

The image shows three vertically stacked video frames from a YouTube video player, likely demonstrating a scroll-through feature or a multi-video interface.

Top Frame: The title is "DV0101EN - Introduction to Data Visualization 4:36". The video content starts with the text "Hello everyone and welcome to the first module of the data visualization with". The YouTube interface includes a progress bar at 0:02 / 4:36, a toolbar with various icons, and a status bar indicating Speed 1.0x, HD, ENG US, and 06/02/2021.

Middle Frame: The title is "DV0101EN - Introduction to Data Visualization 4:36". The video content lists four reasons for building visuals: 1. For exploratory data analysis, 2. Communicate data clearly, 3. Share unbiased representation of data, and 4. Use them to support recommendations to different stakeholders. The YouTube interface includes a progress bar at 1:02 / 4:36, a toolbar with various icons, and a status bar indicating Speed 1.0x, HD, ENG US, and 06/02/2021.

Bottom Frame: The title is "DV0101EN - Introduction to Data Visualization 4:36". The video content continues with the text "recommendations you make to clients managers or other decision-makers in". The YouTube interface includes a progress bar at 1:02 / 4:36, a toolbar with various icons, and a status bar indicating Speed 1.0x, HD, ENG US, and 06/02/2021.

Introduction to Data Visualization | Introduction to Matplotlib and | + https://courses.cognitiveclass.ai/courses/course-v1:CognitiveClass+DV0101EN+v1/courseware/407a9f86565c441897406996... | Watch later Share

DV0101EN - Introduction to Data Visualization 4:36

Best Practices

When creating a visual, always remember:

1. Less is more effective
2. Less is more attractive
3. Less is more impactful

 DARKHORSE ANALYTICS

more effective, it is more attractive, and it is more impactful. In other words, any

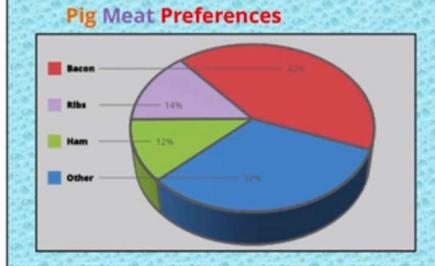
Speed 1.0x HD ENG US 00:34 06/02/2021

Introduction to Data Visualization | Introduction to Matplotlib and | + https://courses.cognitiveclass.ai/courses/course-v1:CognitiveClass+DV0101EN+v1/courseware/407a9f86565c441897406996... | Watch later Share

DV0101EN - Introduction to Data Visualization 4:36

Example

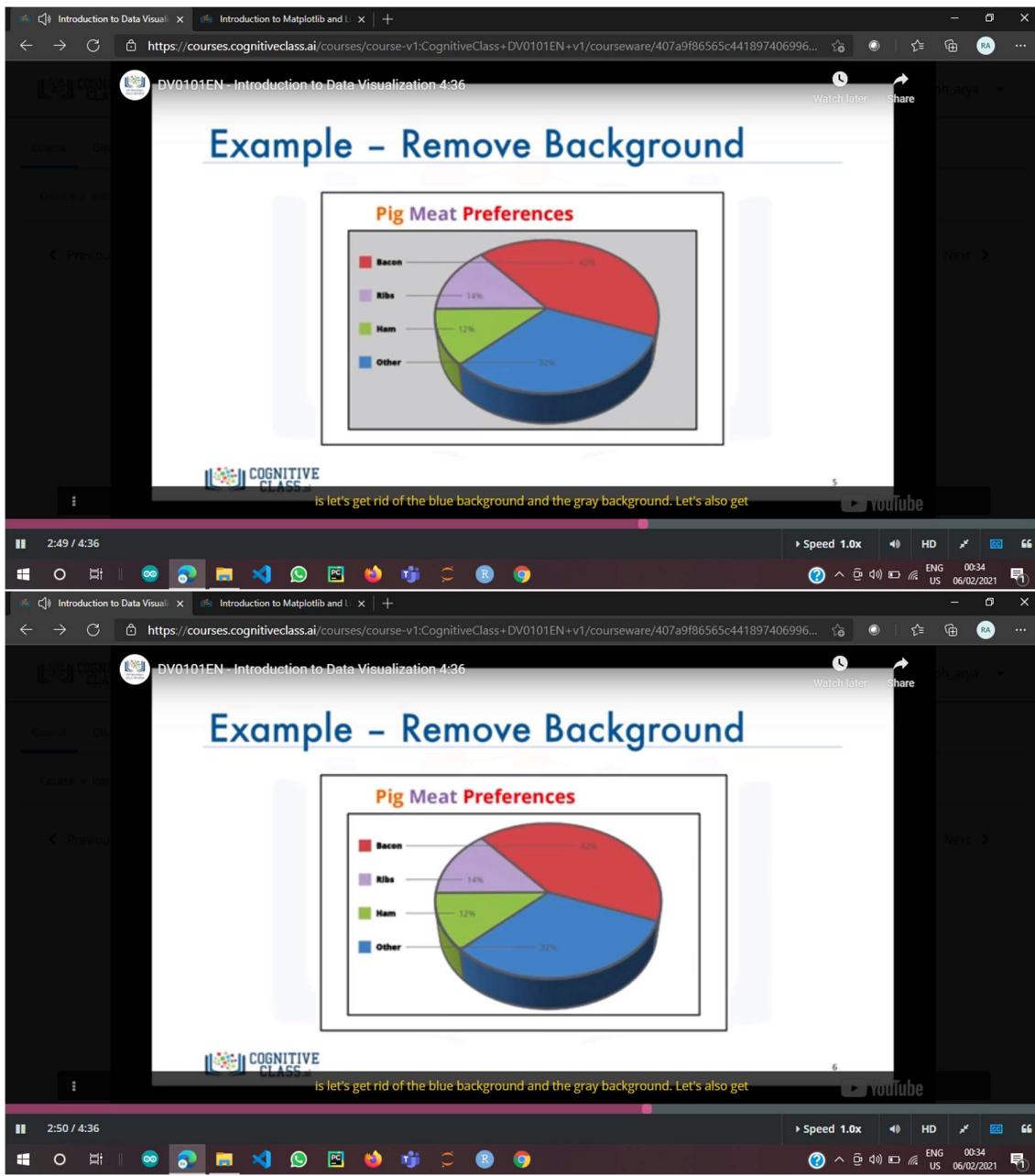
Pig Meat Preferences

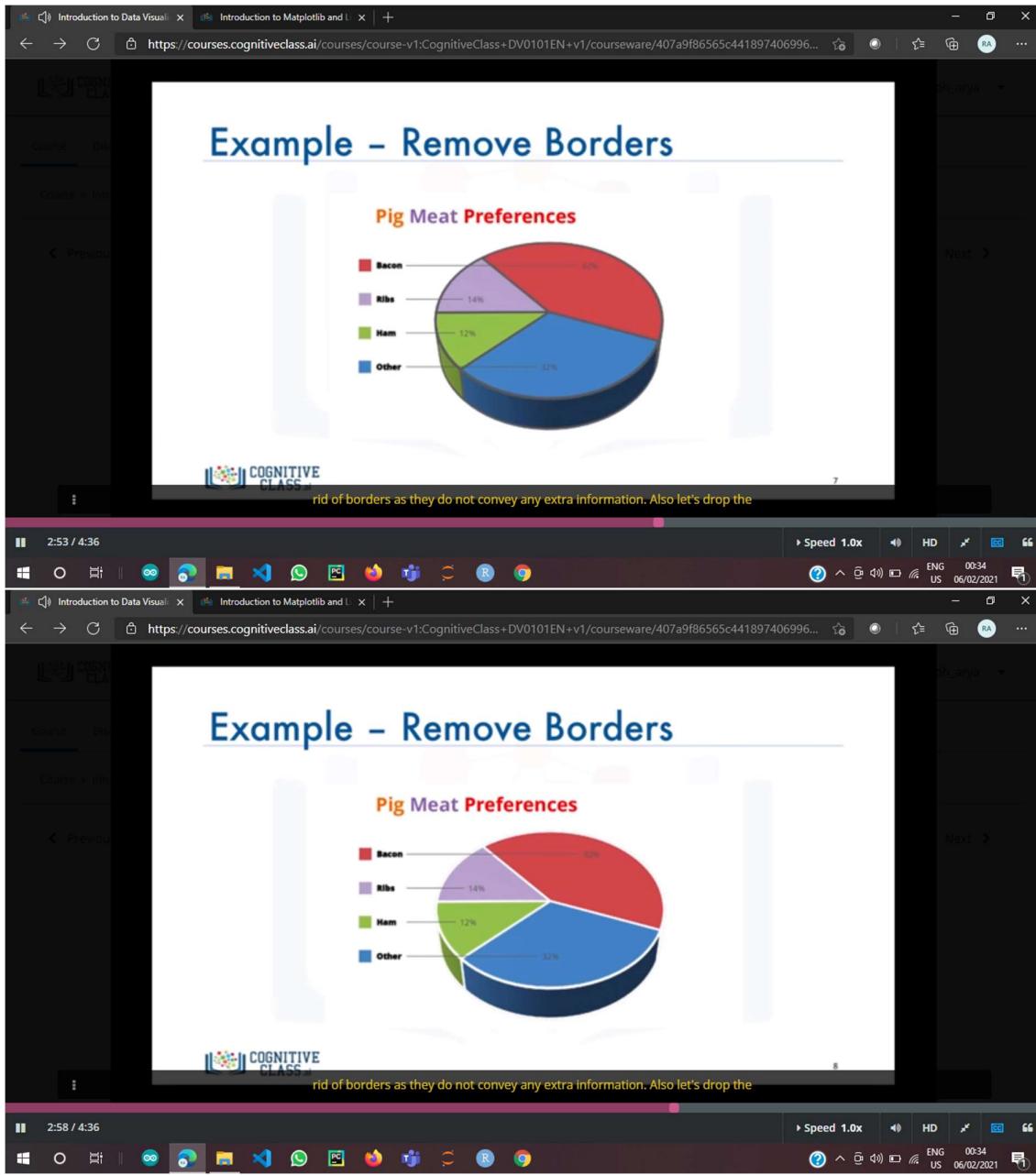


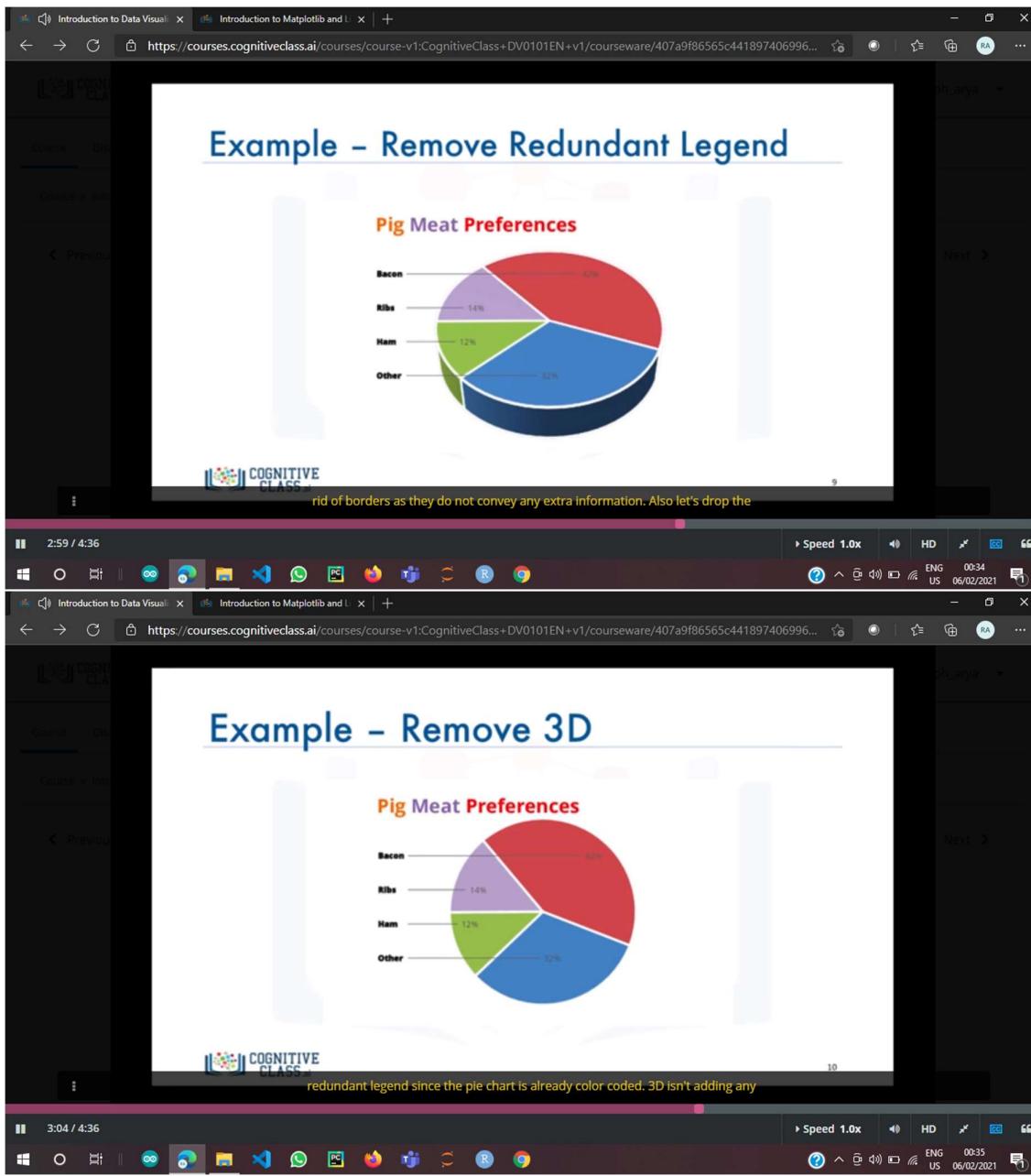
Preference	Percentage
Bacon	32%
Ribs	14%
Ham	12%
Other	42%

looks like people's preferences when it comes to different types of pig meat. The

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Introduction to Data Visualiz... | Introduction to Matplotlib and L... | +

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Example – Remove Text Bolding

Pig Meat Preferences

Bacon 40%
Ribs 14%
Ham 12%
Other 32%

extra information so let's say bye to it. Text bolding is also unnecessary and

11

3:09 / 4:36 Speed 1.0x HD ENG US 06/02/2021

Example – Reduce Color

Pig Meat Preferences

Bacon 40%
Ribs 14%
Ham 12%
Other 32%

let's get rid of the different colors and the wedges. Wow! What just happened?

12

3:13 / 4:36 Speed 1.0x HD ENG US 06/02/2021

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Example – Remove Wedges

Pig Meat Preferences

Bacon	42%
Ribs	14%
Ham	12%
Other	32%

let's get rid of the different colors and the wedges. Wow! What just happened?

3:17 / 4:36

Speed 1.0x HD ENG 00:35 06/02/2021

Example - Thicken Lines

Pig Meat Preferences

Bacon	42%
Ribs	14%
Ham	12%
Other	32%

Well let's thicken the lines to make them more meaningful. Now this looks a

3:21 / 4:36

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Introduction to Data Visualization | Introduction to Matplotlib and Data Visualization

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Example – Emphasize Bacon

Pig Meat Preferences

Preference	Percentage
Bacon	42%
Ribs	14%
Ham	12%
Other	32%

little familiar. Yes! This is a bar graph after all, one with horizontal bars. And

3:31 / 4:36

Speed 1.0x HD ENG US 06/02/2021

DV0101EN - Introduction to Data Visualization 4:36

Comparison

Before

Pig Meat Preferences

After

Pig Meat Preferences

Preference	Percentage
Bacon	42%
Ribs	14%
Ham	12%
Other	32%

better and easier to understand. I hope that we unanimously agree that the bar

3:45 / 4:36

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Introduction to Matplotlib (6:26) | Introduction to Matplotlib and L | +

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DV0101EN - Introduction to Matplotlib 6:26

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Data Visualization with Python

Introduction to Matplotlib

In this video, we will start learning about Matplotlib. This video will focus

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0:00 / 6:26

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00:36 ENG US 06/02/2021

Introduction to Matplotlib (6:26) | Introduction to Matplotlib and L | +

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Matplotlib - History

John Hunter (1968 – 2012)

EEG/ECoG Visualization Tool

Analogous to Matlab scripting interface

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more about this in a moment. Now Matplotlib's architecture is composed of

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1:12 / 6:26

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00:36 ENG US 06/02/2021

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DV0101EN - Introduction to Matplotlib 6:26

Matplotlib Architecture

```
graph TD; A[Matplotlib Architecture] --- B[Scripting Layer<br>(pyplot)]; A --- C[Artist Layer<br>(Artist)]; A --- D[Backend Layer<br>(FigureCanvas, Renderer, Event)];
```

plots. Now let's go into each layer in a little more details.

1:48 / 6:26 Speed 1.0x HD 3 ENG US 06/02/2021

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Backend Layer

Has three built-in abstract interface classes:

1. FigureCanvas: **matplotlib.backend_bases.FigureCanvas**
 - Encompasses the area onto which the figure is drawn
2. Renderer: **matplotlib.backend_bases.Renderer**
 - Knows how to draw on the FigureCanvas
3. Event: **matplotlib.backend_bases.Event**
 - Handles user inputs such as keyboard strokes and mouse clicks

Event, which handles user inputs such as keyboard strokes and

2:13 / 6:26 Speed 1.0x HD 4 ENG US 06/02/2021

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Putting the Artist Layer to Use

- Let's try to generate a histogram of some data using the **Artist** layer:

the artist layer to use and see how we can use it to generate a graphic. So

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DV0101EN - Introduction to Matplotlib 6:26

Artist Layer

- Comprised of one main object – **Artist**:
 - Knows how to use the Renderer to draw on the canvas.
- Title, lines, tick labels, and images, all correspond to individual **Artist** instances.
- Two types of **Artist** objects:
 - Primitive**: Line2D, Rectangle, Circle, and Text.
 - Composite**: Axis, Tick, Axes, and Figure
- Each *composite* artist may contain other *composite* artists as well as *primitive* artists.

contain an axis artist as well as a rectangle or text artists. Now let's put

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Putting the Artist Layer to Use

- Let's try to generate a histogram of some data using the Artist layer:

```
from matplotlib.backends.backend_agg import FigureCanvasAgg as FigureCanvas # import FigureCanvas
from matplotlib.figure import Figure # import Figure artist
fig = Figure()
canvas = FigureCanvas(fig)

# create 10000 random numbers using numpy
import numpy as np
x = np.random.randn(10000)

ax = fig.add_subplot(111) # create an axes artist
ax.hist(x, 100) # generate a histogram of the 10000 numbers

# add a title to the figure and save it
ax.set_title('Normal distribution with $\mu=0, \sigma=1')
fig.savefig('matplotlib_histogram.png')
```

decor the figure with a title and we save it. Now this is the generated

4:58 / 6:26 Speed 1.0x HD ENG US 06/02/2021

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Putting the Artist Layer to Use

Normal distribution with $\mu = 0, \sigma = 1$

decor the figure with a title and we save it. Now this is the generated

5:02 / 6:26 Speed 1.0x HD ENG US 06/02/2021

The screenshot shows a YouTube video player window. The video title is "DV0101EN - Introduction to Matplotlib 6:26". The video content displays a list of bullet points and a code snippet. The code is highlighted with a red box around the first few lines:

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

x = np.random.randn(10000)
plt.hist(x, 100)
plt.title(r'Normal distribution with $\mu=0, \sigma=1$')
plt.savefig('matplotlib_histogram.png')
plt.show()
```

A yellow box highlights the text "whether it is the hist method or showing the figure are part of the pyplot". The video player interface includes a progress bar at 6:09 / 6:26, a toolbar with various icons, and a status bar at the bottom indicating speed 1.0x, HD, ENG, US, and 06/02/2021.

The screenshot shows a YouTube video player window. The video title is "DV0101EN - Basic Plotting with Matplotlib 4:39". The video content displays a slide with the title "Data Visualization with Python" and a subtitle "Basic Plotting with Matplotlib". A yellow box highlights the text "In this video, we will learn how to use Matplotlib to create plots and we will". The video player interface includes a progress bar at 0:04 / 4:39, a toolbar with various icons, and a status bar at the bottom indicating speed 1.0x, HD, ENG, US, and 06/02/2021.

Basic Plotting with Matplotlib

Introduction to Matplotlib and Data Visualization

<https://courses.cognitiveclass.ai/courses/course-v1:CognitiveClass+DV0101EN+v1/courseware/407a9f86565c441897406996...>

DV0101EN - Basic Plotting with Matplotlib 4:39

Matplotlib - Jupyter Notebook

well as the Jupyter notebook. Now for those of you who don't know what the

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0:28 / 4:39

Course: Data Visualization with Python

Courseware

Previous

Next >

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2

YouTube

Basic Plotting with Matplotlib

Introduction to Matplotlib and Data Visualization

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DV0101EN - Basic Plotting with Matplotlib 4:39

Matplotlib - Jupyter Notebook

jupyter Matplotlib - Jupyter Notebook Last Checkpoint 2 minutes ago (unseen changed)

File Edit View Insert Cell Kernel Help

Python 2 | CellToolbar

```
In [1]: import matplotlib as plt
```

```
In [1]:
```

and so if you start a Jupyter notebook, all you have to do is import Matplotlib

Speed 1.0x HD

0:53 / 4:39

Course: Data Visualization with Python

Courseware

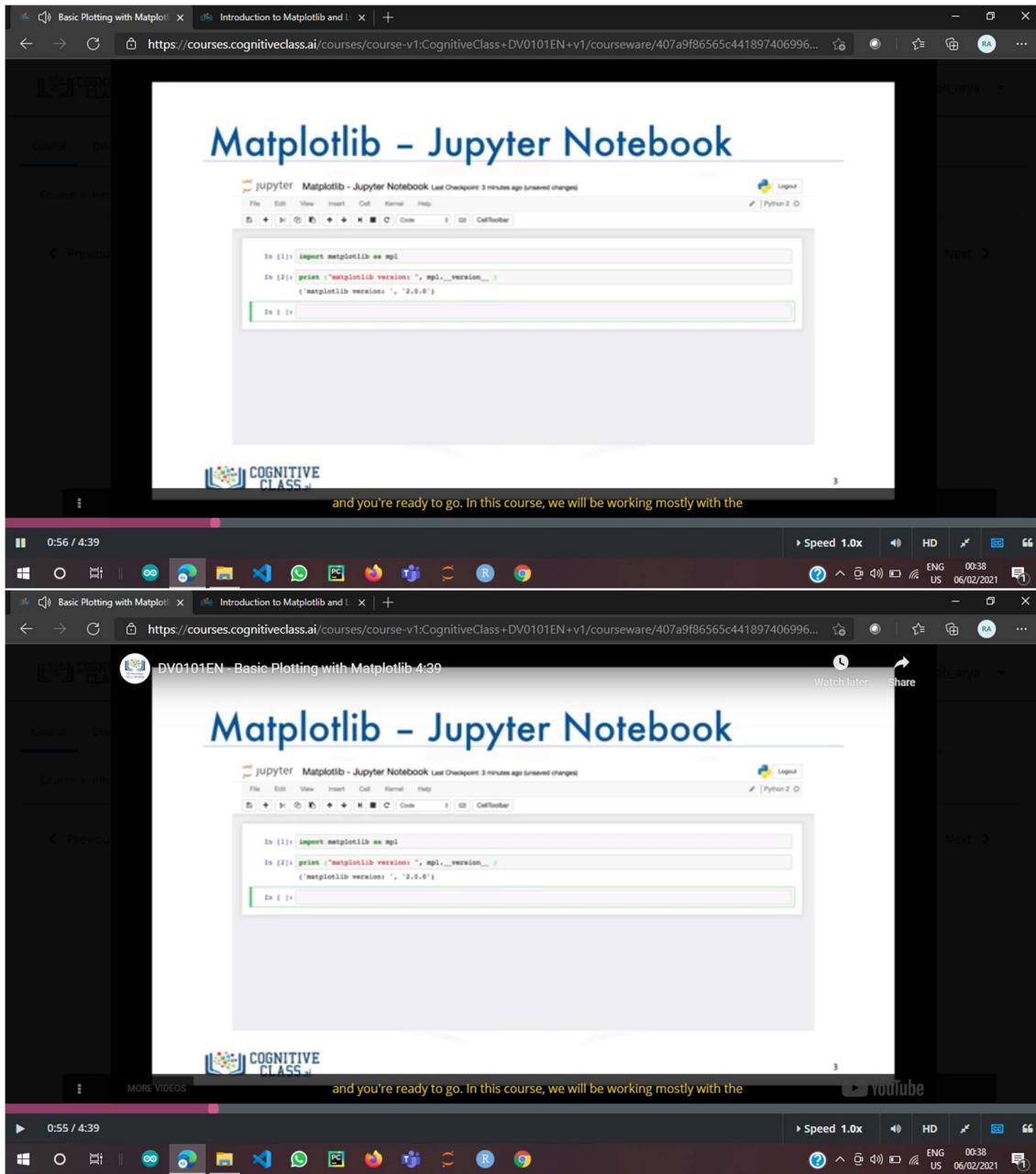
Previous

Next >

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3

YouTube



The screenshot shows a video player interface with a Jupyter Notebook cell output. The video player has a progress bar at 2:10 / 4:39 and a toolbar with Speed 1.0x, HD, and other controls. The Jupyter Notebook cell contains the following code:

```
In [1]: matplotlib inline
import matplotlib.pyplot as plt
In [2]: plt.plot(5, 5, 'o')
plt.show()
```

The output of the cell is a scatter plot with a single blue dot at coordinates (5, 5) on a grid from 4.8 to 5.2 on both axes.

Below the video player, there is a text block from Cognitive Class stating: "Matplotlib has a number of different backends available. One limitation of".

The screenshot shows the continuation of the video player interface. The video progress is now at 2:33 / 4:39. The Jupyter Notebook cell continues with:

```
In [3]: plt.plot(5, 5, 'o')
plt.ylabel("Y")
plt.xlabel("X")
plt.title("Plotting Example")
plt.show()
```

The output of the cell is a scatter plot with a single blue dot at coordinates (5, 5), labeled with "Plotting Example" in the title, "X" on the x-axis, and "Y" on the y-axis.

Below the video player, there is a text block from Cognitive Class stating: "function. A backend that overcomes this limitation is the notebook backend."

Basic Plotting with Matplotlib | Introduction to Matplotlib and Pandas

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DV0101EN - Basic Plotting with Matplotlib 4:39

Matplotlib Backends – Notebook

jupyter Matplotlib - Jupyter Notebook Last Checkpoint: 18 minutes ago Unsaved changes

In [1]: %matplotlib notebook
import matplotlib.pyplot as plt

In [2]: plt.plot([4, 5], 'o')

Figure 1

Plotting Example

In [3]: plt.ylabel('y')
plt.xlabel('x')
plt.title('Plotting Example')

Out[3]: <matplotlib.text.Text at 0x107722910>

0x(2): <matplotlib.lines.Line2D at 0x10786e790>

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axes after the plot was rendered, without the need to regenerate the figure.

3:23 / 4:39

Speed 1.0x HD ENG US 00:39 06/02/2021

Basic Plotting with Matplotlib | Introduction to Matplotlib and Pandas

https://courses.cognitiveclass.ai/courses/course-v1:CognitiveClass+DV0101EN+v1/courseware/407a9f86565c441897406996...

DV0101EN - Basic Plotting with Matplotlib 4:39

Matplotlib – Pandas

india_china_df

	India	China
1980	8880	5123
1981	8670	6682
1982	8147	3308
1983	7338	1863
1984	5704	1527

india_china_df.plot(kind="line")

Figure 1

1980 1985 1990 1995

to line and there you have it: a line plot of the data in the data frame.

4:10 / 4:39

Speed 1.0x HD ENG US 00:39 06/02/2021

Basic Plotting with Matplotlib x Introduction to Matplotlib and Pandas x

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DV0101EN - Basic Plotting with Matplotlib 4:39

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Matplotlib – Pandas

india_china_df

	India	China
1980	8880	5123
1981	8670	6682
1982	8147	3308
1983	7338	1863
1984	5704	1527

```
india_china_df["India"].plot(kind="hist")
```

Figure 1

Frequency

10

to Canada from 1980 to 1996. This concludes our video on basic plotting

YouTube

4:33 / 4:39

Speed 1.0x HD ENG US 06/02/2021

Dataset on Immigration to Canada x Introduction to Matplotlib and Pandas x

https://courses.cognitiveclass.ai/courses/course-v1:CognitiveClass+DV0101EN+v1/courseware/407a9f86565c441897406996...

DV0101EN - Dataset on Immigration to Canada 2:43

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Data Visualization with Python

Dataset on Immigration to Canada

In this video, we will learn more about the dataset that we will be using

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0:02 / 2:43

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Dataset on Immigration to Canada | Introduction to Matplotlib and Data Visualization

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DV0101EN - Dataset on Immigration to Canada 2:43

Dataset

- The Population Division of the United Nations compiled data pertaining to 45 countries.
- For each country, annual data on the flows of international migrants is reported in addition to other metadata.
- We will primarily work with a United Nations data on immigration to Canada.

the data set involving immigration to the great white north Here is a snapshot

0:34 / 2:43 Speed 1.0x HD ENG US 06/02/2021

DV0101EN - Dataset on Immigration to Canada 2:43

Immigration Data to Canada

United Nations
Population Division
Department of Economic and Social Affairs

International Migration Flows to and from Selected Countries: The 2015 Revision
POPDB/MIG/FlowRev.2015
December 2015 - Copyright © 2015 by United Nations. All rights reserved.
Suggested citation: United Nations, Department of Economic and Social Affairs, Population Division (2015). International Migration Flows to and from Selected Countries: The 2015 Revision. (United Nations database).

Reporting country: Canada
Criterion: Citizenship

Type	Coverage	Origin/destination	Major area	Region	Reg. RegName	Dev.	DevName	1990	1991	1992	1993	1994	1995
Immigrants	Foreigners	Afghanistan	935 Asia	5501	Southern Asia	902	Developing regions	16	39	39	47	71	340
Immigrants	Foreigners	Albania	908 Europe	620	Southern Europe	901	Developed regions	1	0	0	0	0	0
Immigrants	Foreigners	Algeria	912 Northern Africa	600	Northern Africa	80	Developing regions	71	69	63	44	44	44
Immigrants	Foreigners	American Samoa	909 Oceania	957	Polycentric	902	Developing regions	2	1	0	0	0	0
Immigrants	Foreigners	America	904 Europe	616	Southwest Europe	914	Developed regions	n/a	n/a	n/a	n/a	n/a	n/a

of the UN data on immigration to Canada in the form of an excel file. As you can

0:41 / 2:43 Speed 1.0x HD ENG US 06/02/2021

Dataset on Immigration to Canada

Introduction to Matplotlib and Data Visualization

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Read Data into Pandas Dataframe

```
import numpy as np # useful for many scientific computing in Python
import pandas as pd # primary data structure library
from __future__ import print_function # adds compatibility to python 2

# install xlrd
!pip install xlrd

print('xlrd installed!')

df_can = pd.read_excel(
    'https://ibm.box.com/shared/static/lwl90pt9zpy5bd1ptyg2awl5awomz9pu.xlsx',
    sheetname='Canada by Citizenship',
    skiprows=range(20),
    skip_footer = 2)
```

pandas function `read_excel` to read the data into a pandas dataframe.

1:51 / 2:43

Speed 1.0x HD ENG 00:40 US 06/02/2021

DV0101EN - Dataset on Immigration to Canada 2:43

Display Dataframe

```
df_can.head()
```

Type	Coverage	OdName	AREA	AreaName	REG	RegName	DEV	DevName	1980	...	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
0	Immigrants	Foreigners	Afghanistan	935	Asia	5501	Southern Asia	902	Developing regions	16	...	2978	3436	3009	2652	2111	1746	1758	2203	2635	2004
1	Immigrants	Foreigners	Albania	908	Europe	925	Southern Europe	901	Developed regions	1	...	1450	1223	856	702	560	716	561	539	620	603
2	Immigrants	Foreigners	Algeria	903	Africa	912	Northern Africa	902	Developing regions	80	...	3616	3626	4807	3623	4005	5393	4752	4325	3774	4331
3	Immigrants	Foreigners	American Samoa	909	Oceania	957	Polynesia	902	Developing regions	0	...	0	0	1	0	0	0	0	0	0	
4	Immigrants	Foreigners	Andorra	908	Europe	925	Southern Europe	901	Developed regions	0	...	0	0	1	1	0	0	0	0	1	

output. As you can see, the output of the head function looks correct with the

2:25 / 2:43

Speed 1.0x HD ENG 00:40 US 06/02/2021

Line Plots (3:41) | Line Plots x Introduction to Matplotlib and L x + https://courses.cognitiveclass.ai/courses/course-v1:CognitiveClass+DV0101EN+v1/courseware/407a9f86565c441897406996... Watch later Share

DV0101EN - Line Plots 3:41

Data Visualization with Python

Line Plots

In this video, things will start getting more exciting. We will generate our first

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Line Plots

A line plot is a type of plot which displays information as a series of data points called 'markers' connected by straight line segments.

Immigration from Haiti

Year	Number of immigrants
1980	~3800
1985	~1800
1990	~2200
1995	~2000
2000	~2500
2005	~1800
2010	~6000

this line plot? Before we go over the code to do that, let's do a quick recap

1:23 / 3:41 Speed 1.0x HD ENG US 06/02/2021

[Line Plots \(3:41\)](#) | [Line Plots](#) | [Introduction to Matplotlib and Data Visualization](#) | +

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Dataset - Recap

Type	Coverage	OdName	AREA	AreaName	REG	RegName	DEV	DevName	1980	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
0	Immigrants	Foreigners	Afghanistan	935	Asia	5501	Southern Asia	902	Developing regions	16	2978	3436	3009	2652	2111	1746	1758	2203	2635	2004
1	Immigrants	Foreigners	Albania	908	Europe	925	Southern Europe	901	Developed regions	1	1450	1223	856	702	560	716	561	539	620	603
2	Immigrants	Foreigners	Algeria	903	Africa	912	Northern Africa	902	Developing regions	80	3616	3626	4807	3623	4005	5393	4752	4325	3774	4331
3	Immigrants	Foreigners	American Samoa	909	Oceania	957	Polynesia	902	Developing regions	0	0	0	1	0	0	0	0	0	0	
4	Immigrants	Foreigners	Andorra	908	Europe	925	Southern Europe	901	Developed regions	0	0	0	1	1	0	0	0	0	1	

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this line plot? Before we go over the code to do that, let's do a quick recap

1:25 / 3:41

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[Line Plots \(3:41\)](#) | [Line Plots](#) | [Introduction to Matplotlib and Data Visualization](#) | +

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DV0101EN - Line Plots 3:41

Dataset - Processed

Country	Continent	Region	DevName	1980	1981	1982	1983	1984	1985	1986	...	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Afghanistan	Asia	Southern Asia	Developing regions	16	39	39	47	71	340	496	...	3436	3009	2652	2111	1746	1758	2203	2635	2004	58539
Albania	Europe	Southern Europe	Developed regions	1	0	0	0	0	0	1	...	1223	856	702	560	716	561	539	620	603	15699
Algeria	Africa	Northern Africa	Developing regions	80	67	71	69	63	44	69	...	3626	4807	3623	4005	5393	4752	4325	3774	4331	69439
American Samoa	Oceania	Polynesia	Developing regions	0	1	0	0	0	0	0	...	0	1	0	0	0	0	0	0	6	
Andorra	Europe	Southern Europe	Developed regions	0	0	0	0	0	0	2	...	0	1	1	0	0	0	0	1	1	15

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Now let's process the dataframe so that the country name becomes the index of

1:52 / 3:41

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Line Plots (3:41) | Line Plots | Introduction to Matplotlib and Data Visualization

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DV0101EN - Line Plots 3:41

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Creating Line Plots

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

years = list(map(str, range(1980, 2014)))
df_canada.loc['Haiti', years].plot(kind = 'line')
plt.title('Immigration from Haiti')
plt.ylabel('Number of immigrants')
plt.xlabel('Years')
plt.show()
```

Immigration from Haiti

Number of immigrants

Years

2010 Earthquake

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magic function %matplotlib with the inline backend. And there you have it: a

YouTube

3:19 / 3:41

Speed 1.0x HD

00:41 06/02/2021