

Programming Assignment 3: Discrete-Time Simulation of Worm Propagation

Assignment Details (Source: Assignment):

- Isolated-Network with 100,000 IP Address space.
- IP Addresses are treated as having values [1, 100000].
 - Note: Code treats each has having values [0, 99999]
- There exists $N = 10000$ computers on the network.
- Computers have IP Addresses:
 - 1, 2, 3, ..., 10,
 - 1001, 1002, ..., 1010,
 - 2001, 2002, ..., 2010,
 - ...
 - 99001, 99002, ..., 99010
- A single computer (1001 is chosen) is infected at time $t = 0$.

Design:

Important Variables:

- `_NumIps`: The total number of IPs in the address space. Set to 100000 by definition of assignment.
- `_NumComputers`: The total number of computers in the network. Set to 1000 by definition of assignment. Once the number of infected computers reaches this number, the simulation is complete.
- `_InfectedComputers`: Set of the infected computers indexed by their IP. The simulation is complete when this set contains all computers.
- `_ScanRate`: The number of IP Address to scan per simulation time tick. Set to 3 by definition of assignment.
- `newlyInfectedComputers`: The set of computers that are infected per time step. Cleared before every time step. This set is added to `_InfectedComputers` to ensure that the newly infected computers do not spread until the next time step.

Random-Scanning Selection Strategy

- Select a random IP on the range $[0, _NumIps)$

Local-Preference Scanning Selection Strategy

- Select a random IP on the range $[x - 10, x + 10] \% _NumIps$
- Where x is the scanning computer's IP

Implementation:

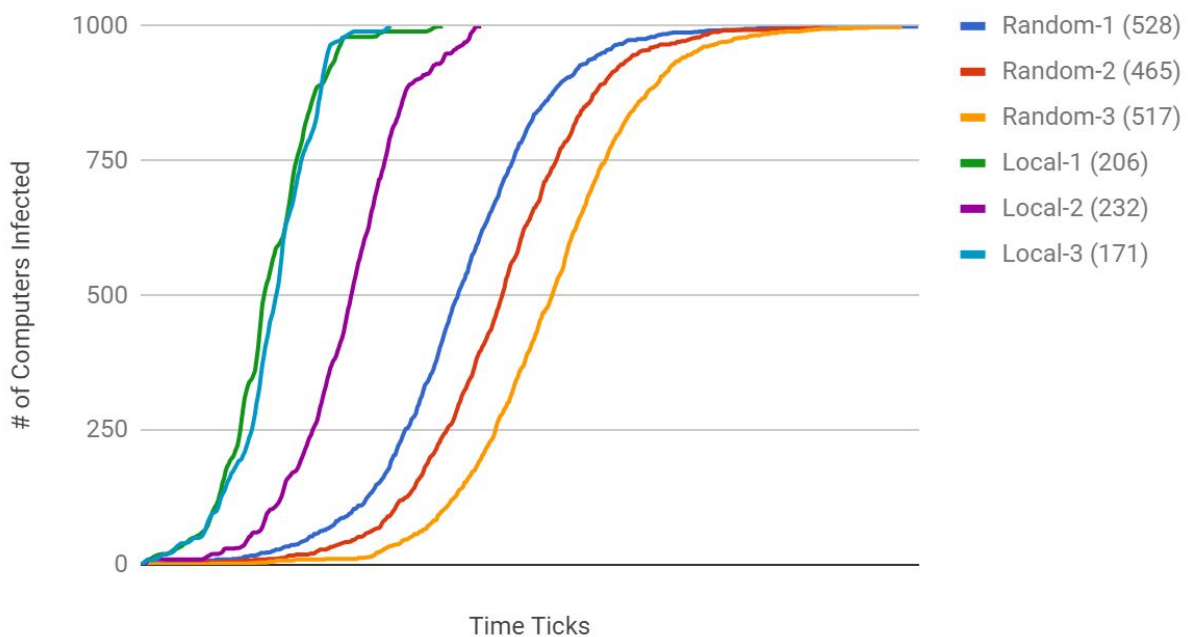
While size of `_InfectedComputers` < `_NumComputers`

- Clear set of `newlyInfectedComputers`
- For each of `_InfectedComputers`
 - For each of `_ScanRate`
 - Scan IP chosen by worm selection strategy (See below)
 - If chosen IP is a valid computer and is not infected
 - Infect chosen IP (Add to `newlyInfectedComputers`)
- Add `newlyInfectedComputers` to `_InfectedComputers`

Results:

Three runs of each of the two described selection strategies are shown. The total number of time ticks to complete infection (1000 computers infected) are shown in parentheses.

Worm Propagation



Future Work:

- Allow user input of each of the listed important variables.
- Simulate different network topologies by altering graph-connectedness.
- Introduce hardening (firewall) of some computers/access points and determine their effect on the spread of worm viruses.