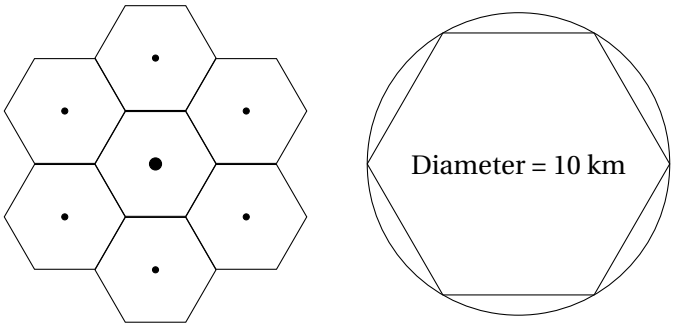
Assignment 4: Ambulance Allocation Optimization

Deadline: Sunday February 2, 2020 at 13:00

An ambulance service at a hospital has to cover a total of seven regions. Every region, which is hexagon shaped and fits precisely inside a circle with a diameter of 10 kilometer, has an ambulance waiting dock placed at its center and the hospital is located in the middle region, thus the hospital is a waiting dock as well. This is also indicated in the figure below. In total, the ambulance server has 20 ambulances that need to be placed at the waiting docks.



Write a simulation program of the ambulance service in order to find the optimal distribution of the ambulances across the regions that minimize the expected number of calls for which the 15-minute response time is not met. In particular, randomly generate emergency calls, process/serve the emergency calls and count the number of calls for which the 15-minute response time is not met. *Hint:* Start by building a simulation program for the central region alone and add new regions after you get the central region working.

The following assumptions are made:

- Consider time in minutes.
- Start with the assumption that the arrival process for arriving emergency calls is the same for all seven regions, namely a Poisson process with rate $\lambda = \frac{1}{15}$.
- Locations of arriving emergency calls are chosen uniform at random in their region of origin.
- The service time of an emergency call is defined by the processing time at the scene, which follows an exponential distribution with rate $\mu = 1$, and the driving time to the hospital.
- After the service of an emergency call is completed, the ambulance has to drive back from the hospital to its base location for replenishment before being able to serve a new emergency call.

- The response time (waiting time) of an emergency call is the time between when the emergency call arrives and when an ambulance arrives at the accident scene.
- The driving distance from Location A to Location B is measured by the Euclidean distance between Locations A and B.
- When driving, the ambulance speed is always 1 kilometer per minute. This means that the travel distance equals the travel time in minutes.
- Ambulances only pick up calls from their assigned region.

The following questions are being asked by the responsible ambulance planner:

1. Where should I place my ambulances given the emergency call arrival processes?
2. For how many calls do we exceed our regulatory 15-minute response time?
3. Does it improve performance if ambulances are allowed to process accidents from other regions?
4. Describe how the optimal solution changes when different arrival rates are used for emergency calls per region.

Each group of 2 students hand in the following:

- A written pdf report of at most six pages in which you present your findings to the questions asked in the assignment.
- The compiled version of your Business Simulation project (`*.jar` file). See Canvas for instructions on the `.jar` file.