Programming Assignment 3:

Internet Worm Propagation Simulation

1. Design overview:

- Both random scan and local preference simulations are written in python language with consideration that EUSTIS machine has python3 version 3.6.9 installed.
- To run the provided python code please follow the instruction given in the last section.
- At the end of simulation runs the program saves the results in csv file which can be used to further analyze the results and draw graphs.

2. Important variables:

- OMEGA constant variable determines total number of ip-addresses
- SIM_NUM defines the total simulation runs
- SIM_TIME defines maximum time tick to run single simulation
- Node_status is a list that defines the status of each ip-address (immune, susceptible, infectious)
- Infected_num variable keeps count of # of infected computers
- Current_infected variable prevents newly infected computers from spreading worm at current time tick
- Sim_result is a 2d array to records # of infected computers at each time tick and is also used to save results in csv file.
- A python specific Enum class is created to assign integer values to immune, susceptible and infectious status
- Node_status[1001] is assigned infectious status to begin worm propagation.

3. Random scan worm propagation simulation design:

- As per requirement this simulation program randomly infects three computers per infected computer in 100000 ip-address space.
- Simulation runs longer and require more time to finish than local preference simulation since it randomly picks three ip-addresses from 100000.
- Code prevents newly infected computers from spreading worm.
- Sim_results array which records # of infected computers at each time tick is initialized with 1000 value for every element. Hence, the graph given below does not drop off to 0 after reaching maximum number of infected computers for subsequent time ticks.
- Few constants for values such as simulation time, # of runs, ip-address space, are declared at the beginning of code to make code reusable and easily modifiable.

4. Local preference worm propagation simulation design:

- As per requirement this simulation picks the computers based on probability. 80% of the time, the infected computer would select a computer with the range of +10 to -10 and for 20% the simulation would pick ip-address randomly.
- Hence, the program is significantly faster at spreading worm than random scan.
- With exception of probability-based scanning, most of the program performs similar to random scan.

5. Figure description:

- Figure 1 below shows the results of three random scan runs. Horizontal axis defies time and vertical axis defines # of infected computers at each time tick. It can be noted that sim1 stops at approximately 281 time-tick, sim2 at 201 and sim3 at 235.

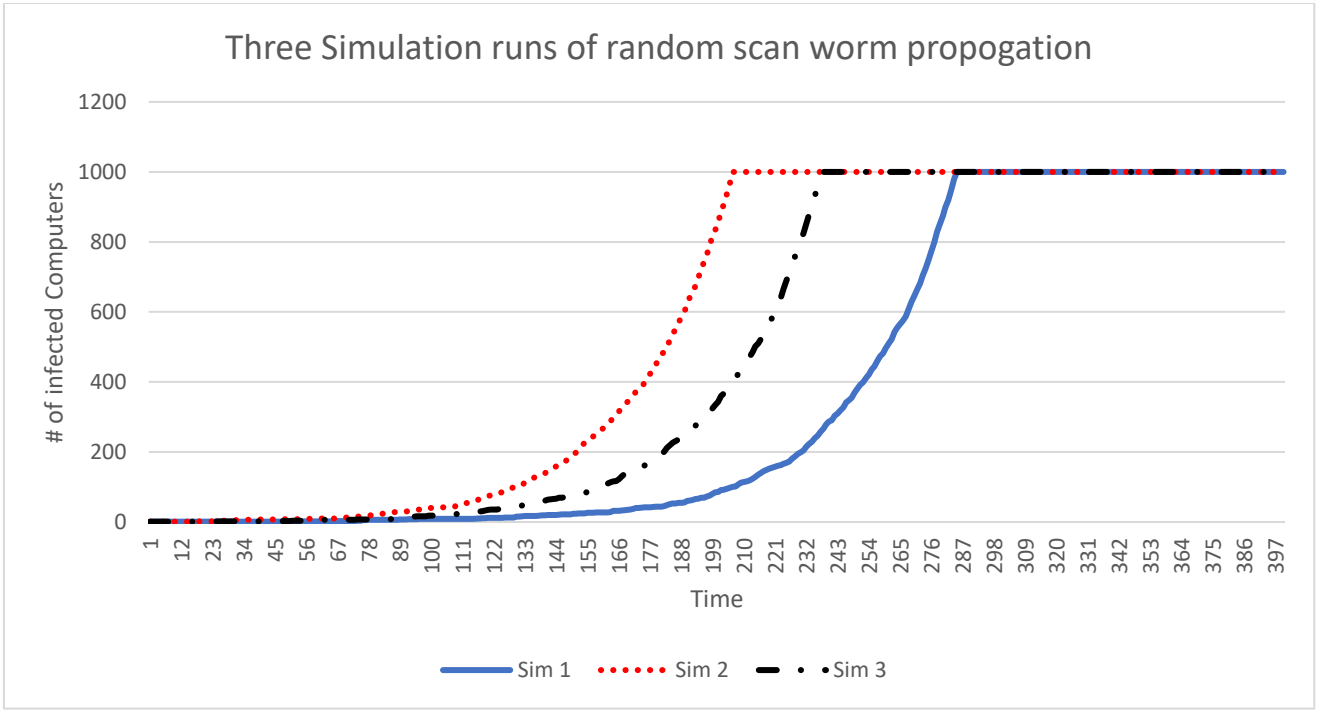
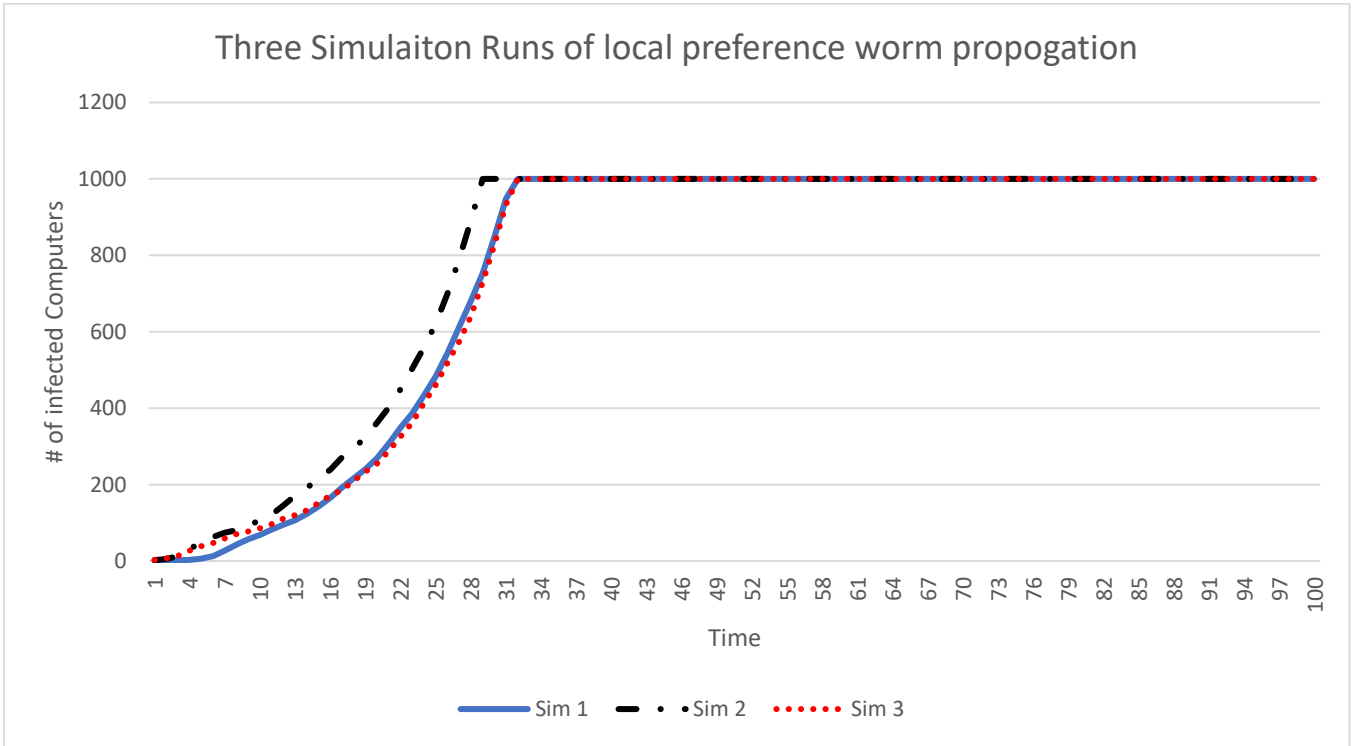


Figure 1

- Figure 2 plots the results of local preference simulation. It's clear from the graph that local preference is faster than random scan and all the three results are closer to each other. Hence, it can be inferred that local preference scan simulation results are more consistent than random scan worm propagation simulation.



6. Screenshot from EUSTIS and how to run python code:

- Results in screenshot might be different than results in figure above as the figures were created on windows laptop.
- To run python3 code, please type below line with appropriate file name into terminal, python3 <file_name>.py
- As file names suggest, random_scanner.py file runs random scan worm propogation simulation and local_preference.py performs local preference scanning.

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ra996142@net1547:~/project3$ python3 random_scanner.py
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Beginning Simulation 1

Setting up lists and variables for simulation....
Last time tick: 234
1000 infected Computers at time tick: 234
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Beginning Simulation 2

Setting up lists and variables for simulation....
Last time tick: 239
1000 infected Computers at time tick: 239
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Beginning Simulation 3

Setting up lists and variables for simulation....
Last time tick: 243
1000 infected Computers at time tick: 243
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Simulation Results saved in random_scan_results.csv
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```
ra996142@net1547:~/project3$ python3 local_preference.py
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Beginning Simulation 1

Setting up lists and variables for simulation....
Last time tick: 35
1000 infected Computers at time tick: 35
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Beginning Simulation 2

Setting up lists and variables for simulation....
Last time tick: 29
1000 infected Computers at time tick: 29
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Beginning Simulation 3

Setting up lists and variables for simulation....
Last time tick: 32
1000 infected Computers at time tick: 32
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