CS 4335 / CSE/ECE 6730 Project: Transportation System Simulation

Due Dates:

- Project Plan: due: 11:59 PM, Wednesday January 25, 2011
- Software Implementation: due 11:59 PM, Friday February 17, 2011
- Final Report: 11:59 PM, Friday February 24, 2011
- Poster Presentation: in class, Monday, February 27, 2011

Problem Statement

To complete this project you must develop plans to route traffic from parking lots near the Georgia Dome to the major Interstates (I75/85, I-20) following the conclusion of a football game. Assume that once an individual has reached the interstate, they can travel freely to their final destination and need not be modeled any further. Your task is to develop a plan to minimize the average delay for a football fan to reach the interstate. Assume that your traffic plan will be implemented by law enforcement personnel placed at specific locations to direct traffic in the manner that you propose. You need not be concerned in your model with the actual deployment of these personnel. You are free to take full control of traffic in the area, e.g., convert two-way streets into one-way streets or take over control of traffic signals.

To complete this project, you must develop two different plans for routing traffic and use your simulation of the traffic network to compare them and recommend the preferred approach.

Simulation Model and Data

The simulation model must be a discrete event simulation program based on a *queueing network* conceptual model. You must identify and review the relevant literature applicable to developing such a model; this literature survey should be described in the project plan and final report.

The simulation must be stochastic, i.e., use random numbers to model unpredictable or unknown elements of the system. You will need to identify the places where randomness is appropriate to use in the model.

You will need to determine what data you need, and collect and incorporate these data in the simulation model. Much of this data, e.g., the topology of the road network and the capacity and location of parking lots, must be stored in a data file and read by the simulation program when it begins to execute.

You may use any programming language to implement your simulator. However, the simulator must be constructed "from scratch" from a set of software modules. Utilizing existing software or software downloaded from the web is not allowed!

The simulator must be developed by the entire team, with all team members developing a significant part of the code. Each team includes a mix of individuals with different amounts of experience in software development. Members with more experience are expected to help those with less (but not write the code for other team members!).

The software must be developed in a modular fashion, with well-defined, documented interfaces. For example, the software must include a future event list (priority queue), and random number generator for required probability distributions. You will likely also want to include a library of model objects, e.g., queues. Your software must use an efficient priority queue with average access time O(log N) or better.

Your software should also include test "driver" programs as needed to verify correct operation of library modules. The validity of random number generators must be verified using appropriate statistical tests.

Teams and Deliverables

You will work in teams of four to five students each. You will need to develop a plan to divide up this task among team players. One person in your team must be designated as the lead who will have the responsibility for organizing the team, scheduling meetings, etc.

Your grade will be based on the following items that must be turned in:

- *Literature survey and plan*. You must prepare a document that describes (1) assumptions you are making in your model, (2) the conceptual model you will use with appropriate citations to the literature, (3) the routing strategies you will test, (4) the data you will (or have) collected necessary to develop the simulation, (5) a block diagram (architecture) showing the major pieces of software that will be developed, and (6) a list of tasks and individuals assigned to these tasks in order to complete the project. Include a bibliography outlining the literature you reviewed. Your plan must be sufficiently detailed to give the reader a clear idea of what exactly you plan to do, what software you will develop. This document will form a major portion of the final report for the project.
- *Software implementation*. Source code for all software in your simulation must be turned in. Note that the due date for the software precedes the due date for the final project report to allow time for designing and completing the experimental study. You are free to modify the software as needed after turning in the software deliverable, but you are discouraged from making significant functional improvements since you should be concentrating on experimentation and output analysis in the latter phase of the effort. In addition to the actual code, the software deliverable must include (1) documentation that you have verified the validity of your random number generator, and (2) performance data of your priority queue implementation as a function of the number of elements in the priority queue. Specifically, indicate the average time to complete an insert followed by a delete operation as a function of the number of elements in the priority queue.
- *Poster session*. You will present your project in a poster session conducted in class, at which time you should be prepared to give a concise (5 minute) presentation of your project, and be prepared to answer questions.
- *Final report*. The final report includes all documentation for the software and simulation study. All work you completed for the project must be documented in this report. The final version of the source code for your simulator must also be provided. The final report should be self-contained.

Grading

Graduate and undergraduate students will complete the same project, but will be graded on different scales. Each person will be assigned two grades: a grade for the project as a whole and a grade for your specific contribution. Thus it is in your best interest both to do whatever is necessary to ensure the overall effort is successful, as well as to make sure you contribute your fair share!

Distance Learning Students

Students taking the class through distance learning may work alone and implement a simplified version. Specifically, distance learning students may utilize existing software for random number generation and the priority queue implementation. The performance of the priority queue implementation need not be evaluated, and a simple linear list may be utilized if desired. Only one traffic routing scenario need be implemented.

Deliverables for individuals or teams that include at least one distance learning student will be delayed one week from the due dates presented above. An electronic version of the poster should be submitted, and the "poster session" will be conducted over the phone.

Final Comments

The challenge problem is, by design, open-ended. A detailed, realistic study of an actual game-day scenario would require more time than what is allowed here. While you will be expect to do some data collection, clearly you will not have all the information you need, and many assumptions and approximations will have to be made. Nevertheless, time constraints and missing important information are the reality in most real world studies. Do the best you can, but be sure you are conscious of the limitations and assumptions you make in completing this study.