Spreading phenomena on networks

If the contact structure of the population does not justify the well-mixed approximation of the mean-field description by the ordinary differential equations, one needs to explicitly simulate a spreading process on a network [1]. In [2] an overview of algorithms for efficient simulation of spreading processes on network is provided.

- Do the literature research.
- Elaborate the standard epidemiological models (SI, SIS, SIR), as well as zombie-infection [3] and investigate stability of their fix points.
- Implement the zombi-spreading dynamics [3] on networks using algorithms from [2]. Use 1) Random Erdő-Rényi (Poisson) network, 2) Scale-free network. Investigate the conditions on the outbreak for the given parameters of the network. Have in mind that the results should be averaged over different network realization and simulation runs of the stochastic dynamics. What are the differences to the mean-field description?
- Modify the spreading algorithm for deterministic spreading dynamics (e.g. 100% probability of infection upon contact of susceptible and infected/zombie) but on a temporal network. Temporal network is given by sequence of the instances of Random Erdő-Rényi (Poisson) network and 2) Scale-free network. Investigate the parameter space and outbreak conditions.
- For network generation and results visualization you could use python libraries "networkx" and "igraph" or any appropriate library of your choice.

References

[1] R Pastor-Satorras et al., Epidemic processes in complex networks, Rev Mod Phys, vol. 87, p. 925 (2015)
[2] P Holme, Model versions and fast algorithms for network epidemiology, arxiv:1403.1011
[3] P Munz et a., When zombies attack!: mathematical modelling of an outbreak of zombie infection, In: Infectious Disease Modelling Research Progress, p. 133 (2009)