

Network Environments in AnyLogic

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Recall: Spatial Types Supported

- Continuous
 - No interference between agents
 - Continuous movement (via velocity)
 - Only spatial dimensions required
- Discrete
 - Space is divided (“tesselated”) into cells
 - Mutual exclusion of agents from a given cell
 - Space information requires dimension & rows/columns (for count of cells in X & Y location)

Networks & Spatial Layouts

- Distinct node attributes: Location & connections
 - Spatial layouts determine where nodes appear in space (and often on the screen)
 - Network type determines who is connected to who
 - For the most part, these characteristics are determined independently
- Network topologies (connectedness) can be defined either *alternative to* or *in addition to spatial layouts*
 - Agents will have spatial locations in either case



Hands on Model Use Ahead



Load model:

Network Modification of SIR AB

Network Types

The screenshot displays the AnyLogic Advanced software interface. The main window shows a project tree on the left with the 'environment' object selected under 'Spatial SEIR with Waning Immunity > Main > Environments'. The 'Advanced' properties panel for the 'environment' object is visible, showing settings for 'Space type' (Continuous), 'Width' (500), 'Height' (500), 'Columns' (500), 'Rows' (500), and 'Neighborhood type' (Euclidean). The 'Network' dropdown menu is open, showing options: 'Scale free', 'Random', 'Ring lattice', 'Small world', 'Scale free', and 'Distance based'. The 'Scale free' option is highlighted. The 'Problems' panel at the bottom left shows several error messages related to undefined methods and unresolved types.

Project

- Parameters
- Functions
 - AddNewAgent
 - AddNewAgentA
 - AddNewAgentB
 - AddNewAgentC
- Environments
- Embedded Objects
- Presentation
- AgentFactory
- Simulation: Main
- Spatial SEIR with Waning Immunity
 - Main
 - Parameters
 - Plain Variables
 - Environments
 - environment
 - Embedded Objects
 - Presentation
 - Person
 - Plain Variables
 - Statecharts

environment - Environment

General

Advanced

Description

Space type: Continuous Discrete GIS

Width: 500

Height: 500

Columns: 500

Rows: 500

Neighborhood type: Euclidean

Layout type: User-defined Apply on startup

Network: Scale free Apply on startup

- Random
- Ring lattice
- Small world
- Scale free
- Distance based

Connections per node: 1

Connection range: 1

Neighbor link function: 1

M: 1

Problems

Description

- Cannot make a static reference to the non-static method getState() of the class Person
- The method getCurrentState() is undefined for the type Person
- Type_statechart cannot be resolved
- The method getCurrentState() is undefined for the type Person
- Type_statechart cannot be resolved
- The method setModified() is undefined for the type Person
- The method setModified() is undefined for the type Person

Model

Action

Analysis

Prese...

Line

Polyline

Curve

Rectan...

Round ...

Oval

Arc

Pixel

Aa Text

Image

Group

Button

Check ...

Edit Box

Radio ...

Slider

Comb...

List Box

File Ch...

Progre...

CAD D...

GIS Map

Connectiv...

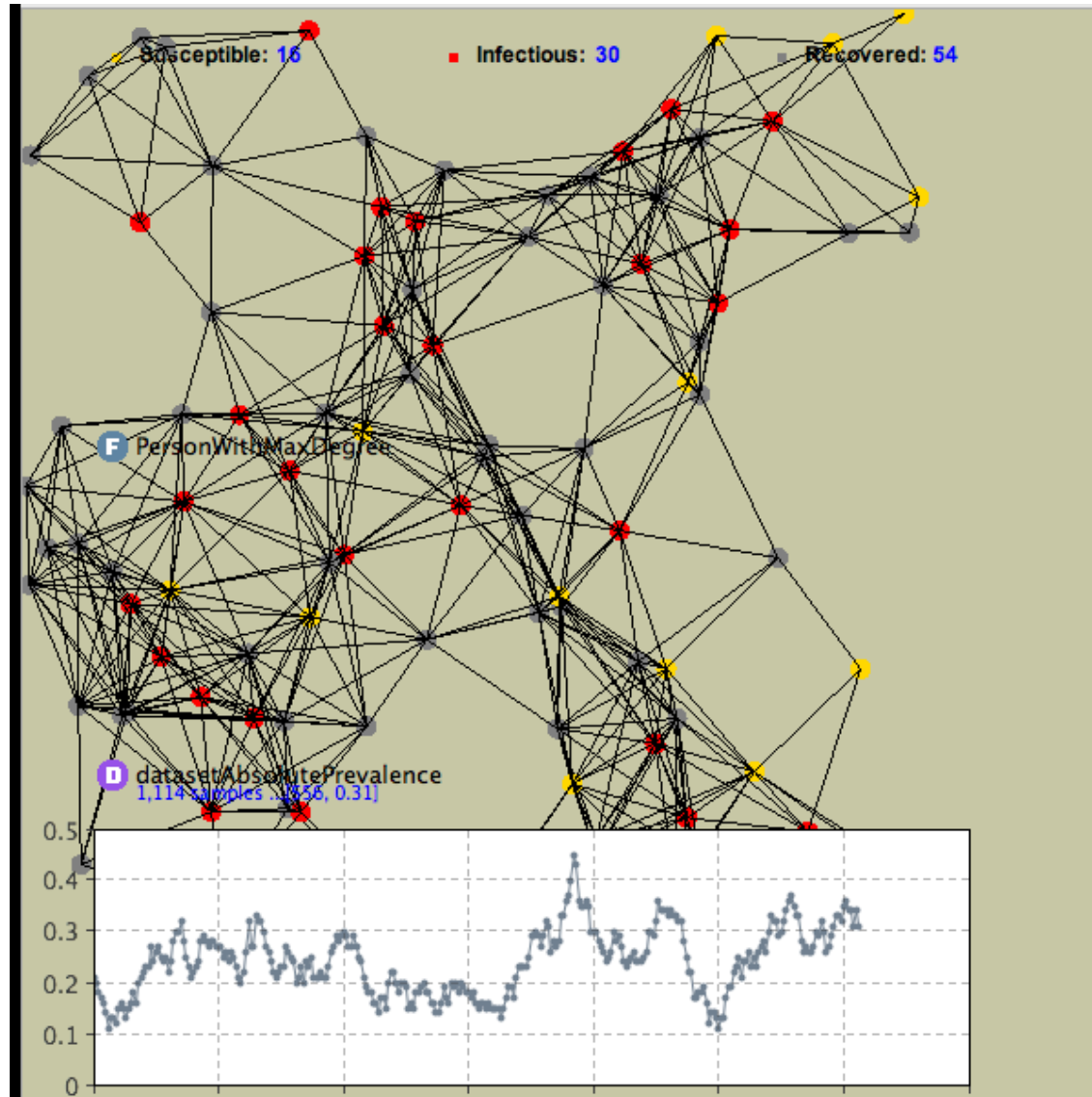
Enterpris...

More Libraries...

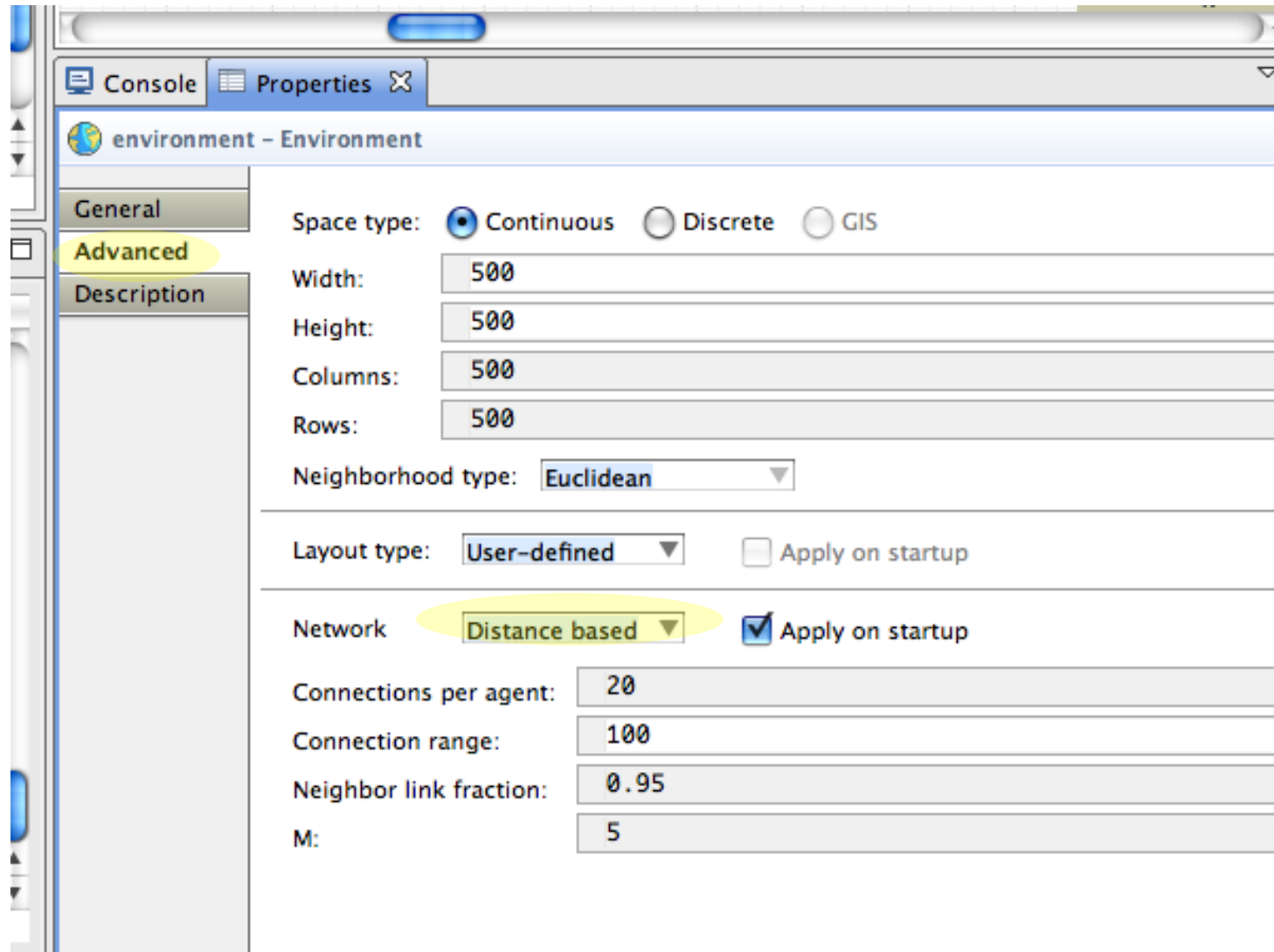
Interaction Between Network&Location 1

- For one type of networks (Distanced Based), whether there is a connection between A and B depends on the distance between A & B
 - This sets connectivity based on location considerations!

Distance-Based Layout



Property for Distance-Based Layout: Distance Threshold



Random Connections

The screenshot shows the 'environment - Environment' properties window in NetLogo. The 'Network' dropdown menu is highlighted in yellow and set to 'Random'. The 'Apply on startup' checkbox for the network is checked. Other settings include 'Space type' set to 'Continuous', 'Width', 'Height', 'Columns', and 'Rows' all set to 500, and 'Neighborhood type' set to 'Euclidean'. The 'Layout type' is 'User-defined' and 'Apply on startup' is unchecked. The 'Connections per agent' is 5, 'Connection range' is 100, 'Neighbor link fraction' is 0.95, and 'M' is 5.

environment - Environment

General

Advanced

Description

Space type: Continuous Discrete GIS

Width: 500

Height: 500

Columns: 500

Rows: 500

Neighborhood type: Euclidean

Layout type: User-defined Apply on startup

Network: Random Apply on startup

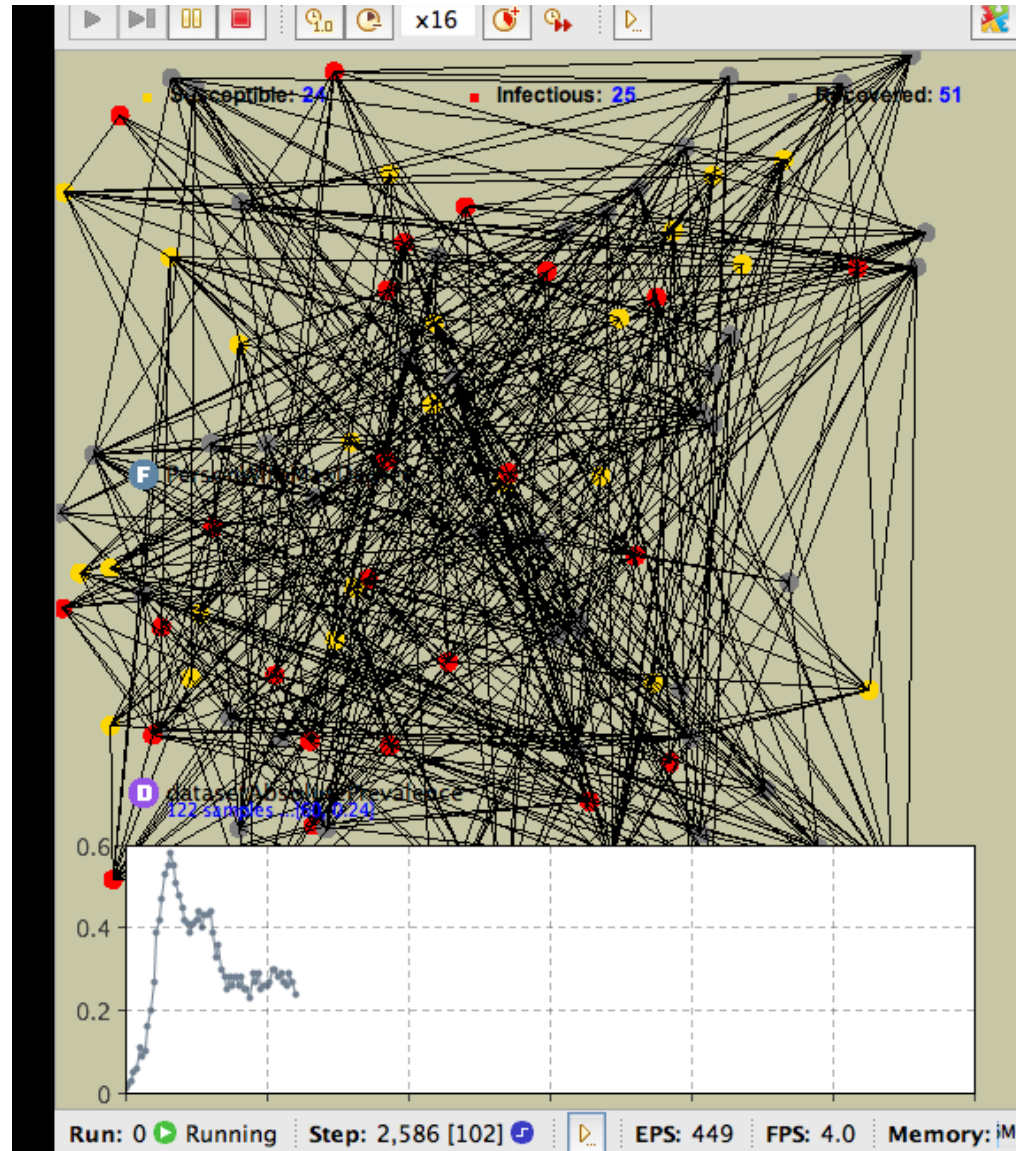
Connections per agent: 5

Connection range: 100

Neighbor link fraction: 0.95

M: 5

With Random Connections



Scale-Free Network

The screenshot shows the 'Properties' dialog box for an environment in NetLogo. The 'Network' section is highlighted, showing the 'Scale free' network type selected. The 'Apply on startup' checkbox is checked. Other settings include a width and height of 500, 500 columns and rows, and a Euclidean neighborhood type.

environment - Environment

General

Advanced

Description

Space type: Continuous Discrete GIS

Width: 500

Height: 500

Columns: 500

Rows: 500

Neighborhood type: Euclidean

Layout type: User-defined Apply on startup

Network: Scale free Apply on startup

Connections per agent: 5

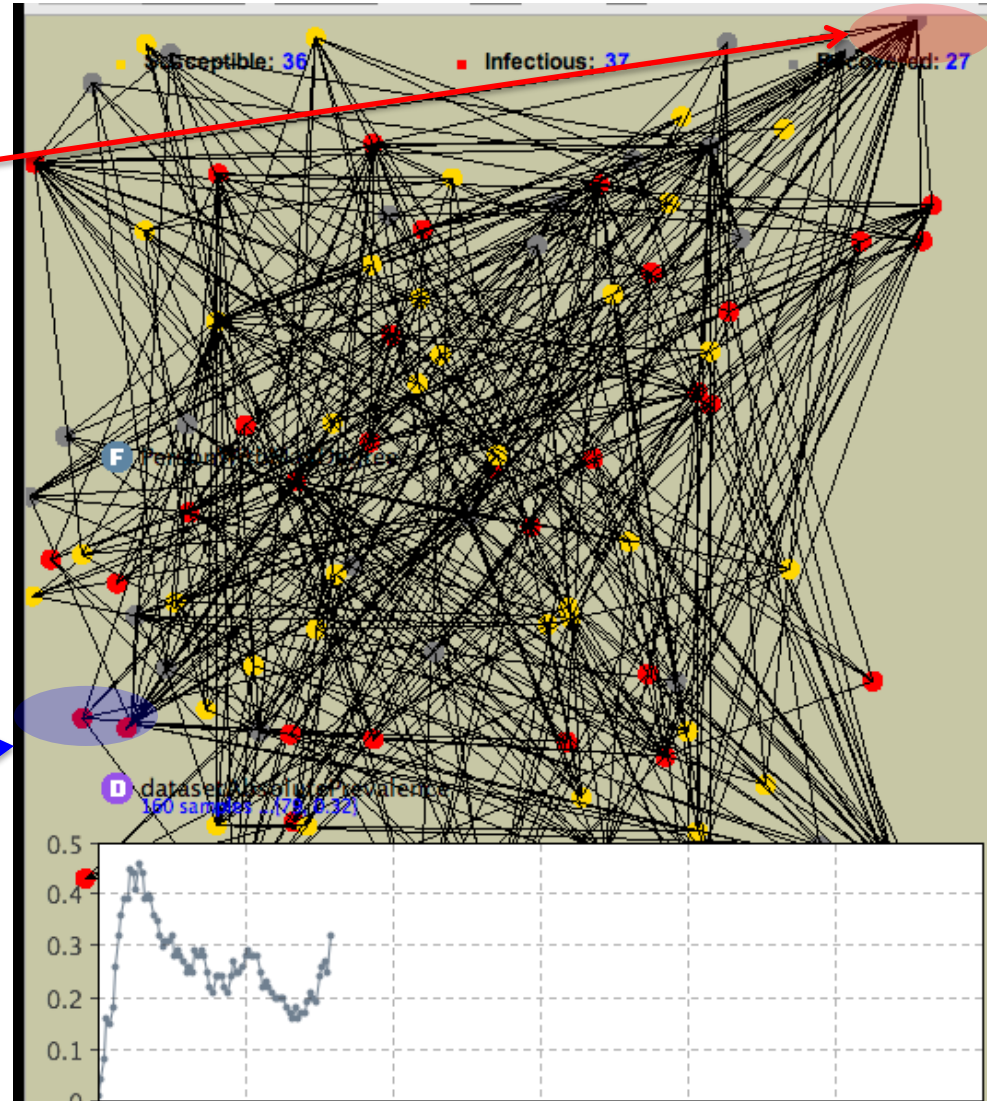
Connection range: 100

Neighbor link fraction: 0.95

M: 5

Scale-Free Network

High degree node



Low degree node

Layout Types

The screenshot displays the AnyLogic Advanced software interface, titled "AnyLogic Advanced [EDUCATIONAL USE ONLY]". The interface is divided into several panels:

- Project Panel (Left):** Shows a hierarchical tree structure. The selected path is "Spatial SEIR with Waning Immunity" > "Main" > "environment".
- Environment Canvas (Top Center):** A grid-based workspace showing a simulation environment with various objects and variables. Visible variables include "ImmunityDuration", "TotalPopulation", "AveragellnessDuration", "ContactRatePerNetwork", "PerContactInfectionProb", and "nSusceptible".
- Properties Panel (Bottom Center):** Displays configuration options for the selected "environment" object. The "Layout type" dropdown menu is open, showing options: "User-defined", "Random", "Arranged", "Ring", and "Spring mass". The "User-defined" option is currently selected. Other visible settings include "Space type" (Continuous, Discrete, GIS), "Width: 500", "Height: 500", "Columns: 500", "Rows: 500", "Neighborhood type: Euclidean", "Apply on startup" (unchecked), "Network", "Connections per...", "Connection ran...", "Neighbor link fraction: 0.95", and "M: 5".
- Problems Panel (Bottom Left):** Lists several error messages, such as "Cannot make a static reference to the non-static...", "The method getCurrentState() is undefined for the type...", "Type_statechart cannot be resolved", and "The method setModified() is undefined for the type...".
- Toolbox (Right):** A vertical toolbar containing various graphical elements and components, including "Model", "Action", "Analysis", "Presentation", "Line", "Polyline", "Curve", "Rectan...", "Round...", "Oval", "Arc", "Pixel", "Text", "Image", "Group", "Button", "Check...", "Edit Box", "Radio...", "Slider", "Comb...", "List Box", "File Ch...", "Progre...", "CAD D...", "GIS Map", "Connectiv...", and "Enterpris...".

Layout Type

- **Random:** Uniformly distribute X and Y position of nodes
- **Arranged:** Set node locations in a regular fashion (normally in a 2D grid)
- **Ring:** Set node locations in periodically spaced intervals around a ring shape
- **Spring Mass:** Adjust node locations such that node locations that are most tightly connected tend to be closer together
 - (Sets location based on network!)
- **User-Defined** User can set location (e.g. in initialization code)

Interaction Between Network & Location 2

- In a Spring-mass layout, the nodes that are highly connected will tend to be clustered
- Here, we are determining the location based on the connectivity!