

CSE PhD Qualifying Exam, Fall 2014: Modeling and Simulation

1. Show the code for computing random variates that follow the triangle distribution (with probability density function $f(x)$ defined below) using the inverse distribution function method. Assume there is a function `rand()` that returns random numbers that are uniformly distributed between 0 and 1. Show all work in deriving your solution.

$$f(x) = x \text{ for } 0 \leq x < 1$$

$$f(x) = 2-x \text{ for } 1 \leq x < 2$$

$$f(x) = 0 \text{ otherwise}$$

2. The Chandy/Misra/Bryant (CMB) null message algorithm is used to compute the lower bound on time stamp (LBTS) of future messages that a logical process may receive. LBTS has some similarities to Global Virtual Time (GVT), a value computed in the Time Warp algorithm to enable operations such as memory reclamation and commitment of I/O operations. Propose a new GVT algorithm based on the CMB algorithm. Specifically:
 - a. describe any changes or constraints that must be included in Time Warp to use CMB for this purpose
 - b. show pseudo-code for your GVT algorithm, and
 - c. briefly comment on the efficiency of this approach to computing GVT.Note that the Time Warp system will still utilize rollbacks, anti-messages, etc., and CMB is used solely for the purposes of computing GVT.

3. Consider the grid-based implementation of the data distribution management services in the High Level Architecture where a grid-like structure is overlaid onto the routing space and used to implement the DDM services. Suppose we add a constraint that publication and subscription regions must be defined so that they *cannot* partially overlap with a grid cell, i.e., for each grid cell G and any publication/subscription region R , either all of G is contained within R , or none of G is contained within R . Describe the impacts of this constraint on the efficiency of the DDM implementation.
4. Algorithms such as Chandy/Misra/Bryant or Time Warp are not used in distributed simulations used for training or video games, e.g., a collection of vehicle simulators used to train drivers. Explain why such algorithms are not used.