1 Introduction

The Hoshen-Kopelman algorithm [2] as described in [1] was implemented for a square site lattice and a series of experiments was run to establish cluster size distributions n_s as a function of different site occupation probabilities p.

2 Algorithm Description

The algorithm was implemented as described in the course lecture notes [1] (page 30) with one difference:
To discover the original cluster of a candidate cluster with negative mass M_k, a recursive function instead of a while loop was used.

3 Results

The program was implemented as described above and submitted with this report. A square site lattice of side length $L = 1000$ and thus size $L^2 = 10^6$ and occupation probabilities $p \in \{0.1, 0.2, 0.3, 0.4, p_c = 0.592746, 0.6, 0.7, 0.8\}$ were used. For each occupation probability, the experiment was run $c = 100$ times with differing seeds for `C++`'s Mersenne Twister `mt19937` to initialize the lattice. The sizes of the obtained clusters were recorded and the total counts per size $\widetilde{n_s}$ over all c experiments then normalized (equation 1) to obtain the cluster size distributions n_s.

$$n_s \leftarrow \frac{\widetilde{n_s}}{L^2 \cdot c} \tag{1}$$

The normalized n_s were plotted against cluster size s (figures 1, 2 and 3) in emulation of the figures shown in the lecture notes [1] (page 31).

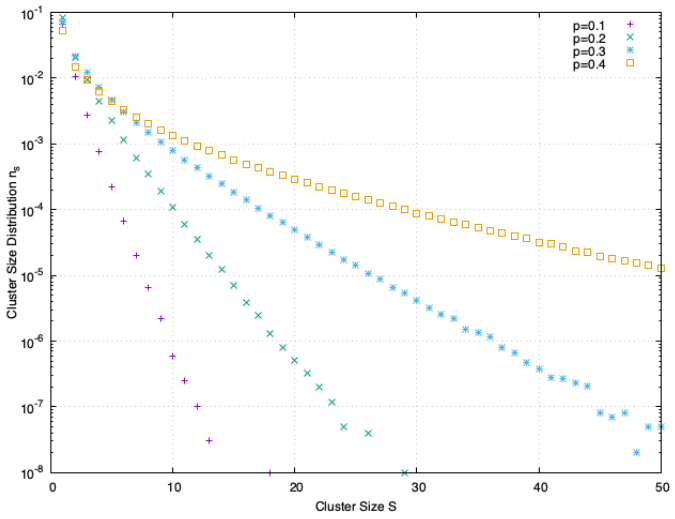

Figure 1: Cluster size distribution for $p < p_c$.

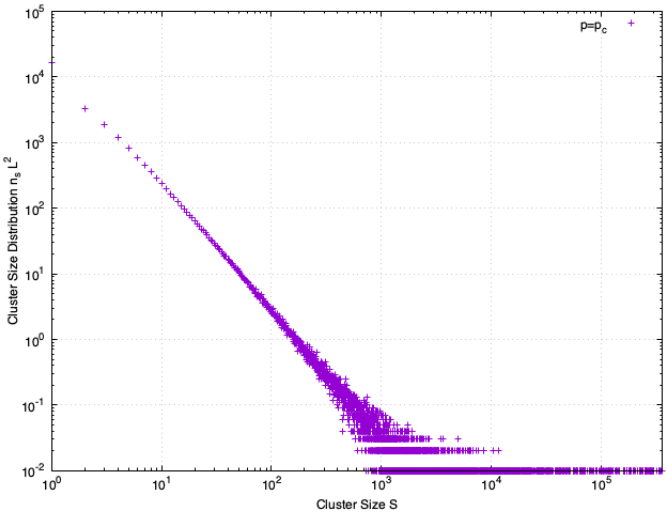

Figure 2: Cluster size distribution for $p = p_c$.

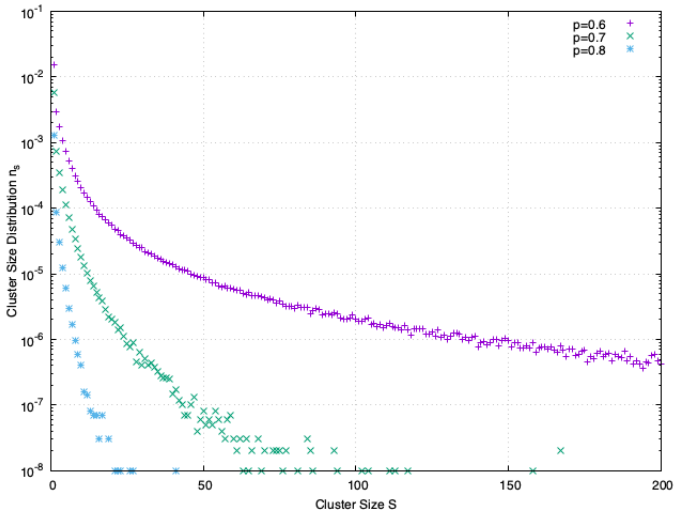

Figure 3: Cluster size distribution for $p > p_c$.

4 Discussion

The results were in line with the theoretical expectations from class. For some reason unknown to me, my personal machine's OS system wouldn't let me allocate memory for $L > 1023$ and terminated with a segmentation fault 11 whenever trying to do so. As the results already were satisfactory with $L = 1000$, I didn't invest any further time in trouble shooting.

References

[1] Herrmann, H. J., Singer, H. M., Mueller L., Buchmann, M.-A.,
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ETH Zurich,
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[2] Hoshen, J., Kopelman, R.,
Percolation and cluster distribution. I. Cluster multiple labeling technique and critical concentration algorithm,

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