CSE 5311: Homework 2

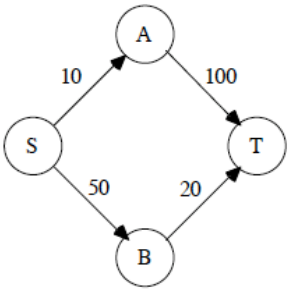
1. 26.2-3, but also include an edge of capacity 10 from v1 to v2. Also solve using preflow-push

2. Determine the lattice of solutions for the following stable marriage problem, given the following precedence lists ordered from most favored to least favored:

Men				Women			
1	2	3	4	1	2	3	4
1	2	3	4	4	3	2	1
2	1	4	3	3	4	1	2
3	4	1	2	2	1	4	3
4	3	2	1	1	2	3	4

3. 22-1

4. Find a maximum flow in the following network using the preflow-push algorithm.

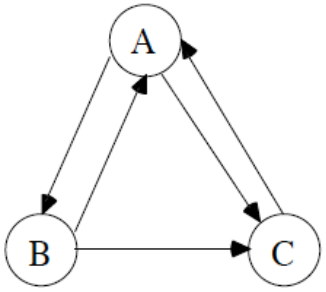


5. Give the Knuth-Morris-Pratt fail links (both methods) and the Z algorithm prefix lengths for the search pattern `abracadabra`.

6. Suppose that matrix multiplication is implemented in a recursive, decomposition fashion like Strassen's method. However, instead of using his equations we use the everyday ones, i.e. $c_{ij} = a_{i1}*b_{1j} + a_{i2}*b_{2j}$ What is the asymptotic complexity, based on the number of scalar multiplies and additions/subtractions?

7. It is easy to test in polynomial time if the sum of the lengths for a set of line segments $\leq$ a given value k. This problem may be generalized to two dimensions to give an NP-complete problem. In the generalized problem, the set of line segments is replaced by a set of rectangles (with dimensions in x and y). We would like to test if the rectangles will fit (without overlap, but they may touch) within another given rectangle, but the given rectangles must remain oriented to the x and y axes, i.e. do not rotate them. Prove that this problem is NP-complete by a simple reduction.

8. In many cases, transitivities may be removed from a directed graph. Instead of allowing you to remove the transitivities you please until none remain, you are required to strategically remove as many as possible for that graph, i.e. removing a transitive edge may make other previously transitive edges non-transitive. As an example, consider:



If I remove edge (B,C), no more transitivities remain, but I could also remove both (B,A) and (A,C) to leave no transitivities.

Prove: Testing if there are k edges that may be removed from a directed graph while still preserving all directed paths from the original graph is NP-complete.

Hint: Use an extraordinarily simple reduction from Directed Hamiltonian Circuit. You may assume that the DHC graph has a directed path between each pair of vertices.

9. 34-1

10. 35.2-2

11. 35.2-3

12. 35.2-4

13. 35.3-1

14. 35.3-2