Artificial Intelligence: Written Exam

29 September 2015

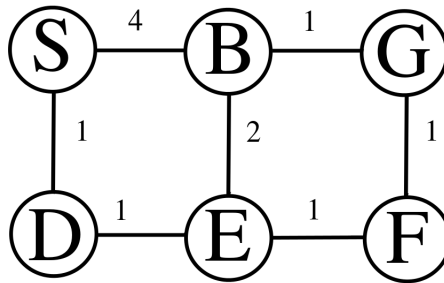## 1   Exercise 1 (Points 25)

Figure 1: Mobility graph

Consider the mobility graph in Figure 1 where S and G are the start and goal positions respectively and labels on edges represent the moving cost between the nodes. Consider the problem of finding a minimum cost path between nodes S and G on this mobility graph and assume we want to solve this problem using search techniques. Answer the following questions:

- State whether a Breadth First Search would return the minimum cost path for this problem. Motivate your answer.

- Compute the maximum number of nodes that a BFS approach must store in memory for this problem in the worst case.

- Show the execution trace of A* (**do not** avoid repeated states on the same branch) and compute the maximum number of nodes that must be stored in memory in the worst case.

2   Exercise 2 (Points 30)

Give an instance of a graph coloring problem and an order for variable expansion such that an approach to find all solutions that employs backtracking plus forward checking is expanding less nodes than backtracking.

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3   Exercise 3 (Points 25)

Consider the following **binary** cost network: Variables, $X = \{x_1, x_2, x_3, x_4\}$.
Constraints $C_h = \emptyset$ and $C_s = \{F_{12}(x_1, x_2), F_{13}(x_1, x_3), F_{14}(x_1, x_4), F_{23}(x_2, x_3), F_{34}(x_3, x_4)\}$
and $D_1 = D_2 = D_3 = D_4 = \{0, 1\}$. Consider the Bucket Elimination algorithm
and the variable ordering $o = \{x_2, x_1, x_4, x_3\}$. Answer the following questions:

- Compute the number of entries for the biggest table generated by the bucket elimination algorithm when using order o.

- is it possible to find a better order for the variables ?   Motivate your answer.
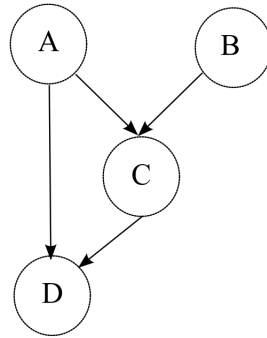
4   Exercise 4 (Points 20)

Figure 2: Bayesian Network.

Consider the Bayesian Network in Figure 4, Answer the following questions:

1. State whether the equation $P(D|A, C) = P(D|A, B, C)$ holds. Motivate your answer.

2. Write down the equation to compute $P(B|C = true)$;