Software System for Engineering Joint Seat Allocation

UCS2201 – Fundamentals and Practice of Software Development

A PROJECT REPORT

Submitted By

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BONAFIDE CERTIFICATE

Certified that this project report titled "**Software System for Engineering Joint Seat Allocation**" is the bonafide work of "RITHEKHA.K(3122225001106), ROSHINI.R (3122225001113) and SHANKARI.S.R (3122225001125)" who carried out the project work in the UCS2201 – Fundamentals and Practice of Software Development during the academic year 2022-23.

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ABSTRACT

The Joint Seat Allocation System (JoSAA) is an online platform used in India for the centralized allocation of seats in engineering and technical programs. It involves the participation of numerous institutions and facilitates the transparent and merit-based allocation of seats to eligible candidates. JoSAA considers the preferences and ranks of candidates and conducts multiple rounds of seat allocation, allowing students to choose from available seats and institutions based on their merit and desired choices

INTRODUCTION

The Software System for Engineering Joint Seat Allocation is a revolutionary project aimed at automating and optimizing the seat allocation process for engineering courses. With a rapidly growing number of aspiring engineering students and an abundance of colleges offering engineering programs, there is a pressing need for an efficient and equitable seat allocation system. This software system addresses these challenges by leveraging advanced algorithms and technologies to ensure transparency, fairness, and effectiveness in the seat allocation process. In this report, we will explore the design, development, and potential impact of this system, highlighting its ability to streamline the admission process and reshape the future of engineering education.

PROBLEM STATEMENT

Develop a software system for the engineering counselling and admission process for two sets of institutes (for example, say IITs and NITs) each having a set of different branches, each branch with a certain number of seats available. Number of candidates can be assumed as 5 times the total number of seats available. Each candidate can provide a list of preferences where each preference is a 2-tuple, (institute, branch). Admission to each set of institutes is based on its own qualifying exam (for example, JEE-Advanced and JEE-Main). Each candidate will have a specific rank in one or both merit lists.

CONSTRAINTS

- Seat allotment for a candidate must be from the list of choices given by the candidate
- Number of preferences given by each candidate is limited to the number of institutes times the number of branches in each institute.
- Each candidate must be allotted only one of his/her choices
- All the available seats in all the branches in all the Institutes must be filled.
- If a student is denied a particular choice, then all those who were allotted that choice must be higher in the respective rank list (Merit should not be violated) .

OUTPUT

Allocation of institute and branch to each candidate as per policy

EXTENDED EXPLORATION OF THE PROBLEM STATEMENT

To gain a comprehensive understanding of the seat allotment process for engineering colleges, extensive research and information gathering were conducted. The research involved studying real-world practices and procedures for seat allocation by browsing the internet and analyzing the algorithms commonly employed. Additionally, insights were sought from individuals who registered for JOSSA (Joint Seat Allocation Authority), which is responsible for central seat allocation in India.

By researching the seat allotment process, we gained valuable insights into the complexities involved, the factors considered, and the best practices employed by reputed institutions. This knowledge formed the foundation for designing an effective system that could replicate and optimize the real-world seat allocation process.

Furthermore, interacting with JOSSA registrants allowed us to gather first-hand information about the information required during the registration process and the candidates' experiences. By understanding their expectations and challenges, we were able to align our system design with their needs and aspirations.

In addition to understanding the registration process and candidate experiences, we delved into analyzing the preferences provided by JOSSA registrants. This analysis helped us identify common patterns and factors that influenced candidate choices, such as the reputation of institutes, availability of preferred branches, and geographical location. Incorporating these insights, we developed an algorithm that considers candidate preferences to ensure an optimal seat allocation.

Moreover, the merit rankings of candidates played a significant role in our system design. By studying the ranking criteria used by exams like JEE-Advanced and JEE-Main, we understood the impact of rankings on seat allocation. This understanding guided us in developing a system that respects candidates' performances and aligns with the institutes' admission criteria.

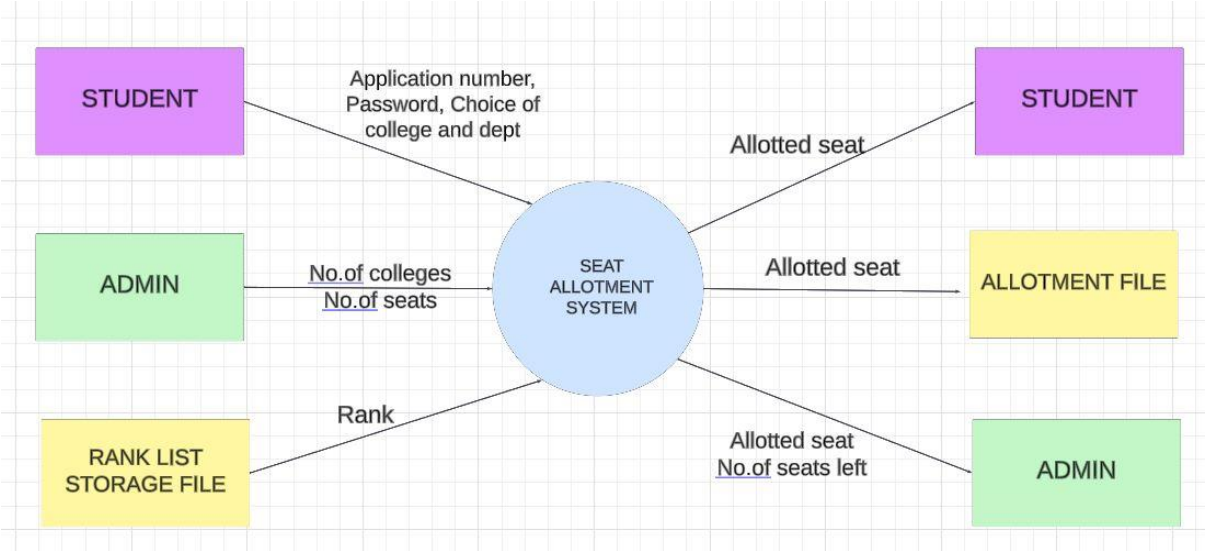
The design process also involved creating a user-friendly interface. By conducting user research and gathering feedback from potential users, we ensured that the interface was intuitive and simplified the registration and preference selection process for candidates. This user-centric approach enhanced the overall user experience and encouraged active participation in the seat allotment process.

Throughout the design process, we followed an iterative approach, incorporating feedback from stakeholders, including candidates and administrative staff. Their valuable insights and suggestions helped refine the system design and ensure that it met the requirements and expectations of all stakeholders. The iterative process allowed us to make necessary modifications and enhancements, resulting in a robust and user-centric system design.

By conducting thorough research, gathering information from JOSSA registrants, understanding candidate preferences and merit rankings, and following an iterative design process, we explored and addressed the key aspects of the problem statement. This exploration formed the basis for the development of a software system that facilitates efficient and fair seat allocation in engineering colleges.

ANALYSIS USING DATA FLOW DIAGRAM

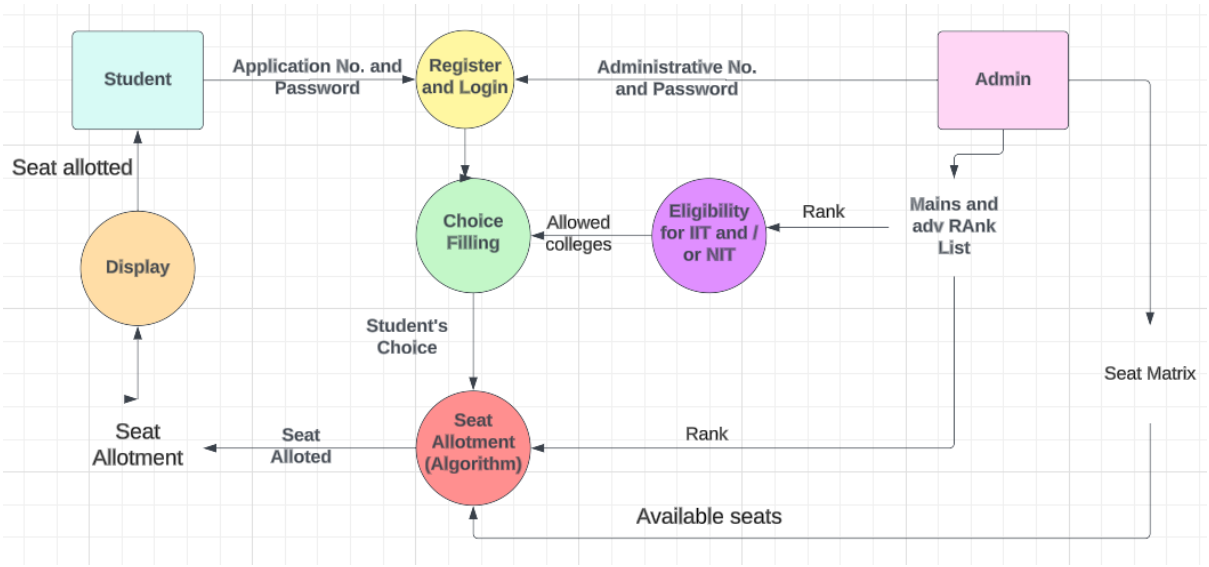
DFD - 0



Explanation:

The student must provide his application number, password for validation and his/her college and branch preferences. The admin must provide the no.of colleges and no.of seats available and a storage file which contains the ranks of the student. These data are to be provided to the seat allotment system, which gives the allotted seat as output to the student and allotment file. It also gives the no.of vacant seats along with the details of the student allotted in each college to the admin.

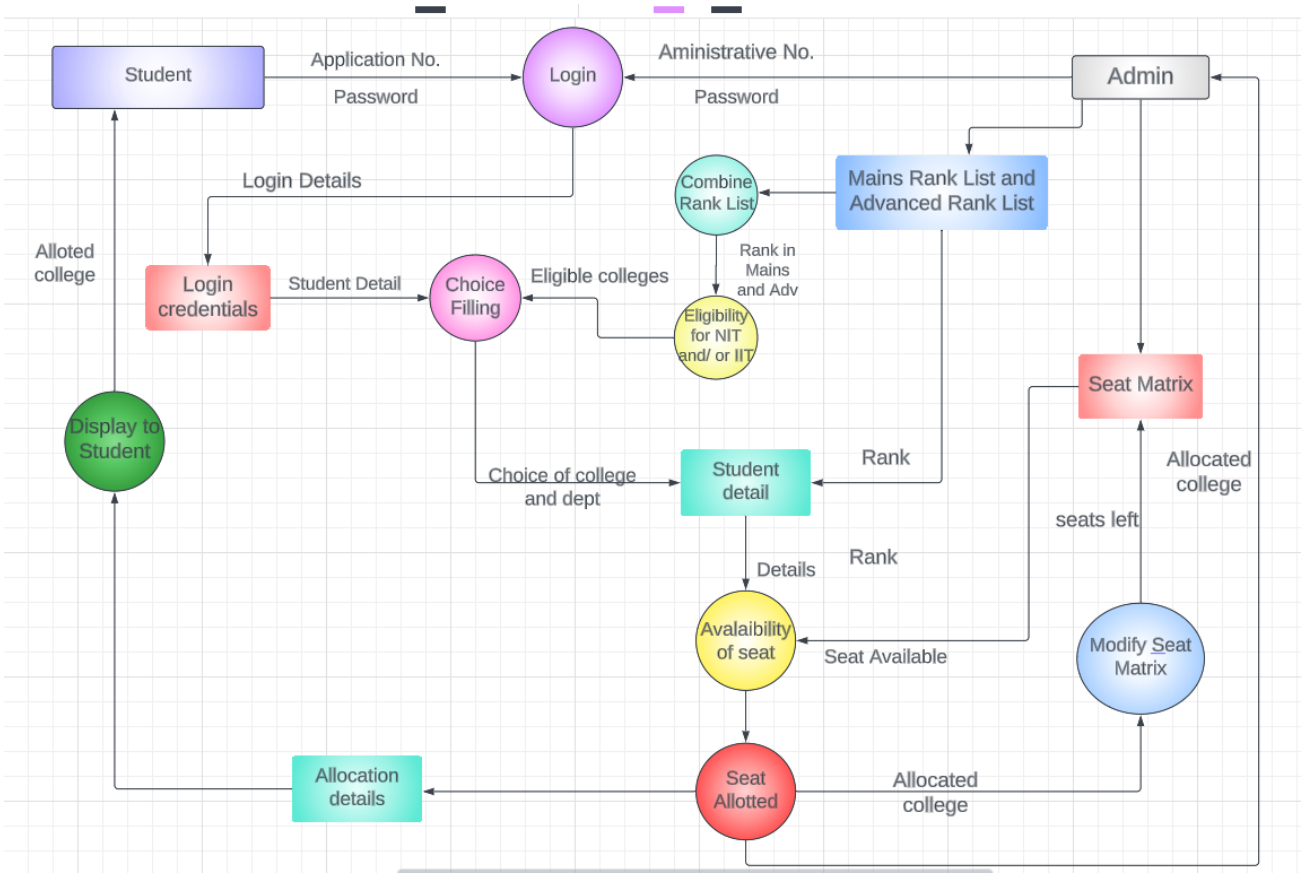
DFD - 1



Explanation:

The student must provide the Application No. and password, whereas the Admin must provide the Administrative No. and password for authorization. The Admin can view the seat matrix, available seats, Mains and Advanced Rank list and he/she should provide the rank of the student from the rank list to the seat allotment process. The student after a successful login must enter his choices with the constraint given by the admin that if the student has not qualified for JEE Advanced exam, then he isn't eligible for IIT's, he/she is eligible for both NIT's and IIT's. After the choice filling the Seat allotment algorithm, takes the first choice, checks the rank of the student and then allots the student. The allotted seat is then displayed to the student.

DFD - 2



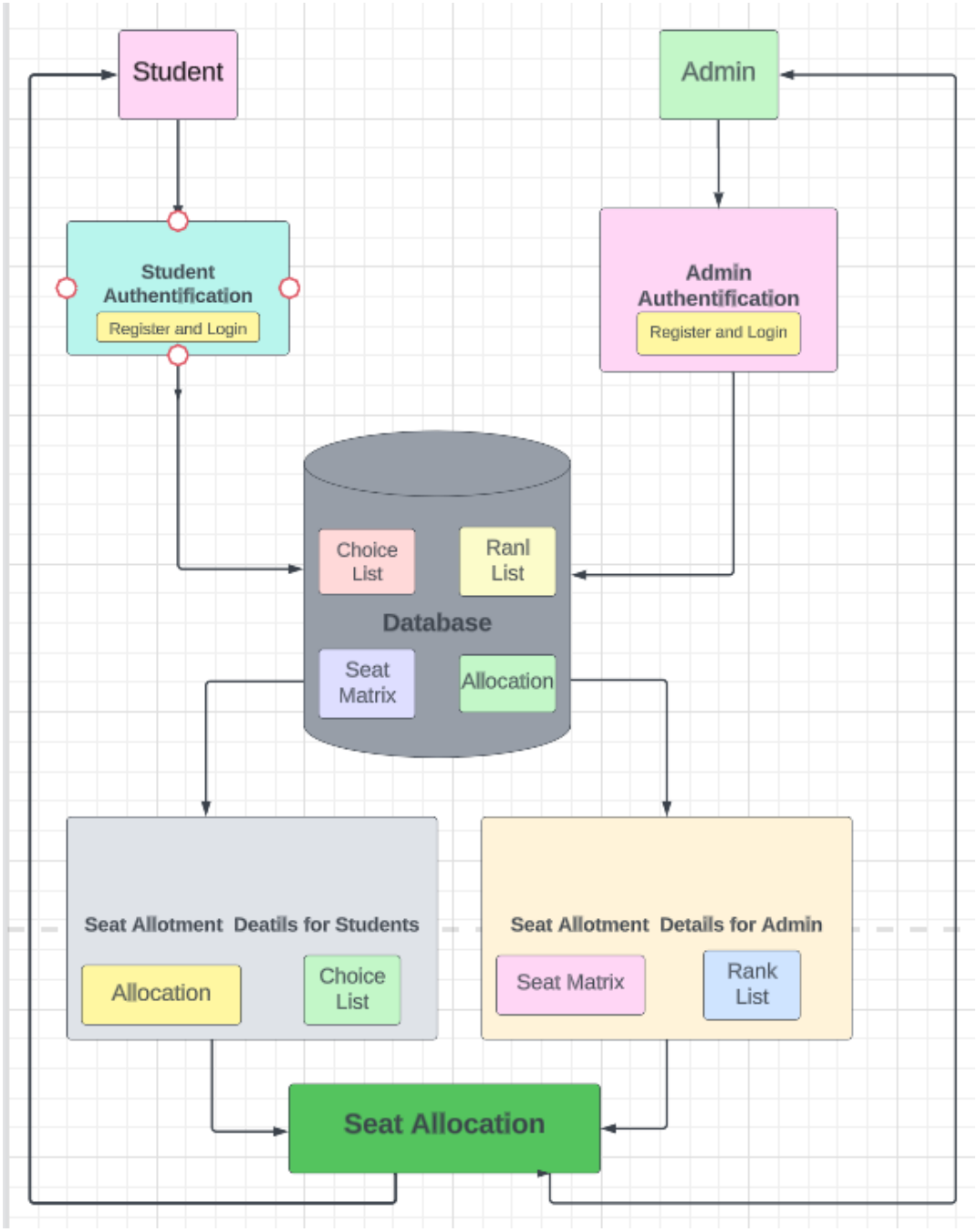
Explanation:

The student must provide the Application No. and password for login whereas the Admin must provide the Administrative No. and password for authorization. The Admin can view the seat matrix, available seats, Mains and Advanced Rank list and the admin will get the rank of the student from the combined rank list. Using this he/she can check whether the student is eligible for IIT's. If no, then the admin must set the constraints in the choice filling process. After the choice filling of desired college and branch is done for all the students, the choice details are carried to the allotment system, which checks the student whether to allot the seat or not. This is done by fetching the student's rank and rank list from the Admin. It checks the availability of seats from the seat matrix, and allots the seat to the student based on their rank. The allotment details and the no.of available seats are sent to the Admin for storing the data and

modifying the seat matrix, before the next seat allotment takes place. The allotted college is then displayed to the student.

DETAILED DESIGN

OVERALL ARCHITECTURE DIAGRAM



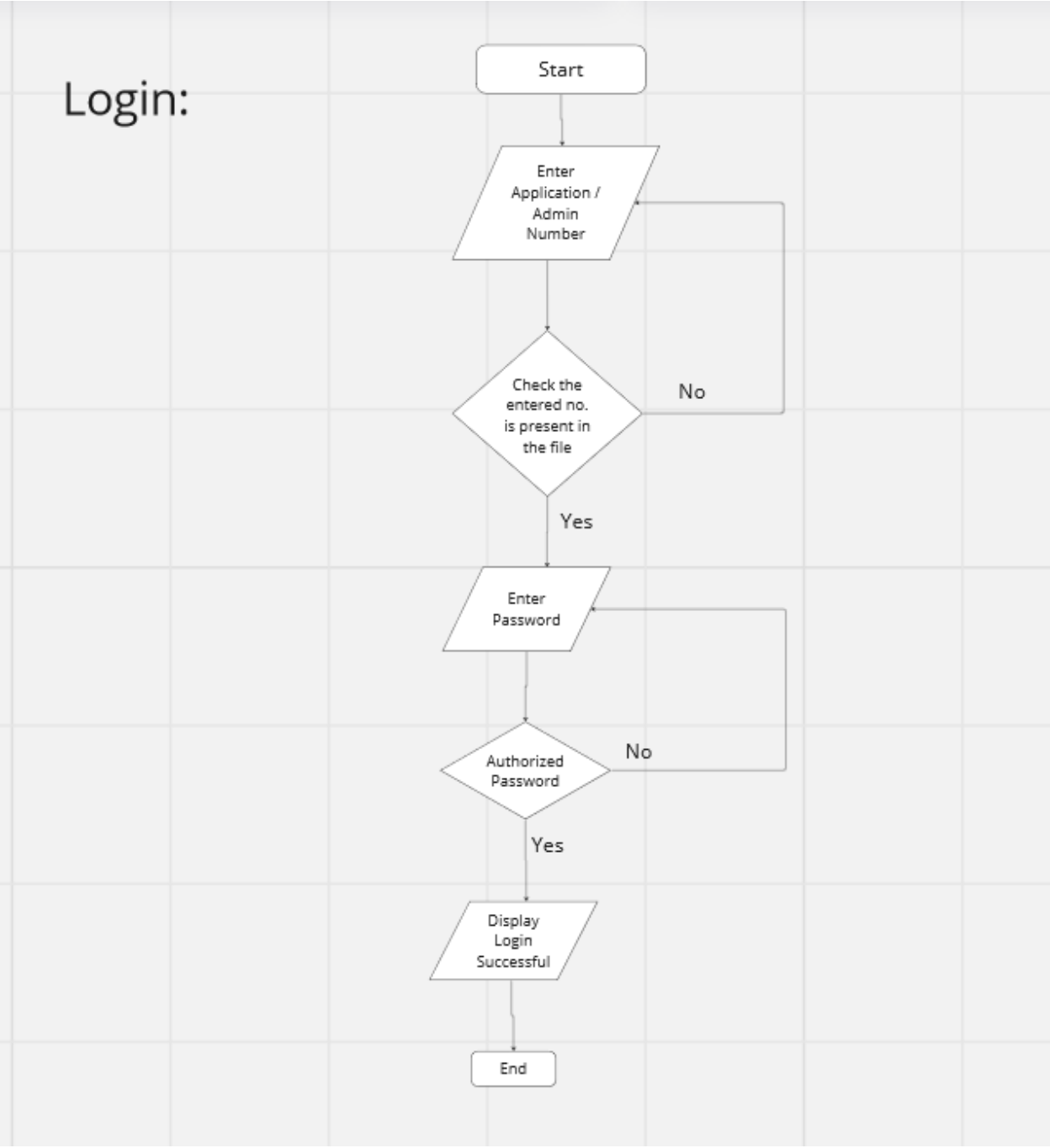
Explanation:

This is the overall structural diagram for the entire project. The project contains 2 users, Student and the Admin. Both of them have a separate authorization system. The database contains the Choice List which is provided by the student, and Rank List and Seat Matrix which is provided by the Admin. All these data are used to allot the seat to the student. After allotment, the allotment details are stored in a new file called Allocation.

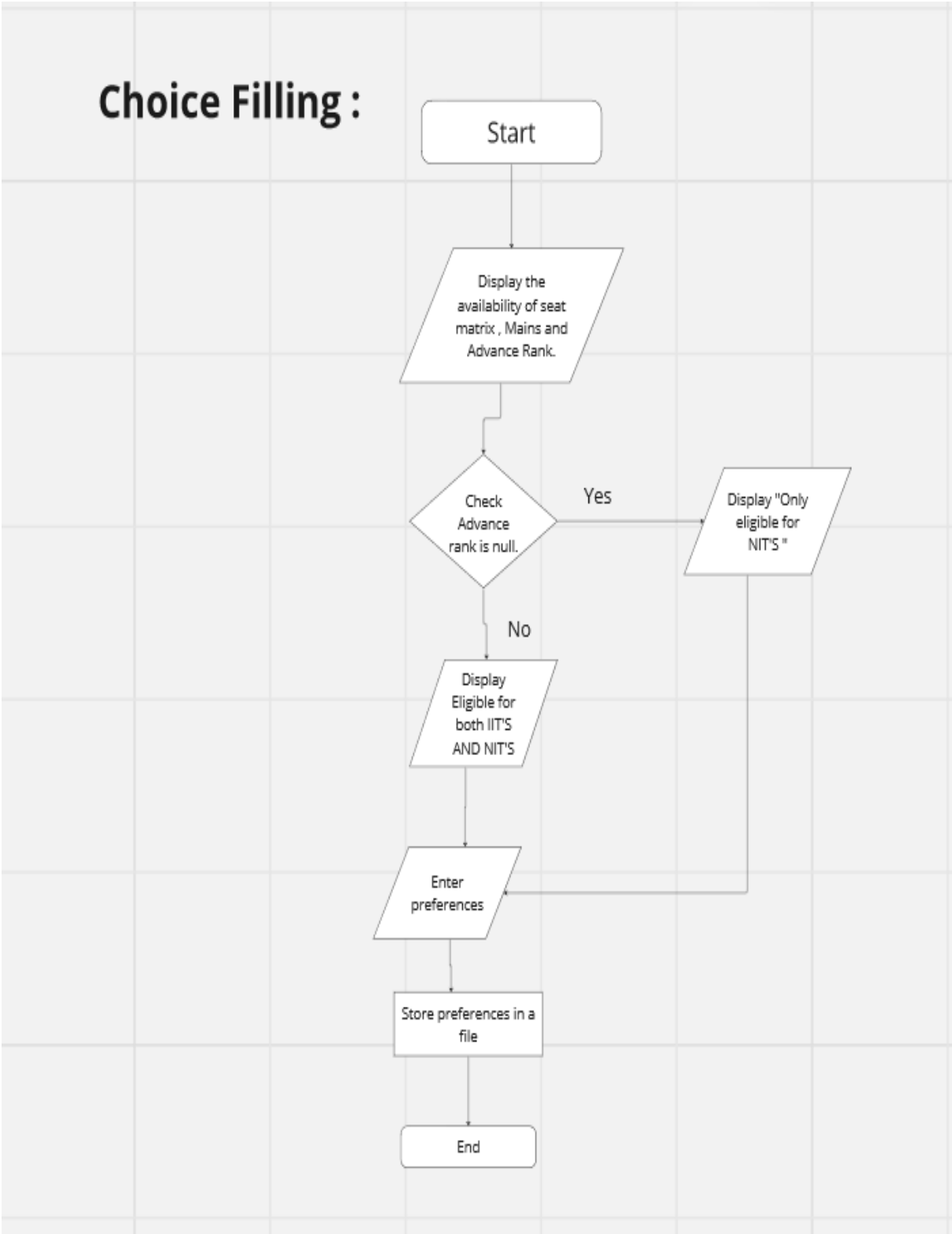
MODULES IDENTIFIED

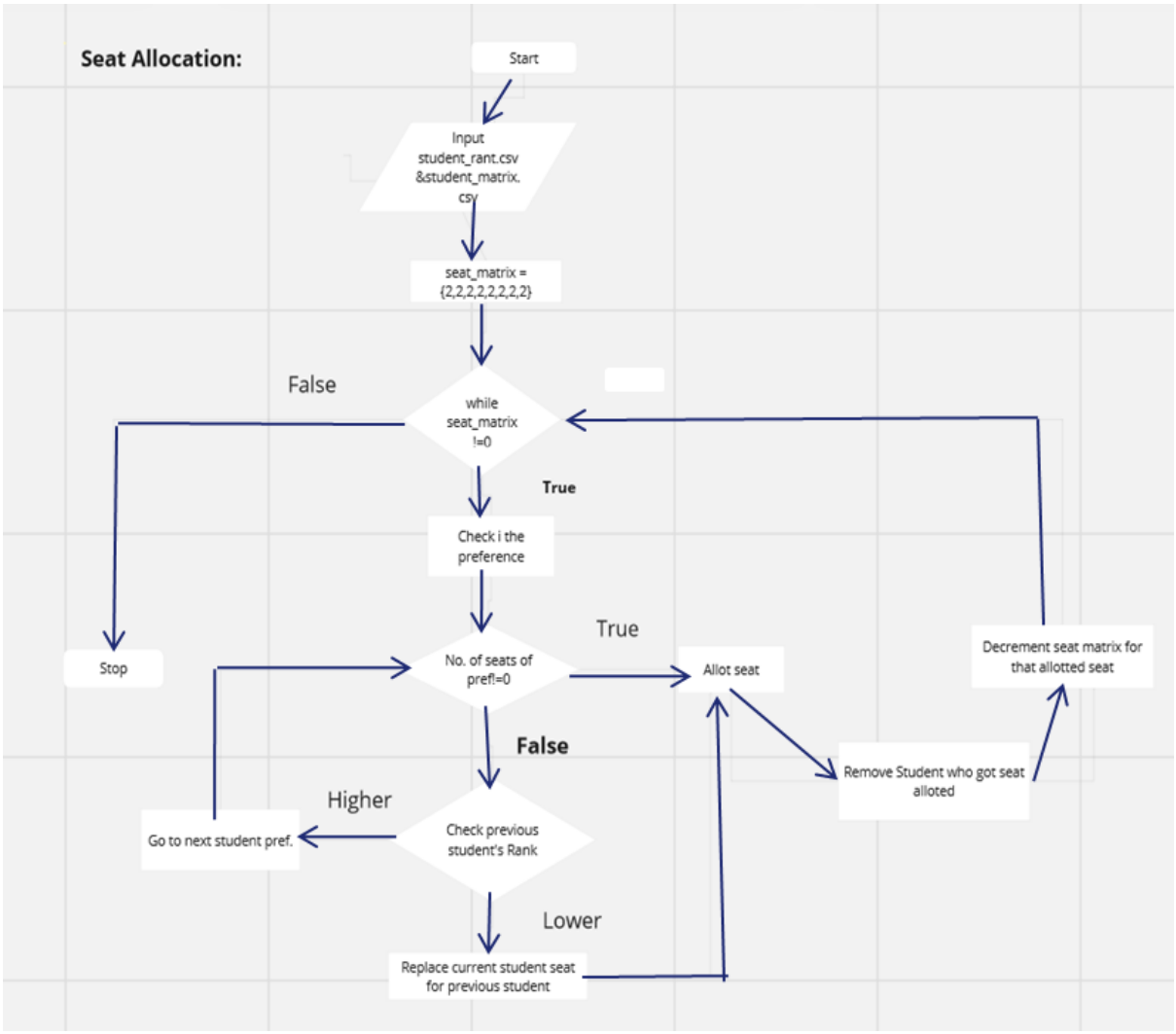
- Login
- Choice Filling
- Allocation of Seat
- Display allotted seat
- Display College wise seats allotted and seats left

FLOWCHART FOR DIFFERENT MODULES

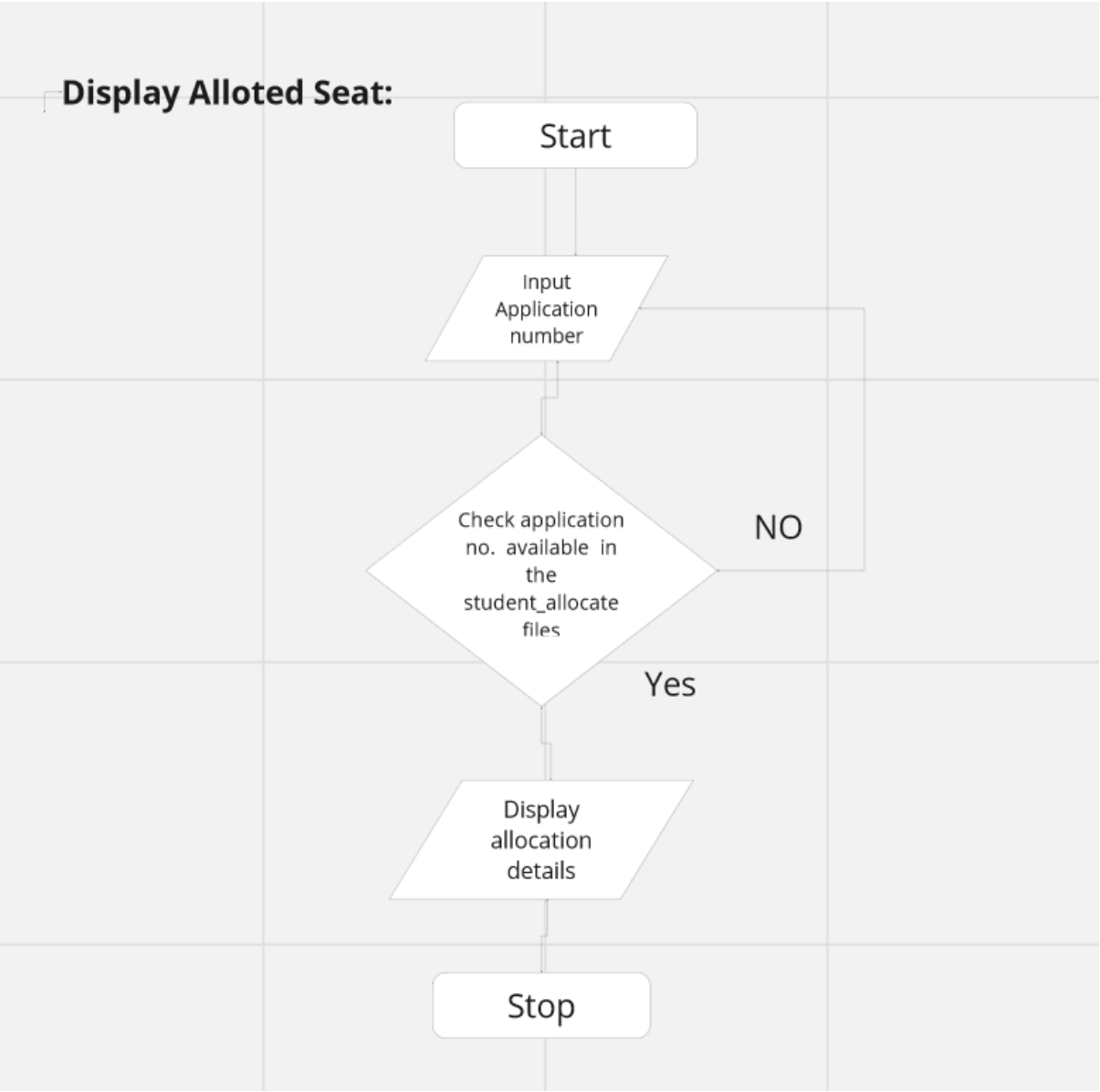


Choice Filling :

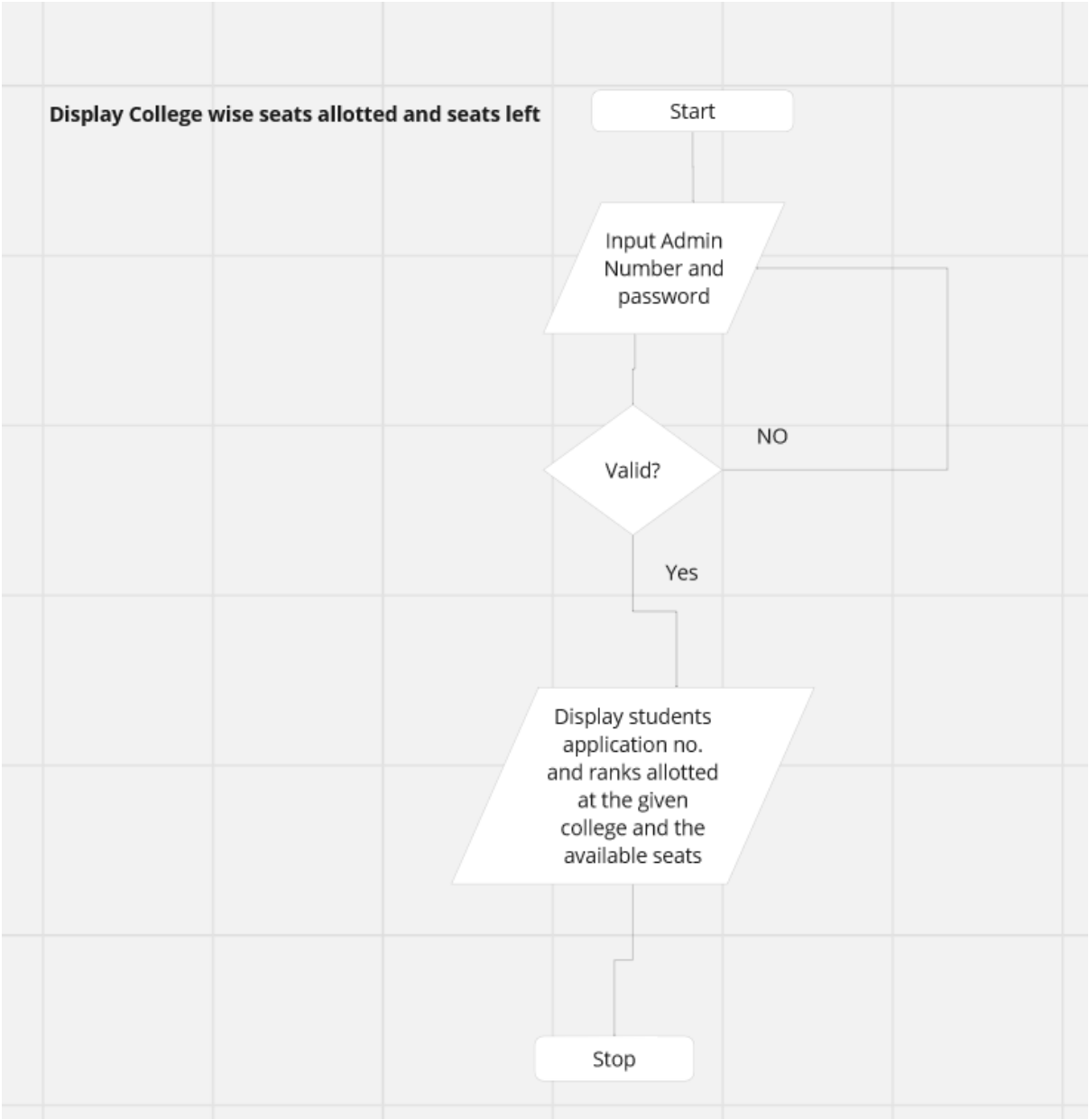



Seat Allocation:
Start
Input student_rant.csv &student_matrix.csv
seat_matrix = {2,2,2,2,2,2,2,2}
False
while seat_matrix !=0
True
Check i the preference
True
Stop
No. of seats of pref!=0
Allot seat
Decrement seat matrix for that allotted seat
False
Remove Student who got seat alloted
Higher
Go to next student pref.
Check previous student's Rank
Lower
Replace current student seat for previous student

Display Alloted Seat:



Display College wise seats allotted and seats left



DESCRIPTION FOR EACH MODULE

1.Login :

The Login module allows the user to enter the Application / Admin Number. It then checks whether the entered number is present in the CSV file named 'student_rank.csv'. If the number is available, it will allow the user to enter a password. Otherwise, it will redirect the user to enter a valid Application / Admin Number. After that, it checks whether the entered password is valid. If it is valid, the login process is successful. Otherwise, it will redirect the user to enter a valid password again.

2.Choice Filling :

The choice filling module shows the available seat matrix and both the JEE Mains and Advance Ranks of the students. It then checks if the Advance Rank is null. If it is null, it automatically allows the user to enter preferences based on NITs only. Otherwise, it allows the user to enter preferences based on both IITs and NITs as they wish. After that, all the preferences will be stored in a CSV file named 'students_matrix.csv'.

3. Seat Allocation:

The seat allocation module first reads the 'students_matric.csv' and student_rank.csv files as a priority. Then, it iterates through each choice and checks if the seat is available. If a seat is available, it is allocated to the current student. Then, the module checks the rank of the previous student. If the previous student's rank is lower than the current student, the current student's seat is replaced with the previous student's seat. Otherwise, directly allots the seat without replacing. This process continues until all seat matrix becomes zero. Overall, this module allocates seats for the students. The allocation details are stored in student_allocation.csv.

4.Display allotted seat:

The display allotted seat module first requests to enter application number. It then checks whether the application number is available in the student_allocation.csv file. If the application number is found, it displays the allocation details. Otherwise, it redirects the user to enter a valid application number.

5.Display College wise seats allotted and seats left:

This module first asks the admin to login. If the administrative no and password is correct, the module reads the details of the students who have been allocated seats in the file student_allocation.csv. Then, for each college, the details of students allotted in that college and the no.of seats left in that college is displayed.

IMPLEMENTATION

Organization of Data:

- In this project, the data has been organised by storing it in structures and files. The reason for storing the data in structures is because it allows us to encapsulate related data elements into a single unit. It is easier to access and modify data stored in a structure.
- But the major disadvantage of structures is that the data stored in them will be gone after the execution of the program. To overcome this, files have been used in this project. The data passed on during the execution can be permanently stored in files.
- Reading and writing an array of structures is not only easy but also increases the understanding of how the data is organised.

Libraries used:

The built-in libraries used in this project are:

1. stdio.h
   This header file is used for input-output operations like printf() and scanf().
2. stdbool.h
   It provides the Boolean data type(‘bool’) and the constants ‘true’ and ‘false’.
3. string.h
   It provides various string manipulation functions.
4. stdlib.h
   It provides functions for memory allocation, random number generation, string conversion and other utility functions.
5. limits.h
   It provides constants for the limits of various data types.

Platform used for Code Development

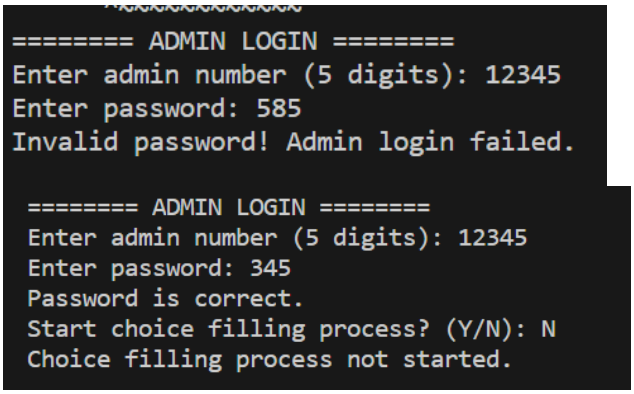
The following platforms were used for code development:

1. Visual Studio Code
2. Replit

Validation through Detailed Test cases for various scenarios

1. Login and choice filling:

Admin login:



Student Login and Choice Filling:

```
======== ADMIN LOGIN ========
Enter admin number (5 digits): 12345
Enter password: 345
Password is correct.
Start choice filling process? (Y/N): Y
Choice filling process started.
======== STUDENT LOGIN ========
Enter application number (5 digits): 27584
Enter password: 982
Invalid password! Please try again.
Enter password: 584
Login successful!
Mains Rank: 15
Advanced Rank: 5
You are eligible for both NITs and IITs.
Colleges available:
College     Seats
IITA CSE    2
IITA IT     2
IITB CSE    2
IITB IT     2
NITA CSE    2
NITA IT     2
NITB CSE    2
NITB IT     2
========= CHOICE FILLING =========
Enter choices (one per line, enter 'q' to quit):
Choice 1: NITA CSE
Choice 2: IITA CSE
Choice 3: NITB CSE
Choice 4: IITB CSE
Choice 5: IITB IT
Choice 6: NITB IT
Choice 7: IITA IT
Choice 8: NITA CSE
Duplicate choice! Please enter a different choice.
Choice 8: NITA MECH
Invalid choice! Please enter a valid choice.
Choice 8: NITA IT

======== STUDENT LOGIN ========
Enter application number (5 digits): 39710
Invalid login! Please try again.
======== STUDENT LOGIN ========
Enter application number (5 digits): 37456
Enter password: 456
Login successful!
Mains Rank: 59
Advanced Rank: 0
You are only eligible for NITs.
Colleges available:
College     Seats
NITA CSE    2
NITA IT     2
NITB CSE    2
NITB IT     2
========= CHOICE FILLING =========
Enter choices (one per line, enter 'q' to quit):
Choice 1: NITA CSE
Choice 2: NITB IT
Choice 3: NITA IT
Choice 4: NITB CSE
You can only choose 4 options. Exiting choice filling...
```

After entering choice list for all students:

```
Maximum number of students reached.
Student Choice List stored in student_choices.csv
All students have entered their choices.
```

Data Stored in student_choices.csv (for the examples shown above):

```
Application Number, Mains Rank, Advanced Rank, Choice1, Choice2, Choice3, Choice4, Choice5, Choice6, Choice7, Choice8
27584, 15, 5, NITA CSE , IITA CSE , NITB CSE, IITB CSE, IITB IT, NITB IT, IITA IT, NITA IT,
37456, 59, 0, NITA CSE, NITB IT, NITA IT, NITB CSE,
```

2.Allocation

```
============= ALLOCATION PROCESS =============
Allocation details are stored in student_allocation.csv
```

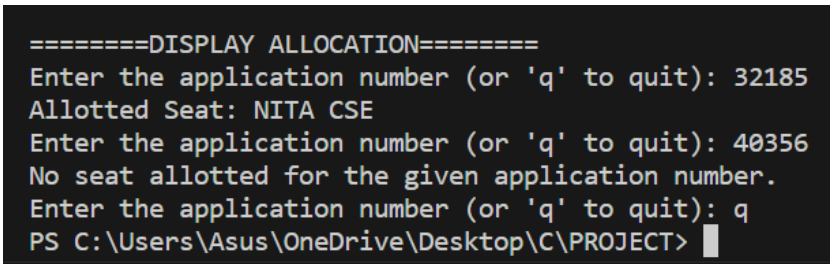
Allocation details stored in student_allocation.csv

```
Application Number,Mains Rank,Advanced Rank,Seat Allotted
46097,73,1,IITA CSE
32185,8,2,NITA CSE
26948,12,3,IITA CSE
67940,97,4,IITA IT
27584,15,5,NITA CSE
78562,16,6,IITB IT
14968,83,7,IITB CSE
52043,114,8,IITA IT
51539,121,9,IITB CSE
63950,31,10,NITA IT
68315,44,11,NITB CSE
52794,66,12,NITB IT
83257,38,13,NITB CSE
37206,2,14,IITB IT
81256,20,15,NITB IT
40356,46,16,Seat Not Allotted
10427,48,17,Seat Not Allotted
89621,1,18,Seat Not Allotted
73197,7,19,NITA IT
95648,33,20,Seat Not Allotted
72013,90,22,Seat Not Allotted
27369,104,23,Seat Not Allotted
12498,3,25,Seat Not Allotted
21739,11,26,Seat Not Allotted
52867,112,31,Seat Not Allotted
79451,51,32,Seat Not Allotted
94573,42,33,Seat Not Allotted
63584,18,34,Seat Not Allotted
42857,68,36,Seat Not Allotted
86493,93,40,Seat Not Allotted
```

3.College-wise student allocation details along with no. of seats left:

```
========== ADMIN LOGIN ==========
Enter the admin number: 12345
Enter the password: 345
Students allotted in IITA CSE:
Reg No          Mains Rank      Advanced Rank
46097           73              1
26948           12              3
Seats left in IITA CSE: 0

Students allotted in IITB CSE:
Reg No          Mains Rank      Advanced Rank
14968           83              7
51539           121             9
Seats left in IITB CSE: 0

Students allotted in IITA IT:
Reg No          Mains Rank      Advanced Rank
67940           97              4
52043           114             8
Seats left in IITA IT: 0

Students allotted in IITB IT:
Reg No          Mains Rank      Advanced Rank
78562           16              6
37206           2               14
Seats left in IITB IT: 0

Students allotted in NITA CSE:
Reg No          Mains Rank      Advanced Rank
32185           8               2
27584           15              5
Seats left in NITA CSE: 0

Students allotted in NITB CSE:
Reg No          Mains Rank      Advanced Rank
68315           44              11
83257           38              13
Seats left in NITB CSE: 0

Students allotted in NITA IT:
Reg No          Mains Rank      Advanced Rank
63950           31              10
73197           7               19
Seats left in NITA IT: 0

Students allotted in NITB IT:
Reg No          Mains Rank      Advanced Rank
52794           66              12
81256           20              15
Seats left in NITB IT: 0
```

4.Display of Seat Alloted to the Student:



LIMITATIONS OF THE SOLUTION PROVIDED

- Limited colleges and courses
- Output displayed only in the terminal, lacking a graphical user interface (GUI)
- Inability to edit or modify choices after submission
- Reservation policy (e.g., quotas, regional preferences) not considered
- Limited error handling and inadequate handling of exceptional scenarios.

OBSERVATIONS FROM THE SOCIETAL, LEGAL, ENVIRONMENTAL AND ETHICAL PERSPECTIVE

Societal Perspective:

- **Access to Education:**JoSAA provides a centralized seat allocation process that enables broader access to quality education for aspiring engineering students, irrespective of their geographical location or background.

- **Equal Opportunities:**JoSAA's process ensures equal opportunities for eligible candidates by considering their merit and implementing reservation policies, promoting inclusivity and social equity in engineering admissions.

Legal Perspective:

- **Compliance with Regulations:** JoSAA must adhere to relevant laws, regulations, and government guidelines governing higher education admissions to ensure a fair and legally compliant seat allocation process.

- **Reservation Policies:**JoSAA is responsible for implementing reservation policies mandated by the government, such as those for reserved categories (SC, ST, OBC, EWS), ensuring that they are followed accurately during seat allocation.

Environmental Perspective:

- **Reduced Carbon Footprint:**JoSAA's centralized process reduces the need for physical travel and paperwork, resulting in a lower carbon footprint by minimizing transportation-related emissions and paper waste.

- **Sustainable Resource Utilization:**JoSAA's seat allocation process optimizes the utilization of resources, including seats in engineering institutions, reducing the need for additional infrastructure development and resource consumption.

Ethical Perspective:

- **Fairness and Transparency:**JoSAA's seat allocation process should prioritize fairness, transparency, and merit-based selection, ensuring that candidates are treated equitably and with integrity throughout the process.

- **Data Privacy and Security:**JoSAA must uphold ethical standards by safeguarding the privacy and security of candidate data collected during the seat allocation process, adhering to applicable data protection laws and ensuring responsible data handling practices.

LEARNING OUTCOMES

During the project, we achieved the following learning outcomes:

- Comprehensive understanding of JOSAA's seat allocation system.
- Proficient in implementing C libraries.
- Effective utilization of files, structures, and arrays.
- Seamless integration of components and modules.
- Developed problem-solving and critical thinking skills.
- Improved communication, collaboration, and teamwork.
- Fostered enthusiasm and collective motivation.
- Demonstrated a strong sense of responsibility.
- Met project deadlines and delivered results efficiently.

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- https://www.geeksforgeeks.org/
- https://stackoverflow.com/
- https://www.quora.com/

CONCLUSION

In conclusion, the Joint Seat Allocation System (JoSAA) project serves as an essential platform for centralized seat allocation in engineering and technical programs. By promoting transparency, fairness, and merit-based allocation, JoSAA contributes to the goal of providing equal opportunities to students. It should also ensure compliance with legal regulations, consider environmental sustainability, and uphold ethical principles to maintain integrity and protect students' privacy. Overall, JoSAA plays a crucial role in streamlining the admission process and supporting the aspirations of aspiring students in India's engineering and technical fields.