TDT4171 - Artificial Intelligence Methods, assignment 3

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Introduction

In this exercise, we have chosen to make a decision support system made to help with vacation planning. To broaden the utulity of the system, we have included three different decisions, each for which we will provide a use-case and result.

This document roughly follows the steps outlined in the slides for the assignment.

Step 0 - Decide what to model

We want to model three related decisions regarding vacations.

Step 1a - Defining variables

Evidence variables

- Ticket Price: [1k-3k, 3k-6k, 6k-9k, 9k-12k]
- Travel time: [1-3h, 3-6h, 6-9h, 9-12h]

Uncertain Variables

- Weather [Dry, Wet]
- Climate [Freezing, Cold, Temperate, Hot]
- Will the persons i meet speak English? [Yes/No]
- Will I get sick? [Yes/No]
- Will I get robbed? [Yes/No]
- Earthquake [Yes/No]
- Hotel quality [Good, Shitty]

Step 1b - Defining decisions

We include the following three decisions in our system:

Where should we travel?

- San Fransisco
- Sao Paulo
- Åre
- Oslo
- Paris
- Bangkok

When should we travel?

- January
- April
- July
- October

What kind of vacation do we want?

- Sunbathing
- Skiing

Use cases

Following are some examples of questions our system can answer.

Where should we travel?

This is the most frequent use-case in our experience. Normally you are in a situation where you know what kind of vacation you want, and you know when your vacation weeks are up front. Discussions tend to center around where to travel given these two constraints, combinded with constraints in budget and perhaps travel time (for a short vacation you might not want to spend 20h on a plane each way).

When should we travel?

Some people (such as students) are more free to choose when they want to take their vacation time. A use case for such a person might be that s/he has decided where to travel and what to do there, but wants to know when would be the best time to go there.

Vacation type

If you have the tickets ready, but are unsure on how to pack, you can constrain the system to location and date, and it will let you know what would most likely be the best way to pack your bags.

Step 2 - The qualitative part

The relations between the varaibles we chose to include in our model are visualized in [fig. 1].

Part of the reason for including more than one decision is that the model ended up being very "shallow" - meaning every random variable is only influenced directly by one or more decision variables, and not any other random variable. We fear that this might be missing part of the point of the assignment (Bayesian), but we found no more reasonable way of modeling the decision influences in this scenario.

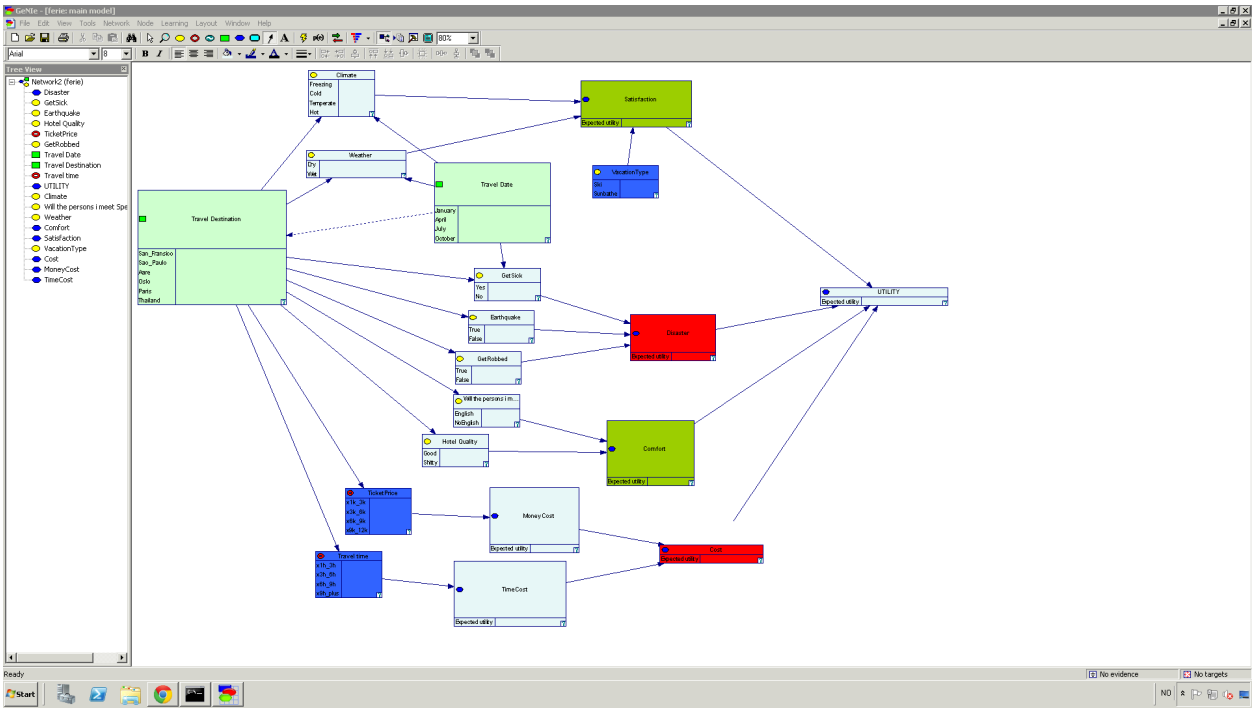


Figure 1: Influence Diagram. Decision nodes in light green. Evidence in blue. Uncertains in light blue circles. Utility nodes are in dark green or red, representing positive or negative utility points.

Most of these variables are obviously conditionally independent given `location`. `(Weather, Climate)` is cond.indep. given `(location, travel date)`.

Step 3a - The quantitive part

Determining probabilities and later utility points was definitely the harest part of the assgnment.

We ended up using a combination of gut feeling and numbers off the internet (e.g. to get a realistic seasonal variation for weather or temperature).

Probability tables for the a selection of the variables follow on the next page.

Step 3b - Utility Function

Due to the "shallow" nature of our model, we end up with a pretty complicated utility function. To alleviate this, we use multiple utility functions, which we then connect to a MAU node, assigning weights to each utility node. This makes the process of defining utility scores more intuitive (for us) - it is easier to decide the

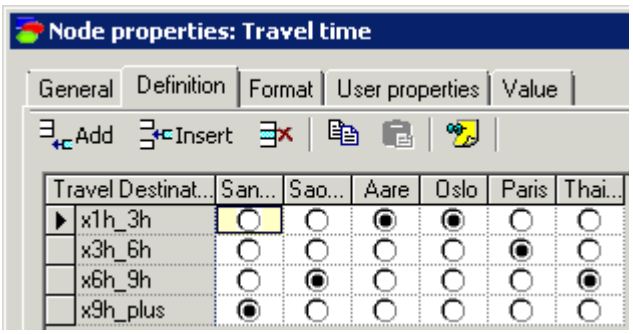


Figure 2: Travel time overview

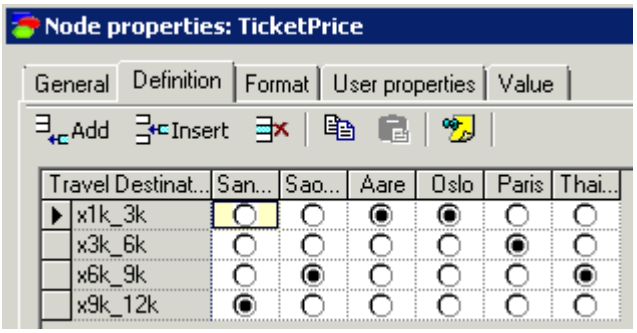


Figure 3: Ticket price overview

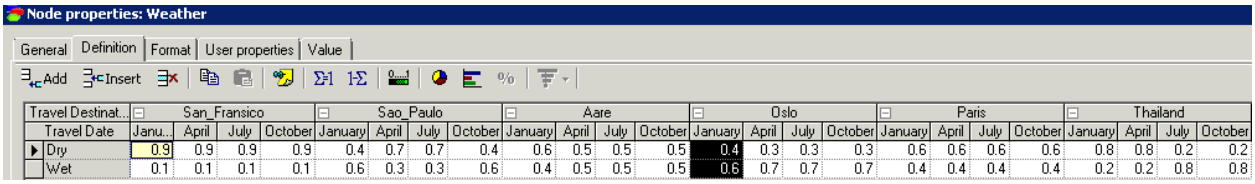


Figure 4: Weather probability distribution

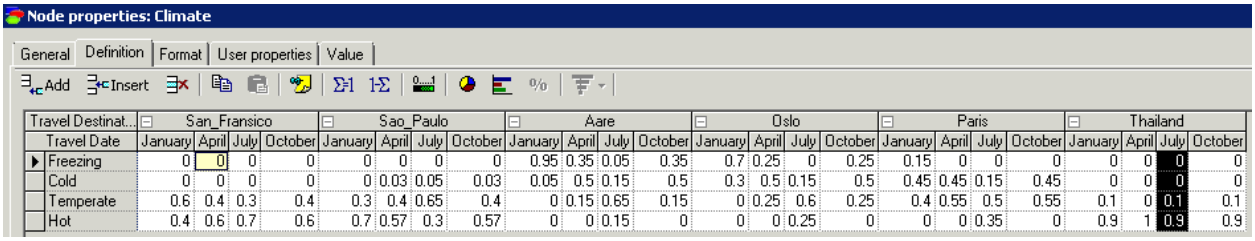


Figure 5: Climate probability distribution

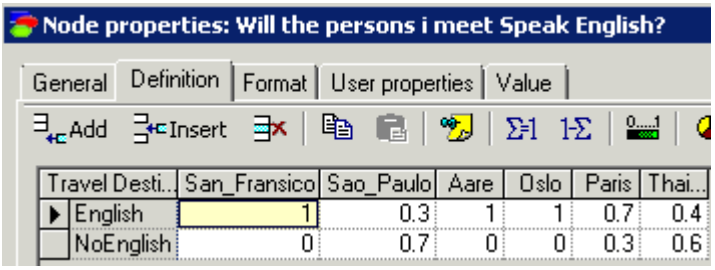
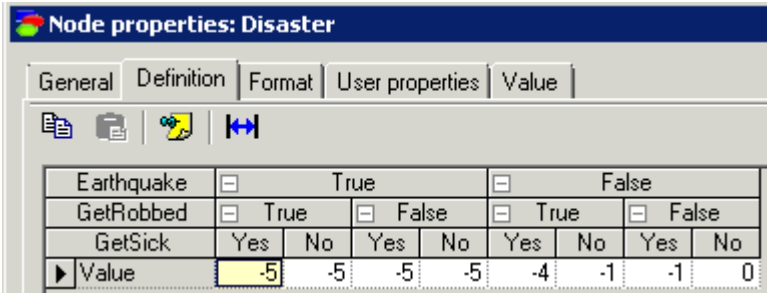


Figure 6: Language probability distribution

relative weight of each utility function in the MAU node, than it would have been to decide simultaneously on the relative weight of each combination of properties in a single Utility Node.

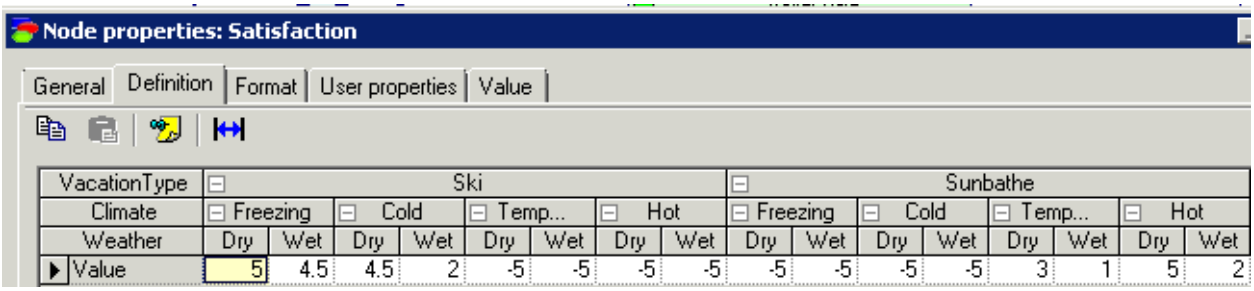


Earthquake	True				False			
GetRobbed	True		False		True		False	
GetSick	Yes	No	Yes	No	Yes	No	Yes	No
Value	-5	-5	-5	-5	-4	-1	-1	0

Figure 7: Utility Node: Disaster

Will the person...	English		NoEn...	
Hotel Quality	Good	Shitty	Good	Shitty
Value	5	0	3	-2

Figure 8: Utility Node: Comfort



VacationType	Ski								Sunbathe							
Climate	Freezing		Cold		Temp...		Hot		Freezing		Cold		Temp...		Hot	
Weather	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Value	5	4.5	4.5	2	-5	-5	-5	-5	-5	-5	-5	-5	3	1	5	2

Figure 9: Utility Node: Satisfaction

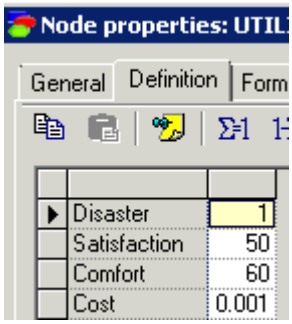


Figure 10: MAU node definition

Step 4 - Verification

We test our model using a few test cases in which the answer is obvious to us. We hope to observe a result that we agree with.

Test case 1: Where to ski

We have a weeks vacation in january, and we want to do some skiing. Where should we travel?

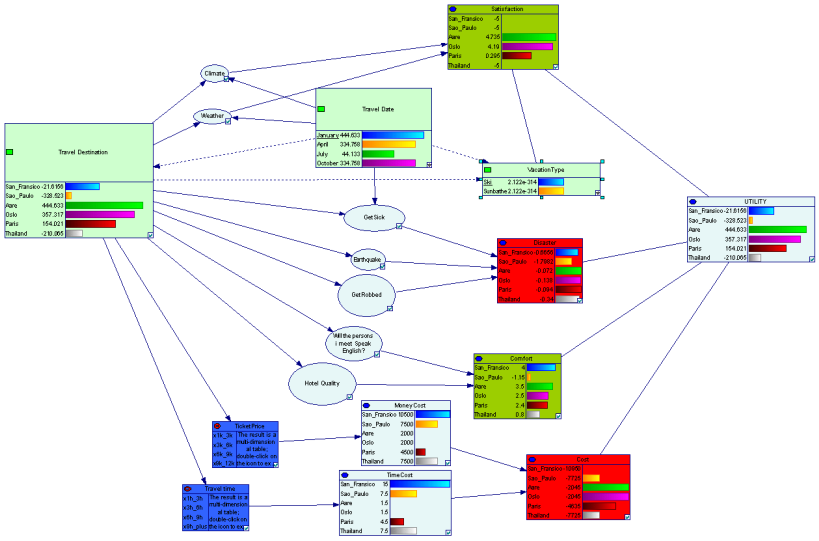


Figure 11: Test case 1: Where to ski

Åre is the obvious winner here.

Test case 2: When to travel?

We decided to take a trip to Thailand for some sunbathing. We want to avoid the rain season. Which month should we take out our vacation weeks?

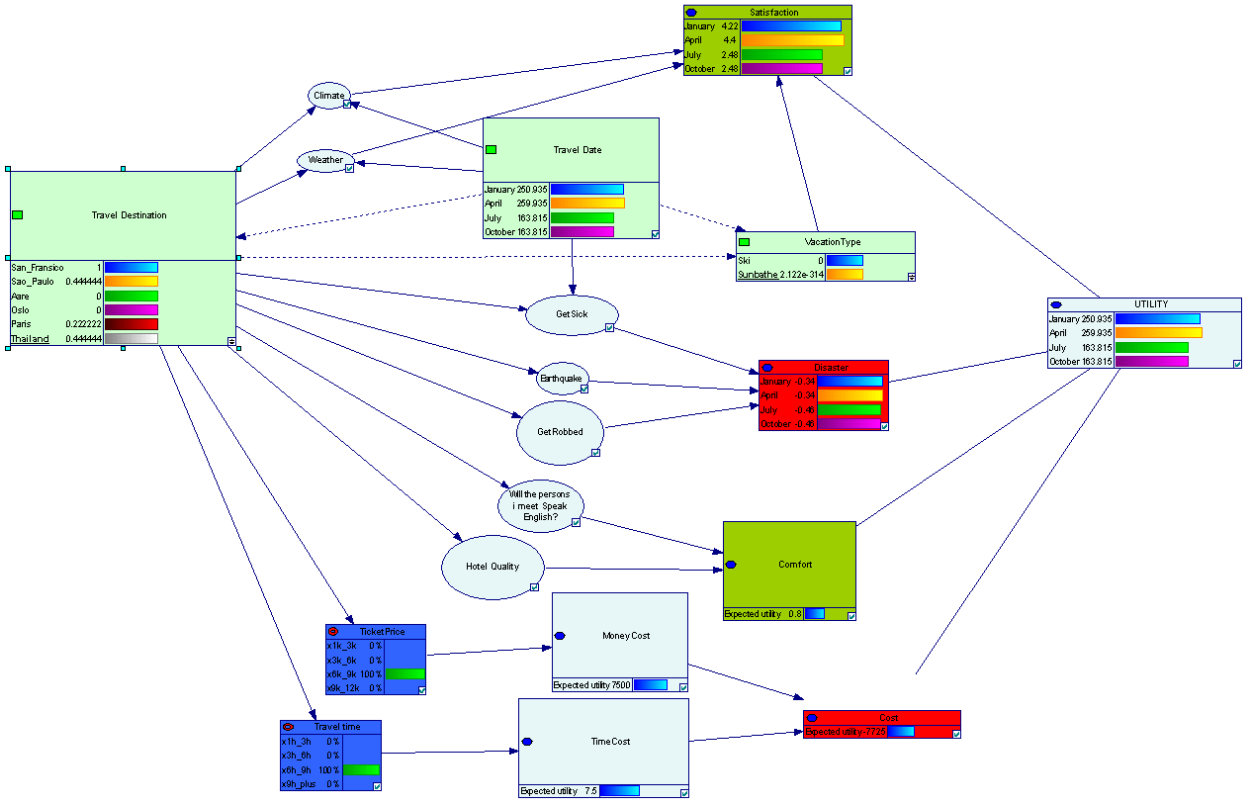


Figure 12: Test case 2: When to travel for Thailand

Test case 3: What to pack

We won a surprise ticket to Oslo. The ticket is in July. Should you pack skis or bikini?

(While playing around, we notice that any other quarter of the year, packing your skis is a better idea.)

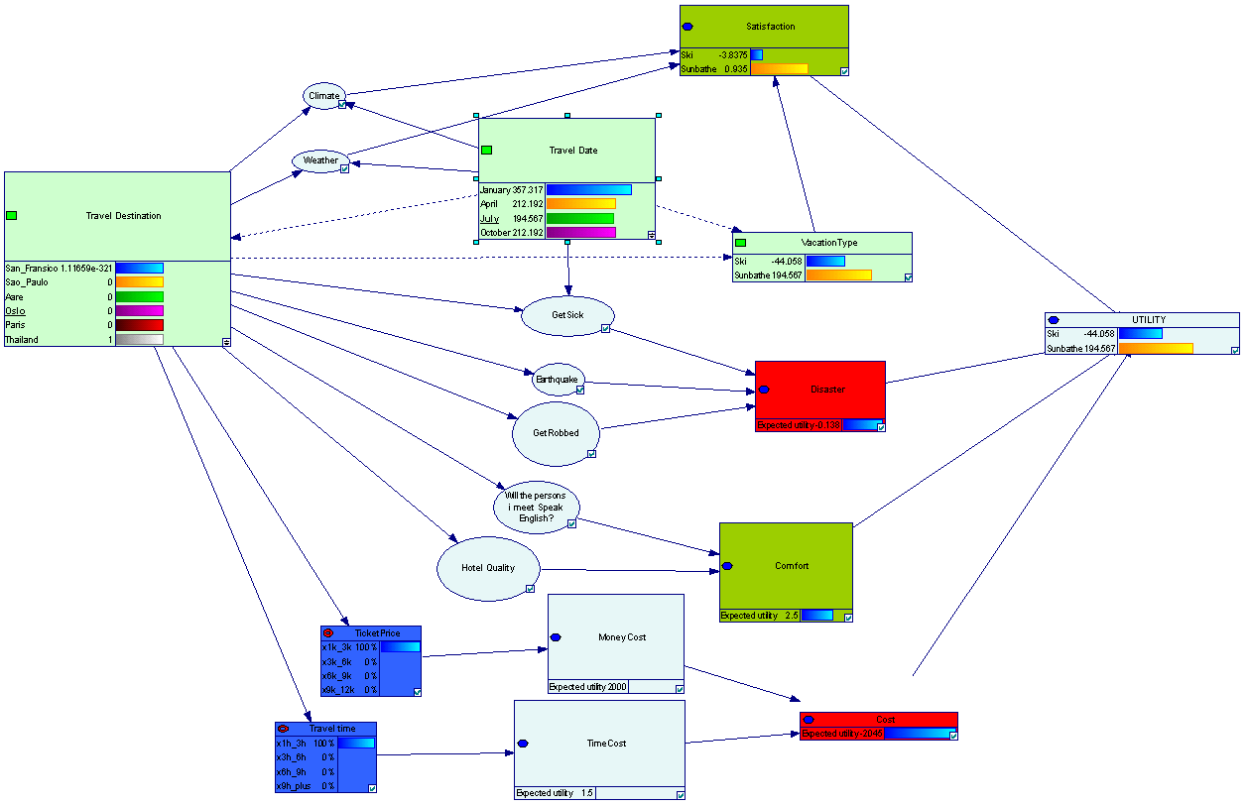


Figure 13: Test case 3: What to pack for Oslo