4DV650 – Systems Modeling and Simulation
Assignment 2

In this assignment, you should be done *in a Group* (2 members). The names of both group members must be reported with the submission.

If you have questions, post them on the forum. It is ok to help each other in public forums. For any question about the Assignment use the **"Course Forum/Slack Channel"** to get in contact with us.

Please note that all tasks **MUST** be documented, that is, a figure/table without text that explains it has little or no value.

Grading

Your submission will receive a grade from 0 to 100. You are allowed to improve your work after the initial submission before the deadline. **The grade is final**, *i.e., you will not get an opportunity to correct/improve after grading*.

Your answers should be your own! You are not allowed to copy code, models, or texts (books articles, blogs, wikis) in your answers! **Each submission will pass through a plagiarism/clone detection system before correction. If plagiarism is detected, the assignment is failed and a formal investigation will be initiated.**

Evaluation Process

Submit a PDF, containing the report (filename: `LastName_FirstName_A2.PDF`)

Submit a ZIP, containing

- Source code of your program (must be fully documented)
- Binaries to be executed
- Instructions for compiling and executing (include external libraries, if needed)
- File containing all the raw data collected during the simulation

NB: **DON'T INCLUDE** the PDF in the ZIP File

Problem: A web application provides booking services. When opening the main web page, a customer may choose from among three options: *Flight Booking*, *Flight and Hotel Booking*, and *Flight, Hotel, and Car Booking*. The web application is hosted on a cloud-based infrastructure composed of 4 VMs. The current configuration can handle 4 requests in parallel and buffer a total of 6 requests.

Observations reveal that:

- The time to complete the different operations is, on average:
  - Flight Booking: 3 sec
  - Flight and Hotel Booking: 7 sec
  - Flight, Hotel, and Car Booking: 12 sec
- Requests arrive at a rate of about 34 per minute:
  - 20% of customers choose *Flight Booking*
  - 70% of customers choose *Flight and Hotel Booking*
  - 10% of customers choose *Flight, Hotel, and Car Booking*

Since many requests are lost, the owners want to invest and improve the infrastructure by adding a VM. The proposed configuration can handle 5 requests in parallel and buffer a total of 5 requests.

Develop a simulation model of the system. Estimate, for both the current and proposed system:

1. The *drop rate* (i.e., the rate at which requests are lost)
2. System performance in terms of *utilization*, and *response time*)

Compare the two configurations and draw the conclusions.

Carefully state any assumptions or approximations you make.

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Task 1: Simulation

Construct the computer program in a general-purpose language (e.g., C, Java, Phyton)

1. Describe how you plan to solve the problem
2. Specify and explain the Event-Graph
3. Describe design choices:
   - How do you advance the time?
   - How do you represent the system state?
   - How do you process the events defined by the Event-Graph?
   - What statistics do you need? How do you compute them?
4. Describe each implemented routine (timing, event handling, statistics etc…)

Task 2: Experiments

Design the set of experiments to run:

1. What type of simulation?
2. How many repetitions do you need to obtain 95% confidence?
3. Collect data (raw data should be included in the Report)

Task 3: Output Analysis

1. For each measure of interest, calculate:
   - Sample Average
   - Sample Variance
   - Confidence Interval half-width
2. Validate the output obtained from the simulation

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