**Research Proposal: Birth and Assassination Process Visualization**

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The “*birth and assassination process*” is described by Prof. Aldous in <http://www.stat.berkeley.edu/~aldous/Papers/me44.pdf>. In summary, this particular branching process is a variant of a simpler process that behaves as the Galton-Watson process. In the simpler process, initial particles have random i.i.d. lifetimes, and during each particle’s lifetime, the particle bears offspring according to a Poisson process with rate lambda. These offspring are initialized with lifetimes according to the specified lifetime distribution, and continue to bear offspring as well. If the number of offspring in the n-th generation converges almost surely to 0, then the process is stable and extinction is probabilistically certain. Otherwise, the process is said to be unstable.

In the *birth and assassination process*, these conditions are the same except that each particle’s lifetime counter does not begin until its parent dies; the particle can still bear offspring according to the Poisson process before its parent dies, and it is only at risk of death after its parent is dead. Aldous provides criteria for stability of the process based on the MGF of the killing (lifetime) distribution. More detailed description can be read in the original paper.

The goal of this project is to simulate the *birth and assassination process* and create a visual animation that adequately displays the key components of the process. To do this, I plan to use the Processing language, which is an extension of JavaScript designed for the visual arts. This project consists of three main problems. First, I will need to think of how to appropriately visualize the branching process. I will need a way to illustrate it such that the screen is not completely cluttered with lines, as the process may involve many particles at once if they are not being killed off fast enough. This may be solved using a color scheme, or by removing items from the screen when particles die. In addition, I will need to decide how to display certain information, such as the lifetimes of particles and when they die out relative to each other. Second, I will need to simulate the process – this should be fairly simple. The simulation framework should be modular enough that I can specify any lifetime distribution by, say, its density function, and sample from this distribution using a technique such as rejection sampling. Finally, I will need to code the animation/visualization in Processing – this would probably be the most time-consuming step. Once this is all completed, I will have an animation for the simulation, and can also verify the simulation with the theory by examining the extinction rate for different lifetime distributions. If time permits, I could also try to deploy this to a web page for easier access.