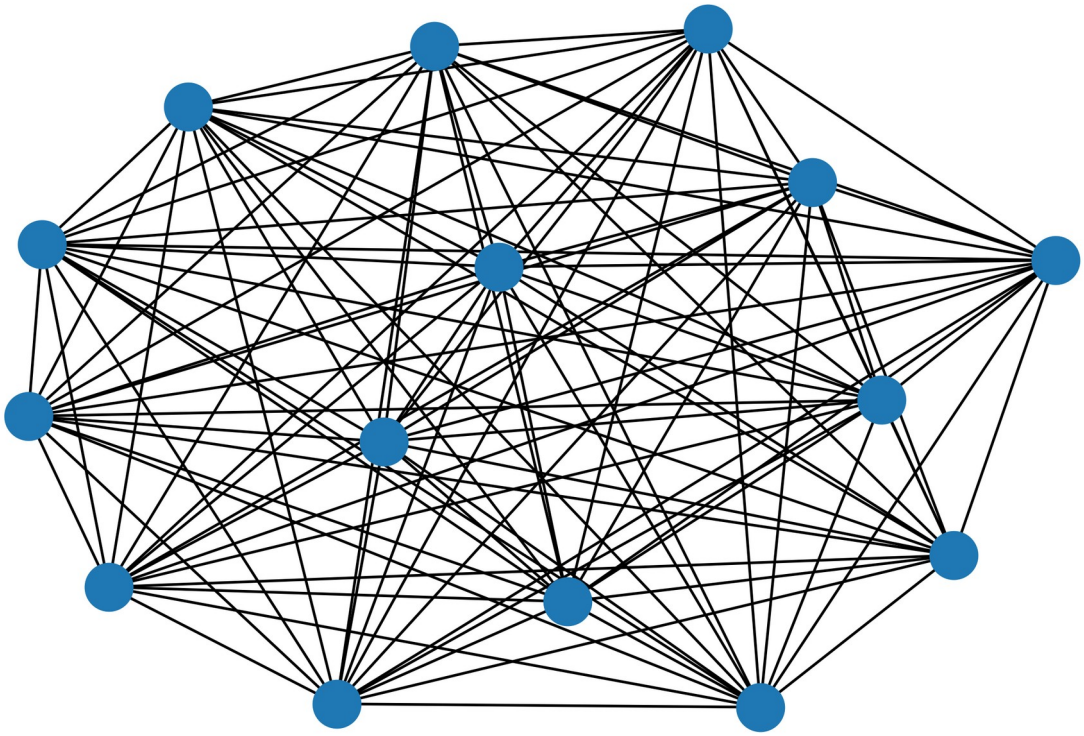
Agent-based network random walks for modelling the spread of a pandemic

Paul Joseph Robin

Though the aim of this was to model the spread of Sars-Cov-2 virus, no special parameters for that have been added. Hence, this random walk can be considered to be any epidemic/pandemic.

Source code: https://github.com/p-j-r/covid-19/blob/master/Network_Walks.py
Other implemented models like SIR can also be found here.



A network of maximum 15 clusters.

***Terms used*:-**

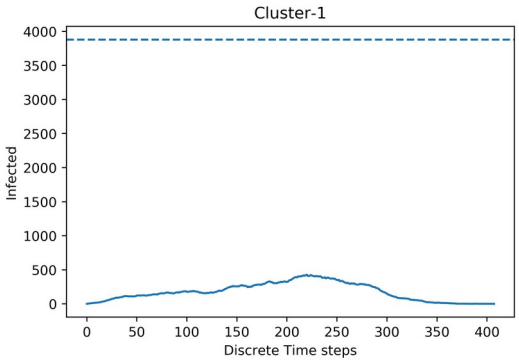
Cluster: **{ class Cluster}**
Any population (big, small, city or even village) can be modelled as a lattice cluster of m*n nodes of some population density per node. A *node* can be thought of as a point in the cluster where the random walkers are free to go! (shops, malls, etc...). *Density* means the intial average number of people per node.

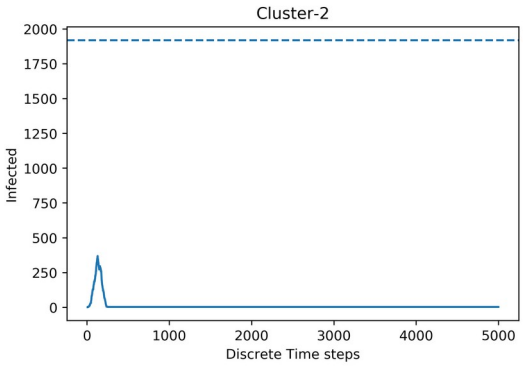
This class is just a more complicated version of corona_walk *which can be found in the same repository. Once formalised, it can be used as a Python package.*

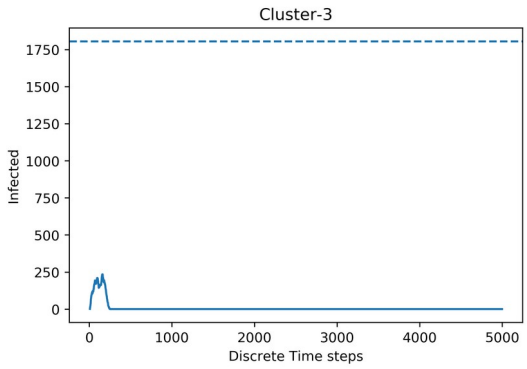
Exit Policy:
So an object (cluster)'s *place* function initialises the walkers at random positions on the lattice. If a walker is already at an ***exit_node***, it stays there. However, any new walker coming to the *exit_node* is jumped to a new cluster!
Each cluster has a unique *exit_node*. So, the graph of clusters G, has a unique one-on-one correspondence to a node!

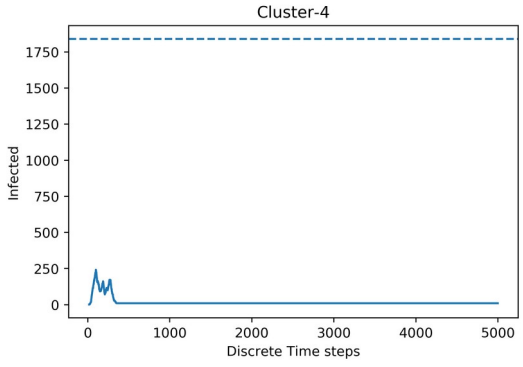
Remove Policy:
When a walker is moved to a new node of G i.e., a new cluster, his (her) *infect* status is upgraded to *3* (removed from cluster). {*0*-initial, not infected; *1*-infected, sick; *2*-dead;}

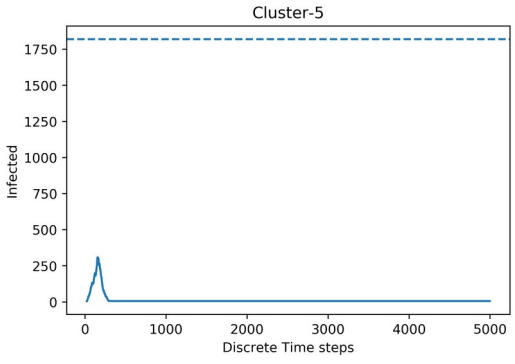
RESULTS

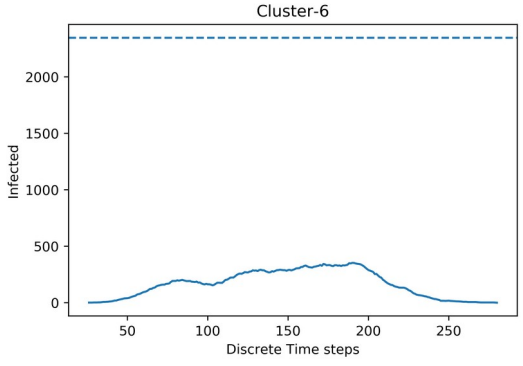


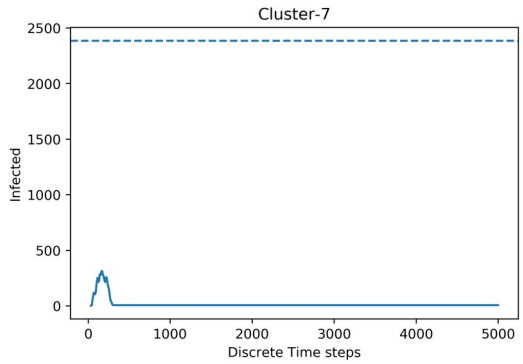


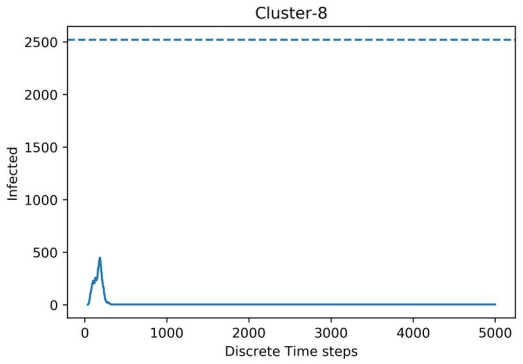


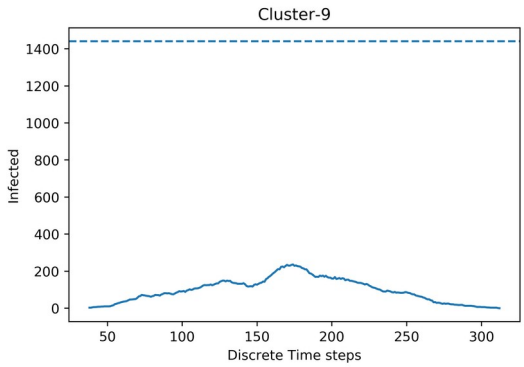


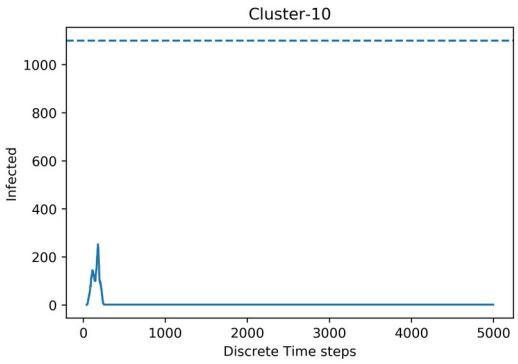


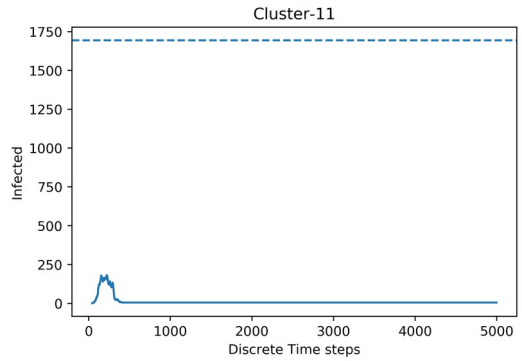


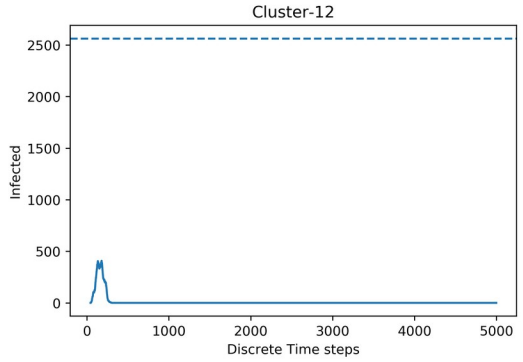

Cluster-7
Infected
Discrete Time steps

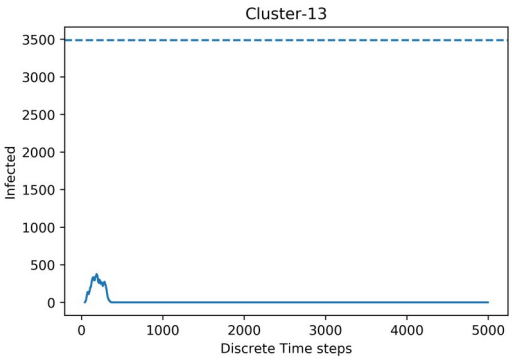

Cluster-8
Infected
Discrete Time steps

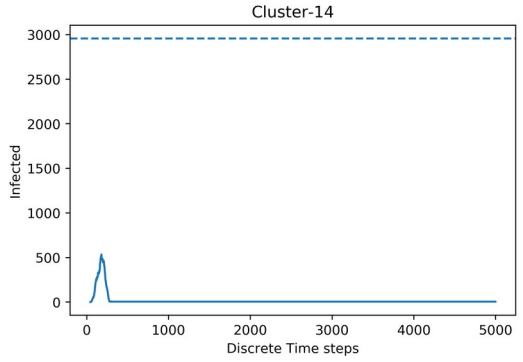

Cluster-9
Infected
Discrete Time steps

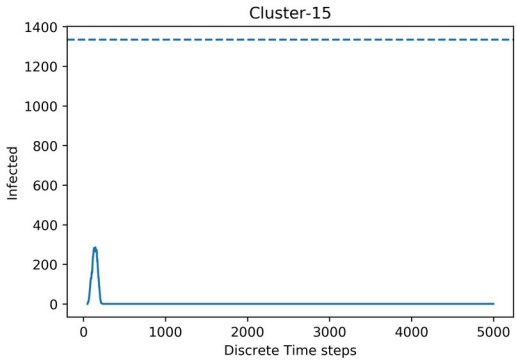

Cluster-10
Infected
Discrete Time steps

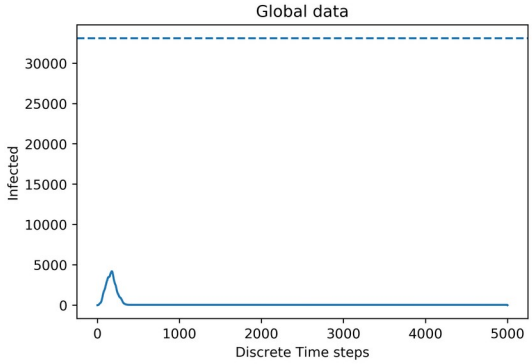

Cluster-11
Infected
Discrete Time steps


Cluster-12
Infected
Discrete Time steps


Cluster-13
Infected
Discrete Time steps


Cluster-14
Infected
Discrete Time steps





*The horizontal line represents the total initial population. Clusters **1,6,9** have their infection dying out within some time [Check the time axis]. Others show an unexpected result, of infection persisting!*
*This is due to either the infection not dying out, or an unexpected error in programming is causing the infection to persist throughout the **max_timescale**.*
{ A final check revealed ?46 or so sick people remaning globally}

Issues:

- The above mentioned issue remains.
- For a better visualisation, the edges of graph G should be colored: red, yellow, green; depending on the number of infected people passing.
- Social distancing menthods to be added by making some % of walkers inactive (*infect[j]=3* or *4*)

Scope:

- Running this program on a cluster?, by having a large max_clusters and an appropriate node density; to give the graph G small world properties (will it show?) to model a country or even the world.