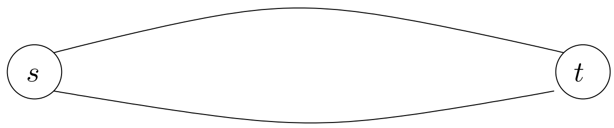
1.3 Packet routing

n packets of data must be routed from node s to node t, along one of two available links, with capacity (bandwidth) $k_1 = 1$ Mbps and $k_2 = 2$ Mbps.



The cost per unit of capacity of link 2 is 30% larger than that of link 1. The following table indicates the quantity of capacity consumed by each packet i, $i \in \{1 \dots n\}$, and the cost to route it on link 1.

Packed	Consumed capacity	Cost on link 1
1	0.3	200
2	0.2	200
3	0.4	250
4	0.1	150
5	0.2	200
6	0.2	200
7	0.5	700
8	0.1	150
9	0.1	150
10	0.6	900

Give an integer linear programming formulation for the problem of minimizing the total cost of routing all the packets. Give also an integer linear programing formulation for the more general case where m links are available.

1.4 Multi-period production planning (uncapacitated lot sizing)

A company A, which produces one type of high-precision measuring instrument, has to plan the production for the next 3 months. Each month, A can produce at most 110 units, at a unit cost of 300 Euro. Moreover, each month, up to 60 additional units produced by another company B can be bought at a unit cost of 330 Euro. Unsold units can be stored. The inventory cost is of 10 Euro per unit of product, per month. Sales forecasts indicate a demand of 100, 130, and 150 units of product for the next 3 months.

1. Give a linear programming formulation for the problem of determinig a production plan (direct or indirect) which minimizes the total costs, while satisfying the monthly demands.
2. Give a mixed integer linear programming formulation for the variant of the problem where production lots have a minimum size. In particular, if any strictly positive quantity is produced in a given month, this quantity cannot be smaller than 15 units.

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