Search & Planning in AI (CMPUT 366) Assignment -2

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QUESTION 1:

(0.5 Mark) In general, does the use of a heuristic function increase or decrease the number of nodes the algorithms need to expand to find a solution?

ANS 1:

We know that a heuristic function — Lowers the total number of node expansions
They offer directionality to nodes and help us to avoid expanding many nodes that are in the opposite direction of the goal node, which would in turn increase the total cost of the solution
Since extending nodes in all directions has an equal likelihood in uniformed search, we expand more nodes even if their direction is counter to the solution path.

QUESTION 2:

(1.5 Mark) What do you expect to observe in terms of the running time of the algorithms that use a heuristic function in comparison to the algorithms that do not use a heuristic function?

ANS 2:

I select the option D) namely

"d) The running time will decrease, but not as much as the number of expansions decreases. For example, if A* expands 27% fewer states than Dijkstra's algorithm, then A* will be a bit less than 27% faster than Dijkstra's algorithm."

Since We expand far fewer nodes with heuristic than with a uniformed search, the overall time for search will be quicker with heuristic than with uniformed.
The heuristic function 'h(n)' will increase the time to expand a single node, so relative to the single node will take more time to expand a single node for heuristic than uniformed search.

QUESTION 3:

(0.5 Mark) Does MM tend to perform more or fewer expansions than Bi-A*?
ANS 3:

The algorithm MM (Meet in the middle algorithm) than Bi-A* performs fewer expansions —
Because while expanding the nodes we don't go past the midpoint.

QUESTION 4:

(0.5 Mark) Did the heuristic-guided bidirectional algorithms deliver their promise of
substantially reducing the number of expansions one needs to perform to solve a problem?

ANS 1:

Yes , a Bi A* algorithm delivers the promise of substantially reducing the number of expansions
one needs to perform to solve a problem.
As,When doing a bi-directional heuristic search, we extend the number of nodes by half and
advance in the objective direction using heuristics.

QUESTION 5:

(1.0 Mark) Speculate on an explanation for the distribution of points in the scatter plot that
compares A* and MM. Since you are being asked to speculate, you will receive full marks in this
question as long as your answer does not contain conceptual mistakes.

ANS 5:

While in A* we only search in one way, in MM we search in two directions and stop when we
get to the centre. In MM, the method expands $2b^{(d/2)}$, which is much less than in A*, where the
algorithm expands b(d) nodes in A*.
Comparing the two plots we get after implementing the our code we find that the nodes expanded
in mm vs A* plot are much more linear than in the mm vs Bi A* plot where it is much more
scattered