Exercise with MESA: a SIR model

Simulation of an epidemic diffusion protocol

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Goal / Task description

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- We will implement, in MESA, a **S**usceptible/**I**nfectious/**R**ecovered (**SIR**) model to demonstrate the spread of a virus through a network
- Each node/agent represents a computer and, in a network of such computers, we model the spreading of a virus
- The spreading process will terminate when all antiviruses will have learned how to detect and remove the virus
- A computer can be in one of these states:
  - *Susceptible*: can be infected because its antivirus does not recognize the virus
  - *Infected*: currently damaged by the virus which can infect other machines
  - *Resistant*, i.e., the antivirus solved the problem

How your AGENT should work

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- At each time step an infected node tries to infect all its neighbors and succeeds with probability = virus_spread_chance
  - Imagine someone on a susceptible PC opening an infected email attachment
- Resistant nodes cannot be infected
  - A security patch or an updated antivirus protect Resistant PCs from the virus
- Infected nodes are not immediately aware of their infection, but they regularly (virus_check_frequency) perform an antivirus scan
- When the virus gets detected there is a probability (equal to recovery_chance) that the antivrus completely removes the virus

How your AGENT should work

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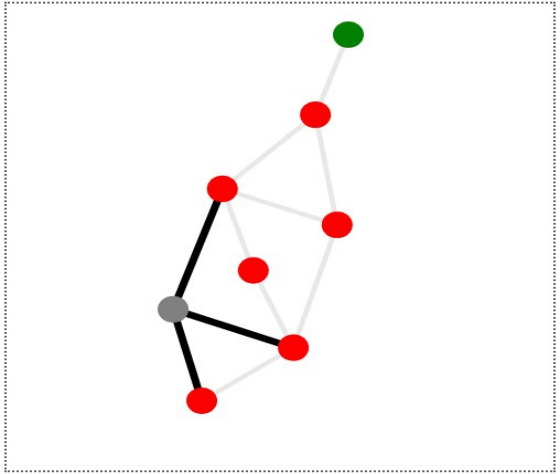
- If the antivirus removes the virus, then the computer has a probability (gain_resistance_chance) to resist to the virus in the future, otherwise it turns susceptible again
- Some suggested colorings:
  - Susceptible nodes should be GREEN
  - Infected nodes RED
  - Resistant nodes GRAY
  - Edges with a Resistant node as endpoint should be BLACK and thicker than regular links between two PCs, these latter links should be LIGHT-GRAY and thinner



How your MODEL should work

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- You should be able to define an initial number of nodes and the average node degree (num_nodes, avg_node_degree)
- Create an ErdosRenyi graph as network

```
self.num_nodes = num_nodes
prob = avg_node_degree / self.num_nodes
self.G = nx.erdos_renyi_graph(n=self.num_nodes, p=prob)
self.grid = NetworkGrid(self.G)
```

- Define a number (initial_outbreak_size) indicating how many PCs start the simulation being already infected

Suggested Agent Flow-Chart

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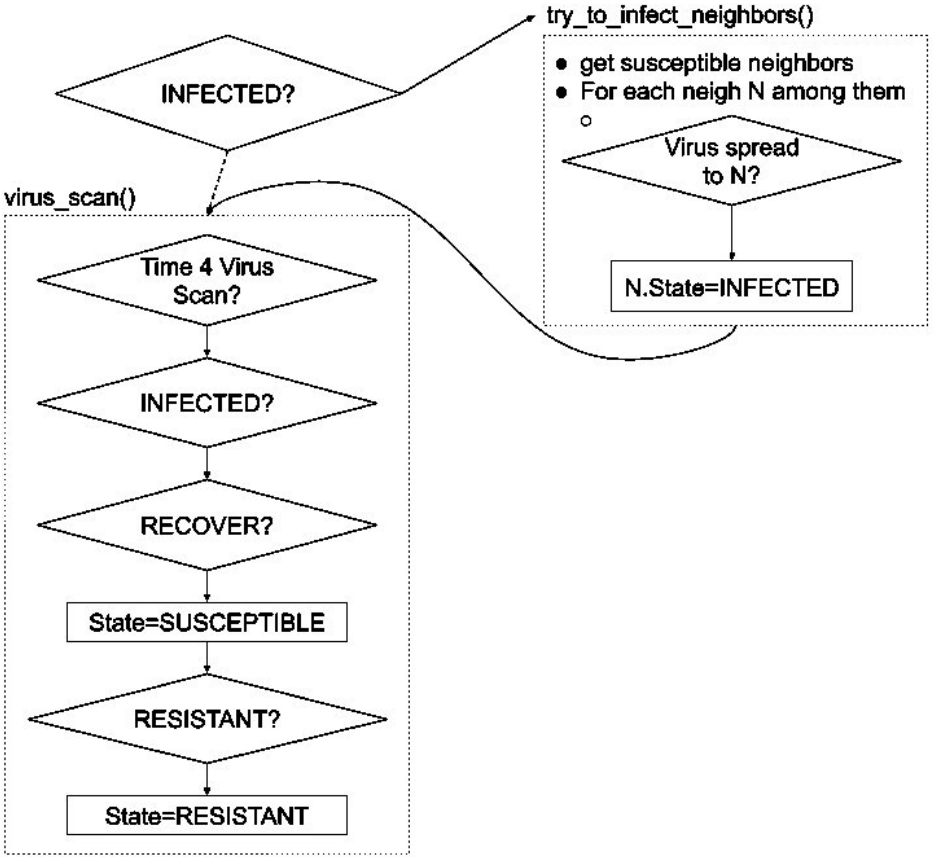

Wishful Result

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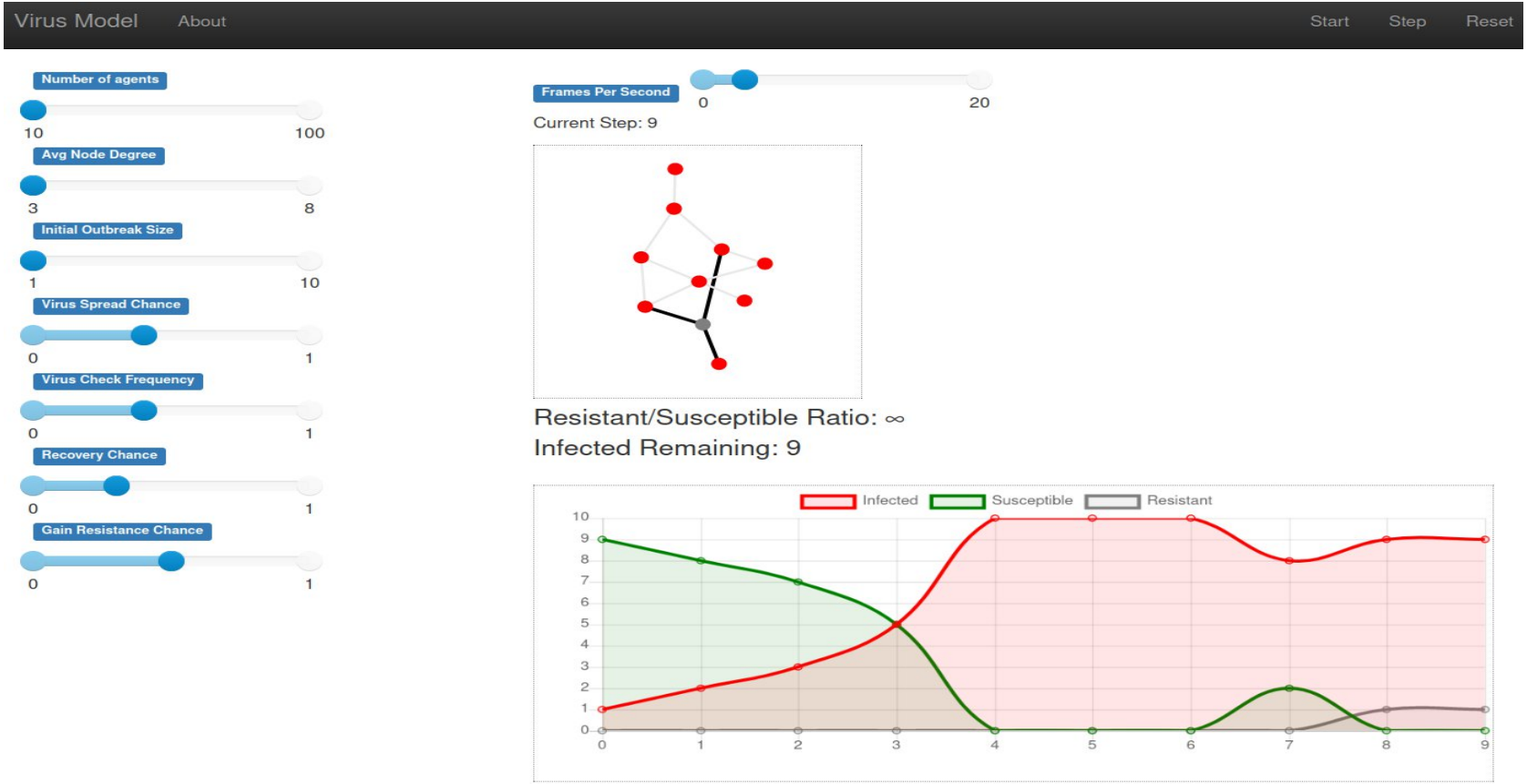

Provided code

- VirusAgent.py is just a template: implement the missing code :)
- Model.py is almost complete, just implement few missing lines. If you don't understand some lines of code... ask to the instructor!
- Server.py if you don't change the model template it should give to your simulation the typical web-based GUI of MESA
- run.py convenience file to run the simulation

GOOD LUCK WITH CODING :)

Questions?