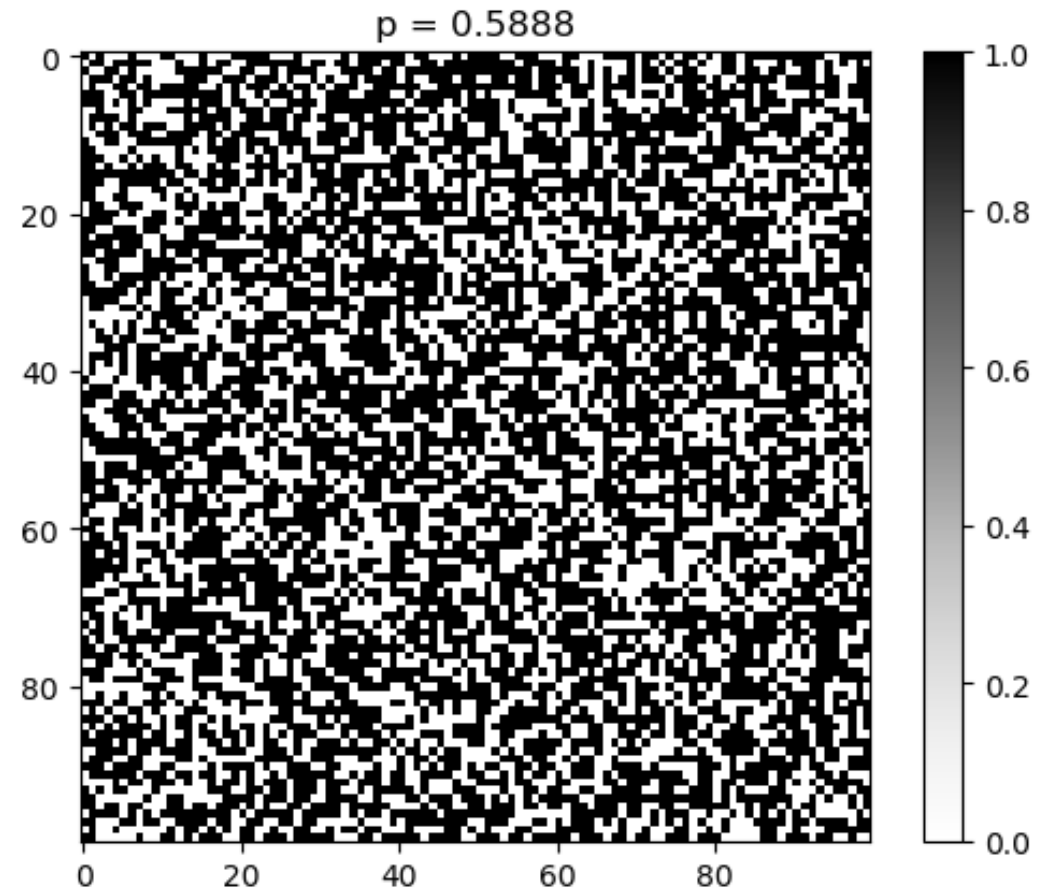


Percolation

EP408 Computational Physics



What is Percolation

- Percolation modelling encompasses a large area of physics from fluid flow to electronics.
- Sites on a lattice are occupied according to a certain probability
- Sites with neighbours form a cluster
- When clusters combine they form a “spanning cluster”

Aim of project

Simulate

Simulate percolation on a 2-D lattice



Determine

Determine if a spanning cluster exists



Calculate

Calculate the percolation threshold

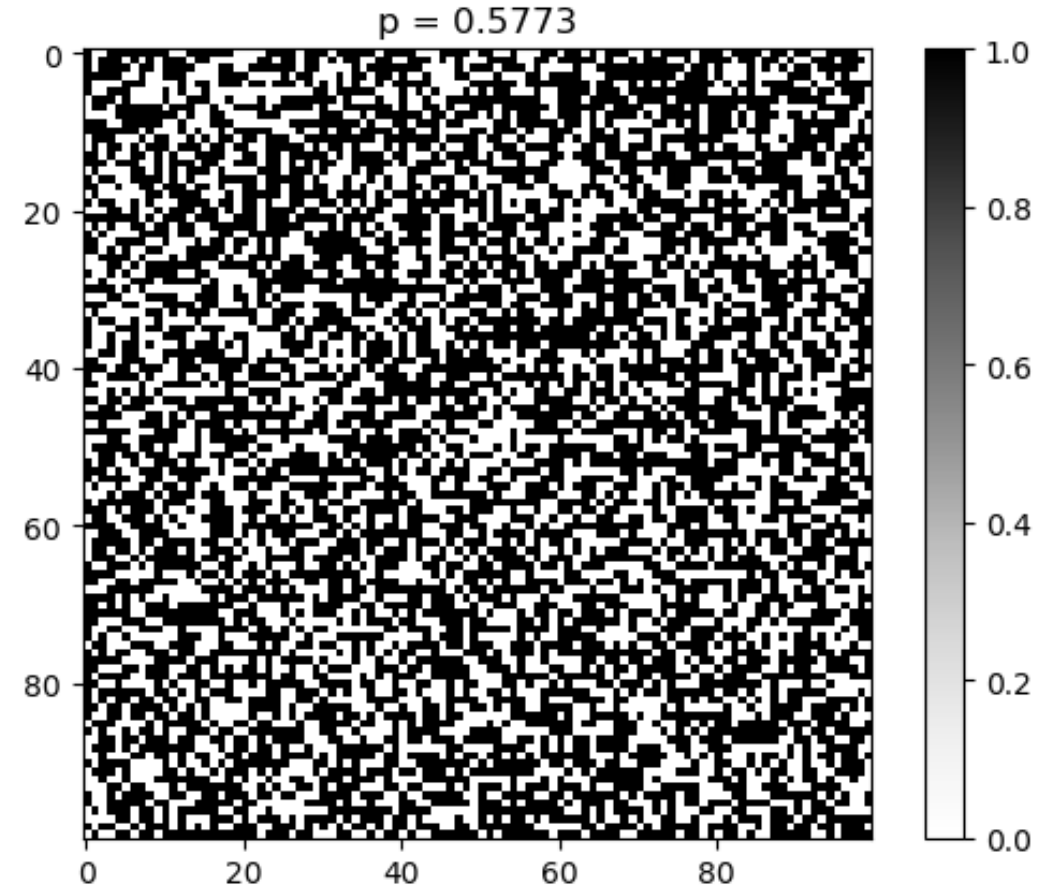


Algorithm

1. Create an empty lattice
2. Randomly occupy sites on lattice numbering each
3. If a site has a neighbouring cluster join to cluster
4. If more than one neighbour combine clusters (re-assigning values)
5. Stop once there is a common value on all 4 sides “spanning cluster”
6. Fraction of unoccupied lattice gives percolation threshold.

Results

- Obtaining average value for percolation threshold on 100 20 x 20 lattices gives a value of $p_c = 0.6007$
- Expected value of $p_c = 0.59$
- For a lattice of 100 x 100 a value of $p_c = 0.5773$ was found



Problems and Changes

- Algorithm is $O(n^2)$ there is an exponential increase in runtime for each increase in lattice size
- Can be improved using Hoshen and Kopelman algorithm which is $O(1)$ giving a linear increase in runtime for each increase in lattice size

Possible changes:

- Coloured graphing of lattice, would require reducing cluster count once clusters are combined