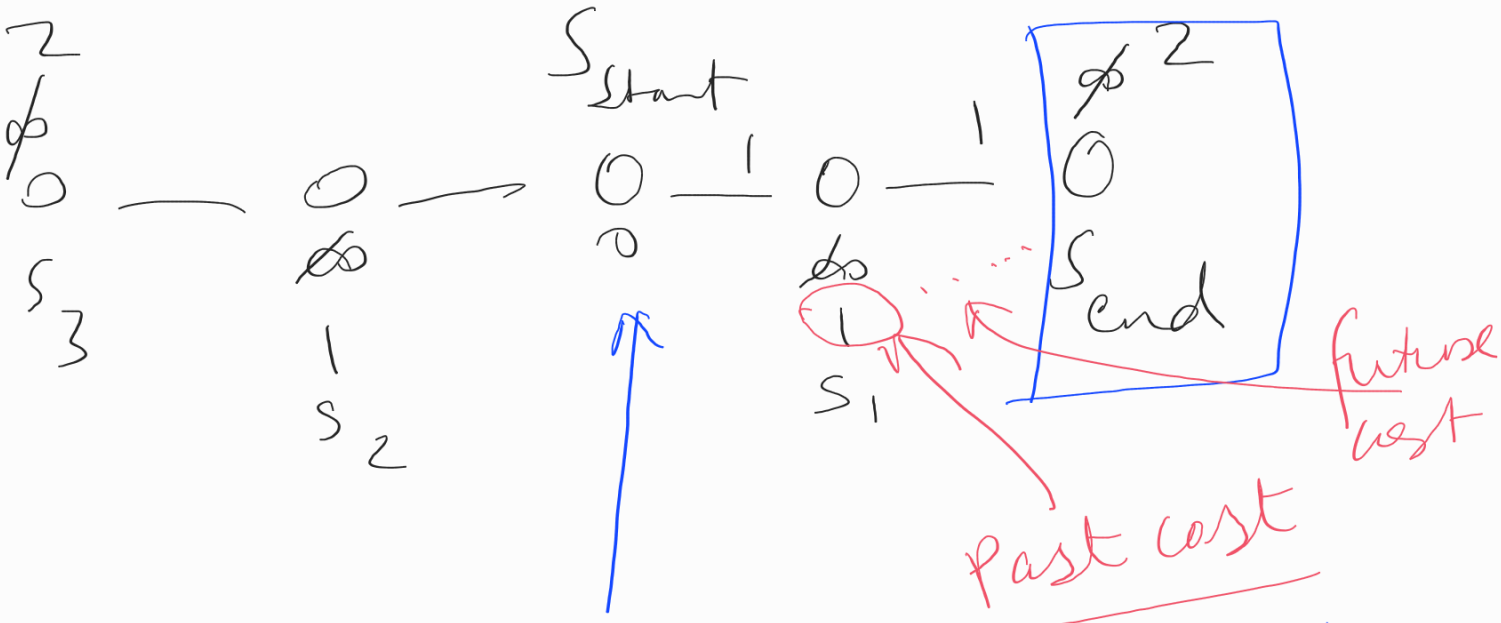
AI Theory, W4L2

A* Search:

Can we improve uniform cost search?



we explored all sides of start. But our goal was on one side.

UCS expands future costs on the basis of past costs.

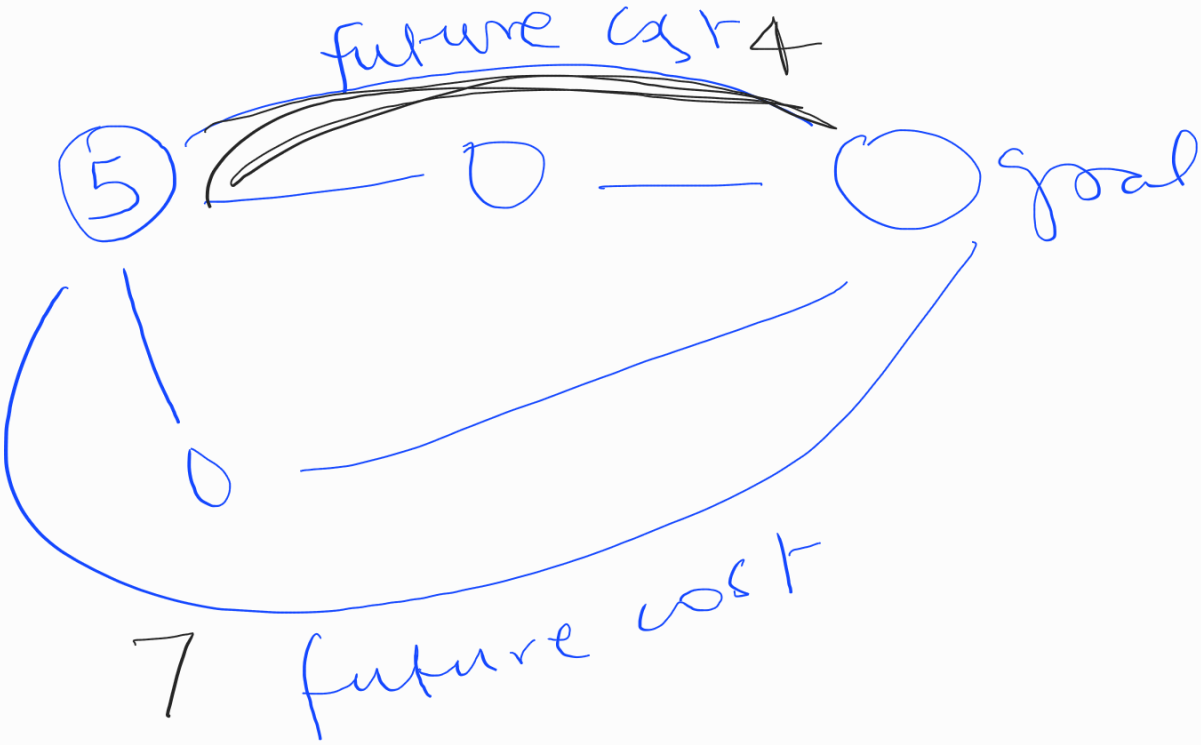
A* search prunes the results on the basis of the direction of goal.

An intuition is that we can penalize any cost moving away from the goal.

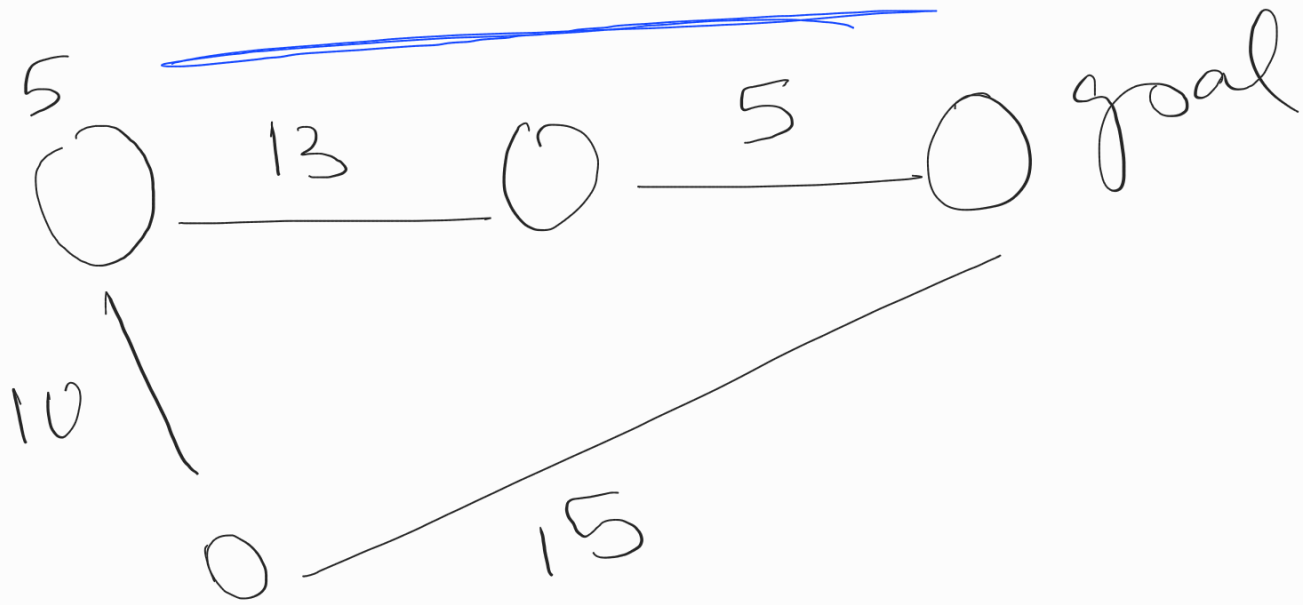
But how do we make this estimate?

See, here is the thing. Humans take the greedy approach.

always guaranteed to give sub-optimal solution.



Now, change the scenario a bit.



total estimate leads to the path in blue.

This leads us to <u>heuristics</u>:

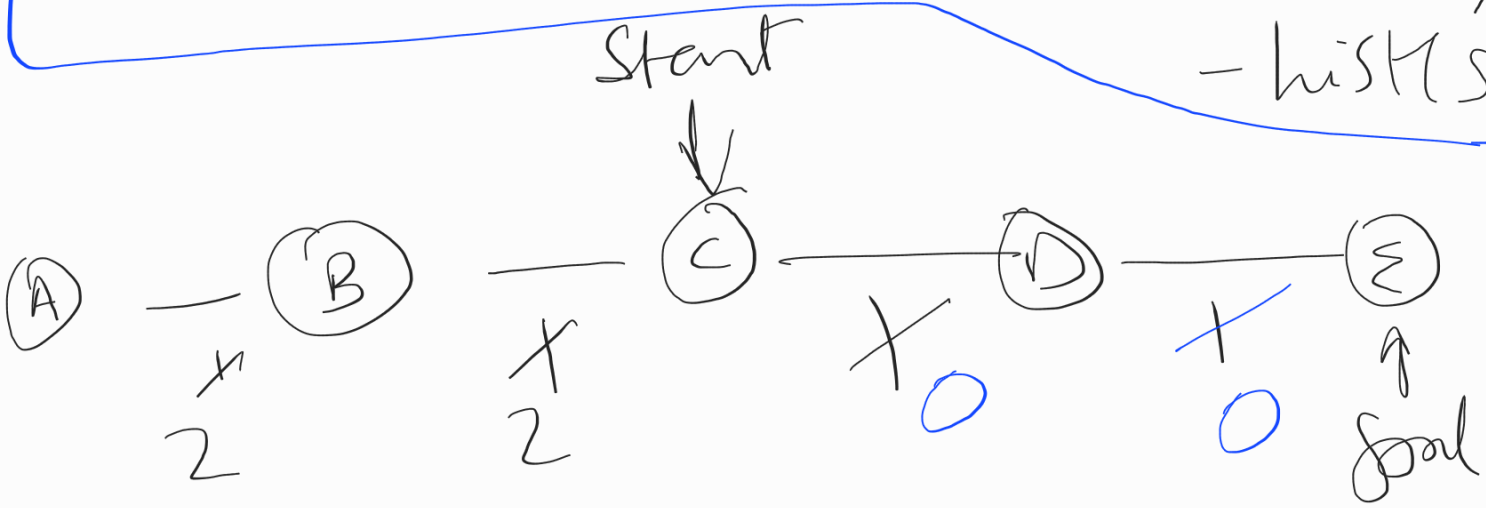
any estimate of the future cost.

So, how do we run heuristics?

Run UCS with <u>modified edge costs</u>.

which is next start state

$$\boxed{\text{Cost}^{\text{new}}(s,a) = \text{Cost}(s,a) + h^{\text{old}}(\text{succ}(s,a)) - h^{\text{old}}(s)}$$



assume already given →

$h(A) = 4$

$h(B) = 3$

$h(C) = 2$

$h(D) = 1$

$h(E) = 0$

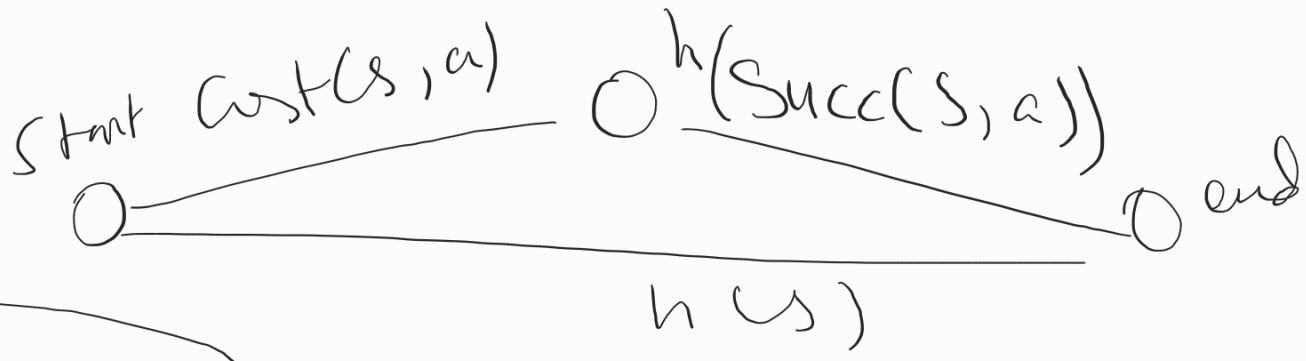
modify edge costs first then run uniform cost search.

Properties of heuristics

① Consistent heuristics. It is if:

→ • $cost^{j}(s,a) = cost(s,a) + h(succ(s,a)) - h(s) \geq 0$

if not this, then it will also explore wrong path.



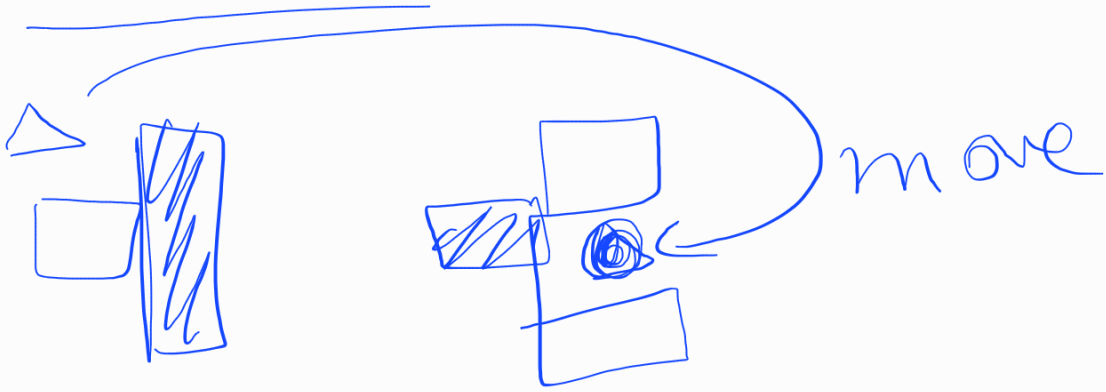
if this doesn't hold h(s) would be explored

→ • $h(s_{end}) = 0$

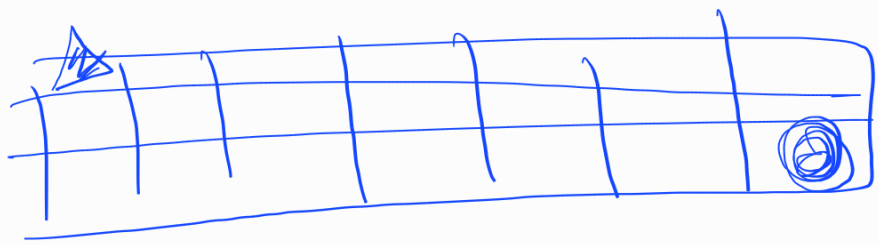
(2) Admissible heuristics if

$h(s) \leq$ future cost

Relaxation: How do we calculate heuristics?



what is the heuristic?



Manhattan distance.

Transportation problem:

constraints:

Tram actions < walks

Heuristics:

Calculate without constraints and this is future cost.

in short:

"remove constraints from hard problem".

the estimate

the greater the better

Roadmap:

reduce costs

↓

remove constraints

closed form solutions

easier search

independent subproblems

combine heuristics using max

Beam Search:

expand BFS on basis of heuristics ($w < n$)

if we explore only one node per step, it is called

$\boxed{\text{hill-climb search}}$

best node explored.