Project Proposal for *Symbolic Computation*
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Abstract

We plan to use Mathematica to enable future students of CS5024 to solve computationally complex problems. By providing additional tools, the students will better understand the material. This project will be delivered in multiple notebooks and they will be organized in parallel with the class material. This is a preliminary proposal. With Dr. Heath's approval, we might add or remove certain topics as our Mathematica skills grow.

1 Stochastic Processes

Solve recurrences for the Birth and Death Processes.

2 Markov Chains

The idea is to let the student enter the Transition Probability Matrix and the following items will be produced:

- Generate graph of chain (limit of 10 nodes), difficult to implement?
- Calculate Reducibility and Reachability (Periodic State, Aperiodic States)
- Calculate Stationary Probability Distribution
- Calculate convergence rates.

3 Queuing Theory

The idea is to let Mathematica know about various models of queues. Let the student choose or enter parameters describing one of the following models:

- M/M/1
- M/M/1/K
- M/M/c
- M/M/c/c
- M/M/∞
- M/M/1/K/K.

Mathematica will produce the following results:

- Compute L_q, L_s, W_q, W_s, L, W
- Show plots of how variance in parameters such as μ, ρ, a affect queuing system in terms of above parameters.
- Produce results for Erlang's Loss and Delay Formulas when appropriate.

4 Queuing Networks

Given a queuing network, Mathematica will give the following:

- Calculate the effective arrival rates
- Calculate queueing delay for each node in the system
- Compute Steady State probabilities for each node.