

# CS 150: Project I

## *How Many Staircases Does A Skyscraper Need?*

Feb 15, 2014

**Due: 11:55pm, Saturday March 8, 2014**

### **Introduction**

Your project is to design a simulation of a multi-storey building so that the builder/architect can determine how many distinct staircases are required for emergency exits in the the event of a fire or something similar that requires evacuation of every person in the building.

### **Project Description**

The simulation is to be constructed as a console program that uses an appropriate set of containers to manage the data for the simulation. Some of the parameters that you might want to consider in designing your program:

- number of occupants per floor
- capacity of the staircase (between each floor) which is based on the time required for a person to make their way to the next floor
- time required to evacuate the building (worst case)

Some basic assumptions that have to be made:

- each staircase (between floors) has a fixed capacity
- a person can enter a staircase only if the capacity of the staircase has not been filled
- each person arrives at a staircase on their floor at random intervals in a Gaussian distribution with a mean of ? seconds and a variance of ? seconds. To see how to generate random numbers with a Gaussian (normal) distribution see <http://www.javapractices.com/topic/TopicAction.do?Id=62>.

The parameters to your program to be read in from a file (*param.txt*) are:

- the number of floors in the building,
- the number of staircases in the building,
- the capacity of each staircase,
- the time required to travel from one floor to the next,
- mean and standard deviation (variance) of number of tenants per floor

and an example is as follows:

```
5
2
20
15
50.0  10.0
```

The minimal requirement is to write a program that will use the above parameters and generate a simulation and results for a building with 3 floors.

Additional functionality for the program includes:

- adding a specification of number of visitors to each floor (mean and standard deviation). You will then have two classes of people - **Tenant** and **Visitor**.
- implementing the classes (where appropriate) as generic classes,
- changing the floor occupancy, such that every 3rd floor has fewer tenants in it (higher level management or conversely the other two floors have more tenants)

## Analysis

Your simulation and analysis should be used to answer questions like the following:

1. If the number of staircases were fixed, how does the time required to evacuate the building grow as the number of floors increases?
2. If the time required to evacuate the building were fixed, e.g., 15 minutes, how does the number of required staircases grow as the number of floors increases?
3. If the number of staircases and the number of floors were fixed, how does the time required to evacuate the building grow as the number of tenants per floor increases?
4. If the number of floors and time required to evacuate the building were fixed, e.g., 15 minutes, how does the number of required staircases grow as the number of tenants per floor increases?

## Constraints

The following constraints apply to the project:

1. The project is to be completed individually. The only person you can consult is the instructor.
2. Each configuration of parameters should be run *at least* 10 times with different random seeds to obtain an "average" value.

## Grading

Your project will be graded on the following criteria (assuming the program compiles and runs):

1. correctness of the program
2. documentation (methods and classes) including javadoc
3. unit testing
4. object oriented design
5. quality of the simulation and analysis