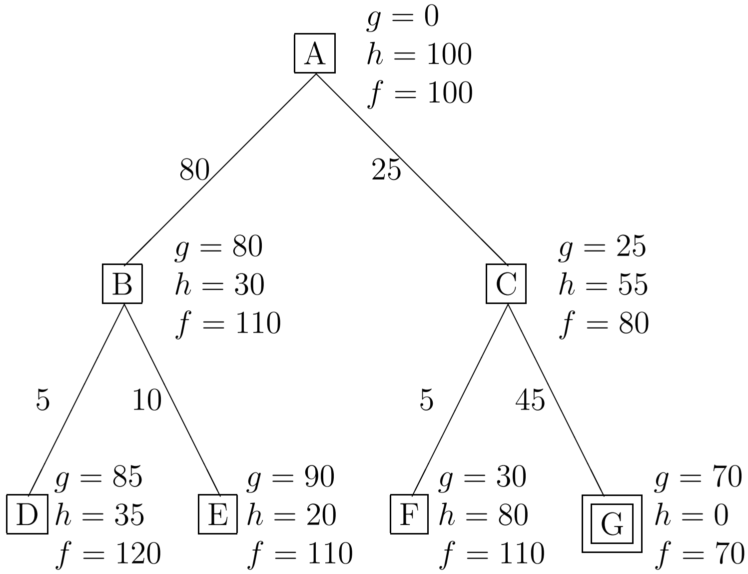
ICS 171 — Quiz #2 — FIFTEEN (15) minutes

1. (5 pts) NAME AND EMAIL ADDRESS:____________________________

YOUR ID:________ ID TO RIGHT:________ ROW:_____ NO. FROM RIGHT:_____

2. (5 pts each, 30 pts total) Use the following tree to indicate the order that nodes are expanded, for different types of search. Assume that G (double box) is the only goal node. Here, path costs are shown to the right of each path, g = cost of path so far, h = estimate of remaining cost to goal, f = estimate of total path cost.



For each search strategy, write down the order in which nodes are expanded. Stop at G.

(2a) DEPTH-FIRST SEARCH:
A **B** **D** **E** **C** **F** **G**

(2b) BREADTH-FIRST SEARCH:
A **B** **C** **D** **E** **F** **G**

(2c) ITERATIVE DEEPENING DEPTH-FIRST SEARCH:
A **A** **B** **C** **A** **B** **D** **E** **C** **F** **G**

(2d) UNIFORM-COST SEARCH:
A **C** **F** **G**

(2e) GREEDY BEST-FIRST SEARCH:
A **B** **E** **D** **C** **G**

(2f) A* SEARCH:
A **C** **G**

3. (5 pts each, 10 pts total) Use the tree above.

(3a) **Y** (Y=yes or N=no) Is the heuristic in problem 2 above **admissable**?

(3b) **Y** (Y=yes or N=no) Is the heuristic in problem 2 above **consistent** (**monotonic**)?

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4. (10 pts) In general, which is the preferred search method when (a) there is a large search space, (b) the depth of the solution is unknown, (c) an optimal solution is desired, and (d) a consistent admissable heuristic is available? (Mark one blank with "X")

______ depth-first search	______ breadth-first search	______ uniform-cost search
______ depth-limited search	__**X**__ A* search	______ bidirectional search
______ greedy best-first search	______ iterative-deepening search	

5. (5 pts each, 30 pts total) Recall that

- True path cost so far = $g(n)$.
- Estimated cost to goal = $h'(n)$.
- Estimated total cost = $f'(n) = g(n) + h'(n)$.

The following is a proof that A* search (queue sorted by f') is optimal if the heuristic is admissable. The lines have been labelled A through G. Unfortunately, they have been scrambled.

Let n_g be the first goal node popped off the queue. Let n_o be any other node on the queue. We wish to prove that n_o can never be extended to a path to any goal node that costs less than the path to n_g that we just found.

$$
\begin{array}{lll}
A: & \text{true total cost of } n_g & \\
F: & = & g(n_g) \quad \text{// because } n_g \text{ represents a complete path} \\
D: & = & f'(n_g) \quad \text{// by definition of } f \text{ with } h'(n_g) = 0 \\
B: & \leq & f'(n_o) \quad \text{// because queue is sorted by } f \\
E: & = & g(n_o) + h'(n_o) \quad \text{// by definition of } f \\
C: & \leq & g(n_o) + \text{true cost to goal from } n_o \quad \text{// because } h' \text{ is admissable} \\
G: & = & \text{true total cost of } n_o
\end{array}
$$

Fill in the blanks with the letters B, C, D, E, F ,and G to prove that the true total cost of $n_g \leq$ true total cost of n_o. The first and last letters, A and G, have been done for you as an example.

__**A**__ __**F**__ __**D**__ __**B**__ __**E**__ __**C**__ __**G**__

6. (5 pts each, 15 pts total) Label the following as "T" (true) or "F" (false).

6.a. __**F**__ An admissable heuristic never underestimates the remaining distance (cost) to the goal.

6.b. __**F**__ A good way to find a heuristic for a problem is to make the problem harder and then solve the new harder problem.

6.c. __**F**__ Let h_1 and h_2 be two admissable consistent heuristics. Heuristic h_1 is stronger (better) than heuristic h_2 just in case, for every search node n, we have $h_1(n) \geq h_2(n)$.