# Homework 11

40 pts ## Problem 1:

Use Ford-Fulkerson on the following problem. For the residual flow, use BFS preferring intermediate nodes according to the alphabetical order. (BFS will always give the shortest paths available. The capacity of the edges is not specifying any distance, if two nodes are connected by an edge, the distance between the origin node and the destination node is 1. Show each residual graph and the flow after each step. Show a max-flow cut.
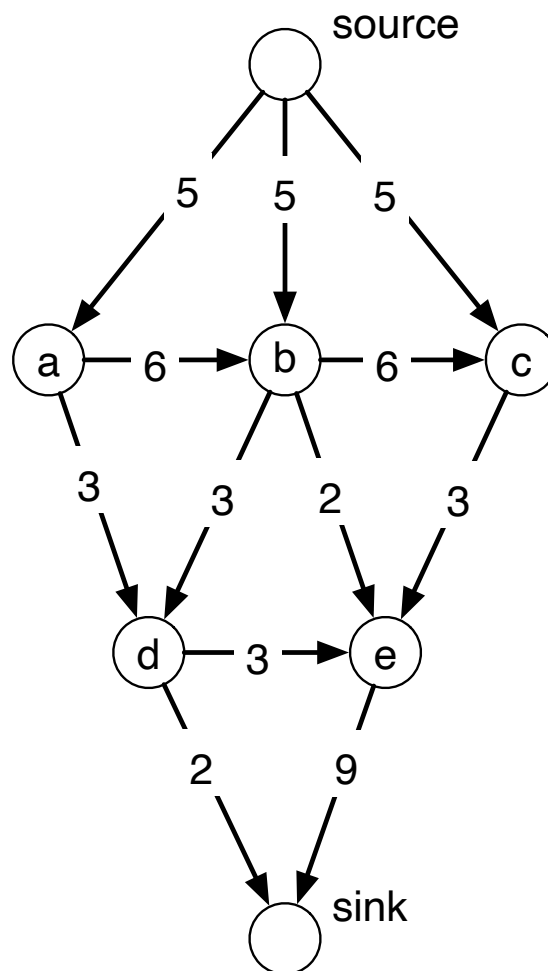
To generate the solution, please draw with black pen on white background and submit clear images in a pdf, unless you prefer to create the solution using a graphical tool.

30 pts

Problem 2:

You are given an array with random numbers. Find three array elements that sum up to a user-chosen number c or report that this is impossible. Your algorithm should run in time $O(n^2)$ or better. (This includes using sophisticated Python data structures.)

30 pts

Problem 3:

Database Management Systems (DBMS) implement transactions by locking and unlocking pages. This means that a thread execution a transaction might have to wait for another thread because the other thread holds a lock on a page that the first thread needs. Given a wait-for relationship between threads, give an efficient algorithm ($O(n^2)$ with n being the number of threads) to find out whether progress can be made or whether one or more of the threads need to be terminated and later restarted.