

TDT4171 Artificial Intelligence Methods

Exercise 3

March 3, 2016

- **Delivery deadline: April 21, 2016** by 8:00 a.m.
- Required reading for this assignment: Chapter 16.7.
- Deliver your solution on *It's Learning*.
- Please upload your report as a single **PDF file**, and pack everything else (such as GeNIe files) into an archive (zip, rar, gz,). Please **do not** put the pdf into the archive, but upload two separate files: pdf + archive. If you use Word, you can convert to pdf on the IDI terminal servers. If you want to use plain ASCII, then you should also convert that to PDF (e.g., by typing in Word and following the procedure just mentioned).
- Students may work in groups of two.
- This homework counts up to 8% of the final grade.
- The homework is graded into three different levels: 8, 4 or 0 points. A full grade will only be given when a decent attempt has been made to build a decision support system with a clear readable report.
- Cribbing from other students ("*koking*") is not accepted, and if detected will lead to the assignment being failed.

Exercise: Create a decision support system for a decision problem of your own choice

In this assignment you should make a decision support system, which should help you make a decision from your every-day life. Examples of possible decision problems you may want to build a decision support system for are:

- Should I go out on Friday or stay home doing this exercise?
- What is the best behavior for a poker game (seen as a sequential decision problem)?

- Selecting your partner
- Choosing a destination for your next summer holidays
- ...etc.

As you see, the decision problems used as examples here are like the ones we do all the time, but they are still fairly complex. For instance, the answers to the decision problems are not trivial before we start modeling! It is required that the decision problem you decide to model has the same property.

More specifically, the decision problem you consider can be big or small, but should involve:

- At least one decision, with explicit decision alternatives, and a non-trivial solution
- Uncertainty that you are able to structure in a model containing at least 10 variables.
 - At least half of the variables should be uncertain, and you need to quantify this uncertainty using probabilities
 - There must be some uncertainty at the time the decision is made. Thus, if all your variables can be observed, at least some of them should not be observed until after the decision is made.
- A way to measure the success of your decision (e.g., a preference structure or a utility function)
 - The preference structure must be represented in a way that facilitates the decisions to be made

To get a grip on how to proceed, it is recommended that you start by reading Section 16.7 in the book, consider to follow the approach outlined there, and see also the lecture slides used to present this exercise. Note, however that copying the model and/or use exactly the same domain is not accepted.

Note!

It is the modeling of the decision problem that is of importance here. Hence, modeling, and not the algorithms that are used to make the decisions, is the focal point of this assignment. This also implies that there will be no need to implement the mathematics of, e.g., the maximum expected utility - principle. Rather, you can use a software package like GeNIe to help you design your model and help you find what quantification that is required for the model to be fully specified. If you choose to use GeNIe you can (partly) document your work by including a screenshot of the GeNIe model.

You should, however, also report at least some of the probability tables and discuss how you were able to quantify them. In the same vein, you are asked to discuss how you decided on the quantification of the utilities.

The homework is graded into three different levels (8, 4 or 0 points). The focus of this assignment is modeling. The grading will be based on

- Your ability to choose a reasonable modeling representation
- That you build a good model:
 - Document the model structure as well as some of the quantitative statements you have used
 - List and discuss assumptions you make, both in the modeling representation (e.g., BNs) and in your particular model (e.g., conditional independence assumptions you make)
 - That you employ and describe a realistic/reasonable scheme for quantification of uncertainties (see, e.g., Exercise 16.1 in the book for a “calibration-technique”)
 - That you employ and describe a realistic/reasonable scheme for quantification of utilities
- “Report quality” (max 8 pages - a typical report from a single student will not be above 6 pages)
 - Your report with a single PDF file should be clear enough to represent your answer. The supplement, such as GeNIe file, will be only used when we verify your answer for evaluation.

For this assignment, you are allowed to work in groups of two students (you may work alone as well). If you team up, however, you need to describe differences in the team members’ preference structures/assessment of uncertainty. Describe where it stems from, and what the effect is on the decision making. If you are cooperating with someone, you should still only deliver the report once for the whole group. Mark your report with the names of the participants, and also use It’s Learning to let the TAs know that the report is a collaborative effort.