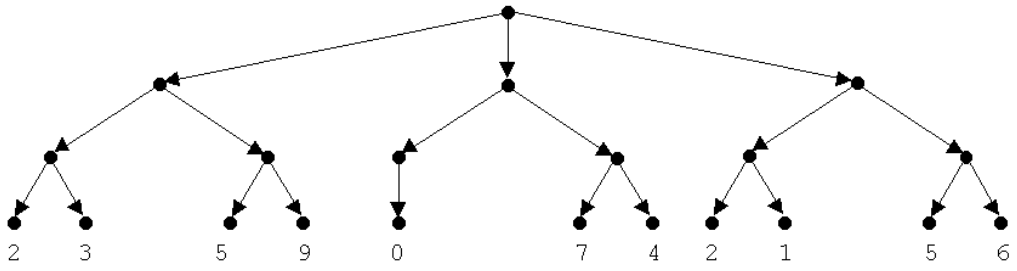
Course	**1595 - Artificial Intelligence**		
Lecturer:	Jan VORACEK	Examination date:	7.4.1999
Notes:	*a) calculators, dictionaries and mathematical handbooks are allowed* *b) type, please, your answers in English*		

Problem 1 - **`Minimax` searching with `Alpha-Beta` pruning** *(3 pts.)*

In the two-player game tree given below:

(a) label the nodes visited with their assigned values determined by running **`Minimax`** with **`Alpha-Beta`** cutoffs (assume left-to-right search),

(b) clearly indicate which branches would NOT be explored due to **`Alpha-Beta`** pruning.



Problem 2 - **Prolog programming** *(3 pts.)*

Write a Prolog program that returns the sum of the numbers between *1* and *N* (assume *N >= 1*).

Problem 3 - **Probability-based reasoning** *(6 pts.)*

Suppose that 5 percent of men and 0.25 percent of women are color blind.

(a) Construct a belief network describing totally this situation (male, female, color blind) to represent knowledge of this domain. Make sure to draw arcs appropriately and indicate the conditional probability tables for each node. Assume that there are an equal number of males and females.

(b) A color blind person is chosen at random. What is the probability of this person being male?

(c) How does your answer to (b) change if the population consisted of twice as many males as females?

Note: let us assume, that only males and females were evaluated.

Problem 4 - **Production systems** *(6 pts.)*

Let us have the well-know water jug problem. Any state may be represented as a pair *(x,y)*, where:

x stands for the amount of water in the 4-liter jug, and
y denotes the amount of water in the 3-liter jug.

The initial state is *(0,0)* and the goal state is *(2,0)*.

All ten basic operations are in this example represented in the language of production rules as follows:

```
R1:  (x,y) -> (4,y)         if x < 4
R2:  (x,y) -> (x,3)         if y < 3
R3:  (x,y) -> (x-d,y)       if x > 0
R4:  (x,y) -> (x,y-d)       if y > 0
R5:  (x,y) -> (0,y)         if x > 0
R6:  (x,y) -> (x,0)         if y > 0
R7:  (x,y) -> (4,y-(4-x))   if x+y >= 4 and y > 0
R8:  (x,y) -> (x-(3-y),y)   if x+y >= 3 and x > 0
R9:  (x,y) -> (x+y,0)       if x+y =< 4 and y > 0
R10: (x,y) -> (0,x+y)       if x+y =< 3 and x > 0
```

(a) Design and describe single steps of your own control strategy of rule-based problem solving approach to this problem. Upper limit of number of rules applied is six !

(b) Express your solution in a tabular form with the following heading:

```
state_number     x     y     rule_applied
```

(c) Sketch complete solution sub-tree with at least three alternatives at each perspective node (if possible). Expand only the path to the final state, all other branches are out of our interest.

Problem 5 - **Inductive learning** *(6 pts.)*

Consider the following six training examples:

Example	Color	Shape	Size	Class
1	red	square	big	+
2	blue	square	big	+
3	red	round	small	-
4	green	square	small	-
5	red	round	big	+
6	green	square	big	-

and compute complete corresponding decision tree, based on the ***largest*** expected ***information gain*** of critical (decisive) attribute (i.e. try to select the attribute that will result in the smallest expected size of the sub-trees rooted at its children) - just as *ID3* algorithm.

GOOD LUCK!