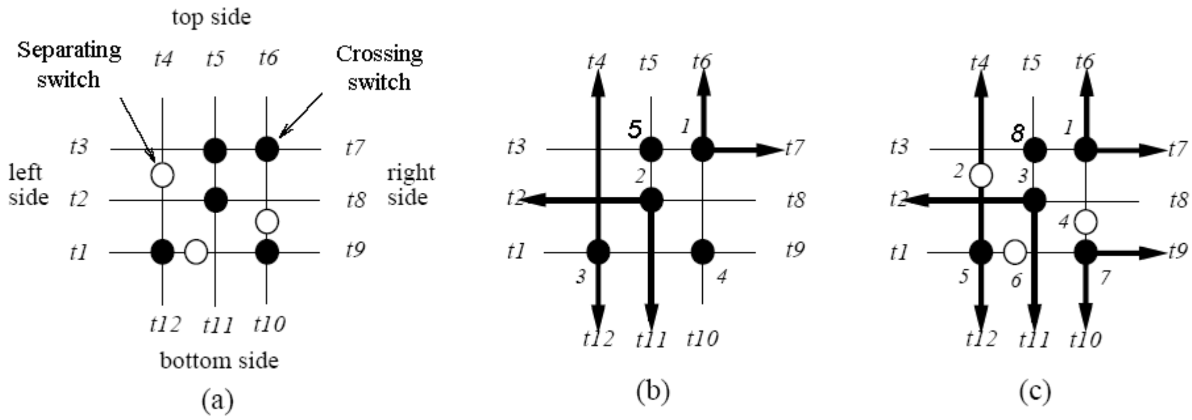
Homework #5 (due 1pm, January 7, 2019 in BL 428)

INSTRUCTIONS: Please slide your homework into my office in BL-428 directly. Because we will make the sample solutions available on-line by 11pm January 7, no late submission after 5pm January 8 will be accepted for this homework. Thank you very much for your cooperation!

1. Exercise 26.2-3 (page 730). **(Please justify the correctness of your answer: why is your resulting flow maximum?).**
2. Problem 26-1 (pages 760–761).
3. Problem 26-3 (pages 761–762).
4. Problem 26-6 (pages 763–765).
5. You are arranging a dating party for p female members $f_1, f_2, \ldots, f_p$ and p male members $m_1, m_2, \ldots, m_p$. Each female member ranks two male members she would like to date, ranking them according to her preference.
   (a) We say that a dating assignment is a *feasible* assignment if every female member dates with a male member within her preference list. How would you find a feasible assignment?
   (b) A feasible assignment is said to be *k-feasible* if it assigns **at most** k female members to their second most preferred male members. For a given k, develop an algorithm for determining a k-feasible
6. Figure (a) below shows a switch matrix with three horizontal and three vertical tracks. There are two types of switches in the switch matrix, *crossing switches* and *separating switches*. (The crossing switches are represented by solid circles and the separating switches by hollow circles.) If a crossing switch at the intersection of a horizontal and a vertical tracks is "ON," the two tracks are connected; if it is "OFF," the tracks are not connected and thus are electrically non-interacting. If a separating switch on a track is "OFF," the track is split into two electrically non-interacting routing segments so that the terminals on opposite sides can be used independently; if it is "ON," the track becomes a single electrical track.

   A *connection* is an electrical path between two terminals on different sides of a switch module. Assume that **at most one switch can be used, i.e., programmed to be "ON," by a connection.** (Based on this assumption, only straight connections can use separating switches. Figures (b) and (c) show some legal connections.) Let the numbers of connections required to be routed through a switch module between the top side and the right side, between the left side and the right side, and between the bottom side and the right side, be n_t, n_l, and n_b, respectively **(i.e., for this problem, we consider the nets routing through the right side only)**. You are asked to answer if a switch matrix can accommodate such n_t, n_l, and n_b connections simultaneously with no connection being electrically shorted.

   (a) For the switch matrix shown in Figure (b) (which has no separating switch), formulate this problem as a bipartite matching problem.
   (b) For the switch matrix shown in Figure (c) (which contains separating switches), formulate this problem as a maximum flow problem.



7. (a) Exercise 34.1-4 (page 1060). (b) Professor Chang finds a fast algorithm for the maximum flow problem on the network $G = (V, E)$ with the capacity $c(u, v)$ for the edge (u, v), which runs in $O(VE \lg C)$ time, where $C = \max_{(u,v)\in E} c(u, v)$. Is it a polynomial-time algorithm? Justify your claim.

8. Exercise 34.4-7 (page 1086).

9. Problem 34-1 (pages 1101–1102).

10. Problem 34-3 (pages 1103–1104).

11. Exercise 35.2-4 (page 1117).

12. Problem 35-1 (page 1134).

13. Problem 35-4 (pages 1135–1136).

14. (DIY Problem) For this problem, you are asked to design a problem *set* related to Chapter(s) 26, 34, and/or 35 and give a sample solution to your problem set. Grading on this problem will be based upon the *quality* of the designed problem as well as the *correctness* of your sample solution.