Discrete Optimisation
Exercise Session 10: Flows

27th November 2015

Exercise 1 (village fair)**.** A village fair gathers the families of the whole village and the close surroundings. The organisers want to have a dinner to end the fair, but they need to sit people to the tables. In order to increase social interactions, at most three members of each family can be present at any given table.

Model this situation as a maximum flow problem, with p families (with a_i members for each family i) and q tables (with a capacity b_j for table j).

Exercise 2 (nurses scheduling)**.** Nurses make shifts in a hospital to fulfil the needs for each and every department and still have some rest. Each shift lasts for eight hours (meaning that there are three shifts per day). Each department has minimum requirements in terms of nurses per day (to be hired for the three shifts); due to the nature of their workload, minimum requirements are also imposed on each shift (summing over the departments). Furthermore, the nurses should be allocated to the departments following some bounds.

Model this situation as a minimum flow problem.

Nurses	Emergency	Neonatalogy	Orthopaedic surgery	
Shift 1	Between 6 and 8	Between 11 and 12	Between 7 and 12	At least 26
Shift 2	Between 4 and 6	Between 11 and 12	Between 7 and 12	At least 24
Shift 3	Between 2 and 4	Between 10 and 12	Between 5 and 7	At least 19
	At least 13	At least 32	At least 22	

Table 1: Nurses requirements.

Exercise 3 (maximum flow)**.** Solve the following maximum flow with the shortest augmenting path algorithm.

Exercise 4 (feasible bounded flow)**.** Solve the following feasibility flow with bound constraints as a maximum flow with edge demands.

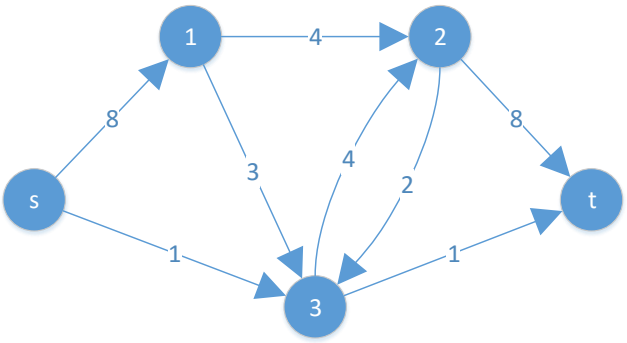

Figure 1: Maximum flow.

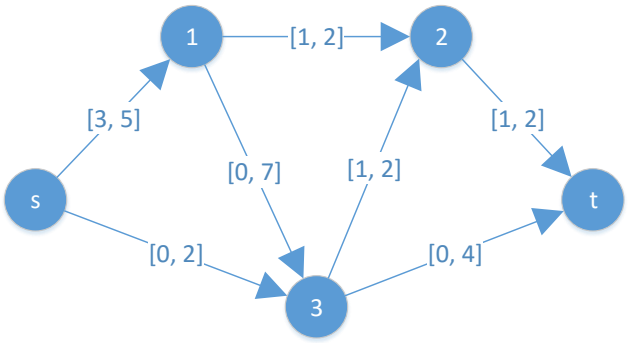

Figure 2: Feasible bounded flow.