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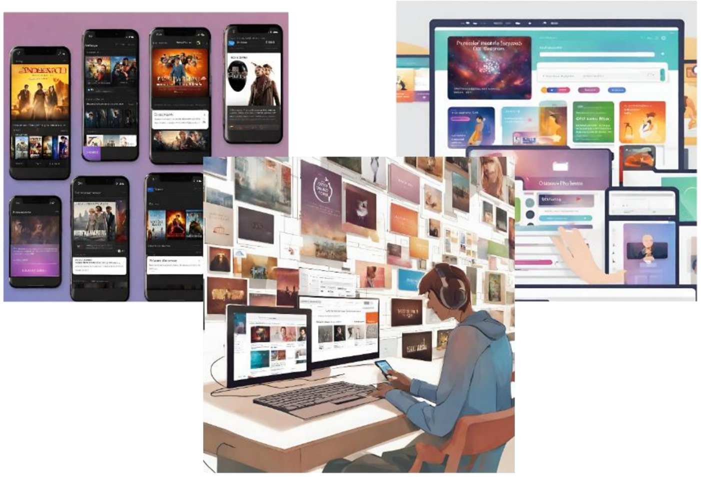
ARTI 401– Artificial Intelligence: Principles and techniques

Term 1 – 2023/2024

Personalized Multimedia Recommendations System



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Abstract (Executive Summary)

In today's fast-paced world, discovering content that aligns with the user's preferences and interests like picking the right movie, TV show or even a book that suits the user’s personality can be a real challenge. Spending too much time searching for the right choice and not enough time enjoying it. For a more efficient and enjoyable entertainment experience, catering to the user's unique preferences, this project aims to develop a smart recommendation system for personalized movies, TV shows, and book suggestions. The objective is to develop a system by specifying Prolog relations (facts and rules) to provide recommendations based on the understanding of each user's preferences, including the genre and rating of their own tailored recommendations. The process involves collecting and categorizing a large number of facts in the knowledge base for movies, TV shows, and books, extracting relevant features, and training the recommendation model. The system demonstrates promising results in accurately predicting user preferences and enhancing the overall user experience. The results highlight the potential of AI technologies in delivering personalized recommendations and shed light on the challenges associated with their implementation. For testing purposes, a group of individuals tested a system and provided ratings, expressing satisfaction levels on a scale of 1 to 5. Overall, this project offers valuable insights into the application of AI in the entertainment industry and serves as a foundation for further advancements in personalized recommendation systems.

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1. Chapter 1: Introduction

In an ever-changing media landscape, movies, books, and TV shows continue to attract audiences globally, providing immersive storytelling experiences that delight, inspire, and provoke meaningful conversations. These types of media serve as outlets for artistic expression, cultural discovery, and escapism, engaging with varied audiences and leaving a lasting mark on popular culture. They create a shared vocabulary that crosses barriers, creating empathy and inviting viewers and readers to explore fresh viewpoints and storylines. Finding movies, books, or TV shows that relate to a person's specific likes and desires may be a difficult task, involving lengthy exploration, and the ability to navigate a wide variety of possibilities and genres. Personal preferences vary widely, making finding that perfect match that grabs one's imagination and establishes a lasting relationship a difficult effort [1] [2].

This project seeks to tackle this issue by creating a “Personalized Media Recommendation System” that utilizes Prolog programming language which is considered a declarative language [3]. The system was implemented in the SWI-Prolog environment where it was fed with a self-constructed knowledge base including rules and facts to deliver personalized recommendations for various media forms based on user preferences. It aims to enhance user experience by delivering content that aligns with individual interests. By considering genre, and content rating, it helps users discover new content, leading to increased satisfaction and engagement. Also, for testing purposes, a group of individuals tested a system and provided ratings, expressing satisfaction levels on a scale of 1 to 5. The diverse range of ratings given provides useful feedback for assessing the system's effectiveness and identifying areas for improvement.

Similar programs use user behavior analysis to provide personalized recommendations, utilizing user reviews, and ratings to enhance discovery and match user preferences. In this project the system considers the inputs and preferences of the user, using them to produce recommendations that are precisely matched to their interests and preferences to generate recommendations that are more likely to align with the user's preferences and improve their media experience overall by comprehending and integrating user feedback. The system currently includes movies, TV shows, and books, however, as part of future work, its scope can be expanded to include a broader range of media types. Furthermore, expanding the knowledge base to ensure more comprehensive and accurate recommendations across various forms of media gives users a broader range of content options to explore.

1.1 Problem Statement

The problem this project aims to tackle is information overload and the challenge users encounter in discovering content that aligns with their preferences and interests in the different multimedia such as movies, books, and TV shows. The abundance of streaming platforms and online marketplaces often overwhelms users with an excessive number of options, resulting in decision fatigue and decreased satisfaction. This project seeks to address this issue by developing Artificial Intelligence (AI) that comprehends individual preferences and provides tailored recommendations of movies, books, and TV shows based on user preference of media rating and genre. The content discovery will be simplified, and the frustration associated with making challenging choices will be alleviated. By doing so, the aim is to facilitate users in finding content they genuinely enjoy, enhancing their overall experience.

1.2 Motivation

The motivations for this system can be stated as follows:

1. Competitive Advantage: Personalized recommendation systems can help multimedia platforms stand out in a crowded field of digital material.
2. Maximizing Content Value: The system makes sure that high-quality content is neither overlooked nor undervalued by efficiently suggesting a wider variety of content.
3. Improved Monetization: More content consumption may result from personalized recommendations, which may raise advertising income, subscription fees, or pay-per-view sales.
4. Enhanced User Experience: The huge amount of content available to people in the digital era frequently leaves them feeling overwhelmed, personalized recommendations greatly enhance user experience by offering material that is in line with specific preferences, interests, and previous interactions. Users may find relevant content more quickly and easily thanks to this customized method, which also saves time and effort while searching for it and facilitates easier and more fulfilling decision-making for users.
5. Customer Loyalty and Retention: Personalized recommendation systems can boost user engagement, lengthen sessions, and encourage repeat visits by presenting information that users are more likely to find enjoyable.

1.3 Objectives

- Searching for suitable data and collecting it.
- Applying the preprocessing techniques and creating the knowledge base.
- Developing a system by specifying Prolog relations (facts and rules) to provide recommendations based on the understanding of user preferences.
- Utilizing prior research and completing a Literature Review (LR) to strengthen the project.
- Testing and evaluating the system using Prolog queries by a group of individuals.
- By the end of this project, we expect to deliver a functional and personalized recommendation system using Prolog that significantly improves user content discovery and engagement.
- The project is expected to be completed within 10 weeks, with 2 main milestones and progress updates.

1.4 Limitation

The lack of variety and feeding in the knowledge base may unintentionally enforce biased recommendation results, which affect relevance and accuracy due to the difficulty of guaranteeing that the recommendations are both pertinent and correct for each particular user. The impact of the system on user decisions and actions raises ethical questions as there is no age filtering in the system, which may lead to suggesting films or books that are not suitable for children and teenagers.

1.5 Notations

Table 1 lists the abbreviations used in this project.

Abbreviations	**Meaning**
AI	Artificial Intelligence
CNN	Convolutional Neural Networks
IMDb	Internet Movie Database
LR	Literature Review
LSTM	Long Short-Term Memory
RNN	Recurrent Neural Networks
TV	Television

Table 1 Abbreviations list

2. Chapter 2: Literature Survey

By examining a wide range of studies, articles, books, and other relevant sources, this section aims to critically analyze the current state of research, identify key themes and trends, and highlight gaps in knowledge that the present study seeks to address.

In [4] the authors propose a personalized TV program recommendation system called queveo. TV that simplifies the job of deciding what TV show to watch. Considering the problem of the presence of hundreds of different programs and TV shows to watch and the constant expansion in the number of channels, people are subjected to information overload. The approach technique used to solve the problem was to combine collaborative filtering and content-filtering techniques by creating a Web 2.0 application. The main findings of this paper are a recommender framework algorithm that merges the results of a collaborative filtering technique that provides recommendations that contain items that people with comparable tastes and preferences have previously enjoyed. and content-filtering technique automatically generates a matching of customer's interests with items comparable to those the user previously chose. The system does not consider different media such as; movies, books, etc..

Paper [5] explores the development of a personalized travel recommendation system utilizing Twitter data. By employing a machine learning classification model, the study identifies travel-related tweets and uses them to customize recommendations for users regarding places of interest such as historical buildings, museums, parks, and restaurants. The model also incorporates travel tweets from the user's friends and followers to further enhance personalization. Performance evaluations reveal a 68% prediction accuracy, which can be improved through a better training dataset and an enhanced travel category identification technique using machine learning. The paper suggests expanding the categories to include additional interests and considering data mining from other social media platforms like LinkedIn or Facebook. Overall, this research showcases the potential of social media analysis to improve the accuracy and relevance of personalized travel recommendations.

The paper [1] reviews personalized TV program recommendation systems, presenting their introduction, relevant work, and philosophies of program description, user profiling, and matching mechanisms. It discusses strategies like implicit and explicit feedback, and content-based and collaborative filtering techniques, and introduces a new system quality evaluation method. The paper proposes a next-generation conceptual architecture for integrating real-time program rating mechanisms with personalization systems using Web Services. The adaptation technique is essential for dynamic purposes and should be further researched. The conceptual architecture of integrating real-time program rating mechanisms with recommendation systems could pave a new way to build Interactive TV solutions in the near future.

The study in [6] aims to create a customized music recommendation framework using Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN(LSTM)). This would help music providers anticipate and provide appropriate songs based on previously heard characteristics. CNN is used for object detection and classification. LSTM, a deep learning algorithm, overcomes long-term dependencies. CNN can accurately understand data using images, so audio data is converted into images and Low-frequency data is down-sampled. The experiment focuses on detecting various musical instruments, with the LSTM model being more stable than the CNN model. Both CNN and RNN models showed better performance in recommending systems.

The system presented in the [2] study seeks to provide the best movie recommendations to users based on their preferences. The article describes a collaborative filtering-based movie recommendation system that analyzes user information and suggests movies based on their preferences, utilizing searching algorithms and the Movielens database. The accuracy of the system was 98%. The authors opted to employ a hybrid algorithm for a movie recommendation system, in which we promote movies to users using a hybrid method and aim to create communities based on user preferences by item category, which allows Engines to propose movies to users more accurately.

The absence of comprehensive systems that can integrate and recommend various media types using AI has left a gap in the field of recommendation systems. Because current systems are built for specific media types, such as movies, music, or books, users must use different systems for each. A comprehensive recommendation system that takes into account users' preferences for these media types could deliver recommendations that are more unique and varied.

3. Chapter 3: System Development and Design

In this chapter, an initial prototype of the system will be presented with a table that illustrates how the system works and a flowchart that describes the flow of the system. Moreover, the data that will be used in the system will be discussed with the tools that will be utilized in writing the code.

3.1 System Prototype

The following table demonstrates the interaction between the users and the personalized media recommendation system, by taking advantage of the capabilities of Prolog programming language by customizing the response based on the queries given by the users which discovered content that matches the users' preferences and therefore, enhances the users experience and satisfies their preferences.

Media	Rule in Prolog	Sample Output	Description

Movie Recommendation Based on The Genre and Rating.	`recommendation_movie(Genre, Rating, Recommendation) :-`
	`movie(Recommendation, Genre, MovieRating),`
	`MovieRating >= Rating.`
		Welcome to the Multimedia Recommendation System!
		Pick a media type:
		movie
		What genre are you interested in?
		action
		What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
		7
		Based on your preferences, we recommend the following:
		- avengers
		- john_wick
		- avengers_endgame
		- the_hunger_games
		Enjoy your multimedia experience!
			Users are asked to choose a media type, such as movies, and then to specify their preferred genre and minimum rating. In this case, the user expressed a preference for the "action" genre, with a minimum rating preference of "7 “. The system then generates a list of recommended movies, including "Avengers," "John Wick," "Avengers: Endgame," and "The Hunger Games." Users are encouraged to enjoy their multimedia experience.

TV Show Recommendation Based on The Genre and Rating.	`recommendation_tv_show(Genre, Rating, Recommendation) :-`
	
	`tv_show(Recommendation, Genre, ShowRating),`
	`    ShowRating >= Rating.`
		Welcome to the Multimedia Recommendation System!
		Pick a media type:
		tv_show
		What genre are you interested in?
		drama
		What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
		8
		Based on your preferences, we recommend the following:
		- westworld
		- the_crown
		- mad_men
		- money_heist
		
		Enjoy your multimedia experience!
			Users are asked to choose a media type, such as TV shows, and then to specify their preferred genre and minimum rating. In this case, the user expressed a preference for the "Drama" genre, with a minimum rating preference of "8”. The system then generates a list of recommended TV shows, including “Westworld”, “The Crown”, “Mad Men.” And “Money Heist” Users are encouraged to enjoy their multimedia experience.

Book Recommendation Based on The Genre And Rating.	`recommendation_book(Genre, Rating, Recommendation) :-`
	
	`book(Recommendation, Genre, BookRating),`
	
	`BookRating >= Rating.`
		Welcome to the Multimedia Recommendation System!
		Pick a media type:
		
		book
		
		What genre are you interested in?
		
		horror
		
		What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
		
		3
		
		Based on your preferences, we recommend the following:
		- pet_sematary
		- frankenstein
		
		Enjoy your multimedia experience!
			Users are asked to choose a media type, such as a book, and then to specify their preferred genre and minimum rating. In this case, the user expressed a preference for the "horror" genre, with a minimum rating preference of "3”. The system then generates a list of recommended books, including “Pet Sematary”, And “ Frankenstein” Users are encouraged to enjoy their multimedia experience.

Rating the System and Calculating the	`%Users Rating`
	
	`:- dynamic rate/1.`
	`rate([5,5,4,3,5,4,5,3,4,5,3,4,5,5,5,5,4,4,5,4]).`
	
	`addRating:-`
	`writeln("Help us develop our system! please enter a`
		Help us develop our system! please enter a number between 1-5 to express how happy you are with the service.
		Enter 1 for poor, up to 5 for excellent
		
		5
			Users are asked to rate their level of satisfaction with a system's service on a scale of 1 to 5. It reads user input and handles invalid input with logical operators and conditional

<table>
<tr><td><b>Rating Average</b></td><td>number between 1-5 to express how happy you are with the service."),

writeln("Enter 1 for poor, up to 5 for excellent"),
read(X),

(
not(X==1),not(X==2),
not(X==3),not(X==4),
not(X==5) ->
writeln("Invalid Input. You should enter a number between 1-5."),
addRating;

(rate(List),

append(List,[X],RatingList),

retract(rate(List)),

assert(rate(RatingList))).

%Sum Rating
sumAverage([X],X).
sumAverage([H|T],Sum):-
sumAverage(T,SumT),
Sum is H+SumT.

% Rating Average
average(Average):-
rate(List),
length(List,Ln),
sumAverage(List,Sum), Average is Sum/Ln.

%Average Rounding
round(X,Y,D) :-
Z is X * 10^D,
round(Z, ZA), Y is ZA / 10^D.</td><td>The average is displayed at the beginning of the system:

Our system total rating is: 4.35</td><td>statements. If the input is correct, the program retrieves the current ratings from a list and adds the user's rating to the updated list. The updated ratings are saved in the code for further analysis or processing.</td></tr>
</table>

Entry Validation (Error Message)	% Media Entry Media \= movie, Media \= book, Media \= tv_show -> write('Invalid Input. please reenter your choice correctly.'), nl,recommendation_sys tem,! % Genre Entry Genre \= fantasy, Genre \= action, Genre \= thriller, Genre \= mystery, Genre \= comedy, Genre \= drama, Genre \= horror -> write('Invalid Input. please reenter your choice correctly.'), nl,recommendation_sy stem,! % Rating Entry Rating \= 1 , Rating \= 2, Rating \= 3, Rating \= 4, Rating \= 5, Rating \= 6, Rating \= 7, Rating \= 8, Rating \= 9, Rating \= 10 -> write('Invalid Input. please write a number between 1- 10 for movies and tv_shows and 1-5 for books.'), nl,recommendation_sy stem,! % System Rating Entry writeln("Enter 1 for poor, up to 5 for excellent"), read(X), (not(X==1),not(X==2), not(X==3),not(X==4),	% Media Entry Pick a media type: -movie -tv_show -book *movi* Invalid Input. please reenter your choice correctly. % Genre Entry What genre are you interested in? -fantasy -action -thriller -mystery -comedy -drama -horror *actio* Invalid Input. please reenter your choice correctly. % Rating Entry What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books) *11* Invalid Input. please write a number between 1-10 for movies and tv_shows and 1-5 for books. % System Rating Entry Help us develop our system! please enter a number between 1-5 to express how happy you are with the service. Enter 1 for poor, up to 5 for excellent *7* Invalid Input. You should enter a number between 1-5.	The code detects invalid input and prompts the user to reenter their selection. Invalid input is dealt with by displaying appropriate feedback and resetting the user's selection.

	not(X==5) -> writeln("Invalid Input. You should enter a number between 1-5."), addRating;		

Table 2 System Prototype

3.2 System Flowchart

The following flowchart in Figure 1 illustrates the flow of the system, where the system asks the user about the media, the genre, and the rating of the desired recommendations. Then the system provides the user with recommendations based on their preferences. The system checks the spelling of the input, if the spelling is incorrect, the system will force the user to reenter the input. After the recommendations appear, the user will be asked to rate and evaluate the system.

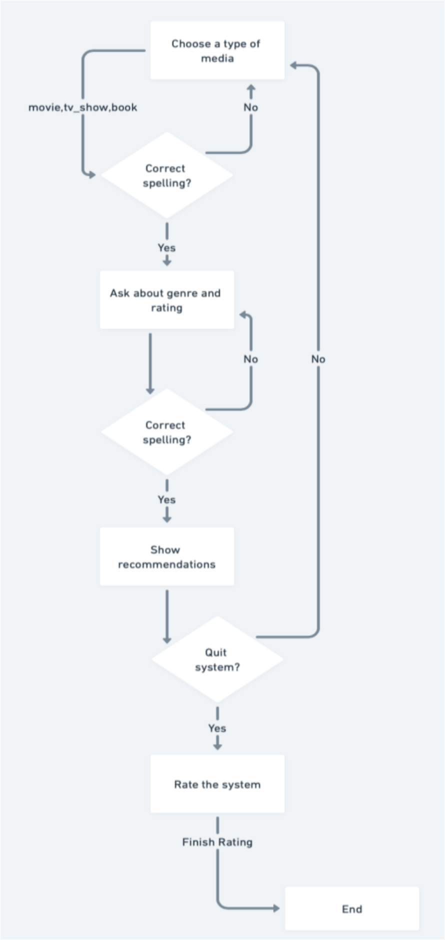


Figure 1 System Flowchart

3.3 Data

For this system, the dataset that will be used includes information about movies, TV shows, and books. The attributes that are needed for this dataset are the name of the media, genre, and rating. The datasets can be obtained through the available public databases such as Kaggle or partnerships with organizations. However, for this system, the dataset will be generated manually by gathering the information needed from the Internet Movie Database (IMDb) which is globally renowned as the foremost and highly regarded platform for movies and TV shows, enjoyed by a vast audience. For the books, GoodReads will be used. Where this dataset will be transformed into facts to build the knowledge base in prolog then utilize these facts in the system rules.

3.4 Tools

Multiple software and hardware will be used to ensure the proposed system's efficiency. The hardware that will be used is personal computers with a screen and a keypad to write and debug the code, and to interact with the users in the testing phase. To facilitate the process of writing the code, SWI-Prolog will be used. It is a free environment that provides a comprehensive interface to write code using the Prolog language. Prolog is a programming language that focuses on logic and is widely used in the field of AI. It is primarily designed as a declarative language, where logic is represented through relationships known as facts and rules in Table 3.

Type of Tool	**Name of Tool**
Hardware	Acer Laptop Huawei Laptop
Software	SWI-Prolog Compiler SWI-Prolog Desktop

Table 3 The Results of The System Ratings Collected from Users

4. Chapter 4: Implementation

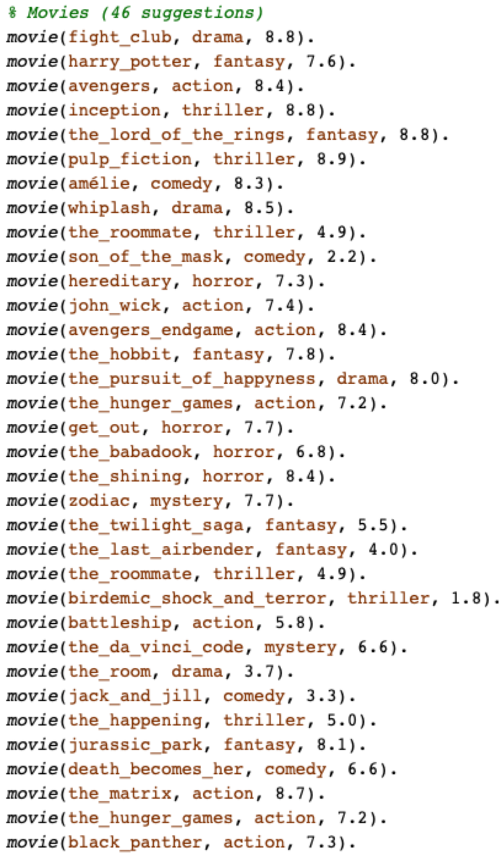
The expert system uses the Prolog programming language and SWI-Prolog environment to implement and run the program. The reason behind choosing Prolog was its popularity in implementing natural language processing, expert systems, and theorems. It operates by the rules and facts declared in it. The user can type consecutive queries, to which the system responds using the facts and rules declared in it. The figures below present the implementation source code used in the system.

4.1 Code

The whole source code for developing the personalized multimedia recommendation system is included in the appendix.

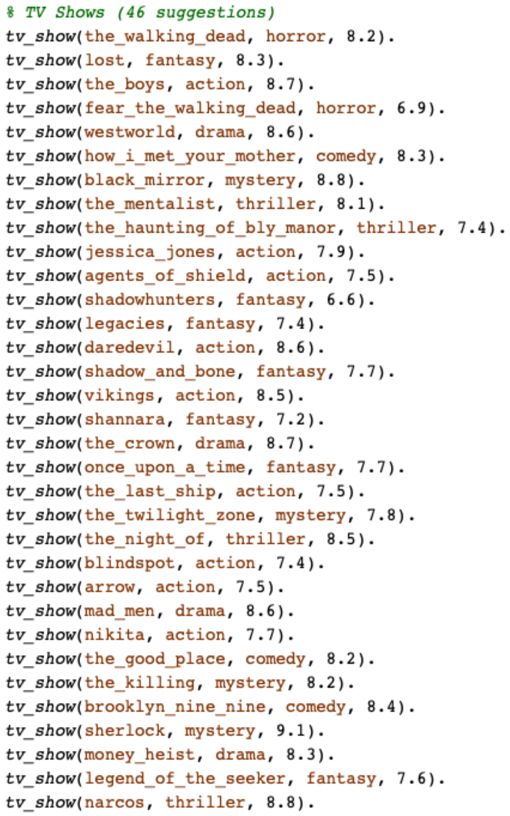
4.2 System's Facts

Figures 2, 3, and 4 show a sample of the data collected for the facts for the types of media such as; movies, TV shows, and books. Each of the media types got 46 suggestions, 138 in total.



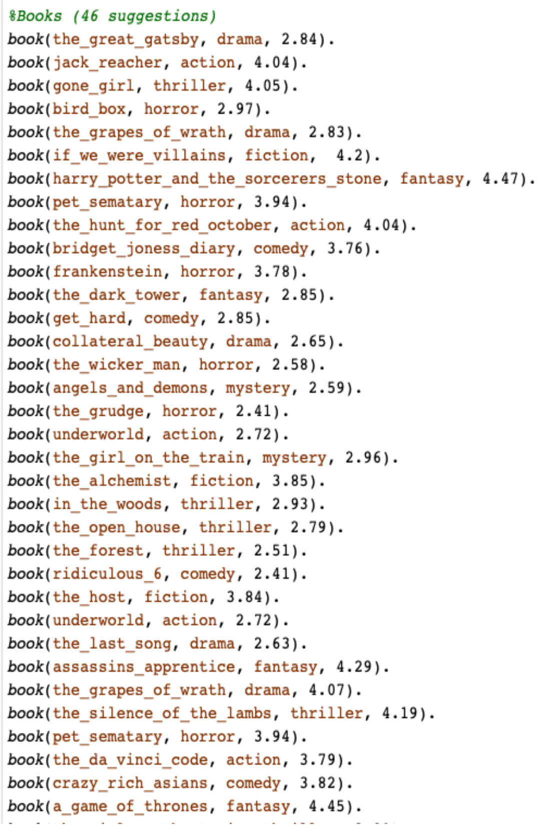
```
% Movies (46 suggestions)
movie(fight_club, drama, 8.8).
movie(harry_potter, fantasy, 7.6).
movie(avengers, action, 8.4).
movie(inception, thriller, 8.8).
movie(the_lord_of_the_rings, fantasy, 8.8).
movie(pulp_fiction, thriller, 8.9).
movie(amélie, comedy, 8.3).
movie(whiplash, drama, 8.5).
movie(the_roommate, thriller, 4.9).
movie(son_of_the_mask, comedy, 2.2).
movie(hereditary, horror, 7.3).
movie(john_wick, action, 7.4).
movie(avengers_endgame, action, 8.4).
movie(the_hobbit, fantasy, 7.8).
movie(the_pursuit_of_happyness, drama, 8.0).
movie(the_hunger_games, action, 7.2).
movie(get_out, horror, 7.7).
movie(the_babadook, horror, 6.8).
movie(the_shining, horror, 8.4).
movie(zodiac, mystery, 7.7).
movie(the_twilight_saga, fantasy, 5.5).
movie(the_last_airbender, fantasy, 4.0).
movie(the_roommate, thriller, 4.9).
movie(birdemic_shock_and_terror, thriller, 1.8).
movie(battleship, action, 5.8).
movie(the_da_vinci_code, mystery, 6.6).
movie(the_room, drama, 3.7).
movie(jack_and_jill, comedy, 3.3).
movie(the_happening, thriller, 5.0).
movie(jurassic_park, fantasy, 8.1).
movie(death_becomes_her, comedy, 6.6).
movie(the_matrix, action, 8.7).
movie(the_hunger_games, action, 7.2).
movie(black_panther, action, 7.3).
```

Figure 2 Movies Facts



```
% TV Shows (46 suggestions)
tv_show(the_walking_dead, horror, 8.2).
tv_show(lost, fantasy, 8.3).
tv_show(the_boys, action, 8.7).
tv_show(fear_the_walking_dead, horror, 6.9).
tv_show(westworld, drama, 8.6).
tv_show(how_i_met_your_mother, comedy, 8.3).
tv_show(black_mirror, mystery, 8.8).
tv_show(the_mentalist, thriller, 8.1).
tv_show(the_haunting_of_bly_manor, thriller, 7.4).
tv_show(jessica_jones, action, 7.9).
tv_show(agents_of_shield, action, 7.5).
tv_show(shadowhunters, fantasy, 6.6).
tv_show(legacies, fantasy, 7.4).
tv_show(daredevil, action, 8.6).
tv_show(shadow_and_bone, fantasy, 7.7).
tv_show(vikings, action, 8.5).
tv_show(shannara, fantasy, 7.2).
tv_show(the_crown, drama, 8.7).
tv_show(once_upon_a_time, fantasy, 7.7).
tv_show(the_last_ship, action, 7.5).
tv_show(the_twilight_zone, mystery, 7.8).
tv_show(the_night_of, thriller, 8.5).
tv_show(blindspot, action, 7.4).
tv_show(arrow, action, 7.5).
tv_show(mad_men, drama, 8.6).
tv_show(nikita, action, 7.7).
tv_show(the_good_place, comedy, 8.2).
tv_show(the_killing, mystery, 8.2).
tv_show(brooklyn_nine_nine, comedy, 8.4).
tv_show(sherlock, mystery, 9.1).
tv_show(money_heist, drama, 8.3).
tv_show(legend_of_the_seeker, fantasy, 7.6).
tv_show(narcos, thriller, 8.8).
```

Figure 3 TV Shows Facts

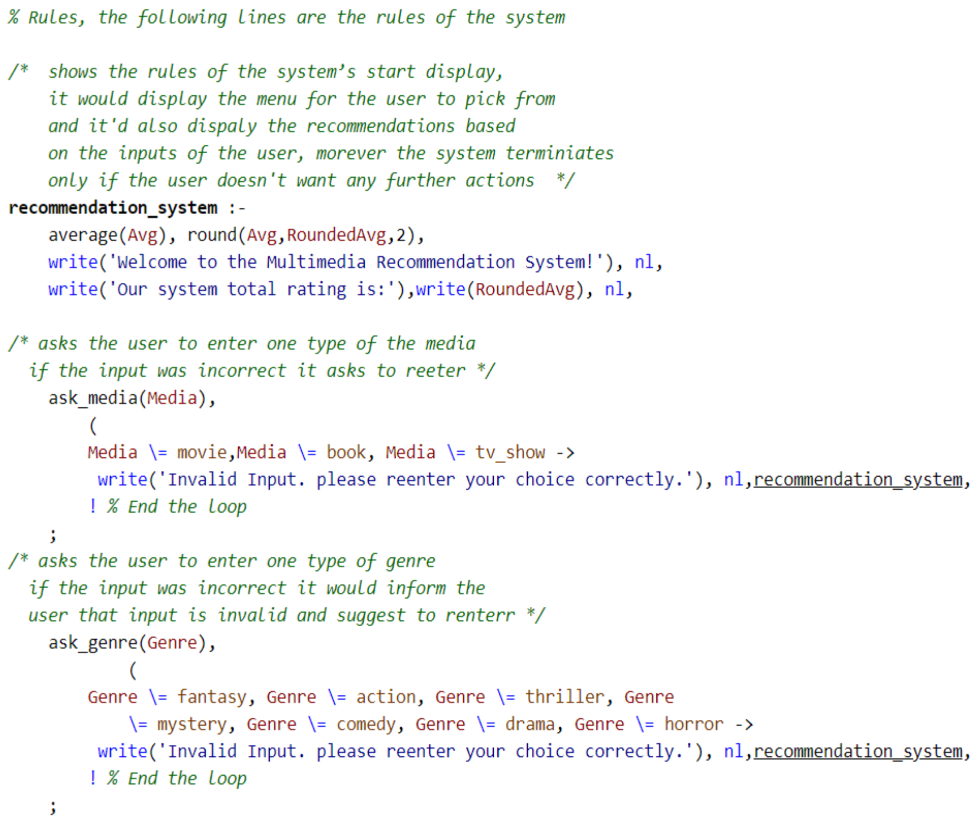


```
%Books (46 suggestions)
book(the_great_gatsby, drama, 2.84).
book(jack_reacher, action, 4.04).
book(gone_girl, thriller, 4.05).
book(bird_box, horror, 2.97).
book(the_grapes_of_wrath, drama, 2.83).
book(if_we_were_villains, fiction,  4.2).
book(harry_potter_and_the_sorcerers_stone, fantasy, 4.47).
book(pet_sematary, horror, 3.94).
book(the_hunt_for_red_october, action, 4.04).
book(bridget_joness_diary, comedy, 3.76).
book(frankenstein, horror, 3.78).
book(the_dark_tower, fantasy, 2.85).
book(get_hard, comedy, 2.85).
book(collateral_beauty, drama, 2.65).
book(the_wicker_man, horror, 2.58).
book(angels_and_demons, mystery, 2.59).
book(the_grudge, horror, 2.41).
book(underworld, action, 2.72).
book(the_girl_on_the_train, mystery, 2.96).
book(the_alchemist, fiction, 3.85).
book(in_the_woods, thriller, 2.93).
book(the_open_house, thriller, 2.79).
book(the_forest, thriller, 2.51).
book(ridiculous_6, comedy, 2.41).
book(the_host, fiction, 3.84).
book(underworld, action, 2.72).
book(the_last_song, drama, 2.63).
book(assassins_apprentice, fantasy, 4.29).
book(the_grapes_of_wrath, drama, 4.07).
book(the_silence_of_the_lambs, thriller, 4.19).
book(pet_sematary, horror, 3.94).
book(the_da_vinci_code, action, 3.79).
book(crazy_rich_asians, comedy, 3.82).
book(a_game_of_thrones, fantasy, 4.45).
```

Figure 4 Books Facts

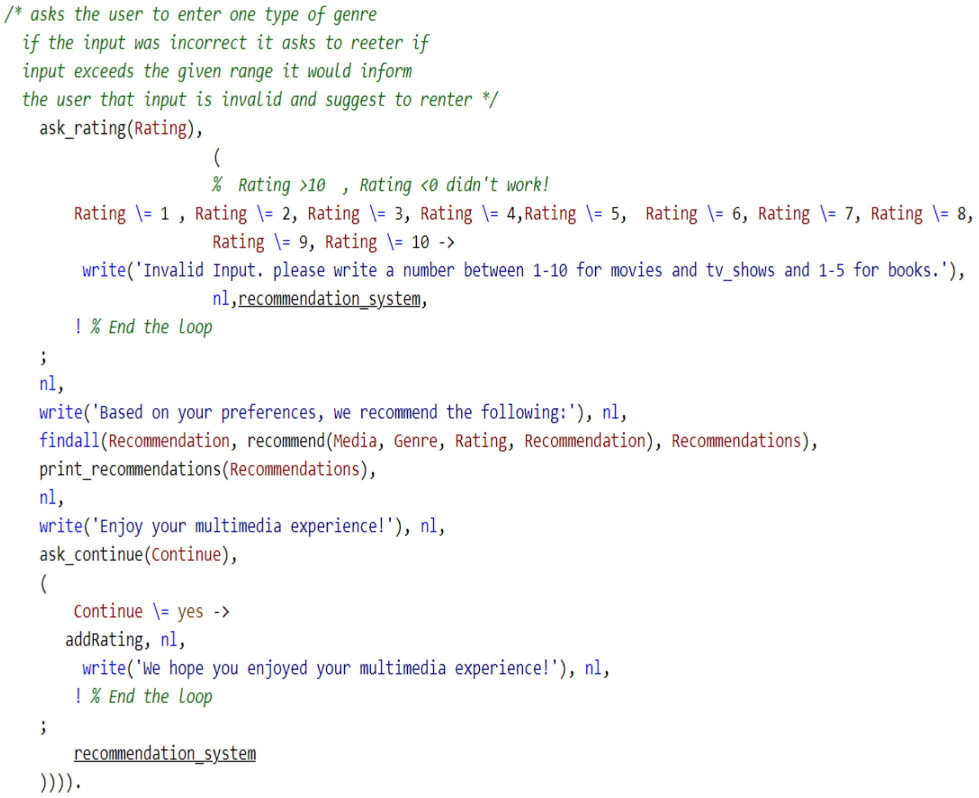
4.3 System's Start Display

The Figures [5], and [6] show the rules of the system's start display, such as the menu that allows the user to pick from, as well as the recommendations based on the user's choices.



```
% Rules, the following lines are the rules of the system

/*  shows the rules of the system's start display,
    it would display the menu for the user to pick from
    and it'd also dispaly the recommendations based
    on the inputs of the user, morever the system terminiates
    only if the user doesn't want any further actions  */
recommendation_system :-
    average(Avg), round(Avg,RoundedAvg,2),
    write('Welcome to the Multimedia Recommendation System!'), nl,
    write('Our system total rating is:'),write(RoundedAvg), nl,

/* asks the user to enter one type of the media
  if the input was incorrect it asks to reeter */
    ask_media(Media),
        (
        Media \= movie,Media \= book, Media \= tv_show ->
         write('Invalid Input. please reenter your choice correctly.'), nl,recommendation_system,
        ! % End the loop
    ;
/* asks the user to enter one type of genre
  if the input was incorrect it would inform the
  user that input is invalid and suggest to renterr */
    ask_genre(Genre),
            (
        Genre \= fantasy, Genre \= action, Genre \= thriller, Genre
            \= mystery, Genre \= comedy, Genre \= drama, Genre \= horror ->
         write('Invalid Input. please reenter your choice correctly.'), nl,recommendation_system,
        ! % End the loop
    ;
```

Figure 5 System's Start Display 1

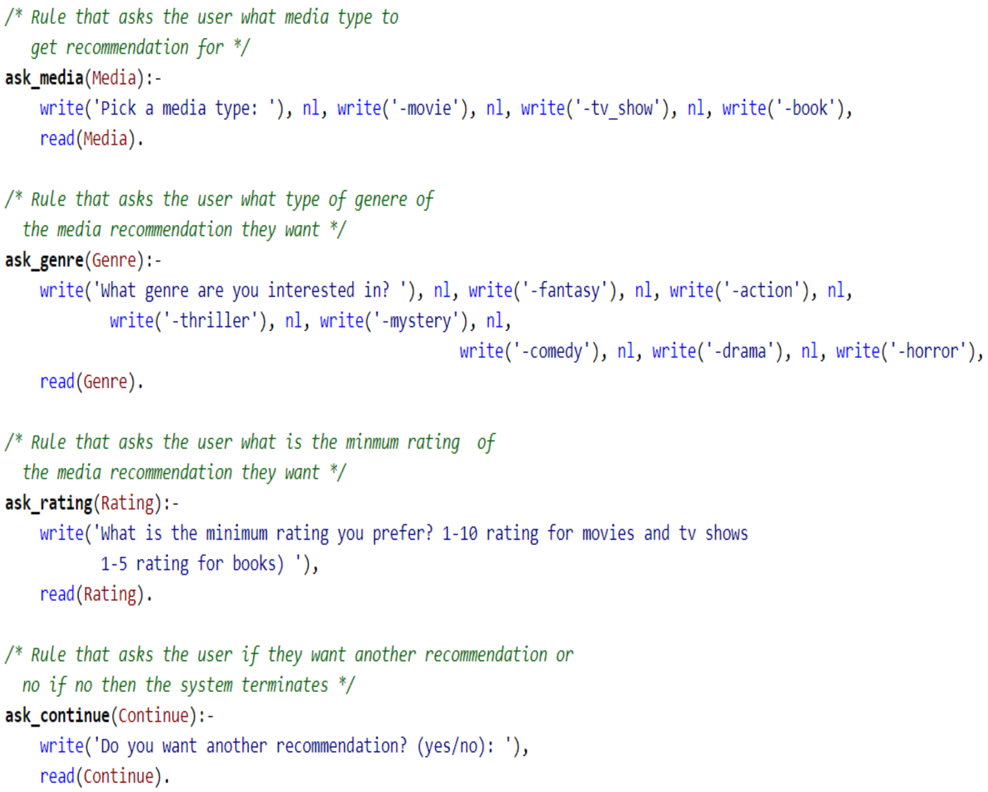


```
/* asks the user to enter one type of genre
  if the input was incorrect it asks to reeter if
  input exceeds the given range it would inform
  the user that input is invalid and suggest to renter */
    ask_rating(Rating),
                        (
                        %  Rating >10  , Rating <0 didn't work!
        Rating \= 1 , Rating \= 2, Rating \= 3, Rating \= 4,Rating \= 5,  Rating \= 6, Rating \= 7, Rating \= 8,
                        Rating \= 9, Rating \= 10 ->
         write('Invalid Input. please write a number between 1-10 for movies and tv_shows and 1-5 for books.'),
                        nl,recommendation_system,
        ! % End the loop
    ;
    nl,
    write('Based on your preferences, we recommend the following:'), nl,
    findall(Recommendation, recommend(Media, Genre, Rating, Recommendation), Recommendations),
    print_recommendations(Recommendations),
    nl,
    write('Enjoy your multimedia experience!'), nl,
    ask_continue(Continue),
    (
        Continue \= yes ->
       addRating, nl,
         write('We hope you enjoyed your multimedia experience!'), nl,
        ! % End the loop
    ;
        recommendation_system
    ))).
```

Figure 6 System's Start Display 2

4.4 User Interaction

Figure 7 shows the rules that deal with the user interaction, it asks the user about the media, genre, and rating of the recommendation they want, and after viewing the recommendations it asks the user if they'd like to get any other recommendations or not.

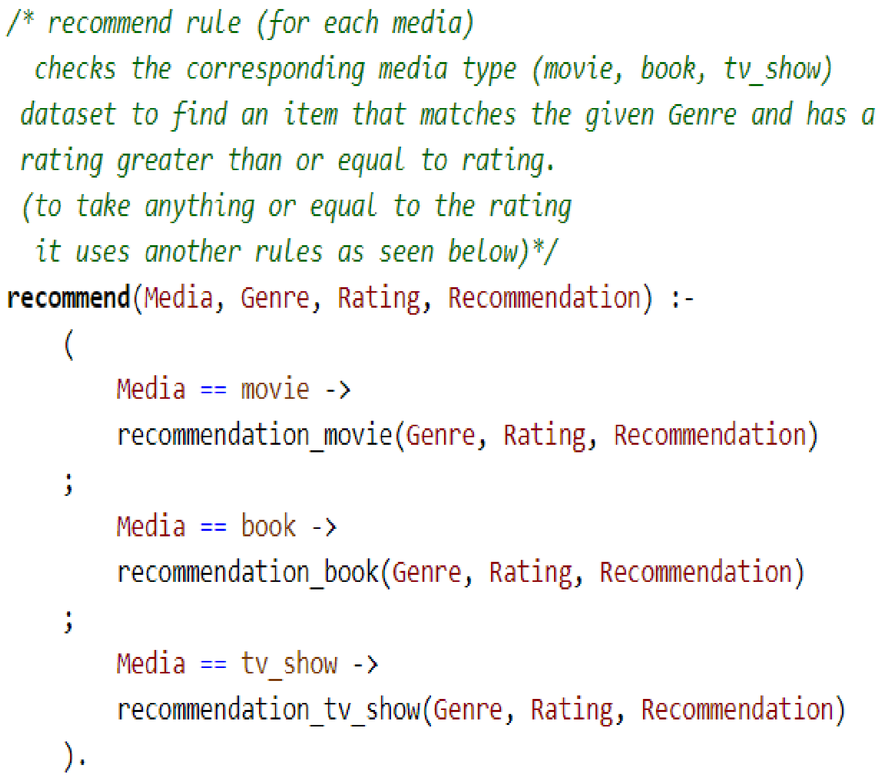


```
/* Rule that asks the user what media type to
   get recommendation for */
ask_media(Media):-
    write('Pick a media type: '), nl, write('-movie'), nl, write('-tv_show'), nl, write('-book'),
    read(Media).

/* Rule that asks the user what type of genere of
  the media recommendation they want */
ask_genre(Genre):-
    write('What genre are you interested in? '), nl, write('-fantasy'), nl, write('-action'), nl,
            write('-thriller'), nl, write('-mystery'), nl,
                                                    write('-comedy'), nl, write('-drama'), nl, write('-horror'),
    read(Genre).

/* Rule that asks the user what is the minmum rating  of
  the media recommendation they want */
ask_rating(Rating):-
    write('What is the minimum rating you prefer? 1-10 rating for movies and tv shows
           1-5 rating for books) '),
    read(Rating).

/* Rule that asks the user if they want another recommendation or
  no if no then the system terminates */
ask_continue(Continue):-
    write('Do you want another recommendation? (yes/no): '),
    read(Continue).
```

Figure 7 User Interaction

4.5 Recommendation Rule to Check the *Corresponding Facts*

Figure 8 is for the rule that checks the corresponding media type (movie, book, TV show) facts in the knowledge base to find an item that matches the given genre and has a rating greater than or equal to the rating, the rule that makes sure it checks the rating of the rest of facts is discussed in the next section.

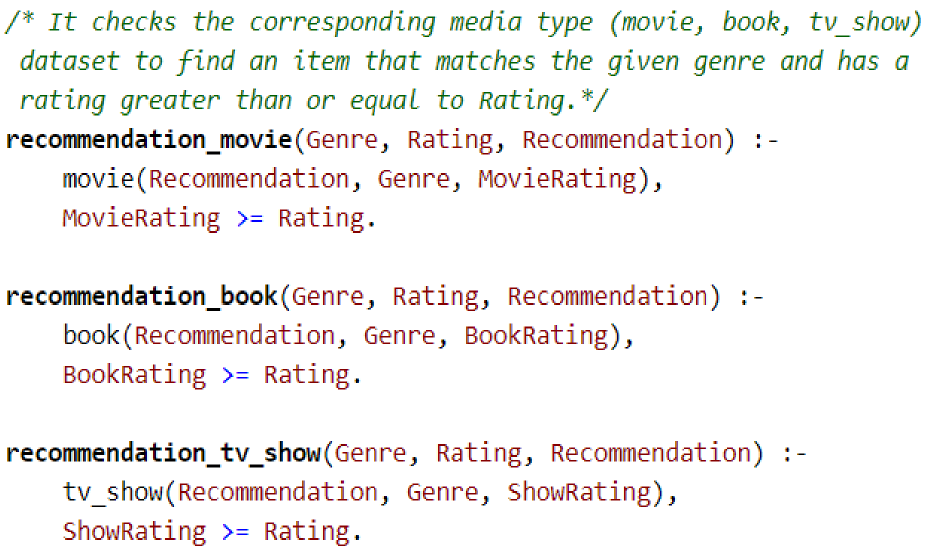


```
/* recommend rule (for each media)
  checks the corresponding media type (movie, book, tv_show)
 dataset to find an item that matches the given Genre and has a
 rating greater than or equal to rating.
 (to take anything or equal to the rating
  it uses another rules as seen below)*/
recommend(Media, Genre, Rating, Recommendation) :-
    (
        Media == movie ->
        recommendation_movie(Genre, Rating, Recommendation)
    ;
        Media == book ->
        recommendation_book(Genre, Rating, Recommendation)
    ;
        Media == tv_show ->
        recommendation_tv_show(Genre, Rating, Recommendation)
    ).
```

Figure 8 Recommendation Rule to Check the Corresponding Facts

4.6 Recommendation Rules to Check the Rating Against Rating Input

Figure 9 checks the corresponding media type (movies, books, TV shows) facts in the knowledge base to find an item that matches the given genre and has a rating greater than or equal to the rating that was given as input by the user.

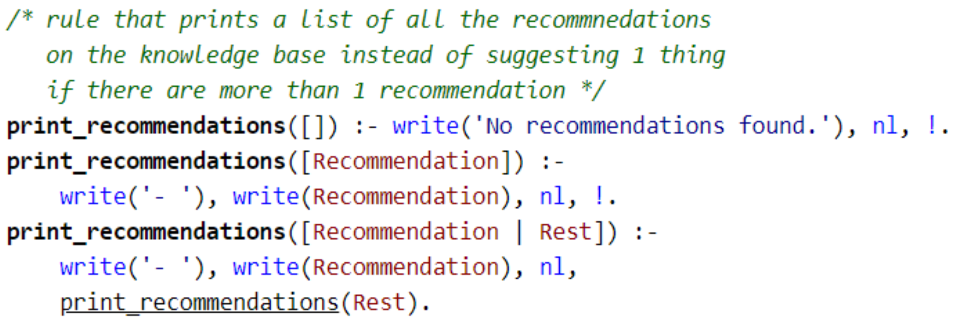


```
/* It checks the corresponding media type (movie, book, tv_show)
 dataset to find an item that matches the given genre and has a
 rating greater than or equal to Rating.*/
recommendation_movie(Genre, Rating, Recommendation) :-
    movie(Recommendation, Genre, MovieRating),
    MovieRating >= Rating.

recommendation_book(Genre, Rating, Recommendation) :-
    book(Recommendation, Genre, BookRating),
    BookRating >= Rating.

recommendation_tv_show(Genre, Rating, Recommendation) :-
    tv_show(Recommendation, Genre, ShowRating),
    ShowRating >= Rating.
```

Figure 9 Recommendation Rules to Check the Rating Against Rating Input

4.7 Print All Recommendations in The Dataset

Figure 10 shows the rule that prints a list of all the recommendations of the facts in the knowledge base instead of recommending one suggestion if there is more than 1 recommendation. If there are no suggestions, then it informs the user that no recommendation was found.

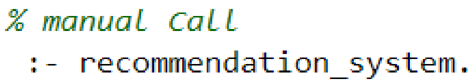


```
/* rule that prints a list of all the recommnedations
   on the knowledge base instead of suggesting 1 thing
   if there are more than 1 recommendation */
print_recommendations([]) :- write('No recommendations found.'), nl, !.
print_recommendations([Recommendation]) :-
    write('- '), write(Recommendation), nl, !.
print_recommendations([Recommendation | Rest]) :-
    write('- '), write(Recommendation), nl,
    print_recommendations(Rest).
```

Figure 10 Print All Recommendations

4.8 System Call

Figure 11 shows the system call. The system call is useful as it ensures that the system gets called to run and is useful to be used recursively making sure it’s running if the system is not terminated by the user.

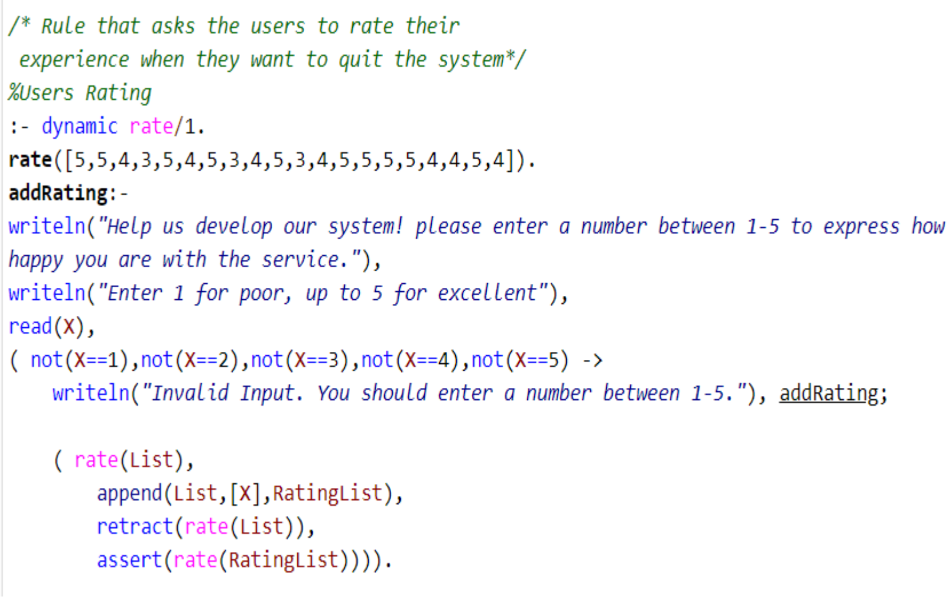


```
% manual Call
 :- recommendation_system.
```

Figure 11 System Call

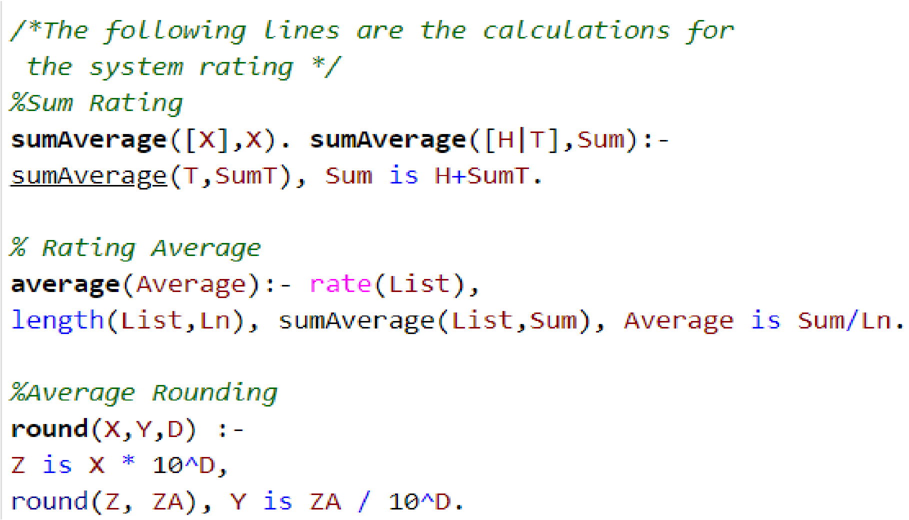
4.9 Rating for The System

Figure 12 shows the rule that asks the user to rate the system based on their experience when they are quitting the system. Moreover, in Figure 13 it shows the calculations done to get an accurate system rating.



```
/* Rule that asks the users to rate their
 experience when they want to quit the system*/
%Users Rating
:- dynamic rate/1.
rate([5,5,4,3,5,4,5,3,4,5,3,4,5,5,5,5,4,4,5,4]).
addRating:-
writeln("Help us develop our system! please enter a number between 1-5 to express how
happy you are with the service."),
writeln("Enter 1 for poor, up to 5 for excellent"),
read(X),
( not(X==1),not(X==2),not(X==3),not(X==4),not(X==5) ->
    writeln("Invalid Input. You should enter a number between 1-5."), addRating;

    ( rate(List),
        append(List,[X],RatingList),
        retract(rate(List)),
        assert(rate(RatingList)))).
```

Figure 12 The System rating’s user experience



```
/*The following lines are the calculations for
 the system rating */
%Sum Rating
sumAverage([X],X). sumAverage([H|T],Sum):-
sumAverage(T,SumT), Sum is H+SumT.

% Rating Average
average(Average):- rate(List),
length(List,Ln), sumAverage(List,Sum), Average is Sum/Ln.

%Average Rounding
round(X,Y,D) :-
Z is X * 10^D,
round(Z, ZA), Y is ZA / 10^D.
```

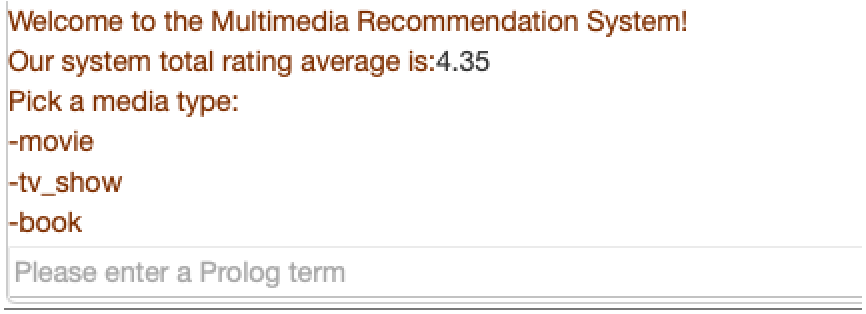
Figure 13 The system rating's calculations

5. Chapter 5: Results and Analysis:

The implemented expert system has been tested and evaluated using different test cases. After the users finish using the system, they are asked to rate the system performance out of 5. 1 for poor and 5 for excellent. These ratings are used to collect feedback from the users to evaluate the system precisely. The figures below show the test cases of the Personalized Multimedia Recommendation System.

5.1 System Call

Figure 14 shows the start recommendation_system output and the main menu.



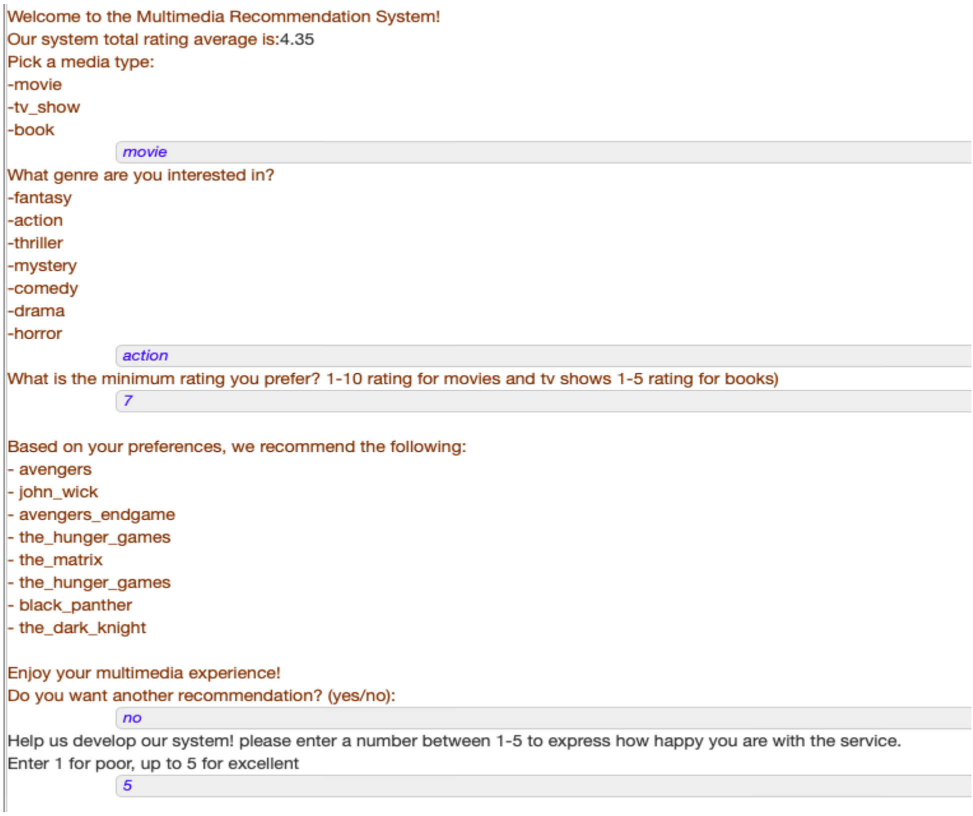
```
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
```

Figure 14 Main Menu

5.2 Test Cases

5.2.1 Case 1: Movies Recommendation

Figure 15 shows action movies recommendation with a minimum rating of 7.

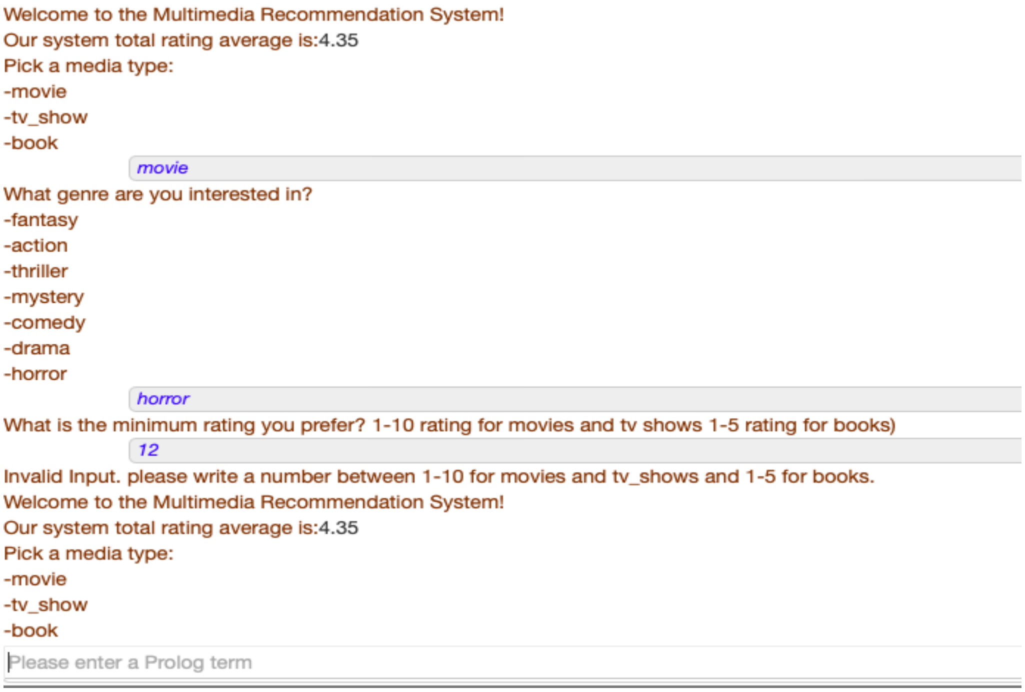


```
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
                movie
What genre are you interested in?
-fantasy
-action
-thriller
-mystery
-comedy
-drama
-horror
                action
What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
                7

Based on your preferences, we recommend the following:
- avengers
- john_wick
- avengers_endgame
- the_hunger_games
- the_matrix
- the_hunger_games
- black_panther
- the_dark_knight

Enjoy your multimedia experience!
Do you want another recommendation? (yes/no):
                no
Help us develop our system! please enter a number between 1-5 to express how happy you are with the service.
Enter 1 for poor, up to 5 for excellent
                5
```

Figure 15 Movie Recommendation

5.2.2 Case 1: Movies Recommendation Fails to Generate

Figure 16 shows horror movies that fail to generate based on a user syntax error causing an error message to be shown to the user and start the system again.

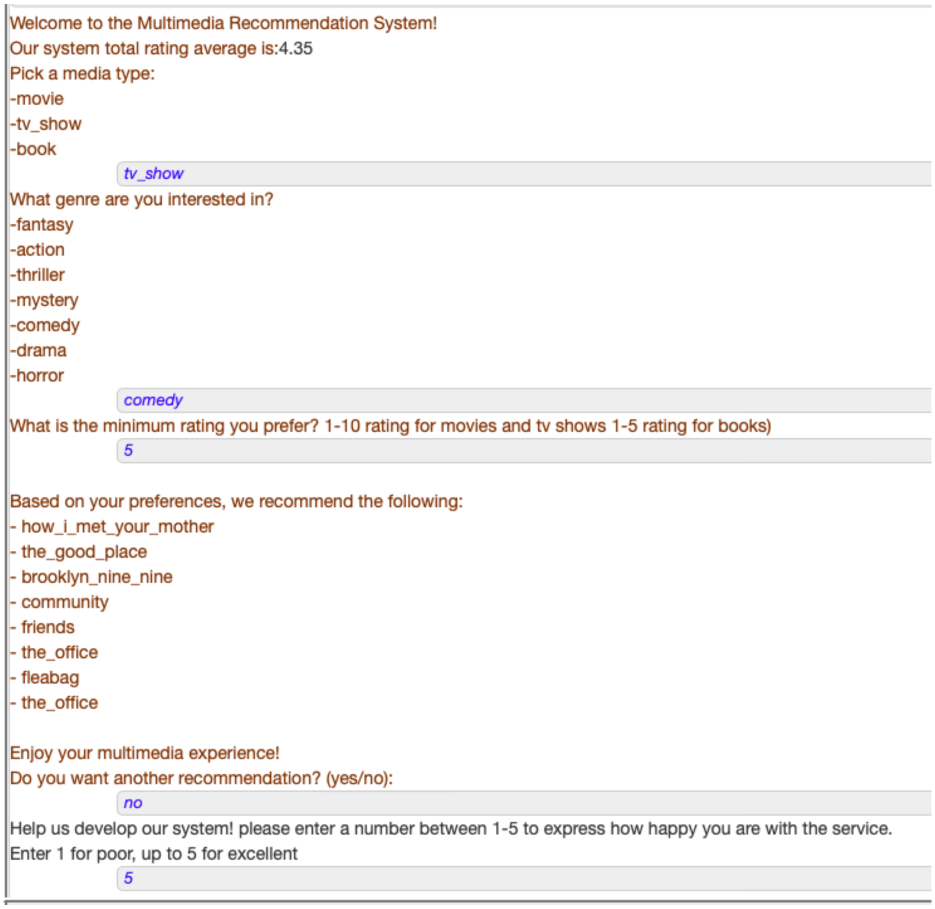


```
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
                movie
What genre are you interested in?
-fantasy
-action
-thriller
-mystery
-comedy
-drama
-horror
                horror
What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
                12
Invalid Input. please write a number between 1-10 for movies and tv_shows and 1-5 for books.
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
```

Figure 16 Movie Recommendation Fails to Generate

5.2.3 Case 2: TV_Shows Recommendation

Figure 17 shows comedy TV shows recommendations with a minimum rating of 5.

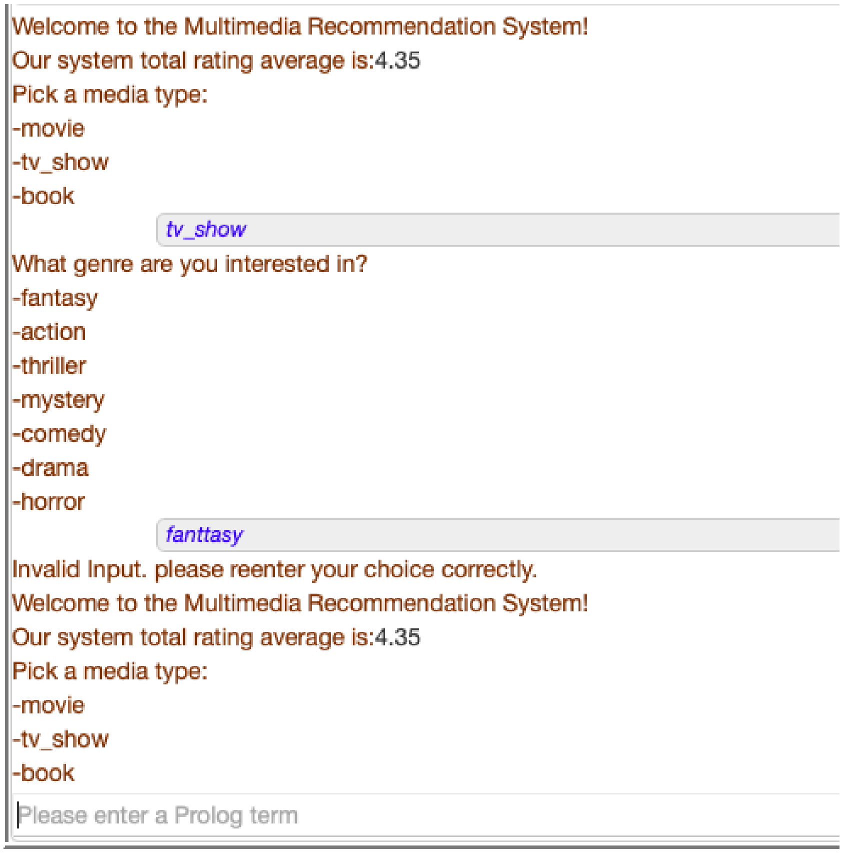


```
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
                tv_show
What genre are you interested in?
-fantasy
-action
-thriller
-mystery
-comedy
-drama
-horror
                comedy
What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
                5

Based on your preferences, we recommend the following:
- how_i_met_your_mother
- the_good_place
- brooklyn_nine_nine
- community
- friends
- the_office
- fleabag
- the_office

Enjoy your multimedia experience!
Do you want another recommendation? (yes/no):
                no
Help us develop our system! please enter a number between 1-5 to express how happy you are with the service.
Enter 1 for poor, up to 5 for excellent
                5
```

Figure 17 TV_Shows Recommendation

5.2.4 Case 2: TV_Shows Recommendation Fails to Generate

Figure 18 shows fantasy TV shows that fail to generate based on a user syntax error causing an error message to be shown to the user and start the system again.

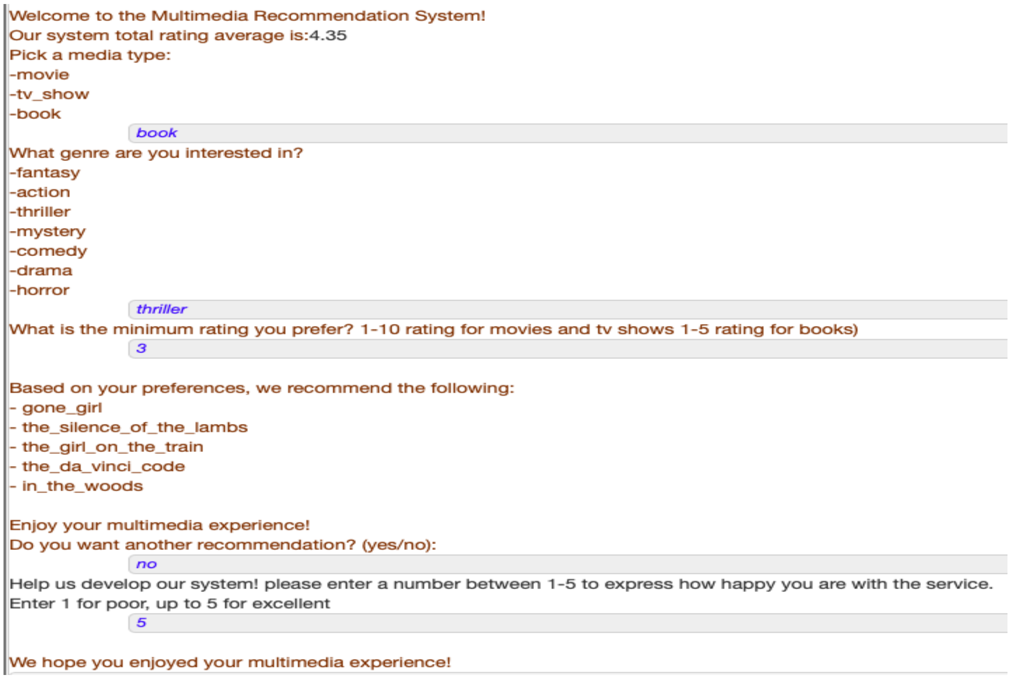


```
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
                tv_show
What genre are you interested in?
-fantasy
-action
-thriller
-mystery
-comedy
-drama
-horror
                fanttasy
Invalid Input. please reenter your choice correctly.
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
```

Figure 18 TV_shows Recommendation Fails to Generate

5.2.5 Case 3: Books Recommendation

Figure 19 shows thriller book recommendations with a minimum rating of 3.

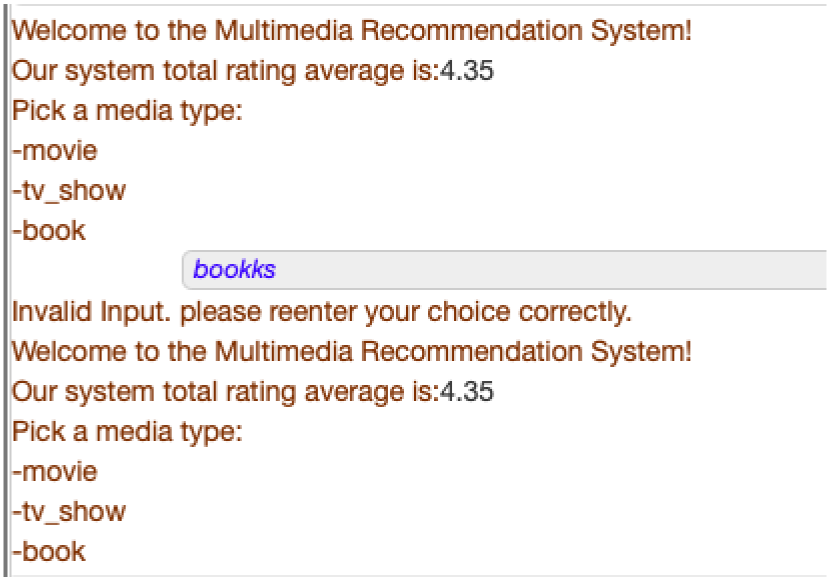


```
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
                book
What genre are you interested in?
-fantasy
-action
-thriller
-mystery
-comedy
-drama
-horror
                thriller
What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
                3

Based on your preferences, we recommend the following:
- gone_girl
- the_silence_of_the_lambs
- the_girl_on_the_train
- the_da_vinci_code
- in_the_woods

Enjoy your multimedia experience!
Do you want another recommendation? (yes/no):
                no
Help us develop our system! please enter a number between 1-5 to express how happy you are with the service.
Enter 1 for poor, up to 5 for excellent
                5

We hope you enjoyed your multimedia experience!
```

Figure 19 Books Recommendation

5.2.6 Case 3: Books Recommendation Fails to Generate

Figure 20 shows book recommendations that fail to generate based on a user syntax error causing an error message to be shown to the user and start the system again.

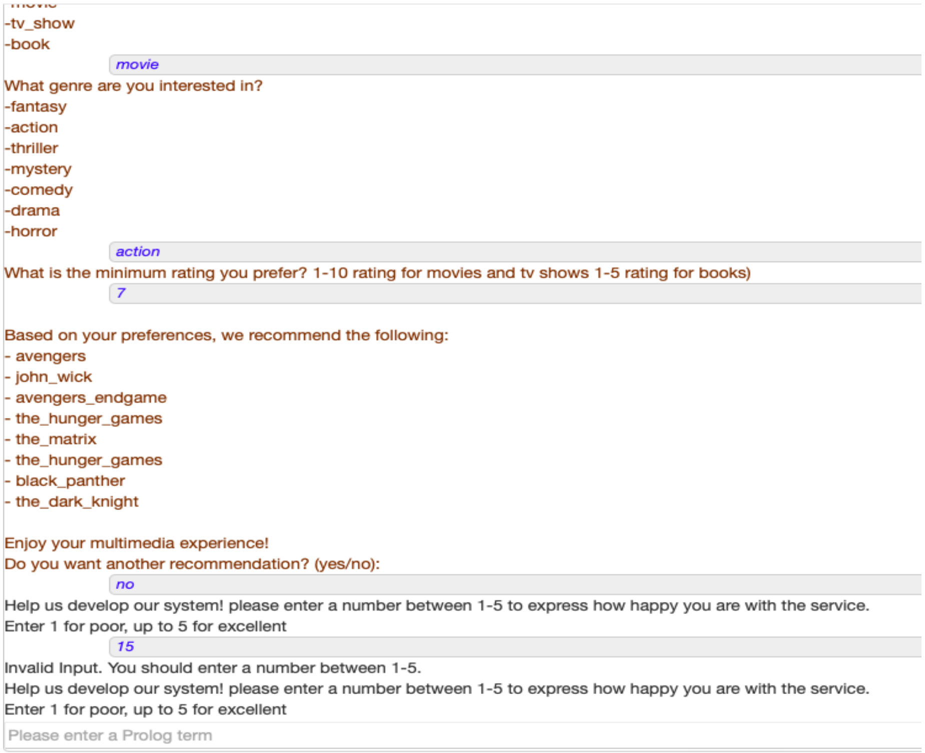


```
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
                bookks
Invalid Input. please reenter your choice correctly.
Welcome to the Multimedia Recommendation System!
Our system total rating average is:4.35
Pick a media type:
-movie
-tv_show
-book
```

Figure 20 Books Recommendation Fails to Generate

5.2.7 Case 4: False System Rating.

Figure 21 shows correct action movie recommendations, but false system rating based on a user syntax error causing an error message to be shown to the user and start the system rating again.



```
-movie
-tv_show
-book
                movie
What genre are you interested in?
-fantasy
-action
-thriller
-mystery
-comedy
-drama
-horror
                action
What is the minimum rating you prefer? 1-10 rating for movies and tv shows 1-5 rating for books)
                7

Based on your preferences, we recommend the following:
- avengers
- john_wick
- avengers_endgame
- the_hunger_games
- the_matrix
- the_hunger_games
- black_panther
- the_dark_knight

Enjoy your multimedia experience!
Do you want another recommendation? (yes/no):
                no
Help us develop our system! please enter a number between 1-5 to express how happy you are with the service.
Enter 1 for poor, up to 5 for excellent
                15
Invalid Input. You should enter a number between 1-5.
Help us develop our system! please enter a number between 1-5 to express how happy you are with the service.
Enter 1 for poor, up to 5 for excellent
```

Figure 21 *False System Rating*

6. Chapter 6: Testing and Evaluation:

The system accomplishes its goal, which is to give accurate suggestions for personalized media recommendations based on the user's input and interests. For testing purposes, a group of individuals were allowed to try the system and provide their ratings. The participants rated the system's performance and service, expressing their satisfaction levels on a scale of 1 to 5. Table 4 shows the results of the ratings collected from users. As shown in the table below, there were no users who responded with poor or fair feedback, and the others rated the system as good (8.06%), very good (35.48%), and excellent (56.45%). The results show that almost (92%) of the users were satisfied with the personalized media recommendations system. Thus, it is proved that the system is satisfactory and makes correct decisions most of the time for the user's entertainment suggestion.

User feedback	**1(poor)**	**2(fair)**	**3(good)**	**4(very good)**	**5(excellent)**
Total number	0	0	5	22	35
Average out of 100%	0	0	8.06%	35.48%	56.45%

Table 4 The Results of The System Ratings Collected from The Users

Test cases confirmed that the system could accurately suggest entertainment recommendations and reduce the time needed to search for that information in the standard way. The end-user now can easily deal with this problem using the proposed media recommendations system.

7. Chapter 7: Conclusions and Future Work:

This project began with an LR, which helped identify a knowledge gap in personalized multimedia recommendation systems. The original contribution of this project is to bridge that gap by addressing the specific challenges and limitations of existing approaches and proposing original solutions to improve the recommendation process. Furthermore, it embraces the creation of a self-constructed knowledge base that includes rules and facts, and the development of an AI prototype using the Prolog programming language. This project's achievements have contributed to the field by providing a personalized media recommendation solution that takes user preferences into account. The specific issue described in Chapter 1, which is information overload, and the challenge users encounter in discovering content that aligns with their preferences and interests has been solved. Furthermore, a group of users rated the system on a scale of 1 to 5, it was rated as good (3), very good (4), and excellent (5), indicating its satisfactory performance and accuracy in making entertainment suggestions. 92% of the users were satisfied. Yet, there is still work to be done to expand the system's capabilities, improve recommendation accuracy, expand the scope to include a broader range of media types, and expand the knowledge base to ensure more comprehensive and accurate recommendations across various forms of media, giving users a broader range of content options to explore. These future directions are relevant and important for the field, and they will necessitate continued effort and research to advance the state of personalized media recommendations.

References

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[6] Anand, R., Sabeenian, R. S., Gurang, D., Kirthika, R., & Rubeena, S. (2021, June). AI based music recommendation system using deep learning algorithms. In *IOP conference series: earth and environmental science* (Vol. 785, No. 1, p. 012013). IOP Publishing.

Appendices

Appendix A

```
% The knoweledge base



/* Facts, the following lines are the dataset that is gathered for each media

% (Movies, Tv shows and books)  */

% Movies (46 suggestions)

movie(fight_club, drama, 8.8).

movie(harry_potter, fantasy, 7.6).

movie(avengers, action, 8.4).

movie(inception, thriller, 8.8).

movie(the_lord_of_the_rings, fantasy, 8.8).

movie(pulp_fiction, thriller, 8.9).

movie(amélie, comedy, 8.3).

movie(whiplash, drama, 8.5).

movie(the_roommate, thriller, 4.9).

movie(son_of_the_mask, comedy, 2.2).

movie(hereditary, horror, 7.3).

movie(john_wick, action, 7.4).

movie(avengers_endgame, action, 8.4).

movie(the_hobbit, fantasy, 7.8).

movie(the_pursuit_of_happyness, drama, 8.0).

movie(the_hunger_games, action, 7.2).
movie(get_out, horror, 7.7).

movie(the_babadook, horror, 6.8).

movie(the_shining, horror, 8.4).

movie(zodiac, mystery, 7.7).

movie(the_twilight_saga, fantasy, 5.5).

movie(the_last_airbender, fantasy, 4.0).

movie(the_roommate, thriller, 4.9).

movie(birdemic_shock_and_terror, thriller, 1.8).

movie(battleship, action, 5.8).

movie(the_da_vinci_code, mystery, 6.6).

movie(the_room, drama, 3.7).

movie(jack_and_jill, comedy, 3.3).

movie(the_happening, thriller, 5.0).

movie(jurassic_park, fantasy, 8.1).

movie(death_becomes_her, comedy, 6.6).

movie(the_matrix, action, 8.7).

movie(the_hunger_games, action, 7.2).

movie(black_panther, action, 7.3).

movie(the_big_lebowski, comedy, 8.1).

movie(the_grand_budapest_hotel, comedy, 8.1).

movie(the_shawshank_redemption, drama, 9.3).

movie(the_dark_knight, action, 9.0).

movie(gone_with_the_wind, drama, 8.1).
movie(the_godfather, mystery, 9.2).
movie(the_wizard_of_oz, fantasy, 8.1).
movie(back_to_the_future, comedy, 8.5).
movie(die_hard, thriller, 8.2).
movie(taxi_driver, drama, 8.2).
movie(the_social_network, drama, 7.7).
movie(inside_out, comedy, 8.1).
movie(airplane, comedy, 7.7).


%Books (46 suggestions)
book(the_great_gatsby, drama, 2.84).
book(jack_reacher, action, 4.04).
book(gone_girl, thriller, 4.05).
book(bird_box, horror, 2.97).
book(the_grapes_of_wrath, drama, 2.83).
book(if_we_were_villains, fiction,  4.2).
book(harry_potter_and_the_sorcerers_stone, fantasy, 4.47).
book(pet_sematary, horror, 3.94).
book(the_hunt_for_red_october, action, 4.04).
book(bridget_joness_diary, comedy, 3.76).
book(frankenstein, horror, 3.78).
book(the_dark_tower, fantasy, 2.85).
book(get_hard, comedy, 2.85).
book(collateral_beauty, drama, 2.65).

book(the_wicker_man, horror, 2.58).

book(angels_and_demons, mystery, 2.59).

book(the_grudge, horror, 2.41).

book(underworld, action, 2.72).

book(the_girl_on_the_train, mystery, 2.96).

book(the_alchemist, fiction, 3.85).

book(in_the_woods, thriller, 2.93).

book(the_open_house, thriller, 2.79).

book(the_forest, thriller, 2.51).

book(ridiculous_6, comedy, 2.41).

book(the_host, fiction, 3.84).

book(underworld, action, 2.72).

book(the_last_song, drama, 2.63).

book(assassins_apprentice, fantasy, 4.29).

book(the_grapes_of_wrath, drama, 4.07).

book(the_silence_of_the_lambs, thriller, 4.19).

book(pet_sematary, horror, 3.94).

book(the_da_vinci_code, action, 3.79).

book(crazy_rich_asians, comedy, 3.82).

book(a_game_of_thrones, fantasy, 4.45).

book(the_girl_on_the_train, thriller, 3.91).

book(eragon, fantasy, 2.78).
book(the_girl_with_the_dragon_tattoo, action, 4.13).
book(where_did_you_go_bernadette, comedy, 3.90).
book(klara_and_the_sun, fiction, 4.75).
book(bossypants, comedy, 3.95).
book(the_da_vinci_code, thriller, 3.79).
book(the_bourne_identity, action, 4.00).
book(the_name_of_the_wind, fantasy, 4.55).
book(in_the_woods, thriller, 3.76).
book(the_final_empire, fantasy, 4.43).
book(the_apparition, horror, 2.71).
book(ghostbusters_2016, comedy, 2.80).


% TV Shows (46 suggestions)
tv_show(the_walking_dead, horror, 8.2).
tv_show(lost, fantasy, 8.3).
tv_show(the_boys, action, 8.7).
tv_show(fear_the_walking_dead, horror, 6.9).
tv_show(westworld, drama, 8.6).
tv_show(how_i_met_your_mother, comedy, 8.3).
tv_show(black_mirror, mystery, 8.8).
tv_show(the_mentalist, thriller, 8.1).
tv_show(the_haunting_of_bly_manor, thriller, 7.4).
tv_show(jessica_jones, action, 7.9).
tv_show(agents_of_shield, action, 7.5).

tv_show(shadowhunters, fantasy, 6.6).

tv_show(legacies, fantasy, 7.4).

tv_show(daredevil, action, 8.6).

tv_show(shadow_and_bone, fantasy, 7.7).

tv_show(vikings, action, 8.5).

tv_show(shannara, fantasy, 7.2).

tv_show(the_crown, drama, 8.7).

tv_show(once_upon_a_time, fantasy, 7.7).

tv_show(the_last_ship, action, 7.5).

tv_show(the_twilight_zone, mystery, 7.8).

tv_show(the_night_of, thriller, 8.5).

tv_show(blindspot, action, 7.4).

tv_show(arrow, action, 7.5).

tv_show(mad_men, drama, 8.6).

tv_show(nikita, action, 7.7).

tv_show(the_good_place, comedy, 8.2).

tv_show(the_killing, mystery, 8.2).

tv_show(brooklyn_nine_nine, comedy, 8.4).

tv_show(sherlock, mystery, 9.1).

tv_show(money_heist, drama, 8.3).

tv_show(legend_of_the_seeker, fantasy, 7.6).

tv_show(narcos, thriller, 8.8).
tv_show(community, comedy, 8.5).
tv_show(true_detective, thriller, 9.0).
tv_show(friends, comedy, 8.9).
tv_show(prison_break, action, 8.3).
tv_show(game_of_thrones, fantasy, 9.3).
tv_show(the_office, comedy, 8.9).
tv_show(outrlander, fantasy, 8.4).
tv_show(house_of_cards, drama, 8.7).
tv_show(stranger_things, horror, 8.7).
tv_show(the_night_manager, mystery, 8.1).
tv_show(the_wire, drama, 9.3).
tv_show(fleabag, comedy, 8.7).
tv_show(breaking_bad, drama, 9.5).
tv_show(the_office, comedy, 8.8).


/* recommend rule (for each media)
  checks the corresponding media type (movie, book, tv_show)
 database to find an item that matches the given Genre and has a
 rating greater than or equal to rating.
 (to take anything or equal to the rating
  it uses another rules as seen below)*/
recommend(Media, Genre, Rating, Recommendation) :-
    (
        Media == movie ->
        recommendation_movie(Genre, Rating, Recommendation)
    ;
        Media == book ->
        recommendation_book(Genre, Rating, Recommendation)
    ;
        Media == tv_show ->
        recommendation_tv_show(Genre, Rating, Recommendation)
    ).

/* It checks the corresponding media type (movie, book, tv_show)
 database to find an item that matches the given Genre and has a
 rating greater than or equal to Rating.*/
recommendation_movie(Genre, Rating, Recommendation) :-
    movie(Recommendation, Genre, MovieRating),
    MovieRating >= Rating.

recommendation_book(Genre, Rating, Recommendation) :-
    book(Recommendation, Genre, BookRating),
    BookRating >= Rating.

recommendation_tv_show(Genre, Rating, Recommendation) :-
    tv_show(Recommendation, Genre, ShowRating),
    ShowRating >= Rating.



/* The following few rules deals with the the user Interaction */


/* Rule that asks the user what media type to
   get recommendation for */
ask_media(Media):-
    write('Pick a media type: '), nl, write('-movie'), nl, write('-tv_show'), nl, write('-book'),
    read(Media).


/* Rule that asks the user what type of genere of
  the media recommendation they want */
ask_genre(Genre):-
    write('What genre are you interested in? '), nl, write('-fantasy'), nl, write('-action'), nl,
            write('-thriller'), nl, write('-mystery'), nl,
                                                    write('-comedy'), nl, write('-drama'), nl, write('-horror'),
    read(Genre).


/* Rule that asks the user what is the minmum rating  of
  the media recommendation they want */
ask_rating(Rating):-
    write('What is the minimum rating you prefer? 1-10 rating for movies and tv shows
           1-5 rating for books) '),
    read(Rating).

/* Rule that asks the user if they want another recommendation or
  no if no then the system terminates */
ask_continue(Continue):-
    write('Do you want another recommendation? (yes/no): '),
    read(Continue).

/* Rule that asks the users to rate their
 experience when they want to quit the system*/
%Users Rating
:- dynamic rate/1.
rate([5,5,4,3,5,4,5,3,4,5,3,4,5,5,5,5,4,4,5,4]).
addRating:-
writeln("Help us develop our system! please enter a number between 1-5 to express how
happy you are with the service."),
writeln("Enter 1 for poor, up to 5 for excellent"),
read(X),
( not(X==1),not(X==2),not(X==3),not(X==4),not(X==5) ->
    writeln("Invalid Input. You should enter a number between 1-5."), addRating;

    ( rate(List),
        append(List,[X],RatingList),

        retract(rate(List)),

        assert(rate(RatingList)))).


/*The following lines are the calculations for

 the system rating */

%Sum Rating

sumAverage([X],X). sumAverage([H|T],Sum):-

sumAverage(T,SumT), Sum is H+SumT.


% Rating Average

average(Average):- rate(List),

length(List,Ln), sumAverage(List,Sum), Average is Sum/Ln.


%Average Rounding

round(X,Y,D) :-

Z is X * 10^D,

round(Z, ZA), Y is ZA / 10^D.


% Rules, the following lines are the rules of the system


/*  shows the rules of the system’s start display,

    it would display the menu for the user to pick from
    and it'd also dispaly the recommendations based
    on the inputs of the user, morever the system terminiates
    only if the user doesn't want any further actions  */
recommendation_system :-
    average(Avg), round(Avg,RoundedAvg,2),
    write('Welcome to the Multimedia Recommendation System!'), nl,
    write('Our system total rating is:'),write(RoundedAvg), nl,


/* asks the user to enter one type of the media
  if the input was incorrect it asks to reeter */
    ask_media(Media),
        (
        Media \= movie,Media \= book, Media \= tv_show ->
         write('Invalid Input. please reenter your choice correctly.'), nl,recommendation_system,
        ! % End the loop
    ;
/* asks the user to enter one type of genre
  if the input was incorrect it would inform the
  user that input is invalid and suggest to renterr */
    ask_genre(Genre),
            (
        Genre \= fantasy, Genre \= action, Genre \= thriller, Genre
            \= mystery, Genre \= comedy, Genre \= drama, Genre \= horror ->
         write('Invalid Input. please reenter your choice correctly.'), nl,recommendation_system,

        ! % End the loop

    ;

/* asks the user to enter one type of genre

  if the input was incorrect it asks to reeter if

  input exceeds the given range it would inform

  the user that input is invalid and suggest to renter */

    ask_rating(Rating),

                        (

                        %  Rating >10  , Rating <0 didn't work!

        Rating \= 1 , Rating \= 2, Rating \= 3, Rating \= 4,Rating \= 5,  Rating \= 6, Rating \= 7, Rating \=
8, Rating \= 9, Rating \= 10 ->

         write('Invalid Input. please write a number between 1-10 for movies and tv_shows and 1-5 for
books.'), nl,recommendation_system,

        ! % End the loop

    ;

    nl,

    write('Based on your preferences, we recommend the following:'), nl,

    findall(Recommendation, recommend(Media, Genre, Rating, Recommendation), Recommendations),

    print_recommendations(Recommendations),

    nl,

    write('Enjoy your multimedia experience!'), nl,

    ask_continue(Continue),

    (
        Continue \= yes ->

       addRating, nl,

         write('We hope you enjoyed your multimedia experience!'), nl,

        ! % End the loop

    ;

        recommendation_system

    )))).




/* rule that prints a list of all the recommnedations

   on the knowledge base instead of suggesting 1 thing

   if there are more than 1 recommendation */

print_recommendations([]) :- write('No recommendations found.'), nl, !.

print_recommendations([Recommendation]) :-

    write('- '), write(Recommendation), nl, !.

print_recommendations([Recommendation | Rest]) :-

    write('- '), write(Recommendation), nl,

    print_recommendations(Rest).


% manual Call

 :- recommendation_system.
```