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Online Campus Recruitment System-A Machine Learning Model

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Abstract—As the job market for college students heats up, firms are paying more attention to campus recruiting as the major way of employing college graduates. This research looks at the indicators and reasons for possible hazards for companies when recruiting on college campuses. Several measures are advised in the interim, which may assist organizations to decrease the hazards connected with campus recruiting and boost its success rate. Training and placement cell operations are expedited, and students are put in the most coordinated scenario feasible, all owing to the campus recruiting system. This promotes the aggregation of student knowledge to boost the selection rate and simplifies the process of automatically creating management data. The major purpose of online training and placement is to automate the placement cell. CV validation, advertising job vacancies to a student community, maintaining contact with companies to invite students to internships and other events, monitoring the selection process, and engaging with a broad variety of users.

Keywords—Machine Learning, campus recruitment, recommendation system, survey, questionnaire.

I. INTRODUCTION

"Recruitment is the exercise of locating and alluring potential candidates to apply for present or upcoming job openings." It works as a connector between persons searching for a job and those who have available opportunities. The objective of recruitment is

1. Drawing a vast pool of skilled people who are willing to take the post if it is supplied and
2. Giving enough information for ineligible participants to eliminate themselves (For instance, a foreign bank's job posting may specifically seek chartered accountants who have passed the JEE on their very first try).

To establish a pool of candidates who want to work for the organization from which the best may be chosen is what Christopher Lewis calls "recruitment." selection as "the action through which an organization utilizes one or more procedures to evaluate persons to reach a choice about their fitness to join the organization to fulfill responsibilities which may or may not be stated" The term "recruitment" has evolved to include not only the supply of a pool of applicants for selection but also subsequent tasks, such as preparing the employment contract, that is necessary to officially welcome the selected candidate into the organization.

Logins for students, employers, and faculty/staff are all part of this campus recruitment system. Students, the institution's placement officer, and the many companies that recruit on campus would all benefit from implementing this plan. Students may generatetheir profiles and submit their information, inclusive of their grades by using the program. The administrator has the option of going through each student's profile and removing any inactive accounts. In addition, the system has a business login so visiting businesses may see a directory of students and individual résumés. The app provides a database of companies that have posted job vacancies that students may peruse. Since the admin controls the whole system, they have the right to filter and delete any data that is not directly relevant to the college placement process. The system can organize and efficiently communicate both academic and corporate data to the relevant stakeholders.

Fig 1. Recruitment process

As the economy has evolved, companies have had to fight with an increasingly intense degree of competition, which is ultimately a talent struggle between the enterprises. [1]

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Recruiting from universities has become more important for companies. When it comes to the war for business, the university is ground zero since it is where future leaders are forged. Although it may at first appear simple, campus recruiting is a lengthy process fraught with risks at every stage. Numerous companies invest substantial time, energy, and funds into campus recruitment in the hopes of locating and hiring exceptional new employees. Fewer studies have focused on risk in university recruitment than on more timely topics like system design, validity, etc.

Fig 2. Recruitment

A system with three levels of access (administrator, corporation, and student) for recruiting and employing college students. The notion benefits not just the students, but also the placement officer and the many companies who recruit on campus. The platform allows students to create profiles and provide comprehensive information, including grades. The administrator has the option of reviewing each student's profile and removing any inactive accounts. An engineering login is also available, allowing visiting engineering to see a database of enrolled students and download resumes.

These days, everyone makes reservations, researches topics for school, blogs, and even searches for employment online. The data of students may be managed in this software for the sake of placement-related duties. Information from both students and engineering may be stored and presented efficiently using the system. Using this system, you may examine the number and percentage of students who have been placed vs those who have not, as well as manage the collection of student data, verification and activation of student profiles, automatic email notification of qualifying applicants, and more. Each company, placement agency, and student is given their unique login credentials and access is restricted by both time and role. Streamlining the placement process via automation is essential for on-campus hiring, and checking-in students should be able to provide relevant data. A web application for the college's placement office is the target of this project. This system might be used by the college's placement officer as a tool for managing student placement data. While checking in, students should be given the option of providing personal details in the form of a résumé. Thus, all information about pupils, such as their background, education, personal details, and resumes, would be preserved. Because of this procedure, the organization may more easily gather placement-related student information. Computer-based information systems are developed to better existing structures.

II. PROBLEM STATEMENT

Manually gathering company information to place students is a time-consuming and labor-intensive process. The greater the population of end users, the more laborious this process gets. With this software, students may easily get ready for their internship or job. The existing approach is very laborious and time-consuming, and it worsens as the number of students increases. Due to the need for human involvement, existing systems are prone to errors. Once lists were compiled for each company, students were obligated to make regular visits to the office to check the bulletin board for updates. There was a delay, and valuable class time was being squandered on unimportant tasks.

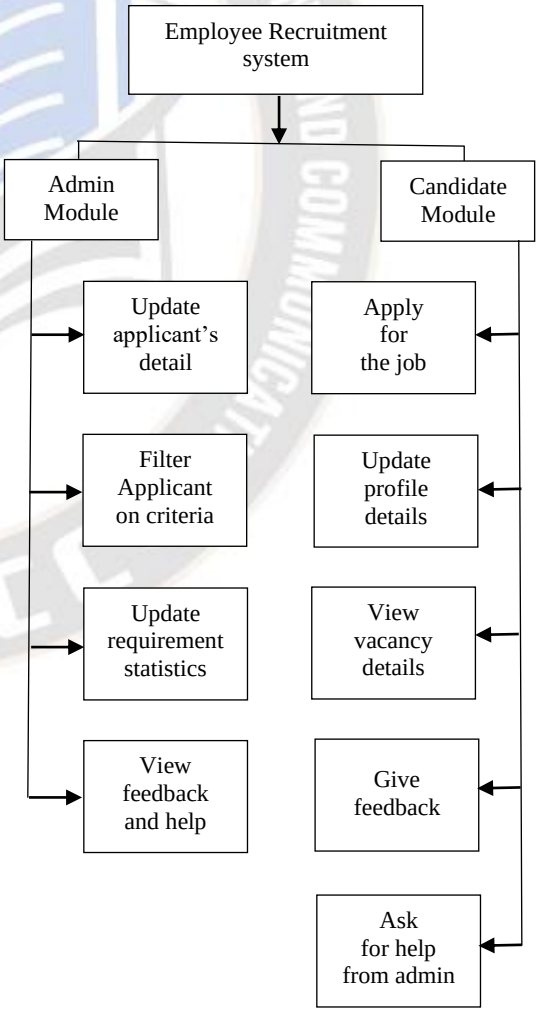

Fig 3. Flow chart

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III. STATEMENT OF PURPOSE

The Campus Placement System is in charge of coordinating how the school handles placement data. It improves upon the existing setup. This system may save time and effort by storing students' information. Because of this, you won't have to expend as plenty of time reporting and collecting data. The Campus Placement Management System is available to anybody on campus who has access credentials.

IV. SCOPE OF STUDY

The scope of this endeavor is rather wide. Enhancing output and efficiency in the utilization of resources is a primary goal of our effort. As was the case when the job was performed by hand, no effort is wasted by doing the same tasks again. Therefore, it reduces work and boosts spirits. The program is supposed to provide simple steps that may eliminate any confusion. This endeavor is a comprehensive administrative and informative system that gives the most recent data on every student at the institution. The difficulty of sifting through potentially hundreds of student records to locate one who is a good fit for recruitment is another obstacle we help the school overcome with our strategy. It helps make the best use of available resources at the right moment. The completed project will provide a reliable, fast, and simple management system. The officer's abilities as a businessperson are high. They may relax and not worry about keeping records. Saving time, money, and trees, the university can keep digital records instead of paper ones.

V. NEED FOR STUDY

The purpose of the Campus Recruitment System (CRS) is to facilitate contact between the company's students and the management team. The primary goal of this solution is to streamline the hiring process for any business. The needs of both the school and the business were taken into account while creating this CRS. Students may use CRS to publish information about themselves, such as their talents and work history, and employers can use it to advertise job openings. Companies seeking new workers may benefit from a Campus Recruitment Management system, as can students looking for employment.

VI. OBJECTIVES OF STUDY

- Building a campus placement system for engineering and management students so that they don’t face any problems for searching the best jobs present in the market.
- The campus recruitment system should give ease to the students and the companies to connect and find the best candidates according to their scores in the 10^{th}, 12^{th}, graduation, and entrance exams whereas students can apply to the best company and schedule their interviews.

Fig 4. Campus recruitment

VII. LITERATURE REVIEW

A.Suresh [1] This paperproposeda few issues surrounding placements and suggests a procedure for managing them. It discusses the educational purpose of placements and suggests that some difficulties that the students face are inevitable and are sources of valuable experience to be capitalized upon. It also focuses on the role of visiting tutors from the college. It describes some tasks that visiting tutors from the education institutes must ideally perform and a few key attitudes that they must adopt. The book considers the workplace supervisor as an educator. It is concerned with the human problems of assessing. Further, the study gives an outline for the placement management process and assessment, which is aimed at minimizing human error in assessment, but also at making assessment an integral part of the process of placement management.

Mr. Nilesh T. Rathod [2]The work values have been receiving increased attention for research. The effects of the work values of the organizations on job gratification, the dedication of the individuals, and individual decision-making have been taken into account. The work values have not been exclusively associated with job choice decisions. With the use of a sample size of professional degree students and policy-capturing design, the researchers have tried to study the impact of work values of the organizational on job choice concerning the job attributes that exhibits theaffectof this decision process. Decisions on where to work were profoundly influenced by the prevailing organizational ideals. People preferred careers where they could exercise values they already held.

Vijay Yadav; Ujjwal Gewali [3]This research gives the perspectives of job-seekers, both present, and prospective, on a selection method or two. Candidates seem to favor selecting approaches that place a premium on content validity, such as business-focused simulations and assessments. Positive comments were also made about background checks and interviews, whereas personality inventories, drug testing, and

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honesty tests were met with indifference. The interviewees' answers varied according to the nature of the questions asked and the character of the interviewer.

Lu Shumin; Rao Yuan [4]Researchers looked at how much of an impact internet recruiting has on prospective employees. It was carried out on a sample of 250 students from various universities in Karachi. The results of the research are helpful for organizations, institutions, and academicians to design web pages to attract potential job candidates.

Ying Zhang; Xuanping Luo [5]The essay provides a classification system for four tiers of online recruiting strategies and then assesses how those strategies have been used in practice in Poland and the United States. The research also shows how important a good brand image is for online recruiting. It is argued that total rewards theory from the HRM domain should be linked to employer branding research rather than similar reasoning and brand equity theory or the two theories describing the influence of a prospective employer's image-creating actions, signal, and cultural value fit (Armstrong, 2010).

M. Mansourvar[6]The impetus of this research was to conduct a literature evaluation on E-recruitment and retention strategies in the mHealth industry. ― At least one online recruiting strategy was used, and many databases were consulted, including PubMed, CINAHL, EbscoHost, PyscINFO, and MEDLINE. More research is needed to analyze the efficacy of E- recruiting and participant retention in the area of mHealth, as was stated in the study.

K. Kopuri [7]Learning about how the Internet is being used to discover and hire qualified workers was the primary objective of the study. The study was conducted through telephonic interviews with managers of various contracting firms. The telephone interviews aimed to understand the status and use of Internet recruitment for hiring skilled labor from the employer ‘s viewpoint and also to identify the major issues facing the industry regarding Internet recruitment. The study concluded that there is underutilization of the Internet for the employment of skilled labor because of existing attitudes and perceived notions of construction organizations regarding skilled labor.

K. Liza [8] The research study purported to create online recruitment software which could help in the selection of qualified candidates more quickly and accurately. For this, we used the Adaptive Waterfall Model and used a questionnaire as our primary data collector. The effectiveness of an internet-based job recruitment system was measured with the help of a 5-point Likert-scale type. From the results, the researcher made a recommendation for the integration of online examination in the recruitment process and security features as accessibility level E-Recruitment Quality of Applicants 57 should be classified based on rank in the organization; as both factors were believed to enhance the software.

O. Shafique [9] The study examined the impact of e-recruitment in influencing candidates' attraction towards applying for jobs in the organization. Studies reveal that management undergraduates search for job openings over the internet, therefore considering this aspect, the researcher carried out the study on a sample of 150 final-year management undergraduates through a self-administered questionnaire. Multiple regressions exhibit how a candidate‘s intention towards applying for a job is shaped not only by the perceived usefulness of the particular job but also by the ease of using the company website for applying. Further, gender differences were found in terms of intent to apply for a specific job. Hence, the research findings are pertinent for an organization to utilize E-recruitment effectively to attract the best candidates.

E. Parry And S. Tyson. [10]The research examined the positive and negative aspects of E-recruitment, as well as the effect of E-recruitment on the interest of potential employees in applying for jobs with certain companies. It is the need of the hour that human resource managers should consider the hiring of staff as the most important part of organizational setup and understand the benefits in terms of cost and efficacy which can be provided by the Recruitment method. Thus, it is imperative to understand the technicalities of the process.

M.G.G. Ventura And R.P. Bringula[11] The study was conducted to widen research in the field of internet-based recruitment strategies for achieving goals by companies, with a special focus on E-recruitment techniques and trends, prevailing in India. The research further aimed to examine which E-recruitment techniques are being utilized and the advantages drawn by the organization by using these procedures. In the current scenario, an organization can have a competitive advantage through the efforts of its HR management for attracting and retaining skilled and talented personnel.

H.H. Frederick And A.D. Plessis [12] This research study investigated the cost of taking a ―bad‖ recruitment decision and its impact on the effectiveness of the organization. In the study, primary data was collated from the responses to the questionnaire given to employees and by conducting semi-structured interviews with the key managers in the organization. The study concluded that there is a high cost involved in the process of recruitment for selection and employee development; therefore, organizations should apply caution while conducting the recruitment of potential candidates.

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Ashworth, Peter [13]Both schools and businesses place a high value on recruiting from their campus communities. According to the analyzed literature, there is a gap between what is expected of pupils and what they learn in school. Several elements might sway a student into accepting a company's employment offer. During the campus recruiting process, the soft sill is given more weight than the technical abilities and topic knowledge. Internships, curriculum development, student workshops, etc., are all great ways for businesses to interact with universities and attract top students. The research highlights the features of campus recruiting.

Timothy JA.; Robert BD [14]When making their initial career choice, engineering students are more likely to consider personal criteria than social or financial ones. On Indian university campuses, IT services firms are the most aggressive recruiters. They employ all branches of engineering because they think anybody with a head for logic and the ability to solve problems can do well in this field. Companies that want to attract the best and brightest students to work for them should take note of the survey's findings and work to improve their image on college campuses. Students in fields other than computer science and information technology often consider a company's reputation when deciding on an employer to work for.

Ahmed Shuaib[16]Many different college recruiting strategies and methodologies were studied by employers from Fortune 1000 engineering. This research has shown that differences exist in organizational norms, hiring procedures, and productivity.

Wozniak, J.[17]relevance of high-quality information for conventional and unconventional uses. Enhancing an organization's capacity to communicate might lead to greater productivity. There is less negotiation required when dealing with traditional benefits since everyone is on the same page. There should be a positive economic benefit to patronizing companies that provide both services. Conventional perks are prioritized since they are preferred by employees.

Lane TS, Armin. [18]Companies need to know what motivates students to major in a certain field to hire the most qualified graduates. The classroom has been transformed into a more casual setting, with an emphasis on hands-on activities for students. They use modern technology like calculators and computers. They did their homework by simply Googling the topic. The advantages of student-engineeringman interaction extend well beyond the classroom.

Haas, C.T., Glover [19]Graduates from prestigious universities are sought out and selected. The company compares its profile of applicants to that of all applicants as a whole. Only bio-data instruments are used in the recruitment and screening of potential college students. In addition to the standard selection methods that may lead an applicant to assume they would be chosen, companies may additionally search for characteristics that might increase their chances of winning an appeal.

Galhena, L. B and Liyanage [21]A company's size are related to the ease with which it can launch a systematic college recruiting operation. As the program gains legitimacy, the organization expands. The company promotes its name and recruits top faculty members using online platforms and career fairs.

Ventura, G. G., And Bringula, P.R [20] The research examines the hiring procedures and links them and worker output, punctuality, and disposition. Seventy men and forty-two women were analyzed, and it was determined that those who obtained employment on their initiative or as a result of an ad in a professional journal or conference were more successful than those who got work via newspapers and college placement offices.

Zin, M. S. Jaafar[22], looked at the data and concluded that the university employment process is not to be seen as a one-time event. It must be seen as an ongoing procedure. The company may save time and money by focusing on a select group of prestigious schools.

Fred, O. M. And Kinange, et.al. [23]The system has the potential to eliminate all of the disadvantages of the current system, including the need to store student information in a database, increase data security, guarantee data accuracy, reduce paperwork and save time, screen applicants thoroughly, to enhance information flow and make report generation simple, to require less physical space, and to cost less money.

Lane TS, Armin J, Gordon JS, **[24]**Android runs on Linux and is the most popular open platform for mobile devices. Information about their school is made available via Android apps. Android gives programmers unrestricted access to the APIs they need to build even the most complicated mobile applications while providing a straightforward framework for doing so. Android is a mobile operating system, middleware, and several useful applications all rolled into one.

VIII.METHODOLOGY

Step1: Import libraries

The step includes importing the necessary libraries for the code to run.

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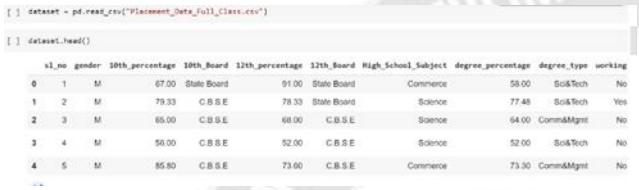
Fig 5. Libraries being imported

Step2: Import dataset

The information gathered by Analytics is combined with information gathered from other sources using Data Import. Analytics may then be used to go through all of the information so that it more accurately represents the study.



	sl_no	gender	10th_percentage	10th_Board	12th_percentage	12th_Board	High_School_Subject	degree_percentage	degree_type	working
0	1	M	67.00	State Board	91.00	State Board	Commerce	58.00	Sci&Tech	No
1	2	M	79.33	C.B.S.E	78.33	State Board	Science	77.48	Sci&Tech	Yes
2	3	M	65.00	C.B.S.E	68.00	C.B.S.E	Science	64.00	Comm&Mgmt	No
3	4	M	56.00	C.B.S.E	52.00	C.B.S.E	Science	52.00	Sci&Tech	No
4	5	M	85.80	C.B.S.E	73.60	C.B.S.E	Commerce	73.30	Comm&Mgmt	No

Fig 6. Dataset inclusion

Step3: Exploratory data analysis

1. **Head**:The top 5 rows of the dataframe are returned by default.
2. **Tail**: The default behavior is to retrieve the most recent 5 rows from the dataframe.
3. **Information**: It is about gathering data.
4. **Describe**: The describe () method returns a description of the data in the Data Frame.
5. **Missing values**: If a statistical observation is lacking a value for a particular variable, this is known as missing data or missing values. Missing data are a common occurrence and can have a significant effect on the conclusions that can be drawn from the data.
6. **Normalizing**: Rescaling a numeric property with a real value to the interval from 0 to 1 is what we mean when we talk about normalization. In machine learning, data normalization is used to reduce the sensitivity of model training to the relative sizes of input characteristics. In the end, this helps our model converge to more accurate weights.

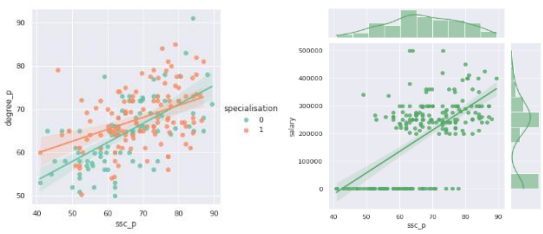


Fig 7. Normalization

Step4: Visualization

Data visualization is the method we use to uncover patterns and connections in our data by displaying it visually.

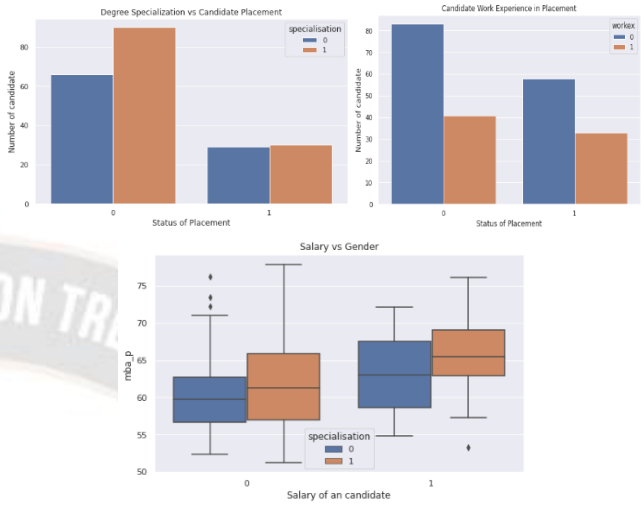


Fig 8. Comparisons of data through visualization

Step5: Correlation: To quantify the linear connection between two variables, statisticians use a coefficient of correlation (meaning they change together at a constant rate). It's a typical way to show cause and effect without really saying those words.

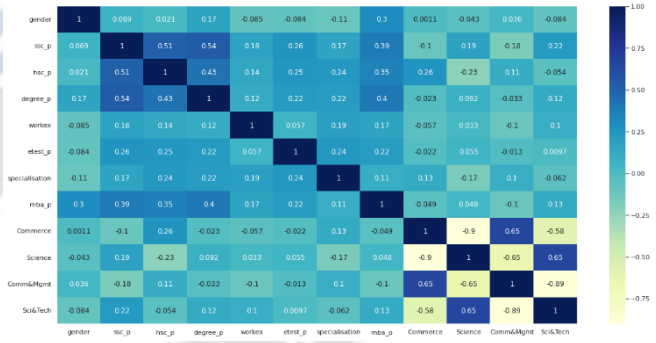


Fig 9. Correlation between academic percentages using the heatmap

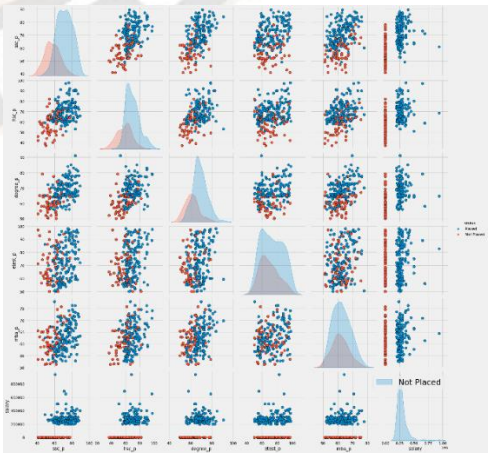


Fig 10. Distribution of our data - Pairplot

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Step6: Data Pre-processing: Data preprocessing refers to any work done on raw data to prepare it ready for use in subsequent data processing operations.

1. **Data cleaning**: The term "data cleaning" refers to the action of fixing any blunders made during data collecting. The presence of blank cells is a kind of inaccurate information. incorrect data structure. data that is not accurate.

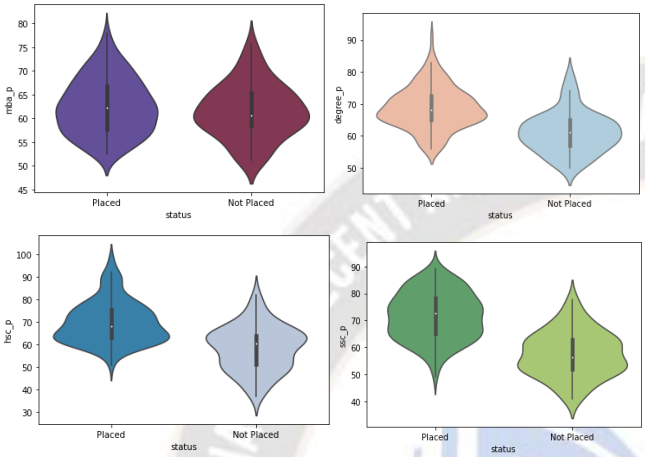

Fig 11. Status vs percentages

2. **Outliers Detection:**An outlier is a result that significantly deviates from the mean or median of the population from which the sample was drawn. This definition, in a manner, leaves it up to the analyst's (or a consensus process') judgment as to what constitutes abnormal behavior.

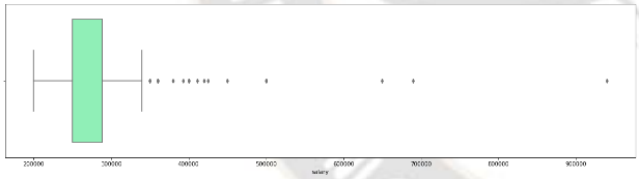

Fig 12. Outliers

3. **One Hot Encoder:**In machine learning, one-hot encoding is used to make categorical data more accessible to machine learning algorithms and, therefore, more useful for making accurate predictions. When processing, one-hot encoding is often used.

4. **Feature Scaling:**Standardization (or Z-score normalization) is a feature scaling methodology that might be a crucial preprocessing step for many ML methods. To achieve normality, the characteristics are rescaled to have a mean of zero and a standard deviation of one.

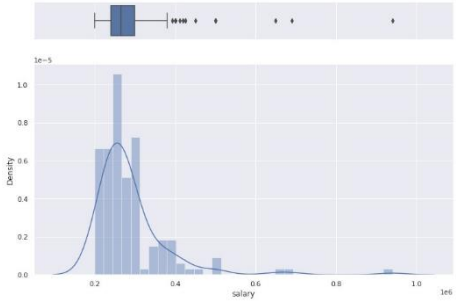

Fig 13. Distribution Salary- Placed Students

When dealing with a wide range of magnitudes, values, or units, this step is performed as part of the data pre-processing.

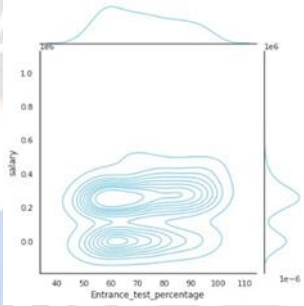

Fig 14. Employability score vs Salary- Joint plot

Step7: Response Variable: The response variable or dependent variable of this data is ‘status’. It is the status of the placement of a student, i.e., if the student got the placement or not. If the student is placed, then it is denoted as ‘Placed’ and if the student didn’t get the placements, then it is denoted as ‘Not Placed’. 148 students out of 215 got placements and 67 were not placed.

Step8: Statistics: Acquiring, characterizing, analyzing, and drawing conclusions from quantitative data are all the purviews of statistics, a branch of applied mathematics.

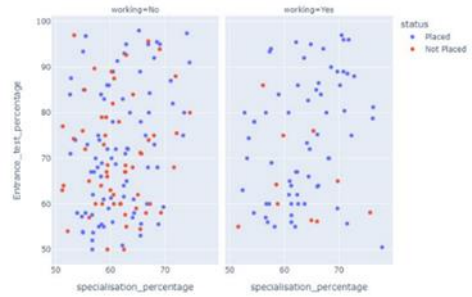

Fig 15. Comparison of specialization percentage vs entrance test percentage

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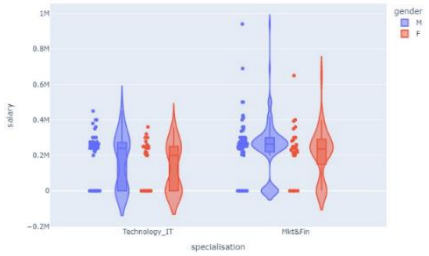

Fig 16. Specialization and salary comparison

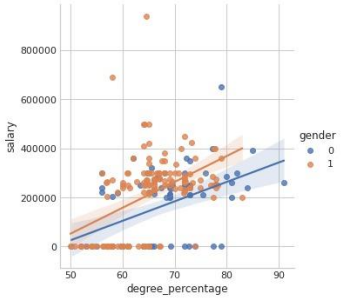

Fig 17. Degree percentage vs salary

Step9: Error rate: One definition of error rate is the ratio of the size of the prediction error to the actual model. As it pertains to classification models, the term "error rate" is often employed.

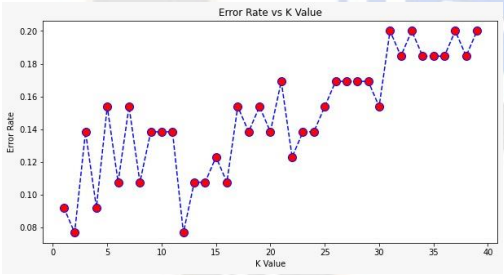

Fig 18. Error rate vs K value

Step10: Train Test Split: Separating a dataset into train and test sets allows us to evaluate the performance of our machine learning model. Known train set data are used to achieve an accurate model fit. The second collection, known as the test data set, is used only for making forecasts.

Step11: Model Building

Support vector machine

By selecting the optimal line or decision boundary that may divide an n-dimensional space into classes, the SVM approach may quickly classify fresh data points in the future. A hyperplane defines the optimal boundaries for making a choice.

```
SupportVectorMachine
Train score of trained model: 93.75
Validation score of trained model: 77.14285714285715
Test score of trained model: 88.88888888888889

Confussion Matrix:
[[12  0]
 [ 4 20]]

Accuracy : 0.8888888888888888
Precision: 1.0
Recall   : 0.8333333333333334
F1 score : 0.9090909090909091
Specificity : 1.0

Classification Report:
              precision    recall  f1-score   support

           0       0.75      1.00      0.86        12
           1       1.00      0.83      0.91        24

    accuracy                           0.89        36
   macro avg       0.88      0.92      0.88        36
weighted avg       0.92      0.89      0.89        36
```

Fig 19. SVM score

Web development, intrusion detection, biometrics (facial, id, email, gene), and linguistics are just a few of the many applications of support vector machines (handwriting, id).

Fig 20. Confusion matrix of SVM

The graphical depiction of the compromise between two kinds of mistakes is the receiver operating characteristic (ROC) curve.

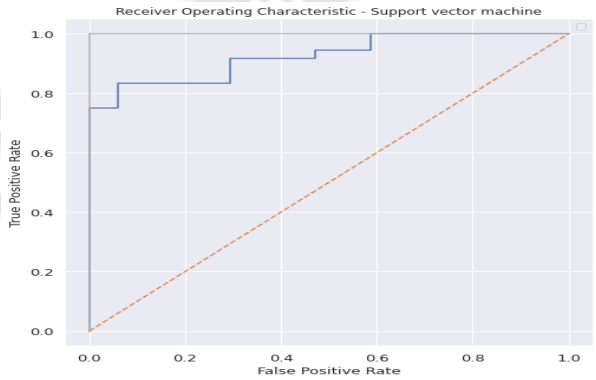

Fig 21. ROC curve of SVM

Step12: Classification: The act of recognizing, differentiating, and comprehending concepts and objects—categorization—is connected to classification. Facts that are connected are categorized.

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	precision	recall	f1-score	support
0	0.91	0.48	0.62	21
1	0.80	0.98	0.88	44
accuracy			0.82	65
macro avg	0.85	0.73	0.75	65
weighted avg	0.83	0.82	0.80	65

Fig 22. Classification of algorithms

Step13: Evaluation: The purpose of a process assessment is to determine whether or not the project followed the strategy or theory of change outlined in the logic model. Inputs, activities, and outputs, together with their interplay, are the focus of process assessments, as opposed to outcomes and impacts.

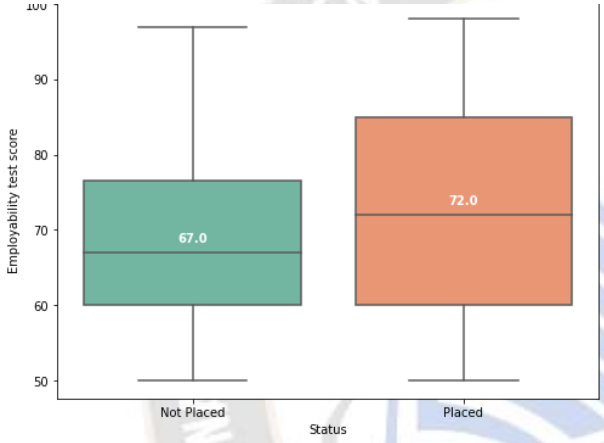

Fig 23. Box plot of Employability test score

IV. RESULT

- The purpose of online recruitment is to provide an organization's HR division with a centralized, web-based recruitment process system.
- Jobs can be posted, application data can be stored, interviews can be scheduled, results can be saved, and successful candidates may be hired with the help of this system.
- A website is being developed as part of this project's online recruitment system, and interested parties may sign up to take the exam there.
- Test scores will be used to narrow down the pool of candidates for the open positions.
- The information on the test, including the date and time, will be made available to them online.
- Applicants and registrants might be from any nation in the world. As a result, the process as a whole is easier to handle.

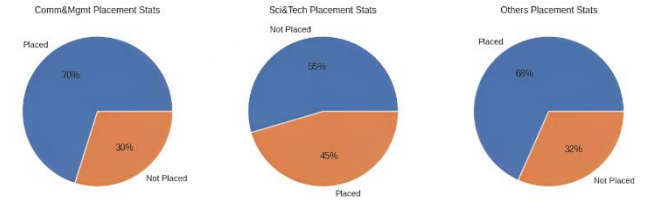

Fig 24. Pie charts of placement stats

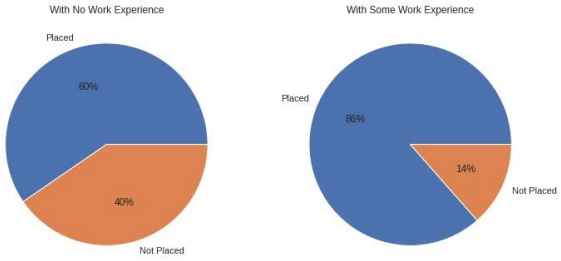

Fig 25. Pie charts of works experience

Fig 26. Linegraph: Predicted salary vs the original salary

What one learns on the job is known as "work experience," and it encompasses all of one's professional and occupational endeavors.

Comparisons of all algorithms

Neural Network Model: An artificial neural network is a simplified model of the brain. To operate, it models a vast network of interconnected processors that behave as abstract representations of neurons. The processing units are organized into many layers.

```
Neural Nets
Train score of trained model: 100.0
Validation score of trained model: 77.14285714285715
Test score of trained model: 80.55555555555556

Confussion Matrix:
[[10  1]
 [ 6 19]]

Accuracy : 0.8055555555555556
Precision: 0.95
Recall   : 0.76
F1 score : 0.8444444444444444
Specificity : 0.9090909090909091

Classification Report:
              precision    recall  f1-score   support

           0       0.62      0.91      0.74        11
           1       0.95      0.76      0.84        25

    accuracy                           0.81        36
   macro avg       0.79      0.83      0.79        36
weighted avg       0.85      0.81      0.81        36
```

Fig 27. Neural Network Model score

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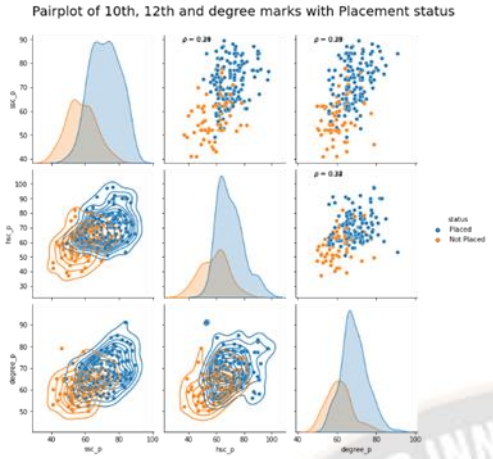

Fig 28. Pairplot of degree marks with placement status

Neural networks are a kind of artificial intelligence that trains computers to think and process information in a way that mimics the human brain.

```
Neural Nets
Train score of trained model: 100.0
Validation score of trained model: 77.14285714285715
Test score of trained model: 80.55555555555556

Confussion Matrix:
[[10  1]
 [ 6 19]]

Accuracy : 0.8055555555555556
Precision: 0.95
Recall   : 0.76
F1 score : 0.8444444444444444
Specificity : 0.9090909090909091

Classification Report:
              precision    recall  f1-score   support

           0       0.62      0.91      0.74        11
           1       0.95      0.76      0.84        25

    accuracy                           0.81        36
   macro avg       0.79      0.83      0.79        36
weighted avg       0.85      0.81      0.81        36
```

Fig 29. Confusion matrix of Neural Network Model

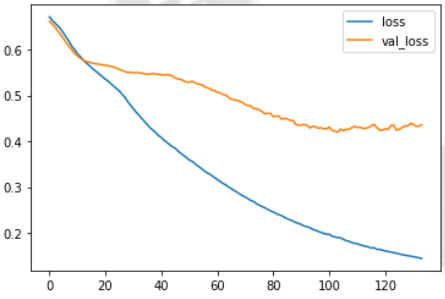

Fig 30. Neural Network Model loss

Stochastic Gradient Descent:To find the model parameters that most closely match the predicted and actual outputs, machine learning applications often use the optimization process of stochastic gradient descent.

```
Stochastic Gradient Descent
Train score of trained model: 89.58333333333334
Validation score of trained model: 77.14285714285715
Test score of trained model: 86.11111111111111

Confussion Matrix:
[[14  3]
 [ 2 17]]

Accuracy : 0.8611111111111112
Precision: 0.85
Recall   : 0.8947368421052632
F1 score : 0.8717948717948718
Specificity : 0.8235294117647058

Classification Report:
              precision    recall  f1-score   support

           0       0.88      0.82      0.85        17
           1       0.85      0.89      0.87        19

    accuracy                           0.86        36
   macro avg       0.86      0.86      0.86        36
weighted avg       0.86      0.86      0.86        36
```

Fig 31. Stochastic Gradient Descent score

A rudimentary yet effective approach. Stochastic gradient descent is widely used in the machine learning community.

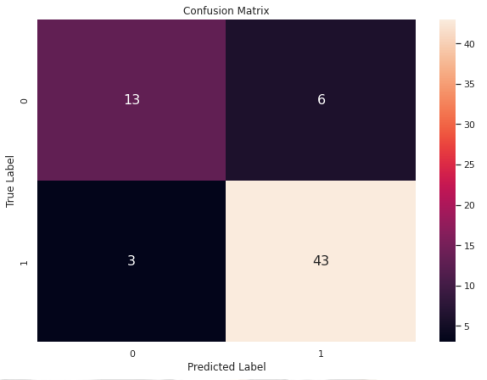

Fig 32. Confusion matrix of Stochastic Gradient Descent

Gradient Boosting Classifier: The machine learning method of gradient boosting has several applications, including the resolution of classification and regression problems. A weak prediction model in the form of an ensemble of decision trees is provided.

```
GradientBoostingClassifier
Train score of trained model: 100.0
Validation score of trained model: 77.14285714285715
Test score of trained model: 88.88888888888889

Confussion Matrix:
[[13  1]
 [ 3 19]]

Accuracy : 0.8888888888888888
Precision: 0.95
Recall   : 0.8636363636363636
F1 score : 0.9047619047619048
Specificity : 0.9285714285714286

Classification Report:
              precision    recall  f1-score   support

           0       0.81      0.93      0.87        14
           1       0.95      0.86      0.90        22

    accuracy                           0.89        36
   macro avg       0.88      0.90      0.89        36
weighted avg       0.90      0.89      0.89        36
```

Fig 33.Gradient Boosting Classifier score

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In cases when a decision tree is a weak learner, the resultant gradient-boosted trees technique often beats random forest.

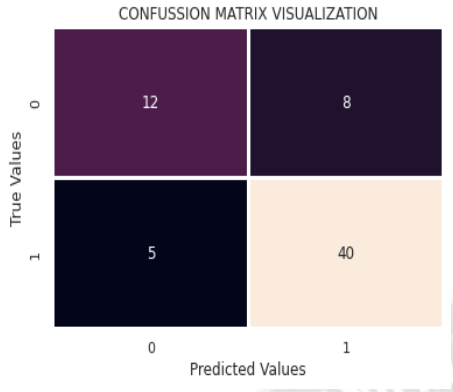

Fig 34. Confusion matrix of Gradient Boosting Classifier

K neighbors classifier: The K-NN technique assumes that the new case is similar to the old cases and assigns it to the group that has the greatest similarities with the existing groups.

```
KNeighborsClassifier
Train score of trained model: 86.80555555555556
Validation score of trained model: 77.14285714285715
Test score of trained model: 69.44444444444444

Confussion Matrix:
[[ 6  1]
 [10 19]]

Accuracy : 0.6944444444444444
Precision: 0.95
Recall   : 0.6551724137931034
F1 score : 0.7755102040816326
Specificity : 0.8571428571428571

Classification Report:
              precision    recall  f1-score   support

           0       0.38      0.86      0.52         7
           1       0.95      0.66      0.78        29

    accuracy                           0.69        36
   macro avg       0.66      0.76      0.65        36
weighted avg       0.84      0.69      0.73        36
```

Fig 35. K neighbors classifier score

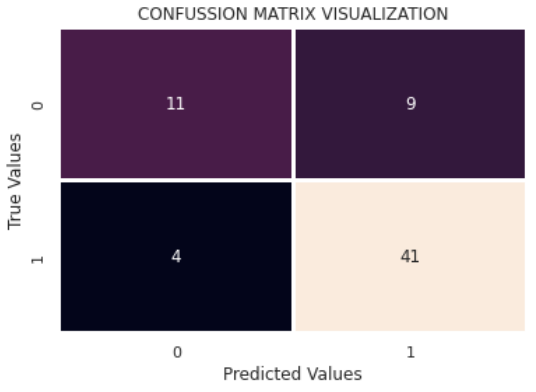

Fig 36. Confusion matrix of K neighbors classifier

The ROC curve is a visually appealing way to demonstrate the accuracy of your model's predictions. This is a graph showing the ratio of accurate to incorrect identifications at various false-positive thresholds. One technique to measure a model's performance is by the calculation of its ROC area.

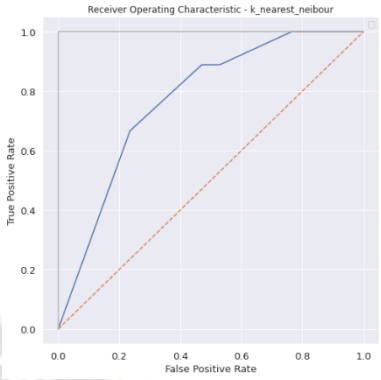

Fig 37. ROC curve of K neighbors classifier

Decision tree classifier:The supervised learning technique known as decision trees may be used for both classification and regression issues, albeit it is not always the best option.

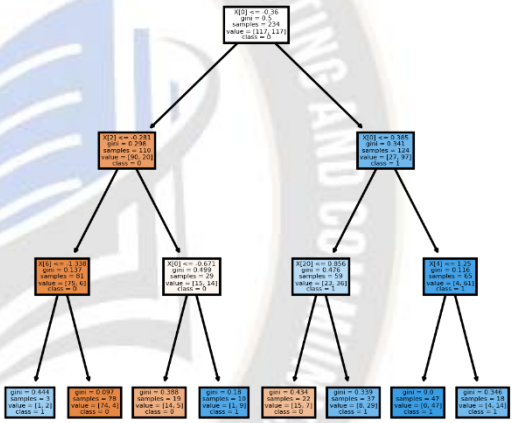

Fig 38. Decision tree classifier

```
DecisionTreeClassifier
Train score of trained model: 100.0
Validation score of trained model: 77.14285714285715
Test score of trained model: 83.33333333333334

Confussion Matrix:
[[13  3]
 [ 3 17]]

Accuracy : 0.8333333333333334
Precision: 0.85
Recall   : 0.85
F1 score : 0.85
Specificity : 0.8125

Classification Report:
              precision    recall  f1-score   support

           0       0.81      0.81      0.81        16
           1       0.85      0.85      0.85        20

    accuracy                           0.83        36
   macro avg       0.83      0.83      0.83        36
weighted avg       0.83      0.83      0.83        36
```

Fig 39. Decision tree classifier score

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This classifier is structured like a tree, with the trunk representing the attributes of the dataset, the branches indicating the reasoning behind the choice, and the leaves representing the individual classifications.

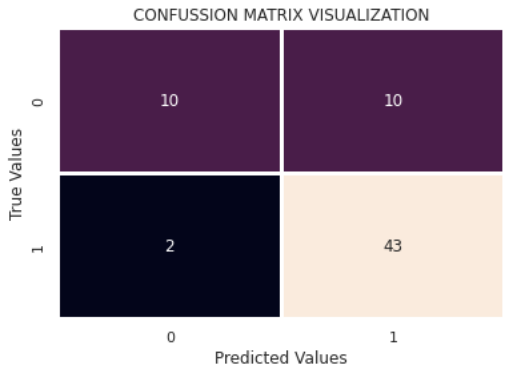

Fig 40. Confusion matrix of a Decision tree classifier

The relationship or trade-off between clinical sensitivity and specificity for each feasible cut-off for a test or combination of tests may be graphically represented using ROC curves.

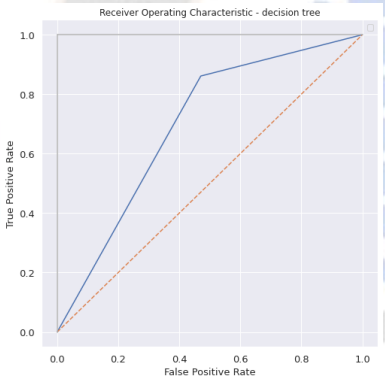

Fig 41. ROC curve of a Decision tree classifier

Random Forest Classifier: To improve the accuracy of its predictions, Random Forest employs many decision trees applied to various subsets of the input information and then averages the results.

```
RandomForestClassifier
Train score of trained model: 100.0
Validation score of trained model: 77.14285714285715
Test score of trained model: 86.11111111111111

Confussion Matrix:
[[12  1]
 [ 4 19]]

Accuracy : 0.8611111111111112
Precision: 0.95
Recall   : 0.8260869565217391
F1 score : 0.8837209302325583
Specificity : 0.9230769230769231

Classification Report:
              precision    recall  f1-score   support

           0       0.75      0.92      0.83        13
           1       0.95      0.83      0.88        23

    accuracy                           0.86        36
   macro avg       0.85      0.87      0.86        36
weighted avg       0.88      0.86      0.86        36
```

Fig 42. Random Forest Classifier score

The random forest takes into account forecasts from each tree and then makes a final prediction based on the majority of those projections rather than a single decision tree's verdict.

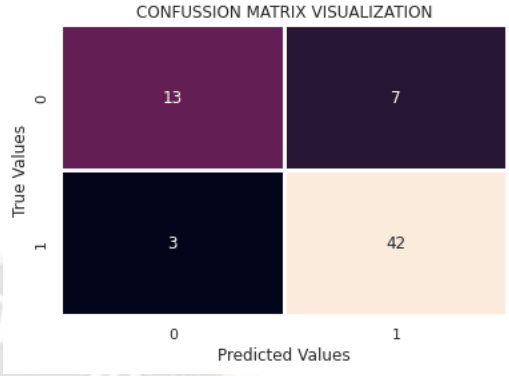

Fig 43. Confusion matrix of Random Forest Classifier

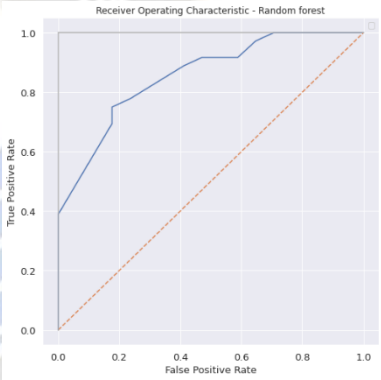

Fig 44. ROC curve of Random Forest Classifier

Logistic Regression: Logistic regression is a method of statistical analysis for making predictions about a binary outcome from a series of prior observations.

```
LogisticRegression
Train score of trained model: 90.27777777777779
Validation score of trained model: 77.14285714285715
Test score of trained model: 88.88888888888889

Confussion Matrix:
[[13  1]
 [ 3 19]]

Accuracy : 0.8888888888888888
Precision: 0.95
Recall   : 0.8636363636363636
F1 score : 0.9047619047619048
Specificity : 0.9285714285714286

Classification Report:
              precision    recall  f1-score   support

           0       0.81      0.93      0.87        14
           1       0.95      0.86      0.90        22

    accuracy                           0.89        36
   macro avg       0.88      0.90      0.89        36
weighted avg       0.90      0.89      0.89        36
```

Fig 45. Logistic Regression score

Predictions are made regarding a dependent data variable using a logistic regression model, which does so by examining the relationship between one or more preexisting independent variables.

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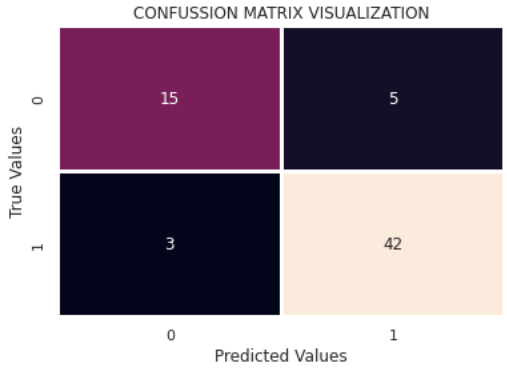

Fig 46. Confusion matrix of Logistic Regression

ROC curves are used in logistic regression to determine the best threshold for classifying a new observation as "failure" (0) or "success" (1).

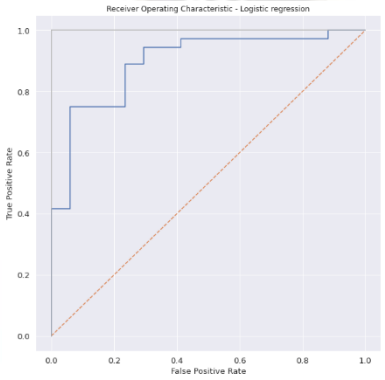

Fig 47. ROC curve of Logistic Regression

Bernoulli NB: It uses the Bayes theorem of probability to make predictions about the category of unknown data sets.

```
BernoulliNB
Train score of trained model: 80.55555555555556
Validation score of trained model: 77.14285714285715
Test score of trained model: 83.33333333333334

Confussion Matrix:
[[13  3]
 [ 3 17]]

Accuracy : 0.8333333333333334
Precision: 0.85
Recall   : 0.85
F1 score : 0.85
Specificity : 0.8125

Classification Report:
              precision    recall  f1-score   support

           0       0.81      0.81      0.81        16
           1       0.85      0.85      0.85        20

    accuracy                           0.83        36
   macro avg       0.83      0.83      0.83        36
weighted avg       0.83      0.83      0.83        36
```

Fig 48. Bernouli NB score

The probability of an event is determined by the Bayes theorem, which takes into account the prior knowledge and other known probabilities of that happening.

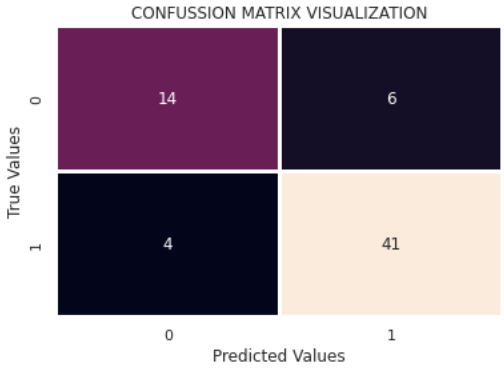

Fig 49. Confusion matrix of Bernouli NB

Gaussian NB: Applying Bayes' theorem under strict independence assumptions yields the probabilistic classification method known as Gaussian Naive Bayes.

```
GaussianNB
Train score of trained model: 81.94444444444444
Validation score of trained model: 77.14285714285715
Test score of trained model: 83.33333333333334

Confussion Matrix:
[[11  1]
 [ 5 19]]

Accuracy : 0.8333333333333334
Precision: 0.95
Recall   : 0.7916666666666666
F1 score : 0.8636363636363635
Specificity : 0.9166666666666666

Classification Report:
              precision    recall  f1-score   support

           0       0.69      0.92      0.79        12
           1       0.95      0.79      0.86        24

    accuracy                           0.83        36
   macro avg       0.82      0.85      0.82        36
weighted avg       0.86      0.83      0.84        36
```

Fig 50. Gaussian NB score

If the curve is skewed toward the ROC space's 45-degree diagonal, the test's accuracy drops.

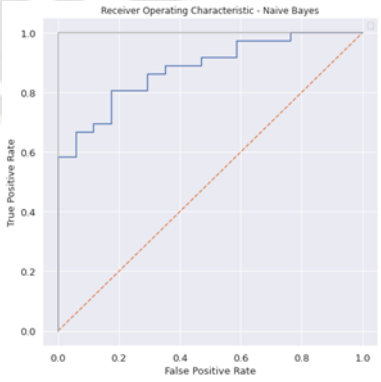

Fig 51. ROC curve of Gaussian NB

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All model tabular and graphical comparison

Table 1. comparisons of models with scores

Models	Accuracy	Precision	Recall	F1 score	Specificity
Neural network	0.8	0.95	0.76	0.84	0.9
Stochastic gradient descent	0.86	0.85	0.89	0.87	0.82
Gradient boosting classifier	0.88	0.95	0.86	0.9	0.92
K neighbors	0.69	0.95	0.65	0.77	0.85
Decision tree classifier	0.83	0.85	0.85	0.85	0.81
Support vector machine	0.88	1	0.83	0.9	1
Random forest classifier	0.86	0.95	0.82	0.88	0.92
Logistic regression	0.88	0.95	0.86	0.9	0.92
Bernouli Nb	0.83	0.85	0.85	0.85	0.81
Gaussian Nb	0.83	0.95	0.79	0.86	0.91

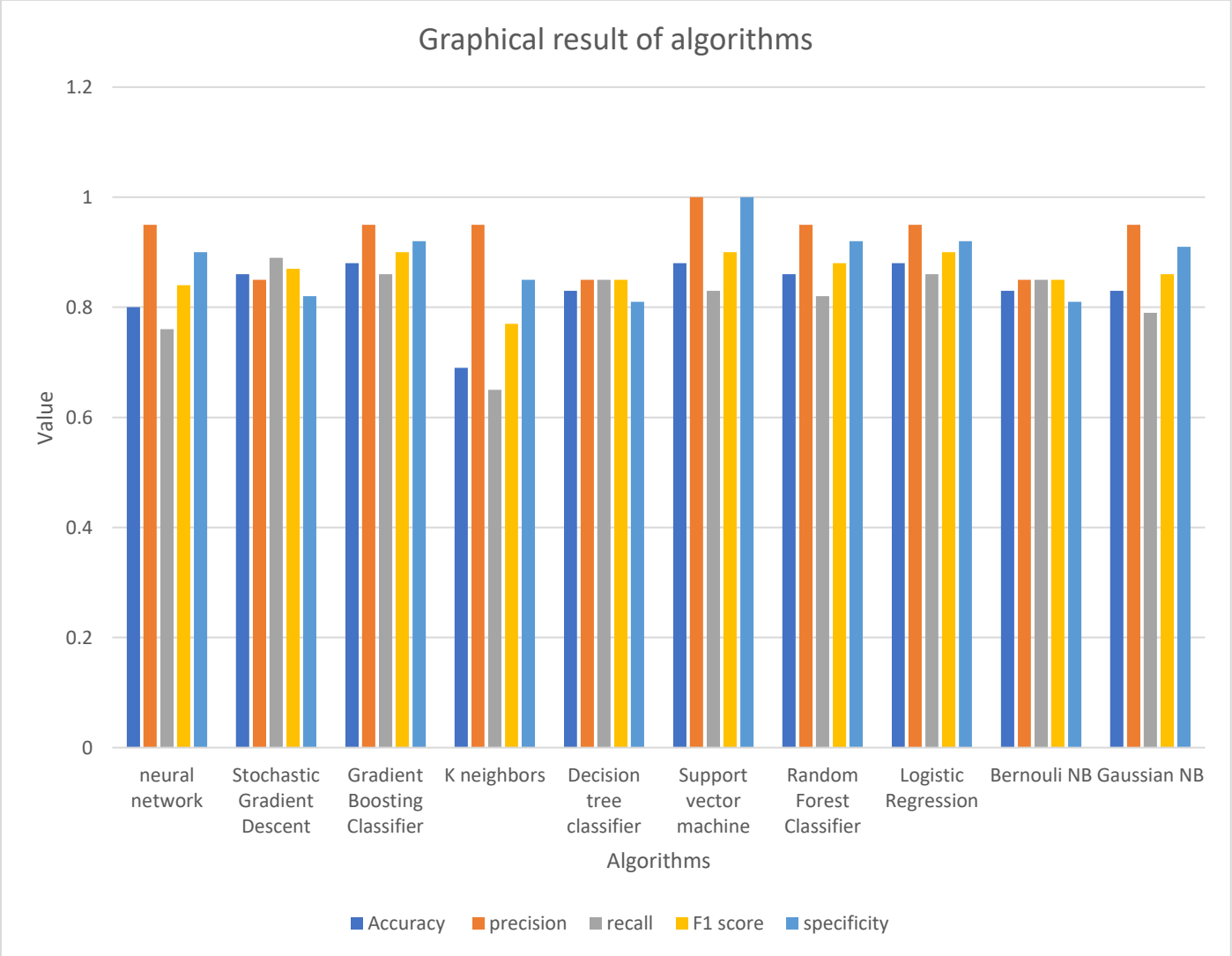

Fig 51. Bar graph for result comparison

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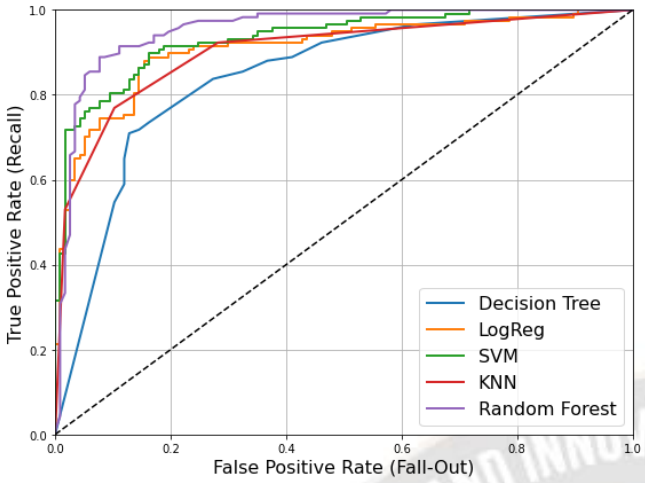

Fig 52. All models compared

V. CONCLUSION

Campus recruitment is the process through which companies identify qualified candidates from colleges and universities for available positions. Employers often inform students about the company and open positions, collect resumes and application materials from interested people, then conduct interviews to pick the best candidates for the open positions.

Employers benefit greatly from a college recruitment system because it provides them with ready access to talented employees. This might be especially useful for engineering that is looking to hire recent college grads who have relevant experience and knowledge in a certain field. Moreover, campus recruitment may help companies build relationships with institutions that might benefit both the company and the school.

But there might be some major drawbacks to using college resources to find candidates. Some students, for instance, may feel compelled to take the first job offer they get, even if the position isn't a good fit for them. Furthermore, picking applicants from a narrow pool of students at a certain educational institution may result in a lack of variety in the recruitment process.

Companies seeking educated and competent workers may find a campus recruitment system useful; nevertheless, they need to be wary of the system's drawbacks and ensure that the process is fair and accessible to all candidates.

Based on the model comparison overall accuracy is higher for Random Forest Classifier which is 80% accuracy. All the other models havean overall accuracy of 75.38%. But the accuracy of classifying the negative class is almost equal for all the models which are 72.72% accuracy. Overall, we can select Random Forest Classifier to classify this data, as it performs well on most evaluation metrics.

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