Albert-Ludwigs-Universität, Inst. für Informatik
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Algorithm Theory, Winter Term 2016/17
Problem Set 5

hand in (hard copy or electronically) by 09:55, Thursday December 22, 2016, tutorial session will be on January 9, 2017

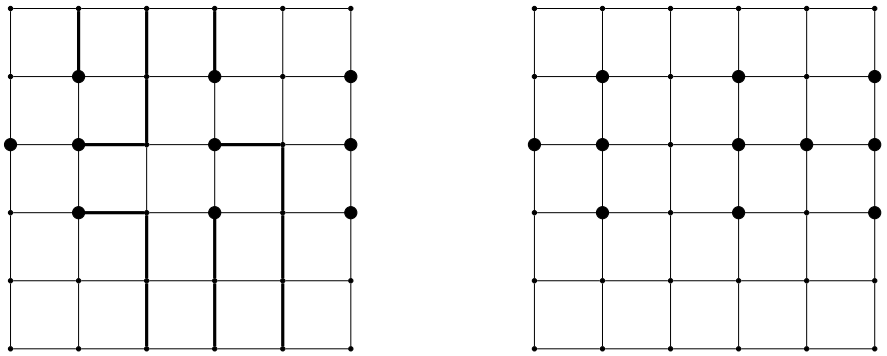
Exercise 1: Circuit Board, Conducting Paths (14 points)

A circuit board with a rectangle grid is given. Some designated points of the grid are connectors and need to be connected with ports via conducting paths. The ports can be anywhere on the rim of the grid. The conducting paths need to run along the grid lines and conducting paths are not allowed to cross.

Design an algorithm which finds a solution for a given grid with designated points or indicates that there is no solution. Your algorithm should run in polynomial time.

Remark 1: If you use any flow network, describe it explicitly.

Remark 2: There is a solution in the left hand side example but no solution in the right hand side example.



Exercise 2: *Smallest* Minimum Cut (14 points)

Suppose that you wish to find, among all minimum cuts in a flow network G with integral capacities, one that contains the smallest number of edges. Show how to modify the capacities of G to create a new flow network G' in which any minimum cut in G' is a minimum cut with the smallest number of edges in G.

Exercise 3: Route Planning with an Intermediate Stop (12 points)

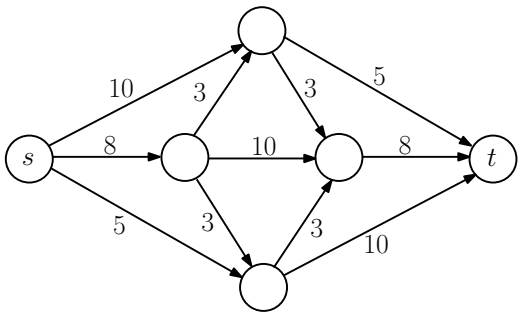
You are given an unweighted undirected graph $G = (V, E)$ and three nodes u, v and w. Devise an efficient algorithm which finds a path from u to w that visits v and visits every node of G at most once.

Exercise 4*: Ford Fulkerson Algorithm (10^* points)

Remark: This exercise is optional and it does not increase the threshold for exam admittance. However, your points in this exercise contribute to reach the 50% threshold to be admitted for the exam.

This exercise will not be presented in the tutorial session. However, a sample solution will be provided.

Consider the following flow network:



a) **(7 points)** Solve the maximum flow problem on the above network by using the Ford Fulkerson algorithm. Give all intermediate results.

b) **(3 points)** Give a minimum capacity s-t cut of the given network. Describe how you can get the cut from the maximum flow computed in a).