# Homework 2 : Advanced Robot Motion Planning

(a) $h_m()$ is an admissible heuristic for $G_{2}$.
Let's prove with Contradiction.
Let $G$ be the goal
$\therefore h(G) = 0$ ; Manhatten distance of Goal from Goal is 0.

Let us assume, for some initial state $i$, optimal Cost $[v^*(i) < h(i)]$ — (1)
↳ Since only four actions are allowed, each action can reduce the manhatten distance $h$ by at most 1.
↳ Since optimal cost of the path from $i$ to $G$ is $v^*$, goal can be reached in $v^*$ steps.

$\therefore h(G)$ can be greater or (in the best case) equal to $h(i) - v^*$

$\therefore [h(G) \geq h(i) - v^*]$ — (2)

But from (1) ; $[h(i) - v^* > 0]$ — (3)

From (3), we can rewrite (2) as

$[h(G) \geq h(i) - v^* > 0]$

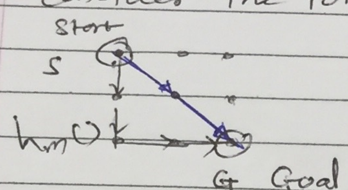
But $h(G) = 0$ ; hence Contradiction on assumption.
$\therefore$ Manhatten distance is the shortest path from any $i$ to $G$. Other Paths are either equal to $h_m()$ or suboptimal. $\therefore$ $h_m()$ is ADMISSIBLE.

(b)

(b) The Heuristic $h_m()$ in case of $G_8$, overestimates the diagonal cost.

$\therefore$ $h_m()$ in case of $G_8$ is <u>NOT ADMISSIBLE</u>.

→ Consider the following case →




* $h_m(s) = |x_G - x_s| + |y_G - y_s|$

$= 2+2 = 4$

* $V^*(s)$, optimal Path is shown in Blue.

$\therefore V^*(s) = \sqrt{2} + \sqrt{2} = 2\sqrt{2}$

clearly, $h_m(s) > V^*(s)$

$\therefore$ we can see that, $h_m()$ in case of $G_8$ is <u>NOT ADMISSIBLE</u>.

Output costs:

30.142135   30.142135   30.627416   31.798989   31.
798989   31.798989
28.727926   29.798996   34.041638   32.041638   31.
455852   32.041638
26.727926   32.21321    40.384782   43.091889   43.
091889   43.091889

Number of Iterations:

99  63  31  27  28  27
379 198 195 156 197 199
1560    1178    923 853 794 770