Regular Discussion 3

1 Arbitrary Graph

Consider tree search (i.e. no closed set) on an arbitrary search problem with max branching factor b. Each search node n has a backward (cumulative) cost of $g(n)$, an admissible heuristic of $h(n)$, and a depth of $d(n)$. Let c be a minimum-cost goal node, and let s be a shallowest goal node.

For each of the following, you will give an expression that characterizes the set of nodes that are expanded before the search terminates. For instance, if we asked for the set of nodes with positive heuristic value, you could say $h(n) \geq 0$. Don't worry about ties (so you won't need to worry about $>$ versus $\geq$). If there are no nodes for which the expression is true, you must write "none."

Test

1. Give an expression (i.e. an inequality in terms of the above quantities) for which nodes n will be expanded in a breadth-first tree search.

2. Give an expression for which nodes n will be expanded in a uniform cost search.

3. Give an expression for which nodes n will be expanded in an A* tree search with heuristic $h(n)$.

4. Let h_1 and h_2 be two admissible heuristics such that $\forall n, h_1(n) \geq h_2(n)$. Give an expression for the nodes which will be expanded in an A* tree search using h_1 but not when using h_2.

5. Give an expression for the nodes which will be expanded in an A* tree search using h_2 but not when using h_1.

Q2. Local Search

(a) Hill Climbing

    (i) Hill-climbing is complete. ☐ True ☐ False

    (ii) Hill-climbing is optimal. ☐ True ☐ False

(b) Simulated Annealing

    (i) The higher the temperature T is, the more likely the randomly chosen state will be expanded.

        ☐ True ☐ False

    (ii) On a undirected graph, If T decreases slowly enough, simulated annealing is guaranteed to converge to the optimal state exponentially slowly. ☐ True ☐ False

(c) Local Beam Search
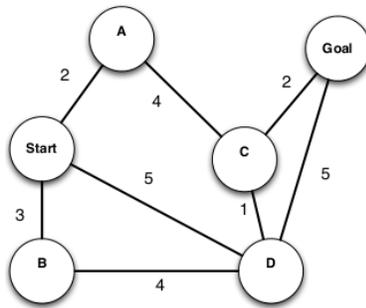
The following state graph is being explored with 2-beam graph search. A state's score is its accumulated distance to the start state and lower scores are considered better. Which of the following statements are true?

☐ States A and B will be expanded before C and D.

☐ States A and D will be expanded before B and C.

☐ States B and D will be expanded before A and C.

☐ None of above.

(d) Genetic Algorithm

    (i) In genetic algorithm, cross-over combine the genetic information of two parents to generate new offspring. ☐ True ☐ False

    (ii) In genetic algorithm, mutation involves a probability that some arbitrary bits in a genetic sequence will be flipped from its original state. ☐ True ☐ False

(e) Gradient Descent

    (i) Gradient descent is optimal. ☐ True ☐ False

    (ii) For a function $f(x)$ with derivative $f'(x)$, write down the gradient descent update to go from x_t to x_{t+1}. Learning rate is α.