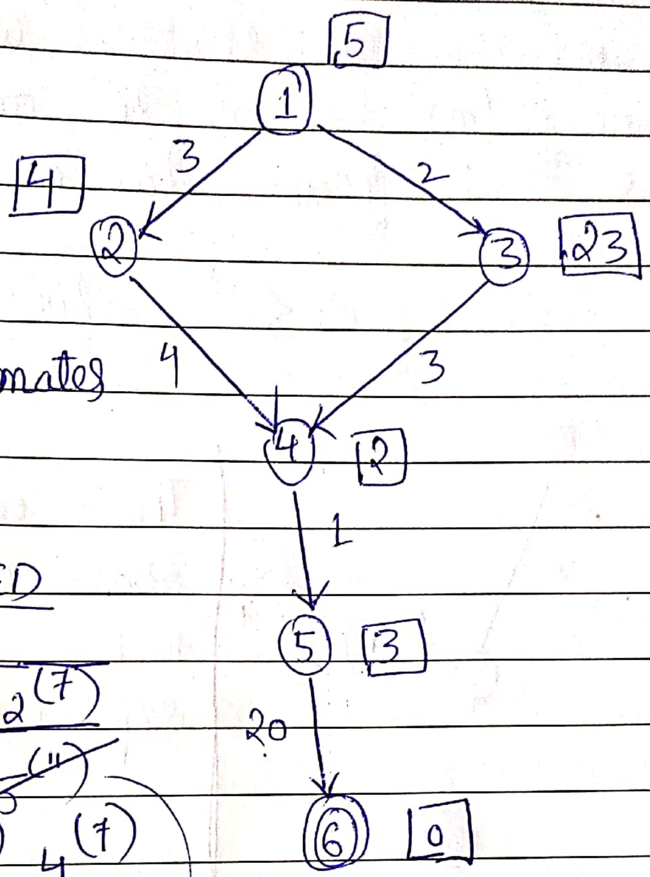
Notes

Algorithm A*

Date

$S = \{ n \mid f(n) < C^* \}$

$|S|$



h(): Always under-estimates

OPEN

$1^{(5)}$		
$2^{(7)}$	$3^{(25)}$	
$3^{(25)}$	$4^{(9)}$	
$3^{(25)}$	$5^{(11)}$	
$3^{(25)}$	$6^{(28)}$	
$4^{(7)}$	$6^{(28)}$	
$6^{(28)}$	$5^{(9)}$	$\emptyset$
$6^{(26)}$		

→ Optimal cost

CLOSED

$1^{(5)}$	$2^{(7)}$

$\cancel{4^{(9)}}$ $\cancel{5^{(11)}}$

$3^{(25)}$ $4^{(7)}$

$5^{(9)}$

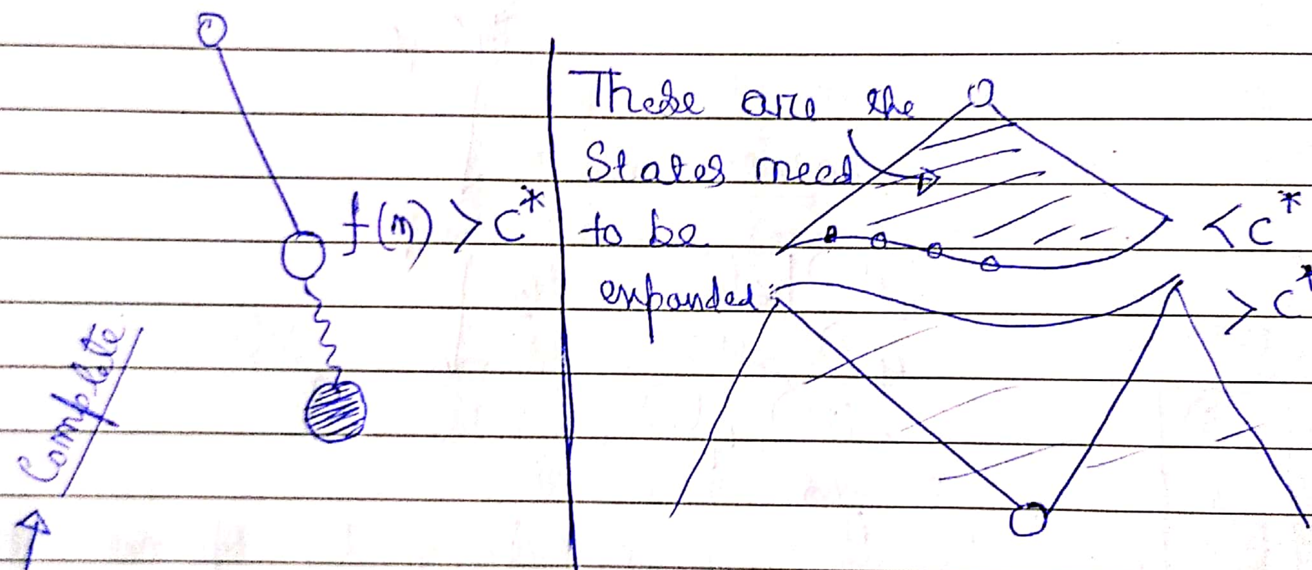
* Along the optimal path well informed
* Along the sub-optimal path not well-informed.

Notes

Properties of A*:

* A heuristic is called admissible if it always under-estimates, that is we always have $h(n) \le f^*(n)$, where $f^*(n)$ denotes the min^m Distance to a goal State from State 'n'.

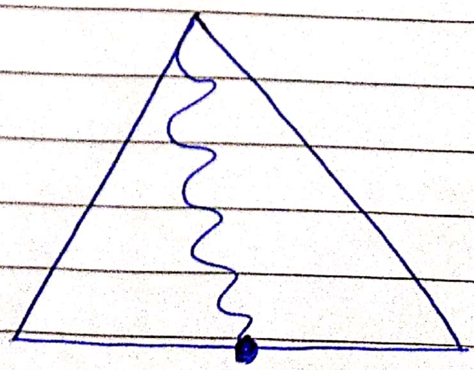
$f(n) < C^*$, $f(n) > C^*$ — never Expanded.



* For finite State Space, A* always terminates.

* At any time before A* terminates there exists in OPEN a State 'n', that is an optimal path from 'S' to a goal State with -

$$f(n') \le f^*(S)$$



Notes Results on A^*: Date | | | | |

1) Algorithm A^* is admissible, that is, if there is a path from 'S' to a goal state, A^* terminates by finding an optimal path

2) If 'A_1' and 'A_2' are two versions of A^* such that A_2 is more informed than 'A_1', then 'A_1' expands at least as many states as does 'A_2'.

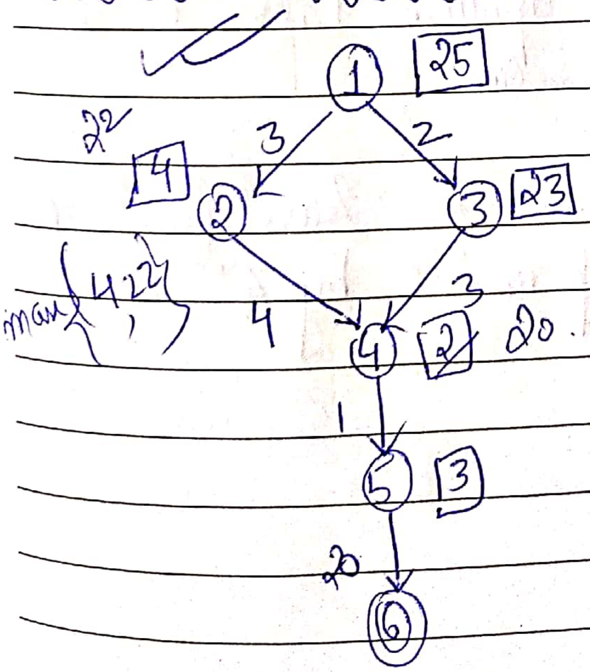
h_1

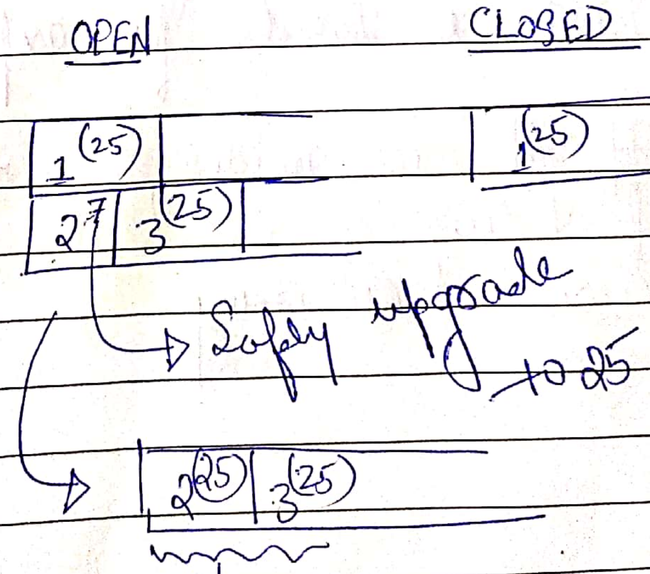
h_2 more informed than h_1

if $\forall n$ $\quad \underline{h_2(n) > h_1(n)}$

$\max\{h_1(n), h_2(n)\}$ at every state 'n'.

Monotone Heuristic :→





Same cost choose the one with lesser 'g' value.

Notes Date

CLOSED:

1(25)	3(25)	2(25)	4(25)

5(25)

OPEN:

2(25)	3(25)
2(25)	4(25)
4(25)	
5(25)	
6(26)	

Monotone Heuristic: →

* An addmissible heuristic function h() is monotonic, if for every successor 'm' of 'n':

$$\boxed{h(n) - h(m) \leq c(n, m)}$$

* If the monotone restriction is satisfied then A^* has already found an optimal path to the state it selects for expansion.

* If the monotone restriction is satisfied the f-values of the states expanded by A^* is non-decreasing.

Scanned with CamScanner

Notes

Pathmax;

non-monotonic $\rightarrow$ Monotonic

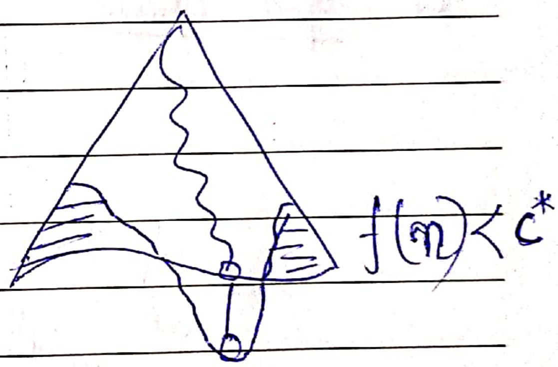
During the generation of successor 'm' on n — we set -

$$h'(m) = \max\{h(m),\ h(n) - c(n,m)\}$$

$\rightarrow$ use this heuristic at 'm'.

Inadmissible heuristic :$\rightarrow$

"Heuristic" $\rightarrow$ Overestimate



Bio-informatics (Over-estimation)

Trade-off

Advantage : In many cases inadmissible heuristics can cause better pruning and significatly reduce the search time!

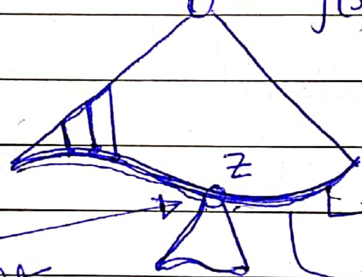
Disadvantage: A* may terminates with a sub-optimal solution

Iterative-Deepening A* (IDA*)

1) Set $c = f(S)$
2) Perform DFBB with cut-off c
   Expand a state 'n' only if its f-value is less than or equal to 'c'
   If a goal is selected for expansion then return 'c' and terminate.
3) Update 'c' to the min^m f-value which exceeded 'c' among states which were examined and go to ~~State~~ Step-2

- No open, closed

S $f(S) = c$



z

Pick-up the one that has the min^m cost.

This is the Frontier

Set of states in the Frontier $f(n) > c$

$c \leftarrow f(z)$

4) In the worst case, only one new state is expanded in each iteration
   * If A* expands 'N' states, then IDA* can expand

$$1 + 2 + 3 + \cdots + N = O(N^2)$$

→ time

→ Linear space