

## Environmental Modeling

### Exercise III: Fire in the Forest



When a model is based on randomness, it is not possible to trust in the result of a single simulation because different simulations will certainly produce different outcomes. In this case, it is necessary to run more than one simulation to estimate the *average* result and its stability. The fire-in-the-forest model is one example. As the initial state of the cells is randomly chosen, running the simulation again can produce different outcomes<sup>1</sup>.

Investigate the fire-in-the-forest model and analyse the results related to the duration of the fire, the number of cells burned, and the number of forest cells that survive at the end of the simulations. Repeat 5 simulations with different percentages of initial forest ranging from 0% to 100% to analyse the following scenarios:

- 1) The original model (forest-fire-random.lua).
- 2) Using a Moore neighborhood (8 neighbors), instead of von Neumann.
- 3) A burning cell becomes burned after two time steps, instead of only one.
- 4) Changing the space to 100x100 cells. Compare this result with the others by assuming that four cells in this case occupy the same space of one cell in the original model, which means that the overall area is the same.
- 5) There is a probability of 90% that a cell will burn if it finds a burning neighbor, adding a second random component to the model.

The scenarios two to five are independent changes of the original model. Deliver the source code as well as a report comparing the different results. For further help see “Percolation on a 2D lattice – a Monte Carlo computational analysis”, at <http://cantab.jkut.com/Percolation%20on%20a%202D%20lattice.pdf>

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<sup>1</sup>In fact, if you run forest-fire-random.lua twice you will get exactly the same result. It happens because random numbers require a seed that needs to be changed from one simulation to another. The way to do this is by using the current time of the computer as seed. Add the command “math.randomseed(os.time())” (without the quotes) in the beginning of the source code to allow simulations to produce different results.