CS5811
Sep. 9, 2020
Wednesday

Reminder

- We have class on Friday, 9/11.
  K-Day starts at noon.

Previous classes

- We defined a unified algorithm for uninformed search strategies: BFS, DFS, DLS, IDS
- We evaluated them along four dimensions:
  - completeness
  - time complexity
  - space complexity
  - optimality
- We used the following parameters:
  - b: branching factor (finite)
  - d: depth of the goal
  - m: maximum depth of the tree
  - ℓ: depth limit
- Time complexity is exponential for all, these are hard problems
- IDS brings together the good parts of BFS and DFS by adding the cost of repetitions.
  The asymptotic cost remains the same.
  IDS is
  - complete and
  - optimal and has
  - linear space complexity.

Main takeaway:

Always know the properties of an algorithm very well and be able to clearly identify the changes to the properties when variations are made to the algorithm.

This lecture

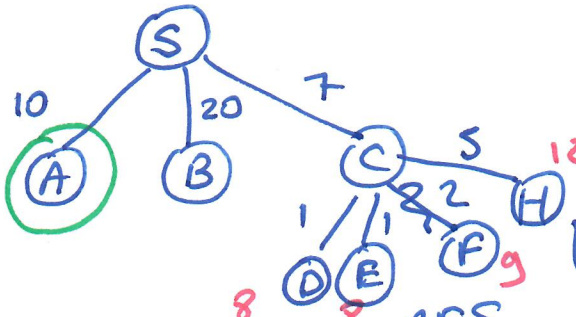
- Uniform cost search
- Tree search and graph search algorithms
- Heuristic "informed" search

Uniform Cost Search

action costs are variable

(special case of BFS)

↳ cost of actions are 1



Frontier

S

BFS

A	B	C
10	20	7

(order doesn't matter all are cost 1)

UCS

sorted to facilitate picking up the lowest cost one first.

~~C~~	A	B
7	10	20

D	E	F	A	H	B
8	8	9	10	12	20

Keep bookkeeping information in a node

In a node:

state, depth, (cost), _____

path "pointer" to the parent

A: S A F: S C F

"It will work just like BFS"

"If all the costs are 1 it is exactly BFS"

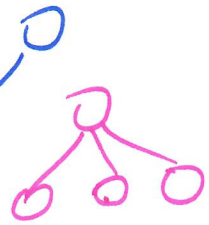
It should be optimal ✓

completeness ✓, time complexity still exponential, space complexity similar to BFS ✓, optimality

when to do the goal test?

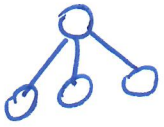
when a node is generated

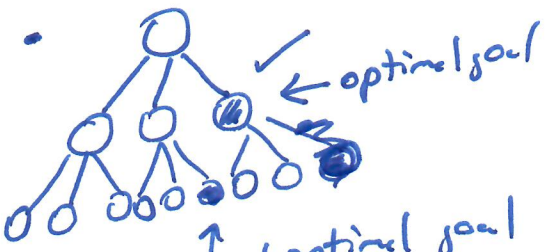
when a node is expanded BFS

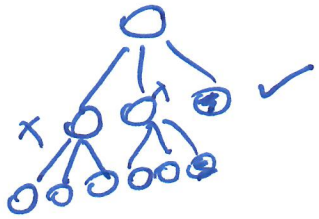


if we do the goal test when a node is generated do we find the optimal goal?

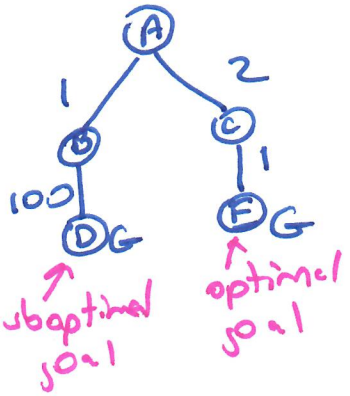
yes







what about uniform cost search?



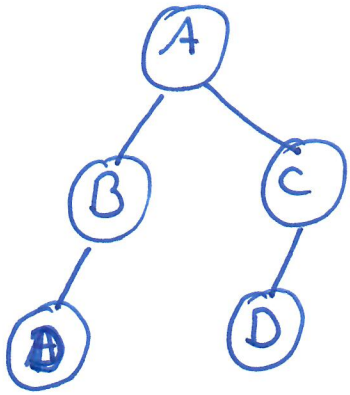
A
0

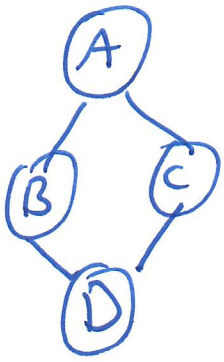
B C
1 2

C D
2 100

checked when generated will be returned as the goal.

F D
3 100

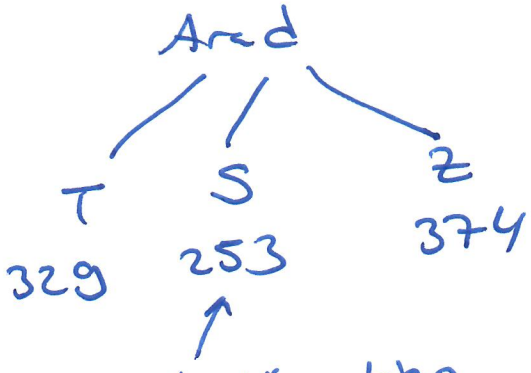




Heuristic search

↳ informed search

↳ gives (hunch) of where the solution lies



↑ "best" option

f heuristic

best-first search

↙ greedy ↘ A*