CSci 4511
Midterm 1

Name: _____

Student ID: _____

Instructions: The time limit is 75 minutes. Please write your answers on a separate piece of paper. The exam is open book and notes. You may use electronic devices to ONLY look at either an e-book version or electronic notes. You may not use the internet, program/run code or any other outside resources. (If you are typing on your keyboard/input device for anything other than ctrl-F to find words in the e-book or notes, this is probably not acceptable.) For all questions if you **show work** you are more likely to receive partial credit for incorrect answers.

Problem (1) [20 points] Suppose you have a matching problem. There are N people in group A and N people in group B. You have to match every person in A with a single person in B. Every person has a dislike amount for every other person in the opposite group (e.g. person A_1 dislikes B_1 an amount 5, but dislikes B_2 an amount 8 so A_1 would prefer B_1). Provide a problem description for this and clearly identify (1) the states, (2) the actions and (3) whether it is an incremental approach or a complete-state formulation. Then (4) provide an admissible heuristic.

Problem (2) [5 points] You start at S and the goal is G. Run the uniform cost search to find the path. At each step be clear as to which node you are selecting to expand (i.e. move out of fringe set) and why.

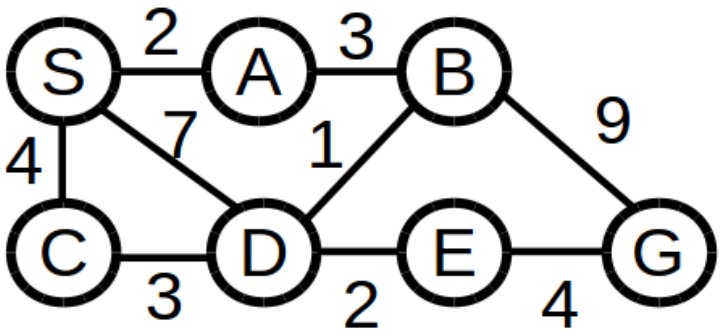

Figure 1: Problem 2 graph.

(MORE ON THE OTHER SIDE)

Problem (3) [30 points] Prove or disprove the following statements:

- (1) You can make a hill-climbing agent that never gets stuck in a local optimum. (i.e. always finds a goal.)
- (2) A* will never expand more nodes (i.e. number of steps) than BFS.
- (3) If a goal exists and you have enough memory and time, BFS will find it.

Problem (4) [25 points] You have an advanced robot agent with one arm and excellent sensors. You task the robot with making you a peanut butter & jelly sandwich (sudo). The robot has the following three actions: grab(object), wiggleHand() and moveHandTo(object). In addition to the robot, the environment has a knife, two slices of bread and a jars of peanut butter and jelly (you may assume the jars have an infinite quantity). To put a substance on the bread, the robot has to do the following steps: grab(knife), moveHandTo(jar), wiggleHand(), moveHandTo(bread), wiggleHand(). The goal is reached when: grab(bread with jelly), moveHandTo(bread with peanut butter). (You may assume if you grab a new object the robot will drop the previous held item.)

- (1) State (and justify if you feel appropriate) whether this problem is: fully observable or partial, single or multi agent, deterministic or stochastic, episodic or sequential, static or dynamic, and discrete or continuous.
- (2) Is this problem a tree search or a graph search?
- (3) Describe what search algorithm you would do on this problem and why (if you choose an informed search you may assume you have a useful heuristic).

Problem (5) [20 points] Answer the following questions with along with providing an explanation:

- (1) Suppose we want to maximize a benefit instead of minimizing a cost. Explain what modifications need to be done to convert the problem and whether the conditions for an admissible heuristic change.
- (2) Suppose we model our cost function as: $f(n) = \omega \cdot g(n) + (1-\omega) \cdot h(n)$, where $f(n)$ is the total estimated cost, $g(n)$ is the current path cost and $h(n)$ is our heuristic for a state/node n. Describe clearly the effects of changing the value of ω between 0 and 1 (inclusive).