CS47100: Introduction to AI Spring 2025

Assignment 1

NAME HERE Date: September 22, 2025

Problem 1 (a)

(i) (LWSN, 0) → (DSAI, 1) → (HAAS, 1) → (PHYS, 1) → (PHYS, 2) → (PMU, 2)

(LWSN, 0) → (PHYS, 1) → (PMU, 2)

(ii) (LWSN, 0) → (DSAI, 1) → (STEW, 2) → (ARMS, 3) → (PMU, 4)

(LWSN, 0) → (DSAI, 1) → (STEW, 2) → (ARMS, 3) → (PMU, 4)

(iii) (LWSN, 0) → (HAAS, 2) → (DSAI, 3) → (PHYS, 5) → (PHYS, 5) → (STEW, 6) → (WALC, 7) → (ARMS, 8) → (PHYS, 9) → (PMU, 11)

(LWSN, 0) → (PHYS, 5) → (PMU, 11)

(iv) (LWSN, 7) → (PHYS, 3) → (PMU, 0)

(LWSN, 7) → (PHYS, 3) → (PMU, 0)

(v) (LWSN, 7) → (HAAS, 15) → (PHYS, 15) → (DSAI, 18) → (PHYS, 21) → (PMU, 21)

(LWSN, 0) → (PHYS, 15) → (PMU, 21)

Problem 1 (b)

(i) A* may fail to find an optimal solution when a negative edge is present in the graph. In this particular case, A* will not find the optimal solution, and furthermore (STEW) will not be expanded.

(ii) The optimal solution is: LWSN $\rightarrow$ DSAI $\rightarrow$ STEW $\rightarrow$ PMU
However, A * will return the same as part (v) in problem 1a.

Problem 2 (a)

Suppose that a heuristic $h(n)$ is consistent.

Pick any node n and call it n_0

So, assume we have the following: start $= n_0 \rightarrow n_1 \rightarrow ... \rightarrow n_k =$ goal

So, $h(n)$ is consitent $\Rightarrow h(n_i) \leq c(n_i \rightarrow n_{i+1}) + h(n_{i+1})$, where $c(n_i \rightarrow n_{i+1})$ is the cost from n_i to n_{i+1}

So, $h(n_0) \leq c(n_0 \rightarrow n_1) + h(n_1)$ and $h(n_1) \leq c(n_1 \rightarrow n_2) + h(n_2)$

Then, $h(n_0) \leq c(n_0 \rightarrow n_1) + c(n_1 \rightarrow n_2) + h(n_2)$

Similarly we know, $h(n_0) \leq c(n_0 \rightarrow n_1) + c(n_1 \rightarrow n_2) + \cdots + c(n_{k-2} \rightarrow n_{k-1}) + h(n_{k-1})$

And, $h(n_{k-1}) \leq c(n_{k-1} \rightarrow n_k) + h(n_k)$

Then, $h(n_0) \leq c(n_0 \rightarrow n_1) + c(n_1 \rightarrow n_2) + \cdots + c(n_{k-2} \rightarrow n_{k-1}) + c(n_{k-1} \rightarrow n_k) + h(n_k)$

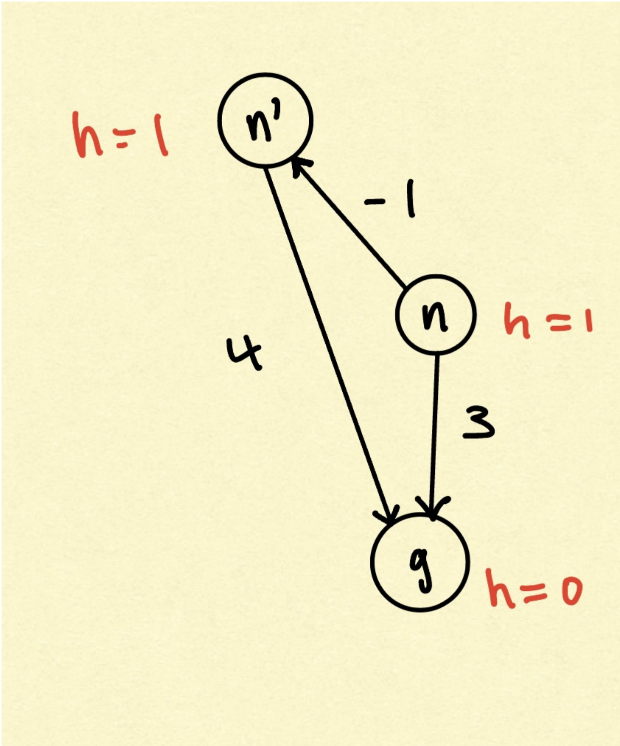
n_k is a goal state so by defintion, $h(n_k) = 0$

So, $h(n_0) \leq c(n_0 \rightarrow n_1) + c(n_1 \rightarrow n_2) + \cdots + c(n_{k-2} \rightarrow n_{k-1}) + c(n_{k-1} \rightarrow n_k)$

And, $\underbrace{c(n_0 \rightarrow n_1) + c(n_1 \rightarrow n_2) + \cdots + c(n_{k-2} \rightarrow n_{k-1}) + c(n_{k-1} \rightarrow n_k)}_{\text{Is the true cost!}}$

So, $h(n_0) \leq h^*(n)$ and $h(n_0) \geq 0$ by definition.

Thus, $h(n)$ must be admissible



Problem 2 (b)

It fails consistency because $h(n) \leq c(n \to n') + h(n') \Rightarrow 1 \leq -1 + 1$ Ouch!

But it is admissible because,

$0 \leq h(n) \leq h^*(n)$

$0 \leq 1 \leq 3$

and $0 \leq h(n') \leq h^*(n)$

$0 \leq 1 \leq 4$