# CHAPTER I
# The Problem and its Background

## Introduction

In a study titled “Implementation of Course Recommender System for Virtual University of Pakistan” by Akhtar (2020), a course recommendation system was specifically designed for the Virtual University of Pakistan with the aim of improving student performance and course selection accuracy. The system applied user-based collaborative filtering and rating prediction techniques to recommend courses that matched student interests, competencies, and past academic performance. To achieve this, the model compared students with similar academic records and used these similarities to forecast likely grades and outcomes in future courses. The dataset simulated included 2,600 students across 470 courses, providing a strong foundation for testing scalability and accuracy. The evaluation of the system, carried out using Mean Absolute Error (MAE) across 100 test cases, showed that predictions fell within an acceptable range of accuracy, proving the model’s reliability for real-world use in academic advising. This study emphasizes how recommendation systems can be effectively applied in higher education to support students in making informed decisions that reflect their interests and increase their chances of academic success.

In the local context, Bucad (2024) conducted a study titled “Towards the Development of a Career Path Recommender System for Senior High School in Selected Public Schools Using MultiLabel Classification,” which aimed to develop a career path recommender system for Grade 10 students in selected public schools in Valenzuela City to reduce strand or track mismatches among Senior High School students. The system utilized multiple student attributes such as family background, Big Five personality traits, academic grades, IQ test results, and data from DepEd’s Multiple Career Development Toolkit, which includes self-assessment and career interest components. It employed multi-label classification and content-based filtering using several algorithms including Decision Tree, K-Nearest Neighbor, Naïve Bayes, and Support Vector Machine to generate accurate recommendations. The study also evaluated not only the predictive performance of the model but also system quality (based on ISO/IEC 25010:2011) and user acceptance (using the UTAUT model), highlighting the growing local interest in using intelligent systems to guide students in making appropriate academic and career choices.

Building upon these studies, the present research entitled “College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree” aims to develop a hybrid recommendation system tailored

for Senior High School (SHS) students in the Philippines. The system seeks to assist students in identifying the most suitable college course based on their academic performance, interests, and individual competencies. By integrating Rule-Based Logic, which uses predefined rules and expert knowledge to assess student profiles, with Decision Tree algorithms, which analyze data patterns to make intelligent predictions, the system combines human reasoning and machine learning. This approach is intended to provide students with personalized, data-driven, and accurate course recommendations, ultimately supporting better educational alignment and informed decision-making as they transition from senior high school to higher education.

## Background of the Study

Studies show that many SHS graduates do not take college courses that match their strand. In one research, 39% of students in SY 2017 - 2018 and 31% in SY 2018 - 2019 had a course mismatch (Quintos et al., 2020). This means a large number of students are not continuing in the field they studied in SHS. Mismatches happen because of family pressure, peer influence, or lack of choices in their area. Another study showed that SHS tracks in Cebu do not always match the jobs that are in demand (Pajares et al., 2021). This makes it hard for students to find jobs related to their skills. In fact, even after finishing college, only about half of graduate's

work in jobs related to their course (PIDS, 2019). This shows that there is a big gap between what schools teach and what jobs require.

Because of these problems, SHS students need more help in choosing the right course. A College Course Matcher using Rule-Based and

Decision Tree Algorithm Questionnaire can be a solution. In this system, students answer a questionnaire about their interests, skills, and goals. Rule-based systems and Decision tree algorithms play critical roles in designing such recommendation engines.

Rule-based recommendation systems utilize explicit, human-crafted IF-THEN logic to filter options based on criteria like academic performance, interests, and career aspirations. This approach ensures transparency and

domain specificity, enabling users to trace how decisions are made (Sundari, 2020). For example, a college course recommendation system can apply clear-cut rules to match students' preferences and proficiencies to suitable electives. A related study at the University of Tabuk also demonstrated how decision trees can generate induction rules that strengthen rule-based advising systems in learning-pathway selection (Elfaki et al., 2015).

Decision trees are valued not only for their performance but also for their clarity, which makes them well-suited for applications that require transparency. Their "white-box" nature makes them easy to interpret and validate a valuable trait when explaining recommendations to users. Studies highlight their effectiveness in recommender systems because of their simplicity and interpretability (Gershman, 2010; Shmuel, 2019).

Hybrid systems that combine both methodologies harness the strengths of each rules offer precision and clarity, while decision trees provide adaptability and data-driven inference. Researchers emphasize the value of such combinations in educational recommendation systems, as they can provide accurate, personalized, and transparent guidance for students (Elfaki et al., 2015; Sundari, 2020). Ultimately, a College Course Matcher that integrates rule-based and decision tree algorithms is expected to

support SHS students in making well-informed decisions, reduce mismatches in course selection, and improve academic outcomes.

## Objectives of the Study

### General Objective

The general objective of this study is to develop a College Course Recommendation System for Senior High School (SHS) students using Rule-Based Logic and Decision Tree algorithms to provide accurate and data-driven guidance in selecting suitable college courses. The system is intended to serve as a support tool that can guide SHS students toward suitable courses based on their individual profiles, thereby helping them make more informed academic decisions about their future.

### Specific Objectives

Specifically, this study aims to:

- To obtain a validated dataset of SHS student profiles, by administering a structured questionnaire that captures personal interests, skills, academic performance, and preferred learning styles.
- To produce a filtered shortlist of college courses, for each student by applying rule-based eligibility and preference constraints derived from the collected data.
- To deliver ranked course recommendations, generated through decision tree analysis of the filtered student data to identify the most suitable course options.
- To present recommendations with transparent rationale, via a user-friendly interface that communicates the decision process and explanation for each suggested course.
- To demonstrate the system's effectiveness, by measuring recommendation accuracy and user usability through testing with SHS students.
- To test the functionality of the system for Course Recommendation System, using the User Acceptance Testing.

## Scope and Delimitation

### Scope

This study focuses on the development of a College Course Recommendation System for Senior High School (SHS) students using Rule-Based Logic and Decision Tree algorithms. Specifically, the system will:

- Assist students in identifying college courses that align with their skills, interests, personality traits, and academic performance.
- Provide personalized recommendations by requiring users to register or log in before accessing the system.
- Collect relevant student information through a structured questionnaire, including situational and interest-based questions.
- Generate recommendations through a two-phase process:
    - **Rule-Based Filtering** - eliminates courses that do not meet the student's qualifications or stated preferences.
    - **Decision Tree Analysis** - ranks and prioritizes courses based on identified patterns from the provided data.

**Delimitation**

The system's recommendations are dependent on the accuracy and honesty of the student's responses in the questionnaire. Recommendations are based on predefined rules and a decision tree model, meaning they do not adapt dynamically unless the knowledge base and decision tree are updated manually. The system does not guarantee absolute accuracy in predicting student success in a recommended course; it only provides guidance based on given input and algorithmic logic. External factors such as financial capability, geographic location, university admission requirements, and personal circumstances are not considered in generating recommendations. The system currently does not include real-time labor market data or job demand analytics, which could influence course relevance in the future. The recommendation coverage is limited to the dataset of courses predefined by the developers and does not include all possible specializations or new programs introduced after the system's development.

**Assumptions and Hypothesis**

This study assumes that Senior High School students will provide honest and accurate information regarding their interests, academic performance, and preferred college courses. It is also assumed that the data collected from students, along with the information provided by guidance counselors, are reliable and sufficient for generating accurate recommendations. Furthermore, it is assumed that the rule-based logic and decision tree algorithm can effectively analyze and process the input data to produce appropriate course suggestions suited to each student's abilities and preferences.

The study hypothesizes that the developed College Course Recommendation System using Rule-Based Logic and Decision Tree Algorithm will significantly improve the accuracy, reliability, and efficiency of course recommendations for Senior High School students compared to traditional manual guidance methods.

## Significance of the Study

This study is intended to provide meaningful contributions to the decision - making process of Senior High School students as they prepare for college, while also offering practical value to parents, guidance counselors, and educational institutions.

The beneficiaries of the study will be the following:

1. **Senior High School Students**
    - Helps students discover the most suitable college courses based on their interests, skills, and decision-making tendencies.
    - Reduces confusion and anxiety in course selection by providing personalized recommendations.
    - Encourages self-awareness about their strengths and career inclinations through the situational and interest-based questionnaire.

2. **Guidance Counselor and Career Advisors**
    - Acts as a decision-support tool to guide students in choosing their college paths.
    - Saves time in evaluating a large number of students, allowing counselors to focus more on mentoring and providing deeper guidance.
    - Provides data-driven insights about student preferences and trends, which can help in career orientation programs.

3. **Educational Institutions**
    - Improves student satisfaction and retention rates, as students are more likely to pursue courses they are truly interested in and capable of succeeding in.
    - Can serve as a supplementary tool for entrance or career assessment programs, enhancing the school's career guidance initiatives.
    - Provides valuable analytics about common student interests, which can influence course offerings or promotional campaigns.

4. **Researchers and Developers**
    - Demonstrates how Rule-Based Logic and Decision Tree algorithms can be applied in educational decision-making systems.
    - Can serve as a reference for future projects involving automated recommendations, academic analytics, or a career guidance system.
    - Opens opportunities for further enhancements, such as integrating machine learning for more adaptive recommendations.

5. **Society**
    - Contributes to producing graduates who are aligned with their passions and strengths, which can lead to better career satisfaction and productivity in the workforce.
    - Encourages a more efficient educational journey, minimizing cases of students shifting courses due to misaligned choices.

Overall, the significance of this study lies in its ability to bridge the gap between self-assessment and informed academic decision-making. It does not claim to provide perfect answers but rather serves as a structured, data-assisted guide that students can use alongside professional and parental advice. By doing so, it encourages more thoughtful choices, supports collaboration between stakeholders, and contributes to better long-term educational outcomes.

## Definition of Terms

**Rule-based Algorithm -** an artificial intelligence system that applies a collection of predefined rules to guide decision-making and problem-solving. These rules are usually structured in an "if-then" format.

**Decision Tree Algorithm -** a supervised machine learning technique for jobs involving both regression and classification.

**Decision Making -** process of making decisions

**User-friendly interface -** a digital interface that enables users to engage with software or websites smoothly, intuitively, and efficiently, emphasizing clarity, consistency, and ease of use.

**Supplementary tool -** any tool, method, or resource that supplements, supports, or compensates for a gap in an existing system or process, typically aimed at improving efficiency, comprehension, or performance.

**User Acceptance Testing -** is the test cases used to ensure that the systems key features such as login, data input, taking the test, and logout function correctly and meet user expectations.

# CHAPTER II
# Review of Related Literature and Studies

## Related Literature

### Foreign Literature

**Recommender System in Academic Choices of Higher Education: A Systematic Review (Kamal et al., 2024)**

In the review *"Recommender System in Academic Choices of Higher Education: A Systematic Review"* (Kamal et al., 2024), the authors examined 56 research works published between 2011 and 2023 that focused on the use of recommender systems in academic decision-making. Their findings revealed that most of these systems were designed to assist in course selection, while fewer were applied to program or university choice. The review highlighted that hybrid approaches, which combine techniques such as collaborative filtering, content-based filtering, and classification methods, were the most effective in generating recommendations. Common data inputs included students' grades, academic performance, preferences, and demographic information. Although many of the systems demonstrated high accuracy and efficiency, the study emphasized that most were tested only in controlled or offline settings rather than in real-world academic environments. The authors concluded that recommender systems hold significant potential in guiding students toward better academic decisions, but

further research is needed to improve personalization, practical implementation, and evaluation of long-term educational outcomes.

**Synthesis:**

This review highlights the growing importance of recommender systems in supporting academic decision-making, particularly in course and program selection. Their review of 56 research works revealed that hybrid approaches combining techniques like collaborative filtering, content-based filtering, and classification are the most effective in generating accurate and personalized recommendations based on factors such as students' grades, preferences, and demographics. This aligns with the objectives of the proposed College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree, which seeks to apply decision-based techniques to provide more practical, personalized, and data-driven course guidance that can be implemented effectively in real educational settings.

**Systematic Review of Recommendation Systems for Course Selection (Algarni & Sheldon, 2023)**

In the review the researchers examined 35 empirical studies (from 2017 - 2022) involving course recommender systems to understand the state-of-the-art in how students are helped to choose courses. The review categorized methods used

such as collaborative filtering (CF), content-based filtering (CBF), hybrid filtering, novel approaches (machine learning / deep learning) and similarity-based filtering. They found that CF and novel approaches are the most common, content-based and similarity-based filtering are much less used. The review also analyzed dataset characteristics (size, public/private, features used, data-preprocessing, train/test splits) and evaluation metrics (MAE, RMSE, etc.) across the included studies. Key gaps identified included: many papers use private or small datasets; often poor or missing details about preprocessing; inconsistent or missing information on how data was split for training/testing; under-utilization of less common recommendation methods; and reproducibility issues. The authors suggest future research should aim for larger, more openly available datasets, clearer methodology reporting, and broader use of hybrid or novel models that can address e.g. cold start and scalability.

**Synthesis:**

This review provides an in-depth examination of course recommender systems, analyzing 35 studies published between 2017 and 2022. Their findings revealed that collaborative filtering and emerging machine learning or deep learning methods are the most commonly used approaches, while content-based and similarity-based filtering remain underexplored. The review also identified significant challenges, including limited dataset size, lack of transparency in preprocessing and data-splitting methods, and reproducibility concerns. The

authors emphasized the need for future research to utilize larger, publicly available datasets and explore hybrid or novel models to address common issues such as scalability and the cold-start problem. This study supports the development of the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree, as it highlights the importance of improving methodological transparency and exploring alternative techniques like rule-based and decision tree algorithms to enhance reliability, interpretability, and practical applicability in academic course recommendations.

**A Survey on Explainable Course Recommendation Systems (Ma, Yang & Ren, 2024)**

The authors examine recent developments in course recommendation systems that don't just predict what courses a student should take, but also explain *why* the system makes those recommendations. The paper introduces a framework that analyzes three key aspects of explainability: the input data (what kind of information about the user and courses is used), the model or algorithm (how transparent or interpretable the system is), and the output or explanation style (how the rationale is communicated to the student). They review different recommendation approaches content-based, collaborative filtering, machine learning/data mining and deep learning and point out that although deep models achieve high accuracy, their "black-box" nature makes it harder for students (and

developers) to understand the decision process. The authors also highlight how explanations vary (textual, visual, rule-based, etc.), and argue that users' trust, satisfaction, and decision quality improve when recommendations are accompanied by clear justifications. The paper concludes that explainability is increasingly important in educational settings, but many systems still focus more on performance metrics than on how useful, understandable, or trustworthy their explanations are

**Synthesis:**

Their framework analyzes explainability through three dimensions input data, model transparency, and explanation style and reviews various methods such as content-based filtering, collaborative filtering, and deep learning. While deep learning models yield high accuracy, the authors note that their "black-box" nature limits interpretability and user trust. They argue that students' satisfaction and confidence in recommendations significantly improve when systems present understandable explanations, whether textual, visual, or rule-based. This aligns closely with the goals of the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree, which aims to deliver transparent and interpretable results. By utilizing rule-based and decision tree algorithms, the proposed system can provide both accurate and explainable course recommendations, enhancing student trust and understanding in their academic decision-making process.

**Extracting Course Features and Learner Profiling for Course Recommendation Systems: A Comprehensive Literature Review (Narimani et al. 2024)**

They published their studies in the International Review of Research in Open and Distributed Learning (IRRODL). The study explored various methods for developing intelligent course recommendation systems by focusing on how learner profiles and course features are extracted and utilized to improve recommendation accuracy. It emphasized that effective course recommendations depend on analyzing students' interests, academic performance, and learning behavior to match them with appropriate courses. This aligns with the College Course Recommendation System for SHS Using Rule-Based and Decision Tree, as both aim to personalize course suggestions through systematic profiling and logical decision-making. The integration of learner data and algorithmic models discussed in the study supports the use of rule-based logic and decision tree techniques to provide more transparent and data-driven educational recommendations.

**Synthesis:**

This review focuses on enhancing the accuracy of course recommendation systems through effective learner profiling and course feature extraction. By analyzing students' interests, academic performance, and learning behaviors, the study demonstrates how intelligent systems can generate more personalized and relevant course suggestions. It highlights that integrating comprehensive learner

data with algorithmic approaches leads to improved recommendation quality and transparency. This directly supports the objectives of the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree, which similarly utilizes systematic profiling and data-driven decision-making to match students with suitable courses. The findings reinforce the value of combining structured learner analysis with interpretable algorithms such as rule-based and decision tree methods to create personalized, transparent, and effective academic recommendations.

**Educational Recommender Systems: A Systematic Literature Review (Auncancela, 2023)**

An intelligent course recommendation model was developed using rule-based reasoning and decision tree algorithms to guide students in selecting the most suitable academic programs. The system analyzed student profiles, including interests, grades, and aptitude scores, to generate personalized course suggestions. Results showed that combining rule-based logic with decision tree classification improved the system's accuracy and transparency, allowing students to better understand how recommendations were made.

**Synthesis:**

This review presents the development of an intelligent course recommendation model that integrates rule-based reasoning and decision tree algorithms to assist students in choosing appropriate academic programs. By analyzing key student data such as interests, grades, and aptitude scores, the system was able to produce personalized and accurate course recommendations. The combination of these two methods enhanced both the precision and explainability of the results, enabling students to clearly understand the basis of each suggestion. This aligns directly with the objectives of the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree, which also aims to deliver transparent, data-driven, and personalized course guidance to support informed academic decision-making.

**Local Literature**

**Career Decisions and Dilemmas of Senior High School Students in Disadvantaged Schools: Towards the Development of a Proposed Career Guidance Program (Joan N. Puebla, 2022)**

Explores the factors influencing SHS students' career and course decision-making in disadvantaged schools. The study investigates both internal and external challenges such as limited access to guidance resources, family expectations, and lack of information, which often lead to confusion and poor decision-making. Based on the findings, the researchers proposed a tailored career guidance program to address these issues and support students in making more informed educational choices.

**Synthesis:**

This literature examines the various factors that influence Senior High School students' decisions regarding their future courses and careers, particularly in underprivileged schools. It identifies both internal and external challenges such as limited access to guidance services, family expectations, and insufficient information that often lead to confusion and poor decision-making. To address these issues, the researchers proposed a specialized career guidance program designed to help students make more informed and suitable educational choices. In connection, the College Course Recommendation System for SHS Using Rule-

Based and Decision Tree shares the same goal of assisting students in making well-guided course selections through an automated, data-driven recommendation process.

**Determinants of Career Paths Among Grade 12 Students, Division of Agusan del Norte, Philippines (Donna Belle M. Intad, 2021)**

The research identified that parental guidance, school environment, community influence, and personal interests significantly affect students' choice of career paths. Results showed that many students prefer pursuing higher education rather than immediately entering the workforce or engaging in technical-vocational tracks. The study highlights the importance of proper guidance and informed decision-making in choosing suitable college courses, which supports the goal of developing systems that can assist students in identifying appropriate educational paths.

**Synthesis:**

This literature reveals that factors such as parental guidance, school environment, community influence, and personal interests greatly shape students' career choices. It also notes that most students aspire to pursue higher education, emphasizing the need for proper guidance in selecting suitable college courses.

Aligned with these findings, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree aims to provide structured and data-driven support to help students make informed and personalized course decisions, addressing the need for effective guidance highlighted in the research.

**Guidelines on the Supervision and Implementation of the DepEd Career Guidance Program for School Year 2023–2024 (Gonong, 2023)**

(DepEd Memorandum No. 473, s. 2023), the Department of Education provides updated directives for the administration and monitoring of career guidance programs in Philippine schools. The memorandum outlines the roles and responsibilities of school heads, class advisers, guidance counselors, and other stakeholders to ensure that career guidance activities are effectively carried out throughout the school year. It emphasizes the systematic supervision and coordination of program implementation across schools, divisions, and regions, including clear reporting mechanisms and timelines for compliance. By setting standardized procedures for supervision, documentation, and evaluation, the memorandum aims to strengthen accountability and ensure that all learners receive structured career guidance support aligned with national goals. This document serves as a crucial local policy framework that reflects the current operational landscape of career guidance in the Philippines, making it highly

relevant for studies aiming to enhance or support guidance implementation through technological or data-driven systems.

**Synthesis:**

This memorandum specifies the roles of school leaders, advisers, and guidance counselors to ensure organized, well-documented, and accountable implementation. Highlighting the importance of providing consistent and structured guidance to help students make well-informed educational and career choices. Correspondingly, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree supports these goals by integrating technology into the guidance process, offering data-driven and personalized course recommendations that align with each student's abilities and interests.

**Manila senior high school learners to undergo career guidance (Ferdinand Patinio, 2024)**

In February 2024, the City Government of Manila launched a career guidance orientation program to assist around 9,000 Senior High School (SHS) students from 27 public schools in exploring possible career paths such as college, employment, or entrepreneurship. The free program, conducted over several weeks, provided full-day sessions to help Grade 11 and 12 students make informed decisions about their future endeavors. This initiative highlighted the

importance of career guidance and educational planning for Filipino youth, emphasizing the role of proper information and counseling in helping students choose suitable college courses and career tracks.

**Synthesis:**

By offering free, comprehensive sessions, the program emphasized the importance of proper counseling and access to information in guiding students toward well-informed educational and career choices. Similarly, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree seeks to strengthen this effort by providing an accessible, technology-driven platform that delivers personalized course recommendations, supporting students in making sound and data-informed decisions about their future.

**Course and Career Preferences Alignment Among Selected State College Students (Tabigne, 2021)**

The research aimed to assess whether students' enrolled courses were aligned with their career preferences determined through the National Career Assessment Examination (NCAE). The findings revealed that while many students in fields like education and business had alignment between their intended careers and actual courses, others especially those whose preferred careers involved

science, maritime, or personal services did not always find matching offerings in their institution. The study also identified factors such as student interest, financial capacity, and availability of course offerings as key influences on course selection.

**Synthesis:**

The study examined the relationship between students' chosen courses and their career preferences as indicated by the National Career Assessment Examination (NCAE). Results showed that while some students had alignment between their interests and enrolled programs, others faced mismatches due to factors such as limited course offerings, financial constraints, and varying interests. In connection with this, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree seeks to minimize such mismatches by providing personalized, data-driven course recommendations that consider students' interests, capabilities, and available educational options.

## Related Studies

### Foreign Studies

**Implementation of Course Recommender System for Virtual University of Pakistan (Akhtar, 2020)**

The system applied user-based collaborative filtering and rating prediction techniques to recommend courses that matched student interests, competencies, and past academic performance. To achieve this, the model drew comparisons between students with similar academic records and used these similarities to forecast likely grades and outcomes in future courses. The dataset simulated included 2,600 students across 470 courses, providing a strong basis for testing scalability and accuracy. The evaluation of the system was carried out using Mean Absolute Error (MAE) across 100 test cases, and the results showed that the predictions fell within an acceptable range of accuracy, proving the model's reliability for real-world use in academic advising. This study emphasizes how recommendation systems can be applied in higher education institutions to support students in making informed choices that not only reflect their interests but also increase their chances of success.

**Synthesis:**

The study highlights the effectiveness of recommender systems in guiding students toward courses aligned with both their interests and success potential. This aligns with the goals of the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree. Which similarly seeks to provide accurate, data-driven, and personalized course recommendations to help students make informed academic decisions and improve their educational outcomes.

**Helping university students to choose elective courses by using a hybrid multi-criteria recommendation system with genetic optimization (Esteban, Zafra, & Romero, 2024)**

A system was developed to assist university students in selecting elective courses. The system combines Collaborative Filtering (CF) and Content-Based Filtering (CBF), integrating multiple criteria derived from both student and course information. To optimize which criteria and parameters to use, a Genetic Algorithm (GA) was employed to automatically determine the best configuration of the recommendation system. The system was tested using real data from the Computer Science degree program at the University of Córdoba, Spain, covering three academic years with 95 students, 63 elective courses, and approximately 2,500 entries. The results indicated that the hybrid approach with genetic

optimization provided more reliable and effective recommendations compared to previous non-hybrid models and identified the most relevant criteria such as student history and course metadata in the context of elective course recommendation.

**Synthesis:**

This study analyzes both student and course attributes. The findings of their study highlight the effectiveness of combining different algorithms and optimizing parameters to produce more personalized and data-driven course recommendations. Similarly, the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree aims to enhance recommendation precision and transparency through logical, data-centered methods aligning with the study's emphasis on combining algorithmic strategies to improve educational guidance and decision-making.

**UniNet: Next Term Course Recommendation using Deep Learning (Araque, Rojas, & Vitali, 2020)**

A system was developed to help university students decide which combination of courses to enroll in for the upcoming term, using their historical grades and the chronological order of courses. The model utilized recurrent neural networks (RNNs) to capture how the sequence of past grades influences the

likelihood of success in future courses. Tested across students of varied GPA levels and courses of different difficulty, the system achieved an AUC (Area Under ROC Curve) of 81.10% using only grade information. By modeling time dependencies, or the order in which courses were taken, the system was able to provide more accurate and meaningful course enrollment recommendations.

**Synthesis:**

This study highlights the importance of leveraging student data to generate meaningful and personalized academic guidance. Similarly, the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree aims to provide accurate and personalized course recommendations but through interpretable and transparent decision-making methods. While UniNet focuses on predictive power using deep learning, the SHS system emphasizes clarity, logic, and accessibility, ensuring that students can easily understand the reasoning behind each recommendation.

**A Decision Support System for Subject Area Selection for Students Transiting from Junior Secondary School to Senior Secondary School (Aziken, Grace Osaretin, Evelyn Ochuwa Emovon, and Ikuobase Emovon, 2021)**

A system was developed to help students choose the appropriate subject area upon entering Senior Secondary School. It was designed to address the difficulty many students face in deciding which track to pursue Science, Social Science, or Arts due to various influences such as parents, peers, and personal interests. The model utilized the VIKOR method, a multi-criteria decision-making (MCDM) approach, and was implemented using PHP as a functional software tool. The decision criteria included academic performance, parental influence, student interest, career prospects, and peer influence. During evaluation, the system analyzed three alternative subject areas and recommended Science as the most suitable track. For validation, it was tested against a previously established example solved using the TOPSIS method, producing the same results and demonstrating consistency with existing decision-support standards. The system was also designed to be flexible, allowing for additional alternatives or criteria when needed.

**Synthesis**:

This study highlights the value of using systematic and data-driven approaches to guide students' academic choices. Similarly, the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree aims to support senior high school students in making informed college course decisions through structured analysis of academic and personal factors. While Aziken et al. utilized an MCDM technique, the proposed SHS system applies rule-based and decision tree methods to achieve the same goal of delivering transparent, logical, and personalized educational guidance.

**A Course Recommender System Built on Success to Support Students at Risk in Higher Education (Wagner et al., 2023)**

Their study focused on helping university students select courses by analyzing previous academic performance and identifying patterns related to success and failure. The system used data mining techniques to recommend courses that align with each student's likelihood of success, aiming to reduce dropout rates and improve academic achievement. This research highlights the potential of data-driven recommendation systems to provide personalized academic guidance and support students in making informed course selections.

**Synthesis:**

The study by Wagner, Merceron, Sauer, and Pinkwart (2023) demonstrates how data mining and recommendation systems can effectively assist students in making informed course choices by analyzing their academic performance and predicting success. It emphasizes the importance of using intelligent systems to support students at risk and improve their educational outcomes. Similarly, the present study applies the same concept of recommendation, but focuses on Senior High School (SHS) students. By using rule-based logic and decision tree algorithms, this research aims to guide SHS students in selecting suitable college courses based on their interests, performance, and strengths aligning with the goal of providing personalized academic assistance just like the foreign study.

**Local Studies**

**Towards the Development of a Career Path Recommender System for Senior High School in Selected Public Schools using MultiLabel Classification (Abelardo T. Bucad, 2024)**

In another local study conducted among selected schools in Valenzuela City, researchers developed a career recommendation system that specifically aimed to reduce strand mismatches among Senior High School students. Strand mismatches occur when students select strands or courses that do not reflect their abilities, leading to disengagement and academic struggles later on. The system made use of classification algorithms such as Decision Tree, K-Nearest Neighbor (KNN), Naïve Bayes (NB), and Support Vector Machine (SVM). Among these, the Decision Tree algorithm was found to be highly interpretable, allowing both students and teachers to understand the reasoning behind course suggestions, while KNN showed strong performance in accuracy. This combination of interpretability and reliability allowed the system to generate recommendations that were both practical and easy to explain. The study highlighted that adopting machine learning–based systems can improve academic decision-making in Philippine schools, where formal guidance counseling is not always accessible. By reducing strand mismatches, the system not only supports students in making better decisions but also helps schools improve retention and performance outcomes.

**Synthesis**:

The researchers utilized several classification algorithms, including Decision Tree, K-Nearest Neighbor (KNN), Naïve Bayes, and Support Vector Machine, with Decision Tree noted for its interpretability and KNN for its accuracy. The study demonstrated that machine learning–based systems can effectively enhance academic decision-making, especially in settings with limited access to guidance counseling. Similarly, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree aligns with this approach by integrating interpretable and data-driven methods to provide clear, personalized, and practical course recommendations that support informed educational choices and improve student outcomes.

**Model Development in Assessing the Career Path of Senior High School Students in Philippine Setting (Jheanel E. Estrada, Glenwin G. Bernabe, Jason S. Lopez, at Joyce Anne S. Potestades, 2018)**

Using RapidMiner tool, model development was conducted using the gathered data from surveys to predict the appropriate course for a certain individual which in this case are Senior Highs. The proponents tried different model in training the data. They've used decision tree, default, naïve bayes, and generalized linear model. The proponents ended up using a polynomial class of Generalized Linear Model which is the most commonly used in social research.

The proponents set the classifier as Split Validation with the use of shuffled sampling as the sampling type to validate the models because it gives the highest accuracy and kappa for the data set. The overall performance of the models regarding accuracy rate and kappa statistic was presented in Figure 3 and Figure 4, respectively. Fig. 5 and 6 shows that Generalized Linear Model shows the highest Accuracy for both training set. Which have an accuracy of 57.14% for the training set and 66.67% in the test set. On the other hand, the kappa is classified as moderately accepted which has 40% in the training set and 59.1% in the test set.

**Synthesis**:

The study utilized the RapidMiner tool to develop predictive models based on survey data to recommend suitable courses for Senior High School students. Several algorithms were tested, including Decision Tree, Naïve Bayes, and Generalized Linear Model (GLM). Among these, the polynomial class of GLM achieved the highest accuracy and moderately acceptable kappa values, indicating reliable model performance. The researchers validated their models using split validation with shuffled sampling to ensure consistency and accuracy. Similarly, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree adopts data-driven techniques to provide accurate and personalized course recommendations. By integrating rule-based logic with

predictive modeling, it aligns with the study's approach of using machine learning to improve academic guidance and decision-making.

**Career track prediction using deep learning model based on discrete series of quantitative classification (Rowell Hernandez at Robert Atienza, 2021)**

The study utilized a Deep Neural Network (DNN) model to assist guidance counselors in identifying the most appropriate Senior High School track for junior high school students. Feature engineering was applied to select relevant input variables, including grades from 11 subjects, gender, age, number of siblings, parental income, and academic strand, resulting in a more efficient model that excluded irrelevant data. Using data from 1,500 K-12 students, the model achieved a prediction accuracy of approximately 83.11%, proving the effectiveness of deep learning in determining suitable academic pathways. Moreover, the system helped guidance counselors address student uncertainties more effectively, demonstrating the practical application of DNN-based recommendation tools. The findings are particularly relevant to the present study, as they support the use of feature-based data input and machine learning techniques for course or track selection, strengthening the integration of logical filtering and predictive modeling in educational recommendation systems.

**Synthesis**:

The study by Hernandez and Atienza (2021) introduced a career-track recommender system utilizing a Deep Neural Network (DNN) model to help guidance counselors recommend suitable Senior High School tracks for students. By applying feature engineering, the researchers identified key input factors such as grades, demographics, and family background, achieving a high prediction accuracy of 83.11%. The system proved effective in assisting counselors with student placement and addressing uncertainties in track selection. In relation to this, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree builds on similar principles by employing structured data inputs and predictive logic. It combines rule-based filtering and decision tree modeling to generate personalized, accurate course recommendations, aligning with the study's goal of enhancing data-driven academic guidance.

**Factors Influencing Career Choice Among Learners in Southern Districts of the Province of Bukidnon (Rhena Mae C. Valiente & Gerlinda G. Corpuz, 2025)**

In a local study conducted among Grade 12 learners in the southern districts of Bukidnon, researchers examined the factors that most strongly influence career choice, focusing on academic ability and parental involvement. Using a descriptive correlational design with 265 respondents, the study revealed that academic ability

had a high level of influence on students' career decisions, while parental factors exerted a very high impact. Although no significant relationships were found between demographics and academic ability, parental influence was shown to have weak yet significant associations with sex, parental educational attainment, and preferred courses. The results emphasized the dominant role of parents in shaping learners' career paths, underscoring the importance of family context when designing interventions for career guidance and decision-making.

**Synthesis:**

The study conducted among Grade 12 students in Bukidnon highlighted that both academic ability and parental involvement significantly affect career decision-making, with parental influence playing a dominant role. It found that while demographics had little connection to academic ability, parental education and student preferences showed weak but notable relationships. These findings emphasize the importance of family context in guiding students' career paths. In line with this, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree aims to complement such influences by providing data-driven and objective course recommendations. The system integrates students' academic performance and preferences to support more informed and balanced decision-making, reinforcing the value of combining family guidance with technological tools for effective career planning.

**Career Choice and Self-Efficacy Toward Senior High School Students' Career Goals in the Philippines (Evelyn T. Gimarino, 2023)**

The study examined Senior High School students in the Philippines using a descriptive-correlational design with 308 Grade 12 respondents. Standardized questionnaires were used to assess students' preferred career domains and their confidence in setting career goals. The results revealed that academic strand has a significant correlation with both career choice and self-efficacy, while age and gender showed no notable effect. Overall, the findings indicate that students possess high levels of self-efficacy in making career decisions, highlighting the importance of strand placement in shaping their future career paths.

**Synthesis:**

This study explored the connection between career choice and self-efficacy among Senior High School students in the Philippines, revealing that strand placement significantly influences both factors. While age and gender showed minimal impact, students generally exhibited strong confidence in setting and pursuing career goals. These findings highlight the importance of appropriate strand selection in shaping students' academic and professional directions. In relation to this, the College Course Recommendation System for SHS Using Rule-Based and Decision Tree supports the same goal by providing a structured, data-driven approach to align students' strands, interests, and abilities with suitable

college courses enhancing confidence and clarity in their career decision-making process.

## Theoretical Background

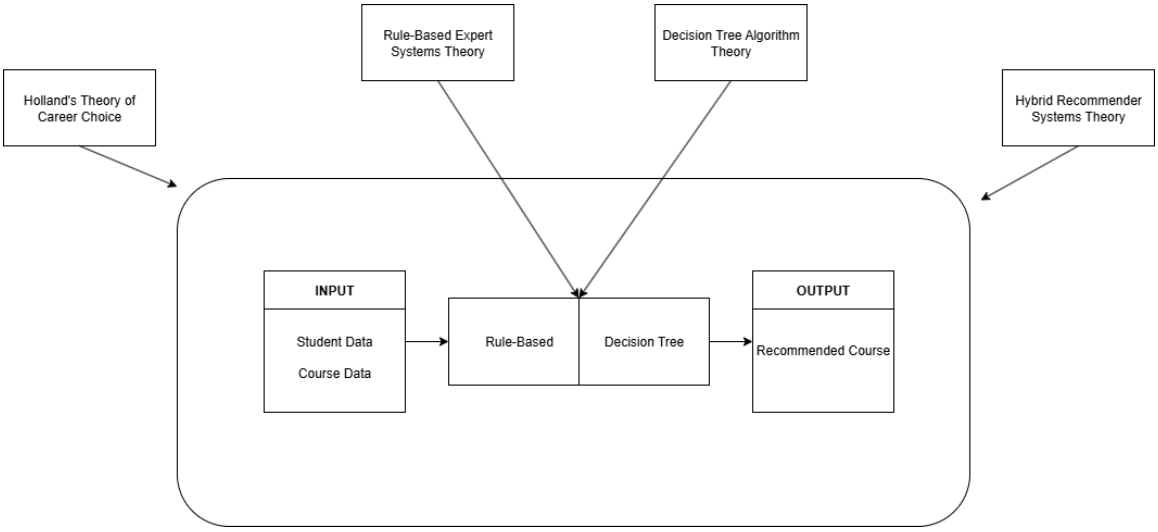


**Figure 1.0:** *Theoretical Background*

The theoretical background of the study integrates both psychological and computational foundations to ensure accurate and personalized course recommendations. Guided by Holland's Theory of Career Choice (1997), the system aligns students' personalities classified under the six RIASEC types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional with compatible college programs, fostering better career satisfaction and academic alignment. To operationalize the recommendation process, the study adopts the Rule-Based Expert Systems Theory (Giarratano & Riley, 2005), which utilizes structured "if - then" rules to evaluate student inputs such as strand, interests, and

grades. This ensures that only courses meeting defined eligibility and preference criteria are shortlisted. Complementing this, the Decision Tree Algorithm Theory (Quinlan, 1986) provides a data-driven mechanism that classifies and predicts suitable courses through hierarchical decision paths based on student attributes.

To further enhance recommendation accuracy and contextual relevance, the system applies the Hybrid Recommender Systems Theory (Burke, 2002), which integrates rule-based reasoning with decision tree learning. Through this hybrid approach, the framework effectively combines human-like logical reasoning and machine learning prediction, resulting in a more reliable, efficient, and tailored course recommendation system for Senior High School students.

## Technical Background

### System Architecture


**Figure 2.0:** *System Architecture*

The system follows a client server architecture composed of three main components: React JS frontend, Python FastAPI backend, and PostgreSQL database. The React JS web application serves as the frontend interface, where senior high school students provide their personal information, academic preferences, and other relevant data required for course recommendation. The frontend also displays the generated recommendations and results in a user-friendly interface. The backend functions as the processing layer. It applies the rule-based screening and decision tree algorithms to analyze student data, retrieve relevant information from the database, and send processed recommendations back to the frontend through RESTful APIs. The database acts as the central storage for student records, course datasets, and generated recommendation results. It enables efficient querying and data management to support the backend's processing requirements. This architecture ensures a smooth flow of data between the user interface, the algorithmic logic, and the database, resulting in a fast and reliable recommendation process.

**Platform and Frameworks**

| FRONTEND | BACKEND | DATABASE |
|---|---|---|
| ReactJS | PythonFastAPI | PostgreSQL |

***Table 1.0:*** *Platform and Frameworks*

The system is built on a modern and efficient web technology stack consisting of a frontend interface, a backend server, and a relational database. The frontend utilizes ReactJS to create a responsive and user-friendly web interface. The backend is implemented in Python using FastAPI frameworks to manage data flow, algorithm execution, and communication between the user interface and database. The database layer, implemented using PostgreSQL, ensures robust handling of structured data such as student profiles, course listings, and recommendation outputs.

**Algorithms and Models**

| | |
|---|---|
| MODEL: | Supervised Machine Learning |
| ALGORITHMS: | Rule-Based Logic and Decision Tree |

***Table 2.0:*** *Algorithms and Models*

The system utilizes Supervised Machine Learning, where algorithms are trained using labeled datasets that map student attributes (such as grades, interests, and strand preferences) to corresponding course recommendations.

It combines Rule-Based Logic and Decision Tree algorithms to ensure accurate and personalized results. The Rule-Based Logic component applies a set of predefined rules derived from career aptitude tests, student interests, and subject strengths to initially filter suitable courses. This ensures that recommendations align with each student's personal and academic profile. The Decision Tree algorithm then analyzes historical data to identify patterns and relationships between input features and target outputs, refining the recommendations through data-driven insights.

By integrating human-defined logic with machine learning, this hybrid system enhances predictive accuracy and provides reliable, customized guidance to help Senior High School students make informed decisions about their future college paths.

**Data Sources and APIs**

The system uses multiple data sources to improve recommendation accuracy. Student information such as academic records, NCAE results, and personal interest surveys serve as the primary dataset. These inputs are processed and stored in the database for continuous learning and refinement. Additionally, the backend system provides RESTful APIs that handle the transfer of data between the frontend and backend, allowing real-time updates and seamless interaction during the recommendation process.

**Development Tools**

| | |
|---|---|
| VERSION CONTROL | Git with repositories hosted on GitHub |
| IDE | Visual Studio Code |
| TESTING | Postman for API testing |
| DEPLOYMENT | Local server and online hosting for web application |

***Table 3.0:*** *Development Tools*

The development tools and environment used in the project are selected to support effective coding, testing, and collaboration. Git, with repositories hosted on GitHub, enables efficient version control and team coordination. Visual Studio Code (VS Code) serves as the primary integrated development environment for both frontend and backend coding. Postman is utilized for API testing, ensuring

proper communication between the client and server. The system is deployed on a local and online environment to test its scalability and accessibility across different user devices.

**Conceptual Framework**

| INPUT | PROCESS | OUTPUT |
|---|---|---|
| **Student Profile Information**<br>• Personal Data<br>• Academic Data<br>• Interests and Abilities<br><br>**Software Applications**<br>• Visual Studio<br>• PostgreSQL | **SDLC - Agile Methodology**<br>**Requirements -** The team identifies and defines project goals and user expectations to establish a clear vision of the system's purpose.<br>**Design -** A detailed plan is created to outline the system's structure, interface, and workflow. | **College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree** |

| | | |
|---|---|---|
| • Git<br>• Github Desktop<br><br>**Tools**<br>• **Frontend:** React JS<br>• **Backend:** Python with FastAPI<br>• **Database:** PostgreSQL<br>• **Software Testing:** Base on ISO 25010 | **Development -** Developers build the system's features in small, flexible increments based on the approved design.<br><br>**Testing -** The system is tested to detect and fix errors, ensuring all features function correctly.<br><br>**Evaluation –** The system's performance and functionality are assessed to ensure that it meets the project goals and user | |

| | | |
|---|---|---|
| | requirements before final deployment.<br><br>**Deployment -** The completed and tested system is released for real-world use or user evaluation.<br><br>**Review -** The team assesses feedback and performance to identify improvements for future development cycles. | |

**Figure 4.0 Conceptual Framework**

# CHAPTER III
# Methodology

## Research Design

This study employs a quantitative developmental-descriptive design to develop and evaluate a College Course Recommendation System for SHS using Rule-Based and Decision Tree algorithms. The quantitative approach is used to collect and analyze numerical data on system accuracy, performance, and user satisfaction.

## Development Model

This methodology is chosen because it promotes flexibility, collaboration, and continuous improvement throughout the project. Agile allows the development team to work in iterative cycles, where each phase from requirements gathering to testing and review is revisited and refined based on user feedback.

By using Agile, the team can quickly adapt to changes, address issues early, and ensure that the system consistently meets the needs of Senior High School students. This approach helps deliver a functional and user-centered recommendation system that accurately suggests suitable college courses based on students' preferences, skills, and academic profiles.

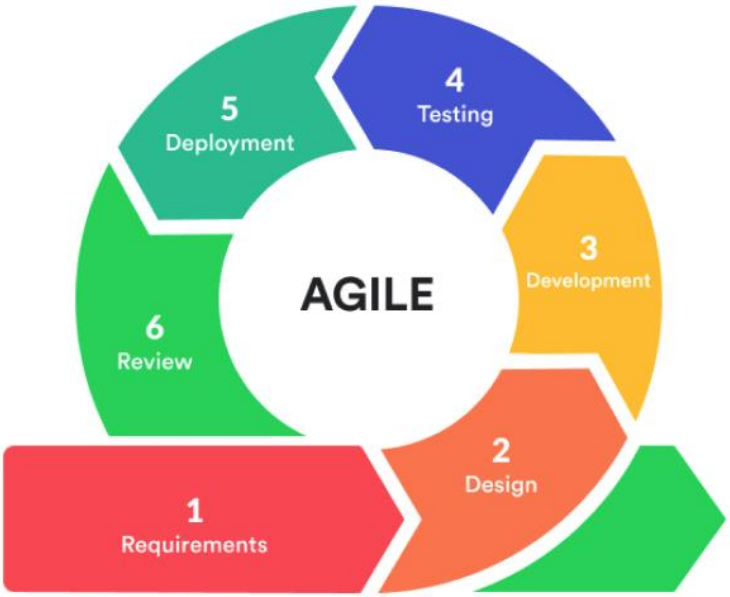


**Figure 4.0:** *Agile Methodology*

**System Development Procedures**

The development of the College Course Recommendation System for SHS Students Using Rule-Based Logic and Decision Tree followed the Agile Method, which emphasizes flexibility, collaboration, and continuous improvement through iterative sprints. This approach enabled the researchers to gather feedback regularly and refine the system after each phase.

**Planning Phase**

In this phase, the researchers identified the project goals and gathered requirements through interviews and surveys with Senior High School students and guidance counselors. Both functional and non-functional requirements were defined to ensure the system's accuracy, usability, and reliability. User stories were

created to guide development, and tasks were divided into short sprints to promote steady progress and adaptability throughout the project.

**Design Phase**

The system architecture, database structure, and user interface were designed based on the collected requirements. The Rule-Based Logic and Decision Tree algorithms were outlined to handle course filtering and ranking, ensuring accurate recommendations. The design focused on simplicity, accessibility, and user-friendliness, and was continuously refined after each sprint based on team and user feedback.

**Development / Implementation Phase**

The system was developed incrementally through multiple sprints. The backend was built to handle data processing and algorithm execution, while the frontend provided an intuitive interface for students. The database was integrated to manage user information, questionnaire results, and course recommendations. The Rule-Based Logic was implemented to filter courses according to student profiles, while the Decision Tree algorithm was used to rank and recommend the most suitable options. Each sprint included testing and feedback, allowing for continuous improvement.

**Testing Phase**

Testing was carried out throughout development to ensure the system's accuracy, reliability, and usability. Each module underwent functional testing, and identified issues were corrected immediately. After full integration, user acceptance testing (UAT) was conducted with selected SHS students and guidance counselors to assess ease of use and accuracy of recommendations. Feedback gathered from users was applied to enhance overall performance and satisfaction before the system's final deployment.

**Tools, Technologies, and Techniques**

| | |
|---|---|
| **FRONTEND** | React JS |
| **BACKEND** | Python with FastAPI |
| **DATABASE** | PostgreSQL |
| **VERSION CONTROL** | Git and Github |
| **ALGORITHMS** | Rule-Based Logic and Decision Tree Algorithm |
| **SOFTWARE TESTING** | Base on ISO 25010 |
| **OTHERS** | Draw.io, Figma and Visual-paradigm |

**Table 5.0:** *Tools*

Table 5.0 presents the tools and technologies used in developing the College Course Recommendation System for SHS using Rule-Based and

Decision Tree Algorithms. The system's frontend was developed using React JS to provide an interactive and responsive user interface, while the backend was built using Python with FastAPI for efficient data processing and API integration. The PostgreSQL database was utilized for reliable storage and management of student data.

Git and GitHub were used for version control to track code changes and support team collaboration. The core algorithms implemented were Rule-Based Logic and the Decision Tree Algorithm, which together generate accurate course recommendations. Software testing was conducted based on the ISO 25010 standard to ensure system quality, functionality, and usability. Additionally, Draw.io, Figma, and Visual Paradigm were employed for system design, and diagram modeling.

**System and Software Requirements**

**Functional and Non-Functional Requirements**

| | |
|---|---|
| **Functional Requirements** | • Allow users to log in, sign up, and log out securely.<br>• Enable users to input their personal and academic information.<br>• Present situational questions to gather user preferences.<br>• Apply rule-based filtering to analyze user responses.<br>• Process data using a decision tree algorithm to generate results.<br>• Display the recommended college courses based on the analysis.<br>• Collect user feedback to improve the system's accuracy and usability. |

| | |
|---|---|
| **Non-Functional Requirements** | • The system should provide accurate and consistent course recommendations based on user inputs.<br>• The system must process data efficiently and display results within a few seconds.<br>• The user interface should be intuitive, easy to navigate, and student-friendly.<br>• The system should ensure the security and confidentiality of all user information.<br>• The system must maintain high availability and reliability during operation.<br>• The system should be compatible with different web browsers and devices. |

| | |
|---|---|
| | • · The system should be designed for easy maintenance and future updates. |

**Table 6.0:** *Functional and Non-Functional Requirements*

**System Requirements**

The system development and testing were carried out using a workstation capable of supporting the processing and execution of rule-based logic and decision tree algorithms efficiently. The development environment operates on Windows 10 or later, equipped with an Intel Core i5 or Ryzen 5 processor and a minimum of 8GB RAM to ensure smooth performance during system testing and data processing. A 256GB SSD or higher is used to store project files, datasets, and system outputs. The system is developed using ReactJS for the frontend and Python-based logic for the backend to handle course recommendation processes. A stable internet connection is also required for testing online functionalities, database connectivity, and system updates. This configuration ensures reliable performance and efficient workflow during the development, testing, and deployment of the College Course Recommendation System.

**Software Requirements**

The system utilizes ReactJS for the frontend and Python for the backend logic. MySQL or PostgreSQL databases are used for data management. Visual Studio Code and PyCharm serve as the primary development environments, ensuring compatibility with both frontend and backend technologies. Testing tools such as Postman and Pytest help ensure the reliability and performance of the developed system.

| Component | Minimum | Recommended |
|---|---|---|
| Operating System | Windows 10 (64-bit) | Windows 11 (64-bit) |
| Programming Languages | Python 3.9+, JavaScript (ReactJS) | Python 3.12+, ReactJS (latest stable) |
| Database | MySQL 8.0 | PostgreSQL 14+ |
| Development Environment | Visual Studio Code or PyCharm Community | Visual Studio Code, PyCharm Professional |
| Web Frameworks & Libraries | ReactJS, Flask (for backend), scikit-learn, pandas | ReactJS, FastAPI, scikit-learn, NumPy, pandas |
| Browser | Google Chrome or Microsoft Edge(Latest) | Google Chrome (latest stable version) |
| Version Control | Git | Git with GitHub/GitLab integration |

| | | |
|---|---|---|
| Testing Tools | Postman for API testing | Postman, Pytest, and Browser Developer Tools |

**Table 7.0:** *Software Requirements*

**Hardware Requirements**

The system requires a computer capable of running modern web development tools and Python-based applications efficiently. The recommended specifications ensure smooth operation of the system during both development and testing phases, especially when handling larger datasets and complex algorithmic computations from the Decision Tree model.

| Component | Minimum | Recommended |
|---|---|---|
| Processor (CPU) | Intel Core i3 (10th Gen) or AMD Ryzen 3 | Intel Core i5/i7 (11th Gen or later) or AMD Ryzen 5/7 |
| Memory (RAM) | 8 GB RAM | 16 GB RAM or higher |
| Storage | 256GB SSD or 500 GB HDD | 512 GB SSD or higher |
| Graphics | Integrated GPU (Intel UHD / Radeon Vega) | Dedicated GPU (NVIDIA GTX 1050 or better) |

| | | |
|---|---|---|
| Network | Stable internet connection | High-speed internet<br>(Fiber/Wi-Fi 6) |

**Table 8.0:** *Hardware Requirements*

**Data Gathering Procedure**

The researchers utilized a stratified sampling technique to ensure fair representation from the different SHS academic strands, including STEM, HUMSS, ABM, and TVL. This method allowed the researchers to gather diverse and balanced data across various academic tracks, ensuring that the results accurately reflected the perspectives of students from each strand.

Questionnaire - A survey questionnaire served as the primary tool for data gathering. It was carefully designed to collect relevant information from Grade 12 Senior High School students, focusing on their academic grades, interests, strand, and preferred college courses. The questionnaire also included an evaluation form to measure the system's usability, accuracy, efficiency, and relevance based on the students' experience.

**Profile of the Respondents**

The respondents of the study consisted of Grade 12 Senior High School students from various academic strands such as STEM, HUMSS, ABM, and TVL, as well as selected I.T. experts. The inclusion of Grade 12 students was based on the fact that they are at a crucial stage of making important decisions regarding their future college courses, making them the most appropriate participants for this research. Meanwhile, the I.T. experts were chosen to provide professional insights and validation regarding the technical aspects and functionality of the developed system. This demographic and academic information was utilized to identify patterns and relationships between the students' academic performance, interests, and their potential college course recommendations.

**Respondents of the Study**

The respondents of the study were Grade 12 Senior High School students from various academic strands, including STEM, HUMSS, ABM, and TVL**,** as well as selected Information Technology (I.T.) experts**.** The Grade 12 students participated in the survey because they are in the stage of preparing for college and making important decisions about their future courses, making them suitable respondents for this research. On the other hand, the I.T. experts were chosen to evaluate and provide professional insights regarding the functionality, usability, and technical aspects of the proposed College Course Recommendation System**.**

| Respondent | Sample |
|---|---|
| **Senior Highschool Students** | **40** |
| **IT Experts** | **05** |

**Table 9.0:** *Sampling*

**Setting of the Study**

The study will be conducted in selected Senior High Schools where the proposed College Course Recommendation System is expected to be most beneficial. The setting includes learning environments where students are preparing for college admission and making decisions about their future academic paths. The system will be tested among Grade 12 students from various strands such as STEM, HUMSS, ABM, and TVL to assess its accuracy and usability in

providing course recommendations based on their interests, academic performance, and preferences.

The chosen schools provide an ideal environment for evaluating how the system assists students in aligning their skills and grades with suitable college courses. This setting also allows the researchers to gather authentic feedback from both students and IT experts, ensuring that the system functions effectively in real educational contexts.

**Statistical Treatment of Data**

Recommendation System for Senior High School Students using Rule-Based Logic and Decision Tree. The researchers applied appropriate statistical methods to summarize the responses, measure the level of user satisfaction, and determine the consistency of the feedback provided. These statistical tools helped in evaluating whether the developed system meets the expectations of its intended users, particularly in terms of functionality, usability, accuracy, and overall performance.

The following tools and formulas were utilized in the study:

1. **Weighted Mean** - The mean was computed by summing all recorded values and dividing the total by the number of responses. It was used to determine the average level of agreement or satisfaction of the respondents with each criterion in the survey.

2. **Percentage** - This tool was used to describe the proportion or distribution of responses among the participants. It helped identify common trends and patterns based on the frequency of specific answers.

3. **Likert Scale** - A five-point Likert scale served as the primary measurement tool to assess the respondents' evaluation of the system. It provided a numerical basis for analyzing qualitative judgments such as "Strongly Agree," "Agree," "Neutral," "Disagree," and "Strongly Disagree."

4. **Standard Deviation** - Standard deviation was employed to determine the level of variation or consistency in the responses. It indicated how closely the respondents' perceptions were aligned regarding the system's effectiveness and user experience.

| Scale/s | Interpretation/s |
|---|---|
| 5 = (4.20 - 5.00) | SA = Strongly Agree |
| 4 = (3.40 - 4.19) | A = Agree |
| 3 = (2.60-3.39) | MA = Moderately Agree |
| 2 = (1.80-2.59) | D = Disagree |
| 1 = (1.00-1.79) | SD = Strongly Disagree |

**Table 10.0:** *Likert Scale*

**Percentage** - The percentage formula was utilized to present the distribution of responses among participants and to describe their

demographic profiles, such as strand, gender, and age group. It also helped identify the proportion of respondents who expressed agreement or satisfaction with the system's usability, functionality, and accuracy.

This **statistical tool made it easier to** interpret the frequency of responses and highlight overall trends in user evaluation.

**Formula:**

$$P = \frac{f}{N} \times 100$$

**Where:**

**P =** Percentage

**f =** Frequency of number respondents who selected a specific answer

**N =** Total number of respondents

**× 100 =** Multiplier to convert the ratio into percentage

**Weighted Mean**

The weighted mean was utilized to determine the overall perception and level of agreement of the respondents regarding each criterion in the evaluation of the College Course Recommendation System for Senior High School Students using Rule-Based Logic and Decision Tree. This statistical tool helped in identifying the general consensus of both students and IT experts toward the systems functionality, usability, accuracy, and efficiency, providing a clear measure of the system's overall effectiveness and user satisfaction.

**Formula:**

$$\bar{x} = \frac{\Sigma f \times x}{N}$$

**Where:**

$\bar{X}$ = Weighted Mean

f = Frequency of responses

x = Weighted value or numerical equivalent of each response

N = Total number of respondents

**Information of each users**

College Course Recommendation System for SHS Using Rule Based and Decision Tree

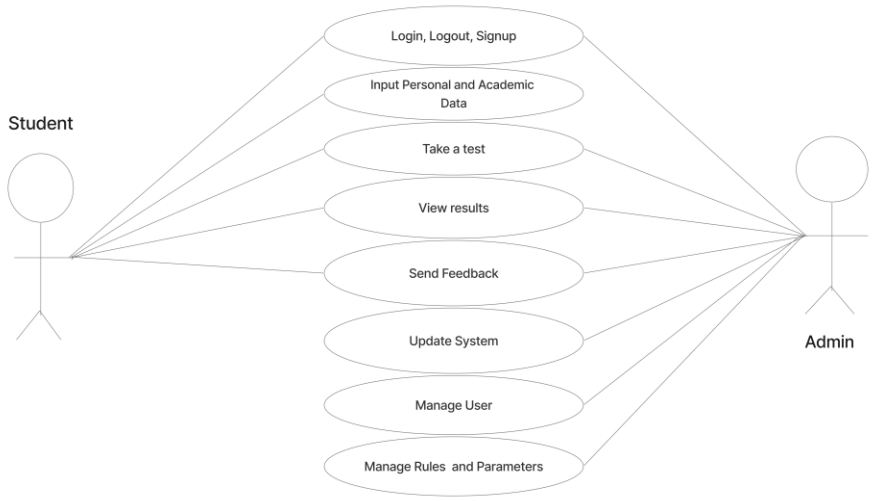


**Figure 3.0:** *Use Case Diagram*

In Figure 3.0, the system provides a college course recommendation platform designed for Senior High School Students and Administrators.

**For students**, the system allows them to log in, input their personal, academic, and preference data, and take an assessment to better evaluate their interests and capabilities.

Using this data, the system applies rule-based screening and a decision tree algorithm to generate tailored course recommendations. Students can then view

their recommended college courses, helping them make more informed and suitable academic choices for their future.

**For the administrator (Admin)**, the system provides access to update and manage critical data, including course information, rule sets, and decision tree parameters. By maintaining and validating these datasets, the Admin ensures that the recommendation outputs remain accurate, up-to-date, and aligned with institutional standards.

## Context diagram

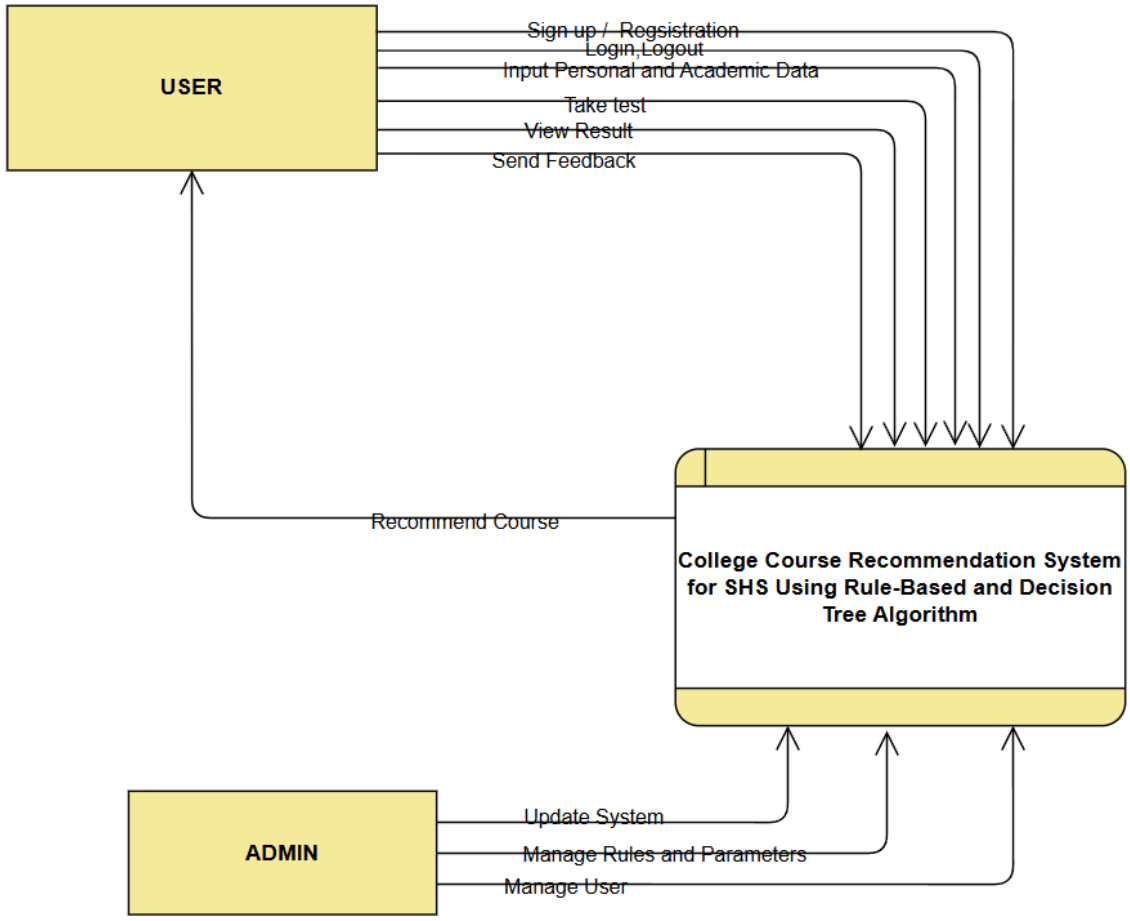


**Figure 4.0:** *Context Diagram*

The Context Diagram illustrates the overall flow of data between the users, administrators. First, the user (student) can log in or log out, input their personal and academic information, and take the assessment test provided by the system. Once the data is submitted, the system processes the information using rule-based screening and decision tree algorithms to generate personalized course recommendations. The system then returns the recommended courses to the user,

which they can view through the interface. Users also have the option to provide feedback to help improve the system.

On the other hand, administrators are responsible for managing and maintaining the data and logic used by the system. They can update datasets, modify rules and parameters for the recommendation algorithms, and manage user accounts to ensure smooth operation. These administrative functions help keep the system accurate, updated, and aligned with institutional policies.

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## Analytical tools

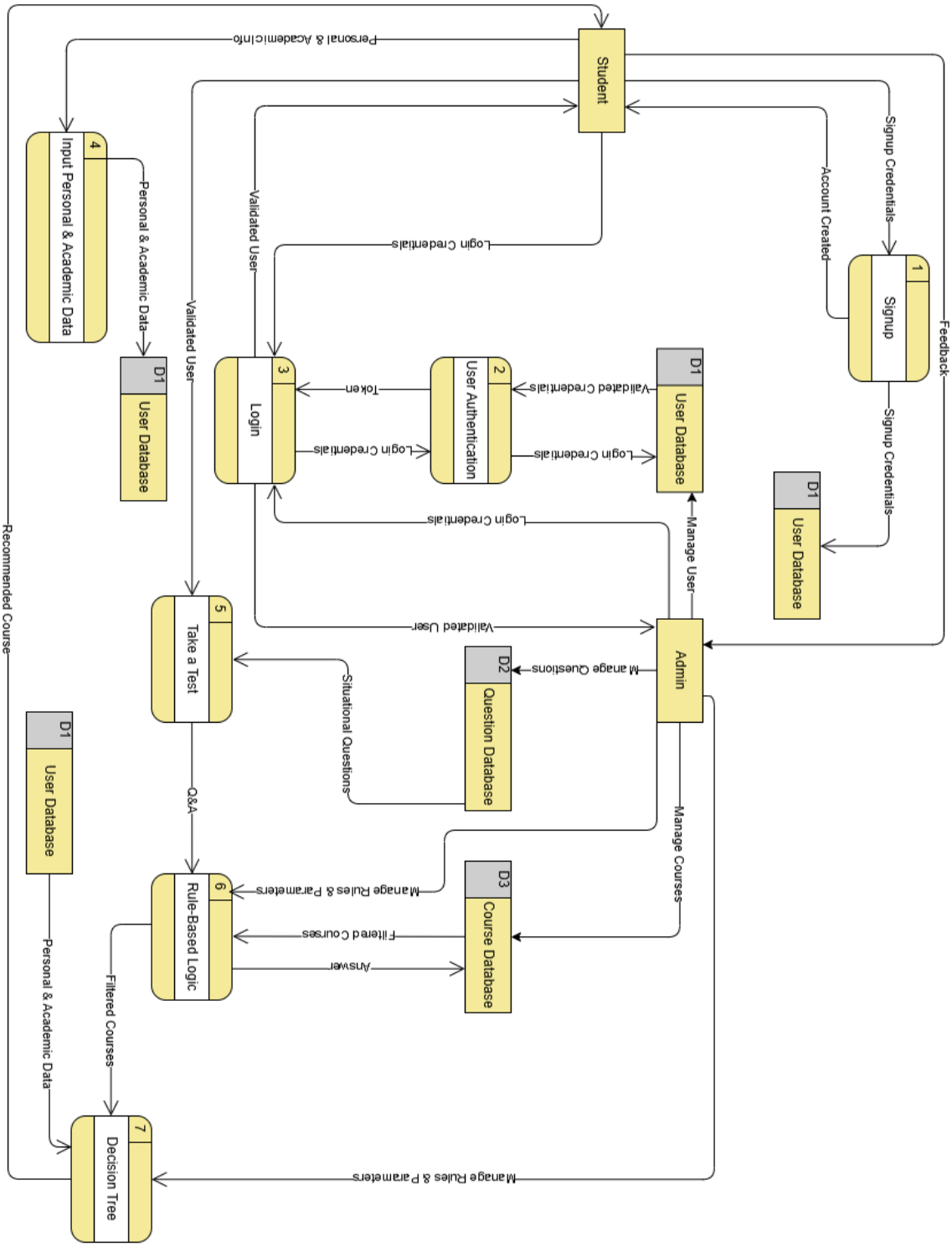

**Figure 5.0:** *Data Flow Diagram (DFD) Level 1*

In Figure 5.0, The Data Flow Diagram (DFD) illustrates how data moves throughout the College Course Recommendation System. The process begins when a student signs up by providing account credentials, which are stored in the User Database. Once the account is created, the student can log in, and their credentials are validated through the User Authentication process before gaining access to the User Interface. From there, the student inputs their personal and academic data, which are stored in the Personal and Academic Database. The student then proceeds to take a test, where questions are fetched from the Question Database, and their responses are stored in the Test Attempt Database. These collected data—personal, academic, and test results—are then processed by the Rule-Based Logic, which applies predefined rules and course parameters retrieved from the Course Database to filter suitable course options. The filtered results are sent to the Decision Tree, which performs a structured evaluation to determine the most suitable course recommendation for the student. Meanwhile, the Admin logs in and manages the system through the Admin Interface, where they can update questions, rules, and courses within their respective databases to ensure the system's accuracy and effectiveness. Ultimately, the DFD shows how student and admin interactions flow through interconnected processes and databases to produce personalized course recommendations

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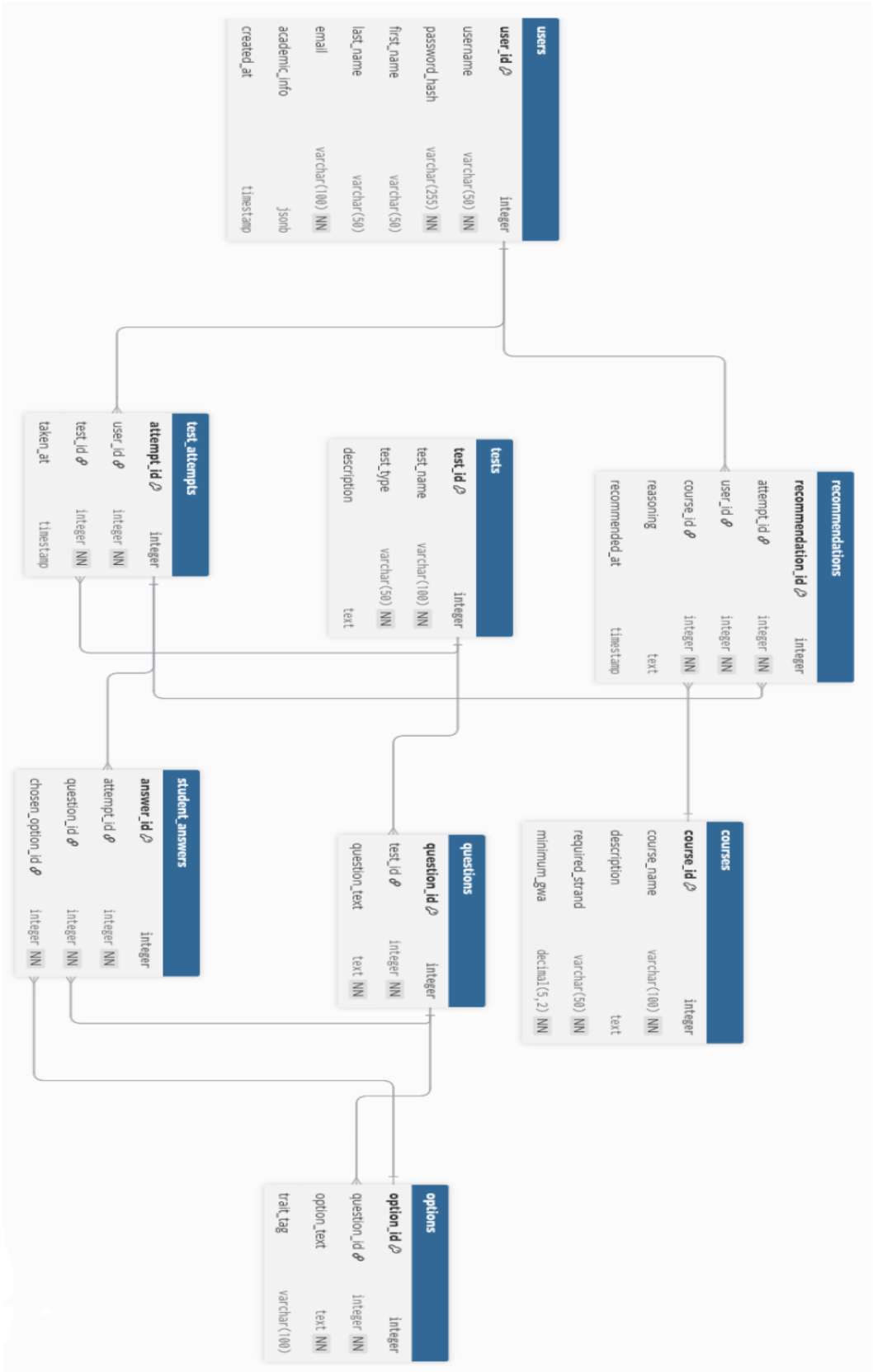


**Figure 5.1:** *Entity-Relationship Diagram*

This Entity-Relationship Diagram (ERD) represents the database structure of the College Course Recommendation System, which supports both rule-based filtering and decision tree analysis. The users table stores student profiles, including their strand and general weighted average (GWA). This information is initially evaluated against the courses table, which contains course details such as required strand and minimum GWA. For the decision tree component, the tests, questions, and options tables support the creation of situational and interest-based assessments. Each option is associated with a trait_tag to help identify student characteristics. When a student takes a test, their session is logged in the test_attempts table, and their selected answers are recorded in the student_answers table, linking each question to the chosen option. These collected traits are then processed to refine the course matching. Finally, the recommendations table stores the result of this process, linking each user to their final recommended course along with reasoning and timestamp, completing the system's data-driven recommendation workflow.

**User Acceptance Testing**

| Test Case ID | Test Scenario | Test Steps |
|---|---|---|
| UAT-001 | Verify login functionality | 1. Open the login page.<br>2. Enter valid username and password.<br>3. Click “Login”. |
| UAT-002 | Verify invalid login handling | 1. Open Login page.<br>2. Choose Another Google Account<br>3. Click “Login” |
| UAT-003 | Verify Personal & Academic Data Input | 1. Navigate to “Profile” or “Input Academic Info” page.<br>2. Fill in the required personal and academic fields.<br>3. Click “Save”. |
| UAT-004 | Verify test functionality | 1. Navigate to “Take a Test” page.<br>2. Answer all the questionnaire.<br>3. Click “Submit” to see the Recommended Course result. |
| UAT-005 | Verify Logout funtionality | 1. Click each menu item. |

**Table 11.0 :** *User Acceptance Testing*

**Evaluation Procedures** (ISO 25010)

This section describes the evaluation procedures used to assess the College Course Recommendation System Using Rule-Based Logic and Decision Tree-Based Suggestions based on selected quality characteristics from the ISO/IEC 25010 software quality model. The evaluation will be conducted by IT experts and student users to ensure that the system meets the standards of functionality, usability, maintainability, performance efficiency, and reliability required for accurate and dependable course recommendations.

**Functionality**

Evaluators will assess whether the system correctly performs its intended tasks, including user registration and login, input of personal and academic data, administration of assessment and situational questions, rule-based course filtering, and decision tree–based recommendation generation. Test cases will be executed to verify that the system processes inputs accurately, applies rules consistently, generates correct recommendations, and handles invalid or incomplete data properly. The evaluation ensures that all core features operate according to the functional requirements.

**Usability**

This criterion measures how easily users can interact with and understand the system. IT experts and student participants will evaluate the interface design, ease of navigation, clarity of instructions, and comprehensibility of the recommendation results. The goal is to confirm that the application is intuitive and user-friendly, even for non-technical users such as senior high school students.

**Maintainability**

This characteristic focuses on how efficiently the system can be updated or modified over time. Evaluators will review the modular structure of the system, the clarity of its documentation, and the organization of its code to determine whether future changes such as updating rules, modifying decision tree models, or revising questionnaires can be made with minimal complexity or risk.

**Performance Efficiency**

Evaluators will measure the system's responsiveness, stability, and resource usage during data processing and recommendation generation.

The evaluation includes testing the response time during navigation, processing duration from test submission to recommendation output, and overall system stability under varying loads. The goal is to ensure that the system delivers quick and stable performance.

**Reliability**

This criterion evaluates the system's ability to perform consistently under normal and stressful conditions. Tests will assess the system's error handling, ability to recover from interruptions, and consistency of recommendation outputs across repeated runs with the same inputs. The objective is to ensure that the system remains dependable and stable without data loss or failures.


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