Unsupervised Learning

Section 2: Python Demos

Python Demos

Section	Title	Description
2.1	NumPy Basic Demo	Numpy array is basic building block used to hold data. This section covers the basic numpy functions to be used in the course.
2.2	Numpy Matrix Operations Demo	This section covers additional numpy functionality related to matrix operations
2.3	Matplotlib Basic Demo	Covers the basic matplotlib plotting functions
2.4	Matplotlib Animation Demo	Covers how to create animations using matplotlib functions
2.5	Pandas Demo	Covers how to use the basic pandas commands to read data from file and perform basic manipulations
2.6	sklearn Demo	Demo of generating datasets using sklearn

Section 2.1: NumPy Basic Demo

NumPy Demo

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

- Key object 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 numpy array as fundamental building block
- See following site for details: https://numpy.org/

Key Numpy Commands and Functions

Operation	numpy functions
Array creation	numpy.array()
Array indexing	
Component-wise operations: addition, multiplication, scalar multiplication and broadcasting	Addition, pointwise multiplication, scalar multiplication
Functions	numpy.exp(), numpy.absolute(), numpy.square()
Sum entries of array and take mean of entries in array	numpy.sum(), numpy.mean()
Array of random numbers: setting seed, from uniform distribution, from normal distribution	numpy.random.seed(), numpy.random.rand(), numpy.random.randn()
Array of zeros	numpy.zeros()

2.1 Numpy DEMO Basic

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/NumpyBasic.ipynb

Course Resources at:

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

Section 2.2: NumPy Matrix Operations Demo

Numpy Functions for Matrix Operations

Operation	numpy functions
Dot product	numpy.dot()
Matrix multiplication	numpy.matmul()
Matrix inverse	numpy.linalg.inv()
Matrix determinant	numpy.linalg.det()

2.2 Numpy DEMO Matrix Operations

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/NumpyMatrixOperations.ipynb

Course Resources at:

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

Section 2.3: Matplotlib Basic Demo

Matplotlib Basic Demo

Matplotlib is a Python package for plotting

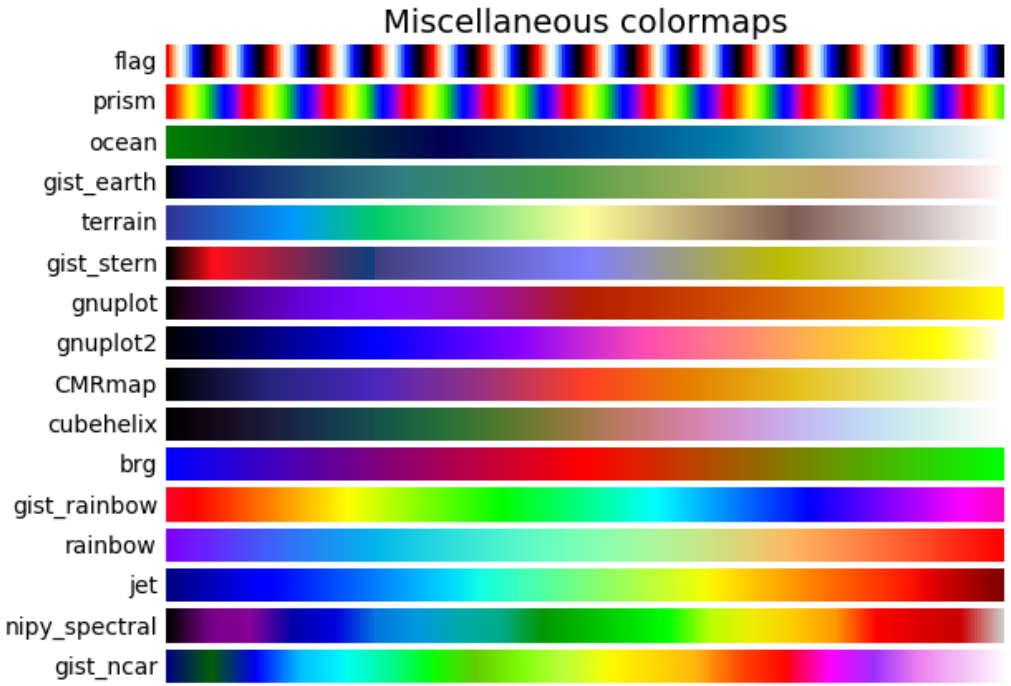
- See following site for details: https://matplotlib.org
- Matplotlib has Matlab-like interface
- This section has a demo of the basic plotting commands

Matplotlib Basics: Commands and Functions

Operation	matplotlib functions
Basic plotting using lists and numpy arrays and adding legends	figure(),plot(), legend(), title(), xlabel(), ylabel(),show()
Multiple plots	subplot()
Object oriented approach	
Scatter plots	scatter()

Matplotlib Basics: 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



2.3 Matplotlib DEMO Basic

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/MatplotlibBasic.ipynb

Course Resources at:

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

Section 2.4: Matplotlib Animation Demo

Matplotlib Animation: Commands and Functions

Function	Notes
ArtistAnimation	Pre-generate a list of frames each containing artist (curves, text, etc) Use ArtistAnimation function to create animation of the frames
FuncAnimation	Create a function to generate each frame of animation Use FuncAnimation to call function and create animation

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 link
- ffmpeg is not required for this course (this information is provided to those who may be interested)

2.4 Matplotlib DEMO Animation

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/MatplotlibAnimation.ipynb

Course Resources at:

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

Section 2.5: Pandas Demo

Pandas Demo

Pandas is a Python package containing data structures and analysis tools

- Will use pandas functions to read data from csv file and process data for applications
- Key structure is data frame
- 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/names
- Pandas reads data and puts into dataframe structure
- Use column names to choose which data to manipulate

Key Pandas Commands and Functions

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

2.5 Pandas DEMO

Jupyter Notebook for demo:

- UnsupervisedML/Examples/Section02/Pandas.ipynb

Course Resources at:

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

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
- Will use for generating datasets for clustering
- See following site for details: https://scikit-learn.org/stable/index.html

2.6 sklearn DEMO

Jupyter Notebook for DEMO

- UnsupervisedML/Examples/Section02/sklearnDatasets.ipynb

Course Resources at:

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