



PES UNIVERSITY, BANGALORE

Department of Computer Science and Engineering

B.TECH. (CSE)

V SEMESTER

UE20303 –SOFTWARE ENGINEERING

PROJECT REPORT

ON

Career Recommendation System

SUBMITTED BY

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PROPOSAL OF THE PROJECT

NEED OF THIS APPLICATION

We live in a progressive world, where technology is developing at a very quick rate. There are lot of opportunities in various fields from which we can make a career out of. We work on several things which interest us but due to our vested interests we may not see the entire picture. This leads to confusion and taking up a route which may not be entirely optimal. This is where career recommendation may help you take the better decision. This application provides guidance to a person to have a clear glimpse on what to pursue and how they may go about pursuing the same.

WORKING OF THE PROJECT

The main purpose of this application is to take inputs from users such as marks, skills, interests, and other additional information, and based on the inputs the application suggests the best suited branch and recommend the best career choices.

ADVANTAGES

1. Students get a better understanding about exactly how and where they fit.
2. The application provides a comprehensive guide to the users, as to what they would be a good fit for and what other resources they need to ensure that they are even a better fit.
3. Assists and provides more information to users about the field they may be good at, which makes choosing a field of study easier.



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FEATURES

1. Create an account if you are a new user and login if you are an existing user.
2. Enter Information Page: User enters various details like Basic Information, Academics Information, interests, hobbies, etc.
3. Output Page: Based on the user inputs and after analysis of the information, the user can view a detailed report on the best suited courses and career options for them along with detailed description for each recommendation. The application also suggests the users the skills they must be proficient in.

MODULES USED

1. Python Flask: A web application framework. It is small and easy-to-extend core.
2. Pandas: It is a library used for python programming language for analysis and data manipulation. To manipulate numeric tables and time series which can be done by data structures and operations.
3. Anova: Analysis of Variance, it is a statistical method, and it is used to test differences between two or more independent regions.
4. Programming Language: Python, JavaScript, HTML, CSS.



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Software Requirements Specification

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Revision History

Name	Date	Reason For Changes	Version

1. Introduction

1.1 Purpose

This Software Requirements Specification (SRS) document will provide a detailed description of the steps, phases and designs necessary for the Career Recommendation System. This SRS document will allow for a complete understanding, of what is to be expected of the CRS to be constructed. A clear understanding of the system and its functionality will allow for the correct software system to be developed for the users of the software and will be used for the development of the future stages of the project. This SRS document will provide the foundation for the project. This SRS document will be used by the software engineers for helping and working side by side with the system analysts while constructing the CRS. The software engineers will also use the SRS document to fully understand the expectations of this CRS, to construct the appropriate software.

1.2 Intended Audience

It is intended that the document may be read by development and design team, quality assurance and testing team, project manager, courier management staff as well as marketing staff. It is suggested to read the document carefully, especially the points highlighted need more intention of the readers. The readers are expected to read the reference books and visit reference sites in case of any inconvenience during reading the document.

1.3 Product Scope

Students are the citizens of the future, and it is necessary that they understand exactly how and where they fit. In the long and arduous path to education, they take up many extracurricular works, which may or may not be academic. These include everything like competitions,



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internships, and projects they have done. All these count as factors along with their education, in their path for the future. The students must be advised on what steps they can take in future to begin their career. It is very easy to be led astray by external sources due to large amount of information that is available. Hence, we must give them a comprehensive guide as to what they would be a good fit for.

1.4 References

Software Engineering: Principles and Practice, Hans van Vliet

Software Engineering: Sommerville Machine

learning by Tom Mitchell

<https://towardsdatascience.com/>

2. Overall Description

2.1 Product Perspective

For college students when facing various career options upon graduation or at any phase of learning, it could be overwhelming to choose a job that better fits with his/her future goals. This is when people start to look for other people who have similar backgrounds to see what their decisions were and where did they end up. Instead of consulting only a few acquaintances, we present a way to help people learn from thousands of others with similar backgrounds and find the best career steps that enable them to reach their goals.

Description of Proposed System:

The first phase of the system namely the prediction stage involves the development of a classifier by extracting unique values of individual employee profile has been extracted and frequencies have been calculated based on various attributes. The second phase namely the



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recommendation stage recommends the user with its predicted career which is possibly attained with the help of highest accuracy obtained through various algorithms which must be carried after the user enters his personal details.

2.2 Product Functions

The main objective of this project is given below:

- User enters various details like Basic Information, Academics Information, interests, hobbies, etc.
- Based on the user inputs and after analysis of the information, the user can view a detailed report on the best suited courses and career options for them along with detailed description for each recommendation.
- Students get a better understanding about exactly how and where they fit.
- The application provides a comprehensive guide to the users, as to what they would be a good fit for and what other resources they need to ensure that they are even a better fit.
- Assists and provides more information to users about the field they may be good at, which makes choosing a field of study easier

2.3 User Classes and Characteristics

Roles and characteristics of each class are discussed here.

- The login details database can be accessed by only those having administrative rights to perform different operations on data from the database.
- Customer/Public will be able to access all the features only if they login or sign up.

2.4 Operating Environment

The proposed system will be able to operate in any operating system.

2.5 Design and Implementation Constraints

The above functionalities are available to all users. To maximize the privacy of data, everyone will have his/her own user ID & password. Only authorized persons will have the access to specific features of the system.



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2.6 Assumptions and Dependencies

- All users are supposed to know how to use the system and basic knowledge about the system.
- It is assumed that the computer system having the proposed system will have enough memory and efficiency to have compatibility with the system.
- The efficiency of system depends upon the interaction of users with the system, overall load to the system & other factors.

3.External Interface Requirements

3.1 User Interfaces

- The interface includes a web page with login/signup options. The interface asks the users multiple questions on the basis of which our model will give a recommendation to the user.
- Our system will make use of the existing web browser such as Microsoft internet explorer or Mozilla.

3.2 Software Interfaces.

- Client on internet: Web browser (Chrome, Mozilla Firefox)
- Operating system (Any)
- Database
- Modules of python-flask.
- Machine learning algorithms

3.3 Communications Interfaces

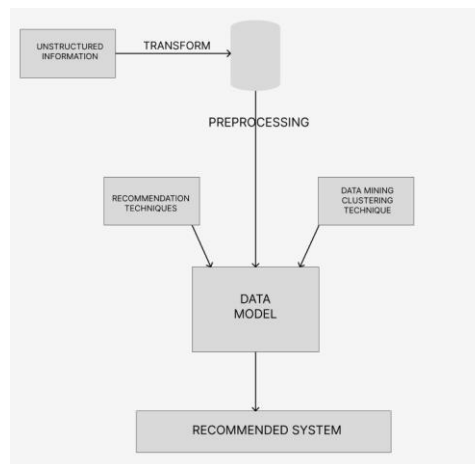
- The career recommendation system shall use the HTTP protocol for communication over the internet.
- Mailing platform services.

4. Analysis Models



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5. System Features

Following are the main features of the system

5.1 Sign Up

5.1.1 Description & Priority

Sign up is the top priority function. Each user is supposed to sign up to the system once and hence to use the feature at least once. The function will create an account for the user providing login credentials.

5.1.2 Stimulus/Response Sequence

After finish sign up, the user will be able to enter their details and get results based on their inputs.

5.1.3 Functional Requirements

The user once signed up to the system do not need to sign up again. Instead, he/she will login to the system. Only signed up users can log into the system.



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5.2 Login

5.2.1 Description & Priority

Login is the most basic & Primary feature of the system which provides privacy as well as secure and safe use of the system. All users are supposed to login to the system first to access the provided features. The user is supposed to provide his/her User ID to login to the system. The users having no login account will sign up to get access to login by creating their account.

5.2.2 Stimulus/Response Sequence

User will be logged in after providing his customer ID as his username and password. The user will be offered to create a new account if he/she does not have an account already.

5.2.3 Functional Requirements

- The user will have to first provide his/her user ID and password before getting logged into the system.
- Users providing valid credentials will be logged into the system
- For invalid credentials, the system will generate “INVALID USER ID or PASSWORD” error.
- The user can create account at the time of log in if he/she is not signed into the system first.

5.3 Enter User Information

5.3.1 Description & Priority

The user after logging in must enter various details like:

- Basic Information
- Academics Information
- Interests
- Hobbies and other details.



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This page is the most important, since without getting inputs from user we cannot predict the career.

5.3.2 Stimulus/Response Sequence

Once the user enters their details, the information will be fed to the model developed and the prediction will be made based on the inputs.

5.3.3 Functional Requirements

- The user will have to fill the required fields.
- All required fields must be filled, otherwise an error will be generated.
- The prediction will be made on the user's input, so the prediction would be best only if the details provided by the user is accurate.

5.4 Output Reports Page

5.4.1 Description & Priority

Once the user enters the inputs and the prediction is made, a report page appears. Based on the user inputs and after analysis of the information, the user can view a detailed report on the best suited courses and career options for them along with detailed description for each recommendation. The page also suggests the users the skills they must be proficient in.

5.4.2 Stimulus/Response Sequence

This is the final output page. The user can use this information to get insights about their career path.

6. Non-functional Requirements

6.1 Performance Requirements

- The system will be efficient to response & simpler and easy to use.
- Application will take less memory space and will run smoothly.



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6.2 Safety Requirements

- New system is safe to use.
- Its usage will not provide any damage or any type of loss of data of the systems currently in use and no leakage of user data.

6.3 Security Requirements

- Security of the system shall be maintained through the username and password.
- Each user will need to be authenticated with a login ID and password.
- There will be a table of all the users in database along with usernames login IDs and passwords of authorized users.
- Only authorized users can access the database.

6.4 Software Quality Attributes

- The proposed system will be a quality system for the different users like students, graduates and working professionals.
- The system will be highly Adaptable, Available, and Portable.

6.5 Business Rules

- The information shared by the users is secured and not shared or published anywhere.

Appendix A: Glossary

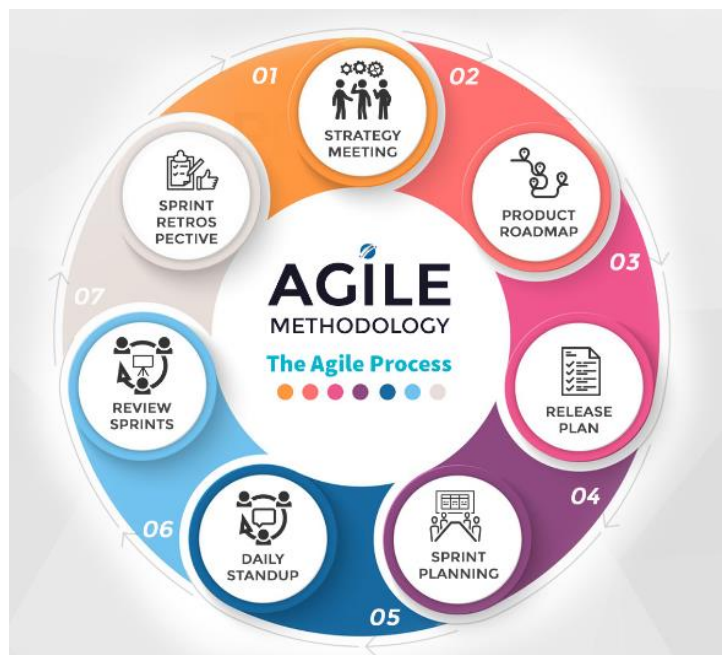
TERMS	MEANING
CRS	Career Recommendation System
SRS	Software Requirements Specification

Project Plan Document

1. Identify the lifecycle to be followed for the execution of your project and justify why you have chosen the model.

Agile Model

Agile Model uses cyclical, iterative progression to produce working software.



The four values of the Agile Manifesto include:

1. Individuals and interactions over processes and tools.
2. Working software over comprehensive documentation.



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3. Customer collaboration over contract negotiation.
4. Responding to change over following a plan.

These values are designed to make a software development process focused on quality and oriented to meeting customers' needs.

The main reasons for selecting the Agile Model are:

- The Agile methodology is well-suited for small teams—the fewer people there are on the team, the easier it is to collaborate and make decisions.
- Faster deployment of software, so you get value sooner
- It's easier for the team to adapt to your requested changes
- Developers quickly detect and fix issues
- You don't have a fixed budget
- They don't know all the requirements

Other traditional models like the Waterfall works best for projects that have well-defined deliverables and concrete timelines. For our project, the project's constraints are unclear. So Agile is the better SDLC, as it enables the developers to be more flexible.

2. Identify the tools which u want to use it throughout the lifecycle like planning tool, design tool, version control, development tool, bug tracking, testing tool.



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Planning Tool – JIRA

Design Tool – Figma

Version control- Git

Development tool- JIRA

Bug tracking- JIRA

Testing tool- Jenkins

3. Determine all the deliverables and categorise them as reuse/build components and justify the same.

The Following are the deliverables:

i) Login Page and Sign-Up Page with database integration:

BUILD COMPONENT

- The login page allows a user to gain access to an application by entering their username and password or by authenticating using a social media login.
- A user is automatically logged out due to inactivity. In this event, they will be returned to the login page, which will display an informational message explaining what happened.
- Once the user logs in again, they should be taken back to the page they were previously on before being timed out.
- A user has forgotten their username and/or password. A link is available to begin the process to reset this information. Once the user clicks on one of these links, the contents of the login page is



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replaced with fields specific to recovering their username and/or password.

- The user could provide their e-mail and be sent a temporary password or a link to reset their password.

ii) User Enters Details Page:

BUILD COMPONENT

In this page, the user fills in various details which will be used by the ML Model for prediction.

Details category 1: Personal Details:

1. First Name
2. Last Name
3. Email
4. Profile Picture (optional)

Details category 2: Educational Details:

1. Highest Qualification
2. Marks for 10th, 12th, and College Marks. + more details.

Details category 3: Activities Details

1. Project Details
2. Hackathons and Contest Participated Details
3. Social Activities Details
4. Interests
5. Hobbies + more details

iii) Output Report Page



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BUILD COMPONENT

The output report page will have the following details:

1. Complete detailed report of recommended career.
2. Each Recommended career will have a detailed description and with explanation for why it best suits the user.
3. The best suited skills they should learn, along with hyperlinks to the best learning resources available on the web.
4. A brief description of the roadmap for a particular career.

iv) Machine Learning – Career recommendation engine

BUILD COMPONENT

This ML engine will be able to recommend the best suited career paths.

The Aim is to come up with a career recommender system, which takes the skills from LinkedIn throws the best career options available for you according to your skills.

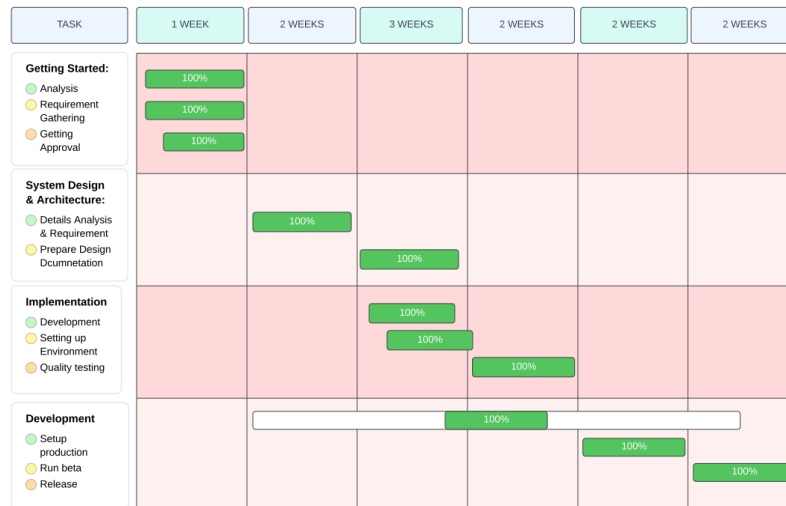
Process: The dataset used is a dataset consisting of LinkedIn profile information. The best matching career options are showed based on matching percentage. We will be using various machine learning algorithms and select the one with best accuracy. The algorithms will be trained on the datasets.

4. Create a WBS for the entire functionalities in detail.



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5. Do a rough estimate of effort required to accomplish each task in terms of person months.

Login Page and Sign-Up Page with database integration – 1 Week

User Enters Details Page – 1 Week

Machine Learning Career recommendation engine – 3 Weeks

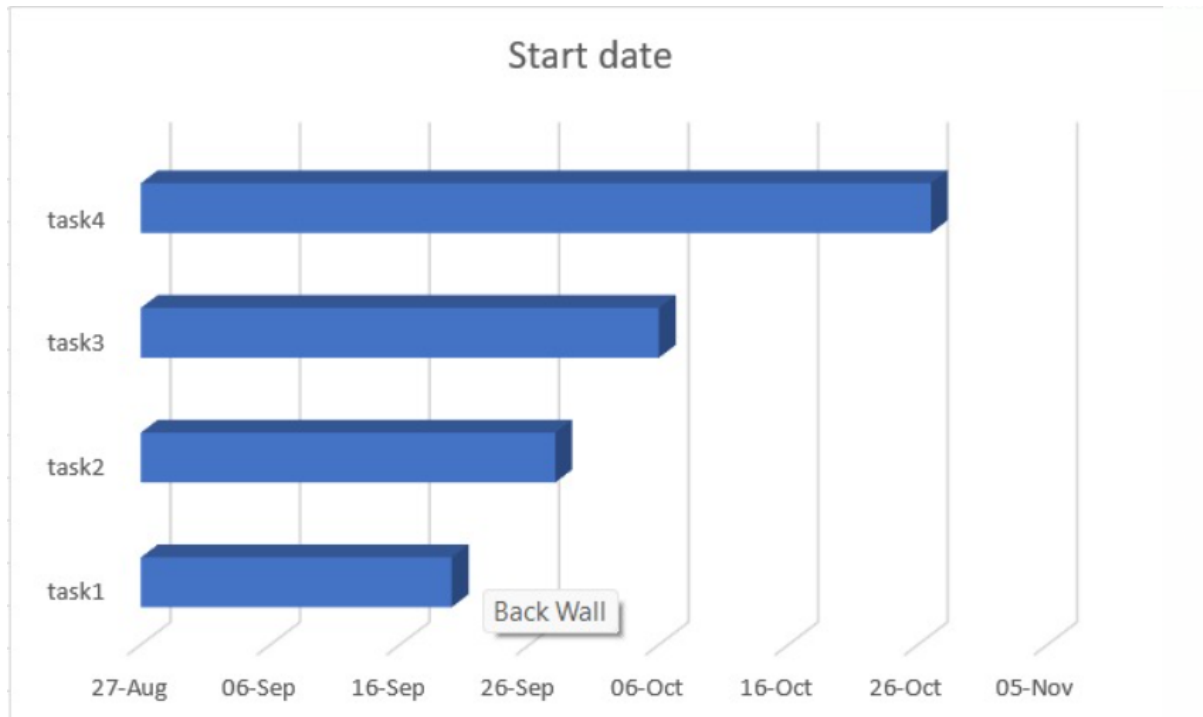
Output Report Page – 2 Weeks



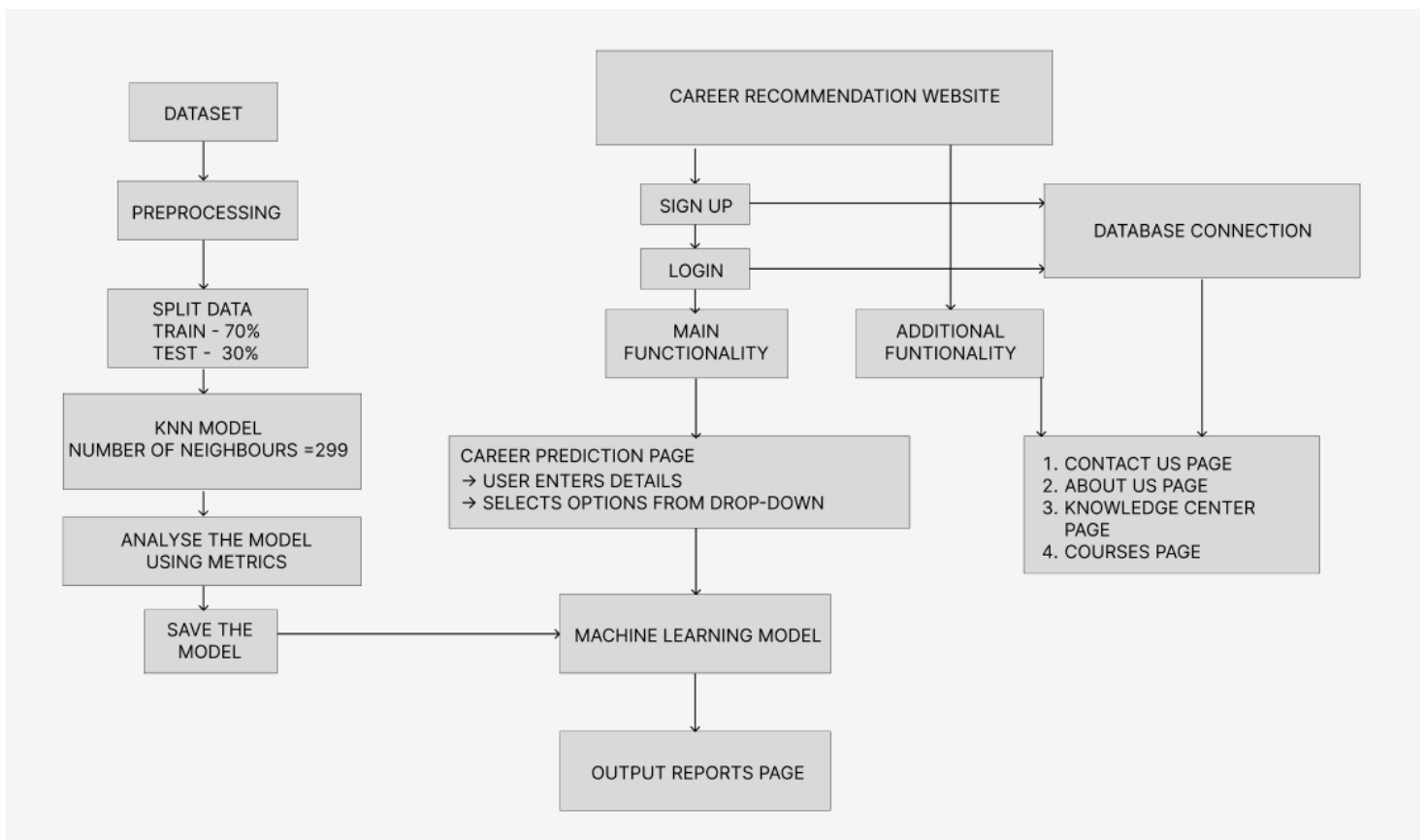
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6. Create the Gantt Chart for scheduling using any tool.



DESIGN DIAGRAM





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TEST CASES

UNIT TEST CASES

Module	Test Case Type	Description
Login Page	Valid	Verify if a user will be able to login with a valid username and valid password
Login Page	Valid	Verify if a user cannot enter the SPECIFIED characters (No special characters)
Login Page	Invalid	Verify if a user cannot login with a valid username and an invalid password
Login Page	Invalid	Verify the login page for both when the field is blank and Submit button is clicked.
Sign Up Page	Valid	Verify if a user will be able to sign with a valid username and valid password.
Sign Up Page	Valid	Verify if a user cannot enter the characters more than the specified range in each field.
Sign Up Page	Invalid	Verify if a user cannot sign-up with a invalid email id verify the sign up page for both, when the field is blank and Submit button is clicked.
Contact Us Page	Valid	Check is the name accept valid names. Check the name fields that accept the alphanumeric



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		values.
Contact Us Page	Valid	Check is the email field allows valid e-mail ids. For example: username@example.com should be accepted.
Contact Us Page	Invalid	Check if the user enters an invalid name and then if the warning message is displaying or not. Check is the system rejects the invalid name
Contact Us Page	Invalid	Check is the warning or error message is displaying on entering the invalid e-mail ids. For example: "username.example@com" should not be accepted.

Boundary Value Analysis:

Contact us form.

we have decided the range of the age to be between 1 and 150. So, the Boundary value test cases would be:

INVALID TEST CASE (MINIMUM VALUE -1)	VALID TEST CASES (MIN, MIN+1, MAX, MAX-1)	INVALID TEST CASE (MAX VALUE +1)
0	1,2,150,149	151



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VALID TEST CASES

<p>Send A Message</p> <p>Adithya</p> <p>1</p> <p>adithyan2002@gmail.com</p> <p>Nice Website</p> <p>Thanks</p> <p>localhost says Your message has been sent</p> <p>OK</p>	<p>Send A Message</p> <p>Bob</p> <p>2</p> <p>bob@gmail.com</p> <p>Works Well</p> <p>Works Well</p> <p>localhost says Your message has been sent</p> <p>OK</p>
<p>Send A Message</p> <p>Bush</p> <p>150</p> <p>Bush@gmail.com</p> <p>Thanks for the recommendation</p> <p>Thanks for the recommendation</p> <p>localhost says Your message has been sent</p> <p>OK</p>	<p>Send A Message</p> <p>Karthik</p> <p>149</p> <p>Karthik@gmail.com</p> <p>Great work guys</p> <p>Great work guys</p> <p>localhost says Your message has been sent</p> <p>OK</p>

INVALID TEST CASES

<p>Send A Message</p> <p>Jalpy</p> <p>0</p> <p>Jalpy@gmail.com</p> <p>Good Work</p> <p>Good Work</p>	<p>localhost says Please enter the age within the limit 1 and 150</p> <p>OK</p>
<p>Send A Message</p> <p>Matt</p> <p>151</p> <p>Matt@gmail.com</p> <p>Thanks Guys</p> <p>Thanks Guys</p>	<p>localhost says Please enter the age within the limit 1 and 150</p> <p>OK</p>



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MUTATION TESTING:

The mutants we have developed are taken such that:

1. We consider a lower value of n_neighbours
2. We consider a very large value of n_neighbours
3. We consider a moderate value of n_neighbours

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.3, random_state = 524)
from sklearn.neighbors import KNeighborsClassifier
from sklearn import metrics
scores = {}
knn = KNeighborsClassifier(n_neighbors=299)

knn.fit(X_train, y_train)
print('X_train', X_train)
print('y_train', y_train)
y_pred = knn.predict(X_test)
print('y_pred', y_pred)
scores[5] = metrics.accuracy_score(y_test, y_pred)
print('Accuracy=', scores[5]*100)

pickle.dump(knn, open('careerlast.pkl', 'wb'))
print('test file created')
```

Mutant 1: Low Value

```
knn = KNeighborsClassifier(n_neighbors=19)

knn.fit(X_train, y_train)
print('X_train', X_train)
print('y_train', y_train)
y_pred = knn.predict(X_test)
print('y_pred', y_pred)
scores[5] = metrics.accuracy_score(y_test, y_pred)
print('Accuracy=', scores[5]*100)

pickle.dump(knn, open('careerlast.pkl', 'wb'))
print('test file created')
```

Accuracy= 94.26289034132171
test file created
PS C:\xampp\htdocs\SE>

Mutant-2: Very high Value

```
knn = KNeighborsClassifier(n_neighbors=1000)

knn.fit(X_train, y_train)
print('X_train', X_train)
print('y_train', y_train)
y_pred = knn.predict(X_test)
print('y_pred', y_pred)
scores[5] = metrics.accuracy_score(y_test, y_pred)
print('Accuracy=', scores[5]*100)

pickle.dump(knn, open('careerlast.pkl', 'wb'))
print('test file created')
```

Accuracy= 93.42774146695714
test file created

Mutant 3: Moderate Value

```

knn = KNeighborsClassifier(n_neighbors=50)

knn.fit(X_train, y_train)
print('X_train', X_train)
print('y_train', y_train)
y_pred = knn.predict(X_test)
print('y_pred', y_pred)
scores[5] = metrics.accuracy_score(y_test, y_pred)
print('Accuracy=', scores[5]*100)

pickle.dump(knn, open('careerlast.pkl', 'wb'))
print('test file created')

```

Accuracy= 97.60348583877996
test file created
PS C:\xampp\htdocs\SE>

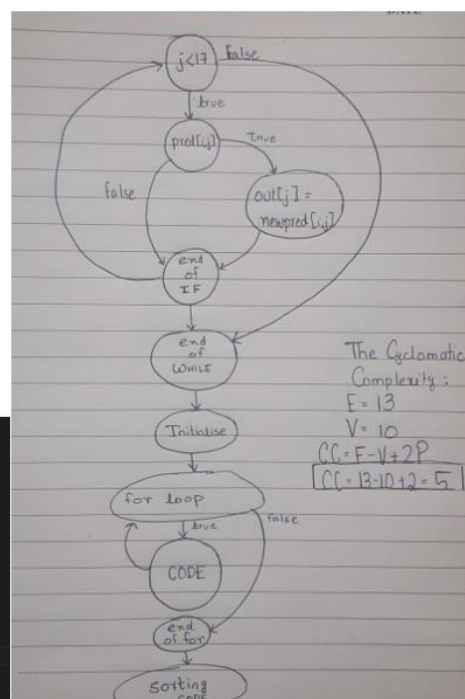
SO, we observe that the original code gives the best performance

STATIC TESTING:

```

while j<17:
    if pred[i,j]:
        output[j]=newpred[i,j]
    j += 1
# for key, values in output.items():
#     outputNames[key] = jobs_dict[key]
k=0
finalOutput = {}
finalArr=[]
for key, values in output.items():
    outputNames[key] = jobs_dict[key]
    finalOutput[jobs_dict[key]] = output[key]
    finalArr.append([values,output[key]])
finalArr = sorted(finalArr,key=lambda l:l[1], reverse=True)

```





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SCREEN SHOTS OF OUTPUT

1. Contact Us Page- Implemented. Meets user requirements.

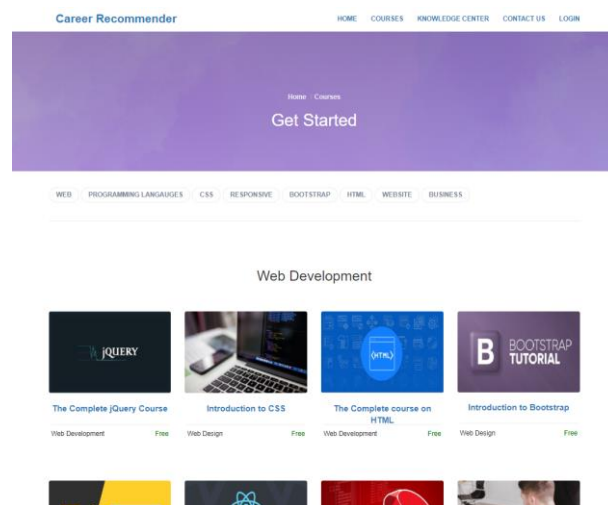
2. Knowledge Centre Page- Implemented. Meets user requirements.



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3. Courses Information Page – Implemented. Meets user requirements.



4. Enter User Information – Implemented. Meets user requirements.

Career.ly Home Courses Knowledge Center Contact Us Login

Please Fill in the Below details to help us find the Best suited Career for you!

Database Fundamentals:

Not Interested

Computer Architecture:

Not Interested

Distributed Computing Systems:

Not Interested

Cyber Security:

Not Interested

Computer Networking:

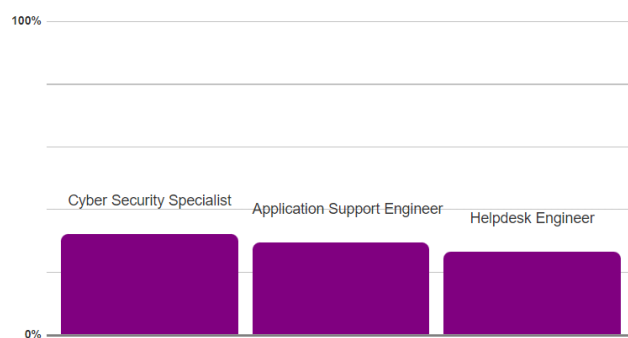


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4.Output Reports Page – Implemented. Meets user requirements.

These are the top jobs that matched your skills!



Cyber Security Specialist :
32.10702341137124% match

Application Support Engineer :
29.431438127090303% match

Helpdesk Engineer :
26.421404682274247% match

[Click to learn more About the Jobs](#)



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Software Engineering: Sommerville Machine Learning by Tom Mitchell

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K. Taunk, S. De, S. Verma and A. Swetapadma, "A Brief Review of Nearest Neighbor Algorithm for Learning and Classification," *2019 International Conference on Intelligent Computing and Control Systems (ICCS)*, 2019, pp. 1255-1260, doi: 10.1109/ICCS45141.2019.9065747.

<https://ieeexplore.ieee.org/document/9065747>

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