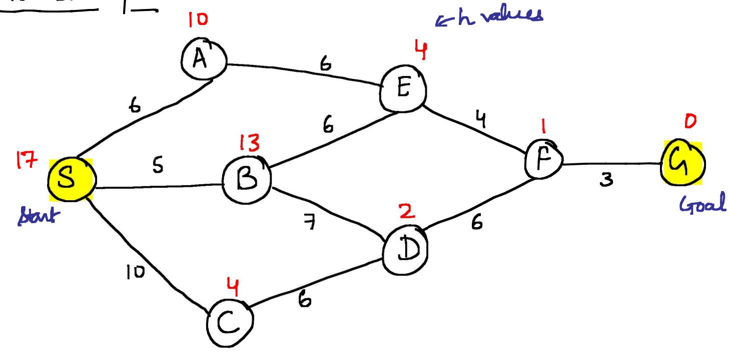
04/02/2022

AI.

A* Search Example

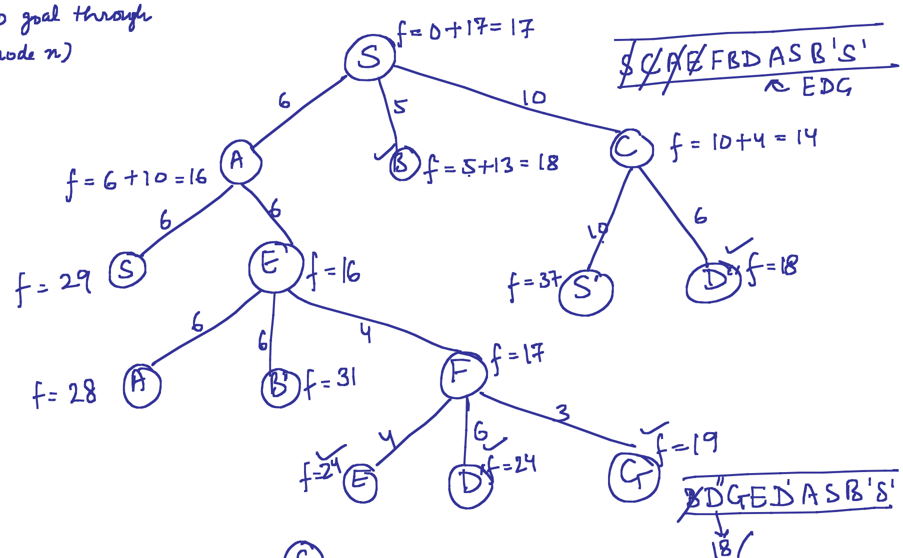


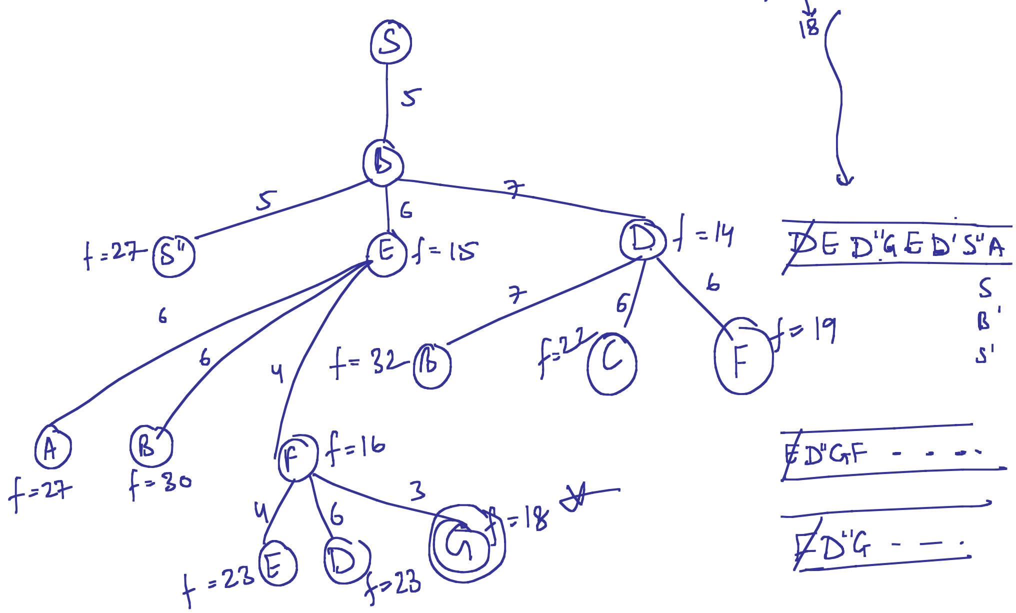
$f(n) = g(n) + h(n)$

$f(n)$: Evaluation func^n (Optimal cost from start to goal through node n)

$g(n)$: Sum of edge costs from start to current node n

$h(n)$: heuristic function value on current node n.





~~G~~ D''

$S \xrightarrow{5} B \xrightarrow{6} E \xrightarrow{4} F \xrightarrow{3} G$

optimal

Total cost = 18.

~~$S \xrightarrow{6} A \xrightarrow{6} E \xrightarrow{4} F \xrightarrow{3} G$~~

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Optimality of A*

Heuristics → 1. Admissibility
→ 2. Consistency

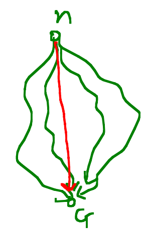
Admissible Heuristics

- A heuristic function $h(n)$ is said to be admissible if for every node n,

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

$h(n)^*$: True cost / Min-cost to reach goal from node n.

- An admissible heuristic can never overestimates the cost to reach goal from the current node n.



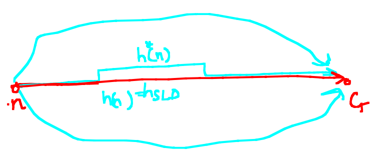
If $h(n) = 0$ then it is obviously admissible.

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

h_{SLD} : Straight-line-distance.

↳ Admissible

$$\boxed{h_{SLD} \leq h(n)^*}$$

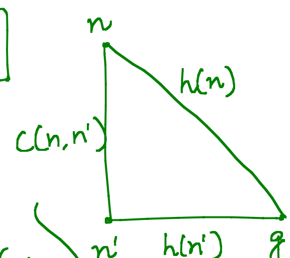


Theorem :- If $h(n)$ is admissible, then A* search is optimal for Tree search paradigm.

2. Consistent heuristics

- A heuristic function is said to be consistent if for every node n, and for every successor node n'

$$\boxed{h(n) \leq c(n, n') + h(n')}$$



- Every consistent heuristic is also admissible.

Theorem :- If $h(n)$ is a consistent heuristic, A* search would be optimal for Graph-Search paradigm also.

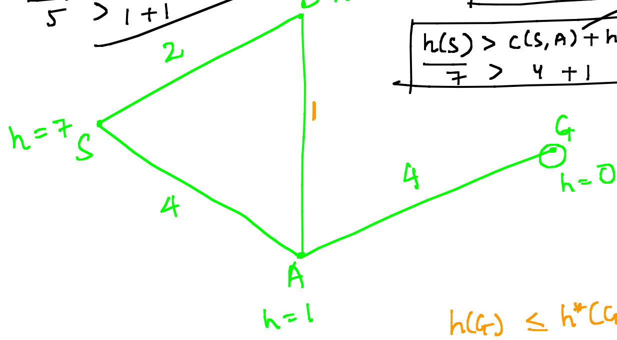
Consistent heuristic : $h(n) \leq c(n, n') + h(n')$

$\boxed{h(n) \text{ is not consistent}}$

$h(B) > c(B,A) + h(A)$

$5 > 1 + 1$

$\boxed{\begin{array}{l} h(S) > c(S,A) + h(A) \\ 7 > 4 + 1 \end{array}}$



Check whether h is admissible?

$h(S) \le h^*(S)$
$7 \le 7$ ✓

$h(A) \le h^*(A)$
$1 \le 4$ ✓

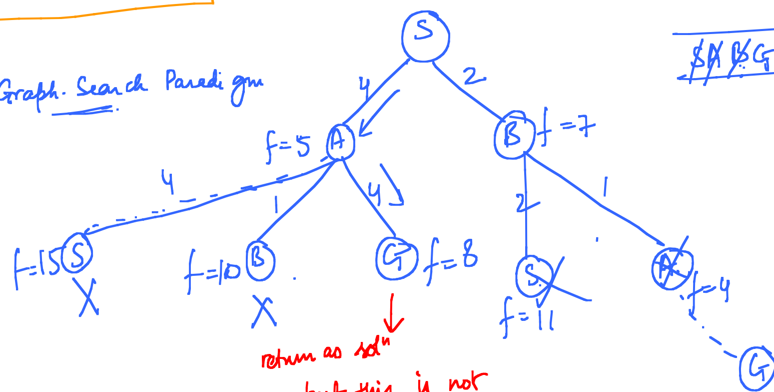
$h(B) \le h^*(B)$
$5 \le 5$ ✓

$h(G) \le h^*(G)$
$0 \le 0$ ✓

$\boxed{h \text{ is admissible}}$

Graph Search Paradigm

~~S~~ ~~A~~ ~~B~~ G



return as solⁿ but this is not optimal.

A* Search