



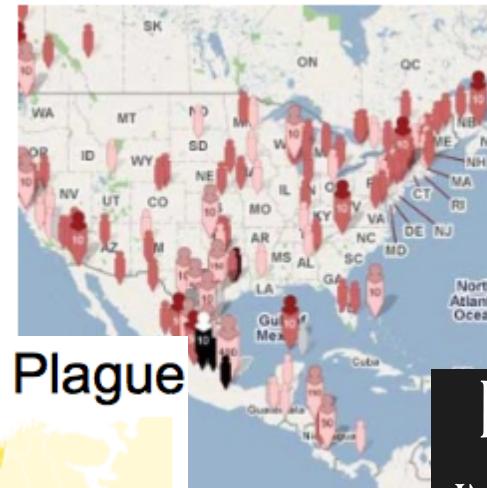
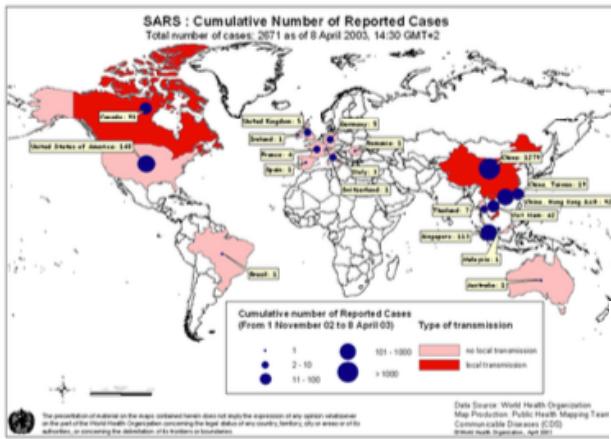
Studying Network Diffusion Dynamics

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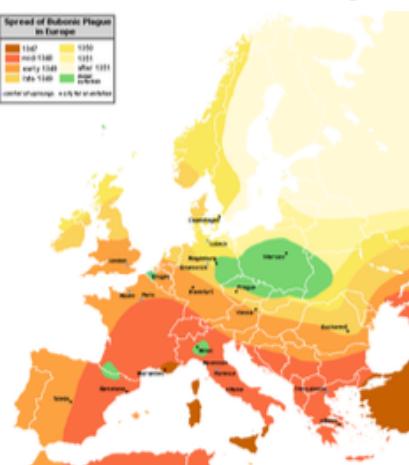
Diffusive Phenomena are everywhere

SARS



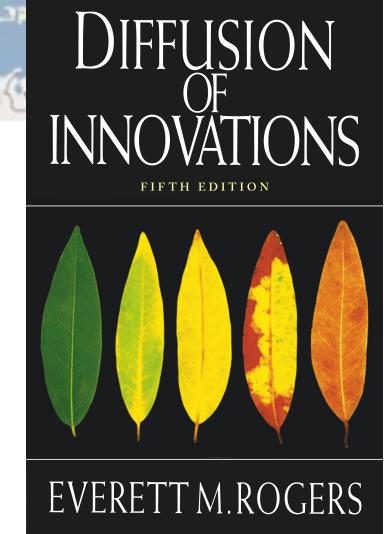
H1N1

The Great Plague



Epidemic Spreading,
Diffusion of Innovations and
Ideas, Gossip...

All those **phenomena** can be
modeled as **diffusive processes**



Diffusive Processe and Networks

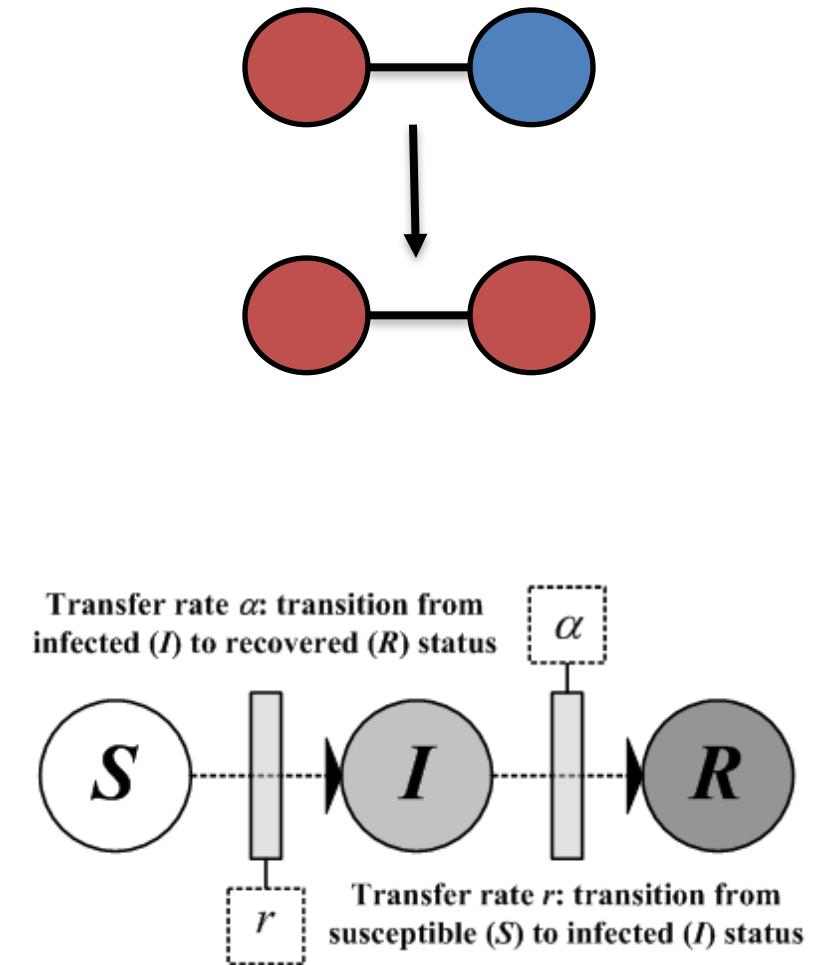
Diffusion implies network structure!

- It happens only when the carriers of the diseases/virus/idea are **connected to each other**.

Diffusive phenomena can modeled by describing “*node statuses*” and “*transition rules*”

Example SIR model:

- Three node status:
(S)usceptible, (I)nfected, (R)ecovered
- Two transition available:
S->I; I->R





Epidemics

(10 Models)

- SI / SIS / SIR
- SEIS / SEIR
- Threshold / Profile / Profile-Threshold / Threshold-Blocked
- Independent Cascades

Available Models

Opinion Dynamics (5 Models)

- Majority Rule
- Voter / Q-Voter
- Sznajd
- Cognitive Opinion Dynamics





A framework for everyone!
Analytics as-a-service for...

... an heterogeneous audience

Researchers

Analysts

Students

...



... coming from several disciplines

Computer science

Physics

Social Sciences

...



.... having different goals!

Test Diffusive models

Perform Experiment

Visualize and Compare models

...





A single workflow, two type of users!

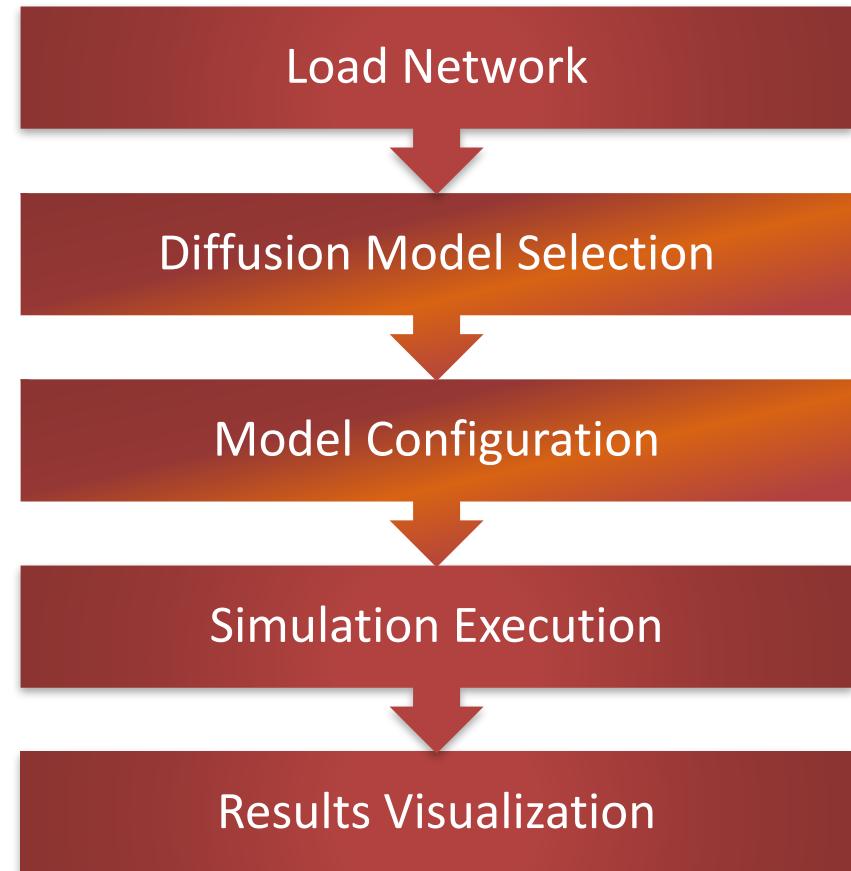
NDlib provide a common workflow to both programmers and analysts:

Programmers:

- Unified interface for several diffusion model
- Results Visualization facilities
- I/O standardization
- Extensibility

Analysts:

- Visual (web-based) platform
- Experiment configuration/execution
- Analytics as-a-service





Programmer: SIR Code Example

A simple, unified, interface:

- Load the Graph
- Select and configure the model
- Run the simulation

All models follow the same programmatic pattern and produce standardized results

```
import networkx as nx
import ndlib.models.ModelConfig as mc
import ndlib.models.epidemics.SIRModel as sir

# Network topology
g = nx.erdos_renyi_graph(1000, 0.1)

# Model selection
model = sir.SIRModel(g)

# Model Configuration
cfg = mc.Configuration()
cfg.add_model_parameter('beta', 0.01)
cfg.add_model_parameter('gamma', 0.005)
cfg.add_model_parameter("percentage_infected", 0.05)
model.set_initial_status(cfg)

# Simulation execution
iterations = model.iteration_bunch(200)
```



Programmer: Visual Analysis

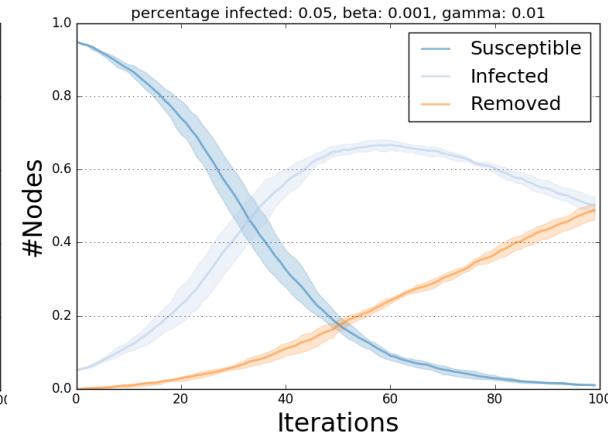
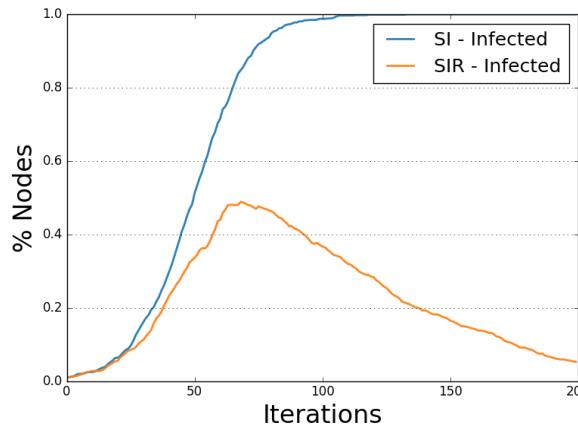
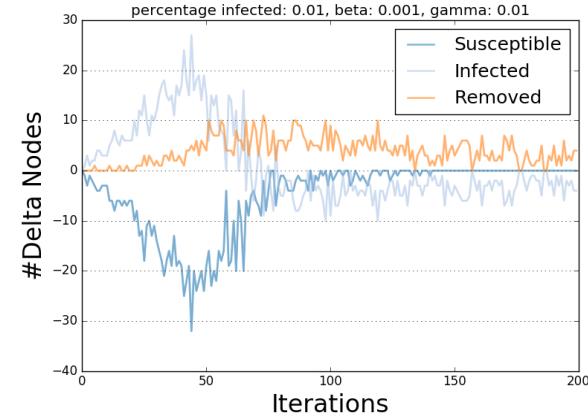
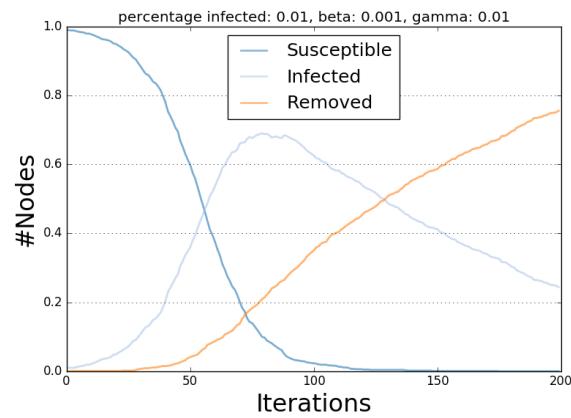
`ndlib.viz` implements
visualization facilities

Base Viz

- Diffusion Trends
- Prevelence

Advanced Viz

- Compare Models
- Multiple Run

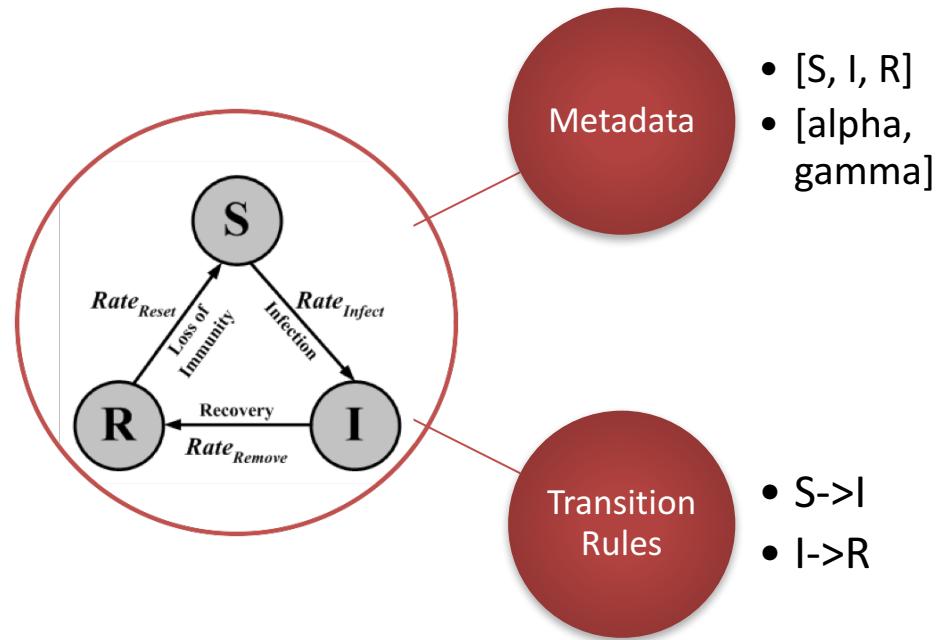




Programmer: Describe New Models

New models can be added to
NDlib easily:

1. Extend the base class
`ndlib.models.DiffusionModel`
2. Specify model **metadata**
(i.e., available status, required parameters)
3. Describe the **transition rules**
(i.e., under which circumstances a node becomes infected?)





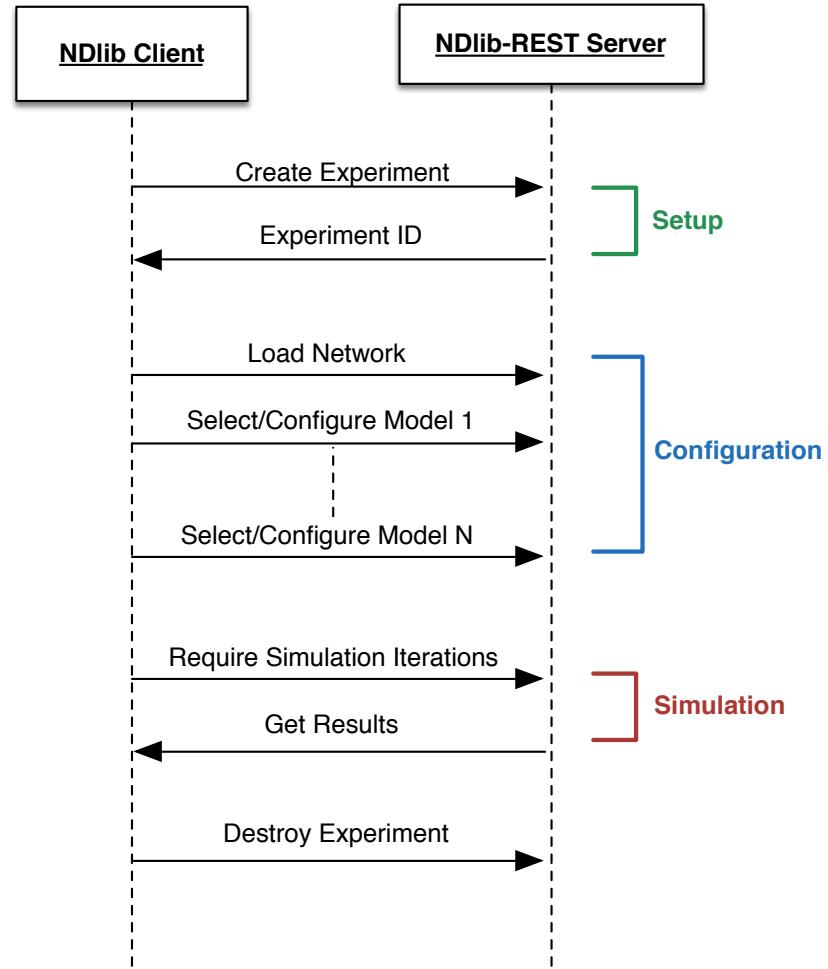
Programmer: Remote Experiments

NDlib offers a **remote experiment server** that, using a REST-full API, allows to:

- Create Ndlib experiments
- Configure them
- Execute them remotely

NDlib-REST aims to:

1. Decouple experiment definition/execution
2. Increase scalability





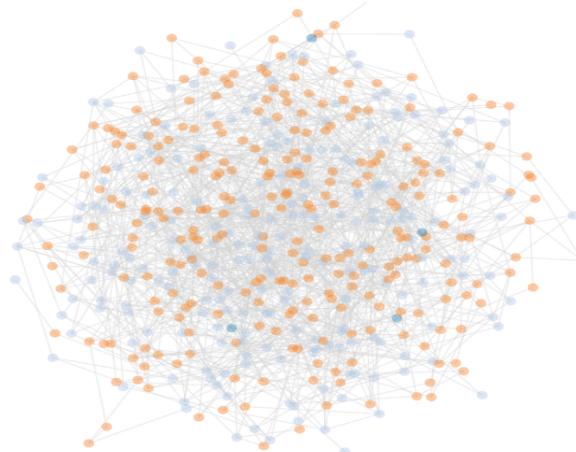
Network Diffusion Library

1. Network

nodes: 500

edges: 1247

Network Visualization



2. Models

SIR_0

SIR_1

Add model

3. Run iterations

Execute the model over the network

Which model(s) to use for the simulation?

All models

10 - +

Run Iterations

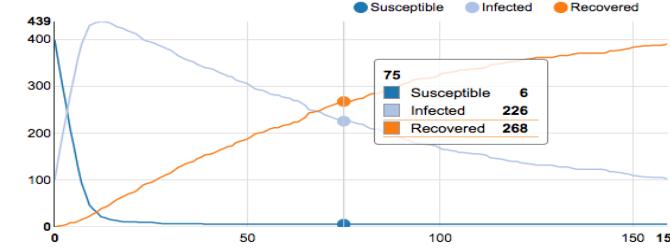
Model Statistics

Selected Model: SIR_0

beta: 0.1

gamma: 0.01

percentage_infected_nodes: 0.2



Analyst: Visual Simulation



Present and Future

Dynamic Network Topologies

What happens when diffusive phenomena occur on top of a **Temporal Network?**



Integration

CIMPLEX (H2020)

“One tool to rule them all...”
Gleam, NDlib... all under a same umbrella!

SoBigData (H2020)

NDlib-REST as-a-service!



Models, Visualizations, Evaluation...

Join us! Implement your model within Ndlib, propose new features





When:

Righ now, [NDlib v3.0.1](#) is out!

Where:

- PyPi: <https://pypi.python.org/pypi/ndlib>
- GitHub NDlib: <https://github.com/GiulioRossetti/ndlib>
- GitHub NDlib-REST: <https://github.com/GiulioRossetti/ndlib-rest>
- Documentation: <http://ndlib.readthedocs.io/>
- SoBigData: <http://www.sobigdata.eu>





For further information,
collaborations,
suggestions...

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