CS380-Homework2

Sai Meda

April 2022

1 Forward-Backward Search (5 points): Eloise claims to be a descendant of Benjamin Franklin. Which would be the easier way to verify Eloise's claim: By showing that Franklin is one of Eloise's ancestors or by showing that Eloise is one of Franklin's descendants? Why?

You would go backward from Eloise since Franklin can have multiple dependents so you'll have to traverse through each of his descendants to find Eloise. But for Eloise, we can quickly go back to see if his ancestor during Franklin's time is Benjamin Franklin or not. So, you would backtrack from Eloise since it's faster to prove if he's a descendant. There are considerably less nodes to traverse back to and also check in the case of Eloise.

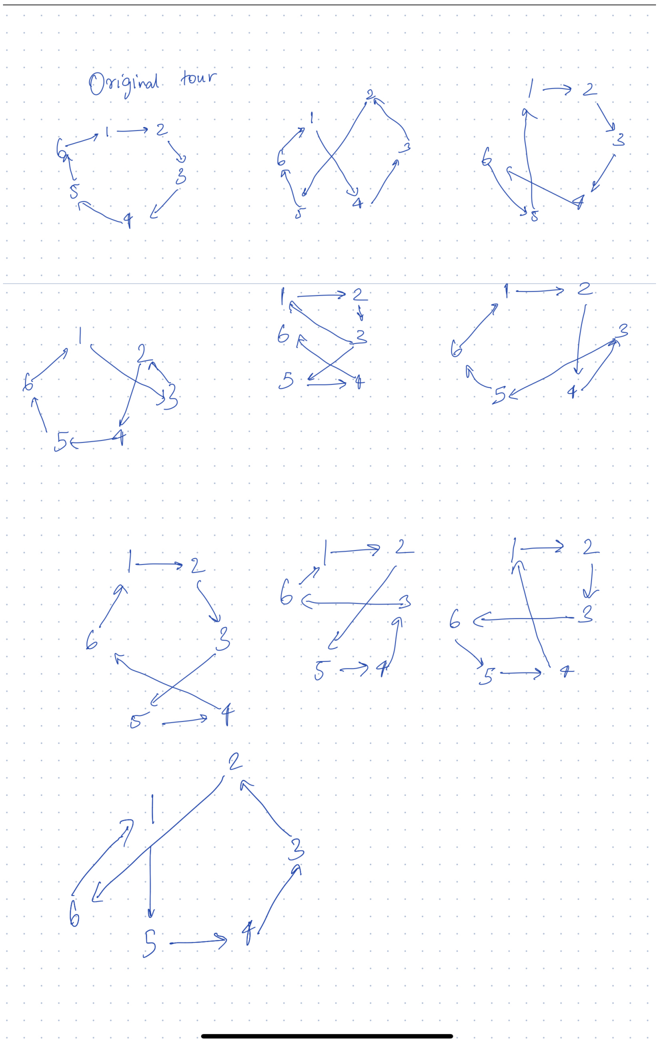
2 The Traveling Salesman Problem (TSP)

- Part A : 1→2 and 4→5 with the edges 1→4 and 2→5 so new tour will 1→4→3→2→5→6→1
- Part B : Below are the 9 possibilities:
  The swaps include :

  1. Cost of original tour is **353**
  2. The cost of new tour with (1,4) edge, and (2,5) edge swapped from (1,2) and (4,5) is $c_{1,4}(78) + c_{2,5}(64) - (c_{1,2}(10) + c_{4,5}(34))$ = **353 + 98 = 451**
  3. The cost of new tour with (4,1) edge, and (3,6) edge swapped from (3,4) and (6,1) is $c_{4,1}(78) + c_{3,6}(82) - (c_{3,4}(79) + c_{6,1}(79))$ = **2 + 353 = 355**
  4. The cost of new tour with (1,3) edge, and (2,4) edge swapped from (1,2) and (3,4) is $c_{4,1}(55) + c_{3,6}(46) - (c_{1,2}(10) + c_{3,4}(79))$ = **353 + 12 = 355**
  5. The cost of new tour with (2,4) edge, and (3,5) edge swapped from (2,3) and (4,5) is $c_{2,4}(46) + c_{3,5}(9) - (c_{2,3}(77) + c_{4,5}(34))$ = **-56 + 353 = 297**
  6. The cost of new tour with (3,5) edge, and (4,6) edge swapped from (3,4) and (5,6) is $c_{3,5}(9)+c_{4,6}(29)-(c_{3,4}(79)+c_{5,6}(74))$ = **-115 + 353 = 238 This is the optimal tour**
  7. The cost of new tour with (3,6) edge, and (2,5) edge swapped from (2,3) and (5,6) is $c_{2,3}(82) + c_{3,6}(64) - (c_{2,3}(77) + c_{5,6}(74))$ = **-5 + 353 = 348**

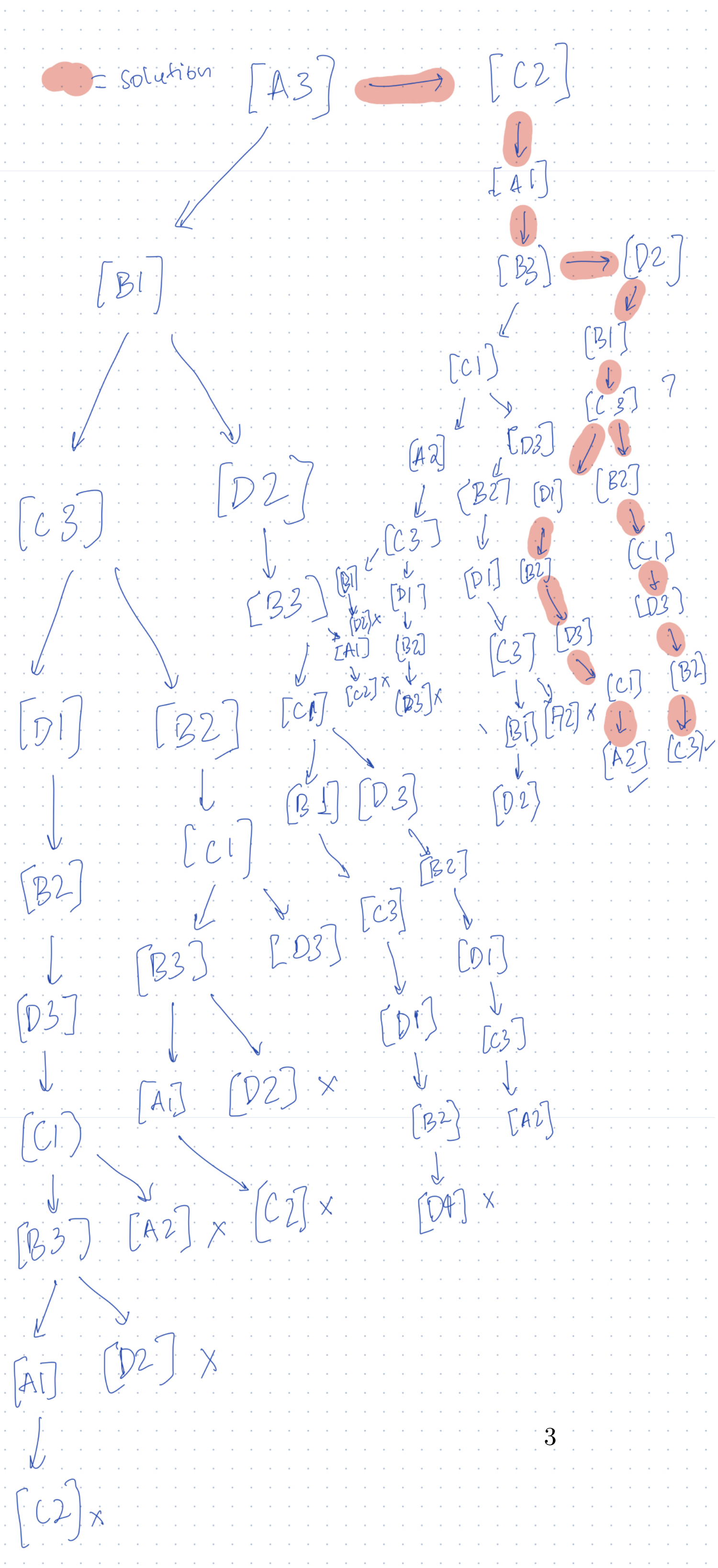
8. The cost of new tour with (4,1) edge, and (3,6) edge swapped from (3,4) and (6,1) is $c_{4,1}(78) + c_{3,6}(82) - (c_{3,4}(79) + c_{6,1}(79)) = \mathbf{2 + 353 = 355}$
9. The cost of new tour with (1,5) edge, and (2,6) edge swapped from (1,2) and (5,6) is $c_{1,5}(93) + c_{2,6}(86) - (c_{1,2}(10) + c_{5,6}(74)) = \mathbf{95 + 353 = 548}$
10. The cost of new tour with (4,6) edge, and (5,1) edge swapped from (4,5) and (6,1) is $c_{4,6}(46) + c_{5,1}(9) - (c_{4,5}(34) + c_{6,1}(79)) = \mathbf{9 + 353 = 362}$

- Since, the lowest cost is 238. The new tour is 1→2→3→5→4→6→1. The edges with most weight are 2→3 which is 77, and 4→6 which is weighed at 79. So replacing these with 2→6 and 3→1 which will result in a weight of 223. And this is the most possible optimal solution.



3 Knights Problem

I used this for testing : http://www.maths-resources.com/knights/



A. Two solution paths

- A3 → C2 →A1 →B3 →D2 →B1 →C3 →D1 →B2 →D3 →C1 →A2
- A3 → C2 →A1 →B3 →D2 →B1 →C3 →B2 →C1 →D3 →B3 →C3

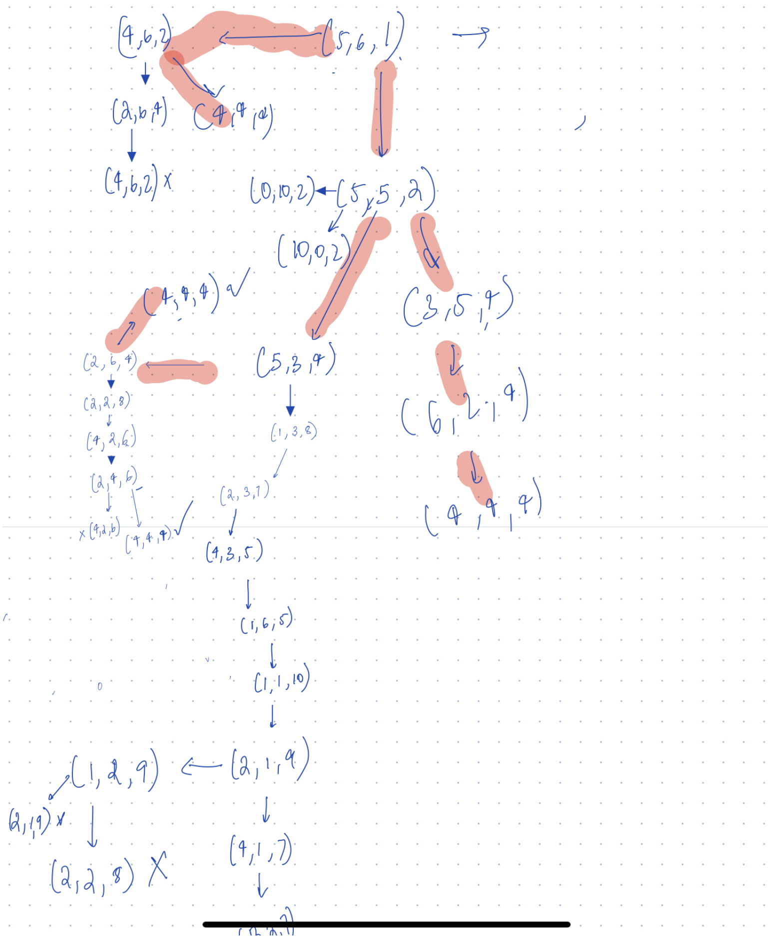
B. The number of terminal nodes would be kn̂ where k is branching factor and n is depth so 8^{36}.

C. The number of terminal nodes for branching factor of 4 would be 4^{36}

D. The formula used for this is $(k^{n+1}–1)/(k–1)$ so the nodes for depth 18 with branching factor 4 would be $(4^(18 + 1) − 1)/(18 − 1)$. This would result is an abnormal number of nodes so this wouldn't be a viable strategy as a lot of work has to be done to traverse this tree.

4 Marble Problem

4.1 Tree Drawn for solution



- A : (5,6,1) $\rightarrow$ (4,6,2) $\rightarrow$ (4,4,4) Depth : 3
- B : (5,6,1) $\rightarrow$ (5,5,2) $\rightarrow$ (3,5,4) $\rightarrow$ (6,2,4) $\rightarrow$ (4,4,4) Depth : 5