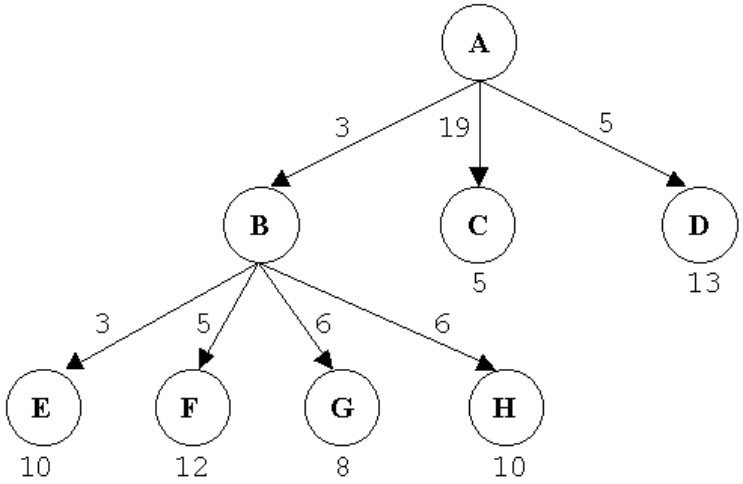
Subject: **1595 - Artificial Intelligence**

Lecturer: Jan VORACEK Examination date: 17.12.1998

Notes: *a) calculators and mathematical handbooks are allowed*
b) please, type your answers in English
c) solutions- see course web page

Problem 1 - Searching *(4 pts.)*

The following diagram shows a partially expanded search tree. Each arc is labeled with the corresponding step cost; all the leaves are labeled with their heuristic evaluation.



Let us suppose that we are in the node A.
Which leaf will be expanded next by :

a) the greedy search,
b) the uniform-cost search,
c) the A* search.

Problem 2 - Production systems *(6 pts.)*

Suppose that we have a production system, which contains following rules:

`R1:` `if` X is divisible by 18 `then` X is divisible by 9
`R2:` `if` X is divisible by 30 `then` X is divisible by 15
`R3:` `if` X is divisible by 9 `then` X is divisible by 3
`R4:` `if` X is divisible by 15 `then` X is divisible by 5

and we know some number `N`, which is divisible by 18 and 30, and the problem is to determinate `if` N is divisible by 5.

a) Formulate (describe) own resolution strategy and solve this problem. Use the two-column notation (working memory, applied rule).
b) Outline the whole possible 'search space' (nodes represent the rule numbers).

Problem 3 - Predicate calculus *(6 pts.)*

a) Answer following question in accordance with the Prolog philosophy and explain your solutions:

Knowledge base:

```
bachelor(P) :- male(P), not(married(P)).

male(henry).
male(tom).

married(tom).
```

Query:

```
?- not(married(Who)).
```

b) Complete following Prolog queries:

```
?- X is 2+3.

?- 2+3 is 2+3.

?- a+b+c = X+Y+Z.

?- a+b = b+a.
```

Problem 5 - Knowledge Discovery *(4 pts.)*

Sketch two diagrams. First should specify the whole Knowledge Discovery problem and second its position in the Decision-Making cycle. Which part(s) of the first and the second ones are the most suitable for AI techniques application?

Problem 6 - Genetic Programming *(10 pts.)*

Describe and sketch the first step of searching for the most suitable formula for the Kepler's Law if you have an adequate number of training samples - pairs `(A,P)`:

planet	A	correct P
Venus	0.72	0.61
Earth	1.00	1.00
Mars	1.52	1.84
Jupiter	5.20	11.9
Saturn	9.53	29.4
Uranus	19.1	83.5

Searched formula is explicitly given as

```
P**2 = c * A**3
```

where `P` is orbital period in Earth years

`A` is average distance from the Sun in Earth units

`c = 1` with these units

Additional requirements:

- Specify own reasonable set of functions and variables.
- Deal only with a syntactically correct constructions.
- Use three initial parse trees (population) of the same depth as the aforementioned equation has
- Define own fitness function and evaluate the whole initial population.
- Formulate own (perspective) population growth strategy.