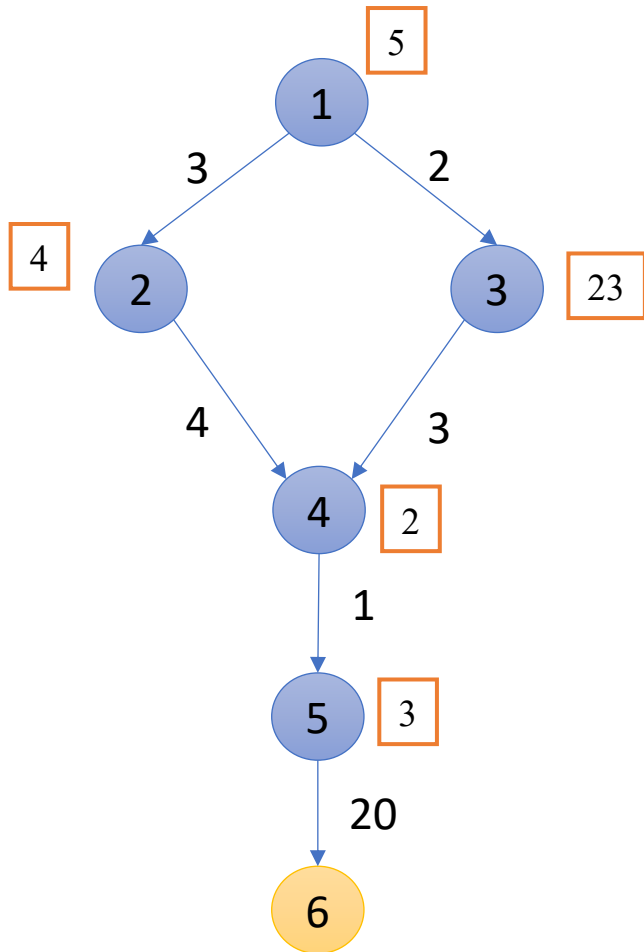


AIFA A^* Analysis

15/01/2024

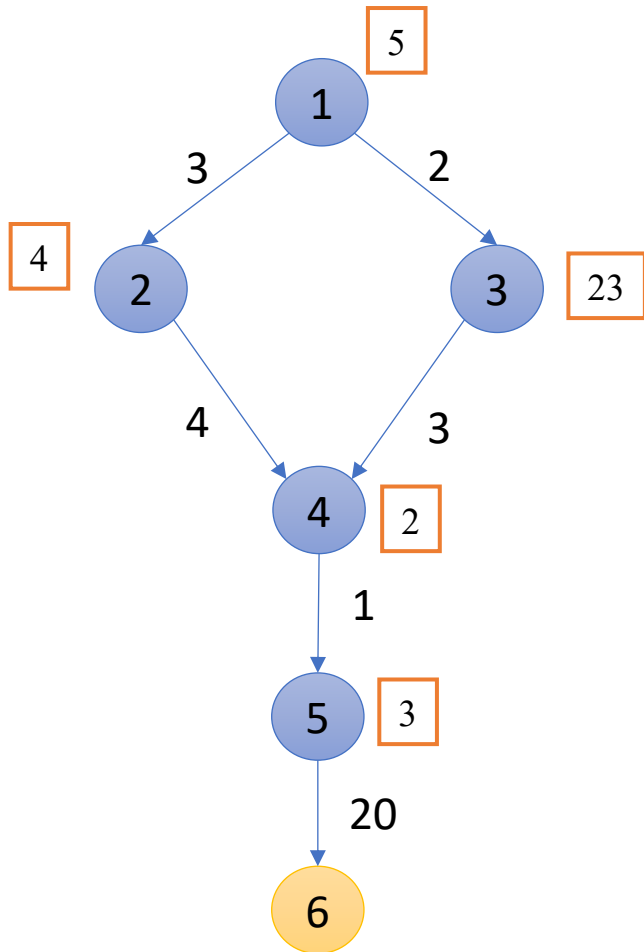
Koustav Rudra

Algorithm A*



OPEN SET	SELECT	GOAL	EXPANDED	CLOSED
[1(5)]	1(5)	N	[2(7),3(25)]	[1(5)]
[2(7),3(25)]	2(7)	N	[3(25),4(9)]	[1(5),2(7)]
[3(25),4(9)]	4(9)	N	[3(25),5(11)]	[1(5),2(7),4(9)]
[3(25),5(11)]	5(11)	N	[3(25),6(28)]	[1(5),2(7),4(9),5(11)]
[3(25),6(28)]	3(25)	N	[6(28),4(7)]	[1(5),2(7), 4(9) ,5(11),3(25)]

Algorithm A*



OPEN SET	SELECT	GOAL	EXPANDED	CLOSED
[3(25),6(28)]	3(25)	N	[6(28),4(7)]	[1(5),2(7), 4(9) ,5(11),3(25)]
[6(28),4(7)]	4(7)	N	[6(28),5(9)]	[1(5),2(7), 4(9) , 5(11) ,3(25),4(7)]
[6(28),5(9)]	5(9)	N	[6(26)]	[1(5),2(7), 4(9) , 5(11) ,3(25),4(7),5(9)]
[6(26)]	6(26)	Y		

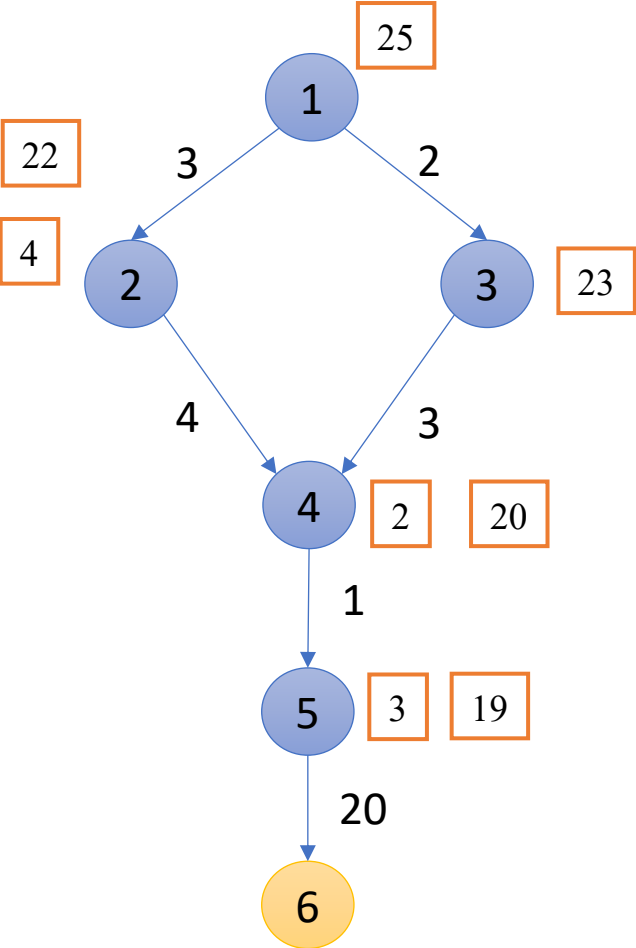
Node Re-Expansion

- Is it possible in searches involving heuristic function?

Monotone Heuristics

- An admissible heuristic function, $h()$, is monotonic if for every successor m of n :
 - $h(n) - h(m) \leq C(n, m)$

Algorithm A*



OPEN SET	SELECT	GOAL	EXPANDED	CLOSED
[1(25)]	1(25)	N	[3(25),2(7)]	[1(25)]
			[3(25),2(25)]	
[3(25),2(25)]	3(25)	N	[2(25),4(7)]	[1(25),3(25)]
			[2(25),4(25)]	
[2(25),4(25)]	2(25)	N	[4(25)]	[1(25),3(25),2(25)]
[4(25)]	4(25)	N	[5(9)]	[1(25),3(25),2(25),4(25)]
			[5(25)]	
[5(25)]	5(25)	N	[6(26)]	[1(25),3(25),2(25),4(25),5(25)]
[6(25)]	6(25)	Y		

Monotone Heuristics

- An admissible heuristic function, $h()$, is monotonic if for every successor m of n :
 - $h(n) - h(m) \leq C(n, m)$
- If the monotone heuristic is satisfied, then A^* has already found an optimal path to the state it selects for expansion

Monotone Heuristics

- An admissible heuristic function, $h()$, is monotonic if for every successor m of n :
 - $h(n) - h(m) \leq C(n, m)$
- If the monotone heuristic is satisfied, then A^* has already found an optimal path to the state it selects for expansion
- How to convert a non-monotonic heuristic to monotonic one?

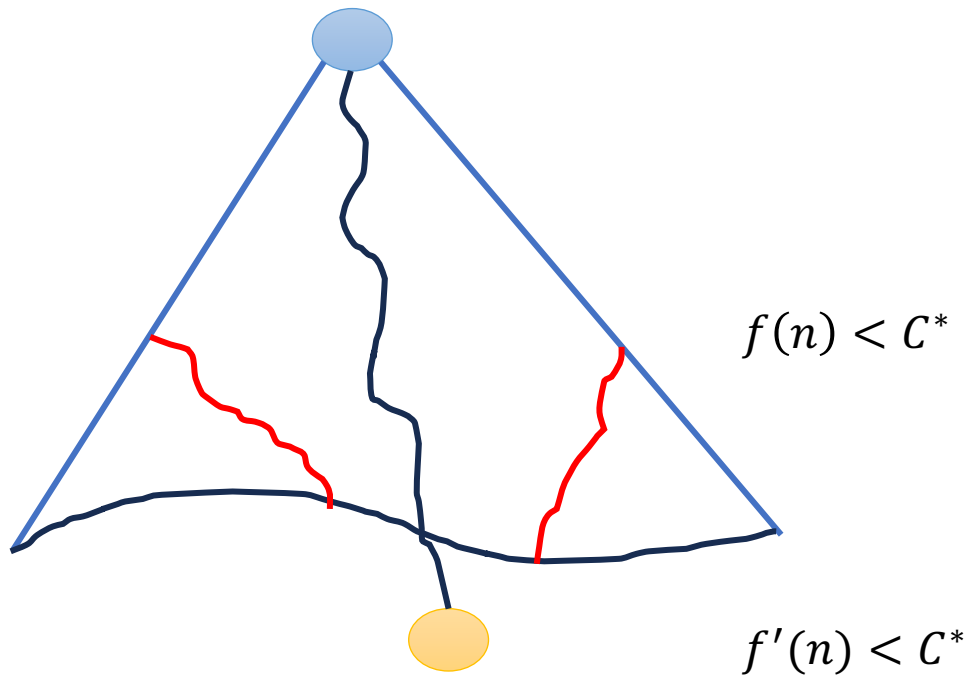
Pathmax

- Converts a non-monotonic heuristic to a monotonic one
 - During generation of the successor, m , of n we set:
 - $h'(m) = \max\{h(m), h(n) - C(n, m)\}$
 - Use $h'(m)$ as heuristic at m

A*: Result

- Heuristic Function is weak
 - ?
- Heuristic function is overestimating
 - Less number of states to explore
 - Does that always help?

A*: Result



When to go for overestimating?

Inadmissible Heuristic

- Advantages

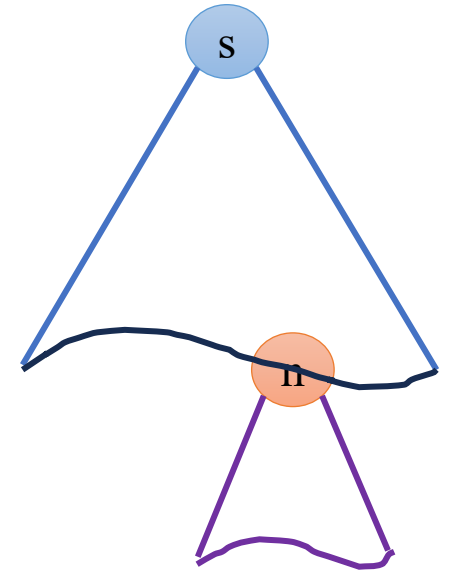
- In many cases, inadmissible heuristics can cause better pruning, and
- Significantly reduce the search time

- Drawbacks

- ?

Iterative Deepening A* (IDA*)

- Set $C = f(s)$
- 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
- Update C to the minimum f -value which exceeded C among states which were examined
- Go to Step 2



Iterative Deepening A* (IDA*)

- In the worst case, only one new state is expanded in each iteration
 - If A* expands N states, then IDA* can expand:
 - $O(N^2)$
- Space Complexity:
 - Linear
- IDA* is asymptotically optimal

Thank You