UNIVERSITAT POLITÈCNICA DE VALÈNCIA

VRAIN
Valencian Research Institute for Artificial Intelligence

# Agent-Based Simulation in Complex Networks

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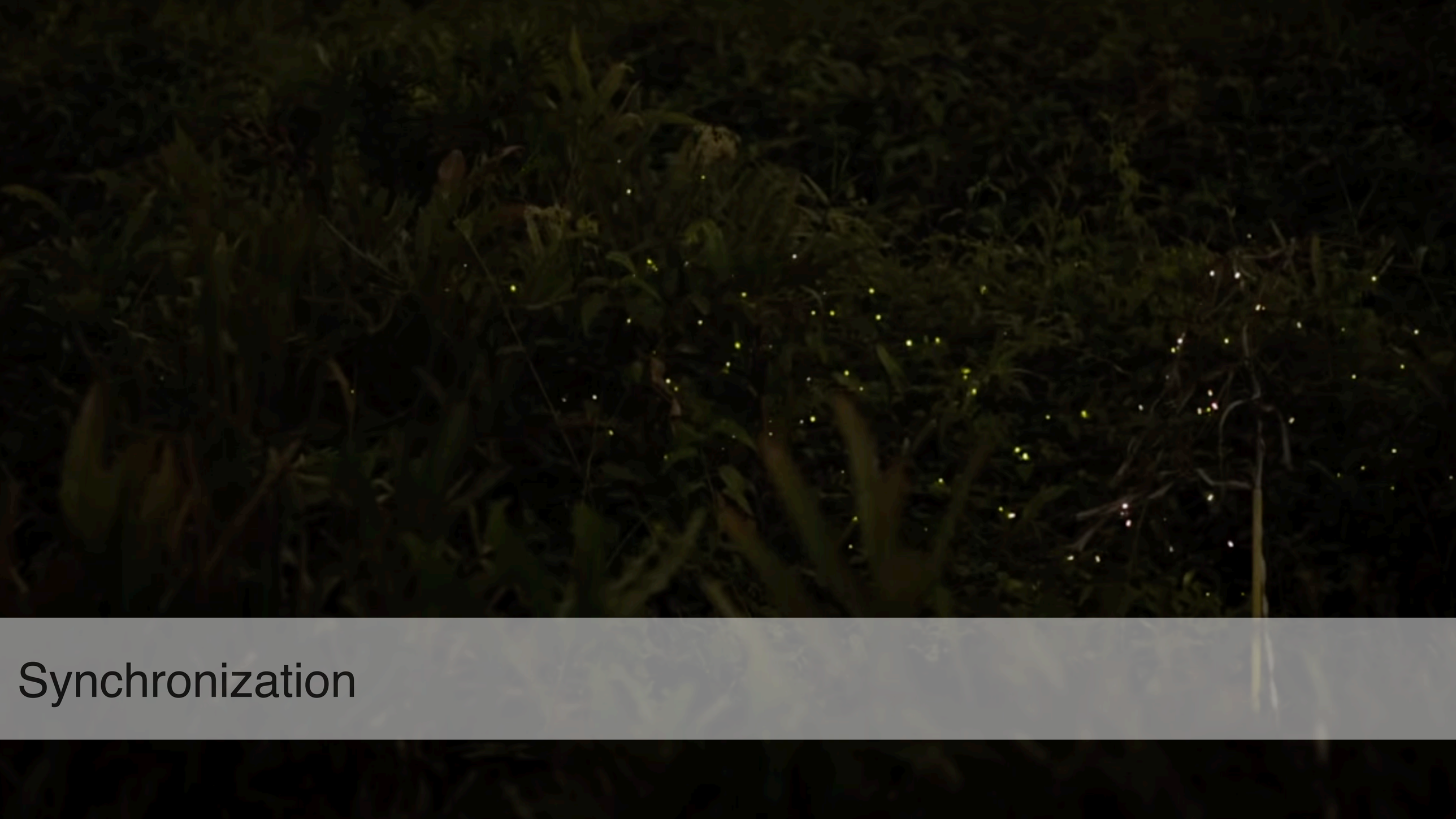
# Outline of the course

- Introduction to Complex Systems
- Basics of Agent-based Modeling
- Complex Networks. Characterization
- Network Dynamics: synchronization, diffusion, opinion formation, spreading phenomena
- Applications: cooperative games, markets, biological agents, social dynamics

# Session 1. Introduction

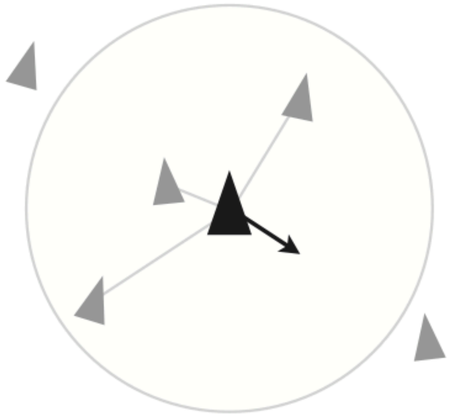
# Collective behavior

# Emergent behavior. Flocks

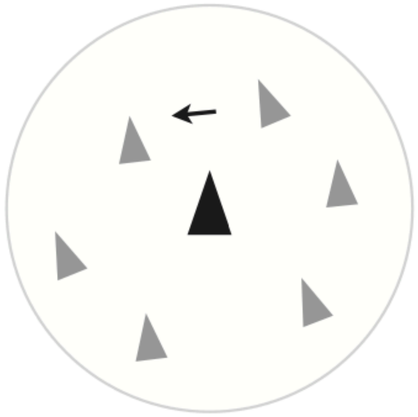


# Synchronization

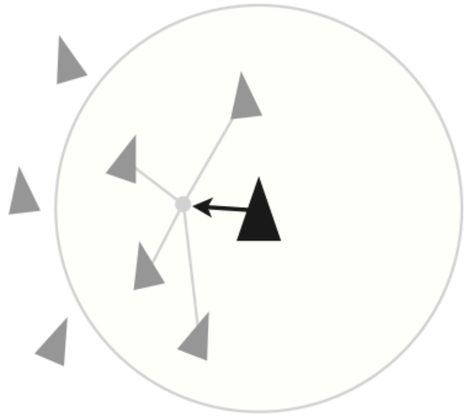
# Flocks. Individual rules



**Separation:**
Steer to avoid crowding local flockmates



**Alignment:**
Steer toward the average heading of local flockmates

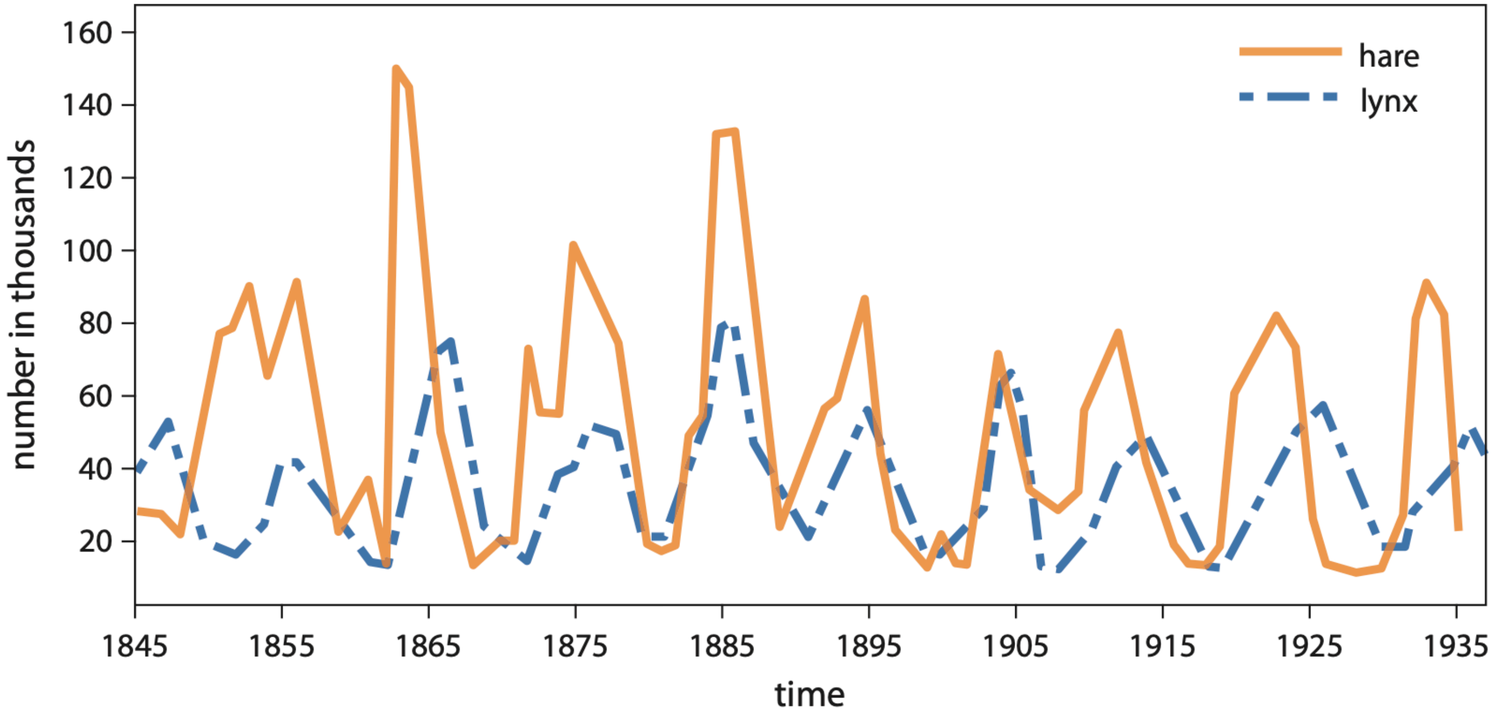


**Cohesion:**
Steer to move toward the average position of local flockmates

- ‘Amount of thinkin’ independent of the size of the flock
- Each individual = computational entity (agent) interacting locally

# Predator-prey (Lotka-Volterra)

$$\frac{dx}{dt} = \alpha x - \beta xy,$$
$$\frac{dy}{dt} = -\gamma y + \delta xy,$$



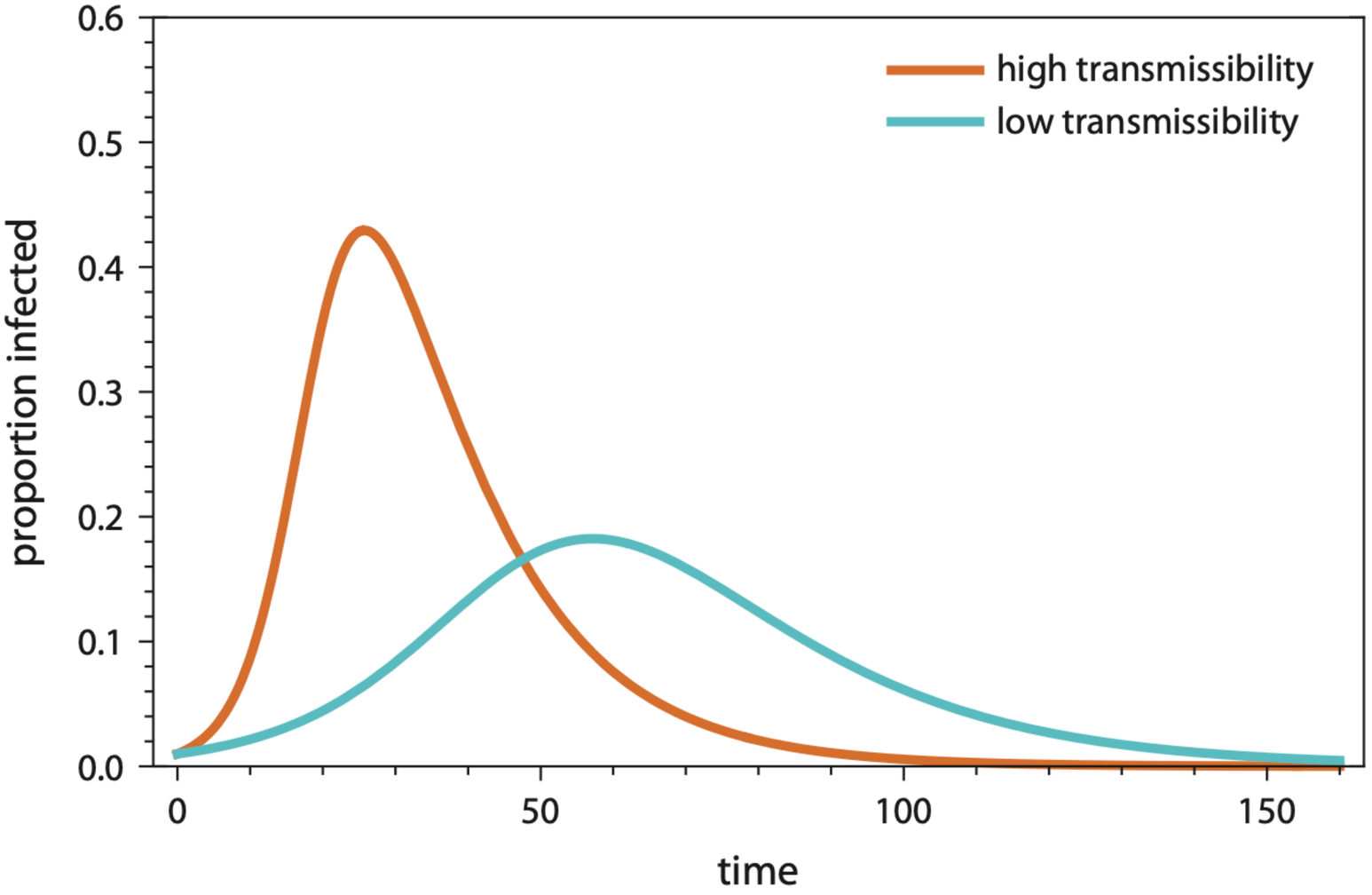
# Equations vs. ABS

Epidemiological model

$$\frac{dS}{dt} = -\beta SI$$

$$\frac{dI}{dt} = \beta SI - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$



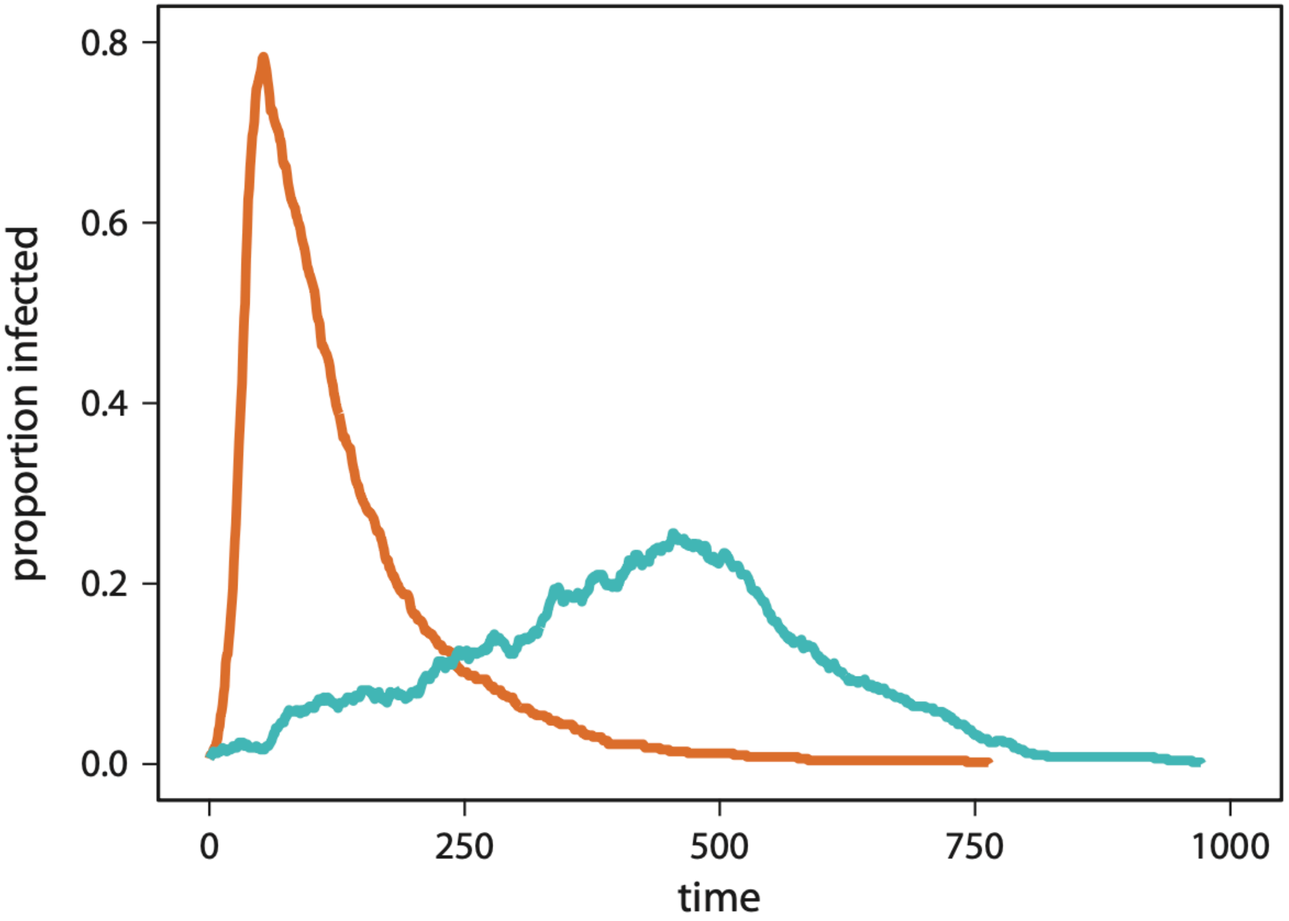
# Equations vs. ABS

Epidemiological model

$$S(t+1) = S(t) - \beta S(t) I(t)$$

$$I(t+1) = I(t) + \beta S(t) I(t) - \gamma I(t)$$

$$R(t+1) = R(t) + \gamma I(t)$$



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# epiDEM Basic

File: New | Revert to Original

Export: NetLogo | HTML

Mode: Interactive  Commands and Code: Bottom

model speed

hours: 32

initial-people 100

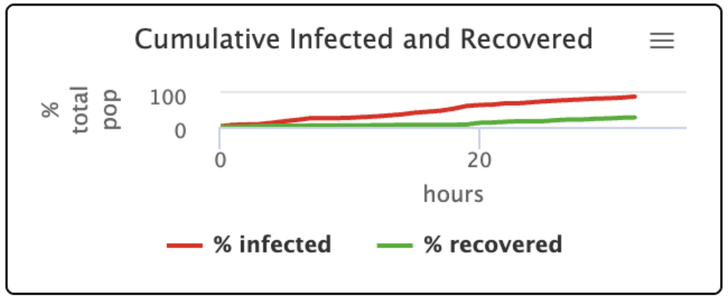
recovery-chance 100

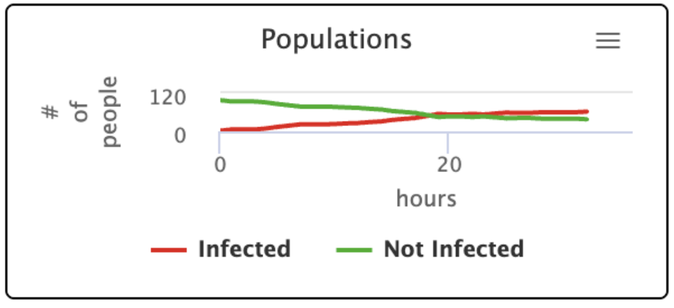
infection-chance 75

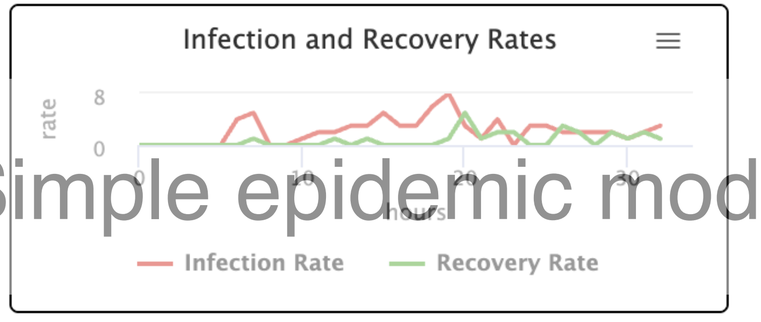
average-recovery-time 120

setup

go

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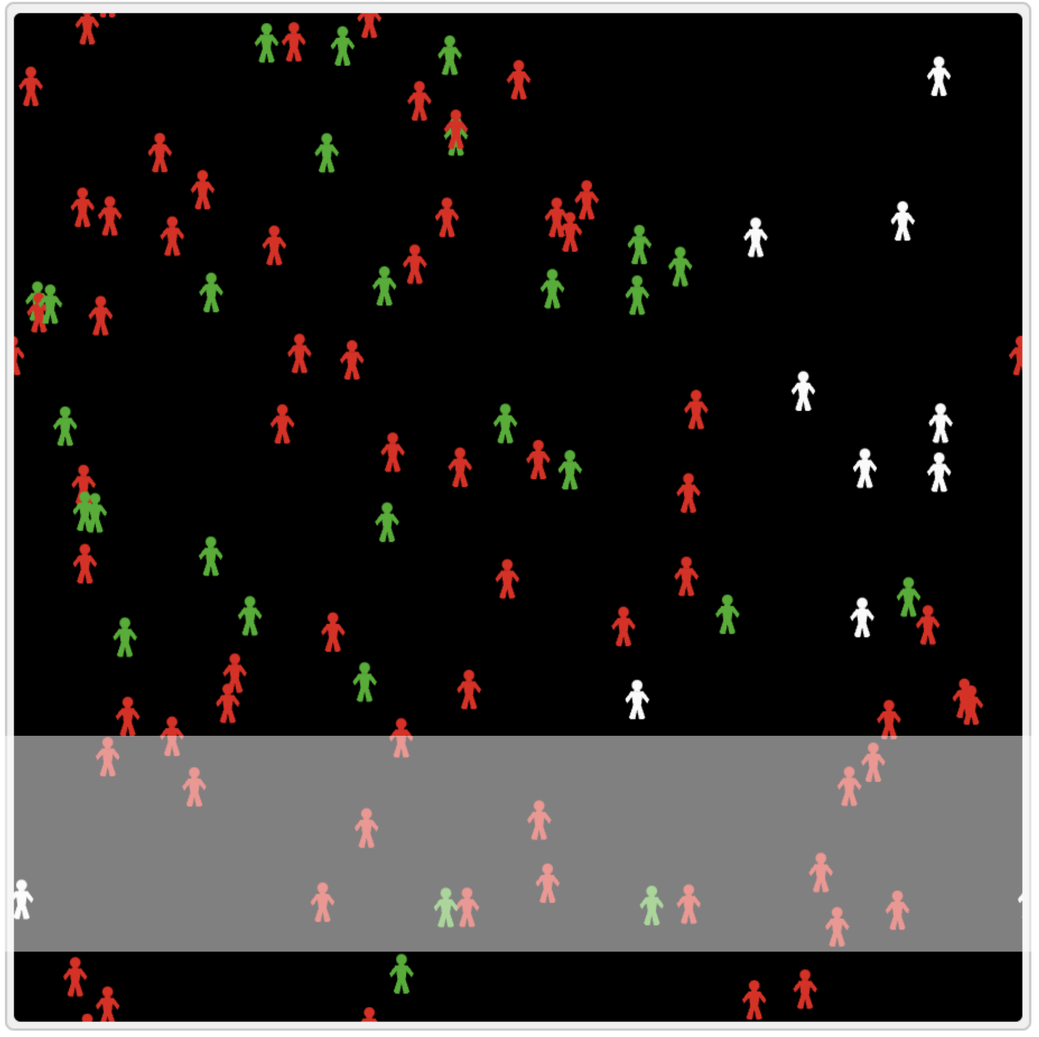

Simple epidemic model with Netlogo