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CS172 Final Project Proposal

Last semester we constructed the foundations of a biophysics simulator which would model the pathogenic behavior and spread of prions in neuronal populations. While major steps towards this goal were taken, time constraints demanded that we make numerous simplifying assumptions in the construction of this model. Such assumptions make the first version inherently inaccurate with respect to the physical processes at work, and thus diminish the accuracy of any theoretical predictions.

In order to rectify this, we intend to introduce a set of features which will better account for the physical mechanisms behind prion transport. First and foremost of these will be the addition of vesicles (small bubbles of cell membrane containing various biomaterials) as explicitly simulated objects. These vesicles will be constructed as objects which store a certain number of prions (determined upon creation), being excreted from a cell to then conduct a thermodynamic random walk until entering another cell, at which point the prions contained are added to the destination cell.

Second will be a more accurate fluid transport model of prion spread through tubules between neighboring cells. To accomplish this, cells will also be constructed as objects such that tubule transport calculations can be performed on the basis of each cell’s three dimensional coordinates.

Finally, we intend to implement a system via which users may input files containing a set of initial conditions consisting of the number of prions found in each cell at the beginning of the time frame to be simulated. As the simulation runs, a file will be generated which lists the prion content of each cell at each time step in the simulation, providing a detailed quantitative record of prion spread within the simulated cell population.