James Bottoms

CX 4010/CSE 6242 – Assignment 1

Simulating Forest Size Through Many Periods of Growth and Decline

My program begins by initializing the state of an empty forest. A 2-dimensional NxN array is created to represent the forest of trees. In the array, a 0 represents a space with no tree and a 1 represents a space with a tree. For each time step of one, from 1 to the specified time (t), the program simulates one growth phase and one fire phase. In the growth phase, each empty space randomly grows a tree with probability g, and in the fire phase, if a space has a tree, then with probability f, the tree in that spot burns and the space becomes 0. The fire then spreads immediately to adjacent trees. This happens through the "burn" function in the program. This function checks all spaces adjacent to the burned space, and if the new checked space also has a tree, then the function is called recursively onto the new space. The program prints the total number of trees remaining after each phase for every time step to show that it works correctly, in addition to printing the average number of trees remaining after the simulation is complete. I ran my experiment using f values of .01, .02, and .05 with g values in increments of 0.1, from 0.1 to 1. To ensure a large time period for accurate results, I used a t value of 1000.

From the results (displayed in the figure below), it appears that for every value of f, the average forest size (P) begins high and then begins to shrink more and more quickly as g increases until reaching 0 trees once g is 1. At a lower value of g, the average forest size P is typically very high, and at a higher value of g, the forest size approaches 0 until reaching it at g = 1. This is because when the growth rate is low, not many trees will grow adjacent to each other, meaning less trees will burn when a tree is struck by lightning. When the growth rate for trees is high, more trees will exist in the forest, meaning that the likelihood of having adjacent trees is much higher (i.e. more trees will burn when a tree is struck by lightning).

The effect of the fire rate (f) is evident when g is less than .7, but less evident when g is .7 or greater. When f is lower, the forest size (P) is higher because there is less likelihood that a tree will catch fire and cause other trees to catch fire. This is very intuitive because there is a lower chance of a tree being struck by lightning. However, once the growth rate (g) reaches a high enough threshold (.7 in this experiment), the growth rate of the trees is so high that most trees will burn with every lightning strike because there are so many trees next to each other in the forest. The fire rate has no main effect on the size P of the forest because the network of trees is so great.