Hyperiondev

TASK

Data Visualisation V

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Introduction

WELCOME TO THE DATA VISUALISATION V TASK!

Now that you are familiar with some of the basic concepts and techniques associated with creating data visualisation with Python, we will begin to explore creating some more advanced visualisations. In this task, you will create 3D visualisations with Matplotlib and be exposed to some other libraries that can be used for data visualisation.

Get in touch

Connect for support

Remember that with our courses, you're not alone! You can contact an expert code reviewer to get support on any aspect of your course.

The best way to get help is to login to Discord at **https://discord.com/invite/hyperdev** where our specialist team is ready to support you.

Our team is happy to offer you support that is tailored to your individual career or education needs. Do not hesitate to ask a question or for additional support!

STACKED AREA CHART EXAMPLE

Below is an example of a stacked area chart. These graphs are often used to compare multiple variables that change over time.

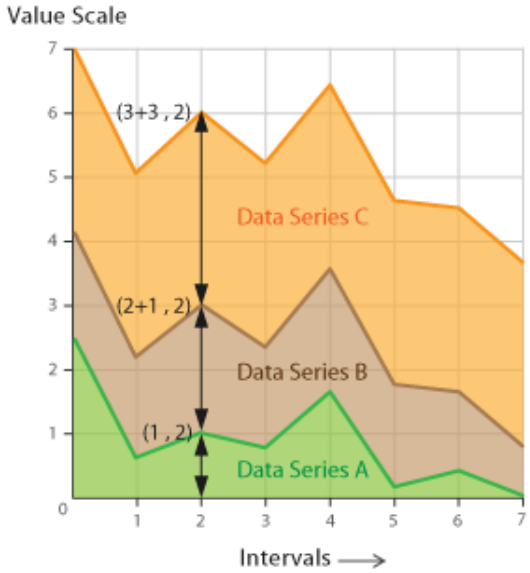


Image source: **https://datavizcatalogue.com/methods/stacked_area_graph.html**

Stacked area graphs can be easily created with Matplotlib as shown in the example below:

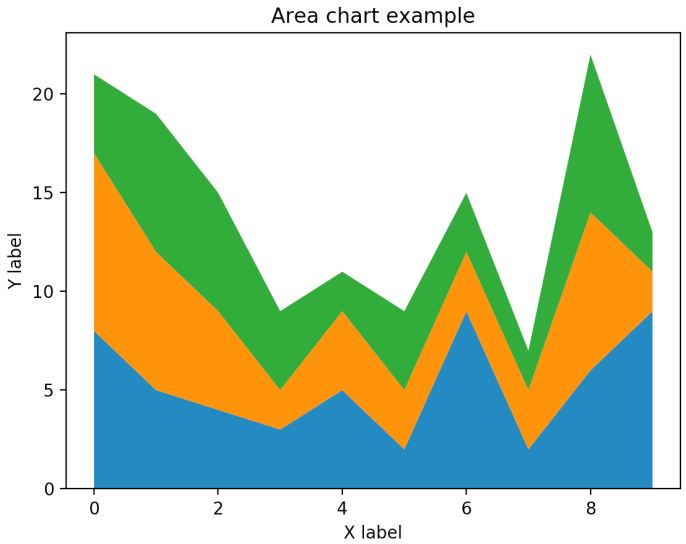
```
import numpy as np
import matplotlib.pyplot as plt

#Generate random data
groupOne = np.random.randint(1,10,10)
groupTwo = np.random.randint(1,10,10)
groupThree = np.random.randint(1,10,10)

#Creating the stacked area
y = np.row_stack((groupOne,groupTwo,groupThree))
x = np.arange(10)

y1, y2, y3=(groupOne,groupTwo,groupThree)

fig,ax = plt.subplots()
ax.stackplot(x,y)

#Labels
```

```
plt.title("Stacked area chart example")
plt.xlabel("X label")
plt.ylabel("Y label")
plt.show()
```

In the code above we have created three arrays (groupOne, groupTwo and groupThree) that contain the data that we want to represent on our stacked area graph. The instruction, `y = np.row_stack((groupOne,groupTwo,groupThree))`, takes a sequence of arrays and stacks them vertically to make a single array. The code, `x = np.arange(10)`, returns an array with evenly spaced elements as per the interval.

With a stacked area graph we want to be able to view different data together in the same graph. To do this we use subplots. A subplot is defined as, "groups of smaller axes that can exist together within a single figure. These subplots might be insets, grids of plots, or other more complicated layouts (VanderPlas, 2016)." Notice that we use the code, `plt.subplots()`. This function returns a figure, which is the top level container for all the plot elements, and an array of Axes objects. The code, `ax.stackplot(x,y)`, creates a stackplot. Stackplots are generated by plotting different datasets vertically on top of one another rather than overlapping with one another.

When you run the program you will get something like this:



3D SCATTERPLOT EXAMPLE

3D scatterplots are useful when one wants to compare 3 characteristics of a data set instead of two. Again, we can use Matplotlib to create a scatterplot as shown below:

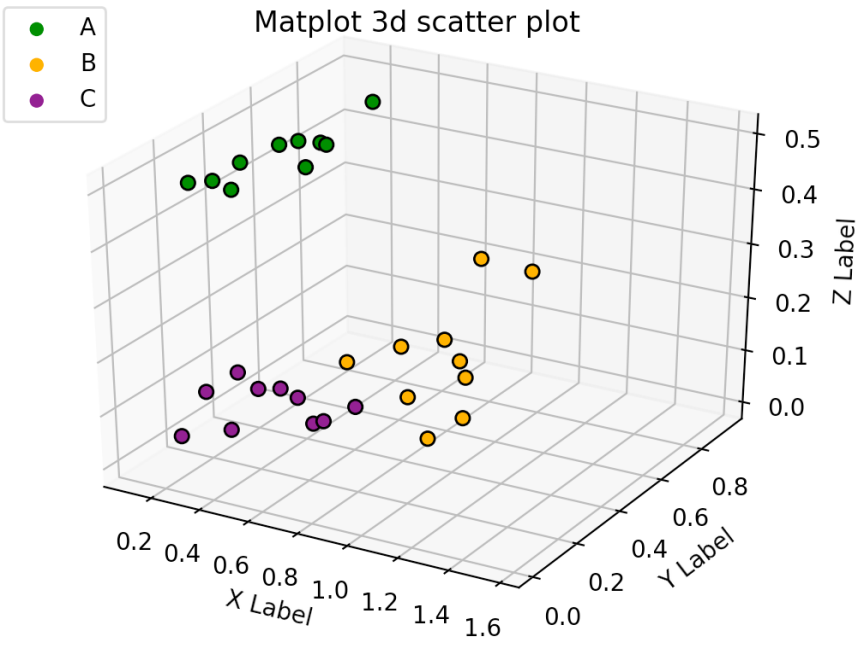
```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

#Generate random data
n = 10
g1 = (0.1+0.2*np.random.rand(n),
np.random.rand(n),0.4+0.1*np.random.rand(n))
g2=(0.7+0.9*np.random.rand(n),0.2*np.random.rand(n),0.51*np.random.rand(n))
g3=(0.6*np.random.rand(n), 0.7*np.random.rand(n),0.4+0.1*np.random.rand(n))

#Create visualisation
data= (g1,g2,g3)
colours = ("green", "orange", "purple")
groups = ("A", "B", "C")

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax = fig.gca(projection="3d")

for data, colour, group in zip(data, colours, groups):
     x, y, z = data
     ax.scatter(x, y, z, alpha = 1, c = colour, edgecolors = "none", s = 35,
label = group)

ax.set_xlabel("X label")
ax.set_ylabel("Y label")
ax.set_zlabel("Z label")

plt.title("3D scatter plot example")
plt.legend(loc = 2)
plt.show()
```

From the code above, notice the following:

- To create 3D visualisations with Matplotlib add the following import statement: `from mpl_toolkits.mplot3d import Axes3D`
- Once you have added this import statement, the option 'projection' becomes available. By default, Matplotlib produces 2D visualisations. Once you have imported mplot3d, you can specify that `projection="3d"`.

- The code, `ax = fig.gca(projection="3d")` gets the current 3D axes on the figure or creates and returns the appropriate axes if they don't already exist.
- `ax.scatter()` creates a scatterplot.

When you run the program you will get something like this:



MULTI-PLOT GRIDS

While 3D plots help us to view the relationship between three different features, this is where it is unfortunately limited. More often than not, we have to visualise relationships between four or more dimensions. In addition, 3D plots can sometimes be a bit difficult to interpret, considering that we are viewing it from a 2D screen.

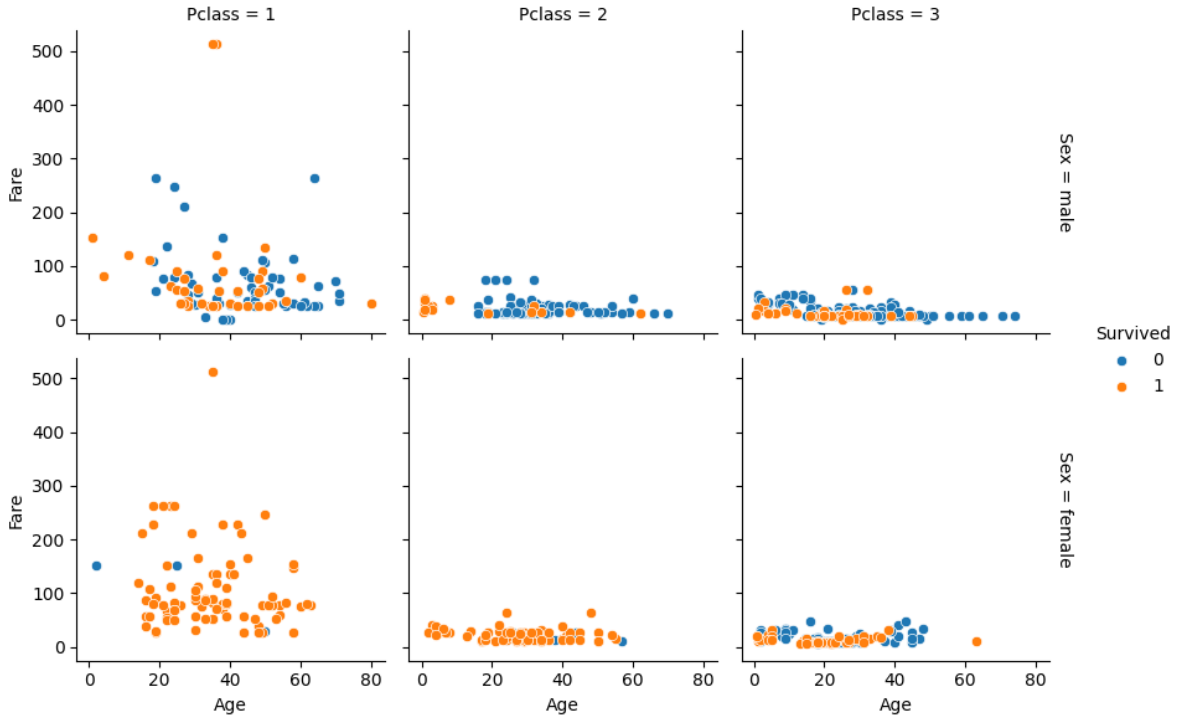
As I'm sure you can imagine, thinking in four dimensions can be difficult. Five dimensions even more so. Imagine a dataset containing 20 columns - that's 20 dimensions that we have to visualise! Luckily, there are workarounds to this.

Seaborn contains a FacetGrid - essentially a grid containing multiple plots. While this can easily be done in Matplotlib, the interface presented in Seaborn is much easier to use.

Let's use the Titanic dataset as an example here. We have multiple factors contributing to whether someone survived or not. Let's take a look at the relationship between a person's Sex, Passenger Class, Age, Fare and whether they survived or not:

```
titanic_df = pd.read_csv('Titanic.csv')

plt.figure()
fg = sns.FacetGrid(titanic_df, row="Sex", col="Pclass", hue="Survived",
margin_titles=True)
fg.map(sns.scatterplot, "Age", "Fare")
fg.add_legend()
plt.show()
plt.close()
```

This produces the following diagram:



This tells us a lot. The first (and most obvious) observation is that Pclass 1 has the most expensive fare. We see that most females survived, and a lot of the blue dots (didn't survive) are at later ages.

CORRELATION HEATMAPS

A correlation matrix is a very important tool to have as a data scientist. This is quite possibly the best way to get a basic understanding of all of the features in a single plot.

Before we talk about a correlation matrix, let's talk about correlation. More specifically, the correlation coefficient. In short, the correlation coefficient is a single number that tells you the relationship between two variables. If one variable increases consistently as another variable increases, this means that they have a positive correlation. If one variable decreases as another increases, this is a negative correlation. If two variables have no effect on each other, this means that they have a zero correlation.

The correlation coefficient has a value between -1 and 1. A correlation of 1 is basically a straight line going upwards from left to right. A correlation of -1 is a straight line going down from left to right.

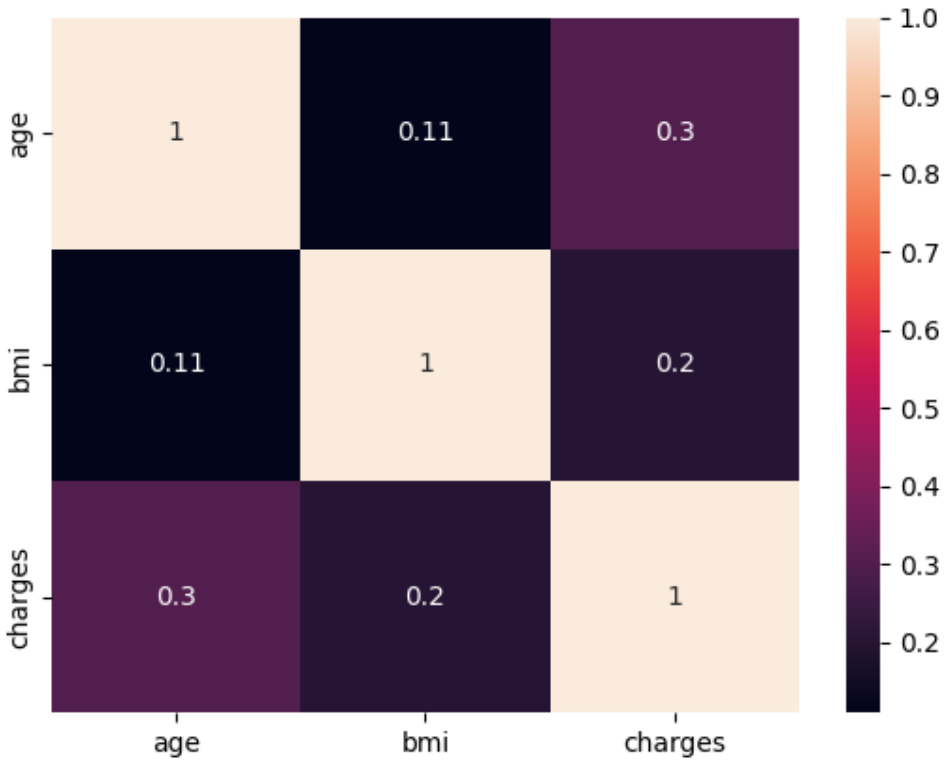
Now that we understand correlation, what is a correlation matrix? It is essentially a 2D square matrix (which means that there are as many rows as there are columns). The value at position (0, 1) in the correlation matrix, for example, will show you the correlation coefficient between features 0 and 1.

The correlation matrix can be viewed as a set of numbers, but numbers have never been very easy to read. The best way to view this matrix is with a heatmap. Thankfully, Seaborn (as always) makes this easy.

Let's take a look at the insurance dataset. Specifically, we want to see the relationship between age, BMI and insurance charges:

```
insurance_df = pd.read_csv('insurance.csv')

age_bmi_charges = insurance_df[['age', 'bmi', 'charges']]

plt.figure()
corr_coeff_mat = age_bmi_charges.corr()
sns.heatmap(corr_coeff_mat, annot=True)
plt.show()
plt.close()
```

This produces the following graph:



What can we tell from this graph? Well, keeping in mind that correlations that are close to zero means that there's little to be seen in terms of a relationship, there is a small amount of correlation between these features. In addition, being older has a higher impact on insurance charges than your BMI (which should make sense).

DATA VISUALISATION USING OTHER LIBRARIES

There are many other libraries out there that can help you create all kinds of data visualisation.

For example, if you want to create a *word cloud* visualisation you can install the **wordcloud** library (`pip3 install wordcloud`). The code below demonstrates how to use this library:

```
import matplotlib.pyplot as plt
from wordcloud import WordCloud

#Create text
text = ("Python Data Visualisation HyperionDev Learning Data Science Mentors
Careers Analytics")
```

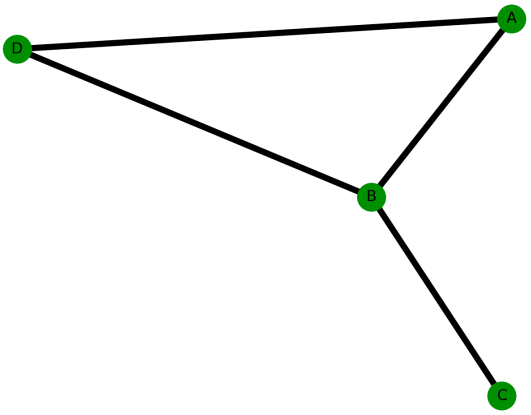
```
#Create visualisation
wordcloud = wordCloud(width = 500, height = 500, margin = 10).generate(text)
plt.imshow(wordcloud, interpolation = "bilinear")
plt.axis("off")
plt.margins(x = 0, y = 0)
plt.show()
```

When you run the program you will get something like this:

A library called **networkx** allows one to create network graphs. Download and install this library here: **https://networkx.github.io/**. The code below demonstrates how to use this library:

```
import pandas as pd
import numpy as np
import networkx as nx
import matplotlib.pyplot as plt

#Create a dataframe
df = pd.DataFrame({'from': ['C', 'A', 'B', 'D'], 'to': ['B', 'D', 'A',
'B']})

#Create the network graph
G = nx.from_pandas_edgelist(df, 'from', 'to')

#Customise the nodes
nx.draw(G, with_labels=True, node_color='green', node_size=500, width=5)

plt.show()
```

When you run the program you will get something like this:



Extra resource

*You can find plenty of python packages related to data visualisation with a quick search. A popular package is **ggplot**. For geographic or map visualisations you can use **geoplotlib**.*

There are always new packages that are created and old ones being updated, make sure you keep track of the latest versions! Sometimes old tutorials may use syntax that does not work for the new package versions.

Instructions

Before you get started we strongly suggest you start using VS Code or Anaconda to open all text files (.txt) and python files (.py). Do not use the normal Windows notepad as it will be much harder to read.

Compulsory Task 1

Follow these steps:

- Create a new jupyter notebook in this task's folder and name it: **wine.ipynb**.
- Read in the **wine.csv** file.
- Do a short Exploratory Data Analysis (EDA) on the dataset to give an idea of the kind of data we are dealing with.
- There are some missing values in the data. Would you undertake imputation? If 'yes', then *how*? Please outline this in the notebook.
- Create a multi-plot grid:
    - Filter the dataset to only contain "Cabernet Sauvignon", "Pinot Noir" and "Chardonnay" wines
    - Use the variety column
    - For each of these three wine varieties, show a histogram plot of the "points" column.
- Create Word Clouds of the Province and the variety of the wine.

NOTE: Be creative and imaginative.

: Your Notebook should be neat and easy to follow

If you are having any difficulties, please feel free to contact our specialist team **on Discord** for support.

Completed the task(s)?

Ask an expert to review your work!

Review work

Things to look out for:

1. Make sure that you have correctly installed any visualisation libraries that you want to use before using them in your code.

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REFERENCES

VanderPlas, J. (2016, November). *Multiple Subplots*. Retrieved from Python Data Science Handbook: **https://jakevdp.github.io/PythonDataScienceHandbook/04.08-multiple-subplots.html**