Norwegian University of Science and Technology

TDT4171 - Assignment 5

Artificial Intelligence Methods

# Decision support system

*Group members*
Zachari Thiry

*Group number:* No Group

February 22, 2023 (Spring 2020)

Comments: None

https://www.ntnu.edu/studies/courses/TDT4171

NTNU
Norwegian University of
Science and Technology

# Introduction

In this assignment, the task consists in creating a decision support system from a chosen decision problem of everyday life.

# 1 Scope of the decision problem

## 1.1 Choosing the problem

This decision problem is based on a common every-day life problem : **"Replacing a computer"**, but tailored with variables specific to me. I was recently confronted with such a problem and used a decision matrix to solve it. Let's see how an influence diagram handles this.

## 1.2 The scope of the problem

In order to limit the problem and keep it simple enough, I will restrain myself from looking out for influences that go beyond a reasonable scope. Thus, this diagram is contained within *some* of the things I will experience during my next semester as an exchange student, especially with regard to professional (and study related), financial and social matters.

# 2 Defining the problem

## 2.1 The variables

First and foremost, let's define the different variables (here the variables that will change how I will experience the semester). For the sake of simplicity, variables will all be binary.

- **EUR_to_NOK:** the exchange rate between Euros and Norwegian krones who will inevitably have an impact on my purchasing power since my only source of income is in Euros for now.
- **Price:** corresponds to the likelihood of my decision being above or below a certain threshold.
- **Workflow:** can be efficient or poor.
- **Trips:** meaning the trips that I will participate to (many or few) and will inevitably be linked to my financial situation, thus my computer choice.
- **Socialising:** How much socialising events I will be attending.
- **Making friends:** can be few or many.
- **Finding love:** a little bit extra, but let's see how this affects everything.

## 2.2 Decisions

In this model, I have decided to add two decisions:

- **Computer type:** which can take the values "mac", "pc" or "None" and represents the chosen computer type for replacement. "None" means no replacement.
- **Find_work:** is a decision I can take and will mostly be affected by my spending (i.e trips and computer price).

# 3 Qualitative work:

I believe a image speaks better than my words, so let's start with the visual representation of the graph.
**NB:** I will be reviewing the utility measures later on.

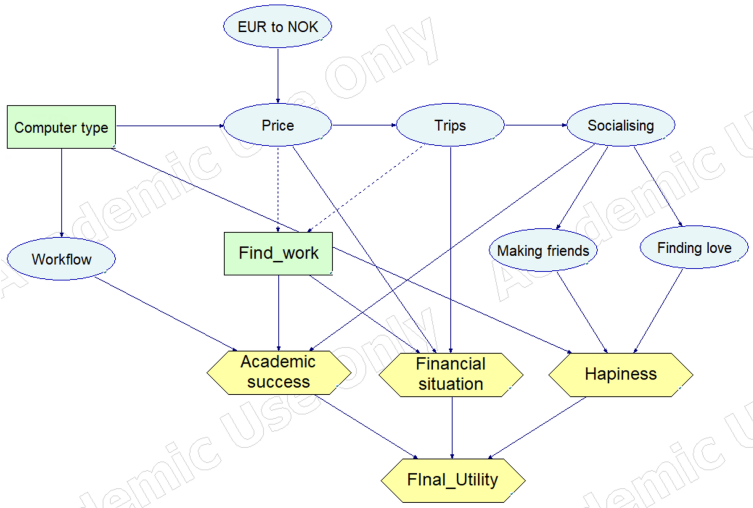


Figure 1: Decision Network

## 3.1 Discussing assumptions

Let's focus on the utility-less part of the influence diagram so we can see better the dependencies. One can notice three distinctive parts to the diagram:

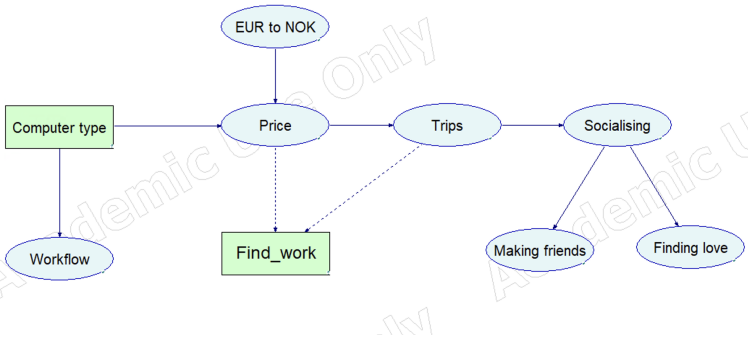


Figure 2: Utility-less decision Network

- The workflow area, which only depends on the chosen computer type : financial situation or social matters are assumed not to have an impact on how efficiently I use my computer
- The financial area, where *Price* depends on the chosen computer type, the evolution of the NOK currency, and how many activities (or trips) I attend. Having to find work will also depend on my spending, namely *Trips* and the computer. *Price*
- The social area which doesn't depend on the currency, nor the trips nor the computer, hence why the single parent *Trips*. Then, with some probability, *Trips* will influence how

much socialising I participate to, thus the friends I make and the likelihood of finding love.

# 4 Quantitative work

## 4.1 The quantitative part of the BN

For this is a short report, I can not go into great details about all the parameters set. Furthermore, it's worth mentioning that I couldn't go deep into choosing very precise parameters since this is solely based on my rough estimates of how things should interact, given the input and my own personality.

**For example :**
See Figure 3 the table of price calculation, based on personally realistic vision of what a mac vs a pc is worth.

| EUR to NOK | c93 | | c110 | |
|---|---|---|---|---|
| Computer type | Mac | PC | Mac | PC |
| less2000 | 0.05 | 0.55 | 0.01 | 0.7 |
| more2000 | 0.95 | 0.45 | 0.99 | 0.3 |

Figure 3: Decision Network

However, even if probabilities seemed realistic at first, the utilities didn't correspond to what I felt exactly, for example, in the Happiness utility (see next part), PC with high social interaction score higher than Mac and low social interaction. This felt biased to me so I decided to tweak some of the probabilities to erase such problems (see left before and right after)

| Computer type | Mac | | PC | |
|---|---|---|---|---|
| Trips | Few | Many | Few | Many |
| Exp. utility | **0.87198** | **0.89851** | 0.80896 | 0.84452 |

| Computer type | Mac | | PC | |
|---|---|---|---|---|
| Trips | Few | Many | Few | Many |
| Exp. utility | **0.780064** | **0.820818** | 0.742008 | 0.793696 |

## 4.2 The utilities

As shown on Figure 1, I make use of four different utilities. The first three are defined as one for each of the fields that matter to me, or how I measure success overall in my life :

- The financial aspect,
- success in what I do,
- feeling of happiness.

These are simple utilities with chosen inputted weights. Although those weights were chosen manually and arbitrarily, they were still distributed in a manner as realistic as possible.

- Academic Success depends on the the efficiency for my workflow, a side job if I have one and how many people I meet. One could argue that it is also related to other nodes, but to keep the model simple, for example with socialising, the parent node only was chosen. This takes values in [0,1].

- Financial Situation : Similar to Academic success, except that the values belong to the interval [-1, 0]. Dependence was given to the sources of spending and earning: *Find_work*, *Price* and *Socialising*

- Happiness : With values in [0, 1], depending on the chosen computer type, since getting a mac has always been a dream. Why isn't *Trips* not connected to *Happiness* ? This is a question of personal choice. In my case, I would argue happiness comes from the people I've met during activities and not activities themselves, hence why *Happiness*is only connected to people. Someone else might could have very well connected it.

On the last step is an Additive Linear Utility called *Final Utility* that just performs a linear transformation over the three inputted Utility results: 0.33 for Academic success, 0.26 for Financial Situation and 0.4 for happiness. These reflect personal preferences and how I weight each of these three criterion in my overall feeling of accomplishment.

## 5 Causality and advice

In terms of advice, this network seems to be giving an accurate description of reality in choosing the computer type: Mac > PC >> None.
This reflects my need for a new computer anyway. As to Mac > PC, this seems to be partly linked to the happiness bias. Removing the direct link between *Happiness* and *Computer_type* indeed brings back the difference between their utilities to almost 0.
In this influence diagram, I was surprised to find how little impact the price had over the utility. Maybe I factored it wrong, though I also thought of the following : Price increasing affects the financial situation negatively, but it increases the chances of finding work, this improving the financial situation.