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CSE422 Sec - 07
ASSIGNMENT - 1
CMR

For consistent

$h(P) \leq h(C) + c(P \to C)$

For admissible

$h(n) \leq g(n)$

$h(A) \leq h(S) + c(A \to S)$

$\Rightarrow 10 \leq 9 + 3$

$\Rightarrow 10 \leq 12$

$\therefore$ consistent

$h(A) \leq g(A)$

$\Rightarrow 10 \leq$

$h(A) \leq h(D) + c(A \to D)$

$\Rightarrow 10 \leq 2 + 7$

$\Rightarrow 10 \leq 9$

NOT consistent

So, Lets consider $\boxed{h(A) = 5}$

Then it will be consistent

~~A~~
~~S~~
~~D~~
~~E~~
~~C~~
~~F~~
~~G~~
~~B~~

$h(S) \leq h(E) + c(S \to E)$

$\Rightarrow 9 \leq 5 + 5$

$\Rightarrow 9 \leq 10$

$\therefore$ consistent

$h(S) \leq h(F) + c(S \to F)$

$\Rightarrow 9 \leq 2 + 4$

$\Rightarrow 9 \leq 13$

$\therefore$ consistent

$h(D) \leq h(G) + c(D \to G)$

$\Rightarrow 2 \leq 0 + 4$

$\Rightarrow 2 \leq 4$

$\therefore$ consistent

$h(E) \leq h(C) + c(E \to C)$

$\Rightarrow 5 \leq 5 + 2$

$\Rightarrow 5 \leq 7$

$\therefore$ ~~NOT consistent~~

$\therefore$ consistent

$h(C) \leq h(G) + c(C \to G)$

$\Rightarrow 5 \leq 0 + 3$

$\Rightarrow 5 \leq 3$

NOT consistent

Let's take $\boxed{h(C) = 1}$

Then consistent.

$h(F) \leq h(G) + c(F \to G)$

$\Rightarrow 2 \leq 0 + 6$

$\Rightarrow 2 \leq 6$

$\therefore$ Consistent

$h(G) \leq h(B) + c(G \to B)$

$\Rightarrow 0 \leq 11 + 8$

$\Rightarrow 0 \leq 19$

Consistent

$h(B) \leq h(A) + c(B \to A)$

$\Rightarrow 4 \leq 5 + 13$

$\Rightarrow 4 \leq 18$

$\therefore$ Consistent.

$h(A) \leq g(n)$
$\Rightarrow 5 \leq 3+5+2+3$
$\Rightarrow 5 \leq 13$

$h(A) \leq g(n)$
$\Rightarrow 5 \leq 3+11+6$
$\Rightarrow 5 \leq 20$

$h(A) \leq g(n)$
$\Rightarrow 5 \leq 7+4$
$\Rightarrow 5 \leq 11$

A
B
C
D
E
F
G

∴

$h(B) \leq g(n)$
$\Rightarrow 9 \leq 5+2+3$
$\Rightarrow 9 \leq 10$

$h(B) \leq g(n)$
$\Rightarrow 9 \leq 11+6$
$\Rightarrow 9 \leq 17$

$h(E) \leq g(n)$
$\Rightarrow 5 \leq 2+3$
$\Rightarrow 5 \leq 5$

$h(C) \leq g(n)$
$\Rightarrow 1 \leq 3$

$h(G) \leq g(n)$
$\Rightarrow 0 \leq 0$

$h(F) \leq g(n)$
$\Rightarrow 2 \leq 6$

$h(D) \leq g(n)$
$\Rightarrow 2 \leq 4$

$h(S) \leq g(n)$
~~$\Rightarrow u \leq 13$~~
$\Rightarrow u \leq 13+7+4$
$\Rightarrow u \leq 24$
$u \leq 3+11+6+13$
$\Rightarrow u \leq 13+3+5+2+3$

Thus Admissible

∴ $\boxed{h(A) = 5 \text{ and } h(C) = 1}$

$h5(n) = \frac{h2(n)}{2}$ | $h6(n) = \frac{h1(n) + h2(n)}{2}$

h6(n) takes the avg. values of both h1(n) and h2(n) whereas h5(n) only takes the value of h2(n). So, h6(n) should always be dominant as it will output a bigger no. than h5(n).

(iii) h3(n) will expand maximum no. of nodes as it will not prune any node and expand nodes till the goal is reached.

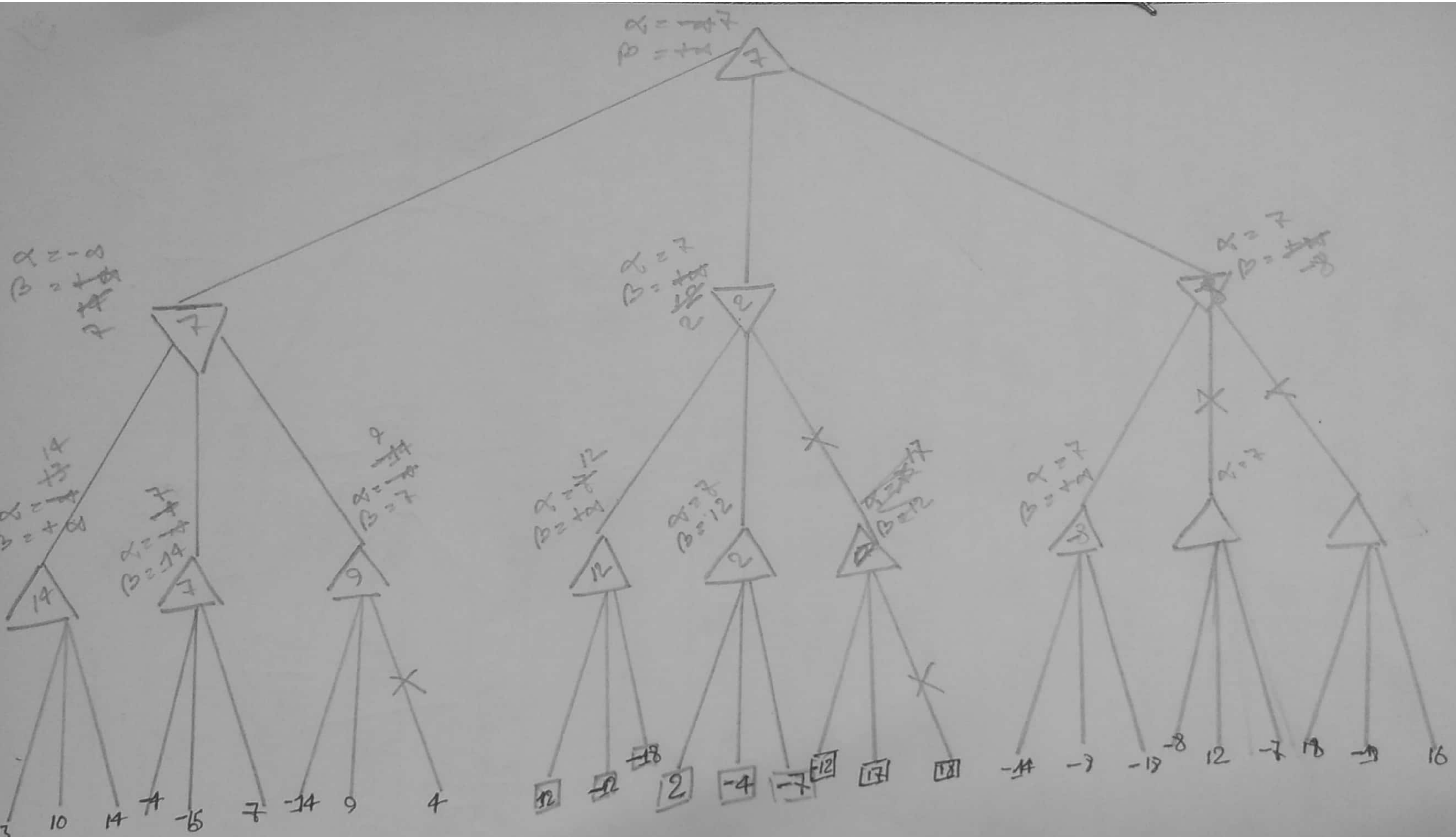
(iv) h7(n) should be best as it will give the max. value.

(i) h3(n) is possibly inadmissible.

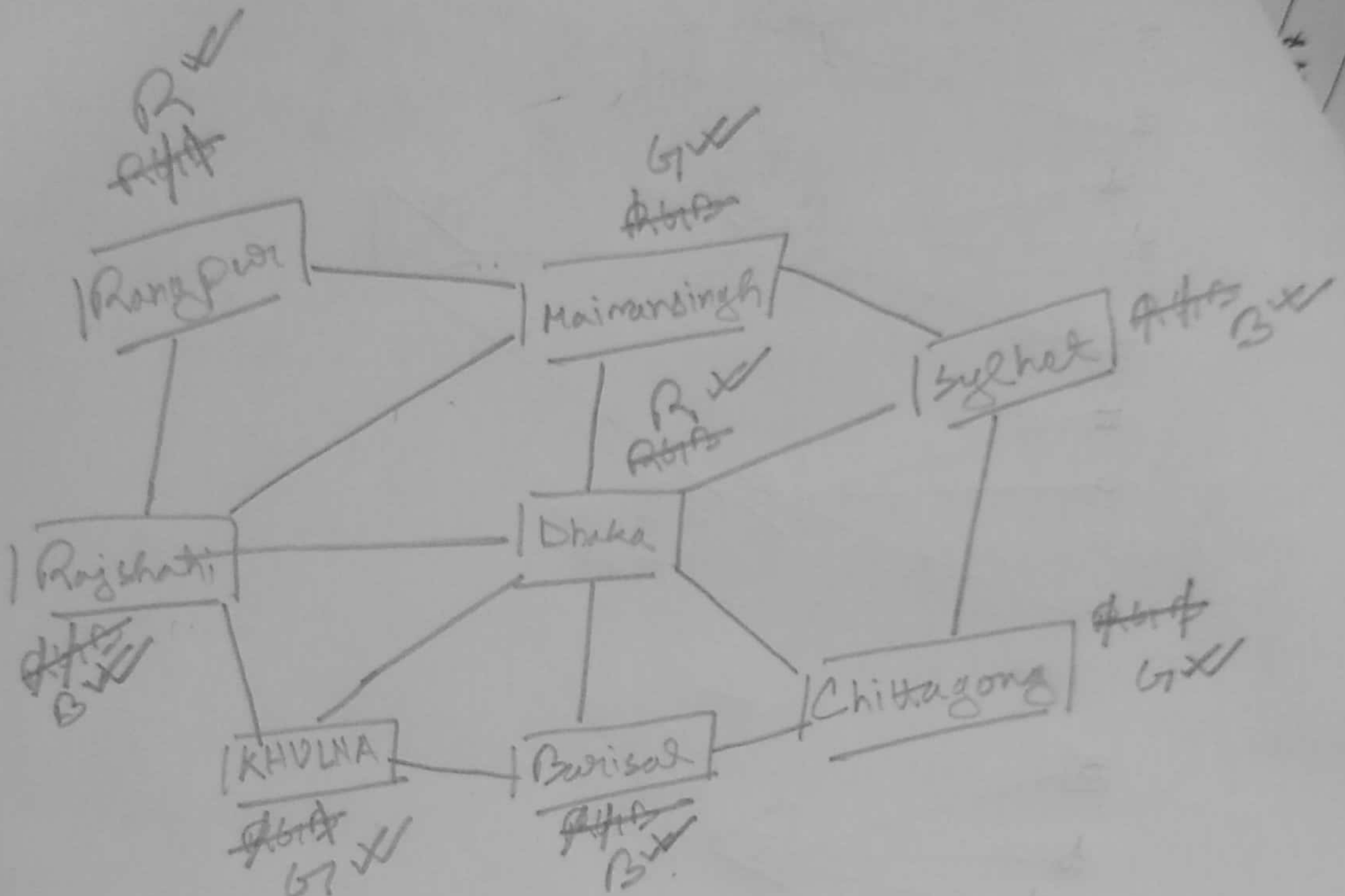
3) Temperature is a control parameter that regulates the probability of making a bad move i.e moving to a worse solⁿ. The amount of exploration vs exploitation on the search depends on the temperature.

Simulated Annealing has a higher probability of making a bad move at high temperatures. This allows the algo to consider more potential solutions. This helps the algo to escape a local optima and land on a global optima solⁿ. The probability of making a poor decision declines as the temperature drops, making it less likely that the algorithm would take a step that produces a worse outcome. As a result, the algorithm can maximize the benefits of the current solⁿ and move closer to the local optimum.

The tolerancy to go down from a higher place to a lower place decreases with decreasing temp. After a certain temp it stops going down and behaves like hill climb.



05)


Rangpur
R
Maimansingh
G
Sylhet
B
Rajshahi
B
Dhaka
R
Chittagong
G
KHULNA
G
Barisal
B

A^{7}

A^{7} | $B_{A}^{10} \quad E_{A}^{6} \quad C_{A}^{9}$

E_{A}^{6} | $B_{A}^{10} \quad C_{A}^{9} \quad H_{AE}^{6} \quad F_{AE}^{9}$

H_{AE}^{6} | $B_{A}^{10} \quad C_{A}^{9} \quad \cancel{H_{AE}^{6}} \quad F_{AE}^{9} \quad X_{AEH}^{9}$

C_{A}^{9} | $B_{A}^{10} \quad \cancel{C^{9}} \quad F_{AE}^{9} \quad X_{AEH}^{9} \quad E_{AC}^{8} \quad F_{AC}^{9} \quad G_{AC}^{9}$

E_{AC}^{8} | $B_{A}^{10} \quad F_{AE}^{9} \quad X_{AEH}^{9} \quad \cancel{E_{AC}^{8}} \quad F_{AC}^{8} \quad G_{AC}^{9} \quad H_{ACE}^{8} \quad F_{ACE}^{11}$

F_{AC}^{8} | $B_{A}^{10} \quad F_{AE}^{9} \quad X_{AEH}^{9} \quad G_{AC}^{9} \quad H_{ACE}^{8} \quad F_{ACE}^{11} \quad H_{ACF}^{7}$

H_{ACF}^{7} | $B_{A}^{10} \quad F_{AE}^{9} \quad X_{AEH}^{9} \quad G_{AC}^{9} \quad H_{ACE}^{8} \quad F_{ACE}^{11} \quad X_{ACFH}^{10}$

H_{ACE}^{8} | $B_{A}^{10} \quad F_{AE}^{9} \quad X_{AEH}^{9} \quad G_{AC}^{9} \quad F_{ACE}^{11} \quad X_{ACFH}^{10} \quad X_{ACEH}^{11}$

F_{AE}^{9} | $B_{A}^{10} \quad \cancel{F_{AE}} \quad X_{AEH}^{9} \quad G_{AC}^{9} \quad F_{ACE}^{11} \quad X_{ACFH}^{10} \quad X_{ACEH}^{11} \quad H_{AEF}^{8}$

H_{AEF}^{8} | $B_{A}^{10} \quad X_{AEH}^{9} \quad G_{AC}^{9} \quad F_{ACE}^{11} \quad X_{ACFH}^{10} \quad X_{ACEH}^{11} \quad \cancel{H_{AEF}^{8}} \quad X_{AEFG}^{11}$

G_{AC}^{9} | $B_{A}^{10} \quad X_{AEH}^{9} \quad \cancel{G_{AC}^{9}} \quad F_{ACE}^{11} \quad X_{ACFH}^{10} \quad X_{ACEH}^{11} \quad X_{AEFG}^{11} \quad X_{ACG}^{8}$

X_{ACG}^{8} | $B_{A}^{10} \quad X_{AEH}^{9} \quad F_{ACE}^{11} \quad X_{ACFH}^{10} \quad X_{ACEH}^{11} \quad X_{AEFG}^{11} \quad \cancel{X_{ACG}^{8}}$

As the goal Node is reached, the algo terminates.

$A \Rightarrow G \quad A \Rightarrow G \Rightarrow$

$A \to C \to G \to X$

Cost : 8

(b) $h(A) \leq h(B) + c(A \to B)$

$\Rightarrow 7 \leq 5 + 5$

$\Rightarrow 7 \leq 10$

~~A~~ ~~B~~ ~~C~~ ~~D~~ ~~E~~ ~~F~~ ~~G~~ ~~H~~ ~~X~~

$h(A) \leq h(E) + c(A \to E)$

$\Rightarrow 7 \leq 4 + 2$

$\Rightarrow 7 \leq 6$ NOT consistent

$h(A) \leq h(C) + c(A \to C)$

$\Rightarrow 7 \leq 6 + 3$

$\Rightarrow 7 \leq 9$

$h(B) \leq h(D) + c(B \to D)$

$\Rightarrow 5 \leq 3 + 2$

$\Rightarrow 5 \leq 5$

$h(B) \leq h(E) + c(B \to E)$

$\Rightarrow 5 \leq 4 + 1$

$\Rightarrow 5 \leq 5$

$h(C) \leq h(E) + c(C \to E)$

$\Rightarrow 6 \leq 4 + 1$

$\Rightarrow 6 \leq 5$

$\therefore$ NOT consistent

$h(C) \leq h(F) + c(C \to F)$

$\Rightarrow 6 \leq 4 + 1$

$\Rightarrow 6 \leq 5$

$\therefore$ NOT consistent

$h(C) \leq h(g) + c(C \to g)$

$\Rightarrow 6 \leq 2 + 4$

$\Rightarrow 6 \leq 6$

$h(D) \leq h(H) + c(D \to H)$

$\Rightarrow 3 \leq 2 + 2$

$\Rightarrow 3 \leq 4$

$\therefore$ NOT consistent

$h(D) \leq h(x) + c(D \to x)$

$\Rightarrow 3 \leq 0 + 4$

$\Rightarrow 3 \leq 4$

$h(E) \leq h(h) + c(E \to h)$

$\Rightarrow 4 \leq 2 + 2$

$\Rightarrow 4 \leq 4$

$h(E) \leq h(F) + c(E \to F)$

$\Rightarrow 4 \leq 4 + 3$

$\Rightarrow 4 \leq 7$

$\left.\begin{array}{l} h(F) \leq h(H) + c(F \to H) \\ \Rightarrow 4 \leq 2 + 1 \\ \Rightarrow 4 \leq 3 \end{array}\right\}$ NOT consistent

$$\boxed{\begin{aligned}&h(G) \leq h(x) + c(G \to x)\\ &\Rightarrow 2 \leq 0 + 1\\ &\Rightarrow 2 \leq 1 \text{ NOT consistent}\end{aligned}}$$

$h(h) \leq h(x) + c(h \to x)$

$\Rightarrow 2 \leq 0 + 5$

$\Rightarrow 2 \leq 5$

$h(x) \leq h(x) + c(x \to x)$

$\Rightarrow 0 \leq 0 + 0$

$\Rightarrow 0 \leq 0$

$\therefore$ The Heuristic is not consistent for 6 cases.

~~h(A) = 1~~
~~h(B) = 2~~
~~h(C) = 3~~
~~h(D) = 4~~
~~h(H) =~~

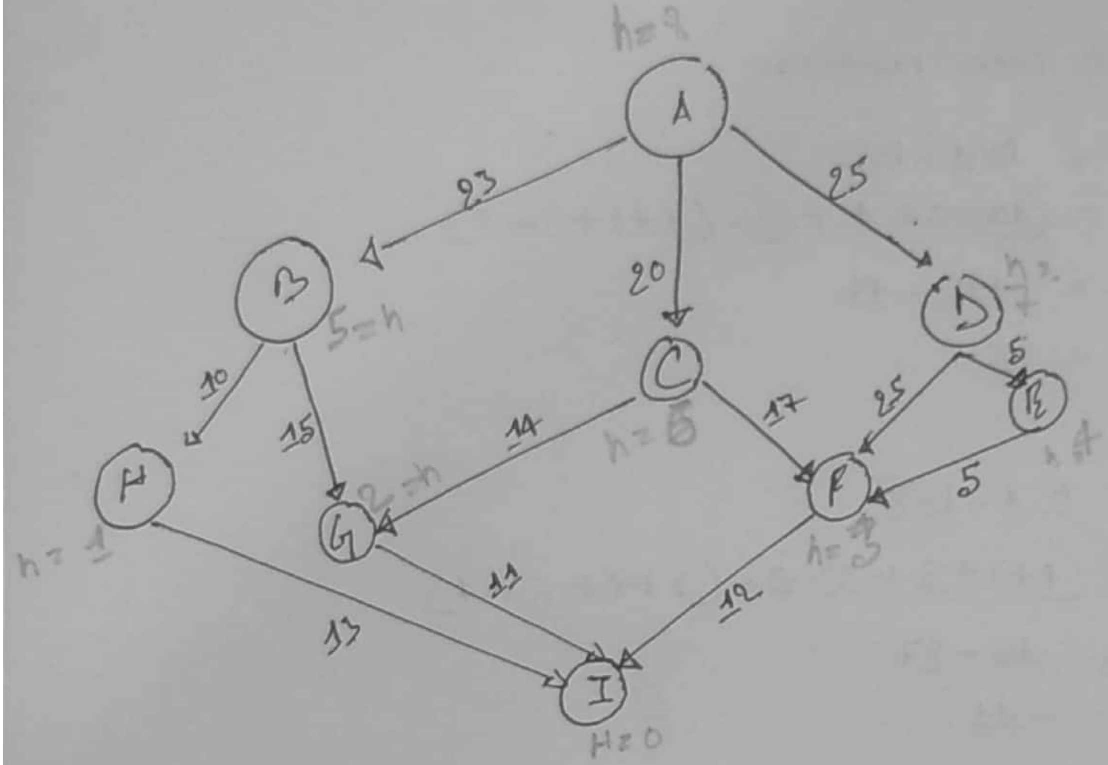
$h(G) \le h(I) + c(G \to I)$

$\Rightarrow 2 \le 0 + 11$

$h(H) \le h(I) + c(H \to I)$

$\Rightarrow 1 \le 0 + 13$

So, all the heuristic values are consistent



~~A~~
~~B~~
~~C~~
~~D~~
~~E~~
~~F~~
~~G~~
~~H~~
I

$h(A) \le h(B) + c(A \to B)$

$\Rightarrow 8 \le 5 + 23$

$h(A) \le h(C) + c(A \to C)$

$\Rightarrow 8 \le 6 + 20$

$h(A) \le h(D) + c(A \to D)$

$\Rightarrow 8 \le 7 + 25$

$h(B) \le h(H) + c(B \to H)$

$\Rightarrow 5 \le 1 + 10$

$h(B) \le h(G) + c(B \to G)$

$\Rightarrow 5 \le 2 + 15$

$h(C) \le h(G) + c(C \to G)$

$\Rightarrow 6 \le 2 + 14$

$h(C) \le h(F) + c(C \to F)$

$\Rightarrow 6 \le 3 + 17$

$h(D) \le h(F) + c(D \to F)$

$\Rightarrow 7 \le 3 + 25$

$h(D) \le h(E) + c(D \to E)$

$\Rightarrow 7 \le 4 + 5$

$h(E) \le h(F) + c(E \to F)$

$\Rightarrow 4 \le 3 + 5$

$h(F) \le h(I) + c(F \to I)$

$\Rightarrow 3 \le 0 + 12$

2) (a) 100 1 3 2 | 4 1 5 8 — PC1

1 9 7 8 | 5 6 3 4 2 — PC2

These are generated Randomly.

(b) D1 ← Sum of odd numbers

D2 ← Sum of even numbers.

$\therefore$ Fitness - PC1 = D1 - D2

= (100+3+4+5) - (1+2+6+8)

= 112 - 17

= 95

Fitness - PC2 = D1 - D2

= (1+7+5+3) - (9+8+6+4)

= 16 - 27

= -11

Crossover:

(c) 100 1 3 2 $\boxed{5}$ 6 3 4

1 9 $\boxed{7}$ 8 4 6 5 8

Mutation

(d) 100 1 3 2 10 6 3 4

1 9 20 8 4 6 5 8

fitness - CC1 = D1 - D2

= (100 + 3 + 10 + 3) - (1+2+6+4)

= 116 - 13

= 103

$$D - CC2 = D1 - D2$$
$$= (1 + 20 + 4 + 5) - (9 + 8 + 6 + 8)$$
$$= 30 - 31$$
$$= -1$$

$\therefore$ Child Chromosome 2 is better.