

Kia Cooperative Systems Summer High School Outreach Module 1

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Python Programming ("Hello World ")

▼ Introduction to Python (KCS LAB)

We will be just going through some basics of Python Programming

```
[ ] print('Hello World')
```

```
Hello World
```

Press Ctrl+Enter or Just use the play button in the cell above

▼ DATA TYPES

1. Numbers - Integers, floats
2. Strings
3. Booleans

```
[ ] x = 4
print(x, type(x))
# Replace 4 , with x = 4.00 , x = 'Summer' , x = True to check the data types
```

```
4 <class 'int'>
```

Go to this link for above description : https://colab.research.google.com/drive/1BLfoWaeBpJTPb2w_0ahmMewdmTrJ-f?usp=sharing

Tutorial about using python in Google-colab

- https://www.youtube.com/watch?v=i-HnvsehuSw&ab_channel=ProgrammingKnowledge
- <https://colab.research.google.com/github/cs231n/cs231n.github.io/blob/master/python-colab.ipynb>

Python Programming: Basics (links)

Data type

<https://youtu.be/gCCVsvgR2KU>

Arrays and matrices

https://www.youtube.com/watch?v=biLz7KPgHJA&ab_channel=TechWithTim (Arrays)

https://www.youtube.com/watch?v=Blzp9iuhZgo&ab_channel=Telusko (Matrix in python using numpy)

<https://www.youtube.com/watch?v=phRshQSU-xA>

For loop

<https://youtu.be/0ZvaDa8eT5s>

While loop

<https://youtu.be/HZARImviDxg>

If condition

<https://youtu.be/PqFKRqpHrjw>

Plotting (using Matplotlib)

https://www.youtube.com/watch?v=wB9C0Mz9gSo&ab_channel=DerekBanas

<https://deparkes.co.uk/2015/03/11/how-to-plot-polygons-in-python/> (plotting, polygons and filled polygons using Shapely)

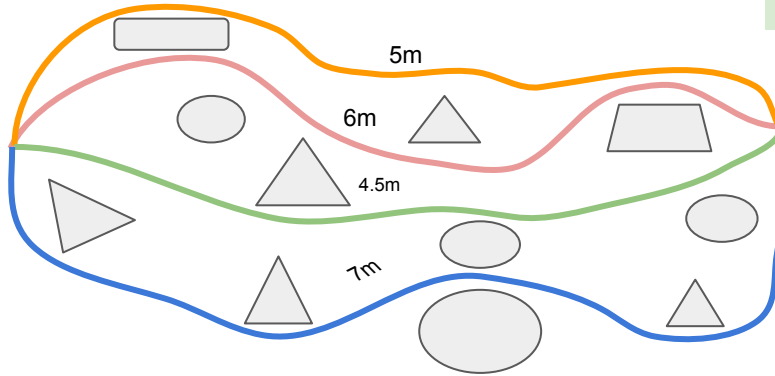
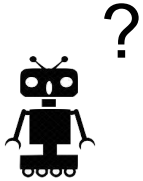
Python (Full Tutorial)

https://www.youtube.com/watch?v=rfscVS0vtbw&ab_channel=freeCodeCamp.org

https://www.youtube.com/watch?v=YYXdXT2l-Gg&list=PL-osiE80TeTt2d9bfVyTiXJA-UTHn6WwU&ab_channel=CoreySchafer

https://www.youtube.com/watch?v=8ext9G7xspg&ab_channel=freeCodeCamp.org

How to represent my problem in the best way possible in Python



How to write a program for the robot to choose the shortest path?

Assignment 1, Problem no 1

Write a program to sort the list of distances stored in an array in descending order?

Example : Input : distances = [9,6,7,1,4,5,8]
Output : distances = [9,7,8,6,5,4,1]

```
### KCS LAB
## finding the shortest path in the array

import numpy as np
paths = np.array([5,6,4.5,7])
# initializing the first item to be the minimum
min = paths[0]
# for loop to run through every elements in the list
for i in range(len(paths)):
    # comparing minimum values with the elements in the list
    if min >= paths[i]:
        # update the minimum value
        min = paths[i]
print('The shortest path is:', min)
```

Output : The shortest path is: 4.5

You can also find the code here:

https://colab.research.google.com/drive/1BLfoWaeBpJTPb2w_0ahmMewdmTtrJ-f?usp=sharing

Python Programming (Numpy libraries and Array)

Numpy:

Numpy is the core library for scientific computing in Python

```
-> import numpy as np
```

Array : Represents a data structure where number are arranged in rows and column

Matrix is a two dimensional array.Example:

```
## Numpy arrays
```

```
import numpy as np
```

```
a = np.array([1, 2, 3]) # Creating an array,rank 1
```

```
print(type(a),a[0],a[1],a[2]) # Printing type and elements of array
```

```
a[0] = 5 # You can change element in an array
```

```
print(a)
```

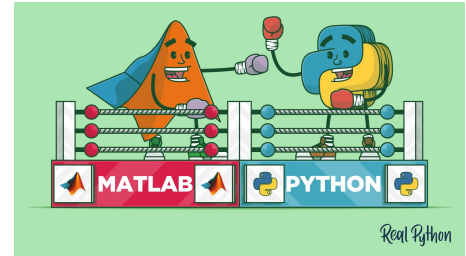
```
[1 2 3
```

```
4 5 6]
```

Output

```
<class 'numpy.ndarray'> 1 2 3
```

```
[5 2 3]
```



Tutorial on Numpy, Array and Matrices

- <https://www.programiz.com/python-programming/matrix> (Good Blog about matrices and array using numpy and Python)
- <https://youtu.be/GB9ByFAIAH4?t=669> (Complete Tutorial on Numpy)

Additional links (*Essence of Linear Algebra*)

- https://www.youtube.com/watch?v=fNk_zzaMoSs&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&ab_channel=3Blue1Brown

Python Programming: matplotlib.pyplot (Plotting the obstacles)

```
# plotting lines between two vertices and creating a polygon
import numpy as np
import matplotlib.pyplot as plt

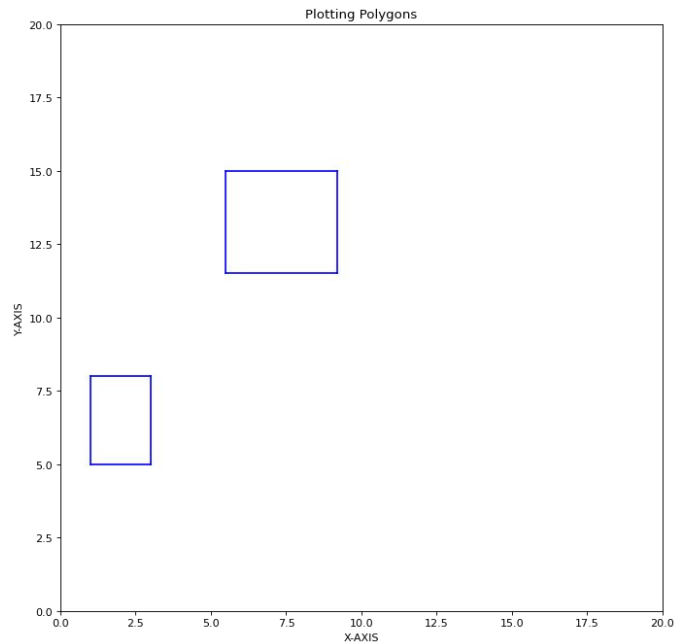
## the vertices for the obstacles
# O1~ v1: (5.5,15), v2: (9.2,15), v3:(9.2,11.5), v4: (5.5,11.5)
# O1~ v1: (1,5), v2: (1,8), v3:(3,8), v4: (3,5)
plt.figure(1, figsize=(10,10), dpi=80)
vertices = np.array([
    [[ 5.5,15.0],[9.2,15.0],[9.2,11.5],[5.5,11.5]],
    [[ 1,5],[1,8],[3,8],[3,5]]
])

# using for loop to go through every polygons
for i in range(len(vertices)):
    #looping every vertices in the polygon
    for j in range(len(vertices[i])):
        if j+1 < len(vertices[i]):
            ## separating the x and y coordinates of two vertices
            x_cord = np.array([vertices[i][j][ 0],vertices[i][j+ 1][0]])
            y_cord = np.array([vertices[i][j][ 1],vertices[i][j+ 1][1]])
            # plotting the line segment between two vertices
            plt.plot(x_cord,y_cord,color= 'blue')
        # to plot the line between the start and end vertex
        elif j+1 == len(vertices[i]):
            x_cord = np.array([vertices[i][j][ 0],vertices[i][ 0][0]])
            y_cord = np.array([vertices[i][j][ 1],vertices[i][ 0][1]])
            plt.plot(x_cord,y_cord,color= 'blue')

## Represents the boundary of x and y coordinate
plt.xlim([ 0, 20]);plt.ylim([ 0,20])
plt.ylabel('Y-AXIS'); plt.xlabel('X-AXIS')
plt.title('Plotting Polygons' )
plt.show()
```

You can also find the code here:

https://colab.research.google.com/drive/1Bl-6WaeBplJTPb2w_0ahmMewdmTtrJ-f2usp?usp=sharing



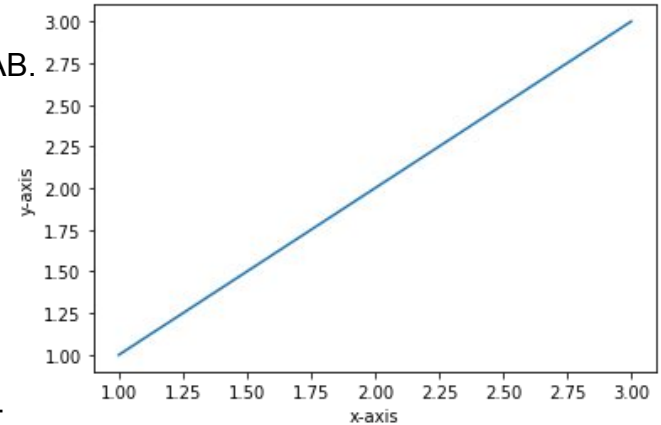
Assignment 1, Problem 2:

Write a code to visualize these obstacles from the above picture, details on previous slide using python matplotlib library?

Python Programming: matplotlib.pyplot (Additional slide)

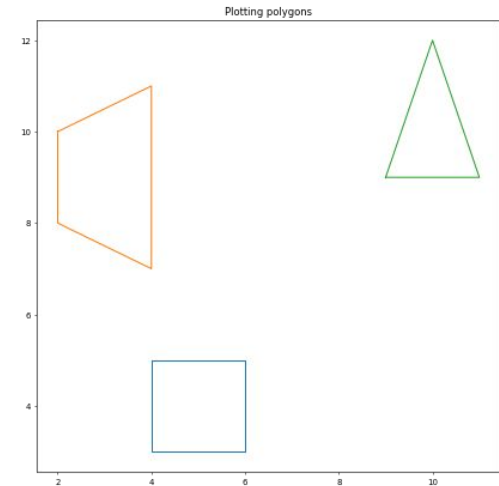
Matplotlib.pyplot is a collection of function that makes matplotlib work like MATLAB.

```
import matplotlib.pyplot as plt ## importing the libraries
x = [1,2,3]
y = [1,2,3]
plt.plot(x,y) ## plotting the coordinates
plt.ylabel('y-axis')
plt.xlabel('x-axis')
plt.show()
```



Another alternative for Drawing Polygons in python

```
import matplotlib.pyplot as plt ## importing matlab pyplot lib
from shapely.geometry.polygon import LinearRing, Polygon, Point
fig = plt.figure(1, figsize=(10,10), dpi=50)
# Defining vertices of a polygon
poly1 = Polygon([(4, 5), (4,3),(6,3),(6,5)]) # this is a square
poly2= Polygon([(2,10), (2,8), (4,7), (4,11)]) # this is the trapezoid
poly3 = Polygon([(0,9), (11,9), (10,12)]) # triangles
plt.plot(*poly1.exterior.xy,*poly2.exterior.xy,*poly3.exterior.xy)
plt.title("Plotting polygons")
plt.show()
```



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