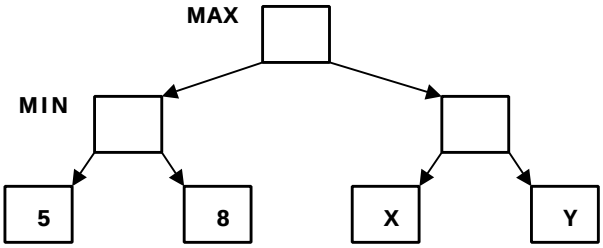
Course: **010 595 001 - ARTIFICIAL INTELLIGENCE**

Lecturer: Jan VORACEK Examination date: 20.4.2001

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

Example 1: **Games** *(3+3 points)*

a) In the *MAXMIN* tree shown below, for what values of node *X* can node *Y* be pruned?



b) Name three conditions that must hold on a game for the technique of *MINMAX* game-tree evaluation to be applicable.

Example 2: **Prolog** *(6 points)*

Suppose that you have the following small family tree in *Prolog:*

```
parent(philip, charles).
parent(philip,anne).
parent(charles, william).
```

Further, you have the following recursive definition of `**ancestor**:

```
ancestor(X,X).
ancestor(X,Z) :- parent(X,Y), ancestor(Y,Z).
```

Now a user comes and issues the query:

```
?- ancestor(A,B).
```

Each time that *Prolog* returns an answer, the user inputs "**;**" to ask it to look for another answer. What answers does *Prolog* return, and in what order?

Example 3: **Alternative optimization** *(3+3 points)*

Local minima can cause difficulties for a hill climbing search strategy. The same holds for the feed-forward neural network adopted with the backpropagation algorithm. Explain the following:

a) local minima of **what** function of **what** arguments,
b) why do they create difficulties?

Example 4: **Inductive learning** *(3+3 points)*

In inductive learning of the definition of a concept from labeled examples:

a) what is a false positive,
b) what is a false negative?

Give one example of each!

Example 5: **Rule-based systems** *(6 points)*

Consider the following set of rules that describe when a person can vote in a presidential election:

```
R1: IF ?x was born in the US THEN ?x is an American
R2: IF ?x received US citizenship THEN ?x is an American
R3: IF ?x's age >= 18 THEN ?x is an adult
R4: IF ?x is American AND ?x is an adult THEN ?x can vote
```

Assume that the operator "**>=**" (*greater than or equal*) is a basic operator implemented in the inference engine. The working memory contains the following assertions:

```
A1: Bill's age is 16.
A2: Sue received US citizenship.
A3: Bill was born in the US.
A4: Sue's age is 20.
```

Use backward chaining (*BC*) to determine whether or not Bill can vote. Construct a tree showing the steps followed by *BC* and show when and how the working memory is updated during the depth first search. Mark tree edges with the numbers of applied rules.