THE OXFORD COLLEGE OF ENGINEERING

Hosur Road, Bommanahalli, Bangalore-560068.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

LABORATORY MANUAL [2021 SCHEME]

SUBJECT NAME & CODE:	**DATA SCIENCE AND ITS APPLICATIONS**
SCHEME-B.E(AIML)	**: 2021 SCHEME**
SEMESTER	**:VI**
FACULTY INCHARGE	**: RASHMI PARUTI, ASST.PROF, TOCE**

Vision of the Institute:

“To be a Respected and Most Sought after Engineering Educational Institution Engaged in Equipping Individuals capable of Building Learning Organizations in the New Millennium”.

Mission of the Institute:

Our Mission is to develop Competent Students with good value Systems and Face Challenges of the Continuously Changing World.

Vision of the Department:

“To Create Technocrats with Cognitive Skills and Technical Proficiency to Succeed in the Challenging World of New Era”.

Mission of the Department:

MD 1	**To Produce outstanding Artificial Engineering Professionals with cognitive skills.**
MD 2	**To Enrich the students’ skill set by continuous learning and research capabilities with vibrant ambience.**
MD 3	**To empower students with Technical Proficiency, Competency and Ethicalness for the new Era.**

Program Educational Objectives (PEOs)

PEO 1	***To* Empower *graduates with* cognitive skills *to lead their professional career in Reputed Industries and Solve Problems by Applying the Principles of Mathematics, Artificial Intelligence and Machine Learning, Scientific Investigations using the Latest Technologies through the opportunities of Artificial Intelligence & Machine Learning.***
PEO 2	***To* Enrich *the graduates by engaging them in research area of Artificial Intelligence & Machine Learning and empower them to work in scientific environment.***
PEO 3	***To create graduates with Professional Advancement, Communication Skills, Life Long Learning Process, Ethical Attitude, Social Responsibility, Team Work, Project Management and Leadership Skills Through Continuing Education.***

Program Specific Outcomes (PSOs)

PSO 1	***Use appropriate Techniques and Tools in application design with a knowledge of Computer Science, Networking, Software Engineering, Programs, Projects, Design of new Algorithms, Artificial Intelligence and Machine Learning Systems for Solving Complex Engineering Problems.***
PSO 2	***Inculcate the ability to work with Professional Ethics, Communication Skills, Team Work, Exchange of Innovative Ideas to Carryout Lifelong Learning with the state of art technologies and development.***

PROGRAM OUTCOMES

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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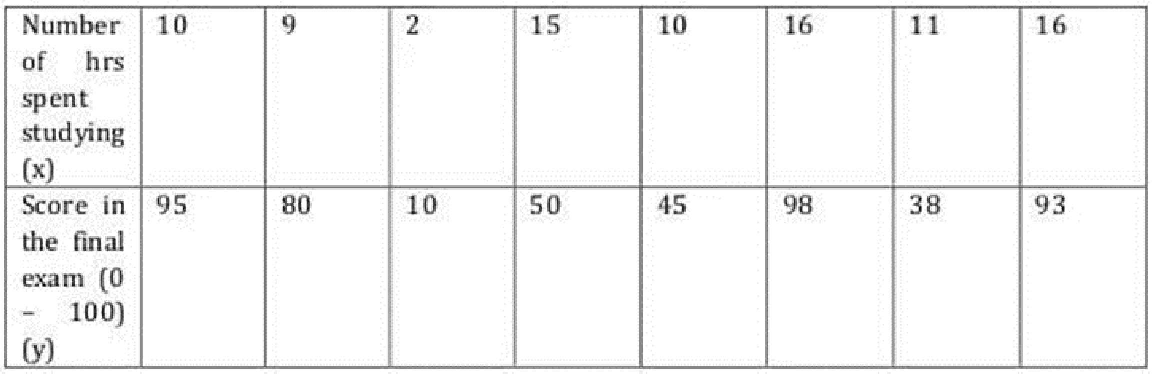
S.NO | EXPERIMENTS | PAGE NO

1.

1. Installation of Python/R language, Visual Studio code editors can be demonstrated along with Kaggle data set usage.
2. Write programs in Python/R and Execute them in either Visual Studio Code or PyCharm Community Edition or any other suitable environment.
3. A study was conducted to understand the effect of number of hours the students spent studying on their performance in the final exams. Write a code to plot line chart with number of hours spent studying on x-axis and score in final exam on y- axis. Use a red '*' as the point character, label the axes and give the plot a title.



Number of hrs spent studying (x)	10	9	2	15	10	16	11	16
Score in the final exam (0 – 100) (y)	95	80	10	50	45	98	38	93

4. For the given dataset mtcars.csv (www.kaggle.com/ruiromanini/mtcars), plot a histogram to check the frequency distribution of the variable 'mpg' (Miles per gallon)

1

2.

1. Consider the books dataset BL-Flickr-Images-Book.csv from Kaggle (https://www.kaggle.com/adeyoyintemidayo/publication-of-books) which contains information about books. Write a program to demonstrate the following.

· Import the data into a DataFrame

· Find and drop the columns which are irrelevant for the book information.

· Change the Index of the DataFrame

· Tidy up fields in the data such as date of publication with the help of simple regular expression.

· Combine str methods with NumPy to clean columns

10

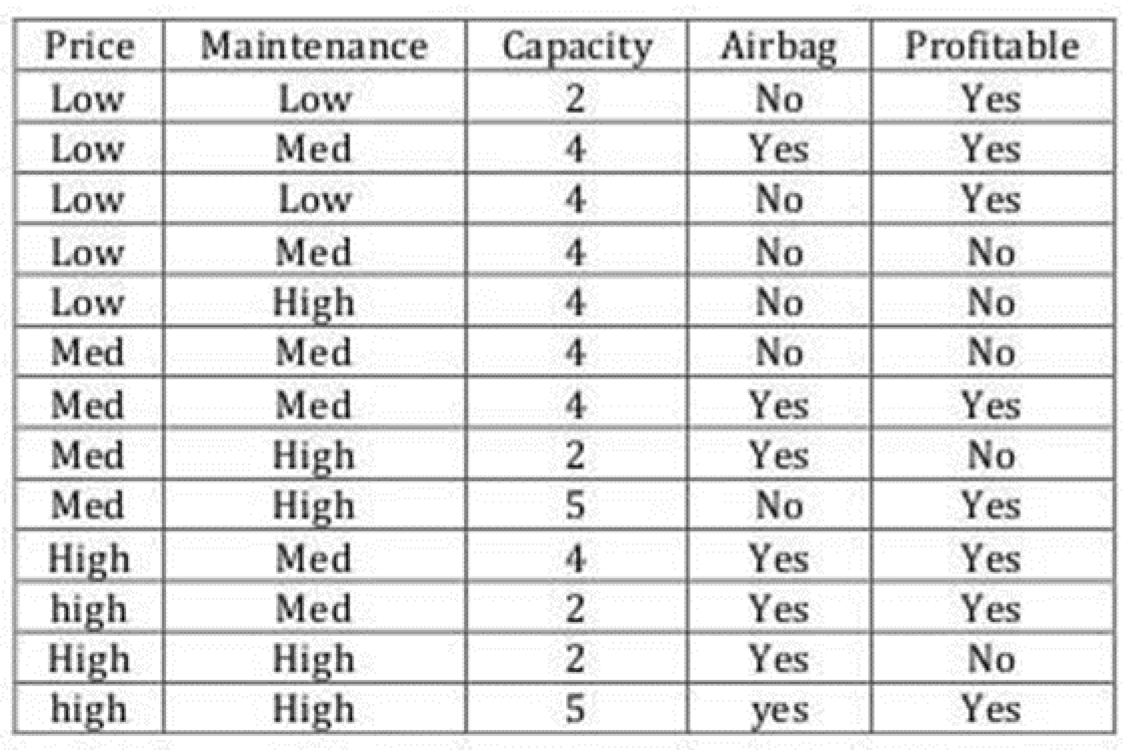
3.

1. Train a regularized logistic regression classifier on the iris dataset (https://archive.ics.uci.edu/ml/machine-learning-databases/iris/ or the inbuilt iris dataset) using sklearn. Train the model with the following hyperparameter C = 1e4 and report the best classification accuracy.
2. Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyperparameters. Train model with the following set of hyperparameters RBFkernel, gamma=0.5, one-vs-rest classifier, no-feature- normalization. Also try C=0.01,1,10C=0.01,1,10. For the above set of hyperparameters, find the best classification accuracy along with total number of support vectors on the test data

14

4.

1. Consider the following dataset. Write a program to demonstrate the working of the decision tree based ID3 algorithm.



Price	Maintenance	Capacity	Airbag	Profitable
Low	Low	2	No	Yes
Low	Med	4	Yes	Yes
Low	Low	4	No	Yes
Low	Med	4	No	No
Low	High	4	No	No
Med	Med	4	No	No
Med	Med	4	Yes	Yes
Med	High	2	Yes	No
Med	High	5	No	Yes
High	Med	4	Yes	Yes
high	Med	2	Yes	Yes
High	High	2	Yes	No
high	High	5	yes	Yes

2. Consider the dataset spiral.txt (https://bit.ly/2Lm75Ly). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods:

- K – means Clustering
- Single – link Hierarchical Clustering
- Complete link hierarchical clustering.
- Also visualize the dataset and which algorithm will be able to recover the true clusters.

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5.

1. Mini Project – Simple web scrapping in social media

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II **SAMPLE VIVA QUESTIONS AND ANSWERS** **41-44**

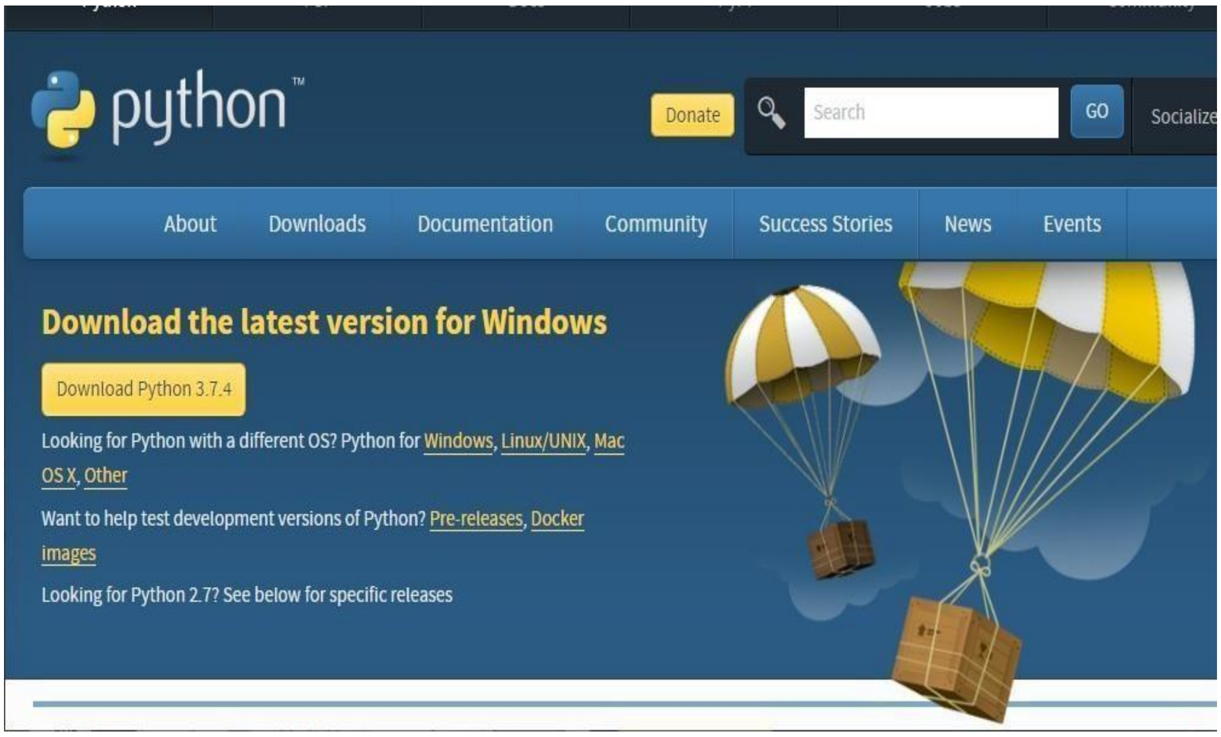
Introduction to Python

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting language to connect existing components together. Python is simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Python Installation

Download Python Interpreter

Go to the Python downloads page and select the version foryour operating system (Windows, Mac, Linux)



Download the latest version for Windows

Looking for Python with a different OS? Python for Windows, Linux/UNIX, Mac OS X, Other

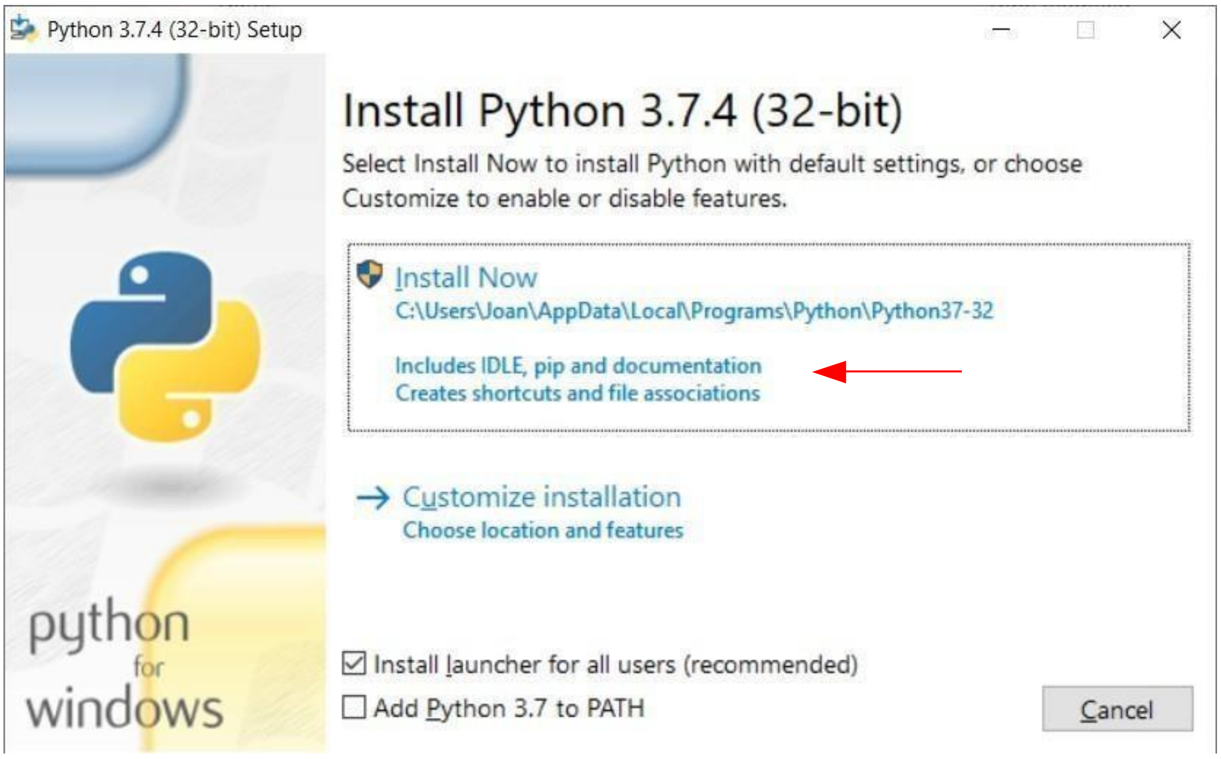
Want to help test development versions of Python? Pre-releases, Docker images

Looking for Python 2.7? See below for specific releases

Install Python Interpreter

- Select the downloaded file to start the installation.
- Important! Remember the directory where Python is installed

- 'Install Now' picks a default directory
- 'Customize installation' lets you specify the directory location



Python 3.7.4 (32-bit) Setup

Install Python 3.7.4 (32-bit)

Select Install Now to install Python with default settings, or choose Customize to enable or disable features.

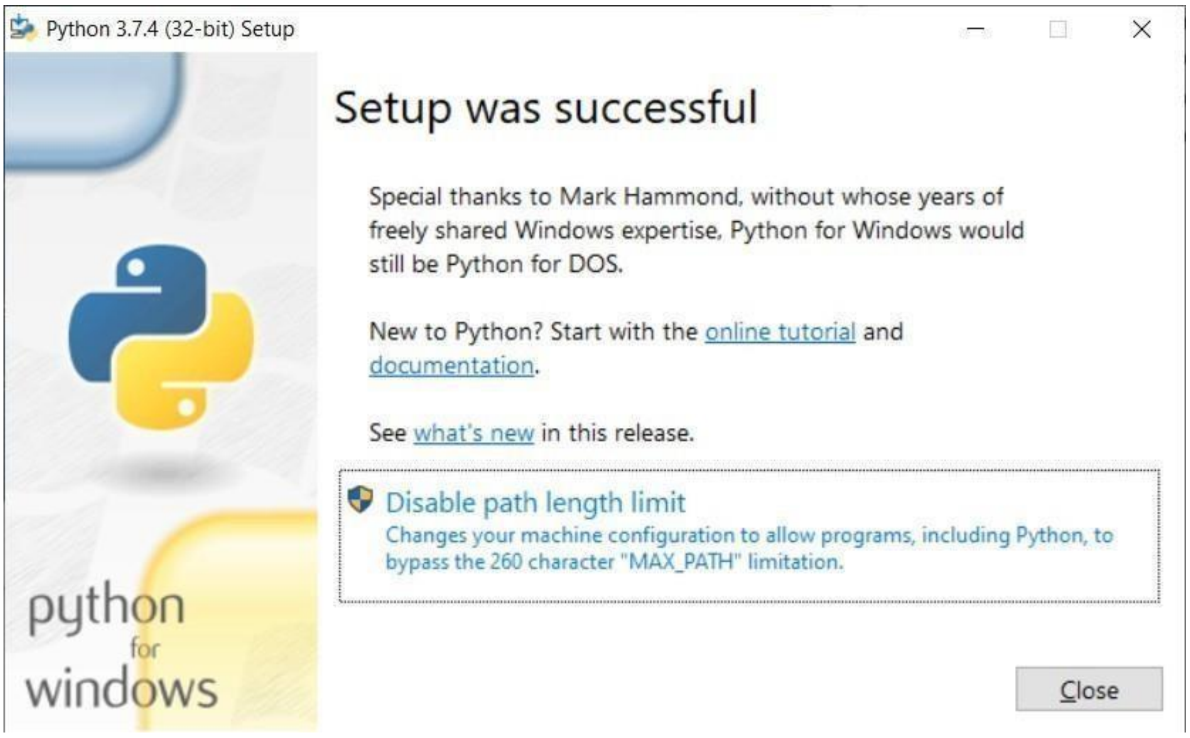
Install Now
C:\Users\Joan\AppData\Local\Programs\Python\Python37-32

Includes IDLE, pip and documentation
Creates shortcuts and file associations

Customize installation
Choose location and features

☑ Install launcher for all users (recommended)
☐ Add Python 3.7 to PATH

If installation is successful, you should see this message



Python 3.7.4 (32-bit) Setup

Setup was successful

Special thanks to Mark Hammond, without whose years of freely shared Windows expertise, Python for Windows would still be Python for DOS.

New to Python? Start with the online tutorial and documentation.

See what's new in this release.

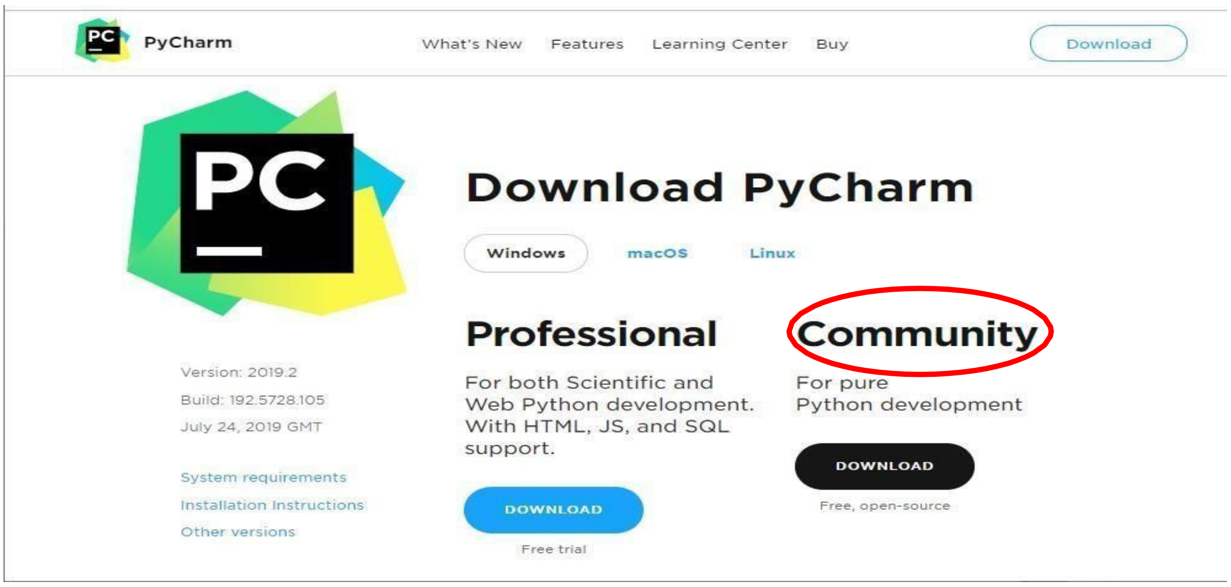
Disable path length limit
Changes your machine configuration to allow programs, including Python, to bypass the 260 character "MAX_PATH" limitation.

Introduction to PyCharm

PyCharm is an integrated development environment (IDE) used for programming in Python. It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems, and supports web development with Django. PyCharm is developed by the Czech company JetBrains.

PyCharm IDE Installation

Go to PyCharm download page and select the FREECommunity Edition



PyCharm What's New Features Learning Center Buy Download

Download PyCharm

Windows macOS Linux

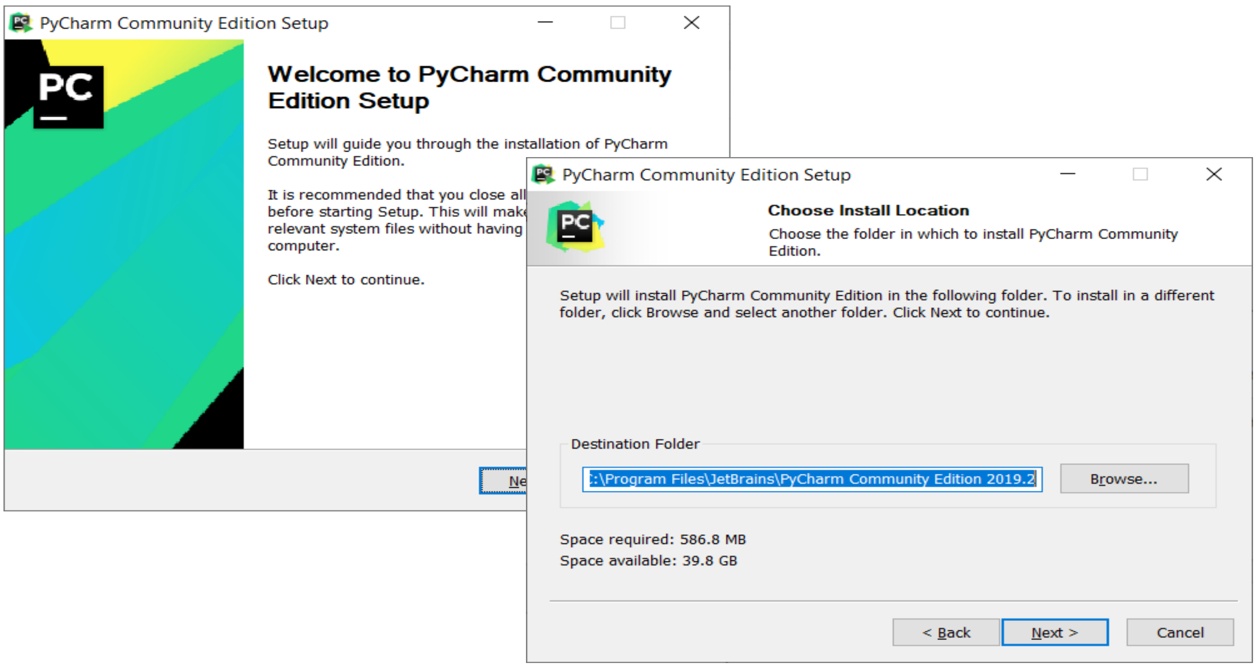
Version: 2019.2
Build: 192.5728.105
July 24, 2019 GMT

System requirements
Installation Instructions
Other versions

Professional
For both Scientific and Web Python development. With HTML, JS, and SQL support.
DOWNLOAD
Free trial

Community
For pure Python development
DOWNLOAD
Free, open-source

Run the installation program



PyCharm Community Edition Setup

Welcome to PyCharm Community Edition Setup

Setup will guide you through the installation of PyCharm Community Edition.

It is recommended that you close all before starting Setup. This will make relevant system files without having computer.

Click Next to continue.

PyCharm Community Edition Setup

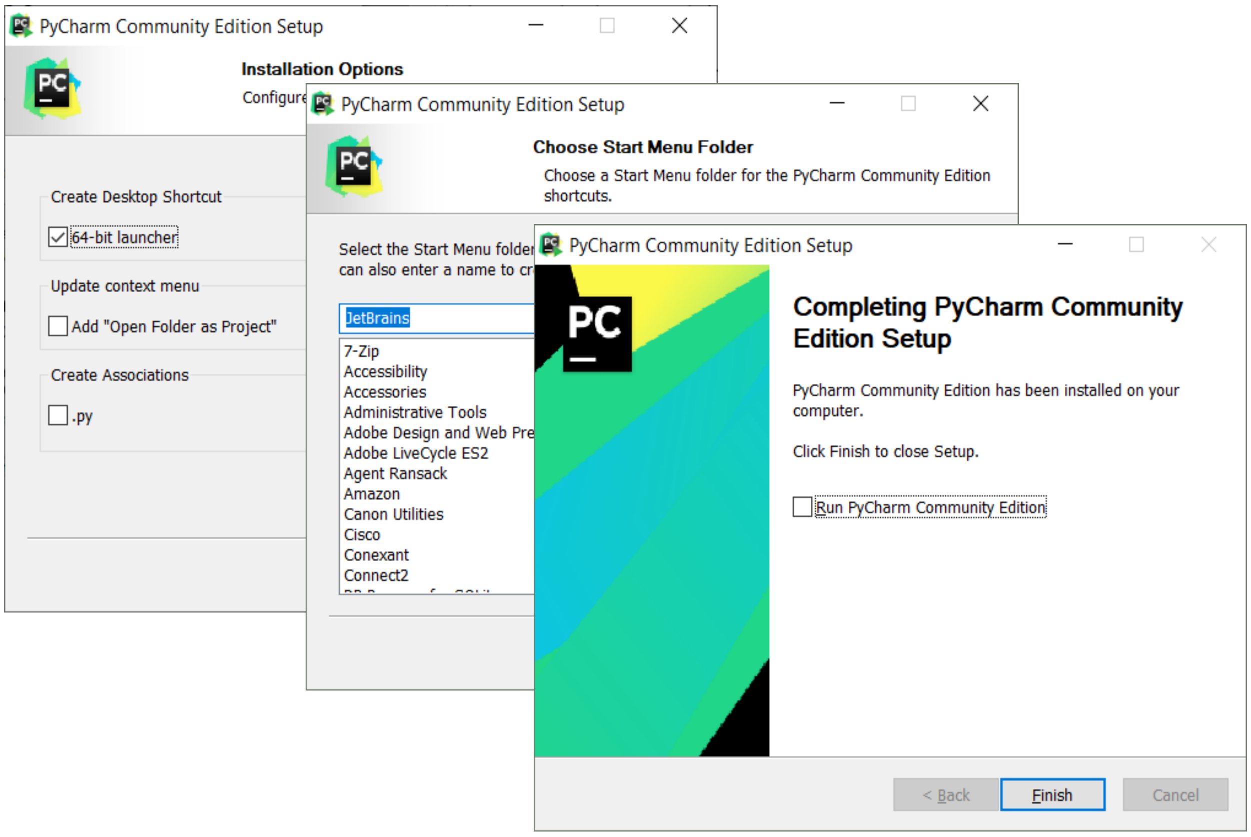
Choose Install Location
Choose the folder in which to install PyCharm Community Edition.

Setup will install PyCharm Community Edition in the following folder. To install in a different folder, click Browse and select another folder. Click Next to continue.

Destination Folder
:\Program Files\JetBrains\PyCharm Community Edition 2019.2
Browse...

Space required: 586.8 MB
Space available: 39.8 GB

< Back Next > Cancel


PyCharm Community Edition Setup

Installation Options

Configure

Create Desktop Shortcut

☑ 64-bit launcher

Update context menu

☐ Add "Open Folder as Project"

Create Associations

☐ .py

PyCharm Community Edition Setup

Choose Start Menu Folder

Choose a Start Menu folder for the PyCharm Community Edition shortcuts.

Select the Start Menu folder
can also enter a name to cr

JetBrains

7-Zip
Accessibility
Accessories
Administrative Tools
Adobe Design and Web Pre
Adobe LiveCycle ES2
Agent Ransack
Amazon
Canon Utilities
Cisco
Conexant
Connect2

PyCharm Community Edition Setup

Completing PyCharm Community Edition Setup

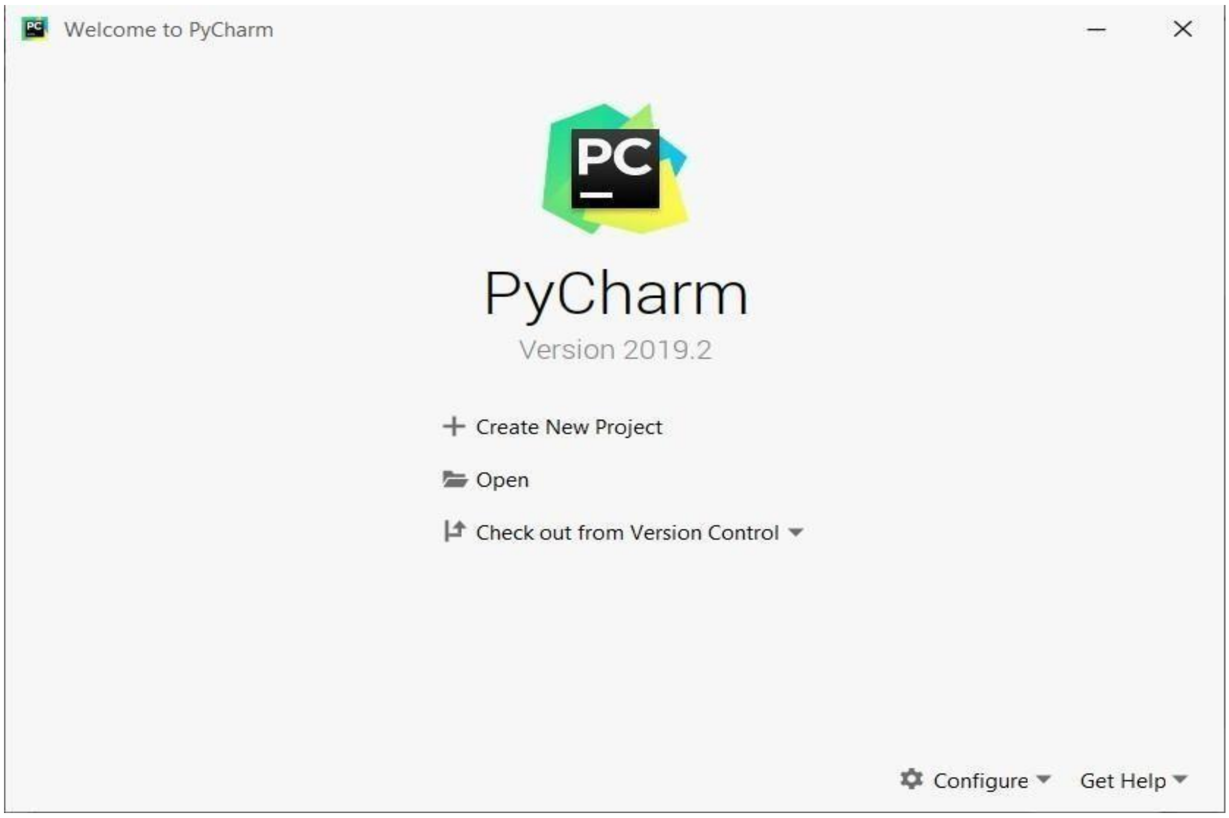
PyCharm Community Edition has been installed on your computer.

Click Finish to close Setup.

☐ Run PyCharm Community Edition

< Back | Finish | Cancel

Using PyCharm: Create a project


Welcome to PyCharm

PyCharm

Version 2019.2

+ Create New Project

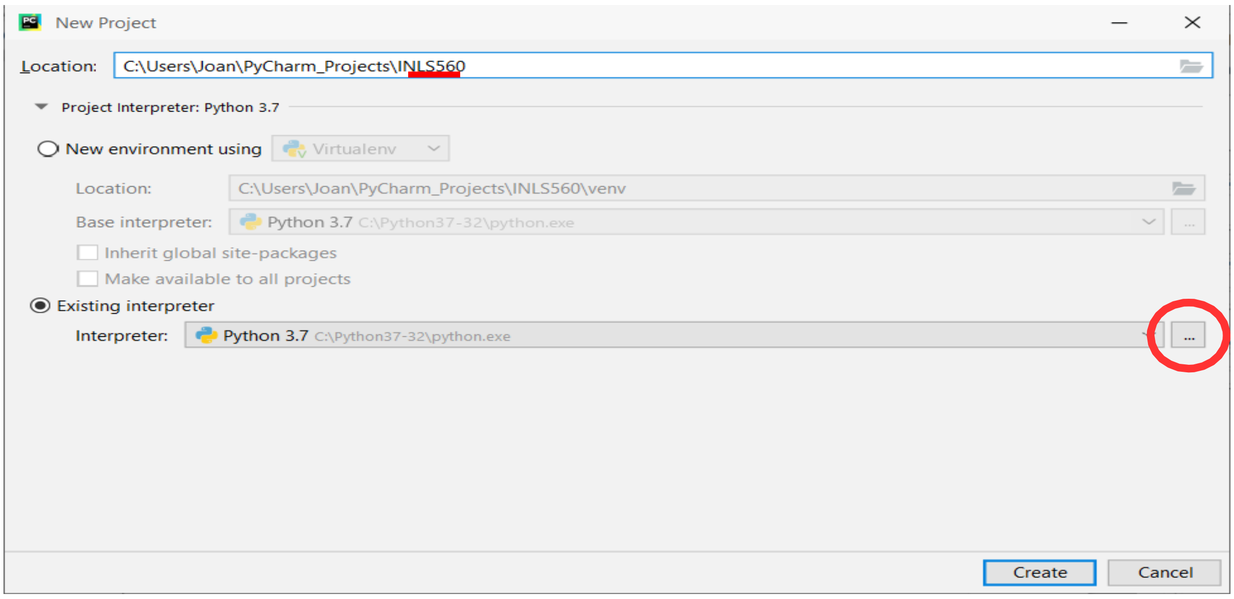
Open

Check out from Version Control

Configure

Get Help

- First, using File Explorer (Windows), or Finder (Mac), create a directory foryour projects, e.g., *PyCharm_Projects*
- Name your project, e.g., *INLS560*
- Specify the Python Interpreter you will use for your projects


New Project

Location: C:\Users\Joan\PyCharm_Projects\INLS560

Project Interpreter: Python 3.7

New environment using Virtualenv

Location: C:\Users\Joan\PyCharm_Projects\INLS560\venv

Base interpreter: Python 3.7 C:\Python37-32\python.exe

Inherit global site-packages

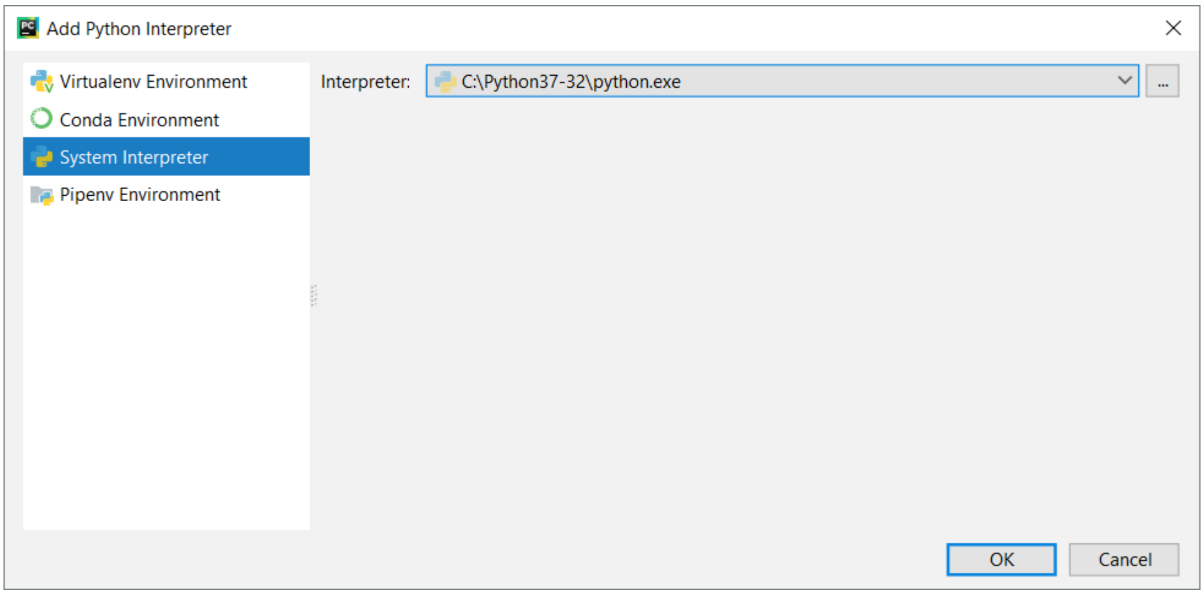
Make available to all projects

Existing interpreter

Interpreter: Python 3.7 C:\Python37-32\python.exe

Specify the Python interpreter to use

- Select System Interpreter
- Ensure that the Interpreter field refers to the Python interpreter that you just installed. Click OK.


Add Python Interpreter

Virtualenv Environment

Conda Environment

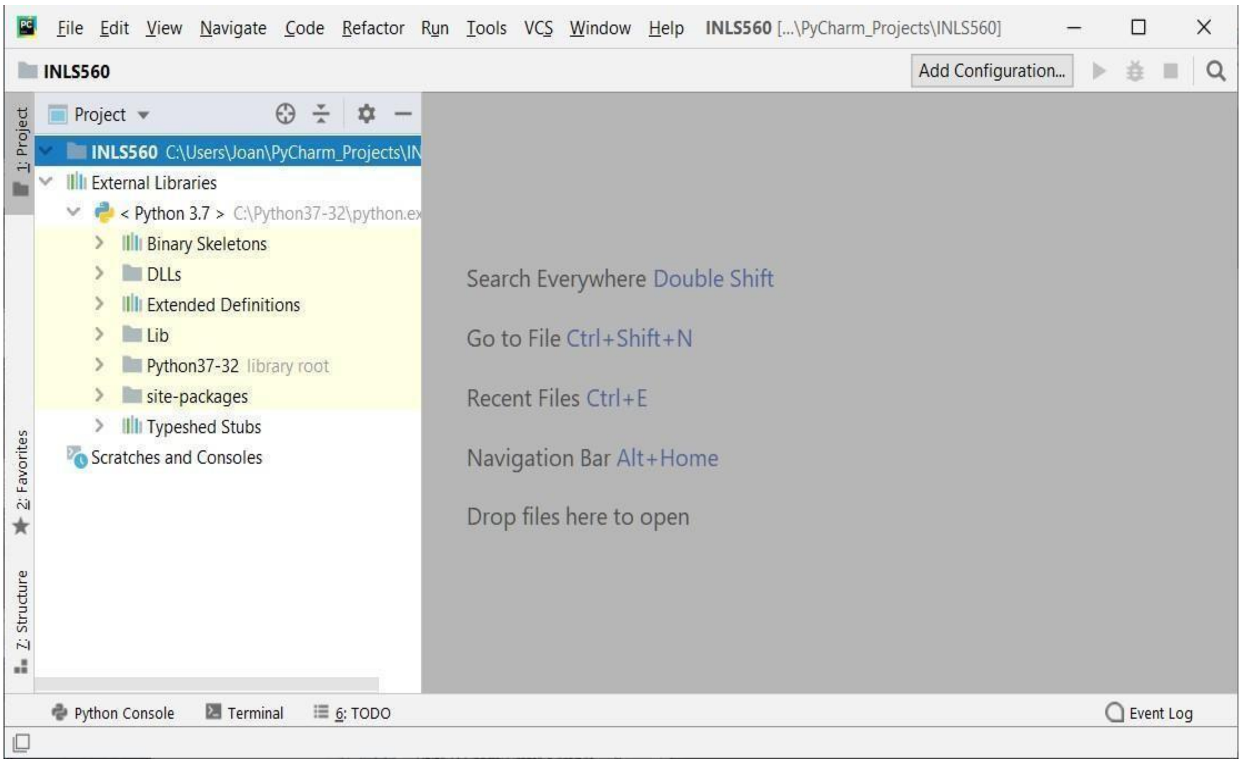
System Interpreter

Pipenv Environment

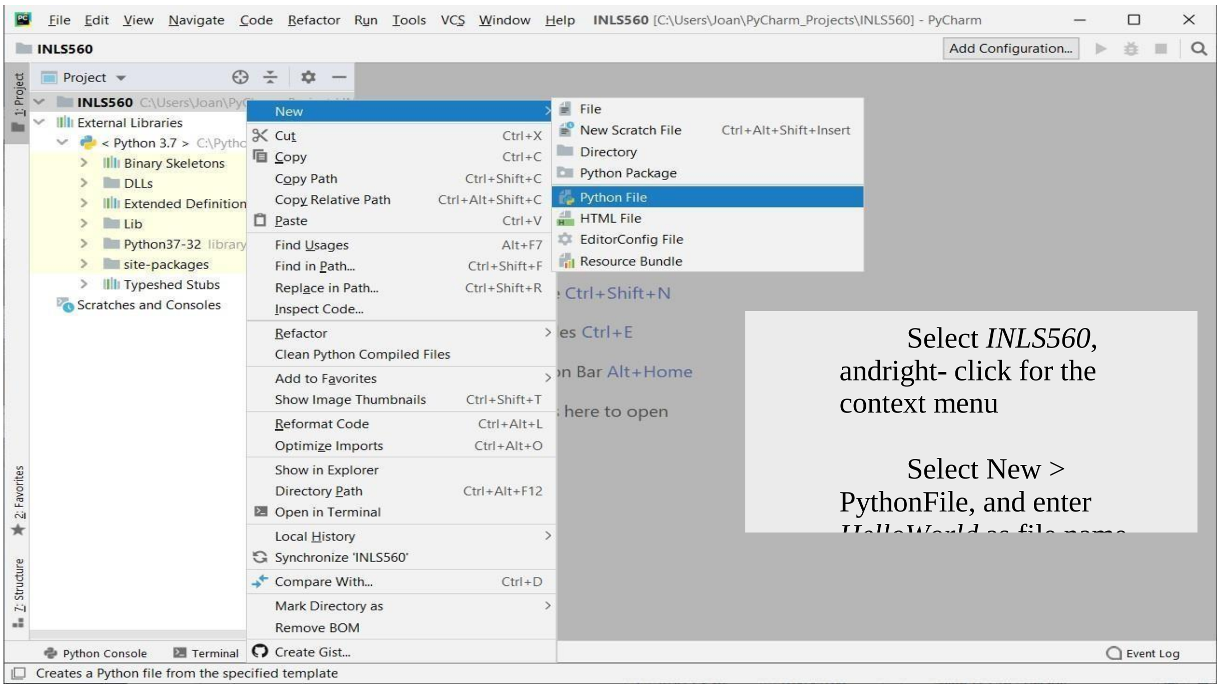
Interpreter: C:\Python37-32\python.exe

Initial project structure for *INLS560*

- Folder for your project
- Folder with External Libraries



Create a Python Program

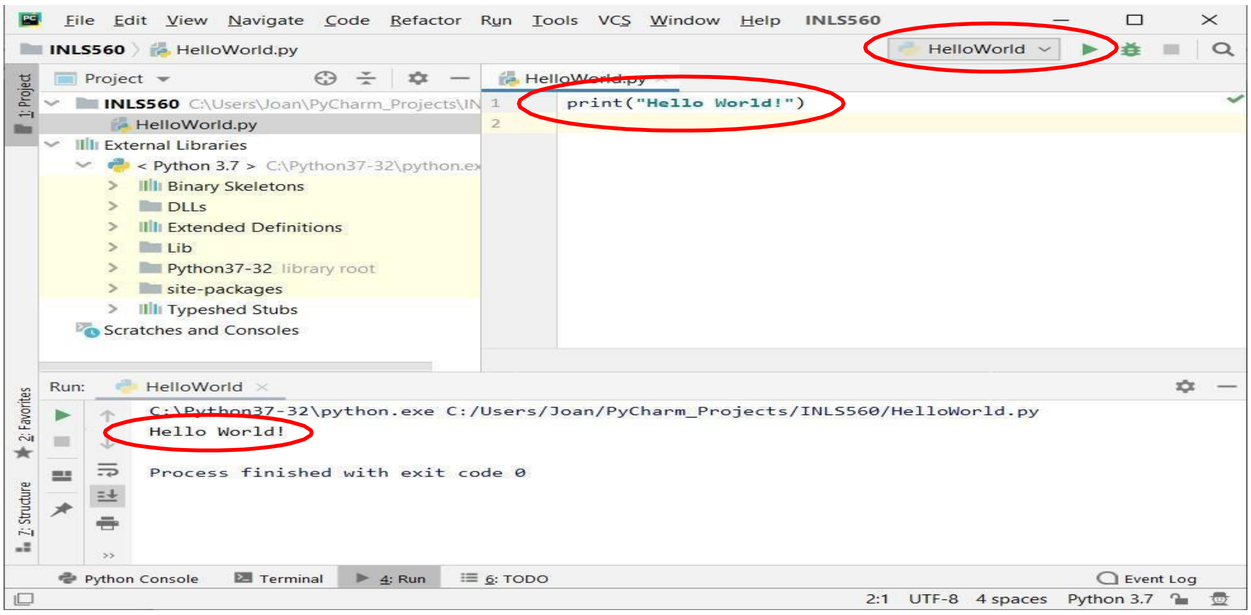


Select *INLS560*, andright- click for the context menu

Select New > PythonFile, and enter

Create and run your program

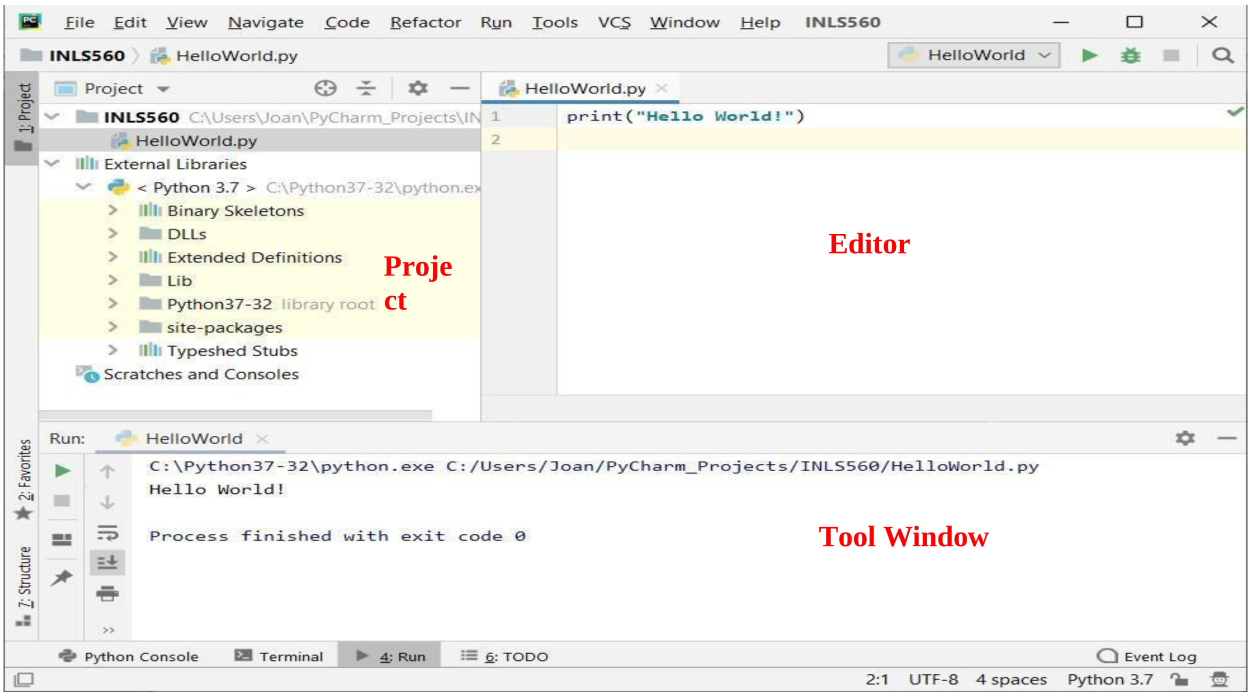
- Enter **print(“Hello World!”)**in the Editor
- Select **HelloWorld.py**and select Run from context menu; or, select Run icon
- Output is displayed in the Run Window in the bottom pane



```
print("Hello World!")
```

```
C:\Python37-32\python.exe C:/Users/Joan/PyCharm_Projects/INLS560/HelloWorld.py
Hello World!

Process finished with exit code 0
```

Default Window Layout



```
print("Hello World!")
```

```
C:\Python37-32\python.exe C:/Users/Joan/PyCharm_Projects/INLS560/HelloWorld.py
Hello World!

Process finished with exit code 0
```

EXPERIMENT -1

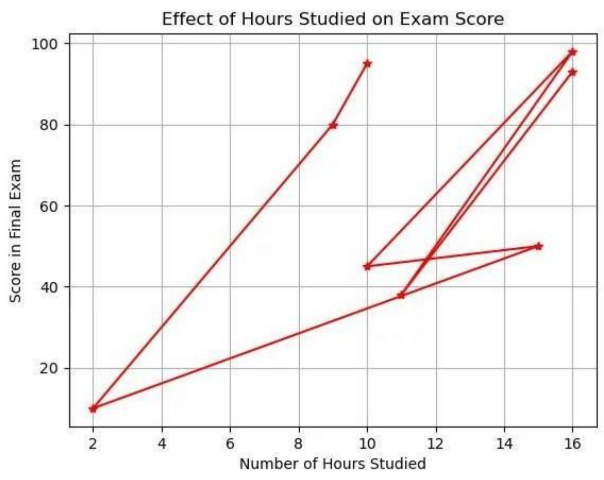
Aim: (3) A study was conducted to understand the effect of number of hours the students spent studying on their performance in the final exams. Write a code to plot line chart with number of hours spent studying on x-axis and score in final exam on y-axis. Use a red ‘*’ as the point character, label the axes and give the plot a title.

Students performance in the final exams

Number of hrs spent studying (x)	10	9	2	15	10	16	11	16
Score in the final exam (0 – 100) (y)	95	80	10	50	45	98	38	93

```
import matplotlib.pyplot as plt
hours = [10,9,2,15,10,16,11,16]
score = [95,80,10,50,45,98,38,93]

# Plotting the line chart
plt.plot(hours, score, marker='*', color='red', linestyle='-')

# Adding labels and title
plt.xlabel('Number of Hours Studied')
plt.ylabel('Score in Final Exam')
plt.title('Effect of Hours Studied on Exam Score')

# Displaying the plot
plt.grid(True)
plt.show()
```

Output



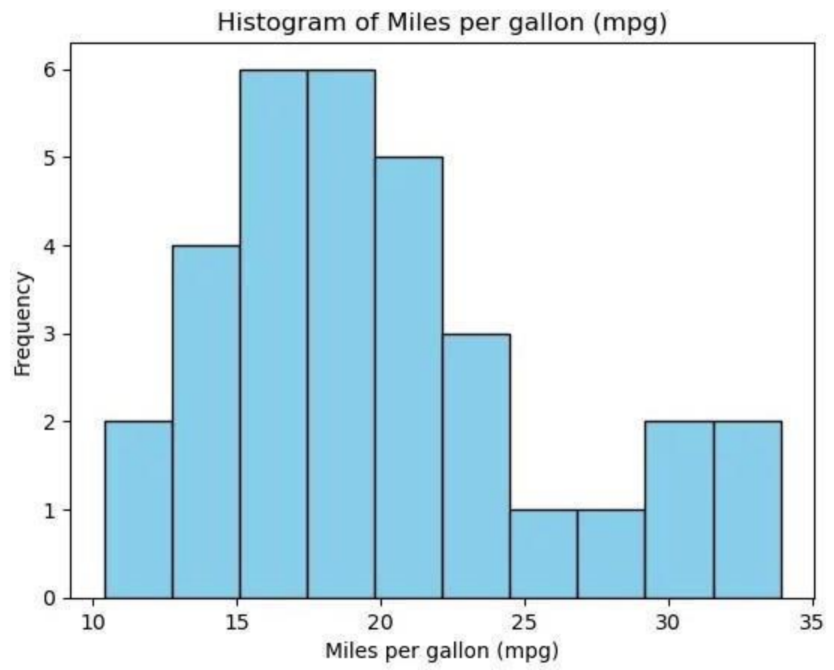
The program above demonstrates a clear trend: generally, the more hours students study, the better they perform on the final exam. However, there are some cases where this relationship isn't quite as straightforward, yielding slightly different outcomes.

Aim: (4) For the given dataset mtcars.csv (www.kaggle.com/ruiromanini/mtcars), plot a histogram to check the frequency distribution of the variable 'mpg' (Miles per gallon)

Histogram to check the frequency distribution

```
import pandas as pd
import matplotlib.pyplot as plt

# Load the dataset
mtcars = pd.read_csv('mtcars.csv') # Replace 'path_to_your_mtcars.csv' with the actual path to your mtcars.csv
file

# Plotting the histogram
plt.hist(mtcars['mpg'], bins=10, color='skyblue', edgecolor='black')

# Adding labels and title
plt.xlabel('Miles per gallon (mpg)')
plt.ylabel('Frequency')
plt.title('Histogram of Miles per gallon (mpg)')

# Displaying the plot
plt.show()
```

Output



EXPERIMENT -2

Aim: Consider the books dataset BL-Flickr-Images-Book.csv from Kaggle (https://www.kaggle.com/adeyoyintemidayo/publication-of-books) which contains information about books. Write a program to demonstrate the following.

- Import the data into a DataFrame
- Find and drop the columns which are irrelevant for the book information.
- Change the Index of the DataFrame
- Tidy up fields in the data such as date of publication with the help of simple regular expression.
- Combine str methods with NumPy to clean columns

Kaggle Book Data set

```
import pandas as pd
import numpy as np

# Import the data into a DataFrame
df = pd.read_csv('BL-Flickr-Images-Book.csv')

# Display the first few rows of the DataFrame
print("Original DataFrame:")
print(df.head())

# Find and drop the columns which are irrelevant for the book information
irrelevant_columns = ['Edition Statement', 'Corporate Author', 'Corporate Contributors', 'Former owner', 'Engraver',
'Contributors', 'Issuance type', 'Shelfmarks']
df.drop(columns=irrelevant_columns, inplace=True)

# Change the Index of the DataFrame
df.set_index('Identifier', inplace=True)

# Tidy up fields in the data such as date of publication with the help of simple regular expression
df['Date of Publication'] = df['Date of Publication'].str.extract(r'^(\d{4})', expand=False)

# Combine str methods with NumPy to clean columns
df['Place of Publication'] = np.where(df['Place of Publication'].str.contains('London'), 'London', df['Place of
Publication'].str.replace('-', ' '))
```

```
# Display the cleaned DataFrame
print("\nCleaned DataFrame:")
print(df.head())
```

Output

```
Original DataFrame:
   Identifier            Edition Statement      Place of Publication \
0        206                         NaN                   London
1        216                         NaN London; Virtue & Yorston
2        218                         NaN                   London
3        472                         NaN                   London
4        480 A new edition, revised, etc.          London

  Date of Publication              Publisher \
0        1879 [1878]       S. Tinsley & Co.
1               1868           Virtue & Co.
2               1869  Bradbury, Evans & Co.
3               1851          James Darling
4               1857   Wertheim & Macintosh

                                            Title     Author \
0                 Walter Forbes. [A novel.] By A. A      A. A.
1  All for Greed. [A novel. The dedication signed... A., A. A.
2  Love the Avenger. By the author of “All for Gr... A., A. A.
3  Welsh Sketches, chiefly ecclesiastical, to the... A., E. S.
4  [The World in which I live, and my place in it... A., E. S.

                                Contributors Corporate Author \
0                              FORBES, Walter.              NaN
1  BLAZE DE BURY, Marie Pauline Rose - Baroness              NaN
2  BLAZE DE BURY, Marie Pauline Rose - Baroness              NaN
3                   Appleyard, Ernest Silvanus.              NaN



0                   NaN          NaN       NaN monographic
1                   NaN          NaN       NaN monographic
4                            BROOME, John Henry.              NaN
```

Corporate Contributors Former owner Engraver Issuance type \

```
2                 NaN        NaN       NaN   monographic
3                 NaN        NaN       NaN   monographic
4                 NaN        NaN       NaN   monographic

                              Flickr URL \
0  http://www.flickr.com/photos/britishlibrary/ta...
1  http://www.flickr.com/photos/britishlibrary/ta...
2  http://www.flickr.com/photos/britishlibrary/ta...
3  http://www.flickr.com/photos/britishlibrary/ta...
4  http://www.flickr.com/photos/britishlibrary/ta...

                    Shelfmarks
0    British Library HMNTS 12641.b.30.
1    British Library HMNTS 12626.cc.2.
2    British Library HMNTS 12625.dd.1.
3  British Library HMNTS 10369.bbb.15.
4     British Library HMNTS 9007.d.28.

Cleaned DataFrame:
           Place of Publication Date of Publication            Publisher \
Identifier
206                        London             1879       S. Tinsley & Co.
216                        London             1868           Virtue & Co.
218                        London             1869  Bradbury, Evans & Co.
472                        London             1851          James Darling
480                        London             1857   Wertheim & Macintosh

                                                    Title     Author \
Identifier
206                       Walter Forbes. [A novel.] By A. A      A. A.
216         All for Greed. [A novel. The dedication signed... A., A. A.
218         Love the Avenger. By the author of “All for Gr... A., A. A.
472         Welsh Sketches, chiefly ecclesiastical, to the... A., E. S.
480         [The World in which I live, and my place in it... A., E. S.

                                                Flickr URL
Identifier
```

```
206        http://www.flickr.com/photos/britishlibrary/ta...
216        http://www.flickr.com/photos/britishlibrary/ta...
218        http://www.flickr.com/photos/britishlibrary/ta...
472        http://www.flickr.com/photos/britishlibrary/ta...
480        http://www.flickr.com/photos/britishlibrary/ta...
```

EXPERIMENT -3

Aim: (1) Train a regularized logistic regression classifier on the iris dataset (https://archive.ics.uci.edu/ml/machine-learning-databases/iris/ or the inbuilt iris dataset) using sklearn. Train the model with the following hyperparameter C = 1e4 and report the best classification accuracy.

Logistic Regression

```
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import make_pipeline

# Load the Iris dataset
iris = load_iris()
X = iris.data
y = iris.target

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Create a pipeline with StandardScaler and LogisticRegression with regularization
pipeline = make_pipeline(StandardScaler(), LogisticRegression(C=1e4, max_iter=1000))

# Train the model
pipeline.fit(X_train, y_train)

# Calculate the accuracy on the testing set
accuracy = pipeline.score(X_test, y_test)
print("Classification accuracy:", accuracy)
```

Output

```
Classification accuracy: 1.0
```

Aim: (2) Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyperparameters. Train model with the following set of hyperparameters RBFkernel, gamma=0.5, one-vs-rest classifier, no-feature-normalization. Also try C=0.01,1,10C=0.01,1,10. For the above set of hyperparameters, find the best classification accuracy along with total number of support vectors on the test data.

SVM classifier

```
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC

# Load the Iris dataset
iris = load_iris()
X = iris.data
y = iris.target
```

```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Set of hyperparameters to try
hyperparameters = [
    {'kernel': 'rbf', 'gamma': 0.5, 'C': 0.01},
    {'kernel': 'rbf', 'gamma': 0.5, 'C': 1},
    {'kernel': 'rbf', 'gamma': 0.5, 'C': 10}
]

best_accuracy = 0
best_model = None
best_support_vectors = None

# Train SVM models with different hyperparameters and find the best accuracy
for params in hyperparameters:
    model = SVC(kernel=params['kernel'], gamma=params['gamma'], C=params['C'], decision_function_shape='ovr')
    model.fit(X_train, y_train)
    accuracy = model.score(X_test, y_test)
    support_vectors = model.n_support_.sum()
    print(f"For hyperparameters: {params}, Accuracy: {accuracy}, Total Support Vectors: {support_vectors}")
    if accuracy > best_accuracy:
        best_accuracy = accuracy
        best_model = model
        best_support_vectors = support_vectors

print("\nBest accuracy:", best_accuracy)
print("Total support vectors on test data:", best_support_vectors)
```

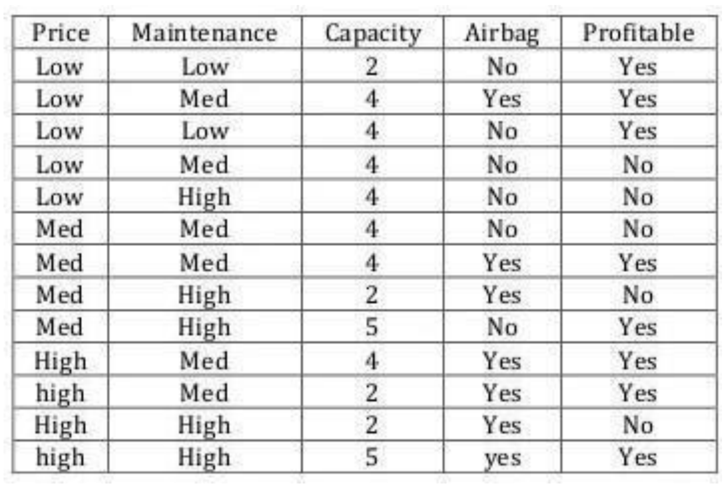
Output

```
For hyperparameters: {'kernel': 'rbf', 'gamma': 0.5, 'C': 0.01}, Accuracy: 0.3, Total Support Vectors: 120
For hyperparameters: {'kernel': 'rbf', 'gamma': 0.5, 'C': 1}, Accuracy: 1.0, Total Support Vectors: 39
For hyperparameters: {'kernel': 'rbf', 'gamma': 0.5, 'C': 10}, Accuracy: 1.0, Total Support Vectors: 31

Best accuracy: 1.0
Total support vectors on test data: 39
```

EXPERIMENT - 4

Aim: (1) Consider the following dataset. Write a program to demonstrate the working of the decision tree based ID3 algorithm.

Decision Tree based ID3 algorithm



Price	Maintenance	Capacity	Airbag	Profitable
Low	Low	2	No	Yes
Low	Med	4	Yes	Yes
Low	Low	4	No	Yes
Low	Med	4	No	No
Low	High	4	No	No
Med	Med	4	No	No
Med	Med	4	Yes	Yes
Med	High	2	Yes	No
Med	High	5	No	Yes
High	Med	4	Yes	Yes
high	Med	2	Yes	Yes
High	High	2	Yes	No
high	High	5	yes	Yes

```
from sklearn.tree import DecisionTreeClassifier, export_graphviz
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
import pandas as pd
from io import StringIO
from IPython.display import Image
import pydotplus

# Define the dataset
data = {
    'Price': ['Low', 'Low', 'Low', 'Low', 'Low', 'Med', 'Med', 'Med', 'Med', 'High', 'High', 'High', 'High'],
    'Maintenance': ['Low', 'Med', 'Low', 'Med', 'High', 'Med', 'Med', 'High', 'High', 'Med', 'Med', 'High', 'High'],
    'Capacity': ['2', '4', '4', '4', '4', '4', '4', '2', '5', '4', '2', '2', '5'],
    'Airbag': ['No', 'Yes', 'No', 'No', 'No', 'No', 'Yes', 'Yes', 'No', 'Yes', 'Yes', 'Yes', 'Yes'],
    'Profitable': [1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0, 1]
}

df = pd.DataFrame(data)

# Convert categorical variables into numerical ones
df = pd.get_dummies(df, columns=['Price', 'Maintenance', 'Airbag'])
```

```
# Separate features and target variable
X = df.drop('Profitable', axis=1)
y = df['Profitable']

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Create a decision tree classifier
clf = DecisionTreeClassifier(criterion='entropy')

# Train the classifier on the training data
clf.fit(X_train, y_train)

# Predict on the testing data
y_pred = clf.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)

# Visualize the decision tree
dot_data = StringIO()
export_graphviz(clf, out_file=dot_data, filled=True, rounded=True, special_characters=True,
      feature_names=X.columns)
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
Image(graph.create_png())
```

Output

```
Accuracy: 0.6666666666666666
```

Aim: (2) Consider the dataset spiral.txt (https://bit.ly/2Lm75Ly). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods:

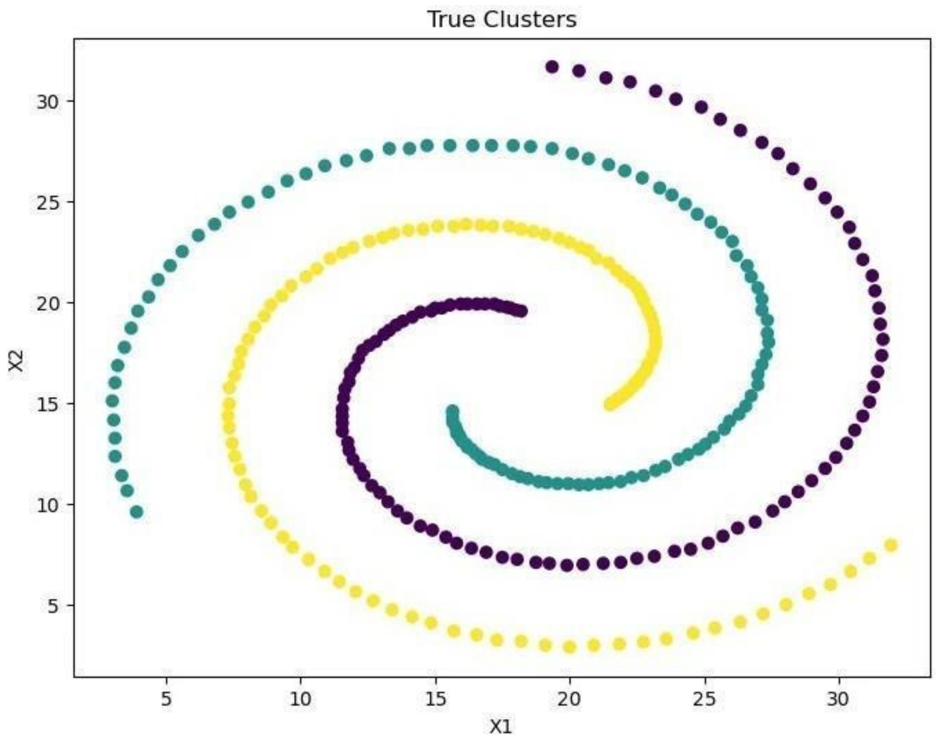
- K – means Clustering
- Single – link Hierarchical Clustering
- Complete link hierarchical clustering.

- Also visualize the dataset and which algorithm will be able to recover the true clusters.

Clustering

```
import numpy as np
from sklearn.cluster import KMeans, AgglomerativeClustering
from sklearn.metrics import adjusted_rand_score
import matplotlib.pyplot as plt
# Load the dataset
data = np.loadtxt("Spiral.txt", delimiter=",", skiprows=1)
X = data[:, :2] # Features
y_true = data[:, 2] # Actual cluster labels

# Visualize the dataset
plt.figure(figsize=(8, 6))
plt.scatter(X[:, 0], X[:, 1], c=y_true, cmap='viridis')
plt.title('True Clusters')
plt.xlabel('X1')
plt.ylabel('X2')
plt.show()

# K-means clustering
# kmeans = KMeans(n_clusters=3, random_state=42)
kmeans = KMeans(n_clusters=3, random_state=42, n_init=10)
kmeans_clusters = kmeans.fit_predict(X)

# Single-link Hierarchical Clustering
single_link = AgglomerativeClustering(n_clusters=3, linkage='single')
single_link_clusters = single_link.fit_predict(X)

# Complete-link Hierarchical Clustering
complete_link = AgglomerativeClustering(n_clusters=3, linkage='complete')
complete_link_clusters = complete_link.fit_predict(X)

# Compute the Rand Index
rand_index_kmeans = adjusted_rand_score(y_true, kmeans_clusters)
rand_index_single_link = adjusted_rand_score(y_true, single_link_clusters)
rand_index_complete_link = adjusted_rand_score(y_true, complete_link_clusters)

print("Rand Index for K-means Clustering:", rand_index_kmeans)
print("Rand Index for Single-link Hierarchical Clustering:", rand_index_single_link)
print("Rand Index for Complete-link Hierarchical Clustering:", rand_index_complete_link)

# This code will compute the Rand Index for each clustering method and provide a visualization of the true clusters.
# The Rand Index ranges from 0 to 1, where 1 indicates perfect clustering agreement with the true clusters.
# The method with a higher Rand Index is better at recovering the true clusters.
```

Output



```
Rand Index for K-means Clustering: -0.0060252369726964605
Rand Index for Single-link Hierarchical Clustering: 1.0
Rand Index for Complete-link Hierarchical Clustering: 0.001841037699419282
```

EXPERIMENT -5

Aim: Mini Project – Simple web scrapping in social media

Mini Project

```
import requests
from bs4 import BeautifulSoup

# URL of the Instagram profile you want to scrape
url = 'https://www.instagram.com/openai/'

# Send a GET request to the URL
response = requests.get(url)

print(response.status_code)

# Check if the request was successful (status code 200)
if response.status_code == 200:
    # Parse the HTML content of the page
    soup = BeautifulSoup(response.text, 'html.parser')

    # Find all post elements
    posts = soup.find_all('div', class_='v1Nh3')

    # Extract data from each post
    for post in posts:
        print("Hi")
        # Extract post link
        post_link = post.find('a')['href']

        # Extract post image URL
        image_url = post.find('img')['src']

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:{post_link}")print(f"Image URL:{image_url}")print(" ")
        print("Failed to retrieve data from Instagram")
```

Output

```
200
```