CS-171, Intro to A.I., Winter Quarter, 2018 — Quiz # 1 — 20 minutes

NAME:____

YOUR ID: ___________ ID TO RIGHT:__________ ROW:_____ NO. FROM RIGHT:______

1. (45 pts total, 3 pts each) Agent/Search Concepts. For each of the following terms on the left, write in the letter corresponding to the best answer or the correct definition on the right. The first one is done for you as an example.

See Chaps. 2, 3.1-3.3.

.A.	Agent	.A	Perceives environment by sensors, acts by actuators
K	Percept	B	All states reachable from the initial state by a sequence of actions
P	Performance Measure	C	Guaranteed to find a solution if one is accessible
L	Rational Agent	D	Process of removing detail from a representation
B	State Space	E	Maximum number of successors (children) of any node
I	Search Node	F	Set of all pending nodes available for expansion at any given time
N	Link between nodes	G	~~Estimates cost of cheapest path from current state to goal state~~
J	Path	H	Guaranteed to find lowest cost among all accessible solutions
D	Abstraction	I	Represents a state in the state space
H	Optimal Search	J	Sequence of states connected by a sequence of actions
C	Complete Search	K	Agent's perceptual inputs at any given instant
M	Expand a state	L	Agent that acts to maximize its expected performance measure
F	Frontier/Fringe	M	Apply each legal action to a state, generating a new set of states
O	Search Strategy	N	Represents an action in the state space
E	Branching Factor	O	How a search algorithm chooses which node to expand next
~~G~~	~~Heuristic Function~~	P	Evaluates any given sequence of environment states for utility

**Cancelled because Heuristic Function was not covered in lecture before quiz was given.
Cancelled means that everyone gets it right, regardless of what you answered.**

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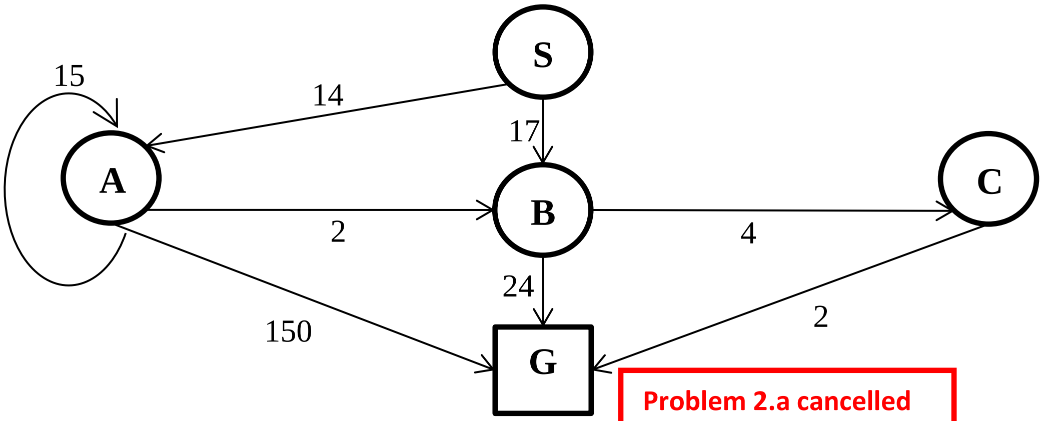
2. (55 pts total, 11 pts each) STATE-SPACE SEARCH STRATEGIES. Execute Tree Search through this graph (i.e., do not remember visited nodes). Step costs are given next to each arc. The successors of each node are indicated by the directed arrows out of that node. Successors are returned in left-to-right order, i.e., successors of S are (A, B), successors of A are (A, G, B), and successors of B are (G, C), in that order. S is the only initial node, and G is the only goal node.

For each search strategy below, show the order in which nodes are expanded (i.e., to expand a node means that its children are generated), optionally ending with the goal node that is found, or indicate the repeating cycle if the search gets stuck in a loop. Show the path from start to goal, or write "None." Give the cost of the path that is found, or write "None." Do check for (higher-cost) duplicate nodes in the Fringe/Frontier, and treat them appropriately. Do not check for loops, nor for duplicate nodes in Expanded.



Problem 2.a cancelled for reasons discussed in lecture. The solution shown here is correct.

~~**2.a. (11 pts total) DEPTH FIRST SEARCH.**~~

See Sections 3.4.3-4 and Figs. 3.16-17.

(7 pts) Order of node expansion: S A A A A A ...

(2 pts) Path found: None **(2 pts)** Cost of path found: None

2.b. (11 pts total) BREADTH FIRST SEARCH.

See Section 3.4.1 and Figs. 3.11-13.

(7 pts) Order of node expansion: S A (G)

(2 pts) Path found: S A G **(2 pts)** Cost of path found: 164

2.c. (11 pts total) UNIFORM C **Fig. 3.24** **H.** **Fig. 3.14**

See Section 3.4.2 and Figs. 3.14-15.

(7 pts) Order of node expansion: S A B B C C (G) or S A B C (G)

(2 pts) Path found: S A B C G **(2 pts)** Cost of path found: 22

2.d. (11 pts total) ITERATED DEEPENING SEARCH.

See Sections 3.4.4-5 and Figs. 3.17-19.

(7 pts) Order of node expansion: S S A (G)

(2 pts) Path found: S A G **(2 pts)** Cost of path found: 164

2.e. (11 pts total) BIDIRECTIONAL SEARCH. Use Breadth First Search. First expand S, then expand G (invert the steps), then expand a node from Fringe(S), then expand a node from Fringe(G) (invert the steps), then expand a node from Fringe(S), then expand a node from Fringe(G) (invert the steps), and so on. On the backward search from G, assume nodes are returned in right-to-left order (which is left-to-right if you stand on your head); i.e., successors of G are (C, B, A), successor of C is (B), successors of B are (S, A), and successors of A are (S, A), in that order on the backward search.

See Sections 3.4.5 and Fig. 3.20.

(7 pts) Order of node expansion: S G (B)

(2 pts) Path found: S B G **(2 pts)** Cost of path found: 41

R&N Sec. 3.4.6 discusses the BDS termination condition for BFS. To clarify it, and to handle UCS:

*** For BFS, the search terminates when one fringe expands a node and discovers that one of the new children is present in the other fringe. This is quick and easy because the other fringe already maintains a hash table holding its fringe, as discussed in the lecture slides about removing duplicate nodes from the fringe, so you just look up the new child in the other fringe's hash table. If present, then you join the path from the Start to that child to the reverse of the path from the Goal to that child, and you have your path from Start to Goal.**

*** For UCS, the same applies, except that afterward you must continue searching until the sum of the costs of the nodes at the head of each queue is greater than or equal to the cost of the path you just found. This continuation guarantees that there is not a longer cheaper path somewhere in the queues. Of course, if you find a cheaper solution as the search winds down, it replaces the previous solution.**