Course: **010 595 002 - ARTIFICIAL INTELLIGENCE**

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Notes:	*a) Students can use an English dictionary and calculators. Any other tools or literature are disabled*		
	b) Type, please, your answers in English		

Example 1

I. Describe and (preferably) draw the main differences between:

a) simple reflex agents	b) agents that keep track of the world	c) goal-based agents	d) utility-based agents

II. Classify the following systems into one of above given classes *a) - d),* like, for example, 1a *(not correct :-)* etc. :
1) complex decisions making systems
2) planners
3) belief networks
4) systems, using situation calculus and diagnostic or causal rules
5) theorem provers
6) searching systems
7) production systems

Example 2

Often we say that the space complexity of breadth-first search is $O(b^d)$ and the space complexity of depth-first search is $O(bl)$. What do b, d and l stand for?

Example 3

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 "`;`" i.e. asking for another possible answer. What answers does *Prolog* return, and what is their exact order?

Example 4

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 "`>=`" is a basic operator for 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.

Example 5

For the below given table of examples find the best attribute for the root node of a corresponding decision tree and justify your solution. Available attributes are *texture, temperature* and *size*, the corresponding classification is under the column *class*

texture	temperature	size	class
Smooth	cold	large	**yes**
Smooth	cold	small	**no**
smooth	cool	large	**yes**
smooth	cool	small	**yes**
smooth	hot	small	**yes**
wavy	cold	medium	**no**
wavy	hot	large	**yes**
rough	cold	large	**no**
rough	cool	large	**yes**
rough	hot	small	**no**
rough	warm	medium	**yes**