Foundations of Artificial Intelligence
Reconstruction of 2014's exam (16.09.2014)

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Permitted exam aids:	none
Duration:	90 Minutes

Task 1 – MinMax Algorithm

Sadly, we weren't able to reconstruct this task.

The only thing we remember is that the tree had a probabilistic step.

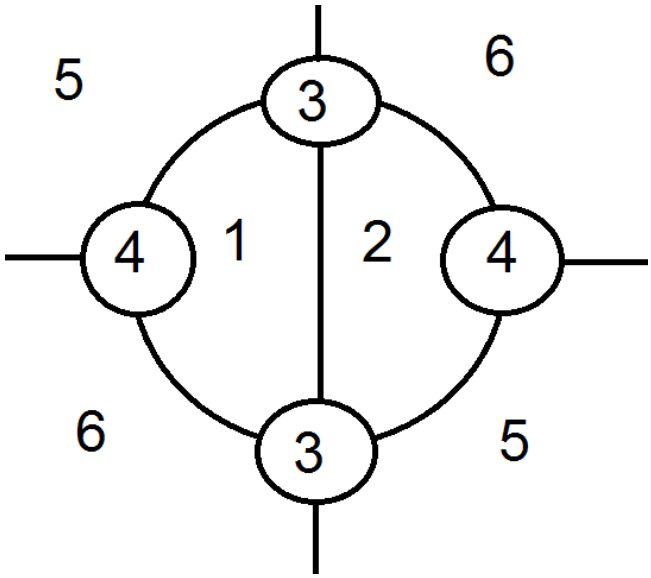
Task 2 – Decision Trees

Sadly, we weren't able to reconstruct this task.

The only thing we remember is that a table was given, one was supposed to calculate the gain values and then build a decision tree and convert it to DNF. The task did have some similarities with Task 6.5 on `http://gki.informatik.uni-freiburg.de/teaching/ss14/gki/exercises/sheet06-english.pdf`.

Task 3 – Forward Checking

You are a gardener assigned to the following garden:



You can choose one flower-type for each patch (1-6). Available flower-types are A, B, C, D and E. You may not assign the same flower-type to two adjacent patches. Execute the forward checking algorithm using the following tie-breakers:

- most constrained first
- if equally many constraints apply, choose the flower-type earlier in the alphabet for the patch with the smaller number

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The result should get inserted into a table, one calculation step per line (one column for each patch). The first line contained the first step as an example.

Task 4 – Allen's Interval Calculus

a) Given the following statements

popcorn $overlaps^{-1}$ movie credits $finishes$ movie

Which statements can get deduced between popcorn and credits?

b) Is $starts^{-1}$ equal to $finishes$? Explain your solution.

Task 5 – STRIPS

Consider $< \mathcal{S}, \mathcal{O}, \mathcal{I}, \mathcal{G} >$ with

$$\begin{aligned} \mathcal{S} &= \{X, Y, Z, G\} \\ \mathcal{O} &= \{A, B, C, D\} \\ \mathcal{I} &= \{X\} \\ \mathcal{G} &= \{G\} \end{aligned}$$

where the actions A, B, C, D are given as

A	pre : $\neg Y$	post : $\neg X$
B	pre : $\neg X$	post : X, Y
C	pre : X, Y	post : $\neg Y, Z$
D	pre : X, Y, Z	post : G

and the plan π, given as

$$\pi =< A, B, C, B, D >$$

a) Execute π as far as possible, and give the set of predicates active after each step of your execution. If π cannot get executed completely, state the reason why the execution failed.

b) Derive a plan π' from π, which solves the planning task. You may only add one single action.

Task 6 – A*-Algorithm

Sadly, we weren't able to reconstruct the actual graph, its costs, and the actual heuristic function. You were given a graph with labeled nodes, and costs assigned to each edge. A text described one note as starting point, and another node as target node. Additionally, a heuristic function h was given as a table (one value for each node in the graph, excluding the target node).

a) Execute the A*-Algorithm. While executing, annotate the graph with all f and g values. Mark each node with the number of the iteration in which it was expanded.

   Draw the resulting tree.

b) What property of the heuristic function is required for A^* to yield a optimal result? What happens if this property is violated?

Although we weren't able to completely reproduce this task, we'd like to note an (in our opinion) important fact about the actual graph that was used in the exam:

One node's g value was updated while applying the algorithm. When drawing the tree while applying the algorithm, this lead to the tree no longer be a tree (as there are two edges towards the updated edge). To preserve the tree, the old edge has to be removed, or the solution wouldn't get accepted.

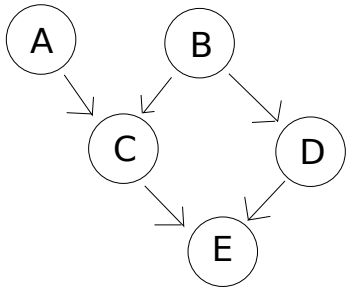
Task 7 – Bayesian Networks

Tables with conditional probabilities were given. **(Which sadly couldn't be reconstructed)**

a) Draw the corresponding Bayesian-Network.

b) Calculate P(D).

c) Give a definition of the Markov Blanked and indicate the Markov Blanket of D in the following network.



Task 8 – Satisfiability

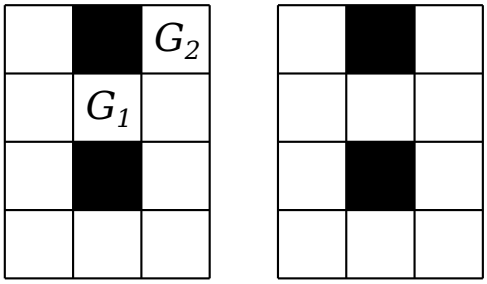
a) Apply the Resolution method to something given (**which is obviously missing in this reconstruction**).

b) Apply the DPLL algorithm on a given Formula (**which is obviously missing in this reconstruction**). **Note: There was one backtrack in the solution.**

Task 9 – Grid World

Consider the grid world, where only horizontal and vertical movements by one position per step are allowed. Positions marked black are inaccessible.

a) Unfortunately, we couldn't remember this task exactly. The rewards of the end positions G_1 and G_2 were given. One $G_?$ had a bad reward and should have been avoided. There must have been further information about the rewarding system (e.g. discount) and probabilities to success or fail, when making a move.
One task was to calculate the *utilites or rewards* of the empty cells on the left. The other task was to fill in the *optimal policy* (obtained by human intuition) on the right.



b) Apply two steps of *value iteration* on the following grid with given (sub-optimal) utilities. Fill in the improved utilities after each step.