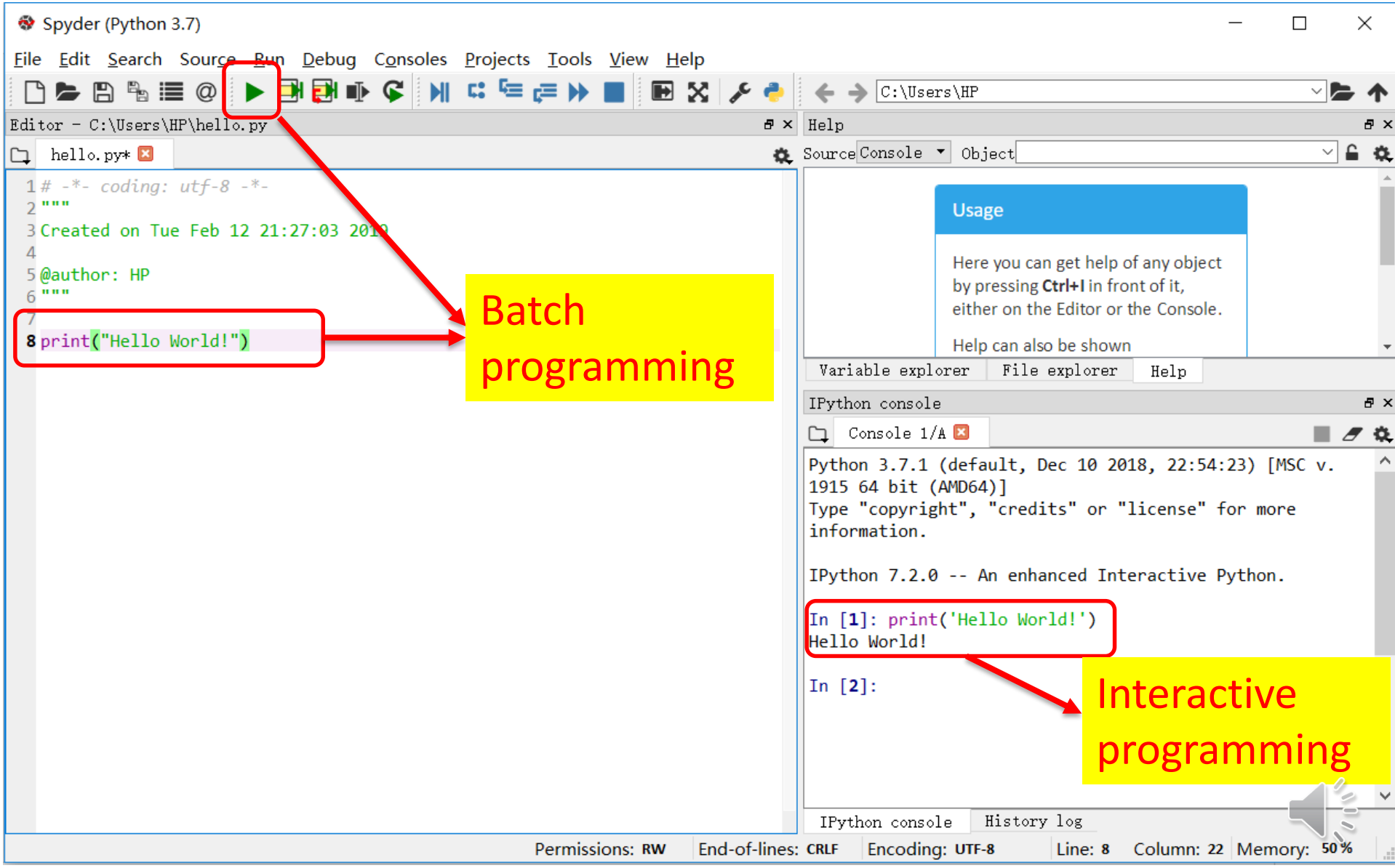
   check syntax
5. **“Run”==>”Run Module”**

   run the program and

   print the result in IDLE



In Spyder (Anaconda)



Print in Python

- print a string: string needs to be surrounded by double or single quotes
  - print(“text”) or print(‘text’)
- print() prints a blank line
- https://docs.python.org/3/library/functions.html#print

Print in Python

```
#hello.py
print('Hello World!')
print("Hello World!")
```

Output

```
Hello World!
Hello World!
>>>
```

What if we want the output to be:

```
‘Hello World!’
“Hello World!”
>>>
```

Print in Python

- We will use escape character (\)

```
#hello.py
print('\'Hello World!\'')
print("\"Hello World!\"")
print('"Hello World!"')
print("'Hello World!'")
```

‘Hello World!’
“Hello World!”
“Hello World!”
‘Hello World!’
>>>

Print in Python

Python escape characters:

For this	Use this	Setting x to:	Printing x will yield:
'	\'	'Don\'t do that'	Don't do that
"	\"	"She said \"hi\""	She said "hi"
\	\\	"Backslash: \\"	Backslash: \
[newline]	\n	"1\n2"	1 2
[carriage return]	\r	"1\r2"	2 overwrites the 1
[horizontal tab]	\t	"1\t2"	1 2
[backspace]	\b	"12\b3"	13
[16 bit unicode]	**u**xxxx	"Katakana a: \u30A1"	Katakana a: ア
[32 bit unicode]	**U**xxxxxxxx	"Katakana a: \u000030A1"	Katakana a: ア

Print in Python

```
#hello.py
print('I\'ll say hello!')
print("I'll say hello!")
print("I'll say\n hello!")
```

```
I'll say hello!
I'll say hello!
I'll say
 hello!
>>>
```

Comments

- Syntax:
  - # comment text (one line)
  - ''' block
    comment ''' (span over lines, use in pairs)
- test.py

```
'''
Fall 2020, SIST
This program prints important messages.
'''
print("Hello, world!")
Print("")                    # blank line
print("I'll say hello!")
```

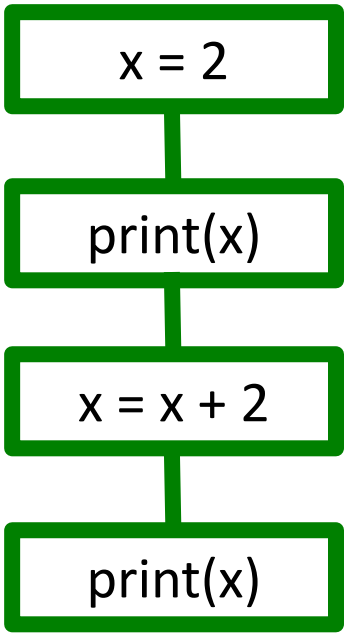
```
Output:
Hello, world!

I'll say hello!
```

Program steps or flow

- Like a recipe or installation instructions, a program is a sequence of steps to be done in order.
  - Some steps are conditional - they may be skipped.
  - Sometimes a step or group of steps are to be repeated.

Sequential steps



Program:

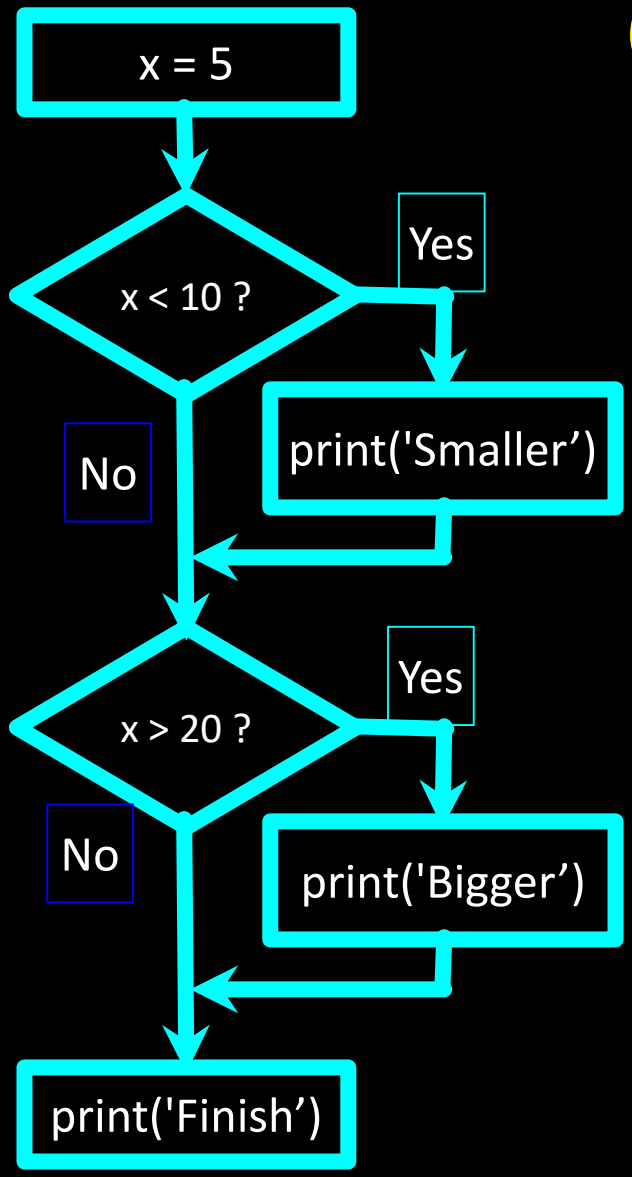
```
x = 2
print(x)
x = x + 2
print(x)
```

Output:

```
2
4
```

When a program is running, it flows from one step to the next. As programmers, we set up "paths" for the program to follow.

Conditional steps



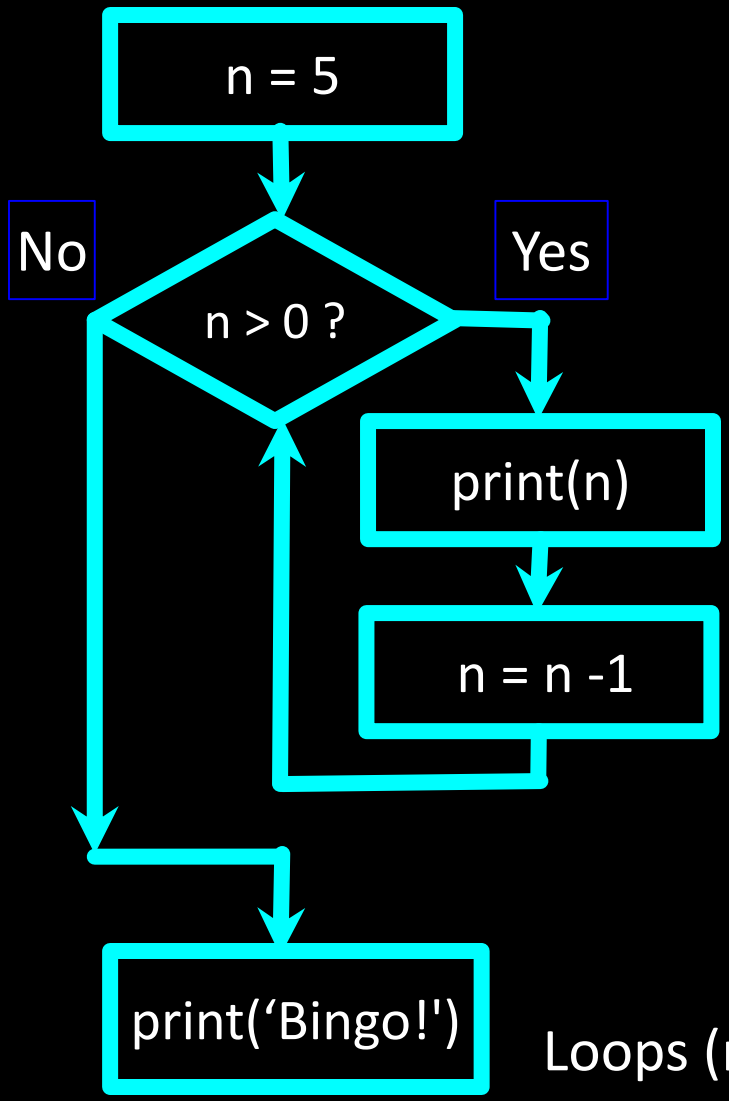
Program:

```
x = 5
if x < 10:
    print('Smaller')
if x > 20:
    print('Bigger')

print('Finish')
```

Output:

```
Smaller
Finish
```



Repeated steps

Program:

```
n = 5
while n > 0 :
    print(n)
    n = n – 1
print('Bingo!')
```

Output:

```
5
4
3
2
1
Bingo!
```

Loops (repeated steps) have iteration variables that change each time through a loop. Often these iteration variables go through a sequence of numbers.

Readings (recommended)

- The Python Tutorial
  - Chapter 3: An Informal Introduction to Python

Assignments and Tutorial 1

- Will release logistics assignment (1% of the SI100B course) and assignment 0 (zero point) today, due in a week
- logistics assignment on academic integrity, due: Sept. 16 23:59 (next Wed.) on Gradescope
- Assignment 0 helping you to get familiar with programming assignment submission. Due: Sept. 16 23:59 (next Wed.) on PIEGEN;

TA Tutorial

- **Time and Location for First Tutorial: 8PM Friday 9/11, TC201**
- Help with setting up the Python environment
- Help with writing and running first Python programs
- Basics on command line and IDE usage
- Help with HW submission (assignment 0)

Recap

- How a programs runs on a basic computer
- What is Python
- How to get Python
- Run a Python program
- Basics about print and comments
- Basic control flow