Term Project Report

Decision Support System
"Choosing the Laptop"

In partial fulfillment of the requirements for INFSCI 2130

Decision Analysis & Decision Support Systems

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Introduction

This project report is made for the Decision Analysis and Decision support system class (INFSCI2130) in order to describe the complete "Choosing a laptop" project. Since the members of the project had realized that choosing a suitable laptop according to one's needs is a hard decision, we thought it would be benefit for many people if we could create a system that can support chooser's decision especially the chooser that does not have enough computer hardware background.

The objective of this project is to develop a decision support system which is able to help people to decide which laptop models they suppose to choose according to their preferences, usage, and budget. The final result of the system would consist of a short list of suitable laptops selected from the laptops database that we create from the available laptop in market. The list of laptops in the database can be updated as often as needed to make the system to be extensible and flexible since the laptop is a kind of technology product which rapidly developed.

Normally, when we want to buy something, we will buy what we think it is the best thing within our budget. To decide what the best thing is, we will consider the highest benefit we expect to get. For buying laptop, we have to consider both tangible and intangible benefit. In this project, we also include the brand preference as one of the important inputs of this system because the brand is a dominant reason that impacts the chooser's decision. We try to make the model that close to the real expert decision.

This report consists of the description of problem and models that base on the real world situation, the decision under expert suggestion and related influence. Also, the quantification of uncertainties and preferences exist in our model, and the result analysis of the option available in the system. It describes the reason of our result design.

All the members of the "choosing a laptop" project hope that the system will help people to find and decide the appropriate computer that matches to their requirements. Also, we hope this project will bring the benefits for regular system users and will be applied to similar types of project in the future.

Problem Description

Choosing a laptop that matches one's needs is a difficult decision since it requires a decision maker to carefully consider the information from many factors such as the fast changes of computer technologies, manufacture reputation, computer component prices, individual preferences, prices, etc. Moreover, the computer manufacturers serve their market with various choices of laptop models that confuse people, especially the non-technology oriented, what they should choose. It is due to the limitation of human memory that makes most people unable to process large amount of the information mentioned before in the same time. Because of these reasons, people always face the complexity whenever they attempt to make a good decision about it.

However, this problem would be easier if decision makers had enough time to inspect each of the decision aspect meticulously and systematically. From our observation, the decision aspects in choosing any laptop always consist of the following factors: performance and functionality, preference and appearance, and price. Specifically, some people might consider the price of the laptop firstly while the others may more focus on the functionality and appearance of the laptop. Anyhow, one of the decision aspects would be motivation that affects a person decision in choosing a laptop but, in most cases, some criteria are more dominant than the others.

Although to consider each decision aspect separately will probably increase a chance of choosing a laptop that exactly matches user's needs, it is still necessary to ask users about their invisible needs with a set of questions in order to find out all the hidden requirements. With this strategy, the decision maker (the system) will be able to choose a laptop for that user better and closer to their actual needs.

In order to make a rational solution for solving this problem, we can use these decision aspects to create the system model to help people making a better decision. Each of the decision aspects will be explained in detail in the following section (the model of the system) for better understand the core model of the system. By interpreting the user requirements, evaluating user activities, estimating the trend of the computer market and getting feedbacks from customer reviews or impartial organization, the model will be able to give more reliable and accurate result to any kind of users and can lessen the confusion when people want to choose the laptop computer.

Model Description

In the end, the laptop that best matches the user need is the one that is the most suitable with their needs and its price must fits with the budget. As the result in the previous topic suggest that there are generally 3 aspects to choose the laptop. The model will represent all these aspects and find which laptop is the best for user.

Input to the system

There are therefore two set of input to the system. One is personal information and preference, the other one is laptop database. Laptop database will be kept on DBMS in a way that the new model can be added to the system and managed easily. However, the price of laptop changes too fast as there are many competitors in this field. To solve this problem, using the DBMS allows to simply change the price for each specific individual laptop through the DBMS software. All necessary operations will be available on web. User may start the program by going to the provided URI.

Personal preferences

There are several kinds of questions for user to enter in order to detect which type of laptop he is. Then all value will be translated to computer specification based on expert information in this area and from other reliable source. For example, suppose user play games a lot then the program would assume that the best suit laptop should have good 3D accelerator and high CPU speed. If user tends to use the computer for programming purpose then the program should assume that the person requires laptop that has much memory and high CPU speed. To make this information more reliable, we did create a model in excel before applying the information into our system.

Laptop database

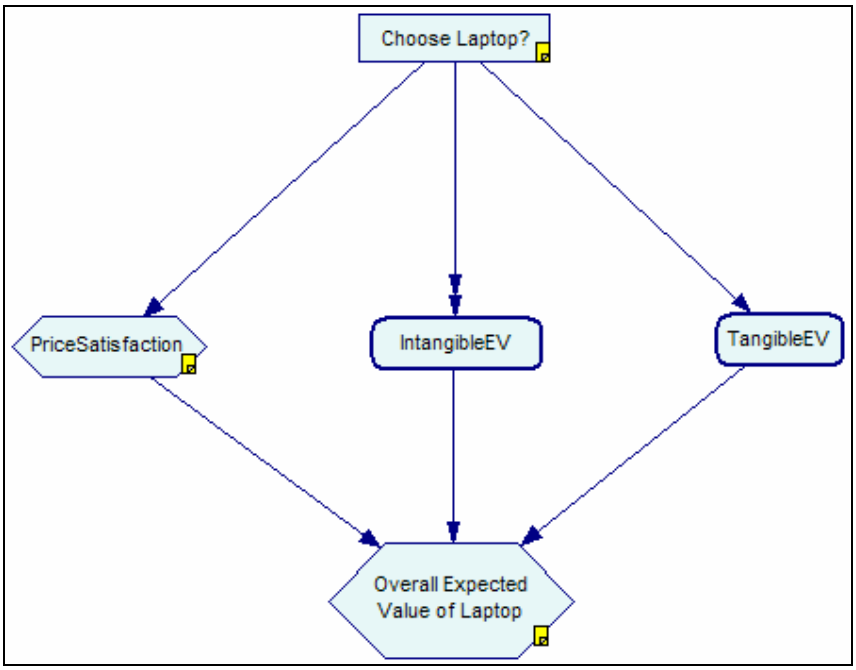
Laptop data will need to be entered in the system in detail. However, scoring the intangible thing such as warranty or durability is not easy task. There is no standard measurement for this type of information so we gathered data from different sources and convert them into one standard. For the laptop specification, we try to get all information directly from manufacturer to make the data more reliable as much as possible. Also to standardize the price information, we decided to use the list price rather than the price from retailer or promotion price. Although we try to use as much data as possible as a decision criteria, but it is impossible to use all hardware component as criteria so that we consider only the key component related to user's activity and usage style.

Output from the system

Output from this system is a list of up to three laptops with their specification and price. The result will be ordered by the level of correspondence to the provided user's information (from input page). We also provide the hyperlink reference to the manufacture webpage of the particular model. The user can find more feature information, detailed technical information, product appearance, and how to buy from the given webpage. All of the data in our output is from the database, so how updated the information depends on how often the database is updated.

Genie Model

As we describe earlier, to choose the laptop, we have three main aspects to consider, which are the computer specification or tangible aspect, the intangible aspect (e.g. brand reputation, warranty information, custom service, reliability), and price and user's budget. This decision can be shown as the following model:



Price Satisfaction

The price satisfaction can be obtained by comparing the maximum budget that user input into the user requirement form with laptop price. The price of laptop models in result list must not exceed the specified maximum budget. That means the user can afford to by the laptop shown in list.

Intangible Value

To get the intangible value, we rely on two kinds of information sources which are the review and the user preference we get from the input form. We get the review information from various sources, for example, the consumer review from website, the computer magazine, and the article about buying laptop suggestion.

For the user preference, as a buyer, user can select to consider some specific factor, for example the brand reputation or the customer service of a particular brand (more detail will be explained in Intangible EV sub model.) For instance, if user selects to prefer any of these factors, we will give more score to the brand that offering better service or having higher reputation.

Tangible Value

The tangible value is obtained by the user activity and style that the user fills in the input form. This information is interpret into value and will be used to refer to the specification of each hardware component. For example, if the user mentions that he wants to use laptop for playing game, it implies that the specification which most likely match his needs must have high CPU speed, with very good display adapter.

More information regarding tangible and intangible value will be explained later in quantification of uncertainties section.

Quantification of Preferences

We can say that make decision about this problem is a kind of **conflicting objective**. It mainly relies on subjective judgment to trade-off the value of each aspect. Among three main aspects, we set the default worth of consideration equally, 33.33% each. However, for each individual person, the level of consideration of each factor possibly is different. So, we assess the weight of each aspect according to the information that user input. If the user considers the price as the important factor, price weight will be higher than other factor. We can represent the decision as the following utility equation:

Before adjustment

EV(Laptop) = p(Price) + q(IntangibleEV) + r(TangibleEV)
,where p=q=r and p + q + r = 1

After adjustment

EV(Laptop) = p(Price) + q(IntangibleEV) + r(TangibleEV)
,where p + q + r = 1

There is certainly a conflict between the tangible and intangible benefit, and price. Therefore, the assessment relies on the user's needs. Yet, finally, the price is the key consideration. The system cannot recommend the laptop that match with the user need with the price exceeding the specified budget.

We can say that the decision in this case is based on the user's preference, so that the most important part of our system is the interpretation of the user needs. Based on the articles[1] we have study, the people with different age and sex have the different computer usage style. We use the age and sex to imply the default value for each user's activity. However, we give more consideration to what user input.

We also allow the user to input his preferred brand of laptop. This is because, for someone, the brand is the most important thing to consider. If user specifies the brand and it is not conflict with other consideration such as price and size, the system will give additional score to that brand. If there is no brand preference specified, the system will not consider the brand when selecting the laptop.

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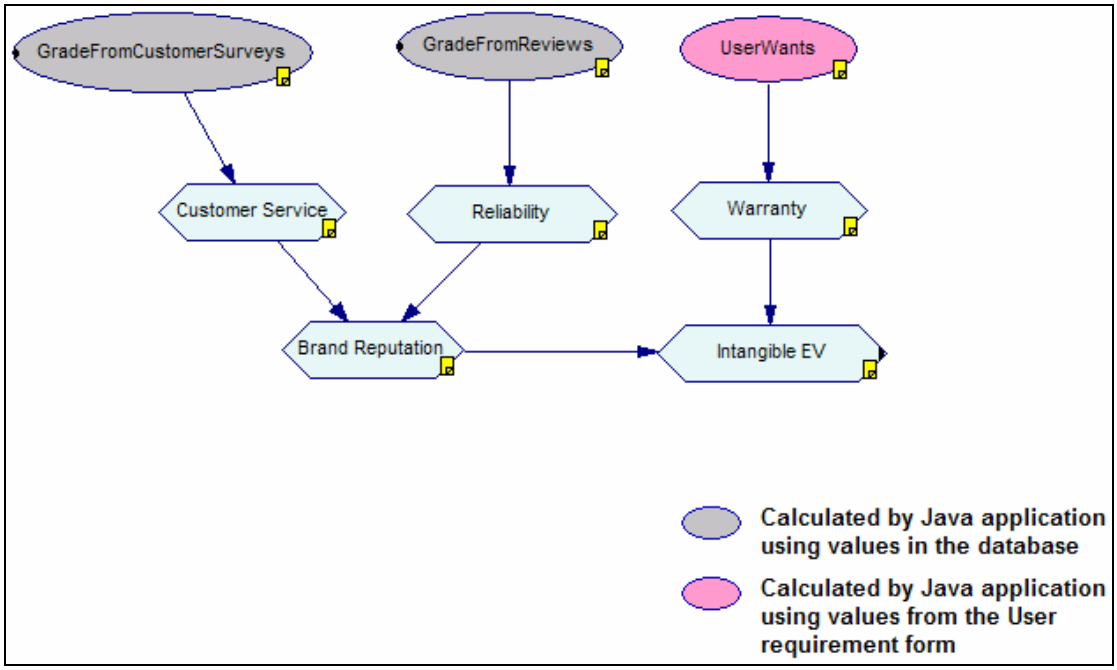
1 Article example: Computer Time, **American Demographics**, August, 1998 by John Robinson, Shawn Levin, Brian Hak;
Culture & Leisure - Lifestyle: Information technology in the home;

Quantification of Uncertainties

Our Genie model contains four main uncertainties which consist of *GradeFromCustomerSurveys* providing facts about the uncertainty of the laptop manufactures' customer service getting from the customer feedback and customer survey, *GradeFromReviews* indicating the uncertainty of the laptop reliability getting from the third party trustworthy sources, *UserWants* telling the uncertainty of user desires. These three refer to the tangible value. The last one is *Activities* indicating the uncertainty of user activities relating to computer usage which refer to the computer hardware or tangible value.



GradeFromCustomerSurveys

As customer service becomes one of the important factors that most laptop buyers concern, reading customer surveys is one way in which buyer can gain knowledge as well as useful information about the laptop manufactures in order to choose a laptop with good customer services better. However, since many surveys have different standard for evaluating the customer service quality, one manufacture can obtain different score levels. As a consequence, the customer service score level becomes uncertain. From this reason, we have collected the customer service score levels from many reliable sources such as PC Magazine (http://www.pcmag.com/) and PC World (http://www.pcworld.com/) to enhance the accuracy of the customer service assessment.

GradeFromCustomerReviews

Another important issue laptop buyers concern is laptop reliability (how consistency of the machine.) Like the customer service, we obtained information about the laptop reliability from various sources. Since every laptop model has unique advantages, it is hard to collect each unique feature of a laptop. Thus, we only analyze reliability reports in the manufacture level instead of laptop model level. From this

point, we are able to assess the reliability of each laptop by using its manufacture's reliability score.

How to calculate the probability of those two uncertainties?

As both *GradeFromCustomerSurveys* and *GradeFromCustomerReviews* obtain their probability values from many reviews and surveys, it will be more flexible to make the system able to add new analysis results into it. As a result, we created a database used for calculating the probability of customer service and reliability. Developers can add more analysis results in order to enhance the accuracy of the customer service and reliability assessment by add more records in the database. For probability calculation, we used all the results from the surveys and review to calculate the probability of each grade level. Customer service has three grade level (BetterThanAverage, Average and LowerThanAverage) while reliability has four grade level (Outstanding, Good, Fair and Poor).

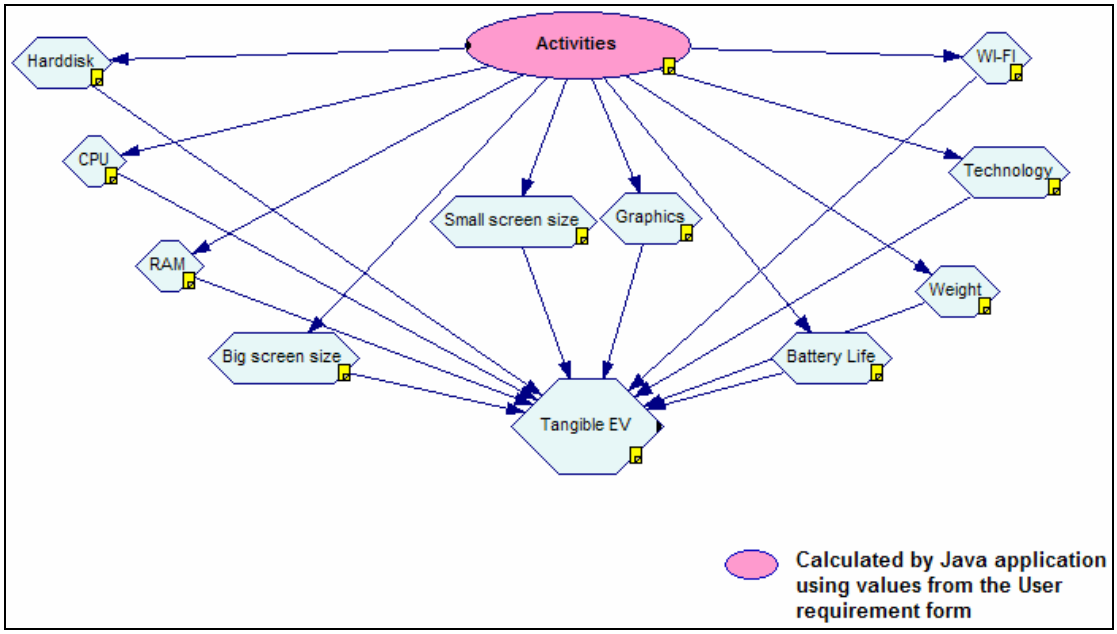
UserWants

Sometimes even customers themselves may not know what they really want or need. As a consequence, it is one of uncertainties happening during the user requirements interpretation processes which the system obtains from the "user requirement" form. The probability of the uncertainty is calculated from the proportion among user desires.

Activities

Like *UserWants*, the uncertainty "*Activities"* happens during the user requirements interpretation processes. The values that we get from the activities are not certainly indicate the component specification, though it can implies some possibility. Once the users fill the user requirement form, the uncertainty happens. The probability of the uncertainty is calculated from user's answers. The system calculates the proportion of the user's activities in order to analyze user's characteristics which will allows system to choose a laptop that matches their uses.

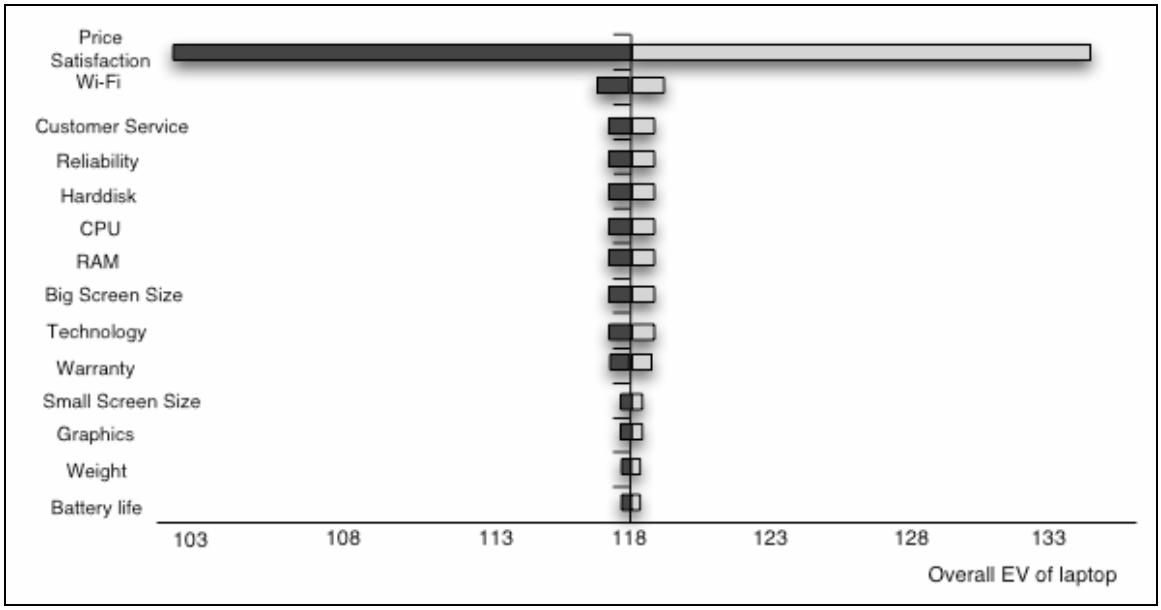
Generally novice users do not know the detailed specification of the laptop they wanted. However, they do know what they are going to use with their new laptop. In short, their preferences are based on activities rather than the laptop's specification. This system captures this idea and so based the decision of choosing the laptop on activities. We then translate activities to each component on the compute (e.g. CPU, RAM, Harddisk). By brainstorming with several computer experts, consult many magazines and web pages, looking for review and consumer reports, we strongly believe that our translation very accurate. We not only based our translation barely on the user's input, but also adjust the value that seems incorrect; for example, if one has age of 50, he certainly does not want to play game a lot so we will reasonably shape down this value.



Based on this diagram, we reflect our thought by modeling the system in a way that we get the information from user activities, and then estimate the value of each laptop component. For example, if the activities require intensive calculation, the laptop with high CPU performance should get higher score. All components have an arc to Tangible EV node to compute the final face value for each laptop. To reduce complexity on our system, we do not calculate all laptops at once. We instead compute face value for each computer at a time. After all laptops have been evaluated, we get a list of laptop along with its face value. The higher face value means the higher match with users' needs.

Evaluation of the model

In order to evaluate sensitivity of our model, we have defined based (estimated) value and reasonable upper and lower bounds. By setting all nodes at based value and varying one node at a time from lower bound to upper bound, we came up with the following tornado diagrams.



From the tornado diagram, we can see that the most sensitive variable – the longest bar – at the top of diagram is Price Satisfaction. This indicates that choosing laptop depends mostly on user budget rather than other input variable. This is obvious because customers usually prefer laptop that satisfied their budget. In this case, overall laptop is insensitive to Battery life, Weight, Graphics and Small Screen Size, so in further analyzing this decision we simply can leave these variables at their base values.

Above all, the information shown in tornado diagram may vary based on each person's preference. If the person do not care about the price (having unlimited budget or the budget is very high), the price may not be the most sensitivity variable like in the above figure.

Recommendations

For further research and development in this project, we recommend the following feature:

1. Development regarding the model
    - In intangible aspect, more uncertainties from various sources can increase more reliability of data. The additional uncertainties should includes the laptop appearance, more information from customer feedback, detailed warranty that manufacturer offered, and more product review from trustworthy source.
    - The activities that refer to the hardware component can be expanded to gather more specific information precisely, at the same time, the number of questions that user needs to input into the system also increase.
    - To get the price satisfaction, we may consider another important factor which is the current promotion at the current situation. The percentage of discount is probably the key factor for some people when buying something.
    - In our model, we interpret the information that user input to be a numerical value. Sometime the score is not perfectly true.

2. Development regarding the system
    - To make the laptop database more up-to-date, the GUI should be developed to allow easier laptop information addition and modification.