exebit2010

Simulation Championship

Teams can have a maximum of **three** participants. Teams may choose either of the problems given below and perform the required simulations. The model, approach and assumptions applied to the problem are more important than mere working code. That said, submissions do require a considerable amount of programming. Any suitable language may be used for the simulations (Java, C, C++, Python, Lisp, Matlab to name a few). Contact us for any clarifications regarding use of non-standard packages or not-so-common languages. The problems are designed to be fairly open-ended, with a lot of room for simplifications and modeling. Keep your assumptions sensible and as true to life as possible.

Submission instructions:

Your submission must be a gzipped archive consisting of the following:

- `INFO.txt` - Specify the names and contact details of all the team members in this file.
- `README.txt` - Provide detailed instructions on compiling and/or running your code.
- `Brief.pdf` - Explain your model, simulation techniques, code and anything else that might be relevant. Interpret the results you obtained from your simulations.
- Plots, snapshots, code and everything else.

Mail your entries to: *simc@exebit.org*

Deadline for submissions: 15th February, 2010

1 Elevator Algorithms

Elevators have been around for quite some time now. Starting from the humble vertical hoisting machines of Vituvius, elevators have come a long way to silent, automatically-controlled armies spanning hundreds of floors and servicing millions of passengers. This simulation aims at developing methods of efficiently using the elevators available in a building.

The classical elevator algorithm, a simple algorithm by which a single elevator can decide where to stop, is summarized as follows:

- Continue traveling in the same direction while there are remaining requests in that same direction.
- If there are no further requests in that direction, then stop and become idle, or change direction if there are requests in the opposite direction.

a) Modern elevators use more complex heuristic algorithms to decide which request to service next. Consider a building with N floors and two elevators, each with a capacity of C. Develop and simulate such a heuristic. Model the arrival of passengers reasonably. Consider the time that elevators might take to move between floors and the time that they spend for loading and unloading.

How does your heuristic scale to three elevators? Or say, in general, n elevators?

b) In taller buildings, elevators are often designed with sky-lobbys, where fast elevators ply to intermediate floors, and slow elevators service individual levels. Consider a building with N floors and M intermediate sky-lobbys evenly distributed across the floors. The building has two fast elevators that stop only at the sky-lobbys, and between adjacent sky-lobbys, there are two elevators each that service individual floors. Develop and simulate a heuristic for such an elevator system. As before, model the arrival of passengers reasonably and consider the time that elevators might take to move between floors and the time that they spend for loading and unloading.

Indicate how this heuristic might scale with M, N and the number of elevators.

Simulate and produce plots as you may deem appropriate.

2 Evacuation Heuristics

Continuing in the same vein, buildings are increasingly becoming more complex, taller and crowded. Evacuation training remains to be an integral part of the security procedures of such a building. Simulations provide invaluable insight into such procedures.

Consider a building with N floors, each containing P number of people, on an average. A fire alarm is set off on the M-th floor. The elevators become immediately dysfunctional. The only path for evacuation is a stairwell, which can service at most x people per minute between two adjacent floors. The fire progresses upwards at an approximate rate of F_u floors per hour, and downwards at a rate of F_d floors per hour ($F_u \ll F_d$). The stairwell for any floor gets damaged approximately within D hours of the fire commencing in that floor. In such a case, access to all the floors above is cut off as well. A floor with fire has a casualty ratio of λ.

It is required to develop a schedule for evacuation which might minimize the casualties. Simulate your heuristic and study its efficiency for various cases and parameters (choose your parameter ranges to be realistic and not utterly depressing).