CS 188
Summer 2022

Exam Prep 3A

Q1. Local Search

(a) Hill Climbing

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

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

(b) Simulated Annealing

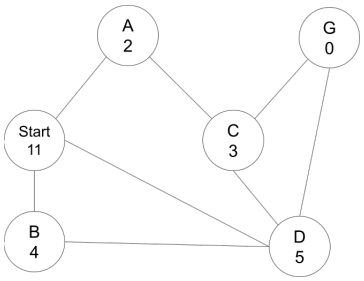
(i) The higher the temperature T is, the more likely the randomly chosen state will be expanded. ☐ True ☐ False

(ii) In one round of simulated annealing, the temperature is 2 and the current state S has energy 1. It has 3 successors: A with energy 2; B with energy 1; C with energy 1-ln 4. If we assume the temperature does not change, What's the probability that these states will be chosen to expand after S eventually?

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

(c) Local Beam Search

The following state graph is being explored with local beam search with a beam of size K=2. The state's score given, 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

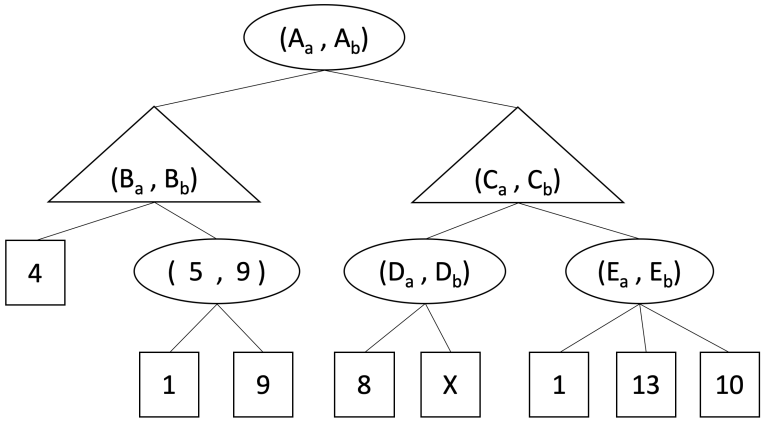
(ii) For a function $f(x)$ with derivative $f'(x)$, write down the gradient descent update to go from x_t to x_{t+1}. Learning rate is α.

Q2. Games

Alice is playing a two-player game with Bob, in which they move alternately. Alice is a maximizer. Although Bob is also a maximizer, Alice believes Bob is a minimizer with probability 0.5, and a maximizer with probability 0.5. Bob is aware of Alice's assumption.

In the game tree below, square nodes are the outcomes, triangular nodes are Alice's moves, and round nodes are Bob's moves. Each node for Alice/Bob contains a tuple, the left value being Alice's expectation of the outcome, and the right value being Bob's expectation of the outcome.

Tie-breaking: choose the left branch.



(a) In the blanks below, fill in the tuple values for tuples (B_a, B_b) and (E_a, E_b) from the above game tree.

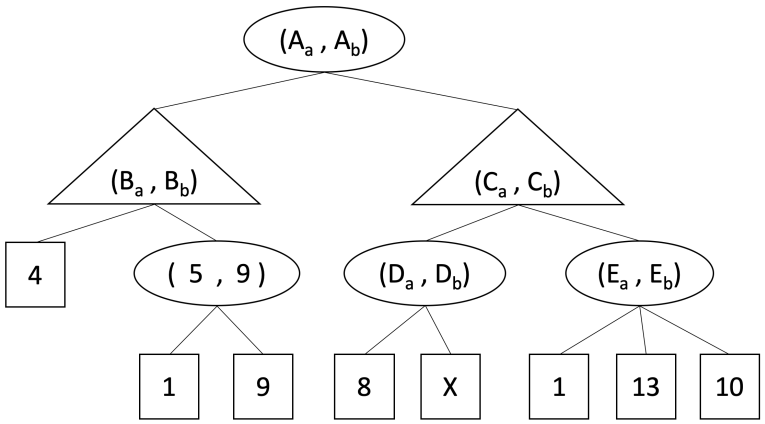
$(B_a, B_b) = ($ ____ , ____ $)$

$(E_a, E_b) = ($ ____ , ____ $)$

(b) In this part, we will determine the values for tuple (D_a, D_b).

(i) $D_a =$ ◯ 8 ◯ X ◯ 8+X ◯ 4+0.5X ◯ min(8,X) ◯ max(8,X)

(ii) $D_b =$ ◯ 8 ◯ X ◯ 8+X ◯ 4+0.5X ◯ min(8,X) ◯ max(8,X)



(The graph of the tree is copied for your convenience. You may do problem e on this graph.)

(c) Fill in the values for tuple (C_a, C_b) below. For the bounds of X, you may write scalars, ∞ or $-\infty$.
If your answer contains a fraction, please write down the corresponding **simplified decimal value** in its place. (i.e., 4 instead of $\frac{8}{2}$, and 0.5 instead of $\frac{1}{2}$).

1. If $-\infty < X <$ [ ], $(C_a, C_b) = ($ [ ] , [ ] $)$
2. Else, $(C_a, C_b) = ($ [ ] , max([ ] , [ ]))

(d) Fill in the values for tuple (A_a, A_b) below. For the bounds of X, you may write scalars, ∞ or $-\infty$.
If your answer contains a fraction, please write down the corresponding **simplified decimal value** in its place. (i.e., 4 instead of $\frac{8}{2}$, and 0.5 instead of $\frac{1}{2}$).

1. If $-\infty < X <$ [ ], $(A_a, A_b) = ($ [ ] , [ ] $)$
2. Else, $(A_a, A_b) = ($ [ ] , max([ ] , [ ]))

(e) When Alice computes the left values in the tree, some branches can be pruned and do not need to be explored. In the game tree graph on this page, put an 'X' on these branches. If no branches can be pruned, mark the "Not possible" choice below.
Assume that the children of a node are visited in left-to-right order and that you should not prune on equality.

◯ Not possible