Final Exam

ARTIFICIAL INTELLIGENCE

Questions: 4 – Total marks: 10 – Time: 120 minutes – Open book

Question 1 (3 marks):

There is a robot that drops balls quite often when its battery is low. It has been tested that the probability that it drops a ball when its battery is low is 0.9. Meanwhile, when its battery is not low the probability that it drops a ball is only 0.01. The battery was recharged not so long ago, so the probability that it is now low is 0.1. There is also an automatic observing system that reports when the robot drops a ball. The reliability of the system is given by the following conditional probabilities:

P(the system reports that the robot drops | the robot does drop) = 0.9

P(the system reports that the robot drops | the robot does not drop) = 0.2

a) Draw the Bayesian network representing these uncertain causal effects between the events. (1 m)

b) Calculate the probability that the battery is low given that the system reports the robot dropping a ball. (2 m)

Question 2 (2 marks):

Suppose the voting table for the fuzzy set *about_2* is as in Figure 2 and the fuzzy set *exactly_2* is defined by {*1*:0, *2*:1, *3*:0}.

a) Derive the fuzzy set *about_2* from the voting table. (0.5 m)

b) Compute the fuzzy sets *about_2*×*exactly_2* (multiplication) using the notion of α–cuts and the interval arithmetic. (0.5 m)

c) Compute the fuzzy sets *about_2*+*exactly_2* (addition) using the extension principle. (1 m)

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1	x	x	x	x	x					
2	x	x	x	x	x	x	x	x	x	x
3	x	x	x	x	x					

Figure 2

Question 3 (3 marks):

Apply Goal Stack Planning to Hanoi Tower problem.

a) Write down the specifications of the robot operations for the problem, modifying the operations (*stack*, *unstack*, *pickup*, *putdown*) and conditions (*on*, *ontable*, *clear*, *holding*, *armempty*) in the Block World. (1 m)

b) Trace the steps followed to make a plan for the problem with three disks as in Figure 3, showing the stack contents in each step. (2 m)

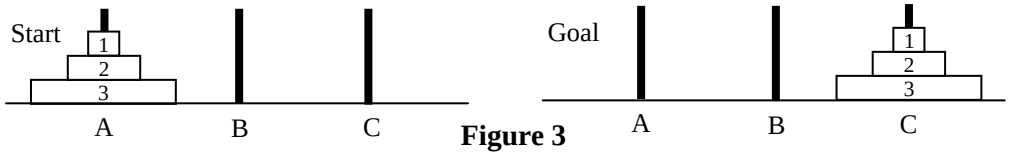

Figure 3

Question 4 (2 marks):

Consider the attribute-classification table for the concept BUY below, where each attribute has only two values, and the hypothesis space **H** = {<∅, ∅>}∪{<*x*, *y*> | *x*∈{*Good*, *Bad*, ?}, *y*∈{*High*, *Low*, ?}}.

a) Use an appropriate algorithm to find all most generic consistent hypotheses for that concept. Then classify the instances (*Good*, *High*) and (*Bad*, *Low*) with respect to those hypotheses. (0.5 m)

b) Use an appropriate algorithm to find all consistent hypotheses for that concept. Then classify the instances (*Good*, *High*) and (*Bad*, *Low*) with respect to those hypotheses. (0.5 m)

c) Compute the sizes of the concept space and hypothesis space **H**. Which concepts cannot be represented by **H**? Is there any bias towards the negative classification? Why? (1 m)

NO.	QUALITY	PRICE	BUY
1	*Good*	*Low*	Yes
2	*Bad*	*High*	No

-------- End --------