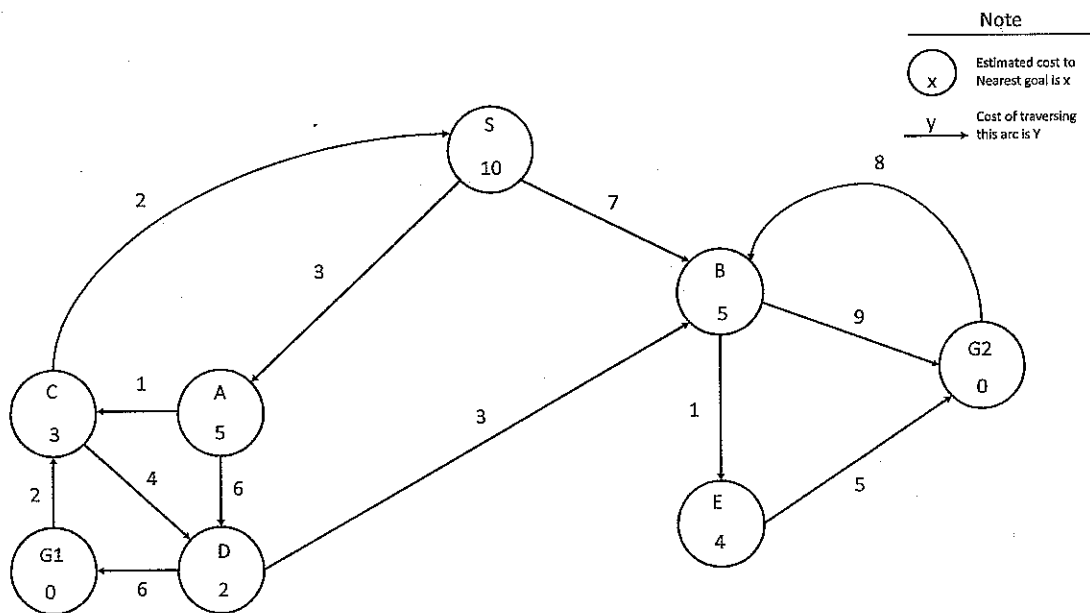

INSTRUCTIONS

- Make sure to write your name and ID in the first page and every page thereafter.
- The question booklet consists of **3** pages. Make sure you have all of them.
- Keep quiet during the exam. For assistance, raise your hand and an invigilator will come to see you
- The mark of each question is printed next to it.
- Keep in mind that possession or use of mobile phones or any other unauthorized electronic devices in the exam room is strictly prohibited.
- Scientific calculators are allowed but graphic calculators are not allowed.

6] 1. Provide brief but precise definitions of the following:

- (a) Greedy best-first search
- (b) Simulated annealing
- (c) Alpha-beta pruning
- (d) Arc consistency
- (e) Rejection Sampling
- (f) Markov Decision Process

6] 2. Consider the following search graph, where S is the start node and G1 and G2 are goal nodes. Arcs are labeled with the path cost and the estimated cost (heuristic) to a goal is reported inside nodes.



For each of the search strategies listed below, indicate which goal state is reached (if any) and list, in order, the states expanded. (Recall that a state is expanded when it is removed from the OPEN list.) *When all else is equal, nodes should be expanded in alphabetical order.*

- (a) Depth-first search
- (b) Breadth-first search
- (c) A* search

- 6] 3. In your local nuclear power station, there is an alarm that senses when a temperature gauge exceeds a given threshold. The gauge measures the temperature of the core. Consider the Boolean variables A (alarm sounds), FA (alarm is faulty), and FG (gauge is faulty) and the multi-valued nodes G (gauge reading) and T (actual core temperature).
- (a) Draw a Bayesian network for this domain, given that the gauge is more likely to fail when the core temperature gets too high. Is your network a polytree? Why or why not?
 - (b) Suppose there are just two possible actual and measured temperatures, normal and high; the probability that the gauge gives the correct temperature is x when it is working, but y when it is faulty. Give the conditional probability table associated with G.
- 6] 4. Consider the 101 x 3 world shown in Figure 1. In the start state the agent has a choice of two deterministic actions, Up or Down, but in the other states the agent has one deterministic action, Right. Assuming a discounted reward function, for what values of the discount γ should the agent choose Up and for which Down? Compute the utility of each action as a function of γ . (**Hint:** Use the mathematical formulas provided at the end of the page. Already two iteration of Newton's method yields quite good approximation of γ .)

+50	-1	-1	-1	...	-1	-1	-1	-1
Start								
-50	+1	+1	+1	...	+1	+1	+1	+1

Figure 1: 101 x 3 world (omitting 93 identical columns in the middle). The start state has reward 0.

- 6] 5. Please write a short essay on Natural language processing (NLP). Introduce your reader briefly to the necessity of NLP then discuss the importance of the language model (i.e. n-gram model) for NLP. Finally, conclude your essay by mentioning and briefly explaining some of the NLP tasks such as text classification, IR, etc.

You may find these helpful.

Finite geometric sum

$$S_n = a_1 \left(\frac{1 - r^N}{1 - r} \right)$$

where a_1 = first term of the series and $0 < r < 1$.

Newton Method: Approximation of the root of nth degree polynomial

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$