“Co-Wish”

Virus Infection Simulator

CO-WISH is a simulator software to represent the viral infection. It is able to display either a single viral infection or co-infection of two viral strains.

The name of the software—Co-Wish—stands for the Avestan word pronounced ‘VISH’ meaning poisonous substance. The prefix “CO” indicates the co-infection of two viral strains.

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Programming Language: C#.Net Framework (WPF Desktop application)
Repository: https://github.com/safarvafadar/virusinfection.

Host	*Simulated host properties*
Description	Host is simulated as a lattice in which each cell illustrates a cell.
Arguments:	
Receptor Count	A positive integer indicates the number of receptors on the surface of each cell.
CellW*Cell_H	A positive integer to determine the dimension of the lattice. The number determines the number of cell in each row of the lattice.
Simulation Step	A positive integer indicates the number of steps to terminate the simulation.
Number Of Neighbors	The option to choose the pattern of viral infection spreading. Square (4) indicates the cross (or quincunx); Square (8) indicates the square form.
Expansion Weights	K1,K2,K3 are positive values from [0,1] to determine the proportion of the number of virions attached to each susceptible cell in three layers in the vicinity of the infected cell, respectively.

Immune System	*Immune system properties*
Description	Activation of the immune system is optional. The designed immune system could resemble as an innate response to the viral infection.
Arguments:	
Kill probability	A positive value from [0,1] to determine the rate at which the immune system eliminates the virions or infected cells.
Delay	A positive integer to specify the step at which the immune system activates.
Killing Mode	The designed immune system is able to eliminate the infected cells (*Whole-cell*) or free virions (*Part of the population*).
Capacity	There are two options: Limited and Unlimited. If Limited is selected, a positive integer indicates the maximum number of infected items which will be eliminated by the immune system. The immune system will be deactivated after meeting the capacity. By selecting Unlimited, the immune system will be active to the end of the simulation.

Viral Infection	*Properties of Viral Infection(a five- stage process)*
Description	Co-Wish is designed to display single strain infection (by choosing *Virus A* or *Virus B*) and also co-infection of two strains (by choosing *Virus A* and *Virus B*). In co-infection conditions, the properties of each strain are set separately. To simulate the infection, the viral growth process is designed in five stages named Attachment; Penetration; Eclipse; Replication and Release, respectively.
Arguments:	
population	A positive integer indicates extracellular viral load.
Start position	The values of *Row* and *Col* determine the position of the first infected cell in the host.
Attachment to Penetration	The probability distribution to generate the Waiting time at Attachment stage can be chosen from *Beta*; *Exponential* or *Weibull*. By selecting each of the distribution, the user is able to determine the parameter values of the distribution. The probability of transition from current stage to the next stage is calculated in Transition Probability *(p*). The probability is generated from Uniform distribution. '*a'* and '*b'* are positive values from [0,1] indicating the parameter value of Uniform distribution.
Penetration to Eclipse	The probability distribution to generate the Waiting time at the current stage can be chosen from *Beta*; *Exponential* or *Weibull*. By selecting each of the distribution, the user is able to determine the parameter values of the distribution. The probability of transition from current stage to the next stage is calculated in Transition Probability *(p*). The probability is generated from Uniform distribution. *a* and *b* are positive values from [0,1] indicating the parameter value of Uniform distribution.
Eclipse to Replication	The probability distribution to generate the Waiting time at Eclipse stage is Weibul. *Shape* and *scale* are positive integers to determine the *Weibull* distribution parameters. The parameter *t* for Weibull distribution is a positive integer indicating the maximum time at which the virus can stay in the current stage and after that it loses its chance to transit into the next stage.

The Transition Probability (*p*) to the Eclipse stage is generated from Beta distribution. (*a+b*) is the sum of the Beta distribution parameters. It is defined as a positive integer .The value of the distribution parameters are calculated automatically based on (*a+b*).

Replication to Release

The probability distribution to generate the Waiting time at the current stage can be chosen from *Beta*; *Exponential* or *Weibull*. By selecting each of the distribution, the user is able to determine the parameter values of the distribution.

To calculate the probability of release, based on the *Logit function*, user has to determine the value of *e* which is defined as the *Neper* number (e=2.71828) by default.