

CIVL 4210 - Advanced Construction with AI and Robotics

Guidebook: Data Visualization

Prof. Yu
HUANG Xuhong

Background

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



Step 1: Import model

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

Step 2: Create array

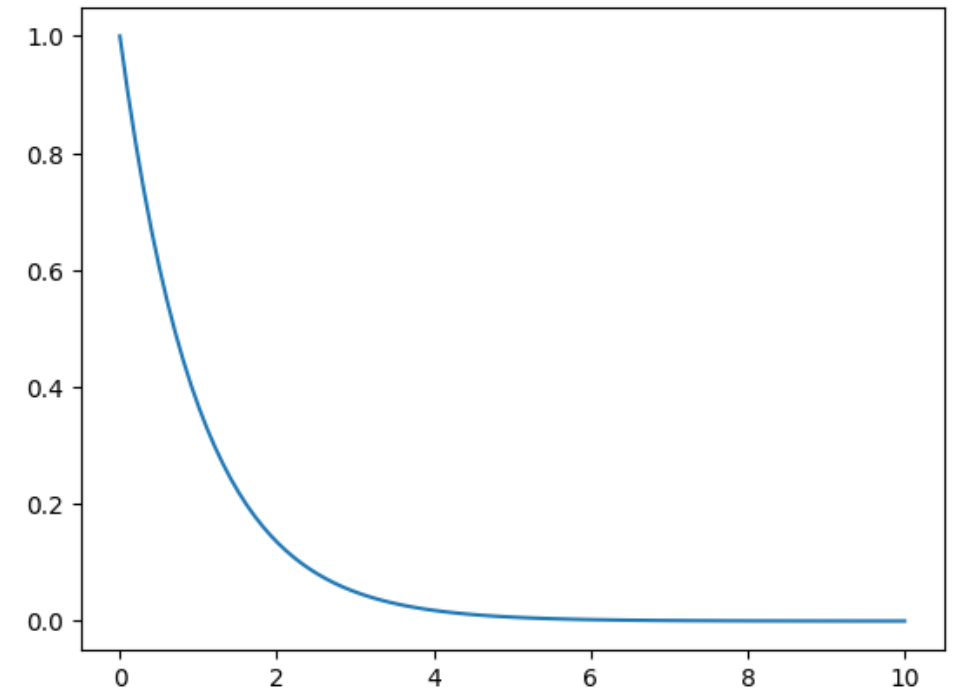
```
import numpy as np  
a=np.linspace(0,10,100)
```

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))
```

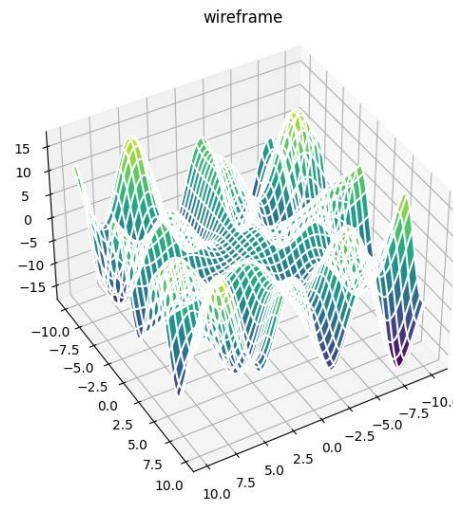
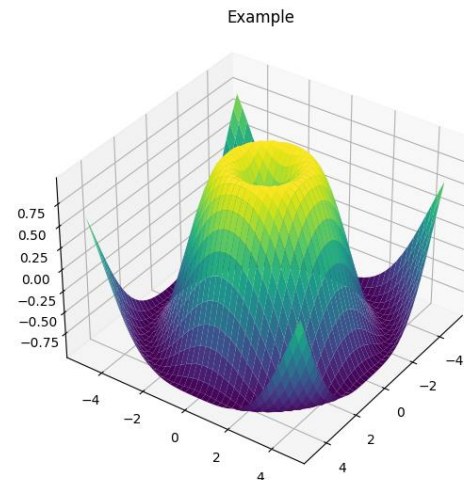
Try to change 'X,Y
arange', 'R', 'Z', 'surf',
'view_init' 😊

Step 2: Create 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,cmap=
ap='viridis')
ax.set_title('Example')
ax.view_init(35,35,0)
plt.show()
```

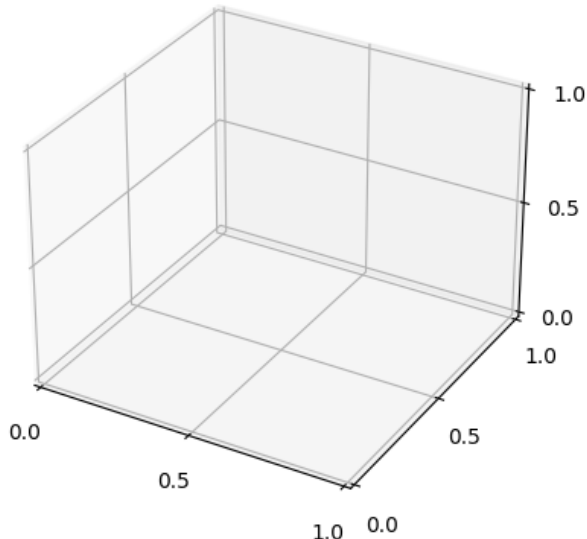


Step 3: Drawing of human posture



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'$z=y=x$')
```

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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

Step 5: Draw 3-D human pose

```
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)
```

```
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)

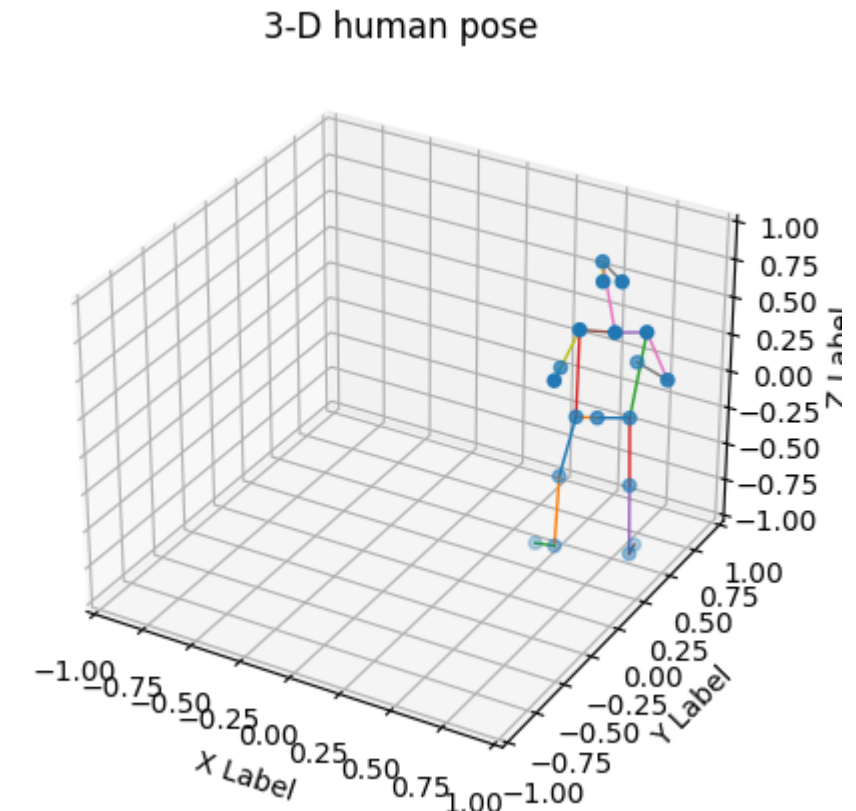
ax.set_ylim(-1,1)

ax.set_zlim(-1,1)

ax.view_init(40,60,0)

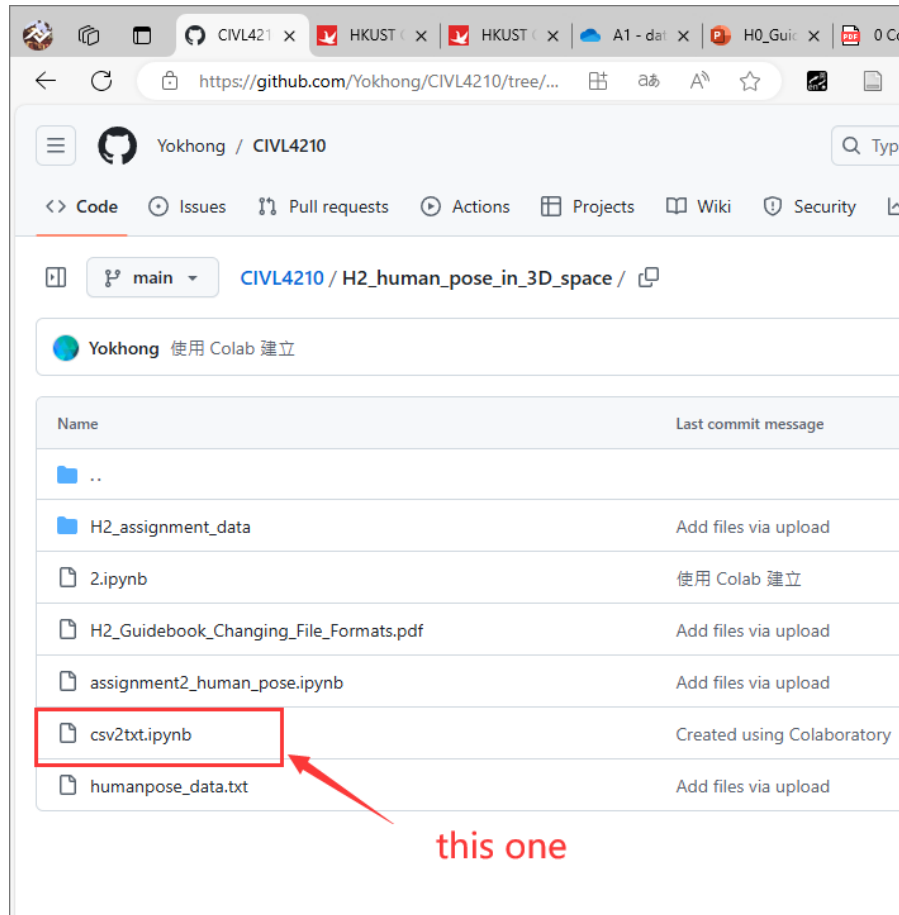
ax.set_title('3-D human pose')

plt.show()
```



Changing File Formats

Convert .csv format to .txt format.



```
csv2txt.ipynb
檔案 編輯 檢視畫面 插入 執行階段 工具 說明
+ 程式碼 + 文字 複製到雲端硬碟
+ 程式碼 + 文字

import csv

csv_pathway = 'testing.csv'
txt_pathway = 'testing.txt'
start_row = 1
end_row = 17
start_col = 2
end_col = 4

with open(csv_pathway, "r", newline='') as csv_file:
    csv_reader = csv.reader(csv_file)
    data = []
    for i, row in enumerate(csv_reader):
        if i >= start_row and i <= end_row:
            row_data = row[start_col:end_col+1]
            data.append(row_data)
    transposed_data = list(map(list, zip(*data)))

with open(txt_pathway, "w") as txt_file:
    for row_data in transposed_data:
        txt_file.write(" ".join(row_data) + "\n")

[ ] ## drafts ##

#CSVfile = "testing.csv"
#CSVdata = pd.read_csv(CSVfile)

#with open('testing.csv', 'r') as CSVfile:
#    CSVdata = csv.reader(CSVfile)
#    with open('testing.txt', 'w') as TXTfile:
#        for row in CSVdata:
#            TXTfile.write(" ".join(row) + "\n")

#selected = CSVdata.iloc[1:17, [2, 3, 4]]
#with open(selected, 'r') as selected_data:
#    #selected_read = csv.reader(selected_data)
#    with open('testing.txt', 'w') as TXTfile:
#        for row in selected:
#            TXTfile.write(" ".join(row) + "\n")

#selected = CSVfile.iloc[1:17, [2, 3, 4]]
#print(selected)
#with open('testing.txt', 'w') as TXTfile:
#    for row in selected:
#        TXTfile.write(" ".join(row) + "\n")
```


Assignment requirement



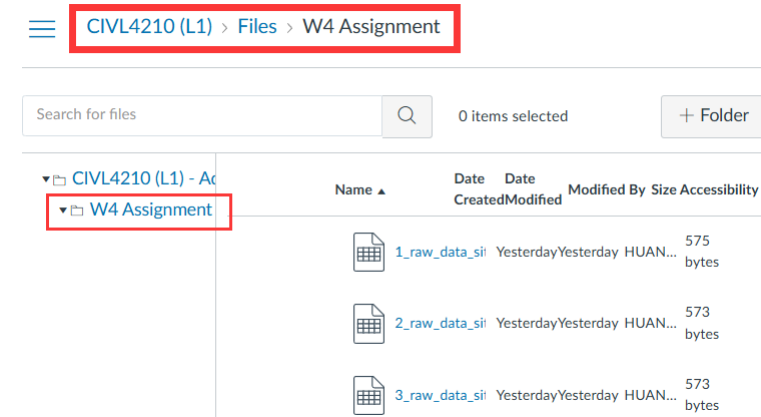
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1. Change the raw data into the format that your code can read.
2. Define a function in which you can join the key points together.
3. Load the files you changed and print out XS, YS, and ZS.
4. Change the view to elevation angles of 40, azimuth angles 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.)

名稱	修改日期	類型	大小
1_raw_data_sitting.csv	25/9/2023 23:50	Microsoft Excel ...	1 KB
2_raw_data_sitting_left_arm.csv	25/9/2023 23:50	Microsoft Excel ...	1 KB
3_raw_data_sitting_right_arm.csv	25/9/2023 23:50	Microsoft Excel ...	1 KB
4_raw_data_sitting_cross_legged.csv	25/9/2023 23:50	Microsoft Excel ...	1 KB
5_raw_data_sitting_cross_legged_left_arm.csv	25/9/2023 23:50	Microsoft Excel ...	1 KB
6_raw_data_sitting_cross_legged_right_arm.csv	25/9/2023 23:50	Microsoft Excel ...	1 KB
7_raw_data_standing.csv	26/9/2023 0:45	Microsoft Excel ...	1 KB
8_raw_data_standing_left_arm.csv	26/9/2023 0:46	Microsoft Excel ...	1 KB
9_raw_data_standing_right_arm.csv	26/9/2023 0:46	Microsoft Excel ...	1 KB
10_raw_data_walking.csv	26/9/2023 1:04	Microsoft Excel ...	1 KB



You can find the data in the course folder “W4 Assignment.”

Assignment requirement

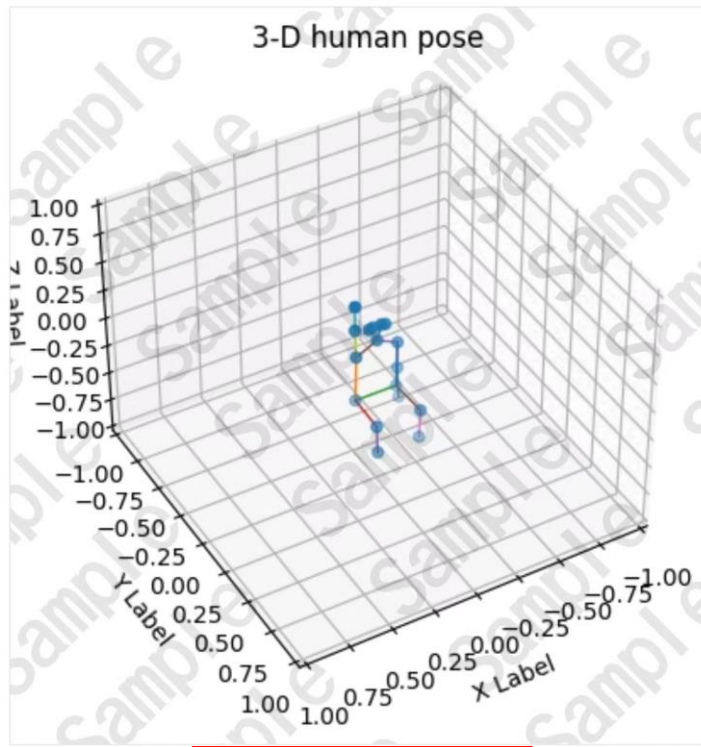


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What you need to submit to Canvas are an **ipynb file** and a **picture of the 3D human pose** named as **your student ID**.



20942549.png



Appendix



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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

