# 3. Deep Learning tools

## 3.5 Scikit-learn

Manel Martínez-Ramón
Meenu Ajith
Aswathy Rajendra Kurup

# Introduction

- Scikit-learn is a free machine learning library in Python developed by David Cournapeau as a Google Summer of Code project in 2007.
- It has various features for pre-processing, model selection, classification, clustering, regression and dimensionality reduction.
- It is built on top of NumPy, SciPy and Matplotlib.

# The Scikit-Learn API

- The API has three interfaces that do most of the ML tasks. It also has pre-built algorithms.

  **Estimator:** It uses the *fit()* method to train the machine learning model. All regression, classification or unsupervised tasks use the estimator interface.
  **Predictor** It uses the *predict()* method to make predictions on test features. A single *fit_predict()* method can be used.
  **Transformer** The *transform()* method provides a library of transformations for data preprocessing, dimensionality reduction, feature extraction, and feature selection. The *fit_transform()* models and transforms the training data simultaneously.

# Datasets

- Toy examples, real data and data generators can be used with the library.
- Here are some examples:

```
#LOADING THE TOY DATSET
from sklearn import datasets
data = datasets.load_wine() #Load the wine dataset.
#LOADING REAL-WORLD DATASET
from sklearn.datasets import fetch_california_housing
house_data = fetch_california_housing() # A housing dataset.

#LOADING GENERATED DATASET
from sklearn.datasets import make_blobs
#Develop isotropic Gaussian blobs for clustering.
X, y = make_blobs(n_samples=60, centers=3, n_features=3,
    random_state=0)
```

# Making blobs

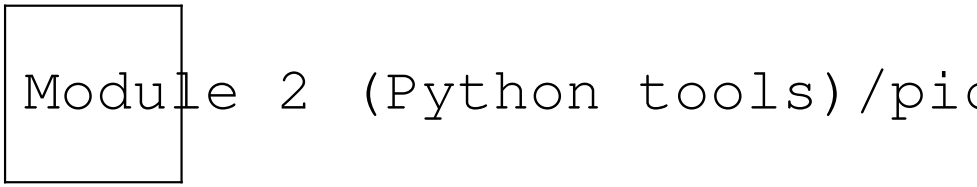
```
1 from sklearn.datasets import make_blobs
2 X, y = make_blobs(n_samples=200, centers=3, n_features=2,
      random_state=0)
```

---

```
1 string=['*r','+k','ob']
2 for j in range(3):
3   ind = np.where(y==j)
4   plt.plot(X[ind,0],X[ind,1],
      string[j])
```

```
5 plt.show()
```

---



# Preprocessing

| **Methods** | **Functions** |
|---|---|
| Standardization | StandardScaler()-Zero mean, unit var.<br>MinMaxScaler()- Between $a$ and $b$. |
| Normalization | Normalizer()-unit norm. |
| Imputing values | SimpleImputer()- Fills up missing values<br>Mean, most frequent, median, constant. |
| Polynomial Features | PolynomialFeatures()- Adds complexity<br>by generating polynomial features. |
| Categorical Features | OneHotEncoder()- Categorical encoding.<br>OrdinalEncoding()- Encodes unique cats. |
| Numerical Features | KBinsDiscretizer()- Real to discrete bins.<br>Binarizer()- Thresholds numerical features. |
| Custom Transformers | FunctionTransformers()- Accepts an existing<br>function and uses it to transform the data. |

Table: Data preprocessing methods and functions

# Preprocessing

- A preprocessing example that does data imputation

```
1 #IMPUTING VALUES
2 import numpy as np
3 from sklearn.impute import SimpleImputer
4 arr3 = np.array([[np.nan, 2, 8, np.nan], [6, np.nan, np.nan,
      12], [7, 6, 4, np.nan]]) #define an array.
5 print("Original array:",arr3)
6 im = SimpleImputer(missing_values=np.nan, strategy='median') #
      define the preprocessing module.
7 arr_im = im.fit_transform(arr3) #fills the missing data.
8 print("Array after imputing values:",arr_im)
```

```
Original array: [[nan  2.  8. nan]
 [ 6. nan nan 12.]
 [ 7.  6.  4. nan]]
Array after imputing values: [[ 6.5  2.   8.  12. ]
 [ 6.   4.   6.  12. ]
 [ 7.   6.   4.  12. ]]
```

# Feature selection and machine learning

- **Feature selection:** Scikit-learn provides several feature selection algorithms. The most widely used methods are Recursive Feature Elimination (RFE) and SelectKBest.
- **Learning models:**
  - **Supervised:** The most commonly used supervised learning method includes linear models such as Linear regression, Logistic regression, Ridge regression, Lasso regression , Decision trees, Naive Bayes Classifier, Support Vector Machines, Random Forests, and others;
  - **Unsupervised:** Isomap, t-SNE, K-Means, Gaussian Mixture Models.
- Examples are provided in separate Jupyter notebooks.