

CS 404 – Artificial Intelligence

HW 2 – Blind Search – AIMA– Chp. 3

75pt

Late homeworks accepted for 2 days (no penalty in the first late day; -10pts off when late for 2 days)

Please type your answers and use only the allocated space.
You may color your answers blue for easy grading.

Objective: To deepend the understanding of time and space complexity in search algorithms and deciding on suitable algorithms for a given problem.

Type your answers, but you can draw any illustrations by hand (if so you can send the scanned document).

1) 30pts –Answer the following using the general Tree Search algorithm (remove front node from the fringe/queue – goal test – expand).

Reminder: You can use the following equality for compactness:

$$1 + b + b^2 + \dots + b^d = (b^{d+1}-1)/(b-1)$$

a) 15pt - How many nodes are **visited** (chosen from the queue, goal tested and expanded) in the worst-case using Breadth-First search, when the solution is at depth d , and the branching factor is b , and the depth of the maximum branch is m ?
Give a formula.

$$(b^{d+1}-1)/(b-1)$$

b) 15pt- How many nodes are **generated** (added to the queue as a result of expanding the parent) in the worst-case using Breadth-First search, when the solution is at depth d , and the branching factor is b , and the depth of the maximum branch is m ?

$$[(b^{d+2}-1)/(b-1)] - b$$

2) 45pt – You are given the problem of finding whether 6-degrees of separation holds between a particular 2 people in the world. E.g. given two people – say you and your favorite celebrity - the software should decide whether they are connected in at most 6 friendship edges (e.g. you-f1-f2-f3-f4-f5-celebrity).

Let's assume you have the list of all friendships for all people in the world and that everyone has exactly $b=100$ friends and that there are 6 billion people in the world.

- a) 18pts) State **whether the following algorithms are complete** (if there is a up to 6-degree path, does it find it?) **and optimal** (defined here as 'does it find the shortest path connecting two people') **for this problem.**
- b) 12pts) If an algorithm is **BOTH complete AND optimal**, comment on its time and space complexity with a one line summary about its suitability (e.g. "will take too much time/space: $O(b^d)$ "). If an algorithm would take too much time or space to be feasible, indicate as such; if it is suitable but is an overkill, you should indicate that also.

Algorithm	Complete (answer as Yes or No)	Optimal (answer as Yes or No)	Feasibility (add a one-line comment)
Breadth first search	YES	YES	Time and space complexity are exponential ($O(b^d)$) and it is not feasible since it will need too much space and time.
Depth first search without repeated state checking	NO	NO	
Depth first search with repeated state checking	YES	NO	
Depth limited search DFS with a depth limit of 6	YES	YES	Space complexity will be linear $O(bd)$ but time complexity will be exponential $O(b^d)$ Therefore, it needs too much time but less space.

Iterative deepening DFS	YES	YES	Space complexity will be linear $O(bd)$ but time complexity will be exponential $O(b^d)$. Therefore, it needs too much time but less space.
Bidirectional search	YES	YES	Time and space complexity are exponential ($O(b^{d/2})$) and it is not feasible since it will need too much space and time.

c) 15pts) Which blind search algorithm (among the ones listed above) **would be best for this problem? Explain your answer.** Consider space, time complexities and completeness and optimality.

Since we need to check at most 6 friendship, the Depth limited search DFS with a depth limit of 6 will be the best for this problem among the all given search algorithm. It is both complete and optimal. Space complexity of that is not exponential unlike the other complete search algorithms. Although time complexity is exponential, it is the best because of a linear space complexity.