1 Introduction

The burning method algorithm to study percolation was implemented. A series experiments on square site lattices of different sizes was conducted using the algorithm.

2 Algorithm Description

The algorithm was implemented as described in the course lecture notes [1] (page 25).

3 Results

3.1 Task 1

The program was implemented as instructed. A sample square site lattice with size 100×100 and occupation probability $p = 0.5$ is shown in figure 1.

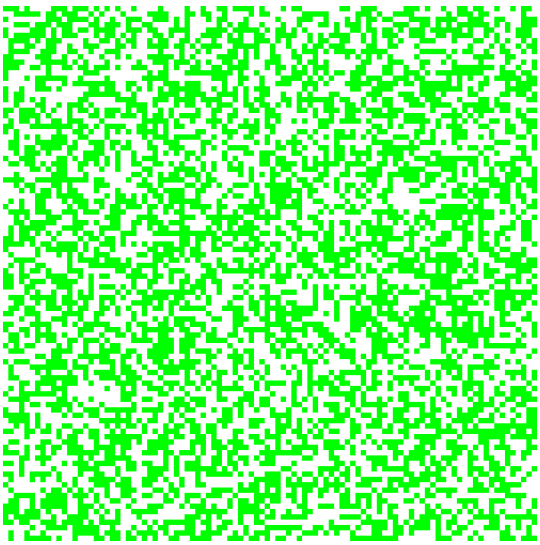

Figure 1: Sample square site lattice with side length $N = 100$ and occupation probability $p = 0.5$.

3.2 Task 2

Based on the code from task 1, the program was implemented without issues. Snapshots from different time steps are shown in figure 2 and in figure 3.

3.3 Task 3

The code was implemented and 1000 measurements were taken for each occupation probability $p \in \{0, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1\}$ for different site lattice side lengths $N \in \{10, 25, 50, 100, 250, 500, 1000\}$. To populate the lattices, the Mersenne Twister pseudorandom number generator from the `C++` standard library was used. The seeds were different for each of the 1000 measurements in each series. The figures show the obtained results for each series' order parameter 4, average fire duration 5 and average shortest path length 6.

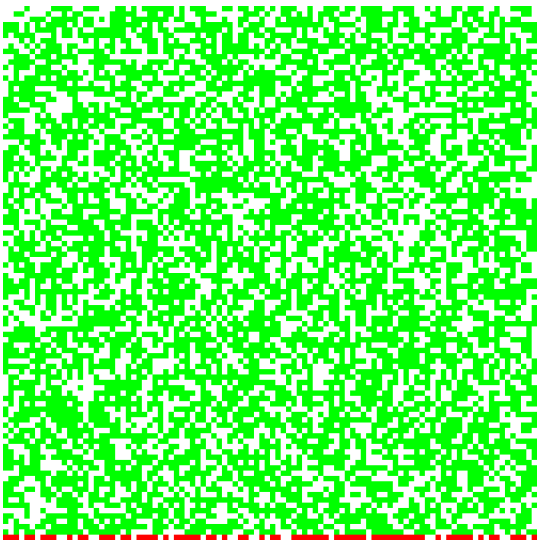

Figure 2: Sample square site lattice with side length $N = 100$ and occupation probability $p = 0.6$: Forest fire simulation at time step $t = 2$.

4 Discussion

The results were in line with the theoretical expectations from class. The algorithm as such already scales badly in N by design; writing (sequential) `.ppm` output files makes things a lot worse. Drawing the lattices for output was therefore skipped in task 3. Additionally, I designed my main function to use a single loop for which parallelisation with `OpenMP` helped increasingly with growing N.

References

[1] Herrmann, H. J.,
Singer, H. M.,
Mueller L.,
Buchmann, M.-A.,
Introduction to Computational Physics - Lecture Notes,
ETH Zurich,
2017.

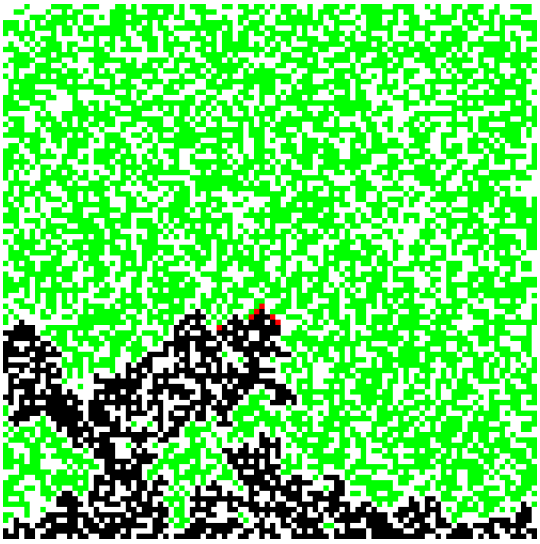

Figure 3: Sample square site lattice with side length $N = 100$ and occupation probability $p = 0.6$: Forest fire simulation at time step $t = 100$.

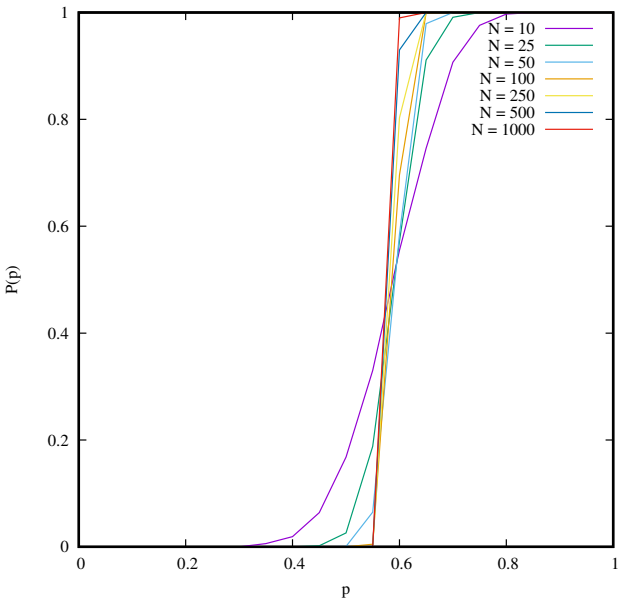

Figure 4: Measured order parameters for different site grid side lengths N and initial site occupation probability p.

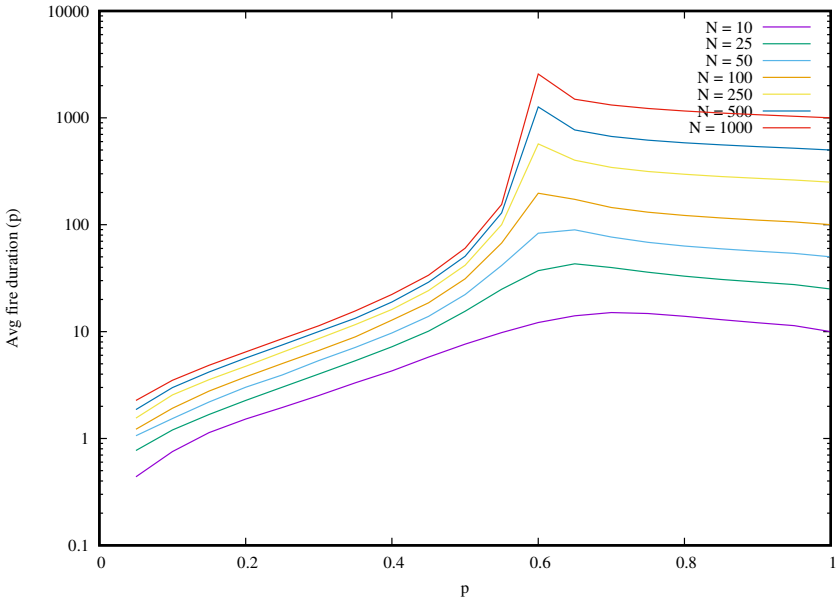

Figure 5: Measured average fire duration for different site grid side lengths N and initial site occupation probability p.

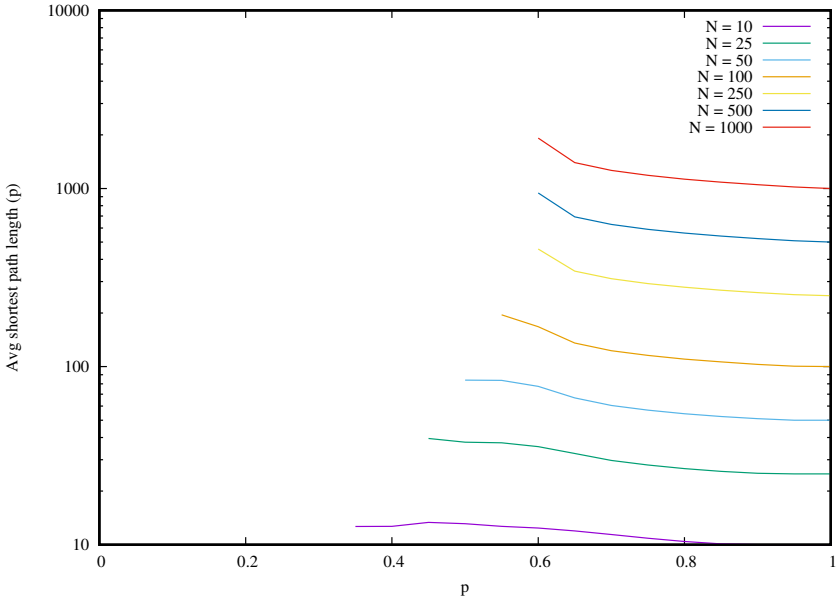

Figure 6: Measured shortest path length for different site grid side lengths N and initial site occupation probability p.