1.5 Computer rental planning

A company must rent computers in order to face the requirements during the next four months:

Month	January	February	March	April
Requirements	9	5	7	9

The rental cost depends on the length of the rental as follows:

Length	1 month	2 months	3 months
Cost (Euro)	200	350	450

Give an integer linear programming formulation for the problem of finding a rental plan of minimum total cost.

1.6 Workforce planning

A ICT services company has estimated the following demand for maintenance and consultancy for the next 5 months:

Month	1	2	3	4	5
Demand (hours)	6000	7000	8000	9500	11000

At the beginning of the planning period, 50 technicians are available. Each technician works at most 160 hours per month. To satisfy the demand, new technicians must be hired and trained. During the training period, which lasts one month, an expert technician must coach the newly hired one for 50 hours.

Expert technicians are payed 2000 Euro per month, while the newly hired ones are payed 1000 Euro, during the training month. We suppose that, at the end of each month, 5% of the expert technicians leave the company to join competitors.

Give a mathematical programming formulation for the problem of minimizing the total costs.

1.7 Facility location and transportation

A distribution company has to supply a single type of good to n clients. Let d_j denote the demand of client j, where $j \in J = \{1, \ldots n\}$. The goods must be stocked in warehouses before being delivered to the clients. The warehouses can be located in m candidate sites. Let f_i denote the cost for opening a warehouse at the candidate site $i \in I$, with $i \in I = \{1, \ldots, m\}$, and b_i denote its maximum capacity. Let c_{ij} be the unit transportation cost from warehouse i to client j, and q_{ij} be the maximum quantity to be transported from warehouse i to client j.

Give an integer linear programming formulation to decide where to locate the warehouses and how to satisfy the client demands so as to minimize the total costs, i.e., the total opening costs plus the total transportation costs.