THE HONG KONG
UNIVERSITY OF SCIENCE
AND TECHNOLOGY

SCHOOL OF
ENGINEERING

CIVL 4210 – Advanced Construction with AI and Robotics

Guidebook: Data Visualization

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Background

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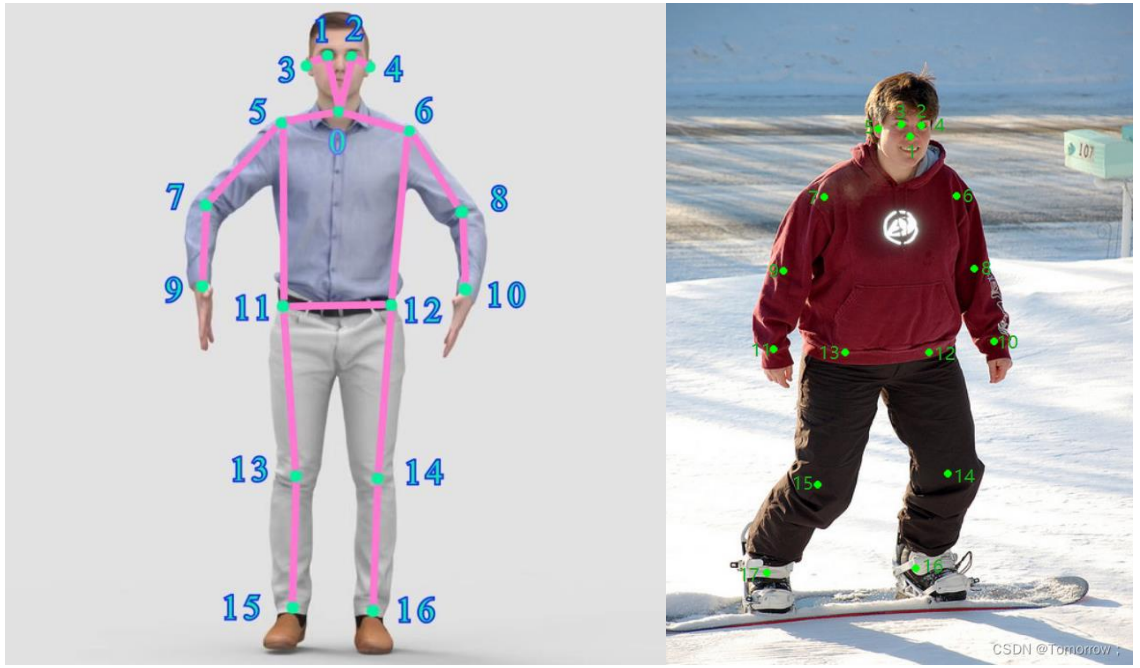
1.Human Pose Estimation - keypoint

In order to represent the human pose, the human body is usually divided into different keypoints, such as the COCO dataset with 17 keypoint types. The body parts 17 key points include:

0: nose, 1: left eye, 2: right eye, 3: left ear, 4: right ear, 5: left shoulder, 6: right shoulder, 7: left elbow, 8: right elbow, 9: left wrist, 10: right wrist, 11: left crotch, 12: right crotch, 13: left knee, 14: right knee, 15: left ankle, 16: right ankle.



2.Matplotlib

Matplotlib is a drawing library for the Python language and its numerical computation library NumPy. It can draw 2D and 3D pictures.

Step 1: Plot a curve

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Step 1： Import model

```
import matplotlib.pyplot as plt
```

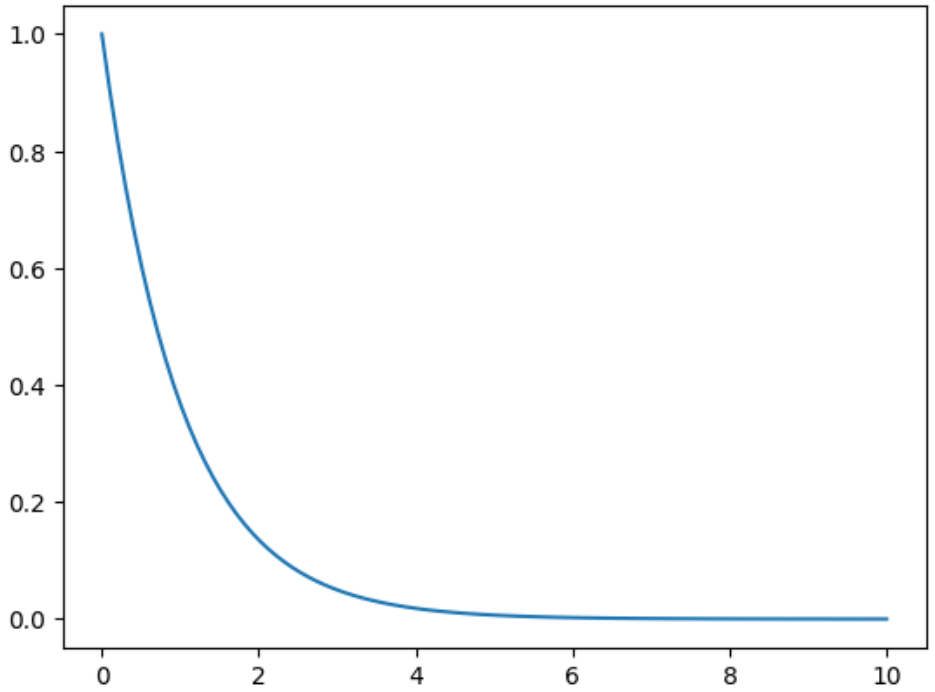
Step 2： Creat array

```
import numpy as np
a=np.linspace(0,10,100)
```

Step 3： Draw the squares of array

```
b=np.exp(-a)
plt.plot(a,b)
```

See the difference when you change “a” and “b”. 😊



Step 2: Draw a surface

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Step 1： Import model

```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
import numpy as np
from matplotlib.pyplot import MultipleLocator
fig=plt.figure()
ax=fig.add_axes(Axes3D(fig))
```

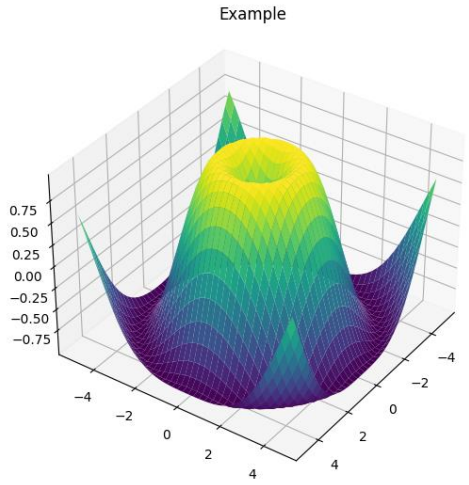
Step 2： Creat array

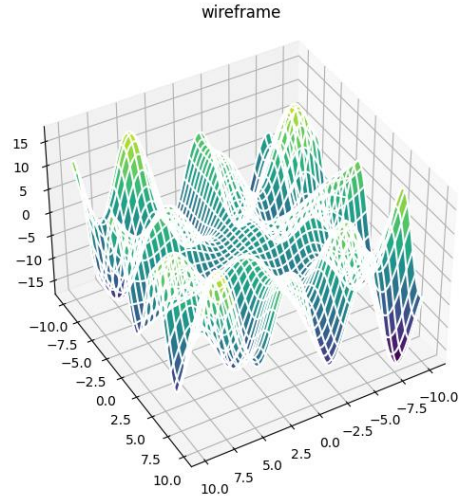
```
X=np.arange(-5,5,0.25)
Y=np.arange(-5,5,0.25)
X,Y=np.meshgrid(X,Y)
```

Step 3： Draw the squares of array

```
R=np.sqrt(X**2+Y**2)
Z=np.sin(R)
surf=ax.plot_surface(X,Y,Z,cm
ap='viridis')
ax.set_title('Example')
ax.view_init(35,35,0)
plt.show()
```

Try to change 'X,Y arange', 'R', 'Z', 'surf', 'view_init' 😊





Step 3: Drawing of human posture

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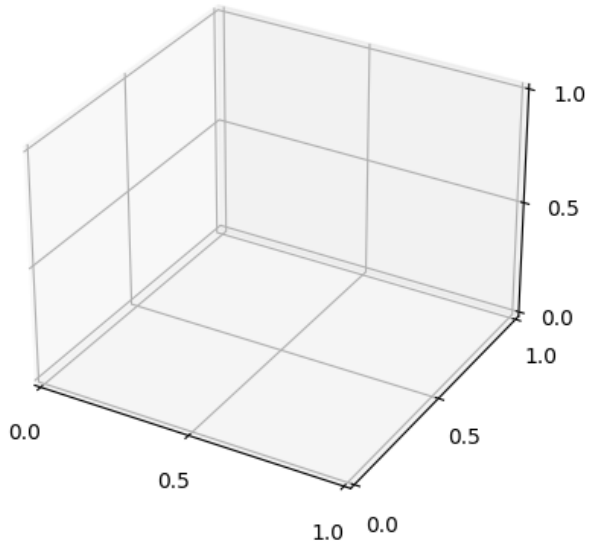
Step 1： Fire up matplotlib create

```
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt
import numpy as np
from matplotlib.pyplot import
MultipleLocator
```



Step 2： Establish connections between keypoints

```
def renderBones(): # define a function
  link = [[0,2],[0,3],[2,5],[3,6],[1,5],[1,6]
        ,[5,11],[11,15],[6,12],[12,16]

,[3,8],[8,14],[14,17],[2,7],[7,13],[13,18]
        ,[1,4],[4,9],[4,10]]
  for l in link:
    index1,index2 = l[0],l[1]
    ax.plot([xs[index1],xs[index2]],
[ys[index1],ys[index2]],
[zs[index1],zs[index2]], linewidth=1,
label=r'$z=y=x$')
```

Step 3： Build 3D image with Matplotlib. pyplot module

```
x_major_locator = MultipleLocator(0.5)
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.xaxis.set_major_locator(x_major_locator)
ax.yaxis.set_major_locator(x_major_locator)
ax.zaxis.set_major_locator(x_major_locator)
x_major_locator = MultipleLocator(0.5)
```

Step 3: Drawing of human posture

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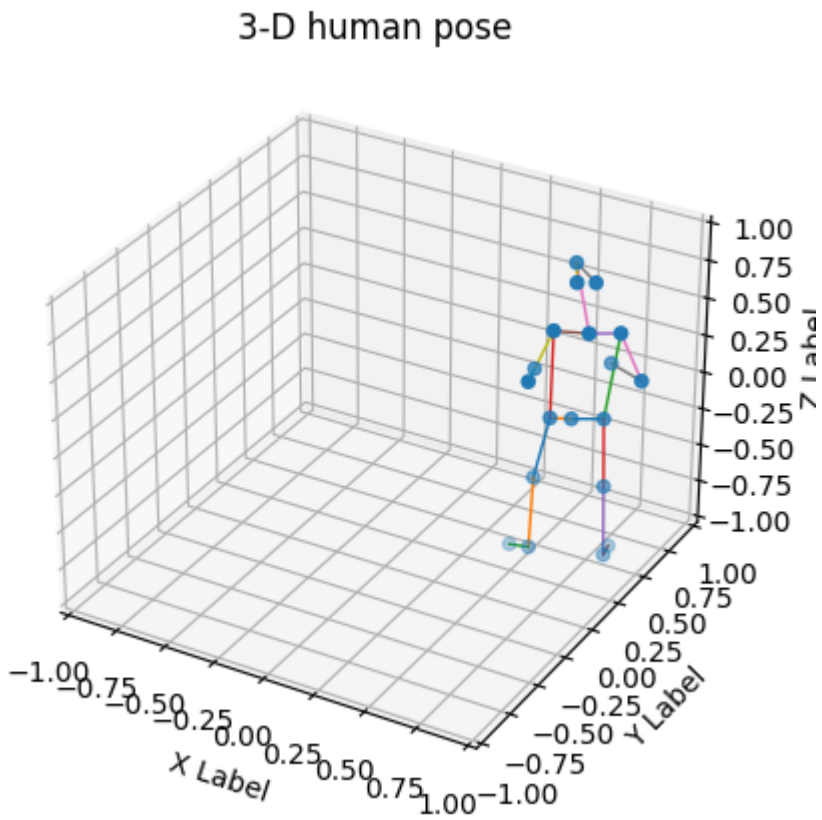
Step 4： Read the data

```
import urllib.request

url='https://raw.githubusercontent.com/Yokhong/CIVL4210/main/H2_human_pose_in

_3D_space/humanpose_data.txt'

urllib.request.urlretrieve(url, "/content/humanpose_data.txt")

file="humanpose_data.txt" # relative address (computing)

nl=[]

with open (file) as f :

for line in f:

nl.extend([float(i) for i in line.split()])

xs=nl[0:19]

print(xs)

ys=nl[19:38]

print(ys)

zs=nl[38:57]

print(zs)
```

Step 5： Draw 3-D human pose

```
fig = plt.figure()

ax = fig.add_subplot(111, projection='3d')

renderBones()

ax.scatter(xs,ys,zs)

ax.set_xlabel('X Label')

ax.set_ylabel('Y Label')

ax.set_zlabel('Z Label')

ax.set_xlim(-1,1)

ax.set_ylim(-1,1)

ax.set_zlim(-1,1)

ax.view_init(40,60,0)

ax.set_title('3-D human pose')

plt.show()
```



Changing File Formats

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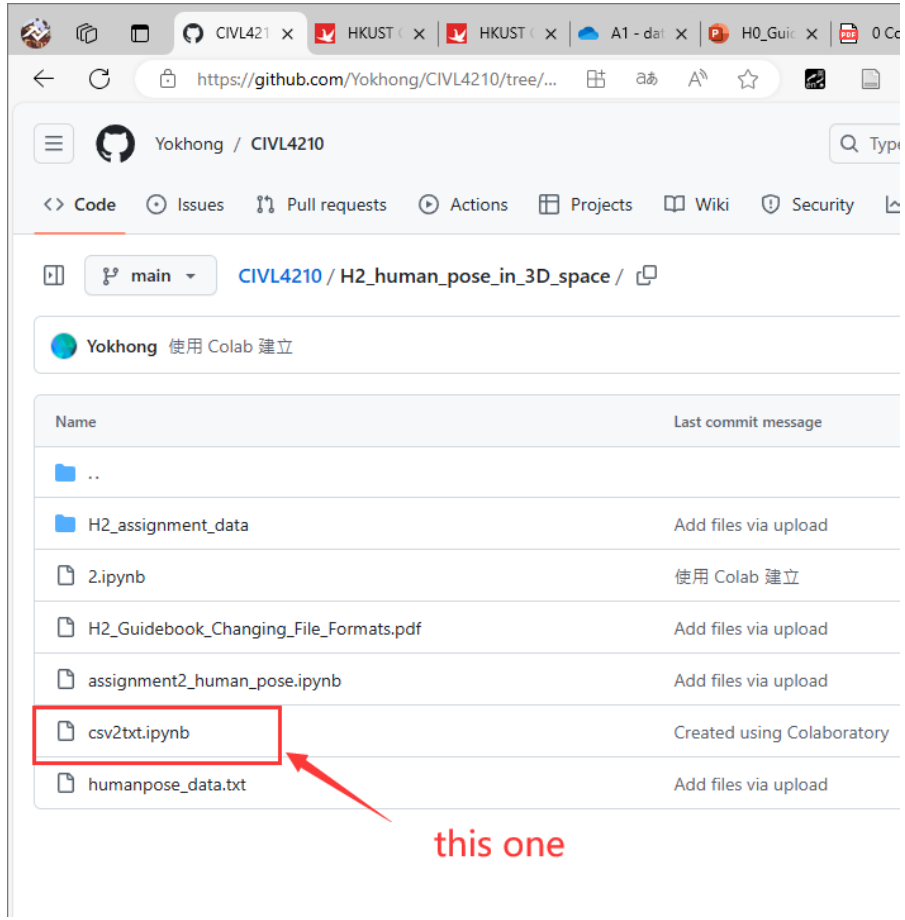
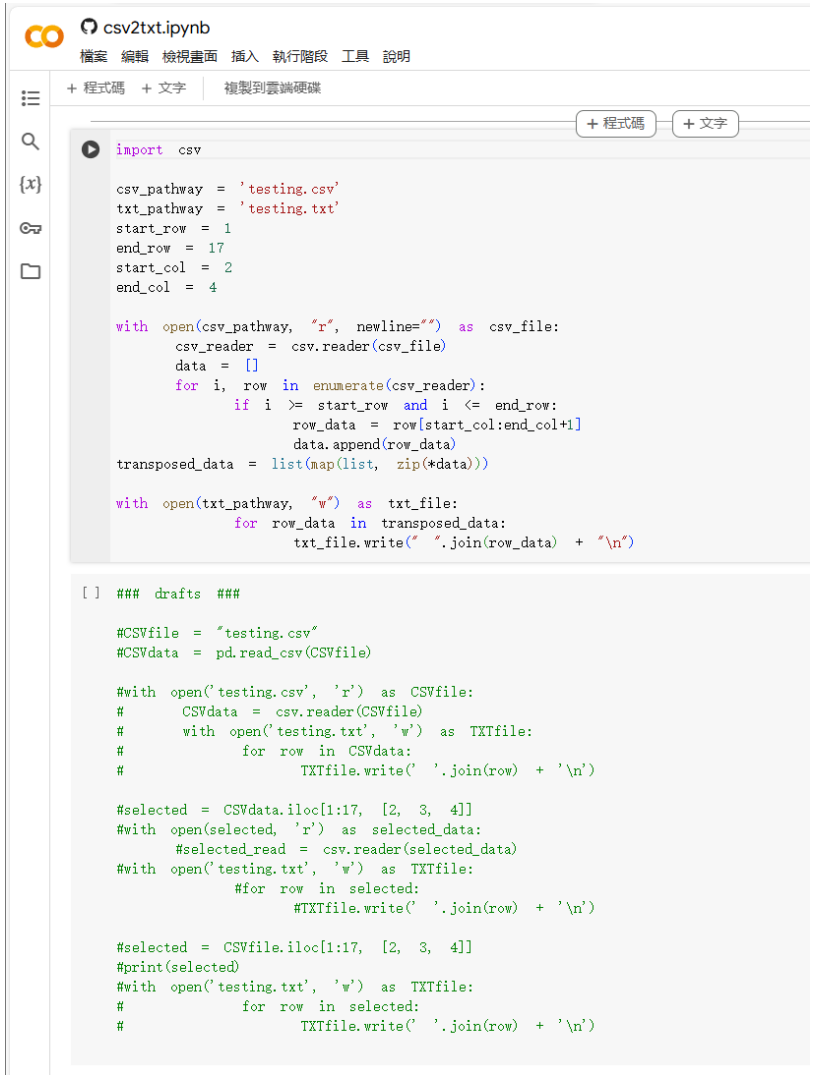
Convert .csv format to .txt format.

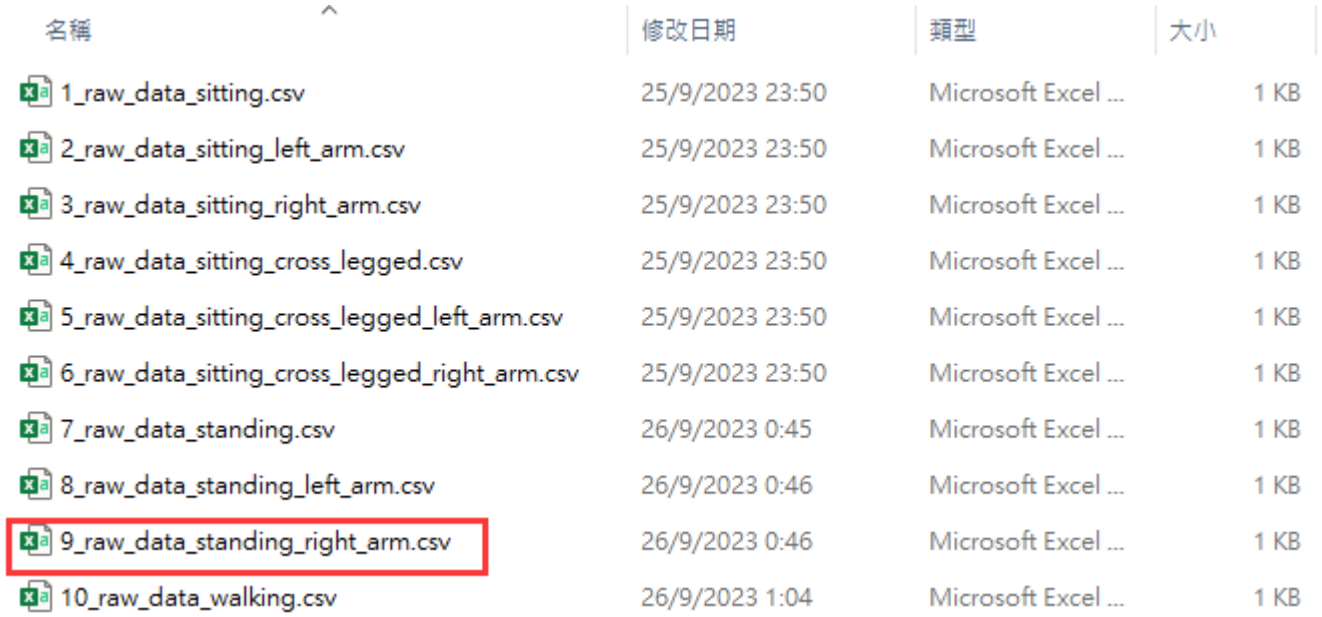


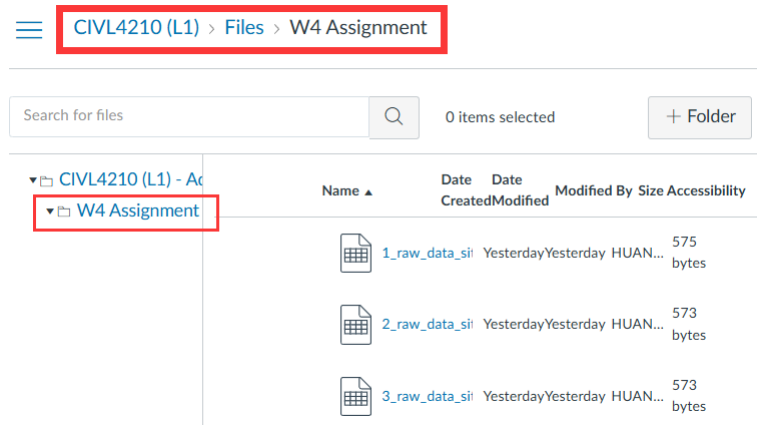


Assignment requirement

1. Change the raw data into the format that your code can read.
2. Define a function in which you can join the key points together.
3. Load the files you changed and print out XS, YS, and ZS.
4. Change the view to elevation angles of 40, azimuth angles of 60, and rotation angles of 0.
5. Plot the 3D human pose and save the picture on your computer.
6. **Please use the last digit of your school number to select the corresponding data number.**

(For example, your student ID is 2094254**9**, so you need to select the data numbered nine.)





You can find the data in the course folder "W4 Assignment."

Assignment requirement

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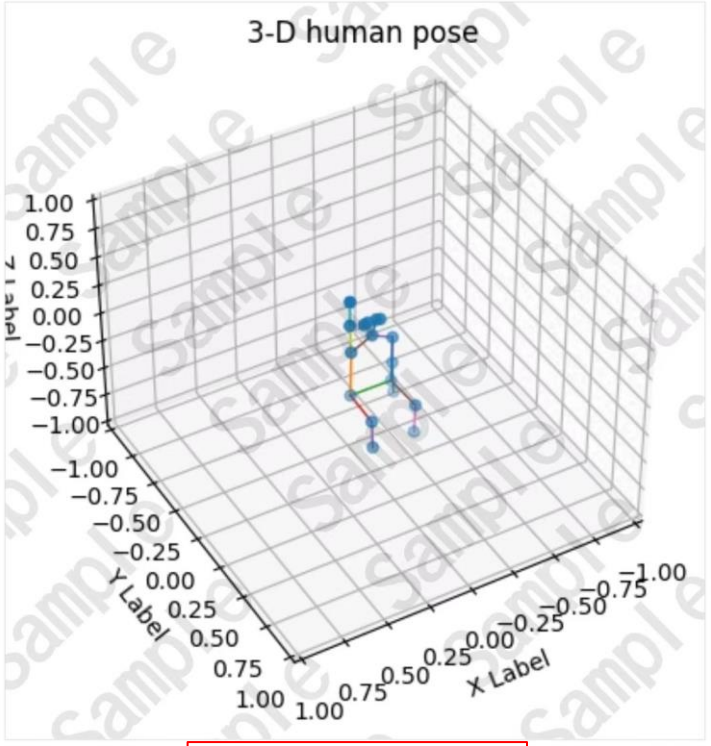
What you need to submit to Canvas are an ipynb file and a picture of the 3D human pose named as your student ID.



20942549.png

Appendix

NUMBER	NAME
0	neck
1	L-eye
2	R-eye
3	L-ear
4	R-ear
5	L-shoulder
6	R-shoulder
7	L-elbow
8	R-elbow
9	L-wrist
10	R-wrist
11	L-hip
12	R-hip
13	L-knee
14	R-knee
15	L-ankle
16	R-ankle