

# Coding seminar

## Lesson 2: Modules

Ikue Hirata, PhD

# Contents

Exercise model answer

Modules: Numpy

Plotting: matplotlib

# Exercise model answer 1

File Edit View Insert Cell Kernel Navigate Widgets Help

Trusted Python 3

In [2]:

```
1 numofattende = 0
2 attendee = []
3 for n in names:
4     if ages[n] > 15:
5         inv = f"Hello {n}, let's grab some
6             beer!"
7         print(inv)
8         if ans[n] == "Yes":
9             numofattende = numofattende + 1
10            attendee.append(n)
11 print(f"{numofattende} people attend.")
12 print(attendee)
```

# Model answer 2: 6 lines

File Edit View Insert Cell Kernel Navigate Widgets Help

Trusted Python 3

In [19]:

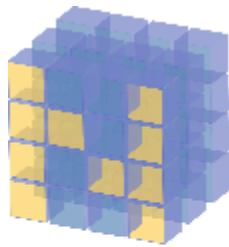
```
1 inv = [n for n in names if ages[n] > 15]
2 for n in inv:
3     print(f"Hello {n}, let's grab some beer!")
4 attendee = [n for n in inv if ans[n] == "Yes"]
5 print(f"{len(attendee)} people attend.")
6 print(attendee)
```

```
Hello Mary, let's grab some beer!
Hello Olivia, let's grab some beer!
Hello Peggy, let's grab some beer!
Hello Rupert, let's grab some beer!
Hello Trudy, let's grab some beer!
Hello Victor, let's grab some beer!
Hello Walter, let's grab some beer!
6 people attend.
```

# What is a module?

Set of functions for specific purpose

- Statistical analysis
- Plotting
- Signal process



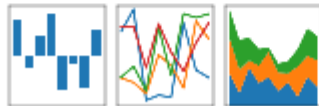
NumPy



**SciPy**

pandas

$y_t$   $\beta'x_{it}$   $\mu_i$   $\epsilon_{it}$



matplotlib

Do not  
reinvent the wheel

# Importing a module

In [1]:

```
import numpy as np  
from numpy import numpy.array
```

# Array

In [23]:

```
import numpy as np
a = np.array([1,2,3])
print(a)
```

```
[1 2 3]
```

In [27]:

```
b = np.array([["x1","x2","x3"],
["y1","y2","y3"]])
print(b)
```

```
[['x1' 'x2' 'x3']
 ['y1' 'y2' 'y3']]
```



# Array – Slice

In [30]:

```
c = np.array([[1,2,3],[4,5,6],[7,8,9]])  
print(c)  
print(c[0])  
print(c[1][1])  
print(c[1,:])
```

```
[[1 2 3]  
 [4 5 6]  
 [7 8 9]]  
[1 2 3]  
5  
[4 5 6]
```

# Array operations

In [33]:

```
print(c.shape)
print(c.dtype)
print(len(c))
print(1 in c)
print(0 in c)
```

(3, 3)

int32

3

True

False

# Arithmetic

In [9]:

```
a = np.array([1,2,3])  
b = np.array([4,5,6])  
print(a + b)  
print(b - a)  
print(a * b)  
print(a / b)  
print(b % a)
```

```
[5 7 9]
```

```
[3 3 3]
```

```
[ 4 10 18]
```

```
[0.25 0.4  0.5 ]
```

```
[0 1 0]
```

# Join arrays

File Edit View Insert Cell Kernel Navigate Widgets Help

Trusted | Python 3 

In [40]:

```
d = np.array([[10,11,12],[13,14,15],  
[16,17,18]])  
print(np.concatenate((c,d), axis=0))  
print(np.concatenate((c,d), axis=1))
```

```
[[ 1  2  3]  
 [ 4  5  6]  
 [ 7  8  9]  
 [10 11 12]  
 [13 14 15]  
 [16 17 18]]  
[[ 1  2  3 10 11 12]  
 [ 4  5  6 13 14 15]  
 [ 7  8  9 16 17 18]]
```

# Inner product

$$a = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix}, b = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$$

$$a \cdot b = a_1 \cdot b_1 + a_2 \cdot b_2 + a_3 \cdot b_3$$

In [11]:

```
print(np.inner(a,b))
```

# Outer product

$$a \otimes b = ab^T = \begin{bmatrix} a_1 b_1 & a_1 b_2 & a_1 b_3 \\ a_2 b_1 & a_2 b_2 & a_2 b_3 \\ a_3 b_1 & a_3 b_2 & a_3 b_3 \end{bmatrix}$$

In [20]:

```
print(np.outer(a,b))
```

```
[[ 4  5  6]
 [ 8 10 12]
 [12 15 18]]
```

# Cross product

$$a \times b = \begin{bmatrix} a_2 b_3 - a_3 b_2 \\ a_3 b_1 - a_1 b_3 \\ a_1 b_2 - a_2 b_1 \end{bmatrix}$$

In [22]:

```
print(np.cross(a,b))
```

```
[-3  6 -3]
```

# Other operations

In [50]:

```
print(np.sum(a), np.prod(a))  
print(np.mean(a), np.var(a), np.std(a))  
print(np.min(a), np.max(a))  
print(np.argmin(a), np.argmax(a))
```

6 6

2.0 0.6666666666666666 0.816496580927726

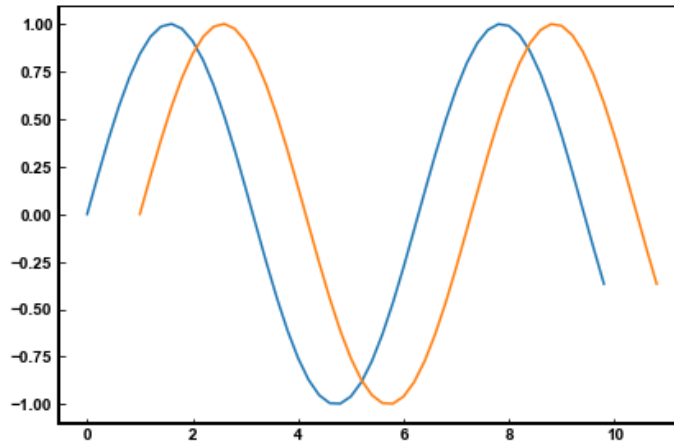
1 3

0 2



# Plot

```
import matplotlib.pyplot as plt
x = np.arange(0, 10, 0.2)
x2 = x+1
y = np.sin(x)
plt.plot(x, y)
plt.plot(x2, y)
plt.show()
```



# Learning plotting

Gallery — Matplotlib 3.1.1 docum

+

← → ↺ 🏠

matplotlib.org/gallery/index.html

🔍 ☆ 📄 ABP T 🧑



Version 3.1.1

Installation

Documentation

Examples

Tutorials

Contributing

home | contents »

modules | index

## Gallery

This gallery contains examples of the many things you can do with Matplotlib. Click on any image to see the full image and source code.

For longer tutorials, see our [tutorials page](#). You can also find [external resources](#) and a [FAQ](#) in our [user guide](#).



Scores by group and gender

Group	Male	Female
Q1	20	30
Q2	30	40
Q3	40	50
Q4	50	60
Q5	60	70

Stacked Bar Graph



Scores by group and gender

Group	Male	Female
Q1	20	30
Q2	30	40
Q3	40	50
Q4	50	60
Q5	60	70

Grouped bar chart with labels



How fast do you want to go today?

Person	Performance
Tom	10
Dick	20
Harry	30
Paul	40

Horizontal bar chart



race interrupted

seconds since start	Value
25	100
100	50
125	20
150	10

Broken Barh



Line plot



Line plot



Line plot

Quick search

Go

Table of Contents

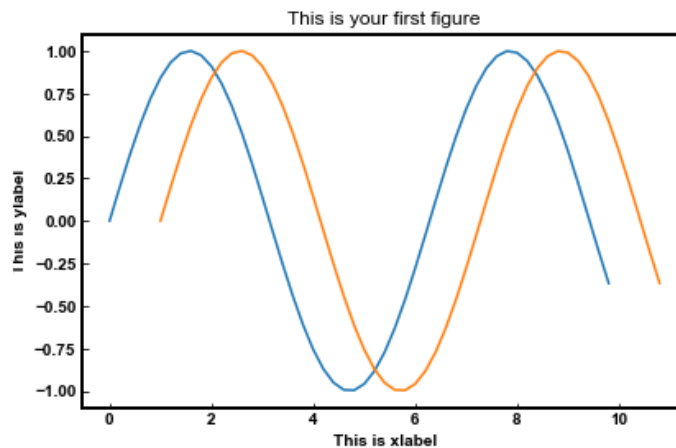
Gallery

- Lines, bars and markers
- Images, contours and fields
- Subplots, axes and figures
- Statistics
- Pie and polar charts
- Text, labels and annotations
- Pyplot
- Color
- Shapes and collections
- Style sheets
- Axes Grid
- Axis Artist
- Showcase
- Animation

# Make it more beautiful

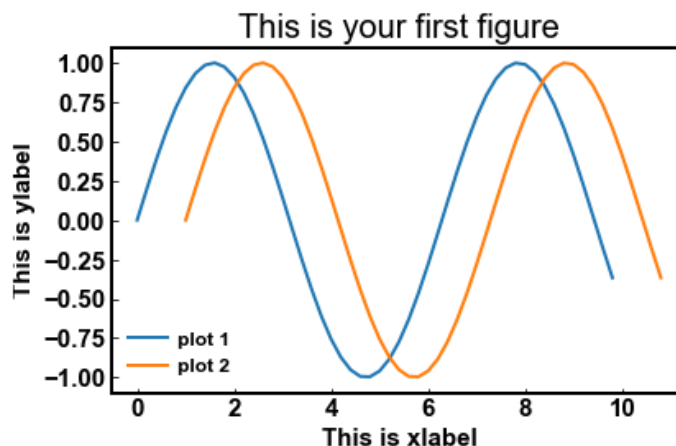
In [64]:

```
plt.plot(x, y)
plt.plot(x2, y2)
plt.xlabel("This is xlabel")
plt.ylabel("This is ylabel")
plt.title("This is your first figure")
plt.show()
```



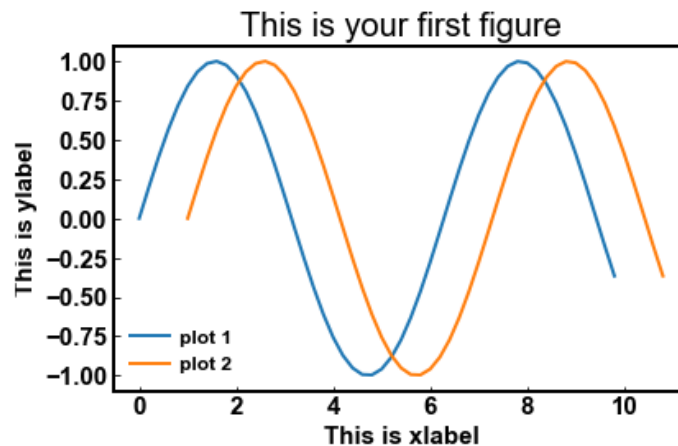
# Make it even more beautiful

```
plt.xlabel("This is xlabel", size=15)  
plt.ylabel("This is ylabel", size=15)  
plt.title("This is your first figure", size=20)  
plt.xticks(size=15)  
plt.yticks(size=15)  
plt.legend(fontsize=12)  
plt.show()
```



# Save it

```
plt.show( )  
plt.savefig("firstplot.png")
```



<Figure size 432x288 with 0 Axes>

# Save it

Files

Running

Clusters

Nbextensions

Duplicate

Shutdown

View

Edit

Upload

New

1

/ Dropbox/ PythonCourse

..

☒

Lesson2.ipynb

Running

数秒前

73.1 kB

☐

firstplot.png

数秒前

11.3 kB

☐

Lesson2.pptx

10分前

634 kB

☐

Lesson1.ipynb

Running

8日前

16.8 kB

☐

Lesson1.pptx

8日前

3.96 MB

☐

before-seminar

9日前

☐

Lesson1\_ppt.pdf

9日前

1.44 MB

☐

README.md

9日前

840 B

☐

Lesson1\_github.pptx

9日前

2.86 MB

☐

Lesson1\_Exercise1.ipynb

9日前

1.91 kB

☐

Lesson1\_Exercise1\_modelanswer.ipynb

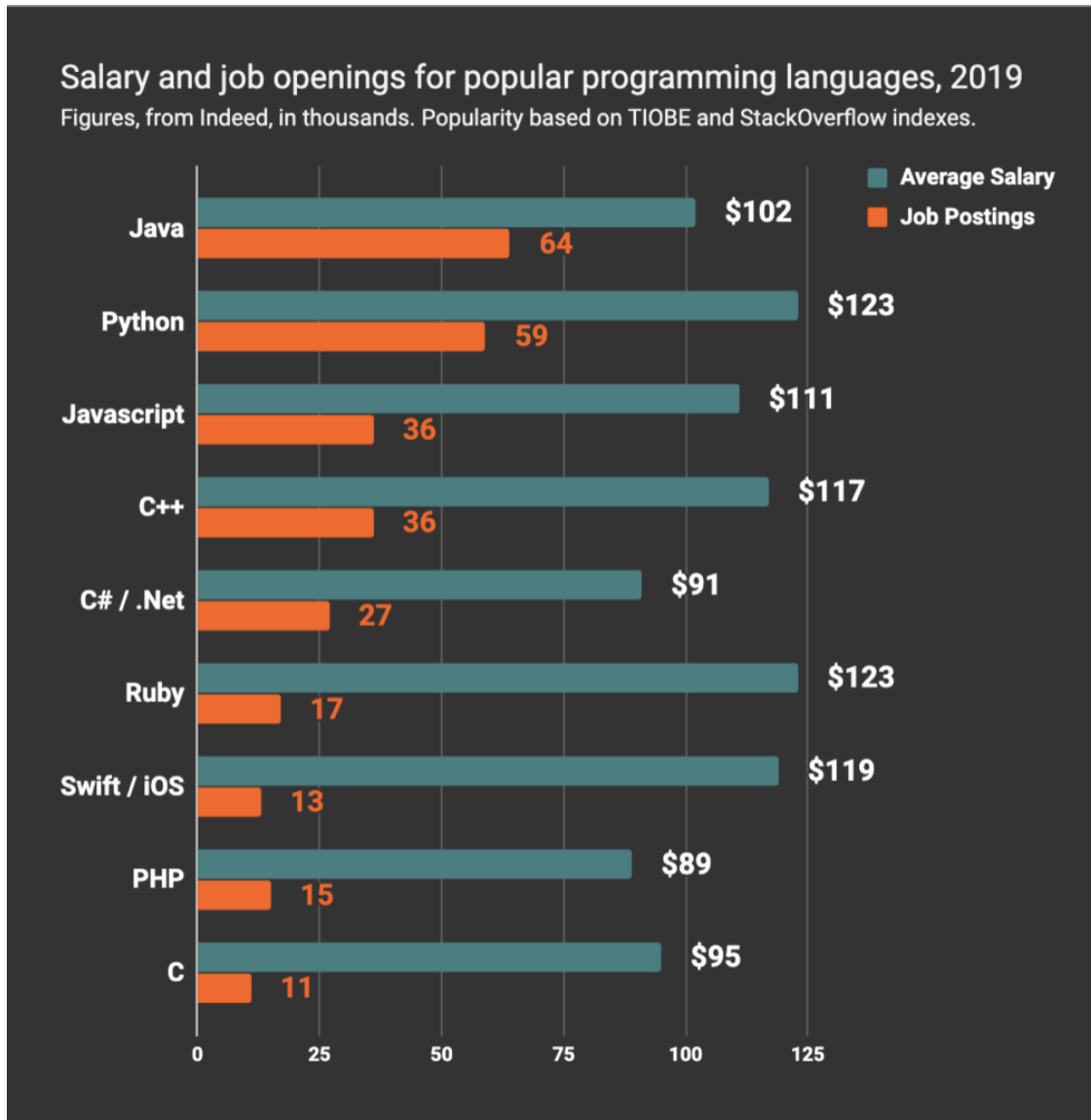
9日前

4.95 kB

# Intro to other languages



# Other languages...





# Ruby/Ruby on Rails

```
1
2 # question: Given a nested array where on any given row, the 0's and 1's are all sorted
3 # ([0,0,0,1,1,1,1,1], not [0, 1, 0 ,1, 1, 0 ,0]), and each row is the same length, find
4 # the furthest to the left 1.
5
6 first_array = [0,1,[0,1],1]
7
8 p /1/ =~ first_array.flatten.join(",").gsub!(/,/,"")
9
10
11 second_array = [0,0,[0,1],1]
12
13
14 def search_for_1(array)
15   array_level = 0
16
17   array.each_with_index do |element, index|
18     if element.class == Array
19       array_level += 1
20       search_for_1(element)
21     elsif element.is_a?(Integer) && element == 1
22       return "first 1 is in array level #{array_level} and is at index #{index}"
23     else
24       next
25     end
26   end
27   return "did not find 1"
28 end
29
30 p search_for_1(second_array)
```

Twitter  
Airbnb  
GitHub  
Kickstarter

# JavaScript

```
1
2 let meetups = [
3   {name:'JavaScript', isActive:true, members:700},
4   {name:'Angular', isActive:true, members:900},
5   {name:'Node', isActive:false, members:600},
6   {name:'React', isActive:true, members:500}
7 ];
8 let sumFPChain = meetups.filter((m)=>{
9   return m.isActive;
10 })
11   .map((m)=>{
12     return m.members - (0.1*m.members);
13   })
14   .reduce((acc, m)=>{
15     return acc + m;
16   }, 0);
17 console.log(sumFPChain); // Output will be 1890
18
```

**Almost all  
websites**

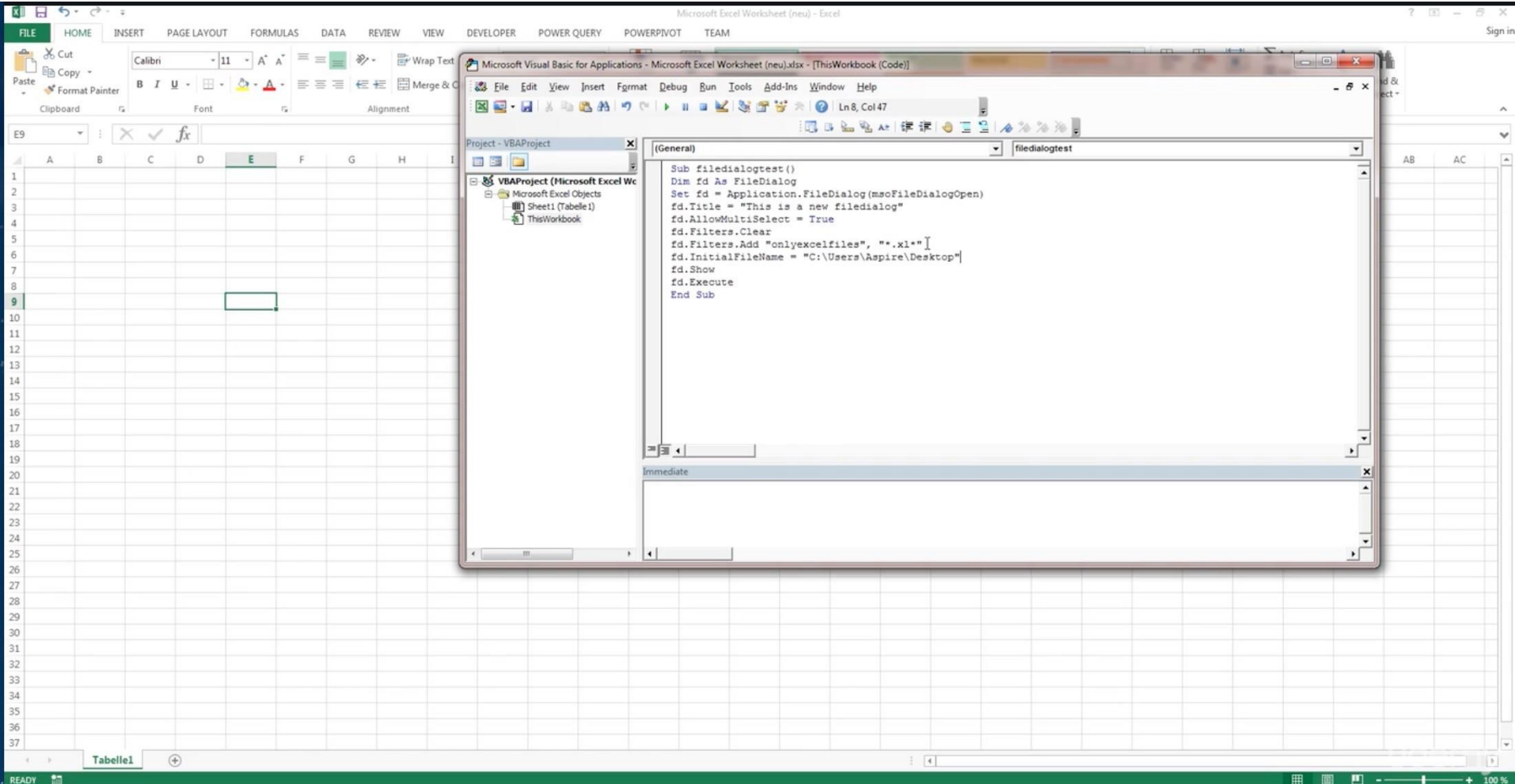
# C/C++/C#

## C PROGRAM TO FIND PRIME NUMBER ENTERED BY USER

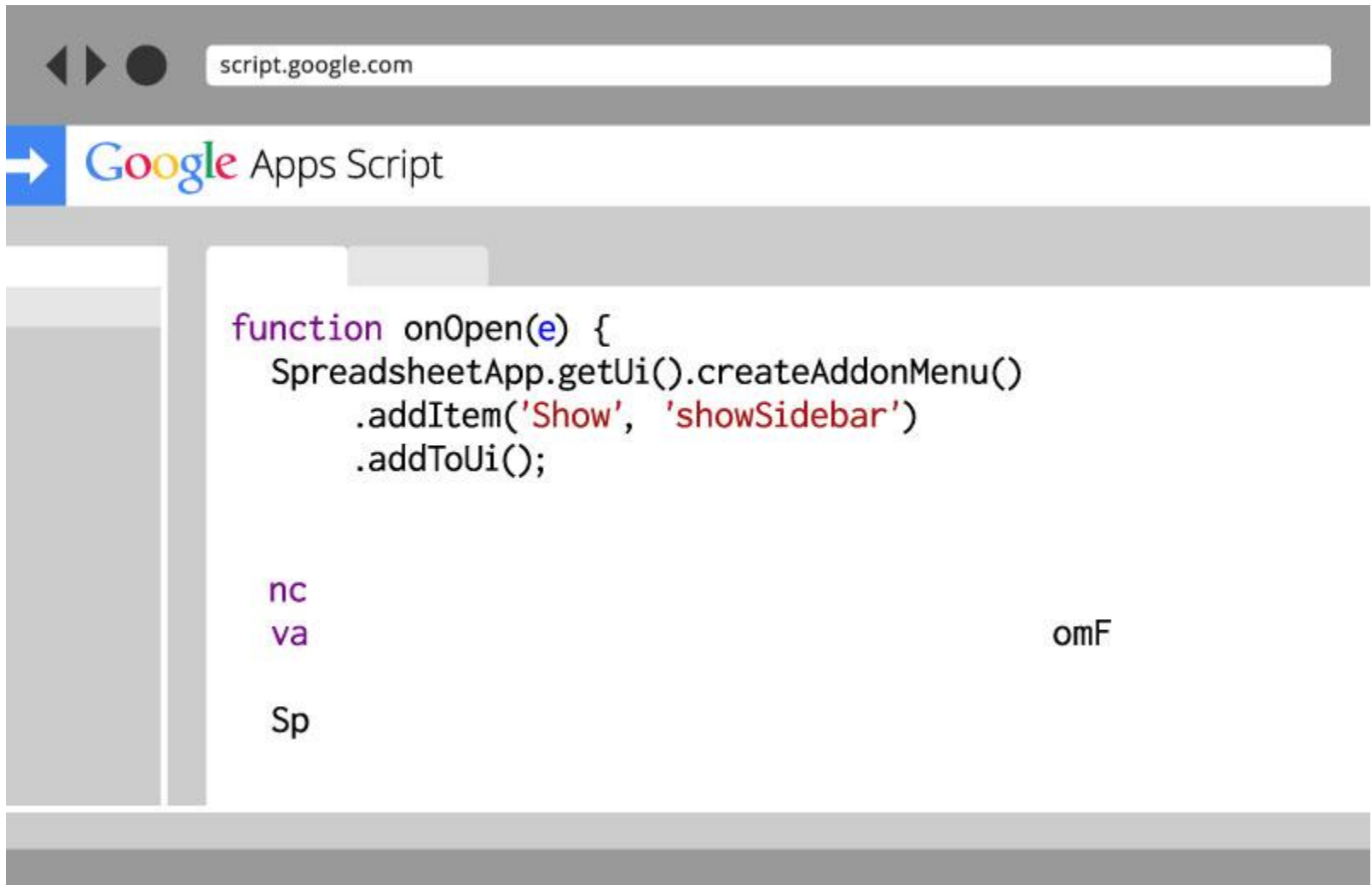
```
1  #include < stdio.h >
2  int main() {
3      int i, num, p = 0;
4      printf("Please enter a number: \n");
5      scanf("%d", & num);
6      for (i = 1; i <= num; i++) {
7          if (num % i == 0) {
8              p++;
9          }
10     }
11     if (p == 2) {
12         printf("Entered number is %d "\
13             "and it is a prime number.", num);
14     } else {
15         printf("Entered number is %d "\
16             "and it is not a prime number.", num);
17     }
18 }
```

@coder\_forevers

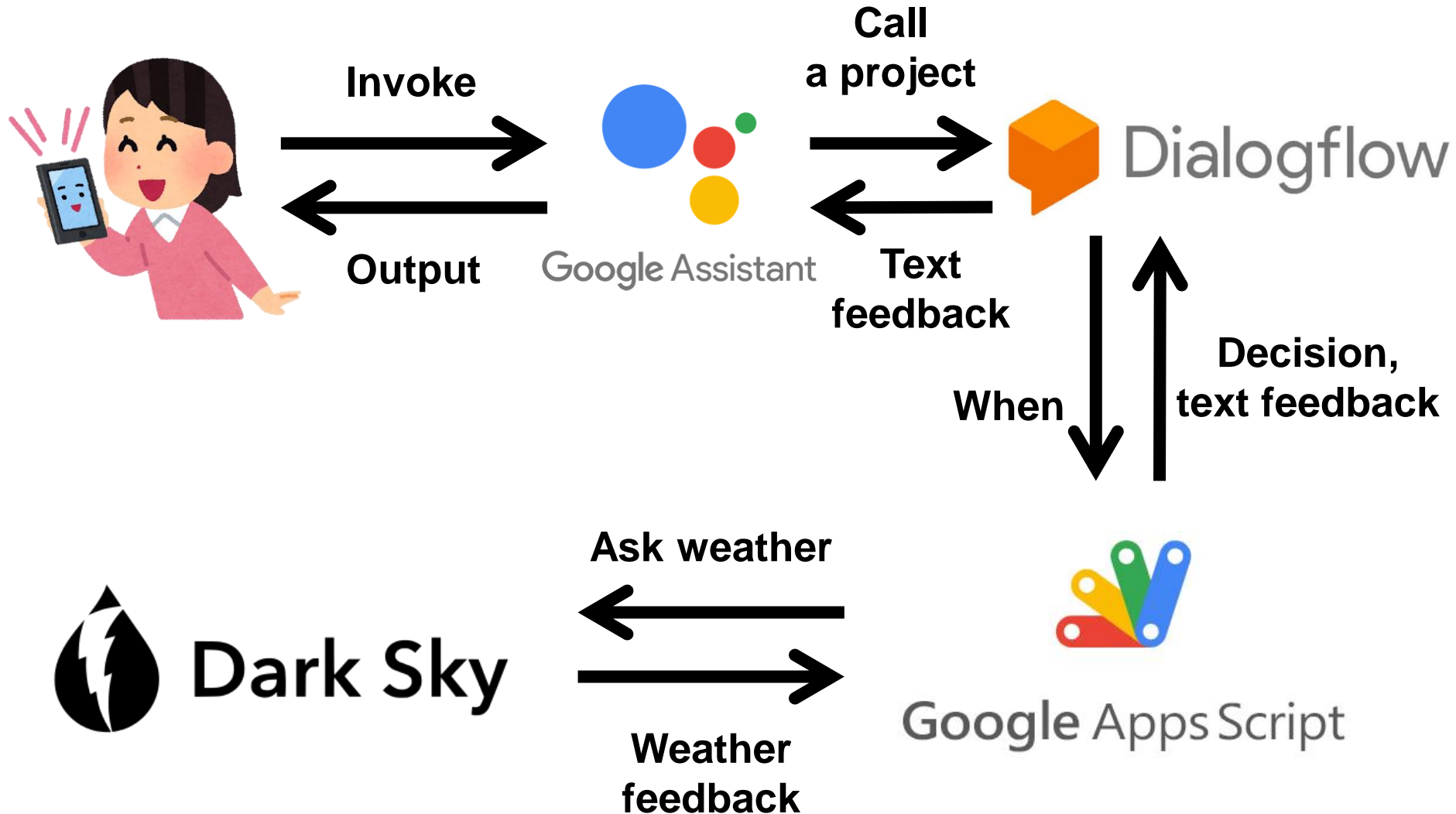
# Excel VBA (but I hate Excel)



# Google Apps Script



# Flowchart



# Today's Summary

Numpy                      array, matrix, etc.

Matplotlib                Everything about plotting

Other languages    You already have basics!

# Exercise 0

Simulate free fall: A ball is dropped from a height of 57 m.

1. Draw a velocity-time graph, provided the object follow Newton's motion equation

$$ma = mg$$

where  $m$  is the weight of the object,  $a$  the acceleration,  $g$  the gravitational acceleration  $9.8 \text{ m/s}^2$ , given no other disturbance.

2. Draw height-time graphs;
  - A. Analytically using

$$h(t) = h_{init} - \frac{1}{2}gt^2$$

- B. Numerically using

$$h(t + \Delta t) = h(t) - v(t)\Delta t$$



# Exercise 1: Random walk

 ikuehirata lesson 2 updated

430cd2a 4 minutes ago

1 contributor

87 lines (87 sloc) | 1.95 KB



Raw

Blame

History



## Lesson 2 - Exercise 1

### One dimentional random walk

Simulate 5-step one dimentional random walk in an array and plot in  $x - t$  graph:

- a dot is positioned at  $x = 0$  at  $t = 0$
- every second the dot moves either left or right at 50% probability *i.e.*

$$x(t+1) = \begin{cases} x(t) + 1 \\ x(t) - 1 \end{cases}$$

Increase the number of step to 20 when you have successfully done 5 steps.

### Two dimentional random walk

Simulate the same in two dimentional space. Plot the movement of the dot in the space.

### Advanced: three dimentional random walk

Simulate the same in three dimentional space and plot the movement in the three dimentional space.

# Exercise 2: Throwing simulation

Branch: master ▾

CodingSeminarCMBR / Lesson2\_Exercise2.ipynb

Find file

Copy path



ikuehirata lesson 2 updated

430cd2a 3 minutes ago

1 contributor

59 lines (59 sloc) | 2.01 KB



Raw

Blame

History



## Lesson 2 - Exercise 2

### Throwing simulation

Three objects are dropped from height. Ball 1 is made of iron (density  $7.87 \text{ g/cm}^3$ ) and the diameter is 1 m, ball 2 made of same iron and the diameter 10 cm, ball 3 a ping pong ball (weight 2.7 g) and the diameter 4 cm. All are perfect spheres.

1. Draw a velocity-time graph of the two objects, provided the velocity of the objects is given by below:

- A. Both objects follow Newton's motion equation

$$ma = mg - F_d$$

where  $m$  is the weight of the object,  $a$  the acceleration,  $g$  the gravitational acceleration  $9.8 \text{ m/s}^2$ ,  $F_d$  the air resistance, given no other disturbance.

- B. Air resistance  $F_d$  is given by

$$F_d = \frac{1}{2} C_d \rho \pi R^2 v^2$$

where  $C_d$  is the drag coefficient 0.47 for all the objects,  $\rho$  the density of the air  $1.205 \text{ kg/m}^3$ ,  $R$  the diameter of the sphere,  $v$  the velocity of the object.

1. The objects are dropped from a height 57 m. Obtain the time when each ball hits the ground and draw a height-time graph of the two objects.

# To study by yourself: codecademy



Learn Python 2 | Codecademy

codecademy Catalog Pricing Try Pro For Free

## Learn Python 2

Learn the basics of the world's fastest growing and most popular programming language used by software engineers, analysts, data scientists, and machine learning engineers alike.

START

\*This is outdated Python 2 – print() function is a bit different from Python 3

Overview Syllabus

Join  
**4,719,900**  
people who have taken