MTECH KE-4102 (ISBA) PROJECT REPORT

TRIPPIER - THE TRAVEL RECOMMENDATION VIRTUAL ASSISTANT

TEAM MEMBERS

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1 EXECUTIVE SUMMARY

An expert system focusing on the tourism domain will capture consumer travel interests and suggests a suitable itinerary. User's travel and persona characteristics are prime factors considered to recommend places which suits them. The heart of such expert systems is the knowledge base as all the facts for building the rules are contained here. The knowledge base is the resultant of knowledge acquisition, knowledge representation and knowledge implementation phases. The source for knowledge acquisition on tourism domain was gathered primarily in the form of interviews with Subject Matter Experts, surveys conducted, various sources on the internet and public journals and articles.

Our travel recommendation system is a rules-based expert system built in CLIPS. The system can be used as a virtual trip planner, useful for tourists and the tourism agencies to select the best package based on factors like the preferred budget, places of interests and personality of the individual. We introduce a unique personality index on the basis of a series of questions to provide places based on persona. Our system also generates dynamic number of recommendations to provide based on user selection.

Keywords: knowledge engineering, rule based expert system, travel planner, CLIPS.

2 PROBLEM DESCRIPTION

In the modern era, the tourism applications are helping the consumers with information to facilitate their decision-making process by giving recommendations. The implicit assumption that is being made is that by capturing the user needs and constraints we can provide a list of products for selection using knowledge compiled into an intelligent recommender.

A classical recommender system in travel and tourism domain would provide the users with a list of options that are relevant to their preferences. With the presence of heterogeneous place of interests in the tourist location we are focusing on the problem of recommending a list of packages to the consumer, where each option would provide a list of Points of Interest (POIs) e.g. Theme Parks, Wildlife, Heritage, etc. that may constitute a tour. The recommended collection of POIs would each have the corresponding cost and time associated with it and the user specified maximum total for the tour. Our prime goal is to suggest the most interesting travel package, where each package adheres to the user provided budget constraints.

2.1 PROJECT OBJECTIVE

Tourism industry has a strong role in contributing towards the economic development of the nation. The tourism receipts for the second quarter (Q2 2017) was estimated at S$6.4 million, which is a 5% growth over the same period last year. This factor links the web and encourages the user interactions by travel planning or sharing their experiences.

We have gone ahead to exploit this opportunity by building an intelligent rules-based expert system that recommends a tourism itinerary by considering the consumer's travel interest and budget preference. The system will interact with the consumer with a set of user friendly questions and records the responses. The responses will then be used as facts for the rules-based engine.

Our system not only notices the user's main needs or constraints in a top-down way but also surveys the option space and recommends to the active construction of user preferences. Per the analysis of the survey done to know the consumers preferences, the certainty factor is deduced, and the rules are framed. Based on the consumer's input feed the corresponding rules are triggered and suitable tourism itineraries are recommended by the system.

The prime focus of our tourism recommendation system in Singapore is to achieve the above-mentioned target. To build an expert system the basic criteria is to form a knowledge base from which useful inferences can be drawn. As tourism is a vast industry which can include many destinations, we have limited the scope of this project to Singapore.

3 KNOWLEDGE MODELING

3.1 KNOWLEDGE ACQUISITION

In order to build our system, we need to model knowledge and data in the tourism and trip planning domain to know about the factors that influence this.

3.2 DOCUMENTED SOURCES

Documented sources cover the internet, journals and two different surveys we conducted. One captures the tourist description and basic requirements and the other aims to determine the tourist's travel persona.

3.3 SUBJECT MATTER EXPERTS

The knowledge base of our system was formed after having organized a scheduled interview with Mr. Desmond Sek (Co-Founder of Xaltius) and Mr. Felix (Co-Founder of Anywhr).

3.4 KNOWLEDGE AND DATA REPRESENTATION

Based on the knowledge gained through the various resources, we have come up with the characteristics used to describe a travel planner.

Variable	Meaning	Remarks for Data Modeling
traveler_type	The type of traveling group	1: Solo, 2: Group
travel_type_group	The travel group type	1: Family, 2: Friends, 3: Colleagues
travel_spend	Trip budget	1: Luxury, 2: Upscale, 3:Mid-tier, 4: Economy
food_type	Cuisine preferred by the traveler	1: Indian, 2: Continental, 3: Chinese, 4: Japanese, 5: Malay, 6: Seafood, 7: Singaporean, 8: Multi-cuisine
age_group	The average age of the traveler(s)	1: 18-25, 2: 26-30, 3: 31-45, 4: 46-60
num_travel_days	Vacation duration	1: 1-3 , 2: 4-7 , 3: 7-10 , 4: 11-15
num_adults	No. of adults in the travel group	Continuous Variable, 1-10.
num_children	No. of children in the travel group(if family)	Continuous Variable, 0-10.
Is_kid_age_below_7	Is kid below 7 years of age? (< 125m)	Yes or No

themes	Travel themes	1: sports, 2: nature, 3: culture, 4: history, 5: lifestyle, 6: adventure

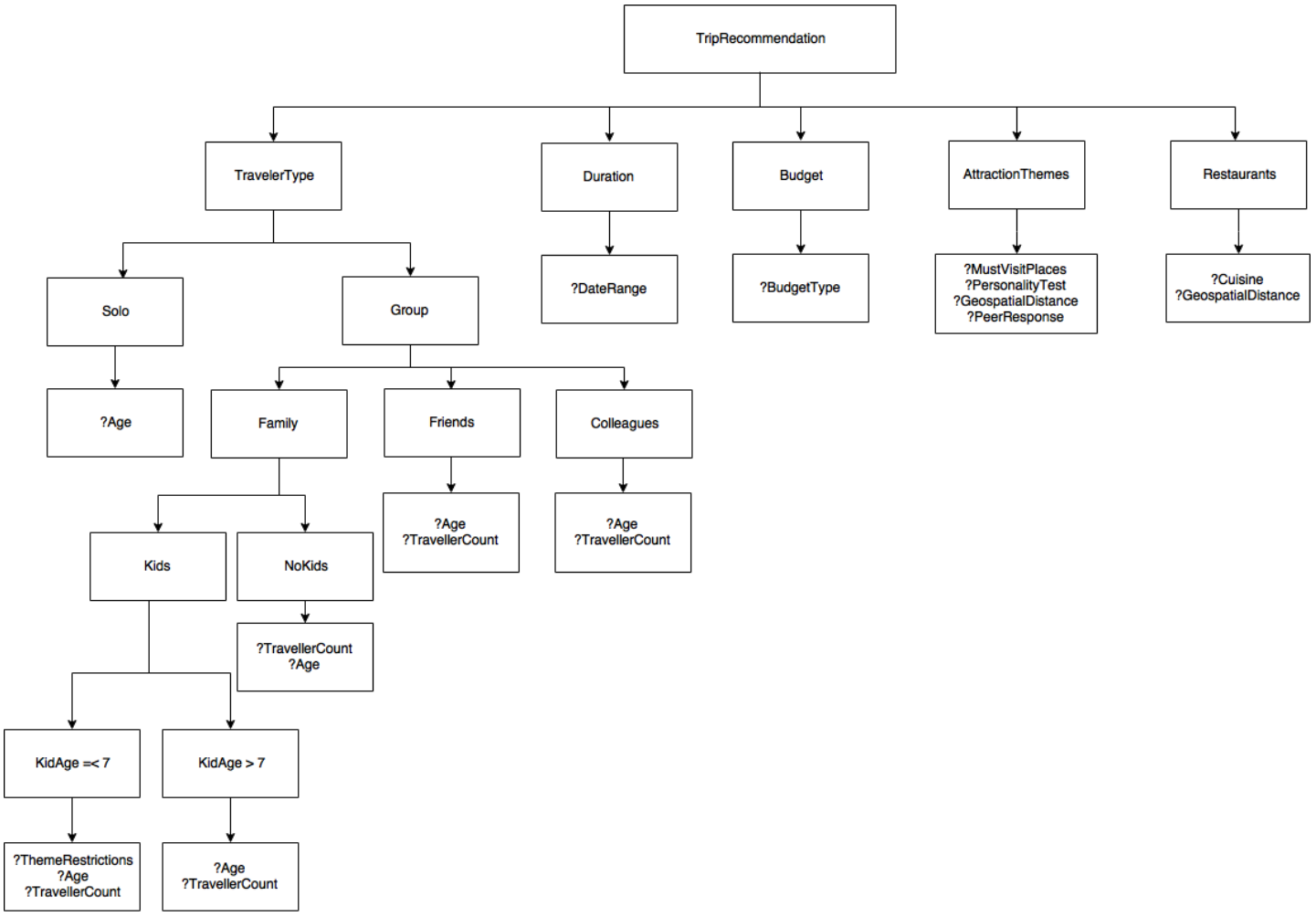
[Table 1 - Knowledge Representation]

3.5 DATA MODELLING

For determining rules from survey, we used association mining and decision tree methodologies. The decision tree was formed using PART and can be found in *j48-decision-tree-rules* file and the rules from JRip can be found in *jrip-rules*

Two aspects of a customer was taken into consideration to decide his/her travel type. First part of the questionaire was dedicated towards the bio data of the person and basic information about the trip planned. The second part was directed towards the personality traits of the person. For this we referred multiple psychology papers and articles. Eight questions were finalized from them to decide the traveler personality. To find out the user personalities, we ran a survey to map these questions to a given travel type. We ran Rule induction(JRIP) and decision tree(PART) algorithms on the survey result. We obtained 81 rules to map the answer pattern to a distinct travel type.

3.6 DEPENDENCY DIAGRAM



[Figure 2 - Dependency Diagram]

3.7 RULES

We generated business rules from the surveys conducted using association mining and decision tree. A summary of the rule base structure as follows:

Rule Category	Number of Rules Generated
Total Business Rules generated	214
Theme based rules	37
Personality based rules	81
Ideal # of places based rules	16
User Input based rules	20
Rules after Optimization	175

4 SOLUTION OUTLINE

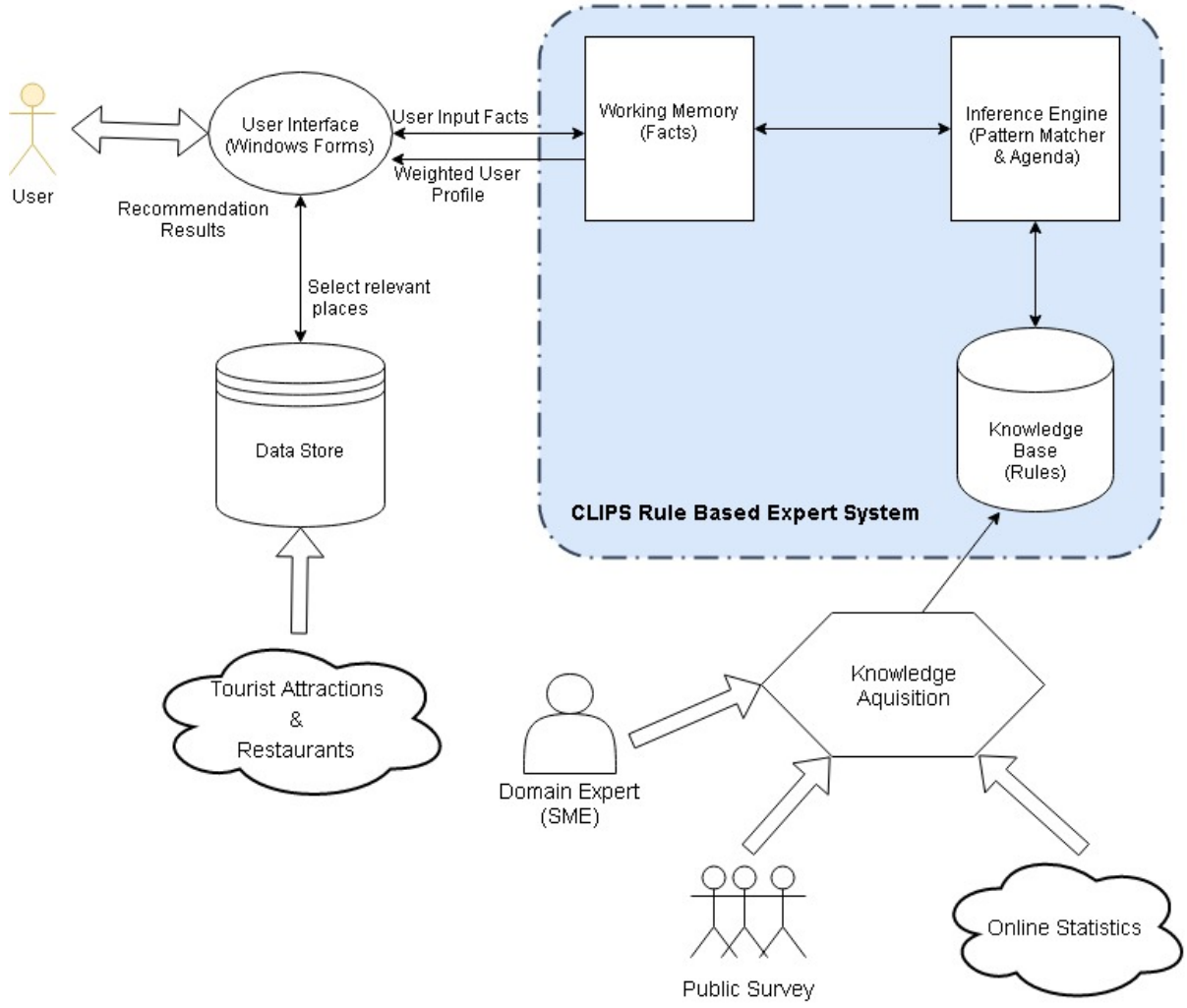
4.1 SYSTEM SCOPE

Our travel recommender system is built using the **'C' Language Integrated Production System (CLIPS)**. It being a recommendation engine enables user to get a tailored itinerary of the places to visit during their trip in Singapore. The user's details, and trip details are gathered along with the user travel persona, which helps recommend places which suits their taste.

This helps a tourist or a travel agency plan better trips. Therefore, can do more than a normal trip recommendation system available today, which requires manual effort.

4.2 SYSTEM ARCHITECTURE

The architecture of our system can be seen in the diagram below.



[Figure 4 - Solution Architecture]

The knowledge acquired from Domain Expert, Public Surveys and Online Statistics have been used to create rules for our knowledge base. We also have a Data Store, which has information about tourist attractions and restaurants all over Singapore. This information has been collected from online sources. The user interacts with the Windows Forms based recommender application.

The CLIPS shell provides basic elements of the expert system :-

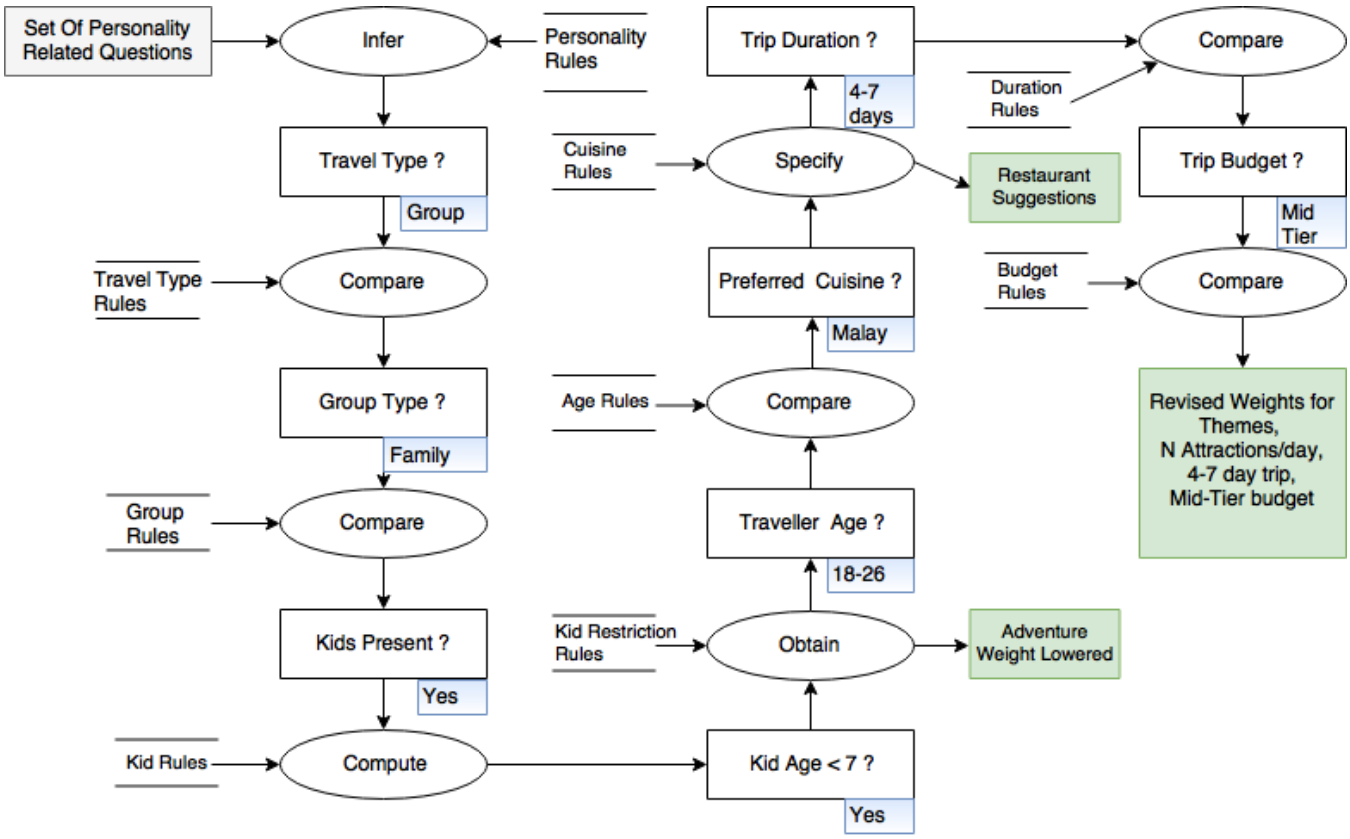
1. Working memory : Has the fact-list, and instance-list. Is the global memory for data
2. Knowledge-base: Contains all the rules, the rule-base
3. Inference engine: Controls overall execution of rules

The facts are loaded into the working memory. Based on the user inputs, the inference engine fires the rules. In our system, CLIPS outputs the revised weights for travel themes. The Data Store is used to generate the itinerary based on these weights and other inputs taken from the user.

4.3 INFERENCE STRUCTURE DIAGRAM

Given below is the inference structure diagrams :

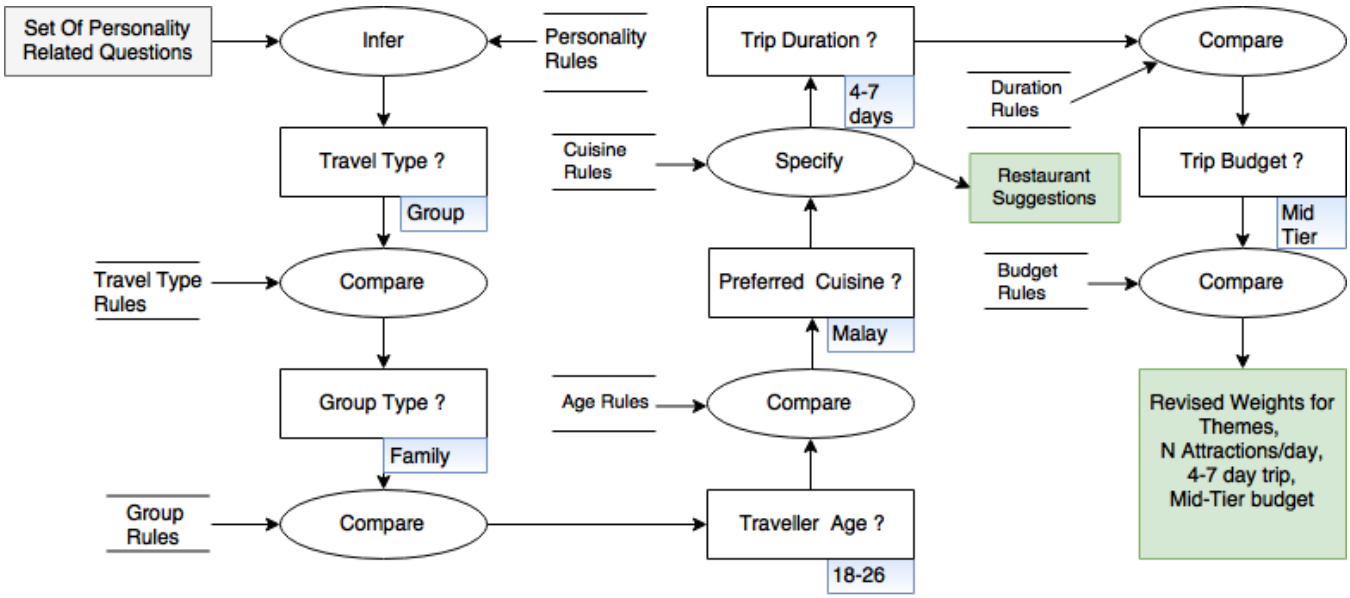
4.3.1 Family traveling with kids below 7 years of age



[Figure 5 - Inference Structure Diagram for case 1]

In this case, if kids below 7 years of age are travelling, the weight of adventure theme will be lowered.

4.3.2 Group of friends traveling



[Figure 6 - Inference Structure Diagram for case 2]

4.4 SYSTEM UNIQUENESS

Our system has a number of unique points that make it useful in the travel and trip planning domain. First, it has an adaptive way of asking questions depending on the user input. For example, if the traveler type is family, it will ask whether children are traveling along with them or not. This won't be asked if the travel group is solo, friends or colleagues.

Our system doesn't just give what places to visit, it will present the user with an itinerary on attraction points and restaurants, along with a map showing the route to these places. These places would be based on the user personality which had been analyzed and weighted priority wise by the questionnaire asked.

4.5 SYSTEM LIMITATIONS & ASSUMPTIONS

The travel and trip planning domain is very vast and a customized trip planner takes into consideration a lot of factors for determining what kind of trip is best suited for a tourist and gives him/her the best experience. Right now, our system doesn't handle all the variables required such that it can accurately customize according to the user needs. For example, we don't do end to end trip planning for the customer. Once the user gets to Singapore, we suggest day wise itinerary which the user can follow. We do not take into consideration the weather or traffic conditions for the itinerary. We assume that the factors such as flights, accommodation preferences etc. are taken care of by the user himself. Secondly, the scope of our trip planning is limited to Singapore for this project. It doesn't handle the planning of trips worldwide.

5 CONCLUSION

While going through the process of building the travel recommender expert system, we came to know about how the various factors work together to play an important role in travel planning.

The system can be improved by collecting more data records by extending surveys to various sets of people and constructing rules dynamically from these cases. Additionally, building the recommender system in CLIPS has given us a deeper appreciation of rule-based expert systems, particularly their advantages and limitations.

Of course, our recommender system is not infallible, and there are always further improvements to be made. We can expand the system's scope to include factors considered during travel such as accommodation preference, weather conditions, inclusion of nearby events, traffic conditions etc. Also we can extend it to include countries other than Singapore.

5.1 REFRENCES

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7. Google Maps API https://developers.google.com/maps/
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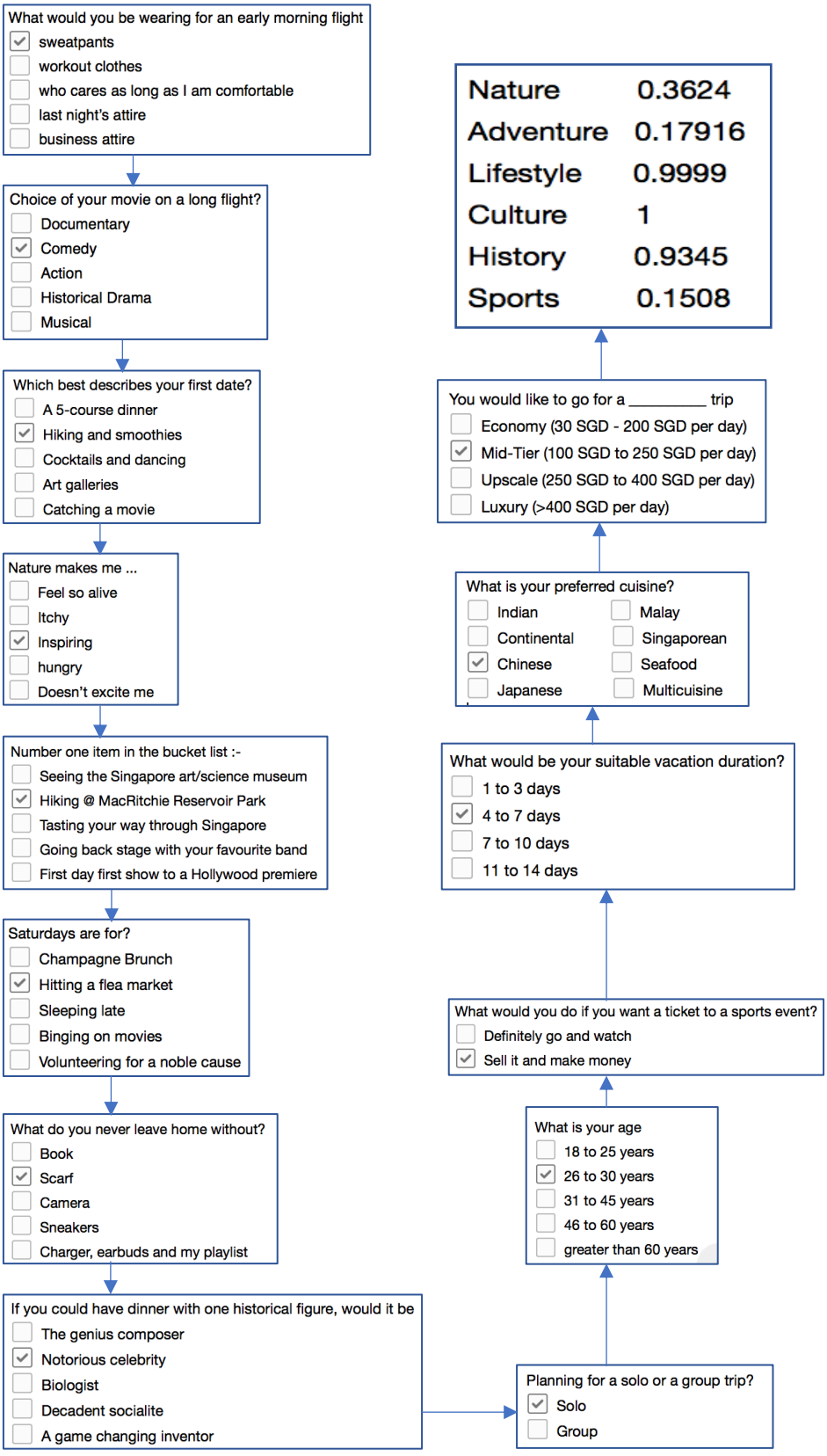
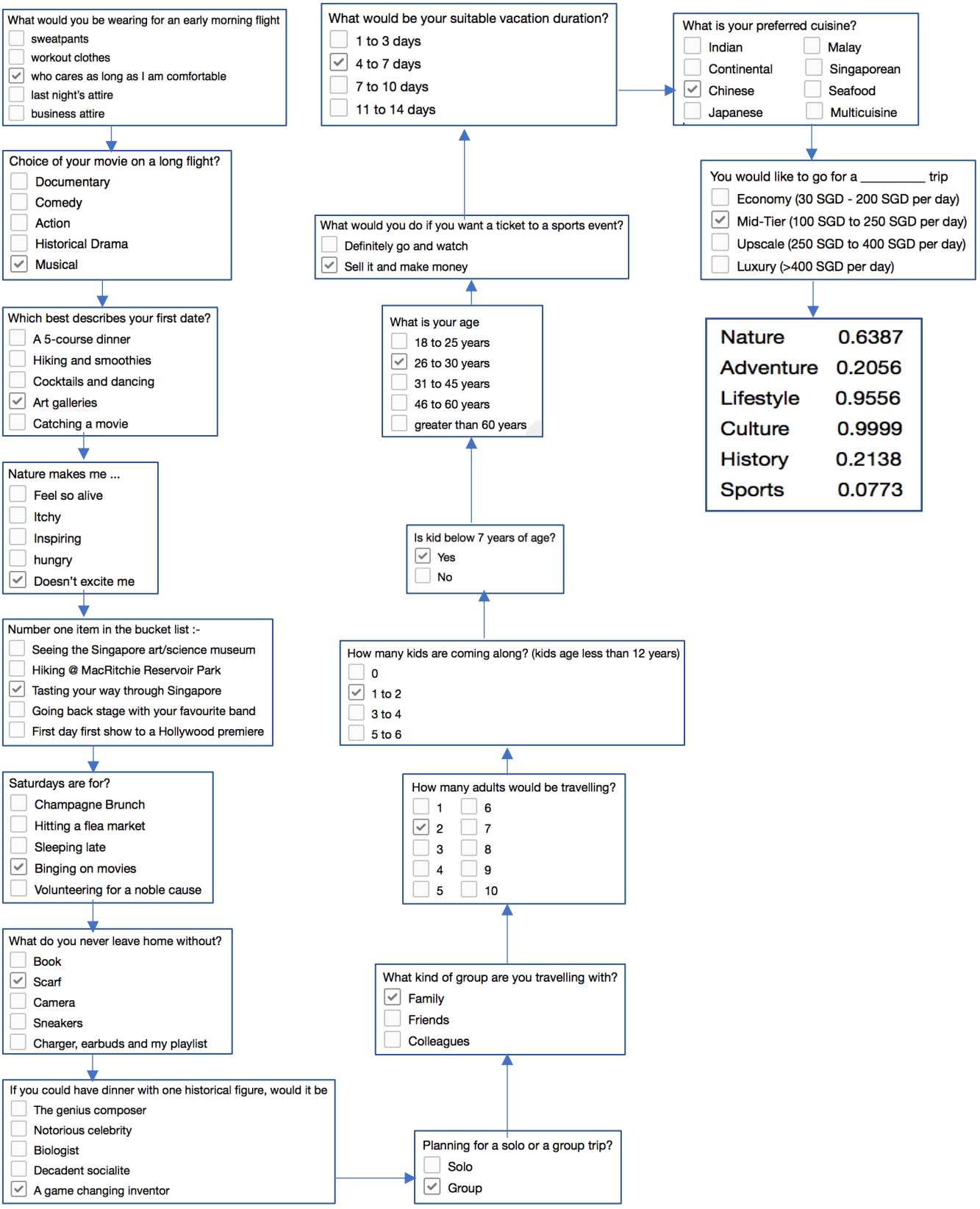
APPENDIX A: SAMPLE INPUT & SYSTEM OUTPUT

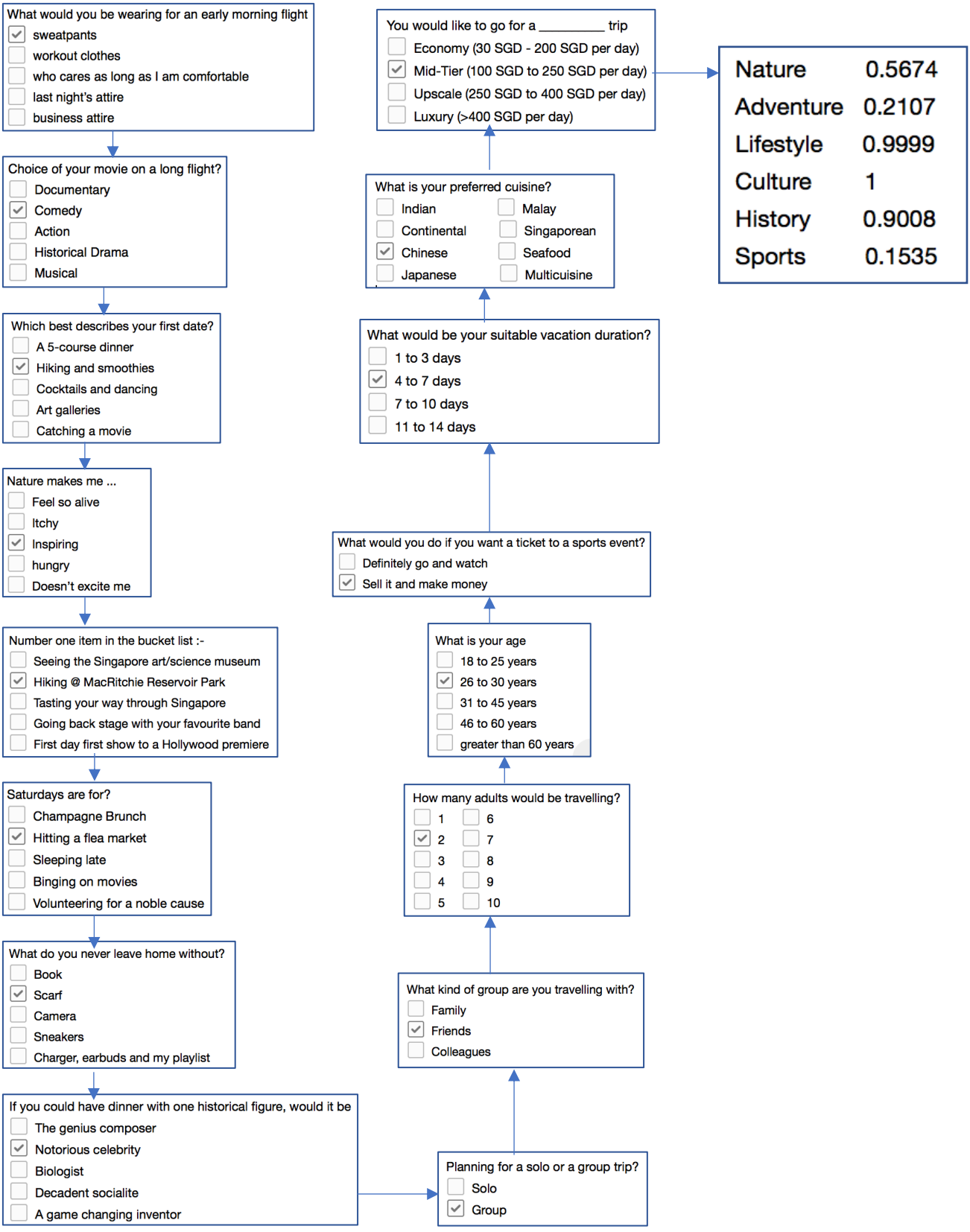
Case 1



Case 2


What would you be wearing for an early morning flight
sweatpants
workout clothes
who cares as long as I am comfortable
last night's attire
business attire
Choice of your movie on a long flight?
Documentary
Comedy
Action
Historical Drama
Musical
Which best describes your first date?
A 5-course dinner
Hiking and smoothies
Cocktails and dancing
Art galleries
Catching a movie
Nature makes me ...
Feel so alive
Itchy
Inspiring
hungry
Doesn't excite me
Number one item in the bucket list :-
Seeing the Singapore art/science museum
Hiking @ MacRitchie Reservoir Park
Tasting your way through Singapore
Going back stage with your favourite band
First day first show to a Hollywood premiere
Saturdays are for?
Champagne Brunch
Hitting a flea market
Sleeping late
Binging on movies
Volunteering for a noble cause
What do you never leave home without?
Book
Scarf
Camera
Sneakers
Charger, earbuds and my playlist
If you could have dinner with one historical figure, would it be
The genius composer
Notorious celebrity
Biologist
Decadent socialite
A game changing inventor
Planning for a solo or a group trip?
Solo
Group
What kind of group are you travelling with?
Family
Friends
Colleagues
How many adults would be travelling?
1
2
3
4
5
6
7
8
9
10
How many kids are coming along? (kids age less than 12 years)
0
1 to 2
3 to 4
5 to 6
Is kid below 7 years of age?
Yes
No
What is your age
18 to 25 years
26 to 30 years
31 to 45 years
46 to 60 years
greater than 60 years
What would you do if you want a ticket to a sports event?
Definitely go and watch
Sell it and make money
What would be your suitable vacation duration?
1 to 3 days
4 to 7 days
7 to 10 days
11 to 14 days
What is your preferred cuisine?
Indian
Continental
Chinese
Japanese
Malay
Singaporean
Seafood
Multicuisine
You would like to go for a _____ trip
Economy (30 SGD - 200 SGD per day)
Mid-Tier (100 SGD to 250 SGD per day)
Upscale (250 SGD to 400 SGD per day)
Luxury (>400 SGD per day)
Nature 0.6387
Adventure 0.2056
Lifestyle 0.9556
Culture 0.9999
History 0.2138
Sports 0.0773

Case 3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greater than 60 years
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Sell it and make money
What would be your suitable vacation duration?
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7 to 10 days
11 to 14 days
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Malay
Continental
Singaporean
Chinese
Seafood
Japanese
Multicuisine
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Mid-Tier (100 SGD to 250 SGD per day)
Upscale (250 SGD to 400 SGD per day)
Luxury (>400 SGD per day)
Nature 0.5674
Adventure 0.2107
Lifestyle 0.9999
Culture 1
History 0.9008
Sports 0.1535

APPENDIX B: USERS MANUAL

B.1 INSTALLING TRIPPIER – THE TRAVEL RECOMMENDATION VIRTUAL ASSISTANT

SYSTEM REQUIREMENTS

This system is supplied with a compressed zip file that contains the following:

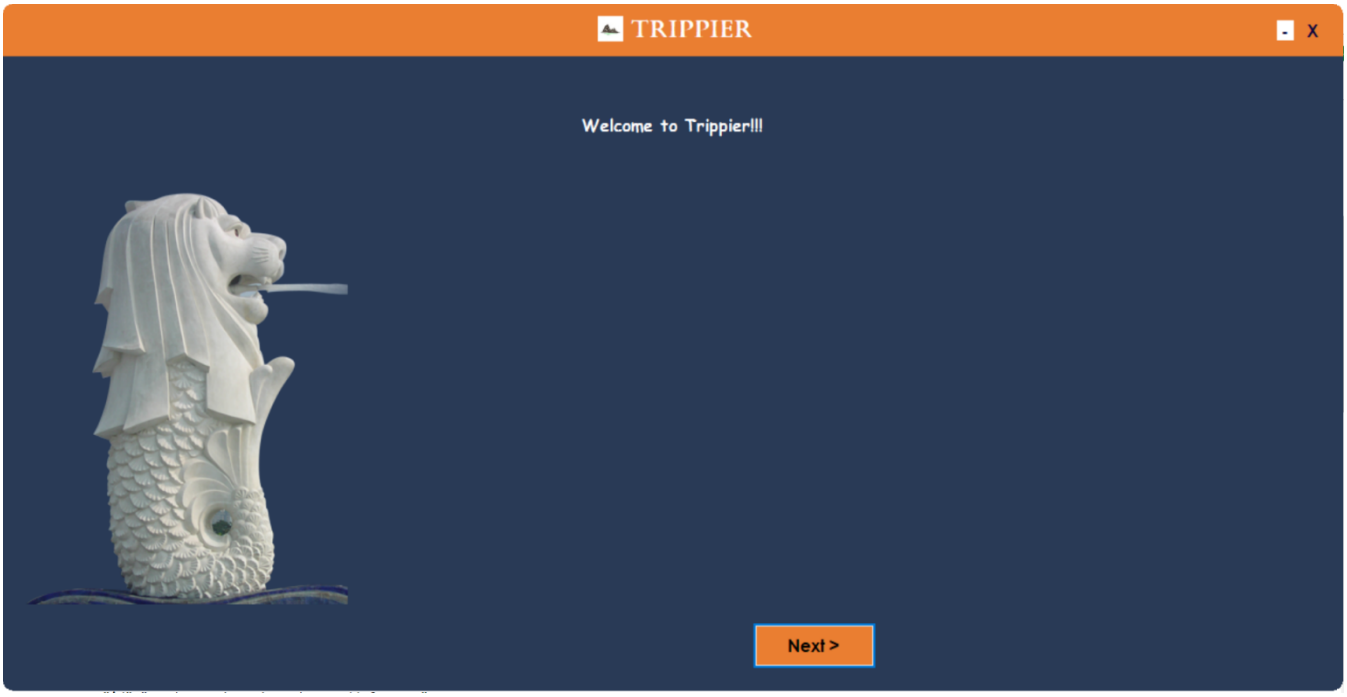
- .NET source files
- .NET executable files
- CLIPS DLL
- Windows forms source files
- CLIPS .NET library files
- Resource files used by the system
- Image files used by the system

Decompress the zip file to the "trippier" folder. This folder contains all the above mentioned files. The system is already compiled into an executable file that can run on any OS platform.

B.2 RUNNING THE SYSTEM

In the "trippier" folder, double-click the self-executable file called **Trippier.exe**.

If successful, users will be first greeted by the Welcome screen of the system as shown below.



[Figure B2- 1 Welcome]

B.3 HOW IT WORKS

B.3.A DYNAMIC QUESTIONING

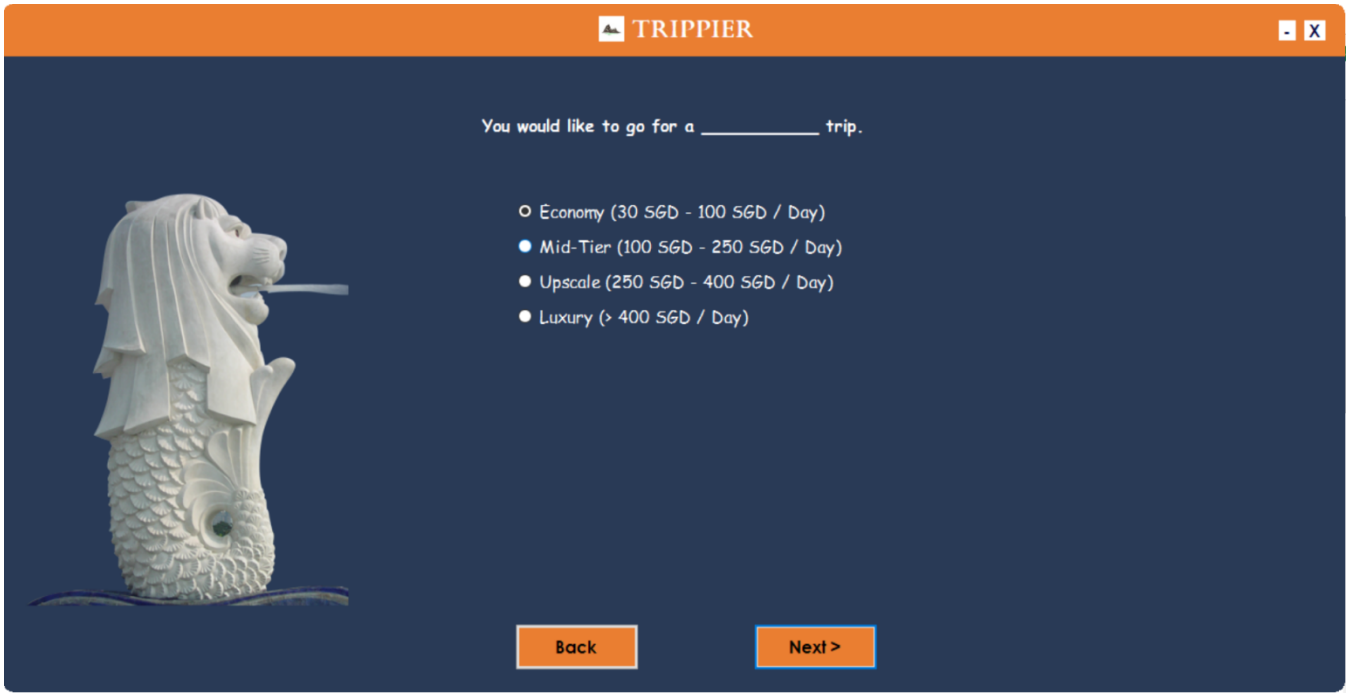
Our system begins with a set of questions, related to trip details and personality of the user.

Click "Next" to start the recommendation system. The system is designed to do dynamic questioning based on the travel group type(solo/group travel). Based on the option selected, it asks separate sets of questions. The system asks the whole set of questions, to display the itinerary at the end.

B.3.B RESPONSE GATHERING

A question may be answered by picking an option from a given set of choices. The UI has been designed in a way that minimizes user input. This has been done to provide the user a smooth interaction with the system.

The figure below shows the widget interface for one of the questions asked.



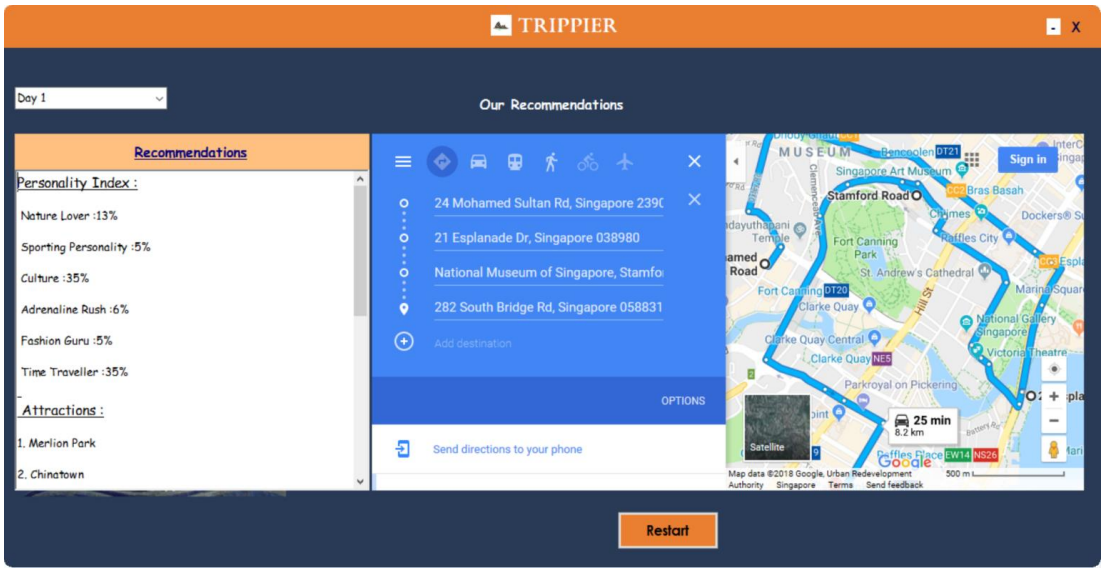
[Figure B2- 2 Budget]

[Figure B2-3 Personality]

At the end we can either end the session by closing the application, or proceed with the questions again, by clicking ‘‘Restart’’.

B.3 DISPLAYING ITINERARY

The final itinerary is displayed as the following. The left panel displays the tourist attractions and restaurants under the **“Recommendations”** window. The right panel shows a Google map route connecting these places. Additional restaurant information (e.g. rating) is also provided wherever possible. Also as it is an itinerary that we display at the end, a drop down has been provided at top left corner of the window to see the day wise itinerary.



[Figure B2- 4 Recommendation Result]