CECS 528, Learning Outcome Assessment 11a, April 28th, Spring 2023, Dr. Ebert

Problems

LO7. Answer/Solve the following questions/problems.

(a) The dynamic-programming algorithm that solves the `Optimal Binary Search Tree` optimization problem defines a recurrence for the function wac(i, j). In words, what does wac(i, j) equal? Hint: do *not* write the recurrence (see Part b).

(b) Provide the dynamic-programming recurrence for wac(i, j).

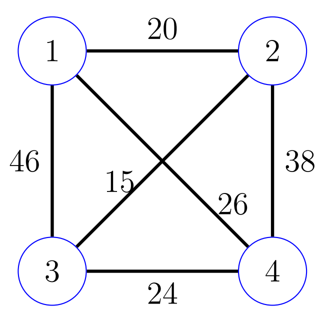
(c) Apply the recurrence from Part b to the keys 1-5 having respective weights 25,45,20,20,30. Show the matrix of subproblem solutions and use it to provide an optimal binary search tree.

LO8. Answer/Solve the following questions/problems.

(a) The dynamic-programming algorithm that solves the `Runaway Traveling Salesperson` optimization problem (Exercise 30 from the Dynamic Programming Lecture) defines a recurrence for the function mc(i, A). In words, what does mc(i, A) equal? Hint: do *not* write the recurrence (see Part b). Note: we call it "Runaway TSP" because the salesperson does *not* return to home after visiting each city.

(b) Provide the dynamic-programming recurrence for mc(i, A).

(c) Apply the recurrence from Part b to the graph below. Show all the necessary computations.



LO9. Consider the `2SAT` instance

$$\mathcal{C} = \{(x_1, \overline{x}_2), (x_1, \overline{x}_3), (x_1, \overline{x}_4), (\overline{x}_1, x_3), (x_2, x_4), (\overline{x}_2, x_3)(\overline{x}_3, \overline{x}_4)\}.$$

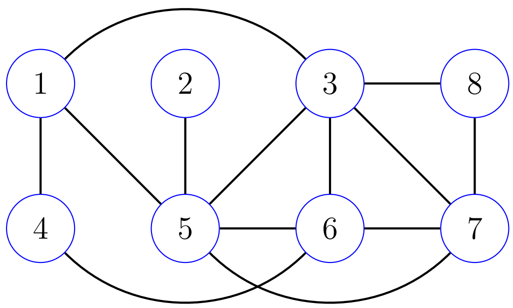
(a) Draw the implication graph $G_{\mathcal{C}}$.

(b) Find a literal l for which i) R_l is an inconsistent reachability set, ii) $R_{\bar{l}}$ is a consistent reachability set, and iii) $\alpha_{R_{\bar{l}}}$ satisfies *all* the clauses of $\mathcal{C}$. For full credit clearly state the literal l you have chosen and verify that each of the three properties are satisfied. Hint: for example, if you choose $l = \overline{x}_3$, then $\bar{l} = \overline{\overline{x}}_3 = x_3$.

LO10. Answer the following.

(a) Provide the definition of what it means to be a mapping reduction from decision problem A to decision problem B.

(b) For the mapping reduction $f : \texttt{Clique} \rightarrow \texttt{Half Clique}$ provided in Exercises 11 and 12, and for `Clique` instance $(G, k = 5)$, determine $f(G, k)$, where G is shown below.



(c) Verify that (G, k) and $f(G, k)$ are either both positive instances or both negative instances of their respective decision problems. Defend your answer.

LO11. Recall the mapping reduction $f(\mathcal{C}) = (S, t)$, where f maps an instance of `3SAT` to an instance of the `Subset` decision problem. Given `3SAT` instance

$$\mathcal{C} = \{(x_1, \overline{x}_2, x_5), (x_2, x_3, \overline{x}_4), (x_1, x_2, x_4), (\overline{x}_1, \overline{x}_3, \overline{x}_5)\}$$

answer the following questions about $f(\mathcal{C})$. Hint: to answer these questions you are *not* required to draw the table.

(a) What is the value of t?

(b) How many numbers (counting repeats) are in S? What is the largest (in terms of numerical value) number in S?

(c) Use satisfying assignment $\alpha = (x_1 = 1, x_2 = 1, x_3 = 0, x_4 = 0, x_5 = 0)$ for $\mathcal{C}$ and use it to identify a subset A of S that sums to t. List all the members of A.