# COMP 2019 Workbook Exercises Week 3 – Heuristic Search – Solution

1) The Manhattan Distance is a consistent heuristic for this search problem, because

- it underestimates the true cost of navigating between adjacent nodes in the graph,
- mhd(L,L)=0, and
- the inequality $mhd(x, L) \leq mhd(y, L) + cost(x, y)$ holds for all adjacent pairs of nodes $(x, y)$.

2) $mhd(A, L) = 4, mhd(B, L) = 4, mhd(G, L) = 4$

3) A* :
Entries in Open are of the form NODE:g value/f value.
Bold face nodes are selected for removal from Open.

| **Open** | **Closed** |
|---|---|
| **A:0/4** | - |
| **C:2/6**,B:3/7 | A |
| **B:3/7**,F:102/105 | A,C |
| **M:7/9**,D:6/10,F:102/105 | A,B,C |
| **D:6/10**,H:15/17,L:17/17, F:102/105 | A,B,C,M |
| H:8/10,~~H:15/17,~~L:17/17, F:102/105,G:106/110 | A,B,C,D,M |
| **I:10/11**,L:17/17, F:102/105,G:106/110 | A,B,C,D,H,M |
| **J:11/13**,K:12/14,L:17/17, F:102/105,G:106/110 | A,B,C,D,H,I,M |
| **K:12/14**,L:17/17, F:102/105,G:106/110 | A,B,C,D,J,H,I,M |
| **L:17/17**, F:102/105,G:106/110 Stop – goal found | |

The path found is A-B-M-L with cost 17.

4) 4 states in the best case, and all except F and G in the worst case.

5) One that guesses the exact distance to the goal for all nodes. If this was known, no search would be necessary. In most interesting problems, the graph is not known a priori; moreover, the goal state may vary between searches.

6) Best-first search

7) Both will yield identical results, as adding a constant offset cannot reorder nodes in the open list.