

**A TECHNICAL REPORT ON  
STUDENTS' INDUSTRIAL WORK EXPERIENCE SCHEME (SIWES)**

**UNDERTAKEN AT:**

**SQI COLLEGE OF ICT,  
H25, 2ND FLOOR HERITAGE MALL, OPP. CENTRAL BANK,  
ALONG COCOA HOUSE, DUGBE, IBADAN, OYO STATE, NIGERIA**

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**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR  
OF TECHNOLOGY (B.TECH.) IN INDUSTRIAL MATHEMATICS.**

**JULY, 2023**

# Certification

This is to certify that this report is a detailed accounts of Students' Industrial Work Experience (SIWES) undertaken by ALAO ADEYEMI OLUWASEYI with matriculation number MTS/17/4557 at SQI College OF ICT, H25, 2nd Floor Heritage Mall, Opp. Central Bank, Along Cocoa House, Dugbe, Ibadan,Oyo state, Nigeria and it has been prepared in accordance to the regulations guiding the preparation of SIWES reports in the Department of Mathematical Sciences, The Federal University of Technology, Akure.

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Date

# Dedication

This report is dedicated to God almighty, who sustained me throughout the six months journey of industrial training and the writing of this report. Moreover, this project is dedicated to my loving parents who supported me both in cash and kind, and also for their assistance and contribution towards the successful completion of my industrial training.

# Acknowledgments

Firstly, I would like to express my profound gratitude to GOD, for His mercy upon me, The Merciful, for the success of this project. My utmost regard goes to my parent Mr. and Mrs. ALAO who painstakingly laid the foundation for my education giving it all it takes for me to achieve my set objectives. My unflinching gratitude goes to my amiable and wonderful supervisor in person of Dr. Owolabi for your thorough supervision, advice, encouragement, support and scolding throughout the report, all which lead to the success of it.

# Abstract

This report summarizes my work experience at SQI College OF ICT, Ibadan, Oyo State, which lasted for 6 months, (December to May 2022-2023). I was exposed to the fundamentals of data science for research purposes, data collection, data analytics and machine learning, with the use of various scientific softwares such as Microsoft Office Excel, Python, Numpy, Pandas etc. A succinct description of the use of these softwares in solving various problems is provided in this report and a project I worked on. This report also contain a brief history of the SIWES, the Vision and Mission statement of the SIWES, the objectives of the SIWES, the benefits of the SIWES to students and employers and the bodies involved in the management of the SIWES. A brief history of SQI College OF ICT was also stated in this report, with the companys Vision and Mission statement, the list of departments in the company and a picture of the companys organogram. The purpose of the project was to create an Image compression System using singular value decomposition and Flask.

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# CHAPTER ONE

## Students' Industrial Work Experience Scheme (SIWES)

SIWES is an acronym for Student Industrial Work Experience Scheme which was established in the year 1973 in order to improve the standard of education in Nigeria and to achieve the needed technological advancement. SIWES was solely funded by ITF (Industrial Training Funds) during its early stage not until it was difficult to continue for economic stress: then the responsibility was shared between Industrial Training Funds (ITF) and the Federal Government. The program was introduced due to students' inability to contribute technically to the industrial sector which is hampering the growth and development of the country. It was designed to expose students in Universities and Polytechnics to industry-based skills and bridge the existing gap between the knowledge acquired in the classroom and practical knowledge of Science, Engineering, Agriculture, Management, and all other fields in Nigeria tertiary institutions. Participation in SIWES has become a crucial precondition for the award of diploma and degree certificates in specific disciplines in most Nigerian higher institutions in line with the government education policies. The Federal Government and Industrial Training Funds (ITF) are actively involved in this scheme. The Federal Government took over the funding of the scheme and Industrial Training Funds took over the managerial position by managing the funds given to them by the Federal Government in order to sustain the scheme.

### 1.1 Mission And Vision Statements of SIWES

#### Mission Statement of SIWES

To set and regulate standards and over direct training intervention in industrial and commercial skills training and development, using a corps of highly competent professional staff, modern techniques and technology.

#### 1.1.1 Vision Statement of SIWES

To be the prime Skills Training Development Organization in Nigeria and one of the best in the world.

## **1.2 Aim And Objectives Of SIWES**

The objectives of the Students Industrial Work Experience Scheme (SIWES) are listed below:

1. To provide an avenue for students in higher institutions to acquire industrial skills and experience in their approved course of study;
2. To promote research and training purposes for Students in higher institutions in their field of study.
3. To expose students to work methods and techniques in handling equipment and machinery not available in their institutions;
4. To equip students with valuable skills, which will give them a competitive edge in today's job market.
5. To make the transition from school to the world of work easier and enhance students' contacts for later job placements;

## **1.3 Benefits of Industrial Training to Students**

1. It aids students to relate with professionals, who are experts in their field of study.
2. It assists students to be ready for a professional carrier in their field of studies.
3. Creating avenue for student to acquire a new skill and practical knowledge in their field of study.
4. It succors the students to appreciate and understand the practical applications of their course of study.

## **1.4 Benefits of Industrial Training to Employers**

SIWES benefits the employers in the following ways:

1. The scheme provides an opportunity for the employer to refine and validate the company's own training methods.
2. SIWES serves as a training program for prospective employees of small business or industry.
3. SIWES provides a pool of part time workers from which to select permanent employees at a later date.

## **1.5 Bodies involved in the management of SIWES**

The bodies involved are: The Federal Government, Industrial Training Fund (ITF), other supervising agent like; National University Commission (NUC), National Board of Technical Education (NBTE), and National Council of Colleges Of Education (NCE). The roles of these agencies include funding of the scheme, establishing of SIWES in the institution, formulating and ensuring rules and regulation are observed in institutions, and supervision of students at their places of attachment etc.

# CHAPTER TWO

## The Company (SQI College OF ICT )

**SQI College of ICT** is a Registered Training Institution which is based in Ibadan, Nigeria located at H25, 2ND FLOOR HERITAGE MALL, OPP. CENTRAL BANK, ALONG COCOA HOUSE, DUGBE, IBADAN, OYO STATE, delivering nationally accredited training and hands-on education in the area of the Data Science, Data Analysis, Software Architecture, Robotics Engineering, UI/UX, Graphics Design and 3D Animation and VFX. SQI ICT Consultants started operation in 2008 as a technological solutions provider for companies and individuals and subsequently, in a bid to proffer solution to the challenge of sourcing world-class tech personnel and products from Africa. SQI proceeded to offer training to personnel through its ICT Academy. Over the past 9 years, SQI ICT Academy has built a reputation as one of the premier hands-on, intensive ICT training schools in the world before being instituted as a college of ICT. SQI teach the fully practical curriculum and this makes every one of their students a bride to any organization they find themselves. So far, SQI have successfully trained, mentored and certified over 4000 personnel in different ICT programs. Another major achievement the institution have recorded is in getting the license to operate as a college of ICT that awards diploma certificates. This was done to better equip the trainees to be able to work both with government parastatal and private organizations- giving industry-standard skills, a professional certificate as well as academic degrees. The institution, which has been accredited by the National Board for Technical Education (NBTE), according to the management of the college, has its main campus in Ogbomosho and the expansion drive led to the acquisition of first satellite campus in Dugbe, second coding campus at Iwo Road and another campus in Abeokuta. These acquisitions have deepened the Company's presence in the Information and Technology markets.

The company specializes at providing efficient services such as;

1. Data Science
2. Robotics Engineering
3. UI/UX
4. Data Analysis
5. Software Architecture
6. Graphics Design and 3D Animation and VFX

## **2.1 Mission and objectives of SQI College of ICT**

### **2.1.1 Mission of the company**

Making Africa a Tech Continent.

### **2.1.2 Objectives of the company**

The Company objective is to widen access to vocational education and offer a credible alternative to higher education, through the provision of relevant industry-specific employable skills. The institution give competence-based skills that are driven by demands from industries and employers. Our principal responsibility is to the demands of the economy for technical knowledge and skills in the field of Information and Communication Technology (ICT). We also envisage to fulfill the following specific objectives:

- Provide the necessary link between education, science, technology, innovation and the labor market.
- Use 21st Century technology to deliver up-to-date curricula and skills relevant to the needs of employers in the labor market.
- Be principally private sector driven, and readily responsive to labor market demands.

## **2.2 Various Departments Of The Company**

The organization has the following departments;

- Software Engineering Department
- Security and Network Administration Department
- Hardware Engineering Department
- Human Resources Department
- Graphics and Multimedia Department

### **2.2.1 Software Engineering Department**

This department is responsible for the design, development, testing, and maintenance of software applications. This department is further divided into sub-departments, namely;

- Mobile Application Development Department:

The engineers in this sub-department are responsible for building the software applications for smartphones and other mobiles, this department consists of seasoned cross-platform mobile engineers which can include personal digital assistants etc.

- **Web Application Development Department:**

The engineers in this sub-department are responsible for building an interactive web user interfaces and also responsible for the integration of data into the web user interface, this department consists of seasoned front-end web engineers with proven experience in the development of web apps. Web application can be divided into two part, Front-End and Back-End.

- **Data Science:** The engineers in this sub-department are responsible for using mathematics, statistics, scientific computing, scientific methods, processes, algorithms and systems to extract or extrapolate knowledge and insight from noisy, structured, unstructured data to make prediction. Data science is multifaceted and can be described as a science, a research paradigm, a research method, a discipline, a workflow, and a profession.

### **2.2.2 Graphics and Multimedia Department**

This department is also under the Nylon Manager of the company, they deal with the supply of every Nylon products in the company. They distribute processed low-density and high-density product to potential customers across Nigeria.

## 2.3 Organization Chart OF SQI College of ICT

The figure below is a descriptive and concise organogram of SQI College of ICT, the arrows indicate the unit the student was attached during the industrial training.

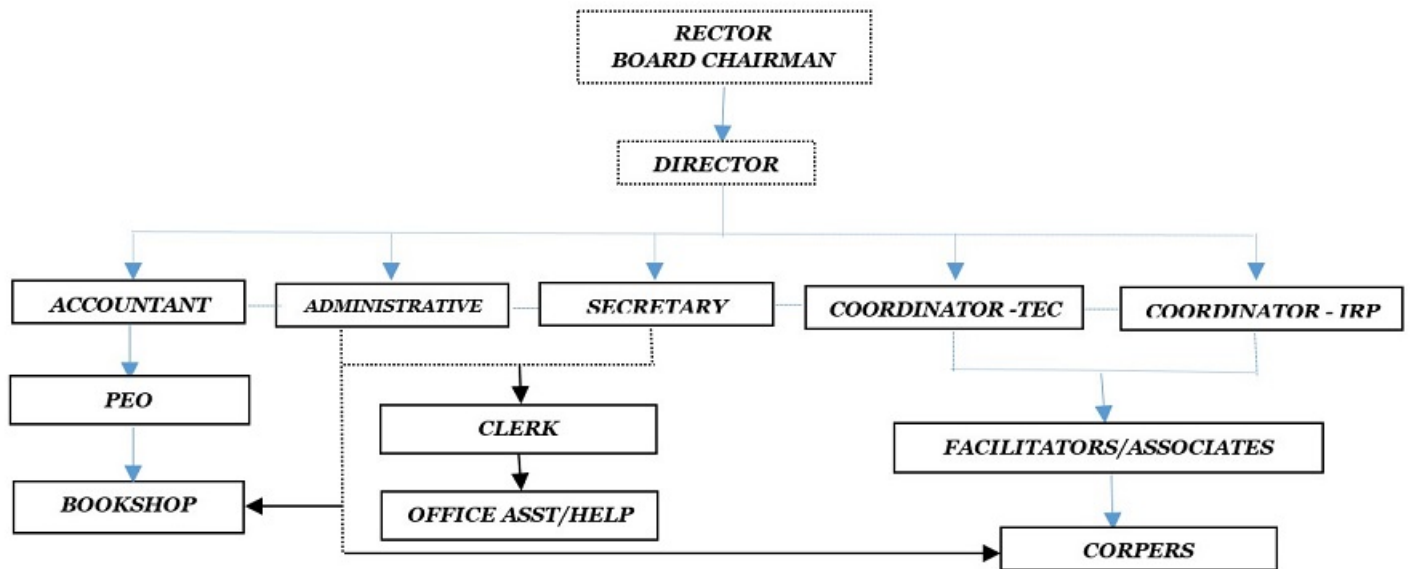


Figure 2.1: The organogram of SQI College of ICT



# CHAPTER THREE

## Work done and Experience Gained

### 3.1 Experience Gained at SQI College of ICT

I had the opportunity to work in the Data Science Department, where the head of the unit provided an overview of its functions. The primary objective of the data science unit is to educate and enlighten students on the field of data science. To achieve this, several measures were implemented to ensure efficiency and effectiveness in various aspects of the organization.

One of the key responsibilities of the data science unit was to maintain a thorough check and balance on important records and to teach student how to use data for prediction and modelling. By working in the data science department, I gained valuable insights into the field of data science while actively participating in various data-related tasks and initiatives. The experience allowed me to witness firsthand the impact of data-driven decision-making and the importance of continuous improvement within an organization.

Finally, throughout my industrial training, the company placed great emphasis on continuous audits. These audits were conducted regularly throughout the year to assess each unit's adherence to the company's standards and their contribution to overall financial goals.

### 3.2 Use of software and Application

Software packages have revolutionized scientific computation and mathematical modeling by automating complex calculations and data analysis tasks. With the advent of computers, programmers have dedicated significant efforts to developing software that can efficiently tackle scientific problems that would otherwise be laborious or impractical to solve manually.

This section gives a report of the software IT students were exposed to during the time of industrial training. The following software and programming language were exposed to the industrial training students during the course of the I.T program.

1. Python programming language
2. Visual studio editor
3. Jupyter notebook
4. Numpy and Pandas

### 3.2.1 Python

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

- Variable and Data Types:

This consist of various data types in Python, such as numbers(integers, floats), strings, booleans, lists,tuples and dictionaries.

- Operators:

It consists of differents types of operators in python, including arithmetic operators(+,-,\*,/), comparison operators(<,i,==,!=), logical operators(and,or,not), and more.

- Control flow:

Control flow consists of statement like if-else, for loops, while loops and how to use them to control the execution flow of your program.

### Workdone with Python

This is a Python program to convert the temperature(degree to celsius, celsius to degree)

C: > Users > TESTL > python pratice > project assignment > tempconvert.py > temp

```
1  temp = input('Enter the unit you want to convert from : ')
2  if temp.upper() == 'C':
3      temps = input('Enter the unit you want to convert to : ')
4      if temps.upper() == 'F':
5          c = int(input('Enter the value for temp(c): '))
6          result = (9/5 * c) + 32
7          print(result, 'F')
8      else:
9          print('Error')
10 elif temp.upper() == 'F':
11     temps = input('Enter the unit you want to convert to : ')
12     if temps.upper() == 'C':
13         f = int(input('Enter the value for temp(f): '))
14         result = (f-32 ) * 5/9
15         print(result, 'C')
16     else:
17         print('Error')
18 elif temp.upper() == 'K':
19     t = input('Enter the unit you want to convert to: ')
20     if t.upper() == 'C':
21         k = int(input('Enter the value for temp(k): '))
22         result = (k - 273.15)
23         print(result, 'C')
24 elif t.upper() == 'F':
```

```
app.py C:\...\myproject\... 9+  app.py C:\...\itproject\...  Untitled-1  tempconvert.p...
C: > Users > TESTL > python pratice > project assignment > tempconvert.py > ...
10 elif temp.upper() == 'F':
11     temps = input('Enter the unit you want to convert to : ')
12     if temps.upper() == 'C':
13         f = int(input('Enter the value for temp(f): '))
14         result = (f-32 ) * 5/9
15         print(result, 'C')
16     else:
17         print('Error')
18 elif temp.upper() == 'K':
19     t = input('Enter the unit you want to convert to: ')
20     if t.upper() == 'C':
21         k = int(input('Enter the value for temp(k): '))
22         result = (k - 273.15)
23         print(result, 'C')
24     elif t.upper() == 'F':
25         k = int(input('Enter the value for temp(k): '))
26         result = (k - 273.15) * 9/5 + 32
27         print(result, 'F')
28 else:
29     print('Unknown Input')
30     quit()
```

### 3.2.2 Visual studio editor

Visual studio code(often referred to as VS Code) is a popular source code editor developed by Microsoft. It provides a lightweight yet powerful environment for editing and debugging a wide range of programming languages.

VS Code is available for windows, MacOS, and Linux allowing developers to work seamlessly across different operating.

app.py C:\...\myproject\... 9+

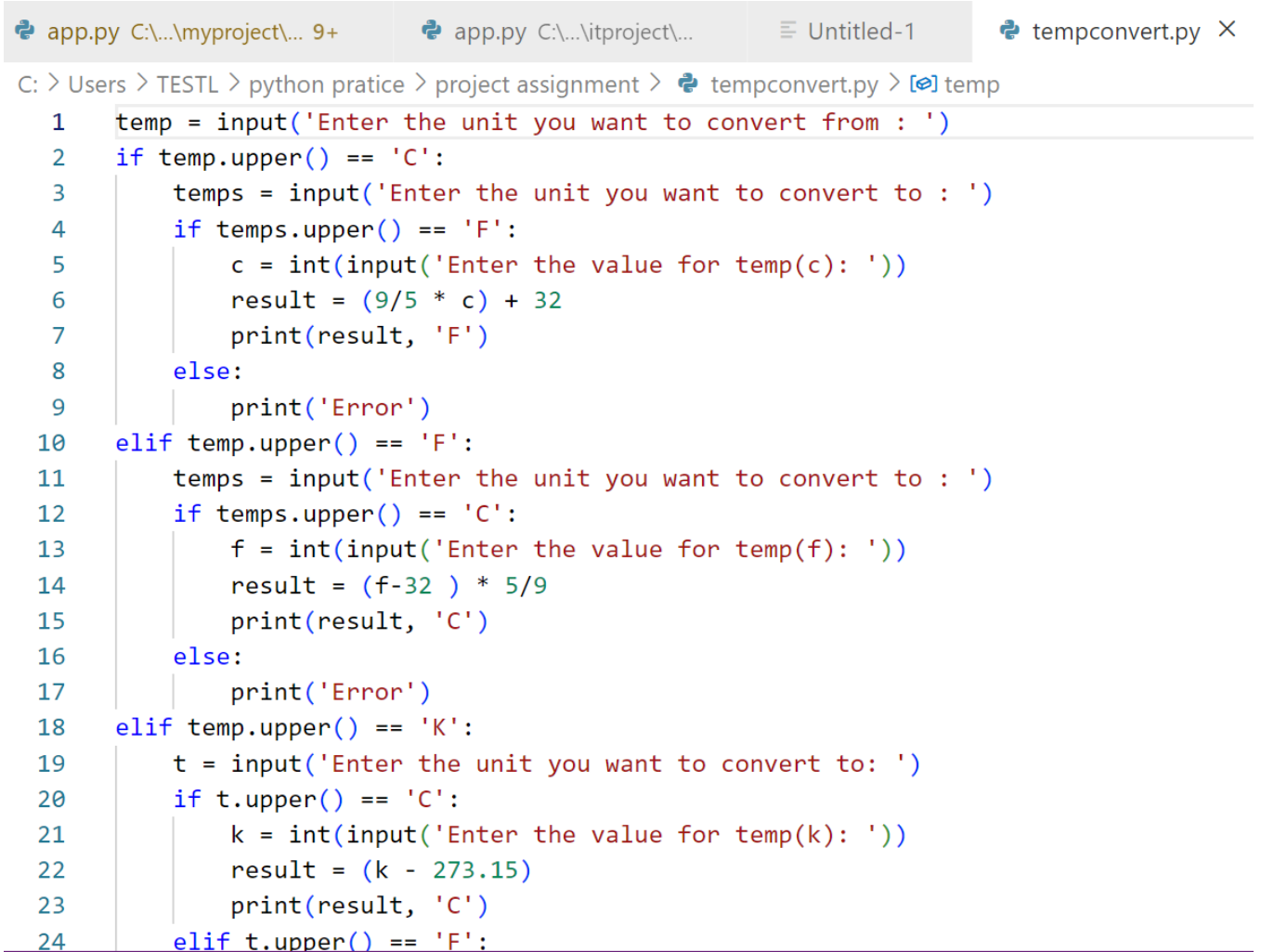
app.py C:\...\itproject\...

Untitled-1 X

1 *Select a language, or fill with template, or open a different editor to get started.  
Start typing to dismiss or don't show this again.*

10

Ln 1, Col 1

The image shows a screenshot of the Visual Studio Code editor interface. At the top, there are three tabs: 'app.py C:\...\myproject\... 9+', 'app.py C:\...\itproject\...', and 'Untitled-1'. On the far right, there is a tab for 'tempconvert.py' with a close button. Below the tabs, the file explorer shows the path 'C: > Users > TESTL > python pratrice > project assignment > tempconvert.py'. The main editor area displays a Python script for temperature conversion. The script starts with a prompt to enter the unit to convert from, then uses a series of if-elif statements to handle conversions from Celsius, Fahrenheit, and Kelvin. Each branch prompts for the value to convert and calculates the result using the appropriate formula. The script ends with a final elif statement for Fahrenheit to Celsius conversion.

```
1 temp = input('Enter the unit you want to convert from : ')
2 if temp.upper() == 'C':
3     temps = input('Enter the unit you want to convert to : ')
4     if temps.upper() == 'F':
5         c = int(input('Enter the value for temp(c): '))
6         result = (9/5 * c) + 32
7         print(result, 'F')
8     else:
9         print('Error')
10 elif temp.upper() == 'F':
11     temps = input('Enter the unit you want to convert to : ')
12     if temps.upper() == 'C':
13         f = int(input('Enter the value for temp(f): '))
14         result = (f-32 ) * 5/9
15         print(result, 'C')
16     else:
17         print('Error')
18 elif temp.upper() == 'K':
19     t = input('Enter the unit you want to convert to: ')
20     if t.upper() == 'C':
21         k = int(input('Enter the value for temp(k): '))
22         result = (k - 273.15)
23         print(result, 'C')
24     elif t.upper() == 'F':
```

Figure 3.1: Workdone with visual studio code editor of temperature conversion

### 3.2.3 Jupyter notebook

Jupyter Notebook is an open-source web application that allows you to create and share documents containing live code, equations, visualizations, and narrative text. It is widely used by data scientists and researchers for interactive computing and data analysis. It supports various programming languages, including Python, R, Julia and more. It provides an interactive environment where you can write and execute code in individual cells.

#### Key features of Jupyter Notebook

- Code execution: It allows writing and executing of code in cells. Each cell can contain a different programming language, making it versatile for multi-language projects.
- Rich output: Jupy allows you to display rich output, such as images, videos, plots, and interactive widgets, directly in the notebook interface.
- Provides a user-friendly interface for mathematical computing.

- Data exploration and visualization: It integrates well with popular data manipulation and visualization libraries, such as pandas, Numpy, Matplotlib, and Seaborn. You can also perform data analysis, create visualizations and share the results.

## Jupyter Notebook commands and actions

Here are some common user interface commands and actions that can be performed within the Jupyter interface;

1. Cell types: Jupyter Notebook supports different cell types, such as code cells and markdown cells. You can change the cell type using the dropdown menu in the toolbar or by pressing 'Esc';
2. Executing cells: To execute a code cell, you can press 'Shift+Enter' or click the 'Run' button in the toolbar. The output of the cell will appear below it.
3. Adding and deleting cells: To add a new cell below the currently selected cell by pressing the 'B' key in command mode or by clicking the 'Insert' button in the toolbar.
4. Saving notebooks: Jupyter Notebook automatically saves your changes periodically, but you can also save the notebook manually using the 'Ctrl+S' keyboard shortcut or by clicking the 'Save' button in the toolbar.
5. Viewing keyboard shortcuts: It provides a comprehensive set of keyboard shortcuts that can help you navigate and interact with the interface more efficiently.

## Workdone with Jupyter notebook

```
import pandas as pd
import numpy as np
import seaborn as sns
from matplotlib import pyplot as plt
```

Figure 3.2: A printed format of necessary libraries

```
train = pd.read_csv('train.csv')
train
test = pd.read_csv('test.csv')
test
```

	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	892	3	Kelly, Mr. James	male	34.5	0	0	330911	7.8292	NaN	Q
1	893	3	Wilkes, Mrs. James (Ellen Needs)	female	47.0	1	0	363272	7.0000	NaN	S
2	894	2	Myles, Mr. Thomas Francis	male	62.0	0	0	240276	9.6875	NaN	Q
3	895	3	Wirz, Mr. Albert	male	27.0	0	0	315154	8.6625	NaN	S
4	896	3	Hirvonen, Mrs. Alexander (Helga E Lindqvist)	female	22.0	1	1	3101298	12.2875	NaN	S
...	...	...	...	...	...	...	...	...	...	...	...
413	1305	3	Spector, Mr. Woolf	male	NaN	0	0	A.5. 3236	8.0500	NaN	S
414	1306	1	Oliva y Ocana, Dona. Fermina	female	39.0	0	0	PC 17758	108.9000	C105	C
415	1307	3	Saether, Mr. Simon Sivertsen	male	38.5	0	0	SOTON/O.Q. 3101262	7.2500	NaN	S
416	1308	3	Ware, Mr. Frederick	male	NaN	0	0	359309	8.0500	NaN	S
417	1309	3	Peter, Master. Michael J	male	NaN	1	1	2668	22.3583	NaN	C

418 rows × 11 columns

Figure 3.3: Image of the dataset(titanic dataset) used

```
# Let perform some visualization on survived(0 is not survived and 1 is survived)
sns.countplot(data = train, x = 'Survived')
```

```
<AxesSubplot:xlabel='Survived', ylabel='count'>
```

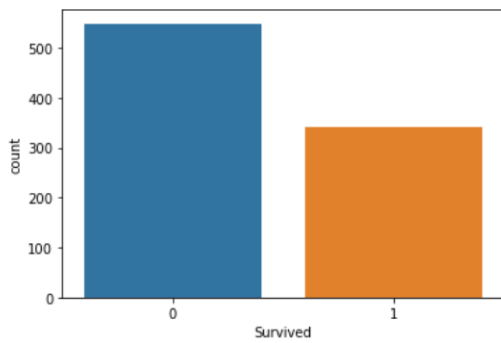


Figure 3.4: Image of the frequency of survival columns

```
# for sex
sns.countplot(data = train, hue = 'Sex', x = 'Survived', palette = 'winter')
```

```
<AxesSubplot:xlabel='Survived', ylabel='count'>
```

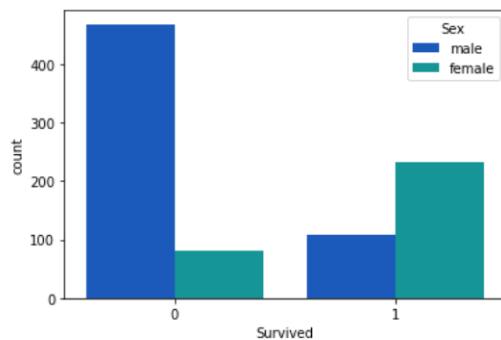


Figure 3.5: Image of survival columns base on gender columns

```
# Let import train_test_split
from sklearn.model_selection import train_test_split
```

```
# Let split test and train
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.469, random_state = 4)
```

```
# 0.469* 891
```

```
# Let make use of logistic regression
from sklearn.linear_model import LogisticRegression
lm = LogisticRegression()
```

```
lm.fit(X_train, y_train)
```

```
C:\Users\Alao Adeyemi O\anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:762: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.
```

```
Increase the number of iterations (max_iter) or scale the data as shown in:
```

```
https://scikit-learn.org/stable/modules/preprocessing.html
```

```
Please also refer to the documentation for alternative solver options:
```

```
https://scikit-learn.org/stable/modules/linear\_model.html#logistic-regression
```

```
n_iter_i = _check_optimize_result(
```

```
LogisticRegression()
```

Figure 3.6: Image of the algorithms used for prediction



```
prediction = lm.predict(X_test)
prediction
array([0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0,
       0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0,
       0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1,
       1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0,
       0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0,
       1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1,
       0, 1, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0,
       0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0,
       1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1,
       0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0,
       1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 1, 1, 0,
       1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0,
       1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1,
       0, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1,
       1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1],
      dtype=int64)
```

```
from sklearn.metrics import classification_report
```

```
from sklearn.metrics import classification_report
```

Figure 3.7: Image of predicted output

### 3.2.4 Numpy and Pandas

Numpy and Pandas are two popular Python libraries used for data manipulation, analysis and computation. They provide powerful tools and data structures that simplify working with numerical and tabular data.

#### Key features of Numpy

Numpy(Numerical Python) is a fundamental library for numerical computing in python. It provides support for multi-dimensional arrays(ndarrays) and efficient mathematical operations on arrays.

- **Powerful array operations:** Numpy provides a wide range of mathematical and logical functions to operate on arrays efficiently.
- **Linear algebra support:** Numpy has functions for linear algebra operations like matrix multiplication, eigenvalues and eigenvectors.
- **Integration with C/C++ and Fortran:** Numpy provides C and Fortran interfaces to work with existing codebases seamlessly.

#### Key features of Pandas

Pandas is a powerful library built on top of Numpy that provides high-level data manipulation and analysis tools. It produces two primary data structure Series and Dataframe.

- **Data Ingestion:** Pandas provides functions to read and write data in various formats, including CSV, Excel, SQL, databases and more.

- Data cleaning and preparation: Pandas offers a range of functions to handle missing data, remove duplicates and transform data into a usable format.
- Integration with other libraries: It integrates well with other python libraries like Numpy, Matplotlib and scikit-learn.

### 3.2.5 Machine learning

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy. Machine learning is an important component of the growing field of data science. Through the use of statistical methods, algorithms are trained to make classifications or predictions, and to uncover key insights in data mining projects. These insights subsequently drive decision making within applications and businesses, ideally impacting key growth metrics. Machine learning algorithms are typically created using frameworks that accelerate solution development, such as TensorFlow and PyTorch.

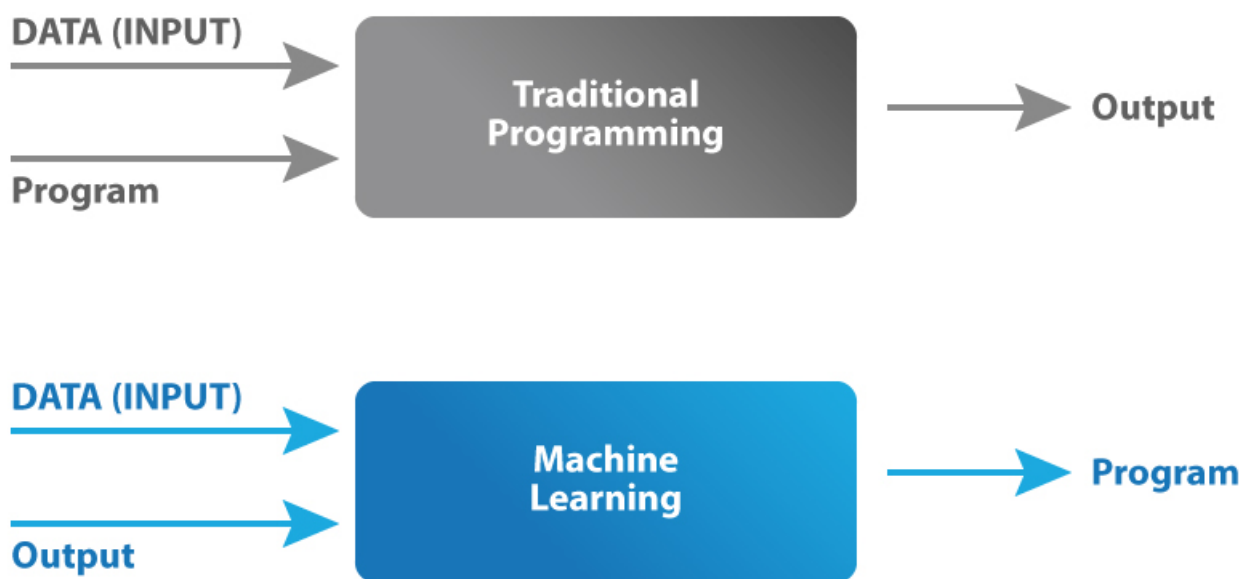


Figure 3.8: Image of machine learning process/operation

### 3.2.6 Steps of Machine Learning

Machine learning life cycle is a cyclic process to build an efficient machine learning project. The main purpose of the life cycle is to find a solution to the problem or project. The most important thing in the complete process is to understand the problem and to know the purpose of the problem. Therefore, before starting the life cycle, we need to understand the problem because the good result depends on the better understanding of the problem. Machine learning life cycle involves seven major steps, which are given below;

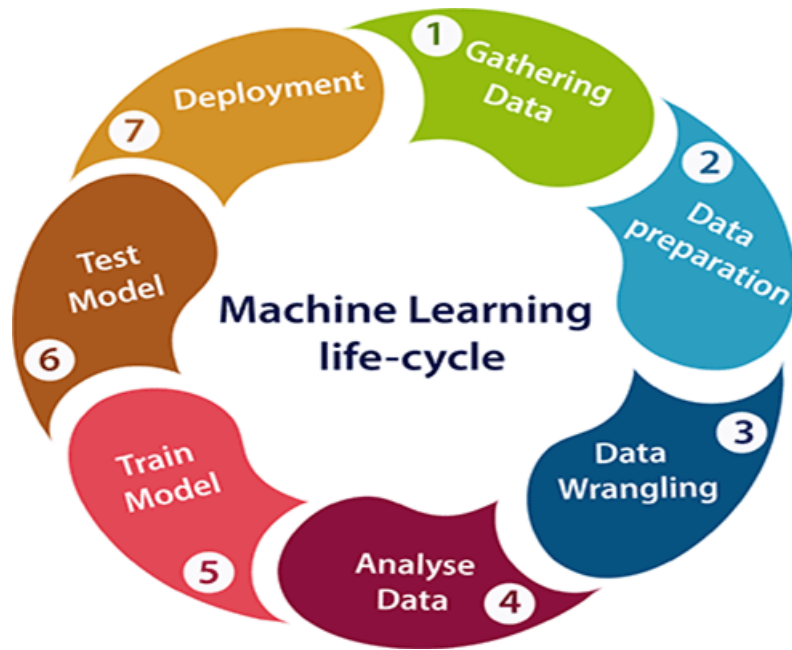


Figure 3.9: Image of machine learning life-cycle

- Data Collection

Data Gathering is the first step of the machine learning life cycle. The goal of this step is to identify and obtain all data-related problems. We need to identify the different data sources, as data can be collected from various sources such as files, database, internet, or mobile devices. It is one of the most important steps of the life cycle. The quantity and quality of the collected data will determine the efficiency of the output. The more data, the more accurate will be the prediction. This step includes the below tasks:

- Identify various data sources
- Collect data
- Integrate the data obtained from different sources

By performing the above task, we get a coherent set of data, also called as a dataset. It will be used in further steps

- Data preparation

After collecting the data, we need to prepare it for further steps. Data preparation is a step where we put our data into a suitable place and prepare it to use in our machine learning training. In this step, first, we put all data together, and then randomize the ordering of data. This step can be further divided into two processes:

- Data exploration: It is used to understand the nature of data that we have to work with. We need to understand the characteristics, format, and quality of data. A better understanding of data leads to an effective outcome. In this, we find Correlations, general trends, and outliers.
- Data pre-processing: Now the next step is preprocessing of data for its analysis.

- Data Cleaning/Wrangling

Data wrangling is the process of cleaning and converting raw data into a useable format. It is the process of cleaning the data, selecting the variable to use, and transforming the data in a proper format to make it more suitable for analysis in the next step. It is one of the most important steps of the complete process. Cleaning of data is required to address the quality issues. In real-world applications, collected data may have various issues, including:

- Missing Values
- Duplicate data
- Invalid data
- Noise

So, we use various filtering techniques to clean the data. It is mandatory to detect and remove the above issues because it can negatively affect the quality of the outcome.

- **Exploratory Data Analysis (EDA)**

Exploratory data analysis (EDA) is used by data scientists to analyze and investigate data sets and summarize their main characteristics, often employing data visualization methods. The aim of this step is to build a machine learning model to analyze the data using various analytical techniques and review the outcome. It starts with the determination of the type of the problems, where we select the machine learning techniques such as Classification, Regression, Cluster analysis, Association, etc. then build the model using prepared data, and evaluate the model.

- **Train Model**

The process of training an machine learning model involves providing an ML algorithm (that is, the learning algorithm) with training data to learn from. The term ML model refers to the model artifact that is created by the training process. The training data must contain the correct answer, which is known as a target or target attribute. The learning algorithm finds patterns in the training data that map the input data attributes to the target (the answer that you want to predict), and it outputs an ML model that captures these patterns.

- **Test Model**

Model testing is referred to as the process where the performance of a fully trained model is evaluated on a testing set. The testing set consisting of a set of testing samples should be separated from the both training and validation sets, but it should follow the same probability distribution as the training set.

- **Deployment**

Deployment can be defined as a process by which an ML model is integrated into an existing production environment to achieve effective data-driven business decisions. It is one of the last stages of the machine learning life cycle.

### **3.2.7 Types of Machine Learning Algorithm**

There are several types of machine learning algorithms, each with its own characteristics and purposes. Each algorithm has its own strengths, weaknesses, and specific use cases. The choice of algorithm depends on the nature of the problem, the availability of labeled data, the desired output, and other considerations. Here are some of the main types:

- **Supervised Learning:**

Supervised learning algorithms learn from labeled training data, where each data instance has input features and a corresponding known output label. The algorithm learns to map the input features to the output labels based on the training data. Examples of supervised learning algorithms include decision trees, random forests, support vector machines (SVM), and neural networks.

- **Unsupervised Learning:**

Unsupervised learning algorithms work with unlabeled data, where the algorithm learns patterns, structures, or relationships in the data without any predefined output labels. The goal is

to discover hidden patterns or groupings in the data. Clustering algorithms, such as k-means and hierarchical clustering, and dimensionality reduction techniques like principal component analysis (PCA) are examples of unsupervised learning algorithms.

- **Semi-Supervised Learning:**

Semi-supervised learning algorithms utilize a combination of labeled and unlabeled data. They leverage the limited labeled data along with the unlabeled data to improve the learning process. This is useful when labeled data is scarce or expensive to obtain. Techniques like self-training and co-training are commonly used in semi-supervised learning.

- **Reinforcement Learning:**

Reinforcement learning algorithms learn through interactions with an environment. The algorithm learns to make a sequence of decisions or actions to maximize a reward signal over time. It receives feedback in the form of rewards or penalties, guiding its learning process. Reinforcement learning is used in applications like robotics, game playing, and autonomous systems. Q-learning and deep reinforcement learning are popular algorithms in this category.

## 3.3 Contribution

During my internship at SQI college of ICT, data collection was a continuous process for the sake of impacting the knowledge of proper analysis in the students. We also check through the process of data cleaning. One of the areas of data cleaning, which is an important process of data analysis, in which I contributed immensely is the area of filling up missing numeric values with the method of LINEAR INTERPOLATION.

### 3.3.1 Linear Interpolation:

Linear interpolation is a simple technique used to estimate values between two known data points. It assumes a linear relationship between the known data points and fills in the missing values based on this assumption. Linear interpolation is commonly used in various fields, including mathematics, statistics, and computer science.

#### The Linear Interpolation Formular

$$y = y_1 + \frac{(x - x_1)(y_2 - y_1)}{(x_2 - x_1)}$$

where:

x is the target position for which we want to estimate the value.

x1 and x2 are the x-coordinates of the two known data points.

y1 and y2 are the y-coordinates of the two known data points.

y is the estimated value at the target position x

### 3.3.2 The Use Of Linear Interpolation For Data Cleaning (Replacing Missing Values)

Data cleaning, also known as data preprocessing, is an essential step in machine learning projects. It involves identifying and handling incorrect, incomplete, irrelevant, or inconsistent data to improve the quality and reliability of the dataset. Effective data cleaning ensures that the data is suitable for analysis and modeling, which ultimately leads to better machine learning results.

Here are some common techniques and considerations for data cleaning in machine learning:

1. **Handling missing values:** Missing data is a common issue in datasets. You can either remove the rows or columns with missing values or fill in the missing values using techniques like mean, median, mode, or regression imputation, depending on the nature of the data and the specific problem you are solving.
2. **Removing duplicate records:** Duplicates can skew the analysis and model training. Identifying and removing duplicate records helps to avoid biased results. Duplicates are typically identified based on all or a subset of features/columns in the dataset.

### 3.3.3 Application of Linear Interpolation

Given a dataset which measure the productivity of different-sized teams in a manufacturing plant, gathering information on the daily output of teams.

SN	Number of employees	Products per day
1	12	152
2	13	161
3	14	170
4	15	nan
5	16	192
6	17	nan
7	18	213
8	19	222
9	20	231
10	21	nan
11	22	253

A data set containing the productivity of different-sized teams in a manufacturing plant, with some missing values. This data set was collected in order to be analyzed and also to be used as the basis for a model to be built for predictive purpose, such that it will not be hard to know the productivity of each teams given the number of the team. But there are some missing values in the dataset(nan), and as such, any analysis performed or any model built on it would have inadequacies and would

birth inadequate results.

Hence, the data set needs to be cleaned and missing values have to be replaced so that a proper analysis can be performed and an accurate model can be built.

Using the linear interpolation formula:

$$y = y_1 + \frac{(x - x_1)(y_2 - y_1)}{(x_2 - x_1)}$$

Where the independent variable  $x$  is the Number of employees and the dependent variable  $y$  is the Products per day.

Solving for the products(per day) which corresponds with 15 number of employees:

$$X_1 = 14$$

$$X_2 = 16$$

$$Y_1 = 170$$

$$Y_2 = 192$$

$$X = 15$$

$$y = 170 + \frac{(15 - 14)(192 - 170)}{(16 - 14)}$$

$$y = 170 + \frac{(1)(22)}{(2)}$$

$$y = 170 + \frac{22}{2}$$

$$y = 181$$

Solving for the products(per day) which corresponds with 17 number of employees:

$$X_1 = 16$$

$$X_2 = 18$$

$$Y_1 = 192$$

$$Y_2 = 213$$

$$X = 17$$

$$y = 192 + \frac{(17 - 16)(213 - 192)}{(18 - 16)}$$



$$y = 192 + \frac{(1)(21)}{(2)}$$

$$y = 192 + \frac{21}{2}$$

$$y = 202.5$$

Solving for the products(per day) which corresponds with 21 number of employees:

$$X_1 = 20$$

$$X_2 = 22$$

$$Y_1 = 231$$

$$Y_2 = 253$$

$$X = 21$$

$$y = 231 + \frac{(21 - 20)(253 - 231)}{(22 - 20)}$$

$$y = 231 + \frac{(1)(22)}{(2)}$$

$$y = 231 + \frac{22}{2}$$

$$y = 242$$

Since the missing values in the data set have been found, analysis can take place, accurate models can be formulated and predictions can be accurate.

SN	Number of employees	Products per day
1	12	152
2	13	161
3	14	170
4	15	181
5	16	192
6	17	202.5
7	18	213
8	19	222
9	20	231
10	21	242
11	22	253

## 3.4 Project Carried Out

### 3.4.1 Image Compression using Singular Value Decomposition (SVD)

Digital images often take up a lot of storage space and can be slow to transmit over networks. Image compression techniques can help reduce the size of images while preserving their quality. One such technique is Singular Value Decomposition (SVD), which is based on matrix factorization and can be used to extract the most important features of an image.

The goal of this project is to explore the use of SVD for image compression and evaluate its effectiveness compared to other techniques.

#### Libraries and software used

1. Singular Value Decomposition: is a powerful matrix factorization technique used in linear algebra and numerical analysis. It decomposes a matrix into three separate matrices and provides valuable insights into the properties and structure of the original matrix.

Mathematics behind SVD: Given an  $m \times n$  matrix  $A$ , the SVD factorizes it into three matrices as follows:

$$A = UWV^T$$

where:

$U$ :  $m \times n$  matrix of the orthonormal/orthogonal eigenvectors of  $AA^T$

$W$ :  $n \times n$  diagonal matrix of the singular values which are the square root of the eigenvalues of  $AA^T$

$V^T$ : transpose of a  $n \times n$  matrix containing the orthonormal eigenvectors of  $AA^T$

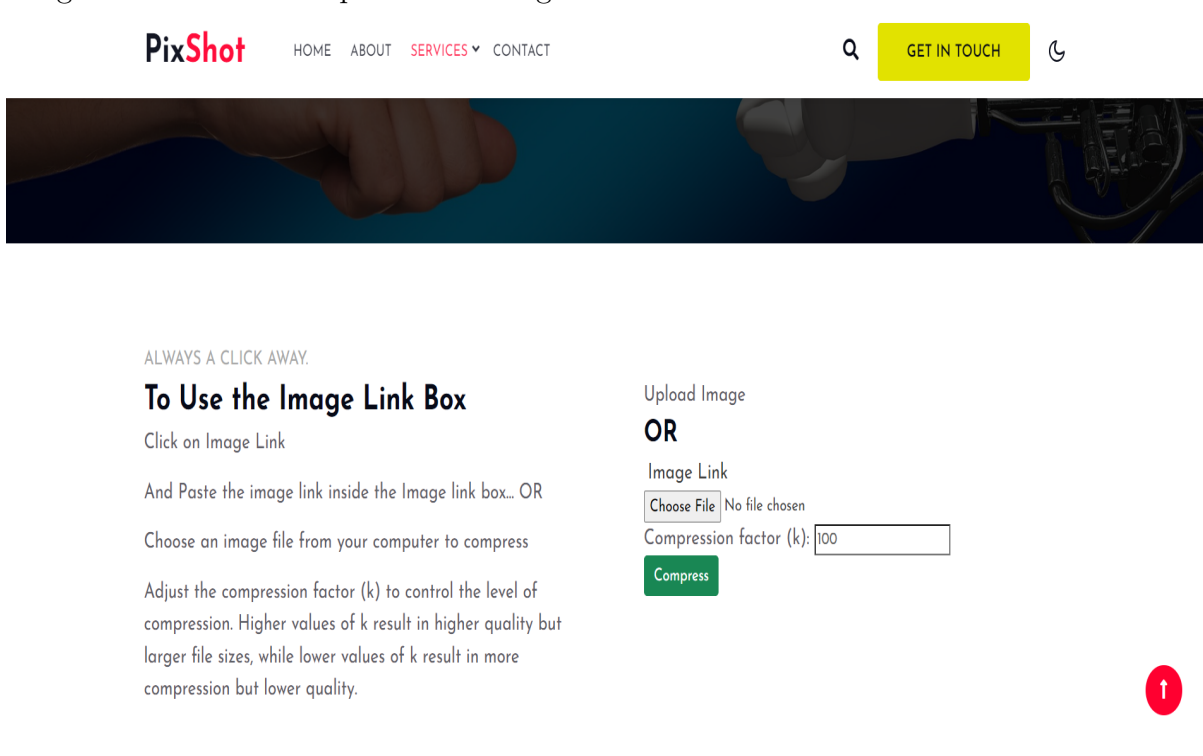
2. Flask: Flask is a lightweight web framework used to build web applications.
3. NumPy: NumPy is a fundamental library for scientific computing in Python and provides support for efficient array operations.
4. OpenCV: OpenCV is a popular computer vision library that offers extensive tools for image and video processing.
5. SciPy: SciPy is a library that provides scientific and technical computing functionalities, including the SVD computation.

The image compression process using SVD in Flask involves the following steps:

1. **Setup:** The Flask framework is imported, which provides the necessary functionalities for building a web application. Relevant libraries such as NumPy, OpenCV, and SciPy are imported to handle image processing, SVD computation, and file operations.

```
app.py C:\...\myproject\... 9+  app.py C:\...\itproject\... X
C: > Users > TESTL > itproject > web > app.py > compress
1  from flask import Flask, request, render_template, send_file, send_from_directory
2  import numpy as np
3  import cv2
4  from scipy.linalg import svd
5  import base64
6  import os
7  import matplotlib.image as img
8  from io import BytesIO
9  from werkzeug.utils import secure_filename
10 import requests
11 import urllib.request
12 import uuid
13 from urllib.parse import urlparse
14 import time
15 import random
16 import string
17
18
```

2. **Flask Routes:** The Flask routes are defined to handle different stages of the image compression process. The '/' route renders the compress.html template, which displays the form for image selection and compression settings.



The screenshot shows the PixShot website interface. At the top, there is a navigation bar with the PixShot logo, links for HOME, ABOUT, SERVICES, and CONTACT, a search icon, a 'GET IN TOUCH' button, and a refresh icon. Below the navigation bar is a large banner image showing a hand holding a camera. The main content area is titled 'ALWAYS A CLICK AWAY.' and 'To Use the Image Link Box'. It provides instructions on how to use the image link box and how to upload an image file. On the right side, there is a form for uploading an image. The form has two options: 'Upload Image' and 'OR Image Link'. Under 'Image Link', there is a 'Choose File' button and a text input field with the value 'No file chosen'. Below this, there is a 'Compression factor (k):' label and a text input field with the value '100'. At the bottom of the form, there is a green 'Compress' button. A red circular icon with a white upward arrow is visible in the bottom right corner of the page.

The '/compress' route is triggered when the form is submitted. It performs the image compression using SVD and returns the compressed image and relevant information to the template.

The screenshot shows the PixShot website header with navigation links: HOME, ABOUT, SERVICES (with a dropdown arrow), and CONTACT. There is a search icon and a yellow 'GET IN TOUCH' button. Below the header is a dark banner image. The main content area has the heading 'ALWAYS A CLICK AWAY.' followed by 'To Use the Image Link Box'. It provides instructions: 'Click on Image Link', 'And Paste the image link inside the Image link box... OR', 'Choose an image file from your computer to compress', and 'Adjust the compression factor (k) to control the level of compression. Higher values of k result in higher quality but larger file sizes, while lower values of k result in more compression but lower quality.'

Below the instructions is a form with two options: 'Upload Image' and 'OR Image Link'. The 'Image Link' section has a 'Choose File' button (showing 'No file chosen') and a 'Compression factor (k):' input field with the value '100'. A green 'Compress' button is at the bottom of the form.

To the right of the form is a diagram comparing 'Original Image' and 'Compressed Image' processes. The 'Original Image' process shows 'DATA INPUT' going into 'Traditional Programming' to produce 'Output'. The 'Compressed Image' process shows 'DATA INPUT' going into 'Image Compression' to produce 'Output'. A red circle with an upward arrow points to the 'Compressed Image' section.

3. Image Compression: When the user selects an image, either through file upload or by providing a link, the selected image is read and stored. The selected image is then decomposed into three color channels (R, G, B) using OpenCV. Singular Value Decomposition (SVD) is performed on each color channel using the SciPy library. The desired compression level is obtained from the form, and the number of singular values to retain (k) is determined. Compression is performed by multiplying the truncated U, W, and V matrices obtained from SVD. The compressed channels are merged back into a color image.

```

# Store the selected image
selected_image = img

# Perform SVD on the image channels (R, G, B)
img_r, img_g, img_b = cv2.split(selected_image)
U_r, S_r, V_r = svd(img_r)
U_g, S_g, V_g = svd(img_g)
U_b, S_b, V_b = svd(img_b)

# Get the value of k from the form
k = int(request.form.get('k', 100)) # Default value of 100 if 'k' is not provided

# Perform compression by keeping only a subset of singular values
compressed_img_r = U_r[:, :k] @ np.diag(S_r[:k]) @ V_r[:, k, :]
compressed_img_g = U_g[:, :k] @ np.diag(S_g[:k]) @ V_g[:, k, :]
compressed_img_b = U_b[:, :k] @ np.diag(S_b[:k]) @ V_b[:, k, :]

# Merge the compressed channels back into a color image
compressed_img = cv2.merge((compressed_img_r, compressed_img_g, compressed_img_b))

```

## Application of Singular Value Decomposition

Given an Image Matrix A:

$$\begin{bmatrix} 100 & 150 & 200 \\ 50 & 75 & 125 \\ 25 & 175 & 225 \end{bmatrix}$$

Since SVD of A is

$$UWV^T$$

Let obtain the value of U:  $= A * A^T$

$$\begin{bmatrix} 100 & 150 & 200 \\ 50 & 75 & 125 \\ 25 & 175 & 225 \end{bmatrix} \times \begin{bmatrix} 100 & 50 & 25 \\ 150 & 75 & 175 \\ 200 & 125 & 225 \end{bmatrix} = \begin{bmatrix} 65000 & 55000 & 80000 \\ 55000 & 47500 & 70000 \\ 80000 & 70000 & 102500 \end{bmatrix}$$

Next is to find the eigenvalues and eigenvectors of  $A * A^T$ .

Solving the eigenvalue problem, we find that the eigenvalues are:

$$\lambda_1 = 202,500$$

$$\lambda_2 = 2,500$$

$$\lambda_3 = 100$$

The corresponding eigenvectors are

$$V_1 = [0.666, 0.561, 0.491]$$

$$V_2 = [0.702, -0.699, -0.141]$$

$$V_3 = [-0.254, -0.444, 0.859]$$

Then normalize the eigenvectors to obtain the columns of U:

$$U_1 = V_1/||V_1|| = [0.646, 0.543, 0.475]$$

$$U_2 = V_2/||V_2|| = [0.821, -0.818, -0.166]$$

$$U_3 = V_3/||V_3|| = [-0.251, -0.437, 0.843]$$

The U matrix is formed by the normalized eigenvectors as columns:

$$\begin{bmatrix} 0.646 & 0.821 & -0.251 \\ 0.543 & -0.818 & -0.437 \\ 0.475 & -0.166 & 0.843 \end{bmatrix}$$

Let obtain the value of W:

$$\begin{bmatrix} \sqrt{\lambda_1} & 0 & 0 \\ 0 & \sqrt{\lambda_2} & 0 \\ 0 & 0 & \sqrt{\lambda_3} \end{bmatrix} = \begin{bmatrix} 471.27 & 0 & 0 \\ 0 & 72.62 & 0 \\ 0 & 0 & 1.64 \end{bmatrix}$$

Let get the value of  $V^T$  :

*The  $V^T$  matrix is formed by the normalized eigenvectors as columns :*

$$\begin{bmatrix} -0.742 & -0.451 & 0.496 \\ 0.637 & 0.535 & 0.555 \\ -0.206 & 0.715 & 0.668 \end{bmatrix}$$

Next step is to reconstruct the image: To reconstruct the image, we can use a subset of the singular values and their corresponding singular vectors. Let's say we retain the first singular value and its associated singular vector.

Reconstructed Matrix:

$$U[:, 0 : 1] @ W[0 : 1, 0 : 1] @ V^T[0 : 1, :]$$

$$\begin{bmatrix} 90.68 & 136.38 & 184.94 \\ 56.15 & 84.22 & 114.77 \\ 30.28 & 45.47 & 61.94 \end{bmatrix}$$

In this example, we retained only the first singular value and its corresponding singular vector. As a result, the reconstructed image matrix is an approximation of the original image matrix. Please note that for larger images, the matrix dimensions and the number of singular values/vectors would increase accordingly.

4. File Operations and Display: The compressed image is encoded as base64 and passed to the compress.html template to display it to the user.

```
# Encode the compressed image as base64
_, img_encoded = cv2.imencode('.jpg', compressed_img)
compressed_img_base64 = base64.b64encode(img_encoded).decode('utf-8')

# Encode the selected image as base64
_, selected_img_encoded = cv2.imencode('.jpg', selected_image)
selected_img_base64 = base64.b64encode(selected_img_encoded).decode('utf-8')

# Encode the compressed image as base64
_, compressed_img_encoded = cv2.imencode('.jpg', compressed_img)
compressed_img_base64 = base64.b64encode(compressed_img_encoded).decode('utf-8')

# Generate a unique filename for the compressed image
random_string = ''.join(random.choices(string.ascii_letters + string.digits, k=8))
compressed_image_filename = f"compressed_{time.time()}_{random_string}.jpg"
compressed_image_path = os.path.join(app.config['DOWNLOAD_FOLDER'], compressed_image_filename)
```

Relevant information such as original image size, compressed image size, and compression differences are calculated and passed to the template for display. The compressed image is saved with a unique filename in the download folder to enable downloading.

```

# compress = compressed_img.nbytes
now = round(selected_image.nbytes, 3)
noow = round(now/ 1024, 3)
new = round(now/1024/1024, 3)

# Get the file size of the compressed image in megabytes
compressed_file_size_b = round(len(compressed_img_encoded), 3)
compressed_file_size_kb = round(len(compressed_img_encoded) / (1024), 3)
compressed_file_size_mb = round(len(compressed_img_encoded) / (1024 * 1024), 3)

# Difference
byte_diff = round(now - compressed_file_size_b, 3)
kb_diff = round(noow - compressed_file_size_kb, 3)
mb_diff = round(new - compressed_file_size_mb, 3)

# Return the compressed image and selected image to the template
return render_template('compress.html', new = new, compressed_image=compressed_img_base64,
selected_image=selected_img_base64, k=k,
now = now, noow = noow,
compressed_file_size_b = compressed_file_size_b,
compressed_file_size_kb = compressed_file_size_kb,

```

**PixShot**

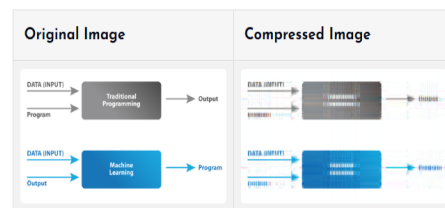
HOME ABOUT SERVICES CONTACT



GET IN TOUCH



Adjust the compression factor (k) to control the level of compression. Higher values of k result in higher quality but larger file sizes, while lower values of k result in more compression but lower quality.



Space needed to store the image	Original Image	Compressed Image	Difference
Bytes:	<b>1083780</b>	<b>61296</b>	<b>1022484</b>
Kilobytes:	<b>1058.379</b>	<b>59.859</b>	<b>998.52</b>
Megabytes:	<b>1.034</b>	<b>0.058</b>	<b>0.976</b>

[Download Compressed Image](#)



The web application successfully compresses images using Singular Value Decomposition (SVD) and provides relevant information to the user. The user can select an image through file upload or by providing a link, and the application displays the original image, the compressed image, and information about the compression process, including image sizes and differences. The user can also download the compressed image. This project demonstrates the implementation of image compression using Singular Value Decomposition (SVD) within a Flask web application. The application allows users to compress images by adjusting the compression level and provides visual feedback and relevant information. The use of Flask, NumPy, OpenCV, and SciPy libraries enables efficient



image processing and SVD computation. This project can serve as a basis for further exploration and optimization of image compression techniques using SVD within web applications. The quality of the compressed image depends on the number of retained singular values. Higher values of  $k$  preserve more image details but result in larger file sizes. Lower values of  $k$  lead to higher compression ratios but may result in noticeable loss of image details and increased distortion. By leveraging the properties of SVD, image compression techniques can reduce the storage space required for images while maintaining an acceptable level of visual quality.

# CHAPTER FOUR

## Conclusion and Recommendation

### 4.1 Conclusion

The Students' Industrial Work Experience Scheme (SIWES) provides students with the opportunity to gain practical experience and apply their knowledge in real-world scenarios. During my SIWES program, I had the privilege to work in a company specializing in data science(machine learning, Data Engineer) where I focused on the implementation of image compression techniques using Singular Value Decomposition (SVD).

The SIWES program provided me with an excellent opportunity to gain hands-on experience in image compression using Singular Value Decomposition (SVD). The project enhanced my understanding of image processing techniques and their practical applications in industry. Through this experience, I gained valuable insights into the challenges and trade-offs involved in image compression, as well as the importance of optimizing compression algorithms to achieve the desired balance between compression ratio and image quality.

### 4.2 Recommendation

Based on the experiences acquired in the cause of the Industrial Training, I would like to make the following recommendations:

#### 4.2.1 To Students

1. The students should be focused and discipline during and after the program. They should not prioritize money over knowledge and experience.
2. Students should learn with humility as they meet people who may not measure up to their qualification in view.

#### 4.2.2 To ITF, The Institution and the Government

1. The government should penalize any organization that uses IT students for unrelated menial job without been payed.
2. The Industrial Training Fund should ensure proper supervision of student during the SIWES so that the aim of the scheme will be achieved.

# References

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