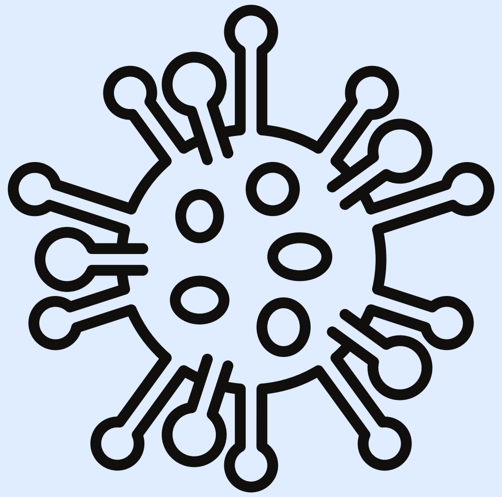
CALDAS Louis

MULTI-AGENT SYSTEMS

Individual project

Epidemic analysis



AI961 – SELF-ORGANISING MULTI-AGENT SYSTEMS

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PROJECT OBJECTIVE

Model the spread of an epidemic by including parameters to fight against its propagation.

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Model the spread of an epidemic by including parameters to fight against its propagation.

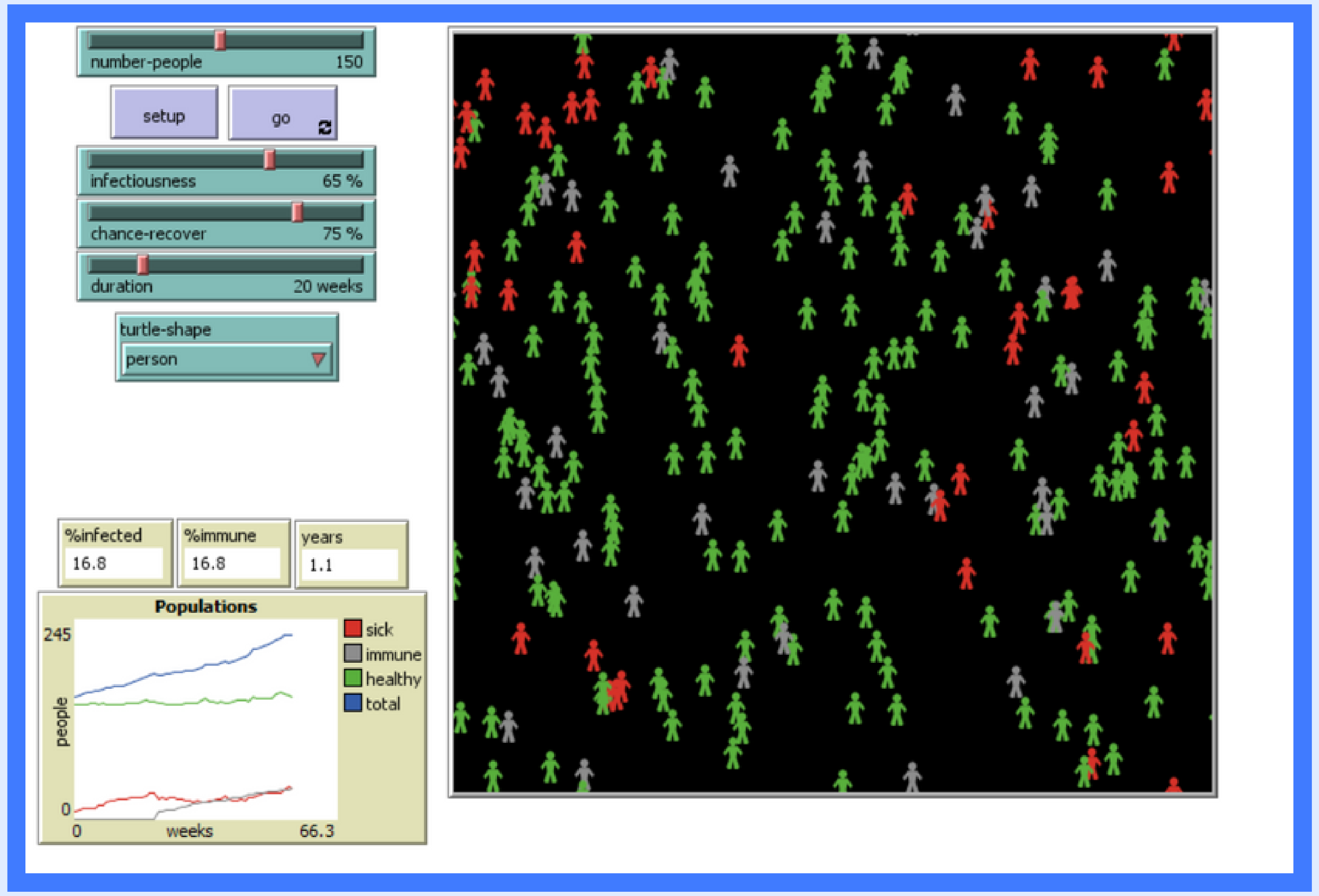
Measures to consider

- Social Distancing/Barrier gestures
- Face Covers
- Restrictions of movements
- Lockdown

PROJECT OBJECTIVE

Model the spread of an epidemic by including parameters to fight against its propagation.

Inspired by



Wilensky, U. (1998). NetLogo Virus model. http://ccl.northwestern.edu/netlogo/models/Virus

MULTI-AGENT SYSTEM

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- **Agent = Individual**
  - → sick [bool]
  - → sick duration [int]
  - → immune [bool]
  - → barrier gesture [bool]
  - → initial patch [patch]
- Each agent moves randomly
- If an agent is sick he can infect his close neighbors (with the probability of infectiousness variable)
  - → if agents respect barrier gestures : infectiousness decreases of 50%
  - → if agents wear mask : infectiousness decreases of 70%

https://www.santemagazine.fr/sante/maladies/maladies-infectieuses/maladies-virales/tout-savoir-sur-les-masques-de-protection-contre-le-coronavirus-433485

MULTI-AGENT SYSTEM

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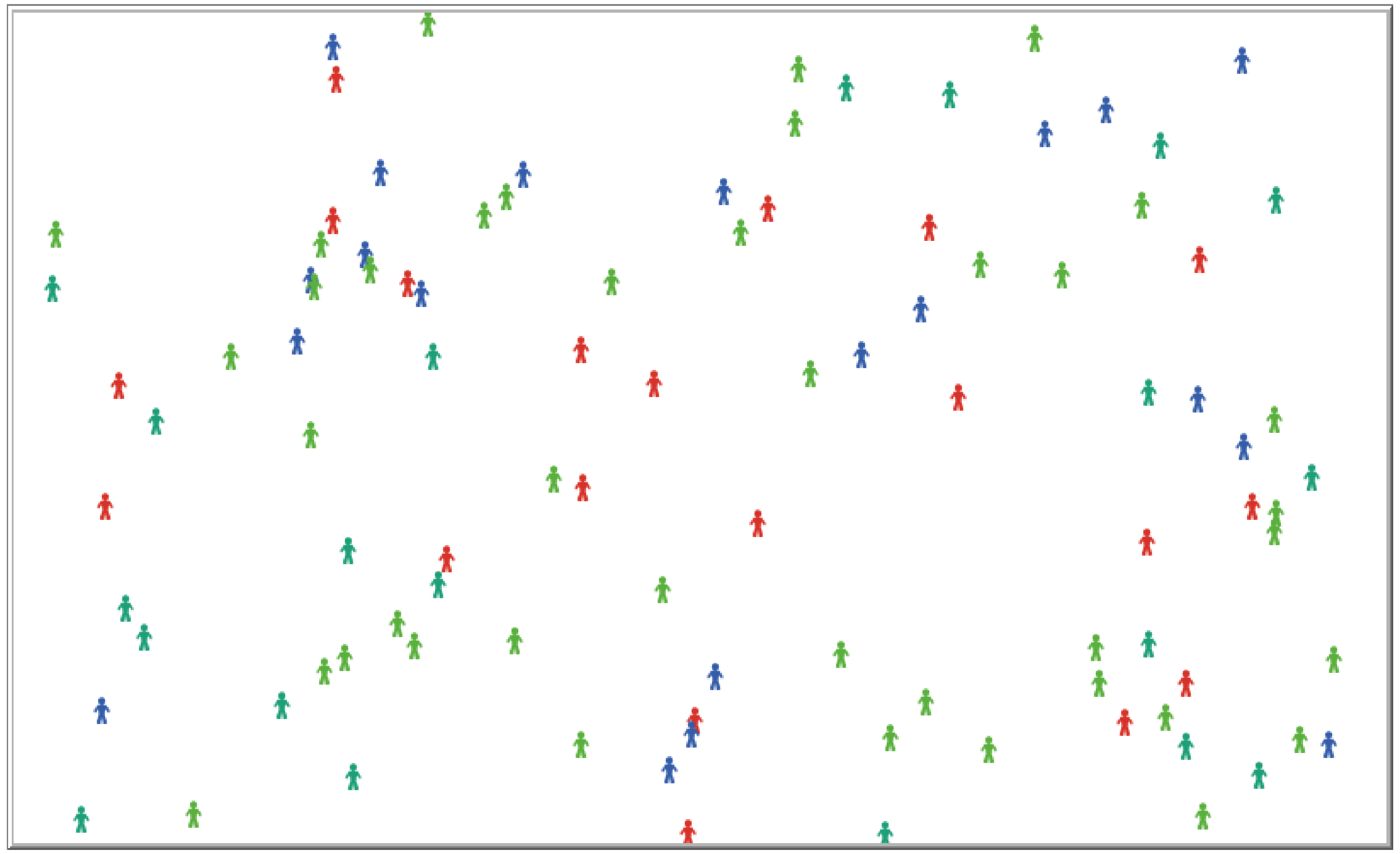
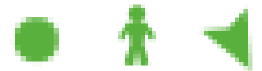
- <u>System properties = Virus properties</u>



→ Population size / Turtle shape 

→ Percentage of sick/immunized individuals

→ Lifespan of the virus

→ Percentage of recovery (otherwise die)

→ Infectiousness

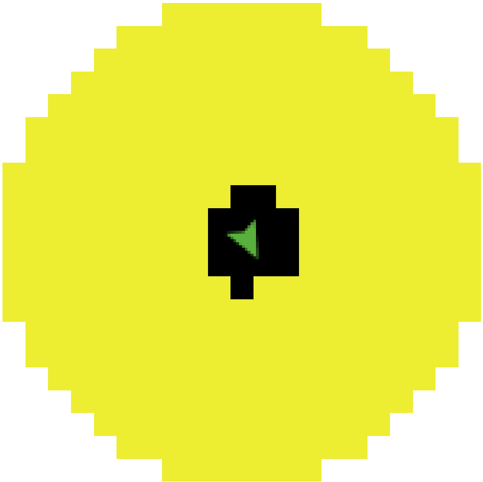
→ Directivity of infectiousness

→ Radius of infection

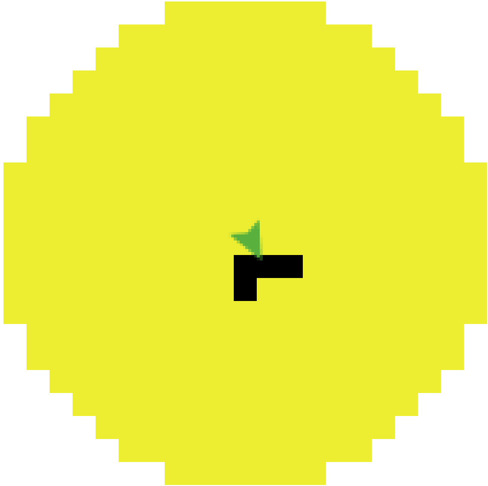
→ Percentage of respect of barrier gestures

→ Wearing a mask or not

→ Radius of deplacement & lockdown



360°



90°

ℹ Lockdown = Only 10% of the individual move at each tick

MULTI-AGENT SYSTEM

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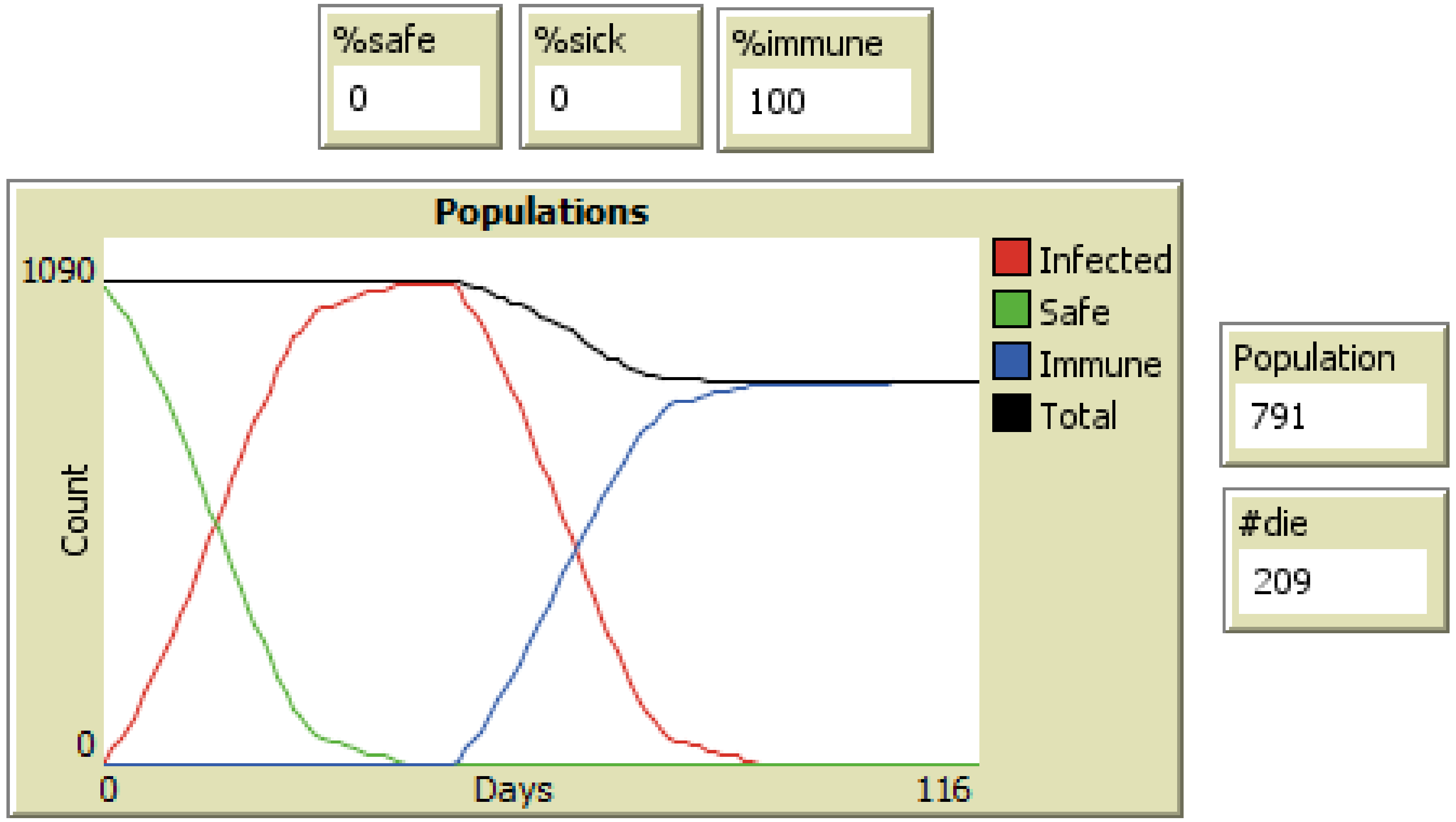
User interface : Plot

→ Number of sick/immune/safe people

→ Number of die



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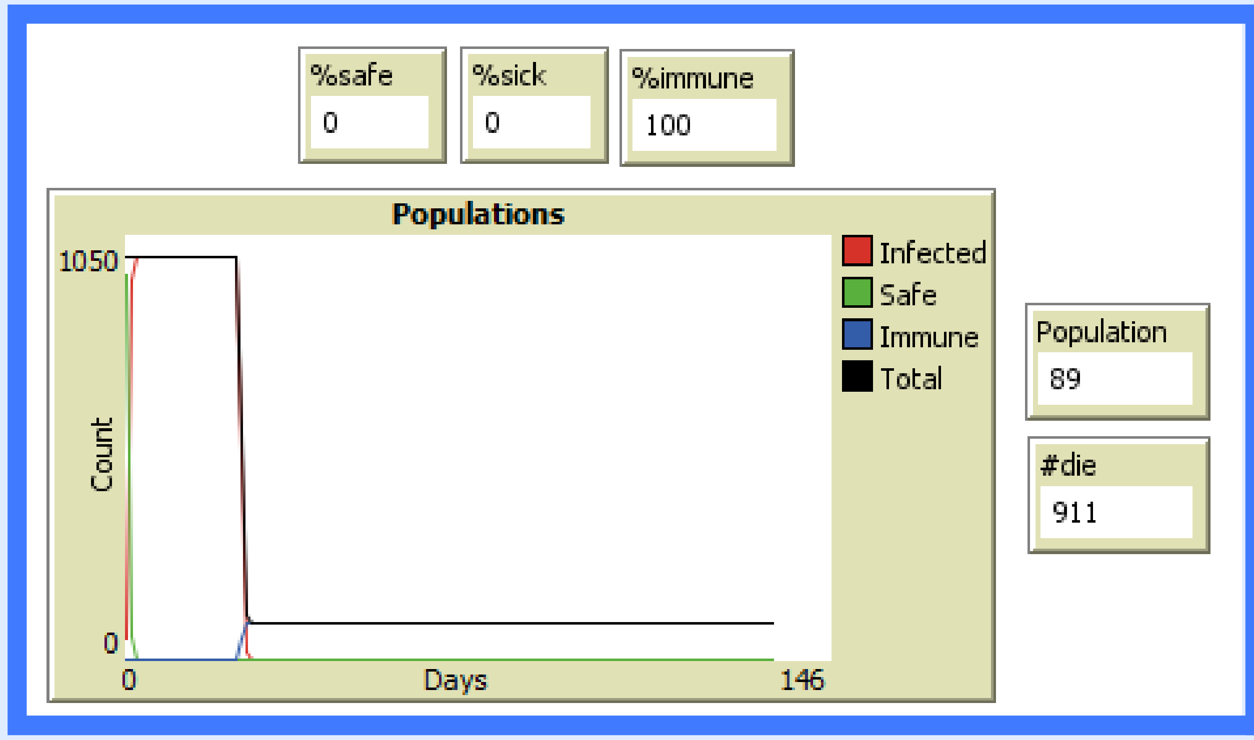
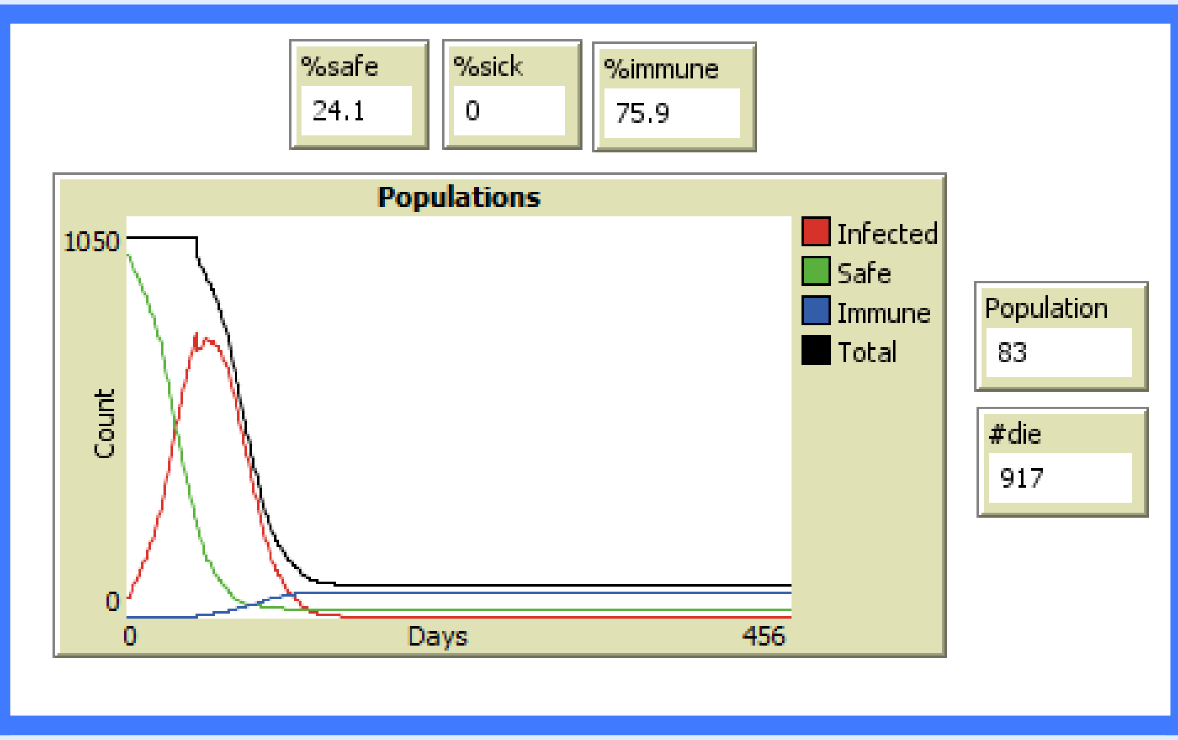
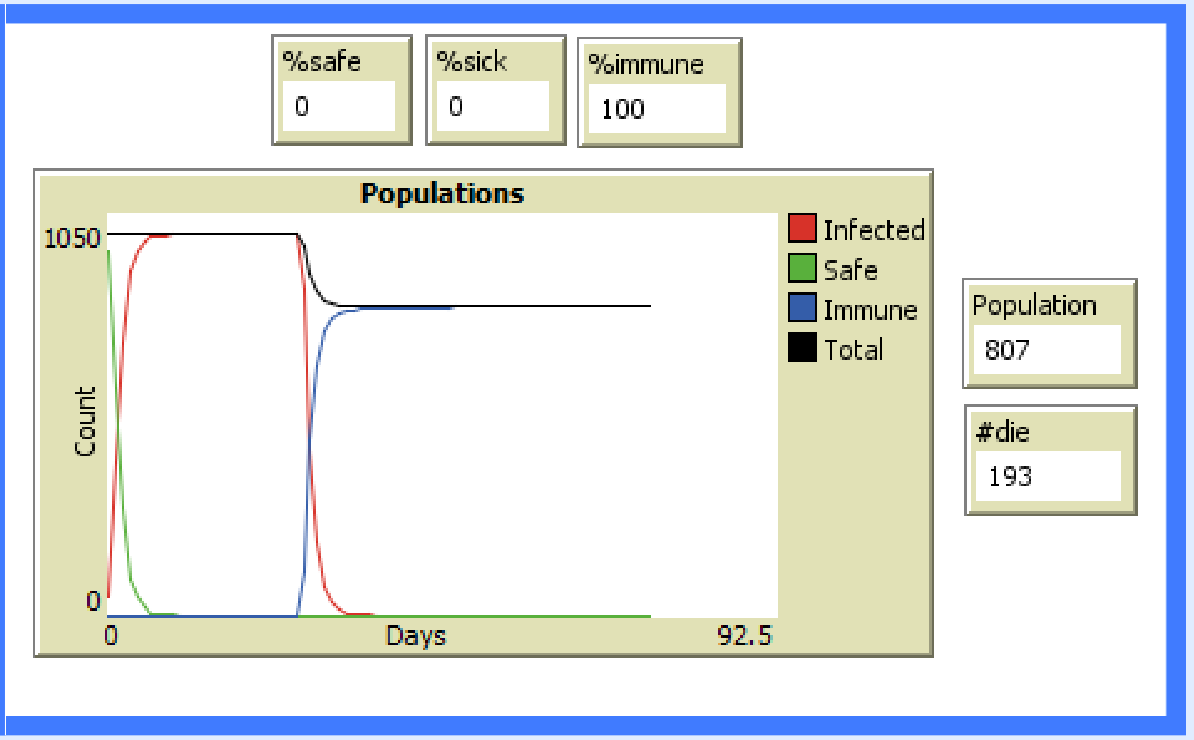
SIMULATIONS

EXAMPLE OF DIFFERENT VIRUS "TYPE" (WITHOUT PROTECTIVE MEASURES)

Initial condition : 1000 individuals - 50 sicks - 0 Immune







Ebola virus

- Low recovery percentage
- High infectiousness
- Very short lifespan
- Low range of infectiousness

HIV virus

- Extremely low recovery rate
- Extremely low infectiousness
- Very long lifespan
- Low range of infectiousness

Covid19 virus

- Extremely high recovery rate
- Extremely high infectiousness
- Medium lifespan
- High range of infectiousness

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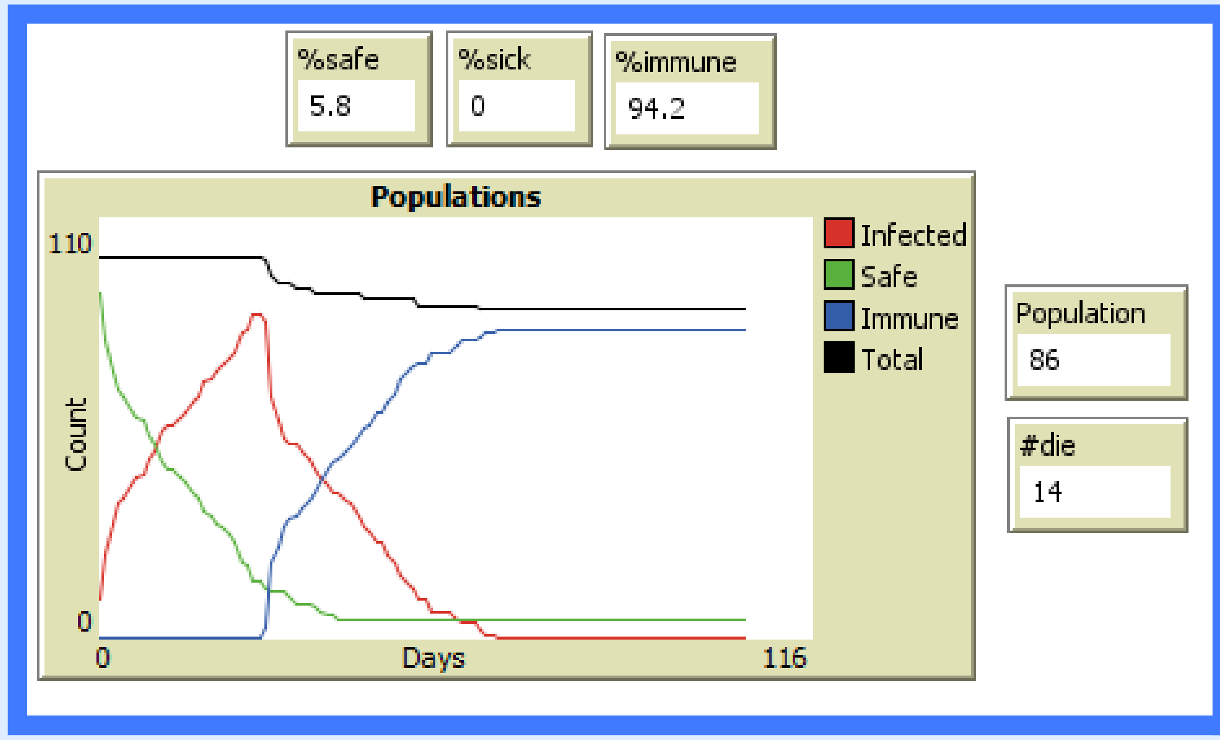
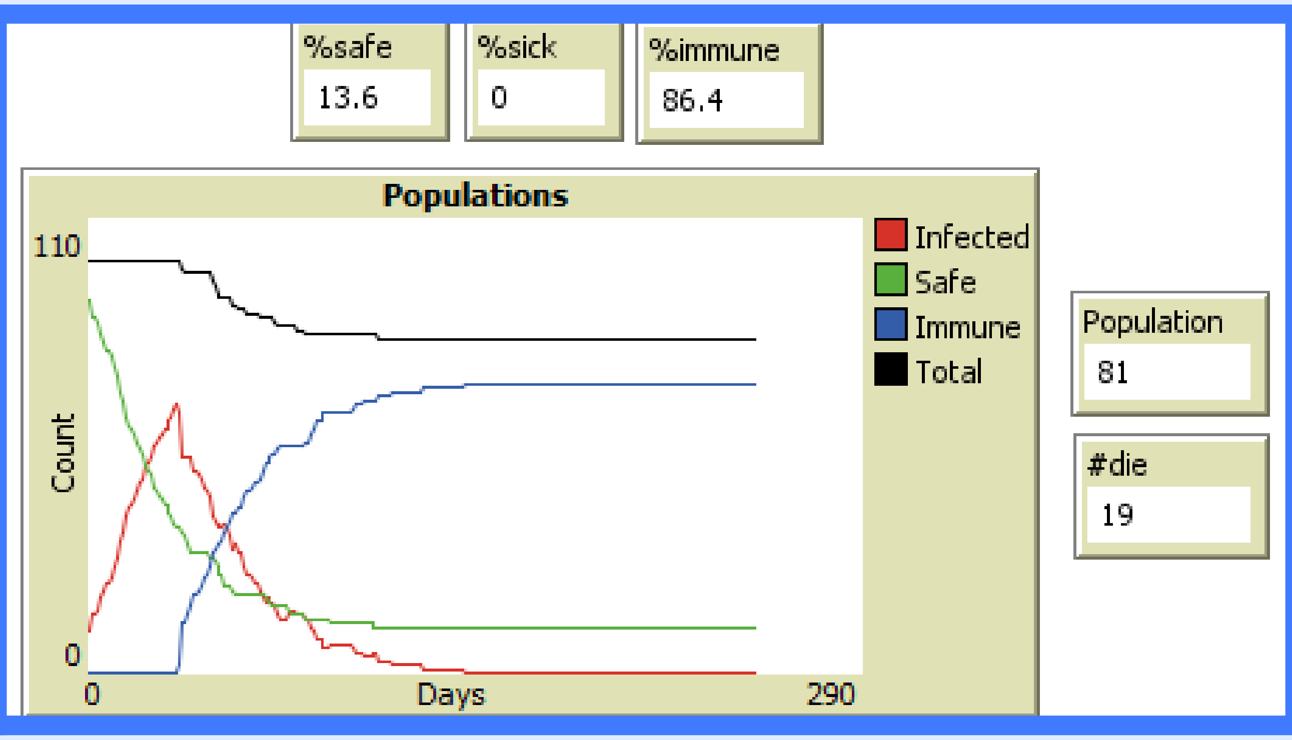
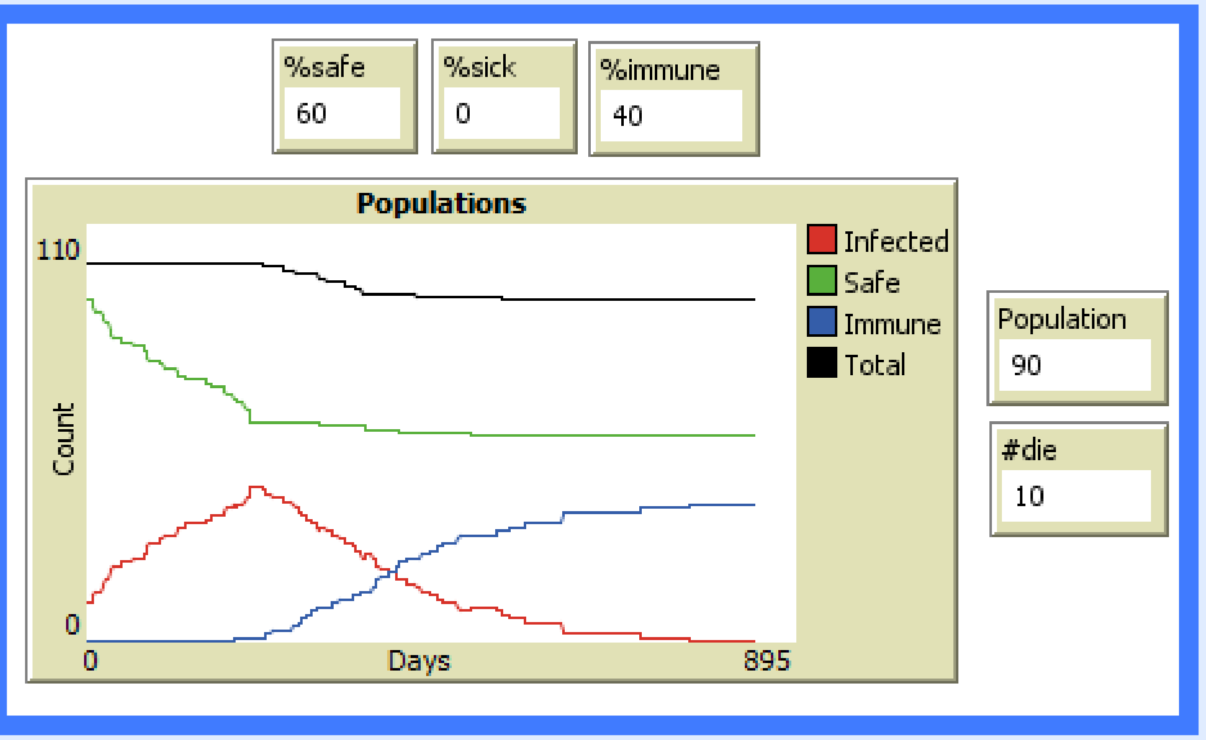
SIMULATIONS

EXAMPLE OF SPREAD OF COVID 19 WITH THE IMPACT OF PROTECTIVE MEASURES

Initial condition : 50 individuals - 5 sick - 0 Immune - High radius of infection







Without measures

- Nightclub
- Family gathering

With barrier gestures & mask

- School
- Shop

With barrier gestures, mask & lockdown

- Lockdown
- Curfew

We smooth the curve!

DEMONSTRATION

CONCLUSIONS

RESULTS

- Lockdown: the most effective measure
- Importance of measures even more indoor

A virus is something complicated to model, there are still a lot of parameters that we do not deal with.

- Taking into account the time of exposure to the virus
- Take into account the age of individuals and adapt the effects of the virus according to their age.

CONCLUSIONS

RESULTS

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A virus is something complicated to model, there are still a lot of parameters that we do not deal with.

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Questions ?