Name:

Birth Date:

Matriculation Number:

Mock Exam
Künstliche Intelligenz-2

July 9., 2017

	To be used for grading, do not write here							
prob.	1.1	1.2	2.1	3.1	4.1	4.2	Sum	grade
total	8	14	20	6	20	12	80	
reached								

Exam Grade: Bonus Points: Final Grade:

The “solutions” to the exam/assignment problems in this document are supplied to give students a starting point for answering questions. While we are striving for helpful “solutions”, they can be incomplete and can even contain errors.

If you find “solutions” you do not understand or you find incorrect, discuss this on the course forum and/or with your TA and/notify the instructors.

In any case, grading student’s answers is not a process of simply “comparing with the reference solution”.

In the course Artificial Intelligence I/II we award 5 bonus points for the first student who reports a factual error (please report spelling/formatting errors as well) in an assignment or old exam and 10 bonus points for an alternative solution (formatted in LaTeX) that is usefully different from the existing ones.

1 Bayesian Reasoning

Problem 1.1 (enumeration)

Explain the Inference by Enumeration algorithm, query variables and hidden variables. 8 pt

4 min

Problem 1.2 (Earthquake Alarm)

Your house has an alarm A which is (verly likely) set off by a burglar B, but can also (rarely) be set off by an earthquake E. Your two neighbours John and Mary are supposed to call you (J and M) when your alarm goes off and you are not at home. 14 pt 7 min

Use the algorithm from the lecture to construct a Bayesian network for these 5 variables. More precisely:

1. State the exact formal condition for when the algorithm inserts an edge between two nodes. 6 pt

2. Execute the algorithm for the variable order $X_1 = B$, $X_2 = E$, $X_3 = A$, $X_4 = J$, $X_5 = M$. 8 pt

Justify your decisions.

Solution:

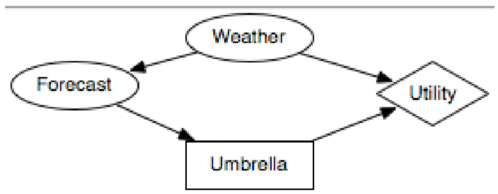
2 Decision Theory

Problem 2.1 (Decision Network)

You try to decide on whether to take an umbrella to Uni. Obviously, it's useful to do so if it rains when you go back home, but it's annoying to carry around if it doesn't even rain. You look at the weather forecast, which hast three possible values: sunny, cloudy and rainy. 20 pt 10 min

1. Draw the decision network for bringing/leaving an umbrella depending on whether it does or doesn't rain later.
2. Explain *formally* how to compute whether or not to take an umbrella, assuming you know $P(rain = b|forecast = x)$ for all $b \in \texttt{Bool}, x \in \{\texttt{sunny}, \texttt{cloudy}, \texttt{rainy}\}$.

Solution:



Let $U_{\pm r,\pm u}$ be the base utilities of having an/no umbrella when it rains/doesn't rain. Assume the forecast says x, then compute:

$$U(umb) = P(rain = \top|forecast = x)U_{+r,+u} + P(rain = \bot|forecast = x)U_{-r,+u}$$
$$U(\neg umb) = P(rain = \top|forecast = x)U_{+r,-u} + P(rain = \bot|forecast = x)U_{-r,-u}$$

If the former is greater than the latter you should take an umbrella.

3 Markov Models

Problem 3.1 (Stationary)

Define what it means for a Markov model to be *stationary*, and why we are interested in stationarity. 6 pt

3 min

Solution:A Markov process is called stationary if the transition model is independent of time, i.e. $\mathbf{P}(\mathbf{X}_t \mid \mathbf{X}_{t-1})$ is the same for all t.

We like stationary Markov processs, since they are finite.

4 Learning

Problem 4.1 (Tennis Trees)
Consider the following decisions on whether or not to go play tennis. The target is "PlayTennis". 20 pt

10 min

Outlook	Temperature	Humidity	Wind	PlayTennis
Sunny	Hot	High	Weak	No
Overcast	Hot	High	Weak	Yes
Rain	Mild	High	Weak	Yes
Rain	Cool	Normal	Strong	No
Rain	Mild	Normal	Weak	Yes

Apply decision tree learning to this table.

Solution:`http://courses.cs.tamu.edu/choe/17spring/633/lectures/slide05.pdf`

Problem 4.2 (Linear Regression)

Given a set of examples $E \subseteq \mathbb{R}\times\mathbb{R}$, explain how to do *linear regression by loss minimization* 12 pt

6 min