

Assignment 5

TDT4171 — Artificial Intelligence Methods

February 2023

Information

- **Delivery deadline: February 27, 2023 by 23:59.** No late delivery will be graded! Deadline extensions will only be considered for extraordinary situations such as family or health-related circumstances. These circumstances must be documented, e.g., with a doctor's note ("legeerklæring"). Having a lot of work in other classes is not a legitimate excuse for late delivery.
- Cribbing("koking") from other students is not accepted, and if detected, will lead to immediate failure of the course. The consequence will apply to both the source and the one cribbing.
- Students can **not** work in groups. Each student can only submit a solution individually.
- Required reading for this assignment: Chapter 15. Making Simple Decisions (the parts in the curriculum found on Blackboard "Sources and syllabus" → "Preliminary syllabus") of Artificial Intelligence: A Modern Approach, Global Edition, 4th edition, Russell & Norvig. (Additional reading on sequential decisions can be found in Chapter 16. Making Complex Decisions.)
- For help and questions related to the assignment, **ask the student assistants during the guidance hours.** The timetable for guidance hours can be found under "Course work" on Blackboard. For other inquiries, an email can be sent to tdt4171@idi.ntnu.no.
- Deliver your solution on Blackboard. Please upload your assignment as one PDF report.

Exercise 1 - Decision Support System

In this task, you will create a decision support system for a decision problem of your choice. This decision support system should help you make a decision from your everyday 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 modeling. The decision problem you decide to model is required to have 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 7 variables.
 - At least 5 of the variables should be uncertain, and you need to quantify this uncertainty using probabilities.
 - The uncertain variables should be observed after a decision is made.
- A way to measure the success of your decision (e.g., a preference structure or a utility)
 - 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 15.5 on Page 534 in the book. Consider following the approach outlined there, and see also the lecture slides concerning this topic. However, note that copying the model and/or using exactly the same domain is not accepted.

It is the modeling of the decision problem that is of importance here. Hence, modeling, and not the algorithms used to make the decisions, is the focal point of this task. This also implies that there will be no need to implement the mathematics of, e.g., the maximum expected utility – principle. Instead, you can use a software package like GeNIe¹ to help you design your model and find what quantification is required for the model to be fully specified. If you choose to use GeNIe, you can (partly) document your work by including screenshots of the GeNIe model in the PDF report. Additionally, you should also report at least some of the probability tables. (See Exercise 16.1 for a “calibration-technique” to help with reasonable quantification of uncertainties.) You do not need to include the GeNIe file in your delivery.

¹Instructions on how to install GeNIe is available on Blackboard under “Course work”.

The delivery should consist of a PDF report of max 5 pages (a typical report will not need to be above 2-3 pages). In the report you should:

- Document the model structure as well as some of the probability tables and utilities you have used.
- List and discuss assumptions you make, e.g. conditional independence assumptions.