Course: **010 595 001 - ARTIFICIAL INTELLIGENCE**

Lecturer: Jan VORACEK Examination date: 28.2.2001

Notes: a) *student can use a general mathematical handbook, English dictionary and a calculator*
b) type, please, your answers in English

Example 1: **Searching** *(2x4 pts.)*

For each of the following, give a graph that is a tree (there is at most one arc into any node), contains at most 15 nodes, and has at most two arcs out of any node.

a) Give a graph where depth-first search (DFS) is much more efficient than breadth-first search(BFS).
b) Give a graph where BFS is much better than DFS.
c) Give a graph where A* search is more efficient than either BFS or DFS.
d) Give a graph where DFS and BFS are both more efficient than A* search.

The comparison criteria (level of efficiency) for all the above cases is the number of expanded nodes.

Example 2: **Prolog programming** *(1x5+3 pts.)*

Consider the following Prolog code:

```
edge(a58, b58).
edge(c24, d18).
edge(a58, c24).
edge(d18, e06).
edge(b58, d18).
connected(Node1, Node2) :- edge(Node1, Node2).
connected(Node1, Node2) :- edge(Node1, Link), connected(Link, Node2).
```

a) What will be Prolog's first answer to the query `connected(d18, Y).` ?
b) What will be Prolog's second answer to the query `connected(X, d18).` ?
c) What will be Prolog's first answer to the query `edge(X, c24).` ?
d) What will be Prolog's first answer to the query `edge(X. a58).` ?
e) What will be Prolog's first answer to query `connected(D18, Y).` ?
f) Do you know some "non-logical", procedural-oriented predicates in Prolog? If yes, give an example and explain why such predicate is useful, otherwise explain why it is impossible to have such elements in the logical programming.

Example 3: **Learning** *(2+2+4 pts.)*

Consider the data on 4 Boolean attributes *a,b,c,*and *d*, where *d* is the target classification:

	a	**b**	**c**	**d**
e1	true	true	false	false
e2	false	true	false	true
e3	false	true	true	true
e4	false	false	true	false
e5	true	false	false	false

In this question we will consider decision-tree learning based on this data.

a) What is a good attribute to split on first? Explain why.
b) Draw a decision tree that a top-down decision tree-learning algorithm could build. For each node (including the leaves) show which examples are used to determine the classification at that node (the root of the tree will be labeled with the list of all of the examples).
c) Explain how the learning bias inherent in learning decision-trees can be used to classify unseen instances. Give all instances that are not in the training data and show how the above tree classifies them. Justify why this is an appropriate classification.

Example 4: **Rule-based systems** *(1.5x4 pts.)*

For each of the following activities explain which technique you should use, forward chaining, backward chaining, or a combination:

a) medical diagnosis,
b) planning a party,
c) natural language understanding,
d) game playing such as chess or bridge.