Course:	**010595001 - ARTIFICIAL INTELLIGENCE**		
Lecturer:	Jan VORACEK	Examination date:	11.1.2001

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

Example 1: **Answer [Y/N] and explain with one sentence the following questions** *(no explanation = no points):*

a) Breadth-first is an optimal search algorithm. *(1 pt.)*
b) Truth tables can be used to establish the truth or falsehood of any propositional sentence. *(1 pt.)*
c) Forward chaining is complete for first-order logic. *(1 pt.)*
d) $\forall x \, \exists y \; x = y$ is a satisfiable sentence. *(1 pt.)*
e) Minimax and Alpha-Beta can sometimes return different results. *(1 pt.)*
f) Simple reflex agents cope well with inaccessible environments. *(1 pt.)*

Example 2: **Logical inference** *(6 pts.)*

If possible, give an unifier for each of the following pairs of sentences or write *"None"* and briefly explain, if not available:

```
1.          Between (1,x,2)            Between (y,F(y),2)
2.          > (x,y)                    < (x,y)
3.          Related (x, Father(x))     Related (Father(y), y)
```

Example 3: **Uncertain knowledge and reasoning** *(8 pts.)*

A policeman views a very expensive care running a stop sign late at night. He immediately pursues. In his mind, he tries to determine the reason that the driver has run the stop sign and comes up with the following reasons along with prior probabilities for each:

```
The car was stolen.                     (20%)
The driver is drunk.                     (30%)
The driver is tired.                     (45%)
The driver is a kid out for a joyride.  ( 5%)
```

The policeman also figures that the likelihood that the driver of a stolen car might run a stop sign is 75%, that drunk driver might run a stop sign is 40%, that a tired driver might run a stop sign is 30% and that a kid out joyriding might run a stop sign is 90%.

Use Bayes' formula to compute the probability of each possible cause. Which one is the most likely?

Example 4: **Learning** *(8 pts.)*

```
RUN    OPERATOR    MACHINE    OVERTIME    OUTPUT
----------------------------------------------
1.     Patrick     a          no          high
2.     Patrick     b          yes         low
3.     Thomas      b          yes         low
4.     Patrick     b          no          high
5.     Sally       c          no          high
6.     Thomas      c          no          low
7.     Thomas      c          no          low
8.     Patrick     a          yes         low
```

Construct the smallest identification tree possible for predicting **the output** in a factory setting using the data recorded in the table above. Use an Average Disorder Formula (ADF) to select which attribute to use at each step of the construction. Show your work and draw the final structure.

$$\text{ADF}: \quad \sum_b \left(\frac{n_b}{n_t}\right) * \left(\sum_c -\frac{n_{bc}}{n_b} \log_2 \frac{n_{bc}}{n_b} \right)$$

```
x         | 1 | 1/2 | 1/3  | 2/3  |  2/5  | 3/5
-------------------------------------------------
log₂(x)   | 0 | -1  | -1.6 | -0.6 | -1.33 | -0.74
```

Theoretical questions

1. Compare principles of Machine Learning (*ML*) and Knowledge Discovery from Databases (*KDD*). *(4 pts.)*
2. Sketch and describe a complete Fuzzy Inference System (*FIS*). *(4 pts.)*