1 Introduction

- percolation on a square lattice
- forest fires
- statistics

2 Algorithm Description

2.1 Percolation

Generate random numbers on a $N \times N$ lattice. For each site of the lattice, if the random number on this site is smaller than the occupying probability p, the site is occupied(assigned to 1), otherwise, it is empty(assigned to 0).

2.2 Forest fires

1. pick parameters N and p, create the lattice as mentioned before
2. set the first row of forests on fire.(change the sites occupied by 1 to 2)
3. for each burned site($B > 1$), check the surrounding place whether the forest(1) exists, if it does, burn it($B = B + 1$)
4. keep burning until there is no forest available for burning
5. calculate the minimum B at the end row, which is the shortest path and decide whether the cluster is spanning or not
6. calculate the maximum B of the whole lattice, which is the life time of fire

2.3 Statistics

Do several tests by varying N and p to get the average value of the shortest path and the life time.

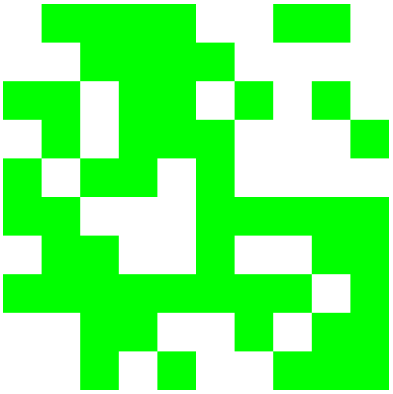
3 Results

3.1 Task 1,2

The percolation on a square lattice 10×10 is shown in Fig.(1a) while the fore fires generate the Fig.(1b).

3.2 Task 3

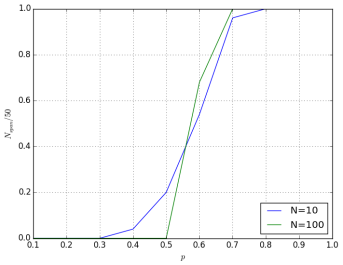
Set the number of tests to be 50, the average shortest path and lifetime are 9.98 and 13.3 for $N = 10$, $p = 0.6$. Pick p in the range $[0, 1]$ with step 0.1 and N to be 10 or 100. The frequency of span cluster versus p is plot Fig.(2a) while the average shortest path and the average life time are plot in Fig.(2b) and Fig.(2c) respectively. The threshold probability $p_c \approx 0.55$.



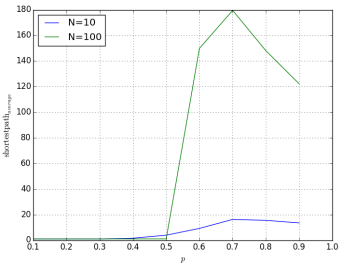
(a) $N = 10$, $p = 0.6$

(b) $N = 10$, $p = 0.6$; the lifetime is depicted in blue, the first row on fire is depicted in red and the burned sites are in black, the cluster is spanning(the shortest path=16)

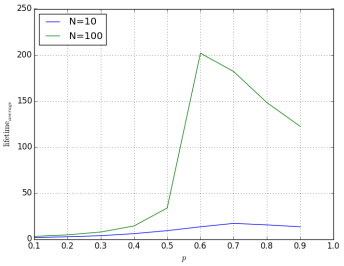
Figure 1: Percolation and Forest fire



(a) The frequency of span cluster versus p



(b) The average shortest path versus p



(c) The average life time versus p

Figure 2: The statistical values of 50 tests for $p = 0.1, 0.2, ..., 0.9$ and $N = 10, 100$