**CS 404 – Artificial Intelligence**

**Spring 2019**

**HW3–Local Search – Adversarial Search**

75pts

**• 5pts –** Give the name of the algorithm that results when you do a local beam search with

k = 1.

**Answer: Hill-Climbing Search**

**• 30pts** - Consider the following **partial** search tree (we are in the middle of the search), where each edge is labeled with the cost of the corresponding operator and the leaves (fringe nodes) are labeled with the value of a heuristic function, h, estimating the remaining cost to the goal. Which node will be expanded next by each of the following search methods? Give a very small explanation or show your work.

**Fringe = [E,F,C,D]**

• Uniform-Cost Search: F

Since Uniform-Cost chooses the cheapest cost state it will choose to expand B firstly.After B is expanded the current Frontier would contain F which has cost of 2 .

• Greedy Best-First Search: D

Chooses the smallest heuristic value since the heuristic function chooses to estimate the distance to the goal state.Node with smallest h(n) value in the frontier is D.

f(n) = h(n) = 4 for D

• A\* Search: D

A\* chooses to expand the node with the smallest f(n) value where f(n) is;

f(n) = h(n) + g(n)

Node with the smallest f(n) is again D since h(n) = 4 which is also the smallest h(n) value compared to other nodes in frontier and g(n) = 5 hence f(n) = 9.

**• 10pts** A heuristic results in exploring N=180 nodes and finds the solution at depth d=2. What is its effective branching factor? Give an **approximate** answer, but you must show your work.

N: Total number of nodes processed.

d: Depth at which the solution node was found.

b\*: Effective branching factor.

N = b\* + (b\*)2 + ... + (b\*)d

N = 180 ; d = 2 which makes N = b\* + (b\*)2 .In order to make a close guess N^(1/d) = 180^(1/2) = 13,416407864998738178455042012388

180^(1/2) ~ 13

**Hint:**

**• 30pts - Game Playing**

Using the following Minimax tree, answer the following questions:

• 5pt - What score is guaranteed for MAX?

**Answer: 7**

• 15pt - Indicate **all the nodes** that are pruned using alpha-beta pruning? You can use the node name or values to indicate.

**Answer: e,f , node with value 6 and node with value 9**

• 5 - True or False: If Max uses alpha-beta pruning in Minimax, can s/he miss the chance of a better play (if s/he did’t prune)? Assume a perfect opponent.

**Answer:False**

d) 5pt - What is the expectimax value for the following chance node (circle)? Assume equal probability for each of the chance outcome and the given expectimax values for the MIN node.

Chance

MIN 3 6 2

**Answer:**(3+6+2) / 3 = 11/3 ~ 4

\*) For those who have requested extra study questions, other good questions to work on (from the topics we covered) are: AIMA 3rd ed: 4.9 (topic not covered, but in the slides) 5.12, 5.15, 5.18, 5.19, 5.21,