Abstract

During the era of digitalization, individuals often find themselves confronted with the daunting task of navigating through a multitude of options when it comes to purchasing electronic items like laptops. The considerations range from selecting a preferred brand and finding the best or most affordable price to identifying essential features and ensuring simplicity in the decision-making process. Given that recommendation systems provide a viable solution to the challenges associated with choosing items from a vast domain, our project seeks to develop an expert system dedicated to offering personalized laptop recommendations based on customers' specifications. The primary objective is to simplify the decision-making for customers, enabling them to acquire devices that precisely align with their needs. This endeavor aims to improve the extensive process of manually selecting through each market item and categorizing them one by one to ultimately select the desired laptop. Our system will precisely analyze various product specifications stored in our database, coupled with user inputs, utilizing the capabilities of Prolog and artificial intelligence to generate personalized suggestions. Anticipated outcomes encompass the provision of a user-friendly interface featuring individualized device recommendations, ultimately enhancing the overall buying experience, ensuring customer satisfaction, and more.

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1. Overview

1.1 Introduction

Modern technology has taken over the world, and it is becoming more and more clear that effective, customized solutions are needed. The choosing of laptops is one such area where people frequently feel overtaken by options. Finding the laptop that best meets their needs may be a difficult endeavor for consumers due to the abundance of brands, models, and specifications available on the market. Users need to remain up to date on the newest advances as a result of the rapid evolution of technology, which further exacerbates this difficulty [1].

By utilizing state-of-the-art artificial intelligence, the suggested expert system seeks to resolve this conundrum by offering customized laptop suggestions. However, why not delve into the realm of expert systems to obtain laptop recommendations? The secret to the answer lies in the complexity and dynamic nature of the laptop market. Although there have been previous attempts to make the choosing activity more efficient, the constantly changing technological landscape demands a more intelligent and flexible solution [2]. By providing customized suggestions based on user preferences, job requirements, and the newest technology advancements, this expert system aims to close the gap.

The "what" of this paper revolves around creating an expert system that utilizes a vast database of laptop specifications, and emerging trends. The "why" is rooted in the desire to simplify the decision-making process for consumers, ensuring that they not only find a laptop that meets their immediate needs but also aligns with their future requirements. The "how" involves the integration of advanced algorithms that can analyze user input and dynamically adapt recommendations based on real-time market data.

While earlier efforts have certainly set the foundation for helping people select laptops, the ongoing advancement of technology demands a more flexible and intelligent approach. The literature review indicates that developing an expert system to recommend laptops to customers is an important problem, particularly in light of the fact that previous research did not keep up with the most recent advancements in expert systems and technology. Additionally, earlier papers emphasized the theoretical concept of developing an expert system that suggests the ideal laptop for the user based on their requirements [3]. However, the focus of this paper will be on the expert system's real-world implementation, which guarantees that the user has access to the most recent information while making decisions and offers an interactive environment.

Anticipated outcomes of this project include a highly user-centric experience and a and a well-defined dataset of laptops and specifications. In addition to helping individuals, the advantages also benefit society as our system encourages informed decision-making, lessen the negative effects of poorly informed purchases on the environment, and advance technology literacy.

In conclusion, our project aims to provide a thorough and well-thought-out answer to the enduring problem of laptop choosing. The expert system seeks to revolutionize the way people purchase computers by fusing the power of artificial intelligence with a user-centric methodology, making the process not only easier but also more informed and future-proof.

1.2 Problem Statement

The process of choosing the perfect laptop has become a complex puzzle in today's tech-savvy society. The abundance of options combined with the rapid advancement of technology causes customers to struggle with making decisions. Conventional manuals and evaluations are too impersonal to provide customized recommendations based on individual preferences and the dynamic tech landscape.

The core issue is that there is not a sophisticated expert system to make the laptop choosing activity easier. Because current solutions are not flexible enough to keep up with the market's constant changes, customers end up making decisions that might not last. A smart system that can learn about user preferences, keep up with emerging technology, and provide tailored recommendations is desperately needed. By slicing through the complexity, our approach hopes to enable users to make astute and forward-thinking laptop decisions in a world full of choices.

1.3 Motivation

Our motivation for this work can be stated as follows:

- The sheer quantity of computers available, each with an abundance of functions, overwhelms consumers. By gathering relevant data based on user requests, a recommendation system would streamline this process.
- Updates and new versions come out often since technology is advancing so quickly. Therefore, an intelligent system is critical to delivering suggestions that are up to date.
- Users have a wide range of expectations, a personalized recommendation system would ensure that customers obtain computers that are tailored to their own needs, especially given the vast diversity of interests.
- Recommendation Systems streamline the selection process and provide users greater confidence in the laptop they have chosen.

1.4 Objective and Goals

Our objectives of this work can be stated as follow:

- Create a program that will suggest laptops to users based on their interests and usage patterns.
- Establish processes to ensure that recommendations are based on the most recent price and trends by inputting the most recent market data into the system on a regular basis.
- Create a thorough engine considering the various demands of users, hardware requirements and software compatibility.
- Design the Prolog laptop recommendation system with a focus on user-friendliness, ensuring a smooth and effortless user experience.

2. Literature Review

2.1 Overview

The development of laptop recommendation systems has been a dynamic journey, reflecting the ongoing pursuit to align technology with evolving user preferences and needs. Over the years, these systems have transformed significantly, transcending from initial theoretical frameworks to sophisticated, user-centric models. This evolution is characterized by the integration of advanced methodologies and innovative technologies, each contributing to enhanced user interactions, accuracy, and the overall user experience. The subsequent literature review delves into the intricate evolution and advancements in laptop recommendation systems, highlighting the pivotal innovations and methodological refinements that have shaped the current landscape of laptop recommendation endeavors.

2.2 Related Work

The evolution of laptop recommendation systems began in 2016. A study was conducted that focuses on MULTIMOORA and MOOSRA methodologies to solve laptop selection dilemma [3]. It opened new dimensions in evaluating laptop features but remained more theoretical and necessitated a more user-centered, practical approach to be fully effective in real-world scenarios. Acknowledging this need, a 2017 study implemented the TOPSIS method to develop a more user-friendly, student-centric laptop recommendation system, effectively transitioning from theoretical propositions to more tangible applications [4]. It validated the potential and feasibility of applied methodologies with a substantial 70% accuracy rate in its recommendations, paving the way for further advancements in user-interactive systems and exposing a ripe field for enhancements in user interaction within laptop recommendation systems.

In 2019, a groundbreaking "Ontology-based conversational recommender system" was introduced, providing a significant shift from the traditional specification-driven models [5]. This model, which prioritized functional requirements, involved users in an interactive dialogue, paralleling a professional sales consultation. The intuitive and tailor-made recommendations set a new standard in laptop recommendation systems, outperforming previous models in their unique approach and effectiveness.

Further innovations continued in 2022, with the integration of advanced technologies like Recurrent Neural Network (RNN) and Robotic Process Automation (RPA) to refine

user experience in laptop recommendation systems [6]. The developed Virtual Assistant, with a notable 96% accuracy, provided sophisticated user interactions, allowing users to receive precise recommendations by inputting specific laptop codes.

In April 2023, there was a noteworthy development in the progression of laptop recommendation systems, with the arrival of a Hybrid Laptop Recommendation System, that was specifically designed for engineering undergraduates [7]. This system, incorporating both Content-Based and Collaborative Filtering, epitomized interdisciplinary advancements in creating user-centric laptop recommendation systems. It underscored the relevance and precision of product suggestions to effectively meet user needs and preferences, utilizing meticulous methodologies and detailed analysis through Python programming.

This literature review illustrates the progressive development of laptop recommendation systems, highlighting the transition from initial theoretical frameworks to sophisticated, user-focused models. In this progression, the proposal to develop an SWI-Prolog-based recommendation system stands out as a potential significant advancement, promising to leverage the accumulated insights and innovations from preceding works. Our system seeks to build upon the enriched understanding of user needs acquired over the years and could potentially represent a new stride in the field, promising novel advancements in user interaction and accuracy of laptop recommendations.

3. Methodology

3.1 Criteria for Performance Evaluation

After the development process is finished, testing the expert system is crucial to guaranteeing it functions as intended, is error-free, and is easy to use. After we finish the system, our expert system (the Laptop Recommendations Expert System) is tested using an online survey tool named "SurveyMonkey." The survey consists of three primary questions that ask users about their satisfaction, the accuracy of the end result, and the system's simplicity after they have used it. We ensured that the people answering the questionnaire were actual individuals who require the system to help them choose the best laptop for a certain purpose, and then we collected their honest feedback. In total, we had 34 participants who evaluated the system's performance.

3.2 Data

Expert systems demand a precisely defined data set to initiate the system's structure and construct the final outputs. We rely on extensive searches for new laptops and their specifications from several reliable distributors / companies to create the knowledge base for our expert system. To make sure that the end result would be the best option in that specific field, we looked at some reviews regarding the devices that were chosen. To narrow down our scope, we divided the laptops into three main categories based on their intended use: daily use, programming, or gaming and designing. Next, we focused on the most important features that are needed in each category. We took into account the user's budget, the laptop and screen kind, portability, and preferred operating system for daily usage. We focused on whether the user needed the laptop for college or not when programming, so for both answers, we took into account different key factors. For example, we took into account the battery life and screen size along with any accessories for collage use, but for other uses, we focused on the user's preferred operating system, portability, and whether or not they plan to develop games. Finally, considering laptop specs that are equivalent for gaming and designing, we took into account the capacity, speed, performance, and screen size and quality.

Our expert system contains 27 rules. After defining our data set, we started the actual coding. We began with the start rule, the starting point of our program, then created the

menu that the user will see and choose from. Next, we structured the questions for each category and the flow of questions after every answer from the user.

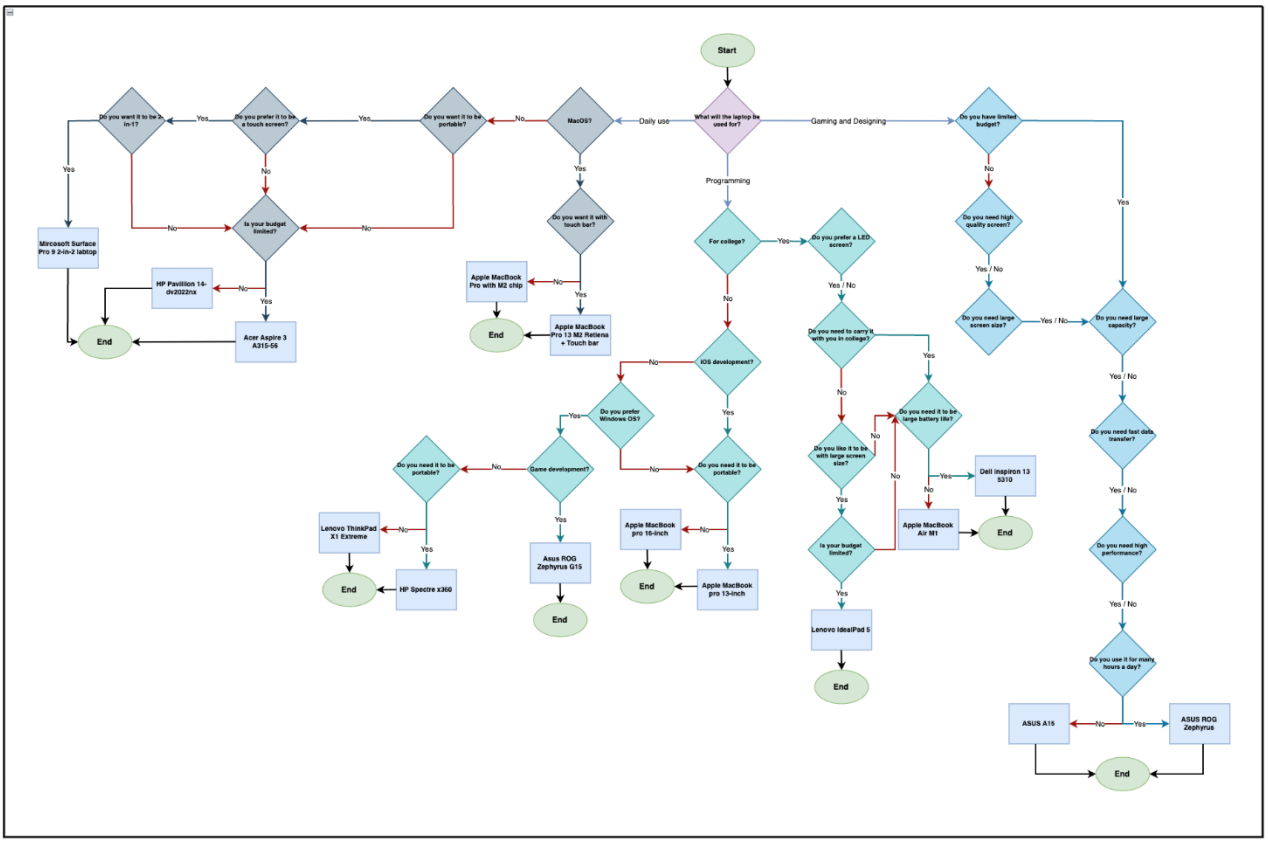


Figure 1: Laptop Recommendations Expert system flow chart

For a better access:
https://drive.google.com/file/d/1xo2dyYY4v1ensnik4HIahA9NERQaVuMg/view?usp=sharing

3.3 Tools

To implement the previously discussed system, we used SWI Prolog as the main tool.

Table 1: Tool used for implementation

Tool	Purpose
SWI Prolog	Consults facts and rules using logical procedures.

4. Implementation

Our laptop recommendation system is developed with SWISH Prolog, a choice inspired by Prolog's widespread use in natural language processing and expert systems. The system's

design leverages Prolog's inherent capability to process facts and rules, enabling it to perform logical analyses and support informed decision-making. Users interact with the system by inputting queries, which are then evaluated against a predefined knowledge base of facts and rules. This approach ensures that the system's operations are traceable, comprehensible, and effective in providing reliable recommendations. The accompanying figures illustrate the source code that powers our expert system.

4.1 Raw data

```
% Daily Use
laptop('Apple MacBook Pro 13 M2 Retina + Touch bar', 1 , 'yes', 'yes').
laptop('Apple MacBook Pro with M2 chip', 1, 'yes', 'no').
laptop('Acer Aspire 3 A315-56',1, 'no', 'yes', 'no', 'yes').
laptop('HP Pavillion 14-dv2022nx',1, 'no', 'yes', 'no', 'no').
laptop('Microsoft Surface Pro 9 2-in-2 laptop',1, 'no', 'yes', 'yes', 'yes').

%Programming
laptop('Dell Inspiron 13 5310',2, 'yes', 'yes', 'yes', 'yes').
laptop('Apple MacBook Air M1',2, 'yes', 'yes', 'yes', 'no').
laptop('Lenovo IdeaPad 5',2, 'yes', 'yes', 'no', 'yes', 'yes').
laptop('Apple MacBook pro 13-inch',2, 'no', 'yes', 'yes').
laptop('Apple MacBook pro 16-inch',2, 'no', 'yes', 'no').
laptop('Asus ROG Zephyrus G15',2, 'no', 'no', 'yes', 'yes').
laptop('HP Spectre x360', 'no',2, 'no', 'no', 'yes', 'no', 'yes').
laptop('Lenovo ThinkPad X1 Extreme',2, 'no', 'no', 'yes', 'no', 'no').

% Gaming and Designing
laptop('ASUS ROG Zephyrus',3, 'yes', 'yes', 'yes', 'yes', 'yes').
laptop('ASUS A15',3, 'yes', 'yes', 'yes', 'yes', 'no').
```

Figure 2: Raw Data

4.2 Code

The appendix will include the source of the code.

4.3 Start Rule & Menu

```
:- discontiguous category/1.
:- discontiguous q1_DU/0.
:- discontiguous q2_DU/0.
:- discontiguous q4_DU/0.

start:-
writeln("****************************** 💻Laptop Selection Recommendation System💻 ************************** *"),
writeln("******************** here you can know the ideal laptop for you in a few minutes! ********************"),nl,
menu.

menu:-
writeln('Please choose the category you intrested in: '),
writeln('1- Daily Use'),
writeln('2- Programming'),
writeln('3- Gaming and Designing'),
read(A),
(not(A==1),not(A==2),not(A==3) ->
writeln("Incorrect entry! choose a number between 1-3."), menu;
category(A)).
```

Figure 3: Start Rule & menu

4.4 Category (1): Daily use questions

```
% ------------------------- Daily Use ------------------------------
category(1):-
    writeln('Mac OS?'),
writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),category(1);
((A=='yes') ->
q1_DU;
q2_DU)
).


q1_DU:-
    writeln('Do you want it with touch bar?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q2_DU;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('Apple MacBook Pro 13 M2 Retiena + Touch bar'),
            writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
            writeln('Apple MacBook Pro with M2 chip'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).
```

Figure 4: Category (1): Daily use question 1

```
q2_DU:-
    writeln('Do you need it to be portable?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q3_DU;
((A=='yes') ->
q4_DU;
q5_DU)
).

q4_DU:-
     writeln('Is your bugdet limtited?'),
    writeln('(yes/no)'),
    read(A),
    (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q5_DU;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('Acer Aspire 3 A315-56'),
            writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
            writeln('HP Pavillion 14-dv2022nx'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).
```

Figure 5: Daily use questions 2&4

```
q3_DU:-
    writeln('Do you prefer it to be a touch sreen?'),
    writeln('(yes/no)'),
    read(A),
    (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q4_DU;
((A=='yes') ->
q5_DU;
        q4_DU)
).

q5_DU:-
     writeln('Decide if you want a 2-in-1?'),
    writeln('(yes/no)'),
    read(A),
    (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q5_DU;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('Mircosoft Surface Pro 9 2-in-2 labtop'),
            writeln('Thank you for utilizing our system!'), abort);

            q4_DU)
).
```

Figure 6: Daily use questions 3&5

4.5 Category (2): Programming questions

```
% ------------------------ Programming ------------------------------
category(2):-
    writeln('For college?'),
writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),category(2);
((A=='yes') ->
q10_PRG;
q20_PRG)
).

q10_PRG:-
    writeln('Do you prefer a LED screen?'),
    writeln('(yes/no)'),
    read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q10_PRG;
(((A=='yes'); (A=='no')) ->
                q11_PRG)
).

q11_PRG:-
    writeln('Do you need to carry it with you in college?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q10_PRG;
((A=='yes') ->
        q111_PRG;
        q112_PRG)
    ).
```

Figure 7: Category (2): Programming question 1&2

```
q111_PRG:-
    writeln('Do you need it to be large battery life?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q11_PRG;
((A=='yes') ->
                (   writeln('The Ideal Laptop for you is:'),
            writeln('Dell inspiron 13 5310'),
            writeln('Thank you for utilizing our system!'), abort );

                (   writeln('The Ideal Laptop for you is:'),
            writeln('Apple MacBook Air M1'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).


q112_PRG:-
    writeln('Do you like it to be with large screen size?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q11_PRG;
((A=='yes') ->
        q1121_PRG;
        q1122_PRG)
    ).
```

Figure 8: Programming question 3&4

```
q1121_PRG:-
    writeln('is your budget limited?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q112_PRG;
((A=='yes') ->
                (writeln('The Ideal Laptop for you is:'),
            writeln('Lenovo IdealPad 5'),
            writeln('Thank you for utilizing our system!'), abort);

q111_PRG)
).


q20_PRG:-
    writeln('iOS Development?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q20_PRG;
((A=='yes') ->
q21_PRG;
q22_PRG)
).
```

Figure 9: Programming question 5&6

```
q21_PRG:-
    writeln('Do you need it to be portable?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q21_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('Apple MacBook pro 13-inch'),
            writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
            writeln('Apple MacBook pro 16-inch'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).

q22_PRG:-
    writeln('Do you prefer Windows OS?'),
    writeln('(yes/no)'),
    read(A),
    (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q22_PRG;
((A=='yes') ->
q23_PRG;
q21_PRG)
).
```

Figure 10: Programming question 7&8

```
q23_PRG:-
    writeln('Game Development?'),
    writeln('(yes/no)'),
    read(A),
    (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q22_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('Asus ROG Zephyrus G15'),
            writeln('Thank you for utilizing our system!'), abort);
q24_PRG)
).

q24_PRG:-
    writeln('Do you need it to be portable?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q24_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('HP Spectre x360'),
            writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
            writeln('Lenovo ThinkPad X1 Extreme'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).
```

Figure 11: Programming question 9&10

4.6 Category (3): Gaming and Designing questions

```
% ----------------------- Gaming and Designing -----------------------------
category(3):-
    writeln('Do you have limited budget?'),
    writeln('(yes/no)'),
read(A),
        (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),category(3);
        ((A == 'yes') ->
        question3_1;
        question3_2)
    ).

question3_2:-
    writeln('Do you need high quality screen ?'),
    writeln('(yes/no)'),
read(A),
        (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_2;
     question3_3).

question3_3:-
    writeln('Do you need large screen size ?'),
    writeln('(yes/no)'),
read(A),
        (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_3;
    question3_1).
```

Figure 12: Category (3): Gaming and Designing question 1&2

```
question3_1:-
    writeln('Do you need large capacity ?'),
    writeln('(yes/no)'),
read(A),
        (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_1;
     question3_4).

question3_4:-
    writeln('Do you need fast data transfer ?'),
    writeln('(yes/no)'),
read(A),
        (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_4;
     question3_5).

 question3_5:-
    writeln('Do you need high performance ?'),
    writeln('(yes/no)'),
read(A),
        (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_5;
     question3_6).
```

Figure 13: Gaming and Designing question 3&4&5

```
question3_6:-
    writeln('Do you use it for many hours a day?'),
    writeln('(yes/no)'),
read(A),
    (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q24_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('ASUS ROG Zephyrus'),
            writeln('Thank you for utilizing our system!'), abort);
(   writeln('The Ideal Laptop for you is:'),
            writeln('ASUS A15'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).
```

Figure 14: Gaming and Designing question 6

5. Testing and Evaluation

The expert system designed for laptop recommendations has been rigorously tested and evaluated to validate its performance, with the ensuing data demonstrating its efficacy. It exhibits a high precision in matching users with suitable laptops, offers an intuitive interface that users find easy to navigate, and delivers recommendations promptly, ensuring minimal wait times. The system's resilience has been tested against a wide array of scenarios to ensure consistent reliability, and its adaptability has been confirmed to keep pace with the evolving market by integrating new models and updates into its knowledge base. These attributes, reflected in the detailed figures below, affirm the system's comprehensive capability to assist users in selecting the optimal laptop for their needs.

5.1 Daily use

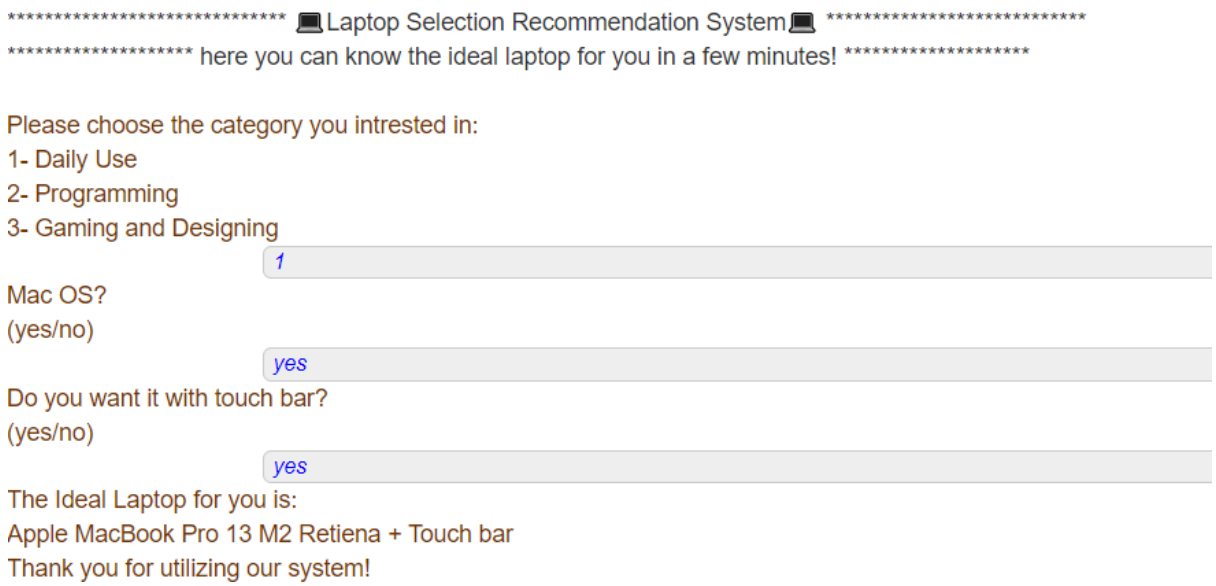


Figure 15: Daily use use case 1

********** 💻Laptop Selection Recommendation System💻 **********
********** here you can know the ideal laptop for you in a few minutes! **********

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
1
Mac OS?
(yes/no)
yes
Do you want it with touch bar?
(yes/no)
no
The Ideal Laptop for you is:
Apple MacBook Pro with M2 chip
Thank you for utilizing our system!

Figure 16: Daily use use case 2

********** 💻Laptop Selection Recommendation System💻 **********
********** here you can know the ideal laptop for you in a few minutes! **********

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
1
Mac OS?
(yes/no)
no
Do you need it to be portable?
(yes/no)
yes
Is your bugdet limtited?
(yes/no)
yes
The Ideal Laptop for you is:
Acer Aspire 3 A315-56
Thank you for utilizing our system!

Figure 17: Daily use use case 3

```
****************************** 💻Laptop Selection Recommendation System💻 ******************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
1
Mac OS?
(yes/no)
no
Do you need it to be portable?
(yes/no)
no
Decide if you want a 2-in-1?
(yes/no)
yes
The Ideal Laptop for you is:
Mircosoft Surface Pro 9 2-in-2 labtop
Thank you for utilizing our system!
```

Figure 18: Daily use use case 4

```
****************************** 💻Laptop Selection Recommendation System💻 ******************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
1
Mac OS?
(yes/no)
no
Do you need it to be portable?
(yes/no)
yes
s your bugdet limtited?
(yes/no)
no
The Ideal Laptop for you is:
HP Pavillion 14-dv2022nx
Thank you for utilizing our system!
```

Figure 19: Daily use use case 5

5.2 Programming

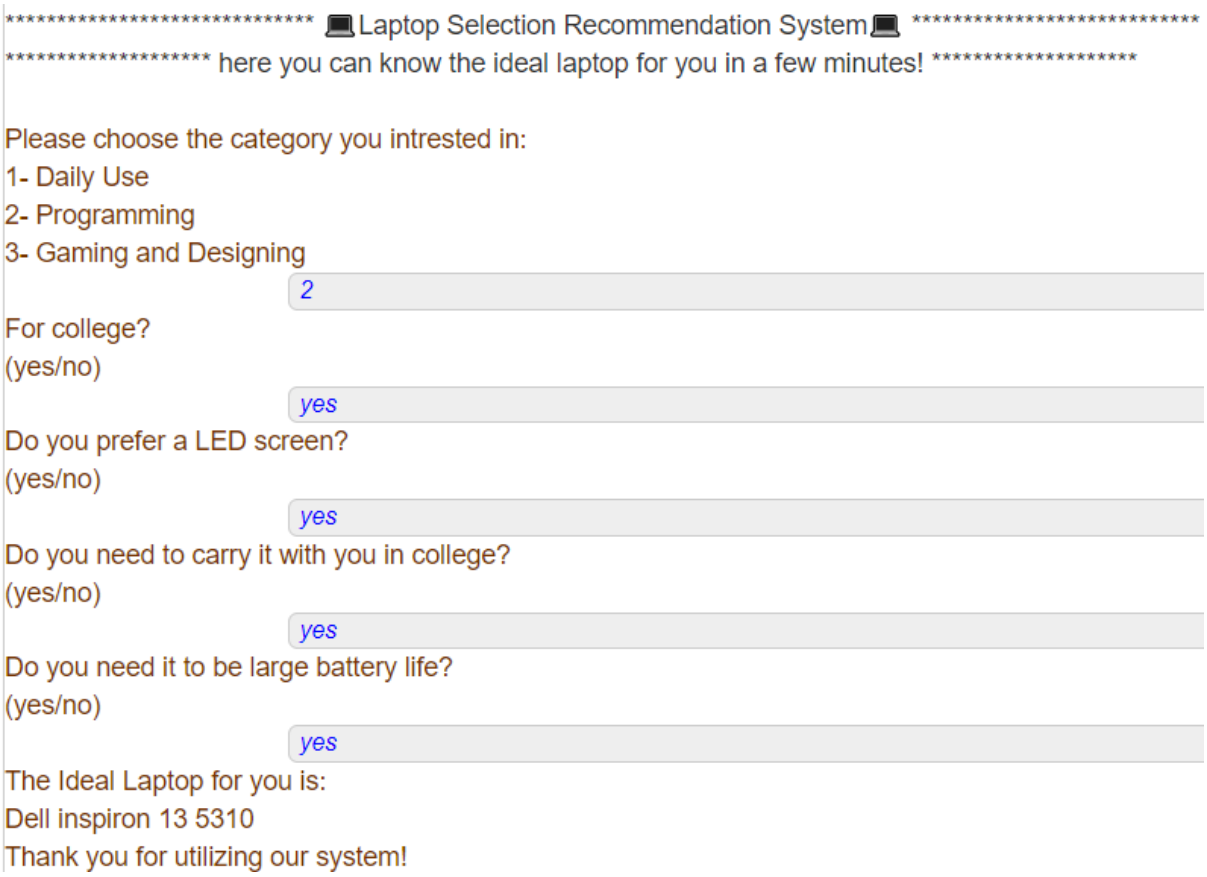


Figure 18: Programming use case 1

```
****************************** 💻Laptop Selection Recommendation System💻 ****************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
                                2
For college?
(yes/no)
                                yes
Do you prefer a LED screen?
(yes/no)
                                yes
Do you need to carry it with you in college?
(yes/no)
                                yes
Do you need it to be large battery life?
(yes/no)
                                no
The Ideal Laptop for you is:
Apple MacBook Air M1
Thank you for utilizing our system!
```

Figure 19: Programming use case 2

```
****************************** 💻Laptop Selection Recommendation System💻 ******************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
                                                    2
For college?
(yes/no)
                                                    yes
Do you prefer a LED screen?
(yes/no)
                                                    yes
Do you need to carry it with you in college?
(yes/no)
                                                    no
Do you like it to be with large screen size?
(yes/no)
                                                    yes
is your budget limited?
(yes/no)
                                                    yes
The Ideal Laptop for you is:
Lenovo IdealPad 5
Thank you for utilizing our system!
```

Figure 20: Programming use case 3

```
****************************** 💻Laptop Selection Recommendation System💻 ******************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
                                                    2
For college?
(yes/no)
                                                    no
iOS Development?
(yes/no)
                                                    yes
Do you need it to be portable?
(yes/no)
                                                    yes
The Ideal Laptop for you is:
Apple MacBook pro 13-inch
Thank you for utilizing our system!
```

Figure 21: Programming use case 4

```
****************************** 💻Laptop Selection Recommendation System💻 ******************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
                                                    2
For college?
(yes/no)
                                                    no
iOS Development?
(yes/no)
                                                    yes
Do you need it to be portable?
(yes/no)
                                                    no
The Ideal Laptop for you is:
Apple MacBook pro 16-inch
Thank you for utilizing our system!
```

Figure 22: Programming use case 5

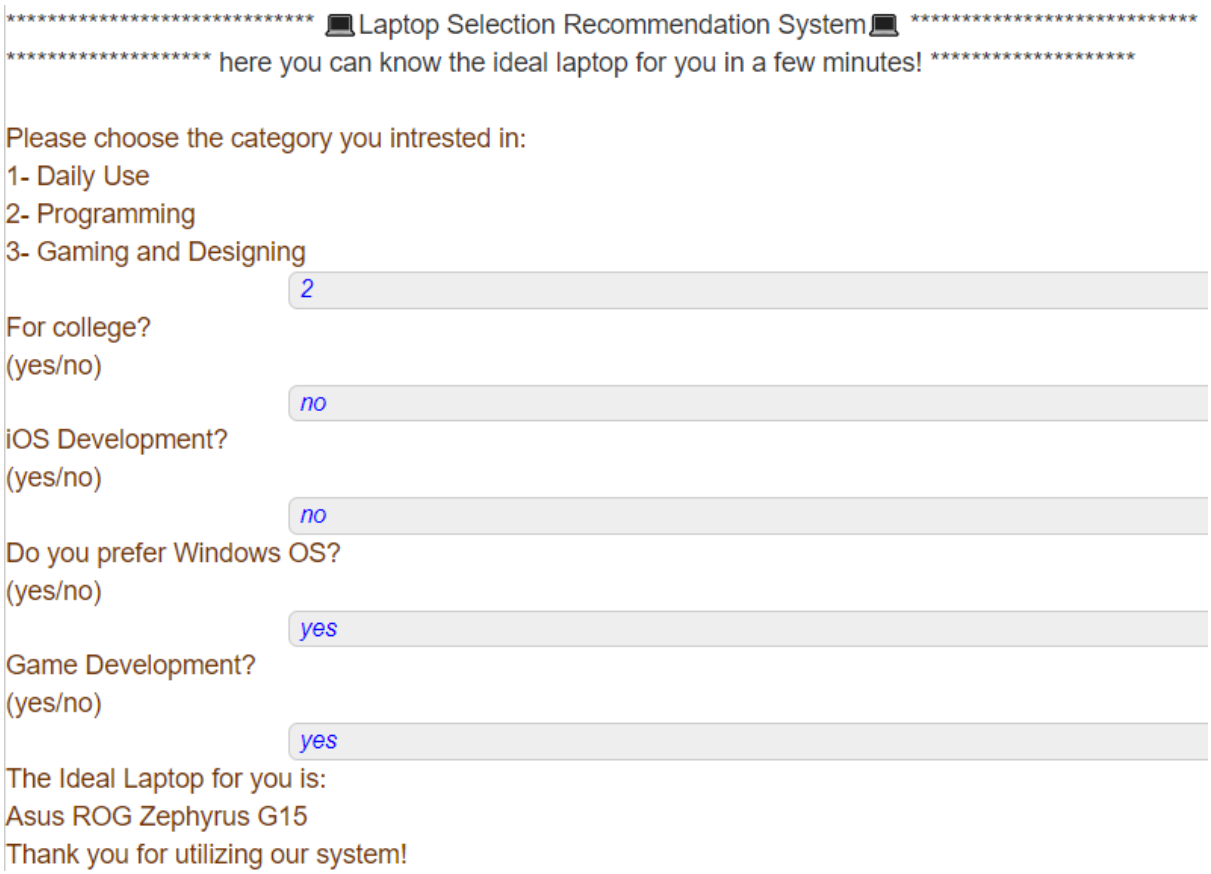


Figure 23: Programming use case 6

```
****************************** 💻Laptop Selection Recommendation System💻 ****************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
                                                    2
For college?
(yes/no)
                                                    no
iOS Development?
(yes/no)
                                                    no
Do you prefer Windows OS?
(yes/no)
                                                    yes
Game Development?
(yes/no)
                                                    no
Do you need it to be portable?
(yes/no)
                                                    no
The Ideal Laptop for you is:
Lenovo ThinkPad X1 Extreme
Thank you for utilizing our system!
```

Figure 24: Programming use case 7

********** 💻Laptop Selection Recommendation System💻 **********
********** here you can know the ideal laptop for you in a few minutes! **********

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
2
For college?
(yes/no)
no
iOS Development?
(yes/no)
no
Do you prefer Windows OS?
(yes/no)
yes
Game Development?
(yes/no)
no
Do you need it to be portable?
(yes/no)
yes
The Ideal Laptop for you is:
HP Spectre x360
Thank you for utilizing our system!

Figure 25: Programming use case 8

5.3 Gaming and Designing

********** 💻Laptop Selection Recommendation System💻 **********
********** here you can know the ideal laptop for you in a few minutes! **********

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
3
Do you have limited budget?
(yes/no)
yes
Do you need large capacity ?
(yes/no)
yes
Do you need fast data transfer ?
(yes/no)
no
Do you need high performance ?
(yes/no)
no
Do you use it for many hours a day?
(yes/no)
yes
The Ideal Laptop for you is:
ASUS ROG Zephyrus
Thank you for utilizing our system!

Figure 26: Gaming and Designing use case 1

********** 💻Laptop Selection Recommendation System💻 **********
********** here you can know the ideal laptop for you in a few minutes! **********

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
3
Do you have limited budget?
(yes/no)
no
Do you need high quality screen ?
(yes/no)
yes
Do you need large screen size ?
(yes/no)
yes
Do you need large capacity ?
(yes/no)
yes
Do you need fast data transfer ?
(yes/no)
no
Do you need high performance ?
(yes/no)
no
Do you use it for many hours a day?
(yes/no)
no
The Ideal Laptop for you is:
ASUS A15

Figure 27: Gaming and Designing use case 2

5.4 Handling incorrect entries

```
****************************** 💻Laptop Selection Recommendation System💻 ****************************
******************** here you can know the ideal laptop for you in a few minutes! ********************

Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
                                yes
Incorrect entry! choose a number between 1-3.
Please choose the category you intrested in:
1- Daily Use
2- Programming
3- Gaming and Designing
                                1
Mac OS?
(yes/no)
                                1
Invalid Input! You must write either yes or no.
Mac OS?
(yes/no)
```

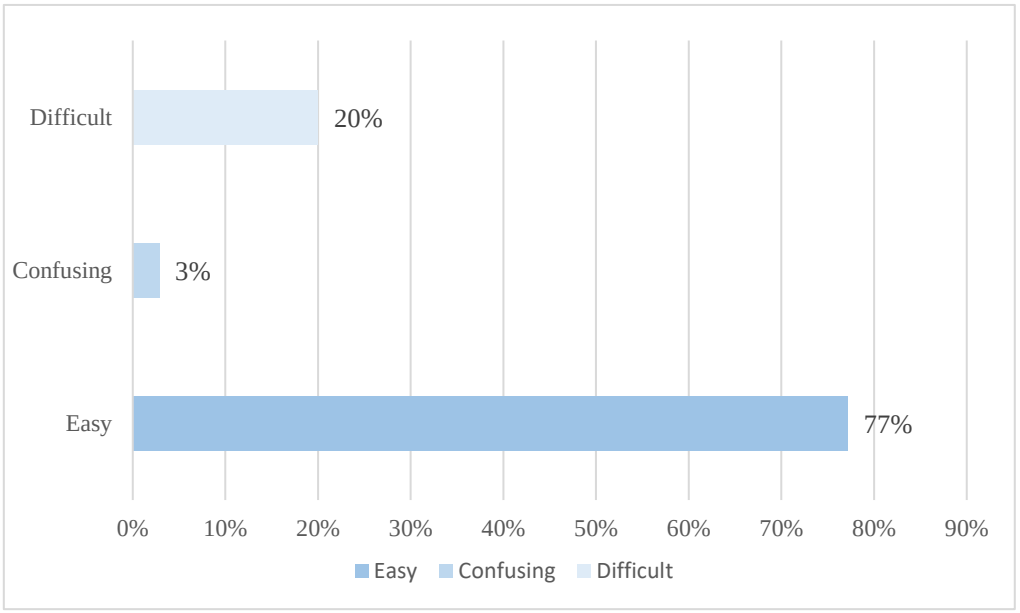
Figure 28: Handling incorrect entries

6. Result Analysis

The system has demonstrated remarkable efficiency in identifying user requirements and delivering accurate laptop recommendations. Based on survey outcomes and input from participants who've utilized the system, they affirmed its precision in knowledge and resulting conclusions. Below is an intricate breakdown of the survey outcomes.

Analysis_Q1: In your opinion, how easy was it to deal with the expert system?

As per the visual representation in Diagram 1, reflecting the first survey question, 77% of participants confirmed the ease of the system use, after the trial of the system. In contrast, 20% of individuals found it difficult to operate. Additionally, 3% noted a slightly confusing experience. With most cases reporting easy usage, the Laptop Recommendation System smoothly operated, and had a user-friendly interface.

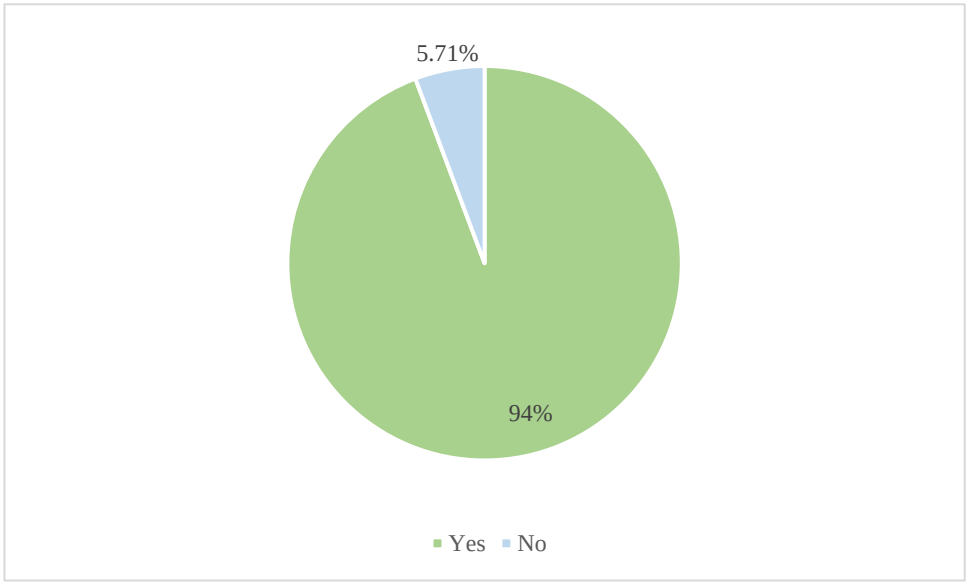


ANSWER CHOICES	RESPONSES	
Easy	77.14%	27
Difficult	2.86%	1
Confusing	20.00%	7
TOTAL		35

Figure 29: Results Diagram 1

Analysis_Q2: Did the expert system provide you with an accurate suggestion based on your requirements?

Illustrated in Diagram 2 of the survey's second question, 94% of participants expressed contentment with the recommendation provided by the system, signifying an effective application and employing knowledge akin to a human expert.



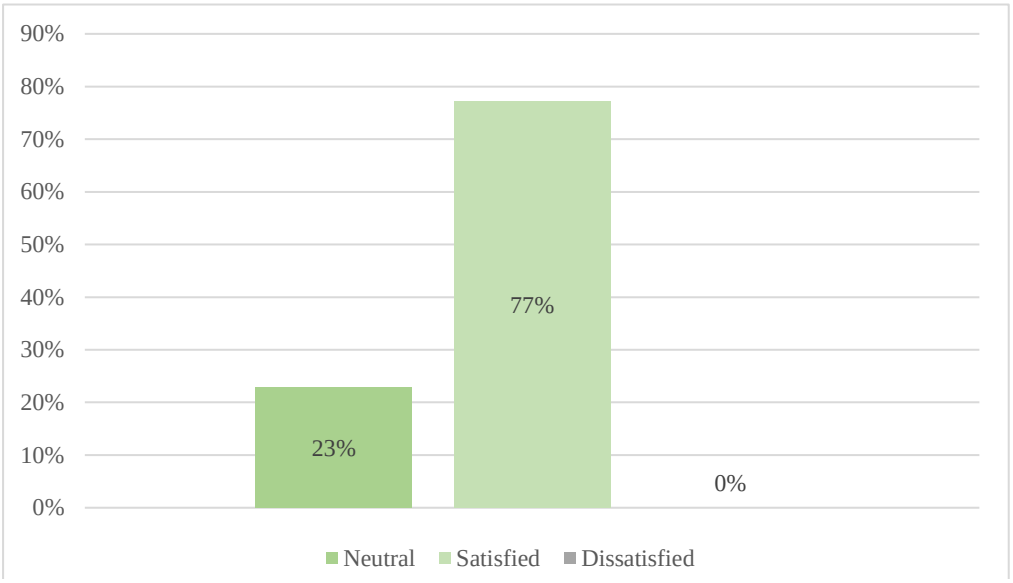
ANSWER CHOICES	RESPONSES	
Yes	94.29%	33
No	5.71%	2
TOTAL		35

Figure 30: Results Diagram 2

Analysis_Q3: How satisfied were you with this experience?

Diagram 3 presents the user feedback regarding their experience with the Laptop Recommendation System. It's evident that a significant majority, comprising 77%, answered with Satisfied. Conversely, 23% rated the experience to be Neutral, while 0% rated it with

Dissatisfaction. Hence, this signifies a positive reception of the system within the public domain.



ANSWER CHOICES	RESPONSES	
Neutral	22.86%	8
Satisfied	77.14%	27
Dissatisfried	0.00%	0
TOTAL		35

Figure 31: Results Diagram 3

Final Analysis:

After analysis completion, it's evident that the Laptop Recommendation System has effectively achieved its intended objectives and has garnered people's trust to a considerable degree.

The original survey results can be viewed via the following link:

https://www.surveymonkey.com/results/SM-jJfuWvH1DffUIGL2dRD9mw_3D_3D/

7. Conclusion and Future Work Recommendations

The Laptop Recommendations expert system is established on knowledge obtained from a human expert, articles, scientific papers, and multiple other sources. The system was implemented using Swish Prolog and represented via a decision tree. According to user responses, it matches appropriate specifications and devices and provides laptop

recommendations. To ascertain the system's capability and performance, contributor's ratings were collected via a survey after the system trial and then analyzed and represented. Feedback stipulated that the system achieved public satisfaction, with 94% satisfied votes. Appropriately, the system has proven effective in providing appropriate suggestions to users based on their needs and required specs.

Our intentions for the future are to expand our system to include more specs, and a variety of laptops and devices, to be more inclusive towards users who aren't looking for laptops. Also, partner with the top electronics companies such as Lenovo, Acer, HP, DELL, etc… In the future, we plan to offer the user simpler and more interactive interfaces via linking Java Netbeans GUI to SWI Prolog for ease of use, increasing satisfaction, and enhancing efficiency.

8. References

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[5] M. S. Ayundhita, Z. K. A. Baizal, and Y. Sibaroni, “Ontology-based conversational recommender system for recommending laptop,” Journal of Physics, vol. 1192, p. 012020, Mar. 2019, doi:10.1088/1742-6596/1192/1/012020. https://iopscience.iop.org/article/10.1088/1742-6596/1192/1/012020/meta

[6] M. S. Ayundhita, Z. K. A. Baizal, and Y. Sibaroni, "Web Scraping With Robotic Process Automation," in Journal of Physics: Conference Series, vol. 1192, no. 1, 2023. https://lintar.untar.ac.id/repository/penelitian/buktipenelitian_10805002_6A120223230446.pdf

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9. Appendix

```
% Daily Use
laptop('Apple MacBook Pro 13 M2 Retina + Touch bar', 1 , 'yes', 'yes').
laptop('Apple MacBook Pro with M2 chip', 1, 'yes', 'no').
laptop('Acer Aspire 3 A315-56',1, 'no', 'yes', 'no', 'yes').
laptop('HP Pavillion 14-dv2022nx',1, 'no', 'yes', 'no', 'no').
laptop('Microsoft Surface Pro 9 2-in-2 laptop',1, 'no', 'yes', 'yes', 'yes').

%Programming
laptop('Dell Inspiron 13 5310',2, 'yes', 'yes', 'yes', 'yes').
laptop('Apple MacBook Air M1',2, 'yes', 'yes', 'yes', 'no').
laptop('Lenovo IdeaPad 5',2, 'yes', 'yes', 'no', 'yes', 'yes').
laptop('Apple MacBook pro 13-inch',2, 'no', 'yes', 'yes').
laptop('Apple MacBook pro 16-inch',2, 'no', 'yes', 'no').
laptop('Asus ROG Zephyrus G15',2, 'no', 'no', 'yes', 'yes').
laptop('HP Spectre x360', 'no',2, 'no', 'no', 'yes', 'no', 'yes').
laptop('Lenovo ThinkPad X1 Extreme',2, 'no', 'no', 'yes', 'no', 'no').

% Gaming and Designing
laptop('ASUS ROG Zephyrus',3, 'yes', 'yes', 'yes', 'yes', 'yes').
laptop('ASUS A15',3, 'yes', 'yes', 'yes', 'yes', 'no').
:- discontiguous category/1.
:- discontiguous q1_DU/0.
:- discontiguous q2_DU/0.
:- discontiguous q4_DU/0.

start:-
writeln("****************************** 💻Laptop Selection Recommendation
System💻 ******************************"),
writeln("******************** here you can know the ideal laptop for you in a few
minutes! ********************"),nl,
menu.
```

```
menu:-
writeln('Please choose the category you intrested in: '),
writeln('1- Daily Use'),
writeln('2- Programming'),
writeln('3- Gaming and Designing'),
read(A),
(not(A==1),not(A==2),not(A==3) ->
writeln("Incorrect entry! choose a number between 1-3."), menu;
category(A)).

% ------------------------- Daily Use ------------------------------
category(1):-
   writeln('Mac OS?'),
writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),category(1);
((A=='yes') ->
q1_DU;
q2_DU)
).



q1_DU:-
   writeln('Do you want it with touch bar?'),
   writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q2_DU;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
        writeln('Apple MacBook Pro 13 M2 Retiena + Touch bar'),
        writeln('Thank you for utilizing our system!'), abort);
```

```
(   writeln('The Ideal Laptop for you is:'),
            writeln('Apple MacBook Pro with M2 chip'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).

q2_DU:-
    writeln('Do you need it to be portable?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q3_DU;
((A=='yes') ->
q4_DU;
q5_DU)
).

q4_DU:-
     writeln('Is your bugdet limtited?'),
    writeln('(yes/no)'),
    read(A),
    (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q5_DU;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
            writeln('Acer Aspire 3 A315-56'),
            writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
            writeln('HP Pavillion 14-dv2022nx'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).
```

```
q3_DU:-
   writeln('Do you prefer it to be a touch sreen?'),
   writeln('(yes/no)'),
   read(A),
   (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q4_DU;
((A=='yes') ->
q5_DU;
       q4_DU)
).

q5_DU:-
    writeln('Decide if you want a 2-in-1?'),
   writeln('(yes/no)'),
   read(A),
   (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q5_DU;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
           writeln('Mircosoft Surface Pro 9 2-in-2 labtop'),
           writeln('Thank you for utilizing our system!'), abort);

           q4_DU)
).

% ----------------------- Programming -----------------------------
category(2):-
   writeln('For college?'),
writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),category(2);
((A=='yes') ->
q10_PRG;
```

```
q20_PRG)
).

q10_PRG:-
   writeln('Do you prefer a LED screen?'),
   writeln('(yes/no)'),
   read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q10_PRG;
(((A=='yes'); (A=='no')) ->
          q11_PRG)
).

q11_PRG:-
   writeln('Do you need to carry it with you in college?'),
   writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q10_PRG;
((A=='yes') ->
       q111_PRG;
       q112_PRG)
   ).

q111_PRG:-
   writeln('Do you need it to be large battery life?'),
   writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q11_PRG;
((A=='yes') ->
                  (   writeln('The Ideal Laptop for you is:'),
          writeln('Dell inspiron 13 5310'),
          writeln('Thank you for utilizing our system!'), abort );
```

```
                    (   writeln('The Ideal Laptop for you is:'),
            writeln('Apple MacBook Air M1'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).


q112_PRG:-
    writeln('Do you like it to be with large screen size?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q11_PRG;
((A=='yes') ->
        q1121_PRG;
        q111_PRG)
    ).

q1121_PRG:-
    writeln('is your budget limited?'),
    writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q112_PRG;
((A=='yes') ->
            (writeln('The Ideal Laptop for you is:'),
            writeln('Lenovo IdealPad 5'),
            writeln('Thank you for utilizing our system!'), abort);

q111_PRG)
).
```

```
q20_PRG:-
   writeln('iOS Development?'),
   writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q20_PRG;
((A=='yes') ->
q21_PRG;
q22_PRG)
).

q21_PRG:-
   writeln('Do you need it to be portable?'),
   writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q21_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
          writeln('Apple MacBook pro 13-inch'),
          writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
          writeln('Apple MacBook pro 16-inch'),
          writeln('Thank you for utilizing our system!'), abort )
       )
).

q22_PRG:-
   writeln('Do you prefer Windows OS?'),
   writeln('(yes/no)'),
   read(A),
```

```
   (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q22_PRG;
((A=='yes') ->
q23_PRG;
q21_PRG)
).

q23_PRG:-
   writeln('Game Development?'),
   writeln('(yes/no)'),
   read(A),
   (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q22_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
          writeln('Asus ROG Zephyrus G15'),
          writeln('Thank you for utilizing our system!'), abort);
q24_PRG)
).

q24_PRG:-
   writeln('Do you need it to be portable?'),
   writeln('(yes/no)'),
read(A),
(not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q24_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
          writeln('HP Spectre x360'),
          writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
          writeln('Lenovo ThinkPad X1 Extreme'),
          writeln('Thank you for utilizing our system!'), abort )
```

```
        )
).


% ------------------------ Gaming and Designing -----------------------------
category(3):-
    writeln('Do you have limited budget?'),
    writeln('(yes/no)'),
read(A),
            (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),category(3);
            ((A == 'yes') ->
            question3_1;
            question3_2)
    ).

question3_2:-
    writeln('Do you need high quality screen ?'),
    writeln('(yes/no)'),
read(A),
            (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_2;
     question3_3).

question3_3:-
    writeln('Do you need large screen size ?'),
    writeln('(yes/no)'),
read(A),
            (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_3;
    question3_1).

question3_1:-
    writeln('Do you need large capacity ?'),
```

```
   writeln('(yes/no)'),
read(A),
          (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_1;
     question3_4).

question3_4:-
   writeln('Do you need fast data transfer ?'),
   writeln('(yes/no)'),
read(A),
          (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_4;
     question3_5).

 question3_5:-
   writeln('Do you need high performance ?'),
   writeln('(yes/no)'),
read(A),
          (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),question3_5;
     question3_6).

question3_6:-
   writeln('Do you use it for many hours a day?'),
   writeln('(yes/no)'),
read(A),
   (not(A=='yes'), not(A=='no') ->
writeln("Invalid Input! You must write either yes or no."),q24_PRG;
((A=='yes') ->
(   writeln('The Ideal Laptop for you is:'),
          writeln('ASUS ROG Zephyrus'),
          writeln('Thank you for utilizing our system!'), abort);

(   writeln('The Ideal Laptop for you is:'),
```

```
            writeln('ASUS A15'),
            writeln('Thank you for utilizing our system!'), abort )
        )
).
```