Hand-in Exercise: Floor Plan

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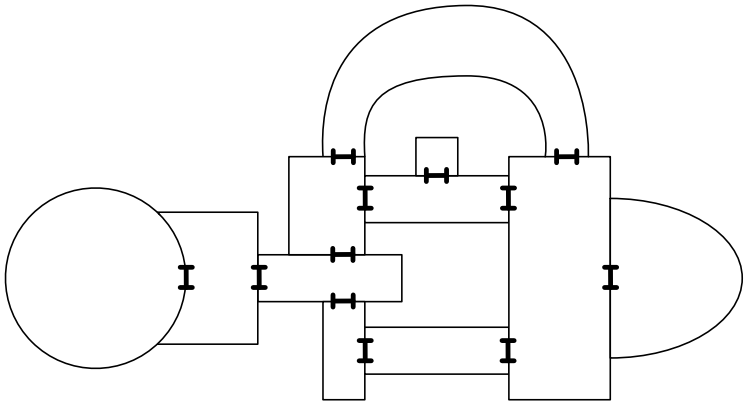
1 Floor Plan

A *floor plan* consists of a set of R rooms $r_0, .., r_{R-1}$ and D doors $d_0, .., d_{D-1}$ that each connects exactly two rooms. Each room is a geometric figure and a door between two rooms are indicated by three small bold lines between the rooms. For instance, the following floor plan P consists of 11 rooms and 12 doors.



1.1 Briefly describe how to model a floor plan as a graph.

1.2 Draw the graph corresponding to the floor plan P in the above example.

1.3 We are are interested in examining if it is possible to evacuate the rooms in case of fire. *The entrance* is a special room on the floor plan. A *fire door* is a door that will automatically close in case of fire. A room can be *evacuated* to the entrance if there is a connection from the room to the entrance that does not use any fire doors. Give an algorithm that given a floor plan, an entrance e and a set B of k fire doors determines if all rooms can be evacuated to e. Argue correctness of your algorithm. Analyze the running time of your algorithm in terms of parameters R, D, and k.

1.4 We are now interested in minimizing the amount of door space in order to increase the amount of wall space for beautiful paintings. We associate each door d with a *cost* $c(d)$ that indicates the wall space taken up by the door. The cost of a floor plan is the total cost of all doors on the plan. Give an algorithm, that given a floor plan, computes a minimum cost set of doors on the floor plan, such that all rooms are connected. Argue correctness of your algorithm. Analyze the running time of your algorithm in terms of parameters R and D.