TDT4171 Artificial Intelligence Methods
Exercise 3

Edgar Vedvik – edgarmv@stud.ntnu.no

2017-03-03

Introduction

In this exercise we were tasked with creating a decision support system for a decision problem of our own choice. The exercise listed some examples, and one of the examples was exactly a problem I was facing this week: *Should I go out on Friday or stay home doing this exercise?* Next week I had many exercises that were due. I also had plans to go to an event Saturday evening. Therefore, I had good reason to stay home. However, as we all know, staying home Friday night doing exercises, while all your friends are out, isn't much fun.

The exercise required that we had to measure the success of our choice. I measured this as the quality of life I would achieve when making this choice. The exercise also required that this decision problem had to contain at least 10 variables, and that half of them would have to be uncertain at the time the decision was made.

The decision problem was modelled in GeNIe, which is a graphical user interface for solving just such a problem. GeNIe's interface was relatively easy to work with once I learned how to create nodes and connect them together and adding probabilities.

Model

Once I had chosen what decision problem to model, and my utility function. I followed the steps recommended in Russell and Norvig (2010, pp. 634) to create the model. The first step was to create a causal model. This meant making a dependency graph, with lines between each dependency. I identified the following variables as directly affecting my quality of life:

- Will I finish the exercise in time?

- Did I have a good time Friday night?
- The amount of money I have.
- My physical state (hungover / tired / well rested)

All of these variables are influenced by many other variables. Including all the variables is not in the scope of this report, but I have included those I found most important:

- Exercise deadline.
- How much of the exercise have i already done (progress).
- Are my friends going out on Friday?
- Did I work this week?
- Did I go out on Thursday?
- Do I have plans on Saturday?
- Will I make those plans?

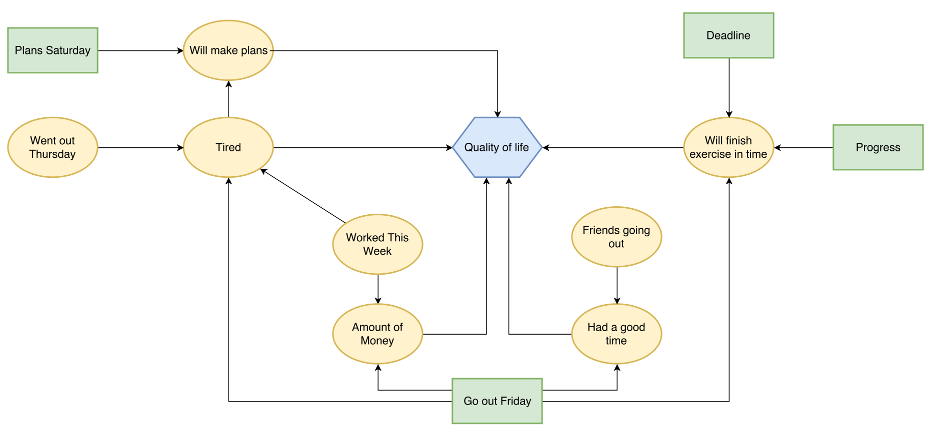

Figure 1: The model of the decision problem. The green rectangles are observable variables. The yellow ellipses are unknown at the time the decision is made, and the blue hexagon is the utility.

After adding all the variables and identifying the dependencies between them I ended up with the model seen in Figure 1. The majority of the dependencies are self-explanatory. Such as why *Will finish exercise on time* depends on when the deadline is and how much of the exercise I have already done. One might think that it should also depend on whether I worked this week as well, since that would take time away from doing exercises. The reason why this is not the case is because when I work, I work mondays. and therefore it becomes too long ago for it to matter. If the exercise is due next week then it will be affected by work that week, but not this week.

The second step was to simplify and remove variables that did not affect the decision. Because my model was so simple and all variables affected my utility function, I skipped this step.

Next step was to assign probability to each unknown state. Some of these were simple, like whether my friends are going out, if I have to work this week and the probability of going out on a Thursday. None of these variables depended on other variables, making figuring out the probability as easy as just remembering how often these things happen.

With all the edge variables and decisions added, the more complex variables had to be created. These are also based mostly on empirical evidence. The most complex probability table was the *Will finish exercise in time*, which depended on when the deadline was, my progress on the exercise and whether I would go out on Friday. Since both deadline and progress had three values to choose from, making it a 18x2 big probability table. A small piece of it can be seen in Table 1.

Progress	Halfway		
Go out on Friday	No		
Deadline	Two weeks	Next week	Tomorrow
Yes	0.95	0.95	0.9
No	0.05	0.05	0.1

Table 1: Probability of finishing the exercise before deadline.

Whether the deadline is next week or the week after, almost doesn't matter. I normally don't start exercises weeks ahead of time, so for me not to make it in time, depends on other factors that I have not added to my model (such as sickness). If the exercise was due on Monday, for example, then there should be a difference, but since I am already half way done, I should have more than enough time. We also see that even if the exercise was due tomorrow, the probability of making it is still very high. This is because I have no problem pulling an all-nighter if I have to.

The next step was to assign utilities. I decided to use an additive utility model because it seemed natural for this problem. My quality of life is improved more by finishing the exercise than being well rested for example. The value of each variable affecting my quality of life can be seen in Table 2. All of these are taken from my personal experience of what I value most in life. I decided that each value should be in the range $[-10, 10]$.

I decided that my utility function should be the change in my quality of life.

Variable	Utility
Finish exercise	9
Tired	-1
Made plans	5
Money(Broke, Some, Rich)	-1, 4, 6
Had a good time	6

Table 2: How much the variables affect my quality of life.

Meaning that it could be both negative and positive. My utility function therefore adds the inverse value for the inverse variable. For example, not finishing the exercise would add minus nine to the utility function. This does not apply to the money variable, since it is not a yes/no variable. With this, the best achievable quality of life is 27 and the worst is -22.

Russell and Norvig (2010, pp. 634) suggests two more steps: verify and refine the model and perform sensitivity analysis. These two steps were done in parallel with the previous steps. Whenever a variable got a value that did not match with my perception of it, I went back and adjusted the probabilities.

Results

After following all the steps, I ended up with the model seen in Figure 2. I have entered evidence such as when the exercise is due and how much of it I had done. I also had plans Saturday so I entered that as well. The difference in staying home, doing exercise and going out are not that big, with only a difference in 1.5 between them. Regardless of my choice, my quality of life would improve,

To make sure my model was good, I tried out a few other scenarios. The results can be seen in Table 3 and Table 4.

	Quality of life
Went out	-0.4725
Did exercise	6.067

Table 3: If the exercise was due Saturday instead of next week.

If the exercise is due tomorrow, quality of life drops significantly regardless of my choice, but drops much more if I go out. It also matters very little whether the exercise is due next week or the week after, which is as expected since I usually don't do exercises that are due more than a week from now.

If I do not plan on going out on Saturday, going out on Friday increases by about 4. This makes sense since I usually go out on at least Friday or Saturday. There is also a slight increase in staying home if I have no plan on Saturday.

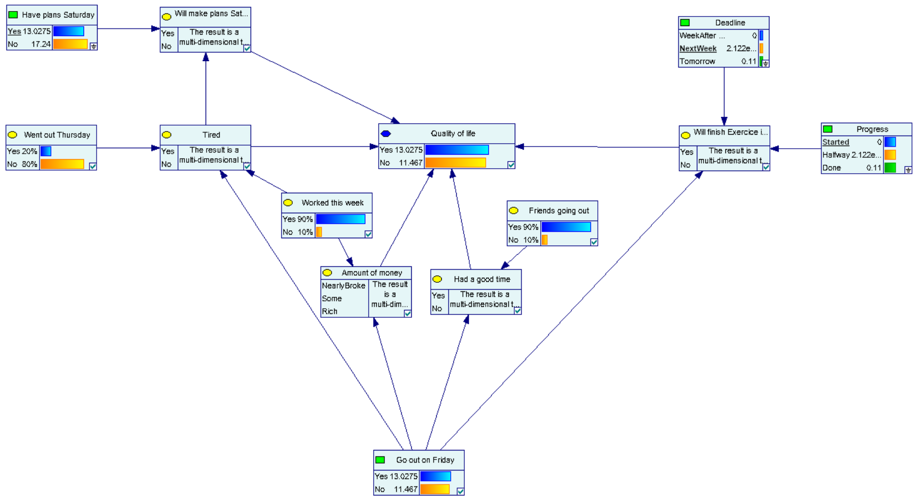

Figure 2: The finished model in GeNIe.

	Quality of life
Went out	17.38
Did exercise	12.59

Table 4: If I have no plans of going out on Saturday.

This points to that my model is not perfect, since ideally this should stay the same, or go down slightly.

Discussion

Overall, the results from my model matches my expectations. My quality of life increases regardless of my choice, since either I get to have fun or I am one exercise closer to being done for this semester. Both of which affects my life in a positive way.

There were, however, some inconsistencies. If I did not have plans on Saturday I expected the model to show a slight decrease in life quality if I then chose to not go out on Friday. However, my model gave it a slight increase. This is because, in my model, the quality of life is not dependent on a *did I go out this weekend* variable, which it should have been.

References

Russell, S. J., & Norvig, P. (2010). *Artificial intelligence: A modern approach* (3rd ed.). Pearson Education.