

Unsupervised Machine Learning with Python

Section 2.0: Python Demos

Overview

Python Demos Overview

Section	Title	Description
		Jupyter Notebooks in UnsupervisedML/Examples/Section02
2.1	NumPy Basic Demo	Examples of basic numpy functionality
2.2	NumPy Matrix Operations Demo	Examples of matrix operations numpy functionality
2.3	Matplotlib Basic Demo	Examples of basic matplotlib plotting functionality
2.4	Matplotlib Advanced Demo	Examples of matplotlib scatter plot and animation functionality
2.5	Pandas Demo	Examples of pandas functionality for reading data from csv
2.6	sklearn Demo	Examples of generating datasets using sklearn

For links to additional resources see:

[UnsupervisedML/Resources/UnsupervisedML_Resources.pdf](#)

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Section 2.1: NumPy Basic Demo

NumPy

NumPy/Numpy/numpy is a Python package for scientific computing

- Key structure is multi-dimensional numpy array
- numpy functions manipulate these arrays
 - Can perform standard matrix and vector operations
 - Can perform operations on entire array without explicit looping
- Course codes use the numpy arrays for holding datasets and employ numpy functionality for clustering and dimension reduction algorithms
- See following site for details: <https://numpy.org/>

Key Numpy Commands and Functions

Operation	numpy functions
Array creation, indexing, and size	arange, array, size
Componentwise operations: addition, multiplication, scalar multiplication and broadcasting	
Functions	absolute, square
Finding entries	where
Concatenating and reshaping arrays	concatenate, reshape
Sum entries of array	sum
Maximum of entries	max, argmax
Creating array of zeros	zeros
Creating arrays of random numbers: setting seed, from uniform distribution, from normal distribution, generating random integers, choosing randomly from array	random.seed, random.rand, random.randn, random.randint, random.choice

2.1 Numpy Basic DEMO

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/NumpyBasic.ipynb

Course Resources at:

- <https://github.com/satishchandrareddy/UnsupervisedML/>

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Section 2.2: NumPy Matrix Operations Demo

Numpy Functions for Matrix Operations

Operation	numpy functions
Transpose	.T attribute
Flip matrix up/down or left/right	flipud, fliplr
Dot product	dot
Matrix multiplication	matmul
Matrix inverse	linalg.inv
Matrix determinant	linalg.det

2.2 Numpy Matrix Operations DEMO

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/NumpyMatrixOperations.ipynb

Course Resources at:

- <https://github.com/satishchandrareddy/UnsupervisedML/>

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Section 2.3: Matplotlib Basic Demo

Matplotlib Basic Demo

Matplotlib is a Python package for plotting

- See following site for details: <https://matplotlib.org>
- Matplotlib has Matlab-like interface
- This section has a demo of the basic plotting commands

Matplotlib Basics: Commands and Functions

Operation	matplotlib functions
Creation of figure and basic plotting of data and adding titles, labels, and legends	figure, plot, legend, title, xlabel, ylabel, show
Multiple plots	subplots
Object oriented approach	subplots

2.3 Matplotlib Basic DEMO

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/MatplotlibBasic.ipynb

Course Resources at:

- <https://github.com/satishchandrareddy/UnsupervisedML/>

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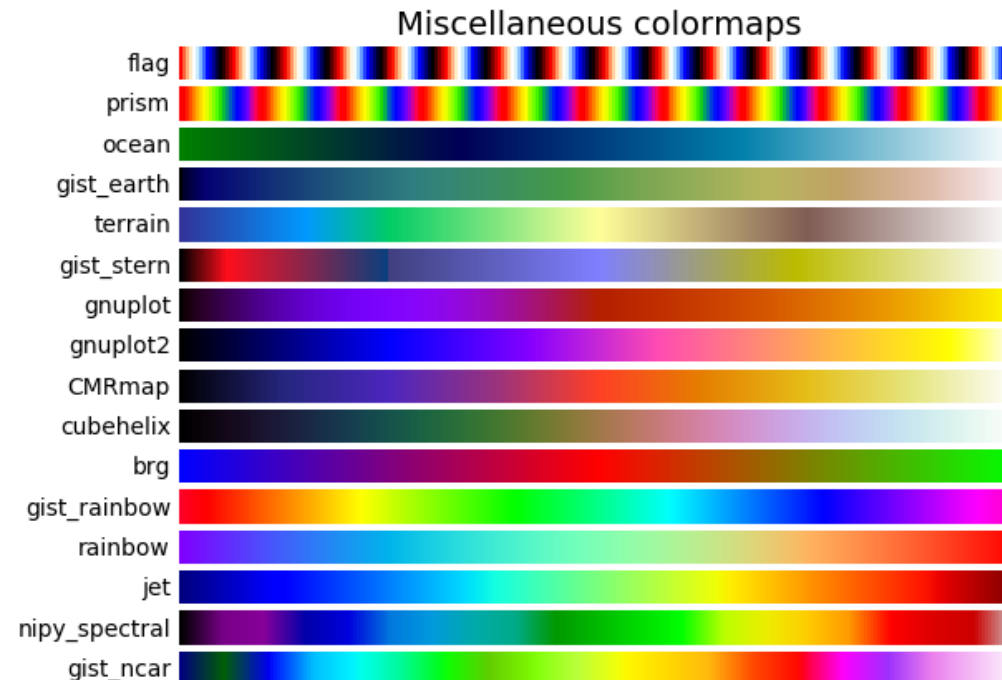
Section 2.4: Matplotlib Advanced Demo

Matplotlib Advanced: Commands and Functions

Operation	matplotlib functions
Colormesh useful for plotting images	pcolormesh
Scatter plot	scatter
Animation of scatter plot	Create a function to generate each frame of animation Use FuncAnimation to call function and create animation

Matplotlib Colormaps

- Load colormaps from matplotlib (examples shown below)
- Can choose color using `cm.name(value)`
 - name: is colormap name (flag, prism, ocean, etc)
 - Value is in $[0,1]$ – 0 gives color on left and 1 gives color on right



Creating MP4 Files from Matplotlib Animations

- ffmpeg used to convert matplotlib animations into mp4 files
- Many online tutorials describing how to install ffmpeg
 - See Chapter 2 of resources file for links
- ffmpeg is not required for this course (this information is provided to those who may be interested)

2.4 Matplotlib Advanced DEMO

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/MatplotlibAdvanced.ipynb

Course Resources at:

- <https://github.com/satishchandrareddy/UnsupervisedML/>

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Section 2.5: Pandas Demo

Pandas Demo

Pandas is a Python package containing data structures and analysis tools

- We will use pandas functions for reading/processing data from csv files for clustering for real-world examples
- Key structure is dataframe
- See following site for details: <https://pandas.pydata.org/>

Reading From CSV

	A	B	C	D
1	label	feature 1	feature 2	
2	0.123	0.715279	-1.5454	
3	1.23	0.5	-0.72009	
4	-1.45	0.5	0.004291	
5	0.51	0.433026	1.203037	
6				
7				

- Typically csv file has columns of data with headings
- Pandas reads data and puts into dataframe structure
- Can manipulate data by referring to column name

Key Pandas Commands and Functions

Operation	pandas functions
Read data from csv file and put into data frame	<code>pandas.read_csv</code>
List items in dataframe	<code>pandas.head()</code> , <code>pandas.tail()</code>
Extract column from dataframe	
Remove column from dataframe	<code>pandas.drop()</code>
Extract data from dataframe in form of numpy array	<code>pandas.values</code>

2.5 Pandas DEMO

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/Pandas.ipynb

Course Resources at:

- <https://github.com/satishchandrareddy/UnsupervisedML/>

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Section 2.6: sklearn Datasets Demo

sklearn Datasets Demo

- sklearn is shortened version of name of package scikit-learn
- sklearn is a package for machine learning
- Demo shows how to create datasets for testing clustering algorithms
- See following sites for details

https://scikit-learn.org/stable/modules/generated/sklearn.datasets.make_blobs.html

https://scikit-learn.org/stable/modules/generated/sklearn.datasets.make_moons.html

https://scikit-learn.org/stable/modules/generated/sklearn.datasets.make_circles.html

Links in Section 2 of UnsupervisedML_Resources.pdf

2.6 sklearn DEMO

Jupyter Notebook for DEMO

- UnsupervisedML/Examples/Section02/sklearnDatasets.ipynb

Course Resources at:

- <https://github.com/satishchandrareddy/UnsupervisedML/>