Report for Assignment 1

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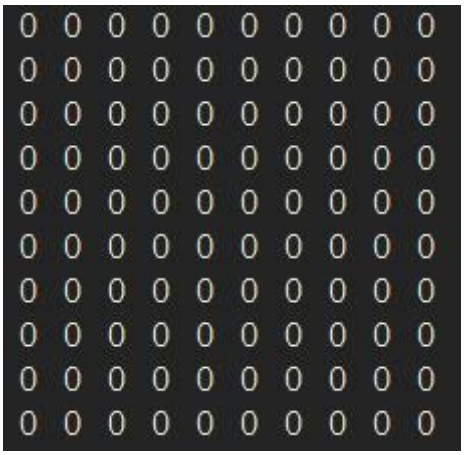
My program simulates the change of forest size over time.In this 2D cellular automaton, all cells have 2 states: 0(empty),1(occupied).

1. During one time step

Here we use a 10*10 grid as a simple example(I will simulate a 100*100 grid later when collecting data).

1）At first, the init_cells() function initializes all cells to 0.The forest state is:

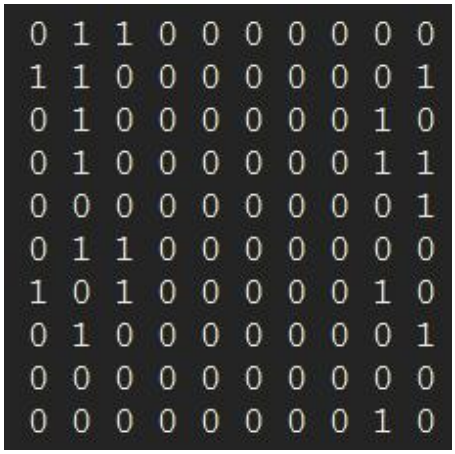


2）Then the forest goes through a growth phase. In this example, g is set to 0.3. After the first growth phase, the forest state is:

3）After that, the fire phase begins. In this phase, some trees are hit by ligntning(f

is set to 0.1 in this example). They catch fire and become 0(empty). The burning trees spread fire to their neighbors, who also spread fire to their neighbors, until they have no neighbor trees. I used a recursion to simulate this process and when there are no trees to which fire can spread, the recursion ends.

At the end of each time step, the program prints the change of forest size.

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At time step1, 34 trees grow up.
At time step1, 14 trees were burned.
By the end of time step1, the amount of trees is 20
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2.Many time steps

Here we use step=100 as an example.(grid=100*100, g=0.3,f=0.1) At the end of each time step, the program prints the change of forest size. If all the steps are finished, the program also calculates the average size P.

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At time step100, 2684 trees grow up.
At time step100, 2378 trees were burned.
By the end of time step100, the amount of trees is 1605

the average size of forest is 1483.66
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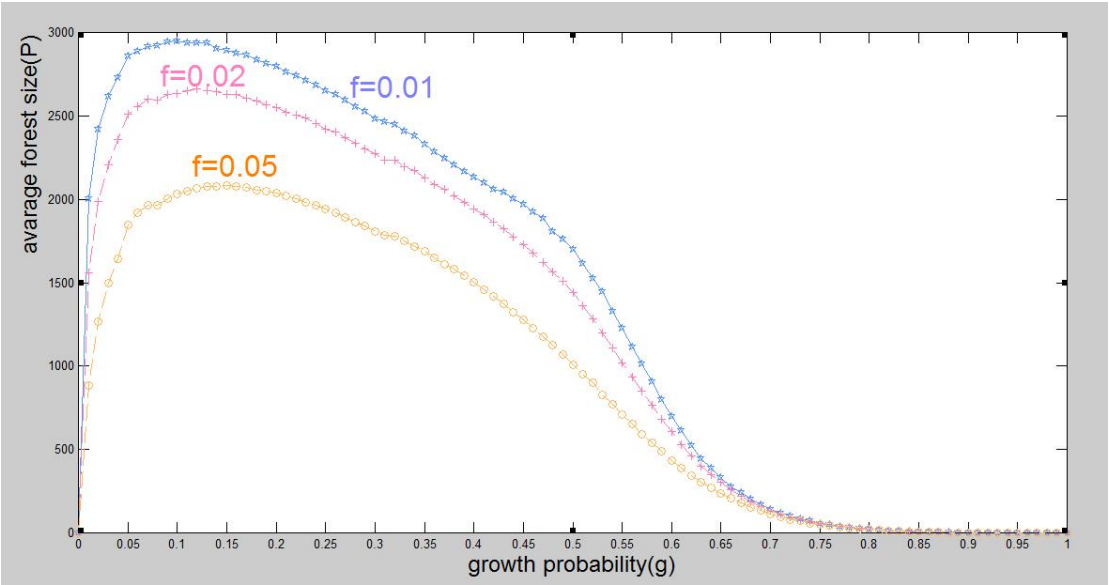
3.Results

I used the collect_data() function to collect (g,P) when f=0.01, 0.02 and 0.05 respectively. The output data is saved in “data for graph.txt”. Then I used matlab to create a graph with P on the vertical axis and g on the horizontal axis.



3.1 results

According to this graph, each curve has a peak ,denoted by (g*,P*). g* is approximately equal to 0.1~0.15 and it varies slightly as f changes.

For each curve, if g<g*: P increases when g increases;

If g>g*: P decreases when g increases.

When g is given, P decreases when f increases.

3.2 explanation

3.2.1 relationship between g-P when f is fixed

These results indicate that when growth probability(g) is relatively small, the average forest size(P) increases as g increases, because more trees grow up after a fire.

However, if g is greater than g*, when g increases, large-scale vegetation clusters take place, which provides enough fuel for the fire spread, and the average forest size(P) declines because a great number of trees are burnt after fire propagation.

3.2.2 relationship between f-P when g is given

The probability that a tree is struck by lightning(f) can apparently reduce the average forest size(P) because greater f implies greater chance of catching and spreading fire.