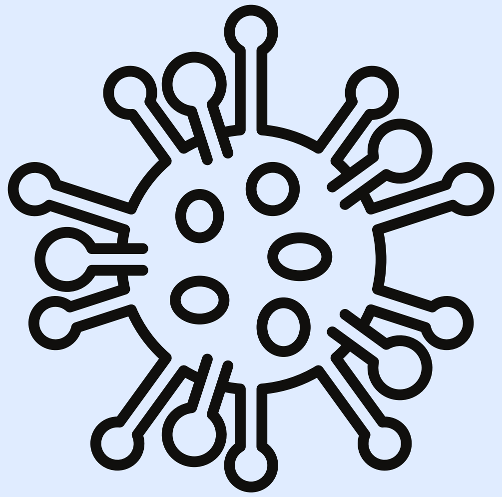
CALDAS Louis

MULTI-AGENT SYSTEMS

Individual project

Epidemic analysis



AI961 – SELF-ORGANISING MULTI-AGENT SYSTEMS

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PROJECT OBJECTIVE

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

PROJECT OBJECTIVE

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

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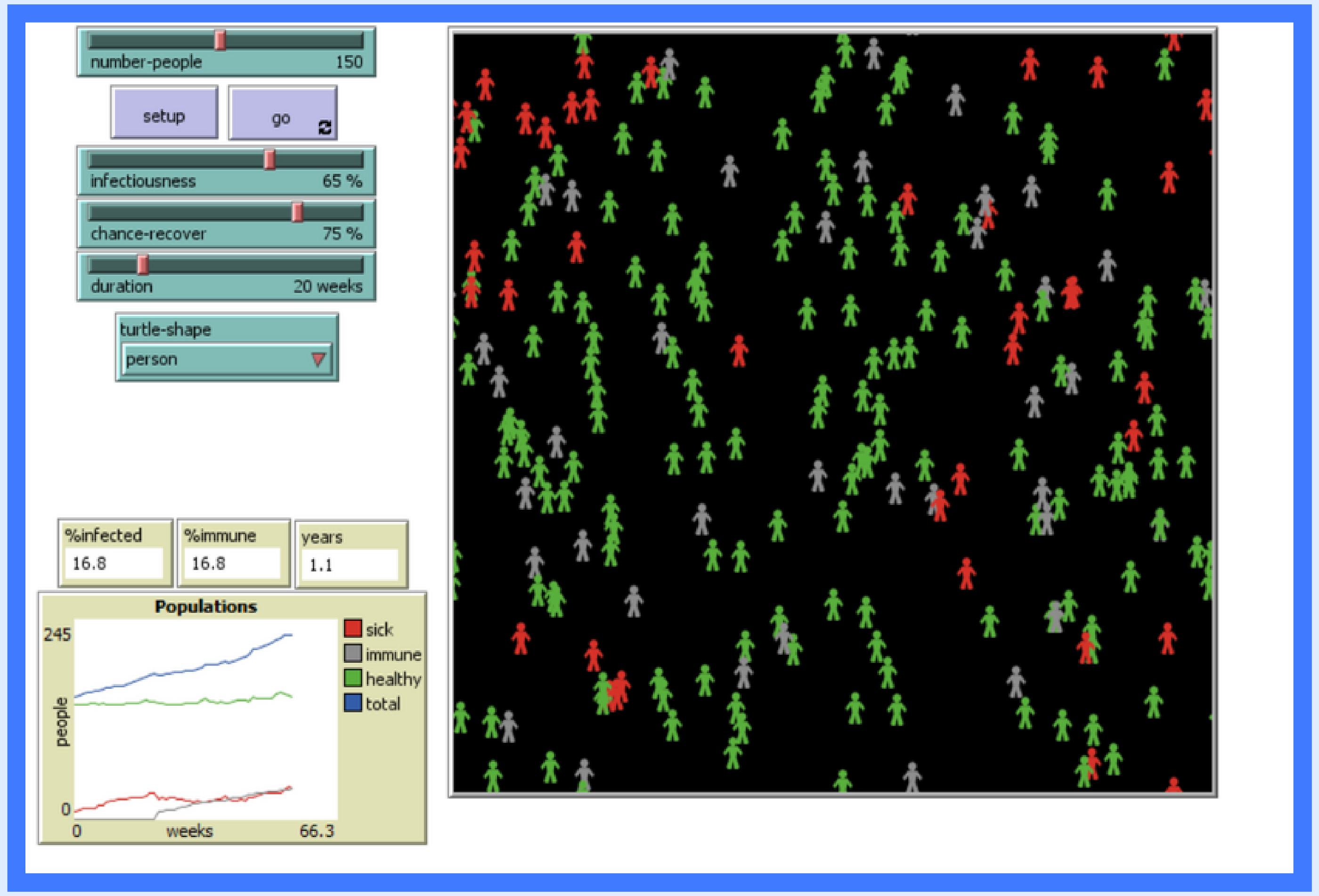
PROJECT OBJECTIVE

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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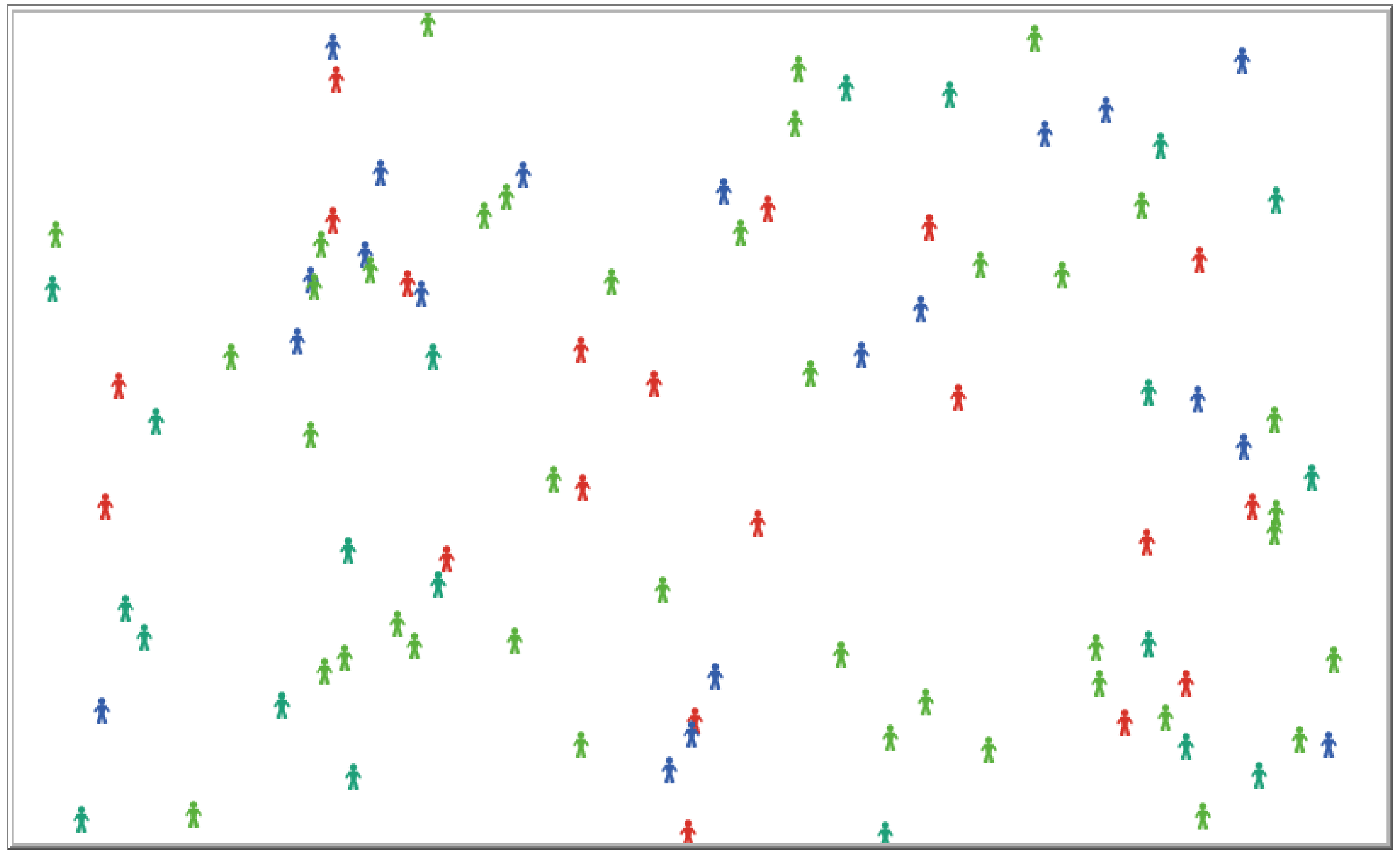
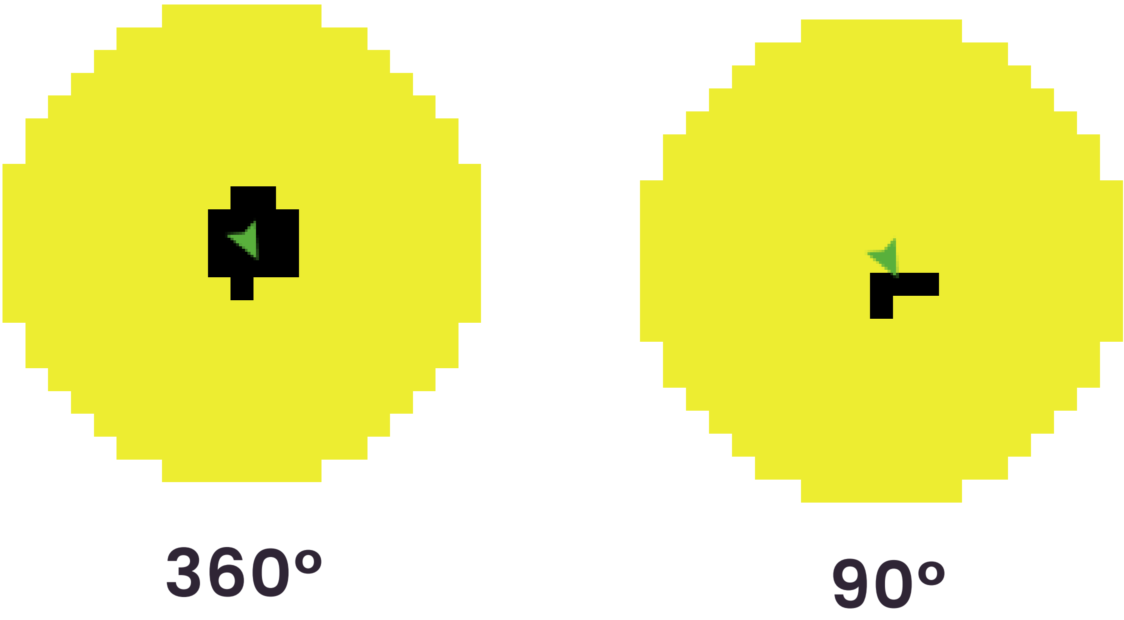
- <u>Agent = Individual</u>
  - → sick [bool]
  - → sick duration [int]
  - → immune [bool]
  - → barrier gesture [bool]
  - → initial patch [patch]
- Each agent moves randomly
- If an agent is sick he can infect his close neighbors (with the probability of infectiousness variable)
  - → if agents respect 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

System properties = Virus properties





- 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

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

MULTI-AGENT SYSTEM

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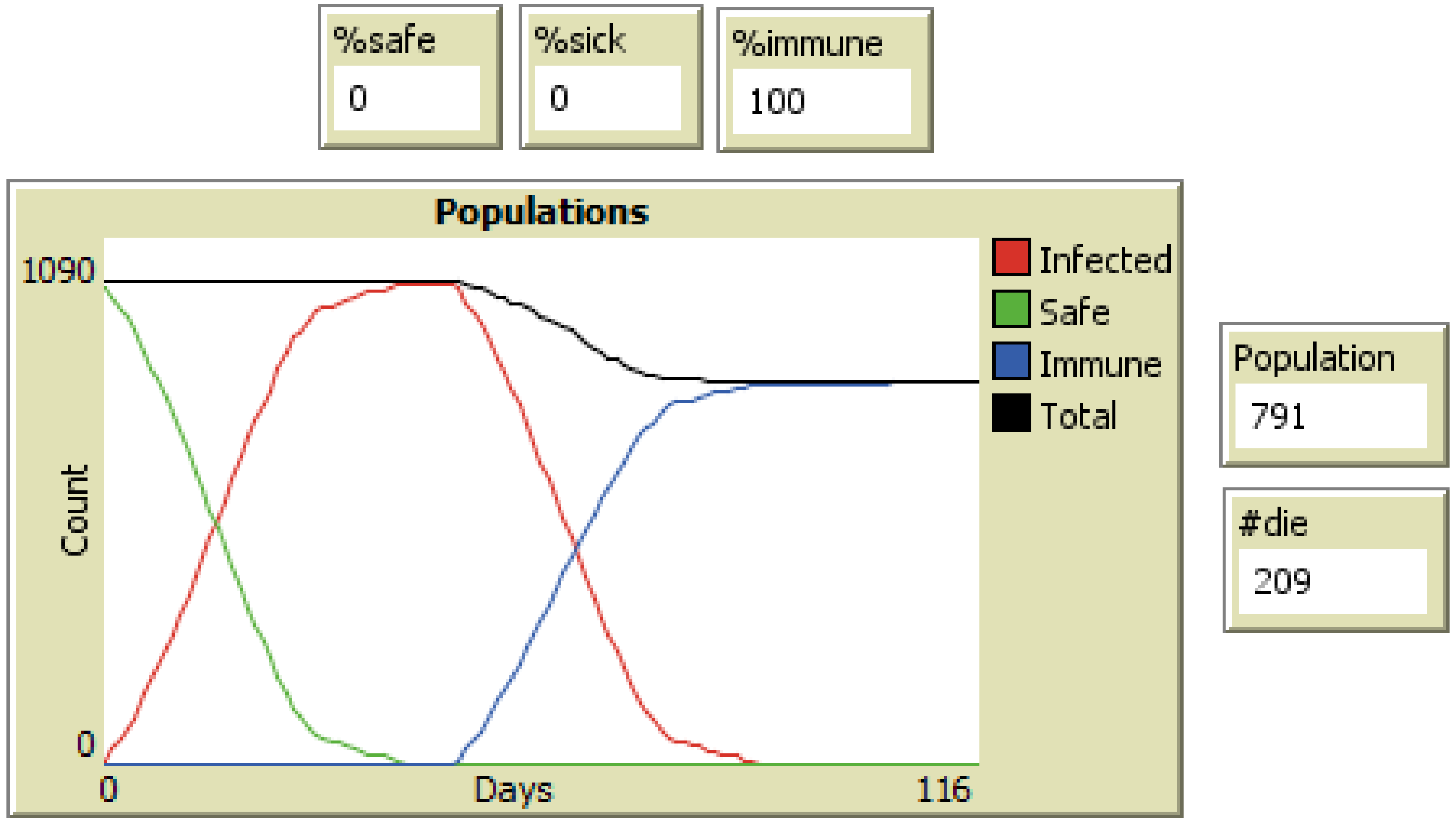
- <u>User interface : Plot</u>

→ Number of sick/immune/safe people

→ Number of die



SIMULATIONS

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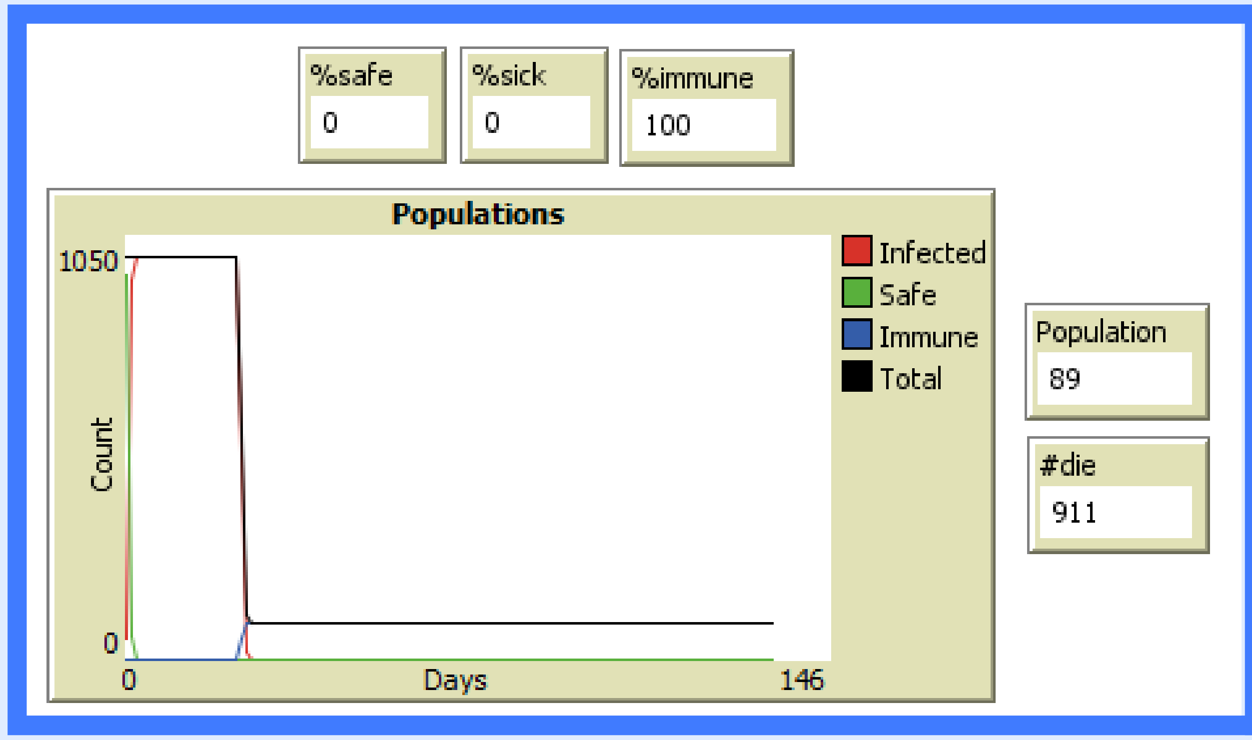
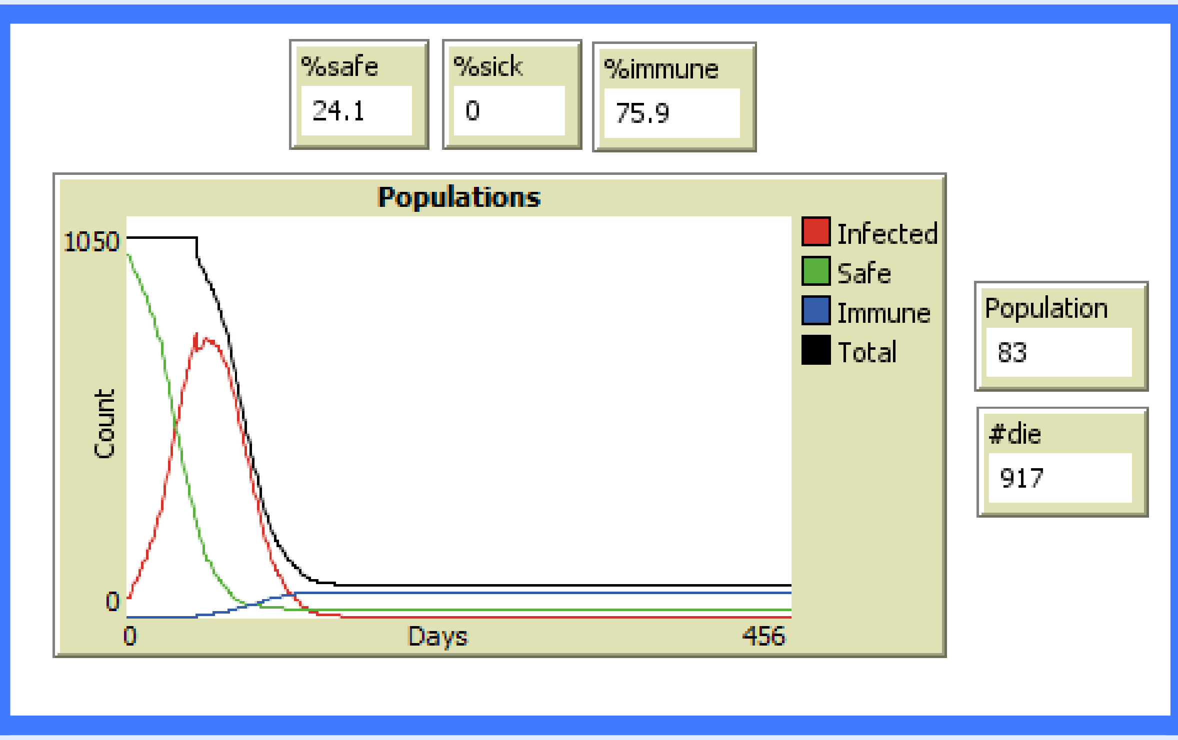
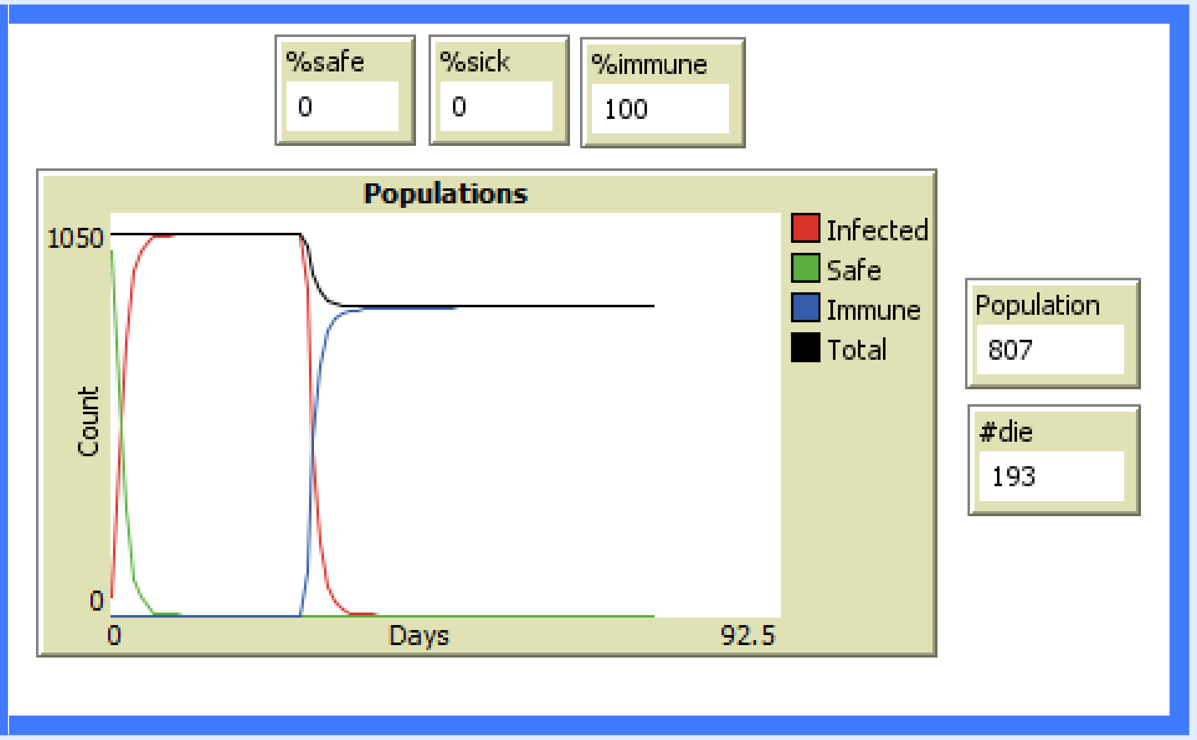
EXAMPLE OF DIFFERENT VIRUS "TYPE" (WITHOUT PROTECTIVE MEASURES)

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

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

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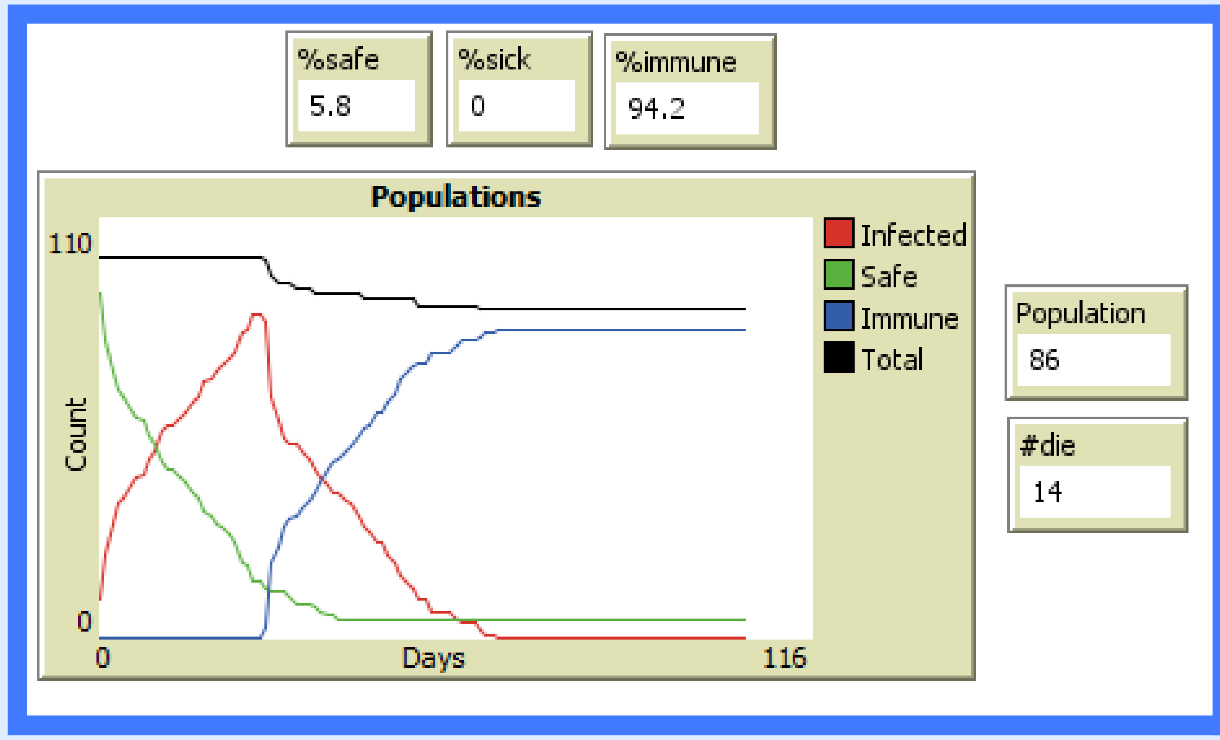

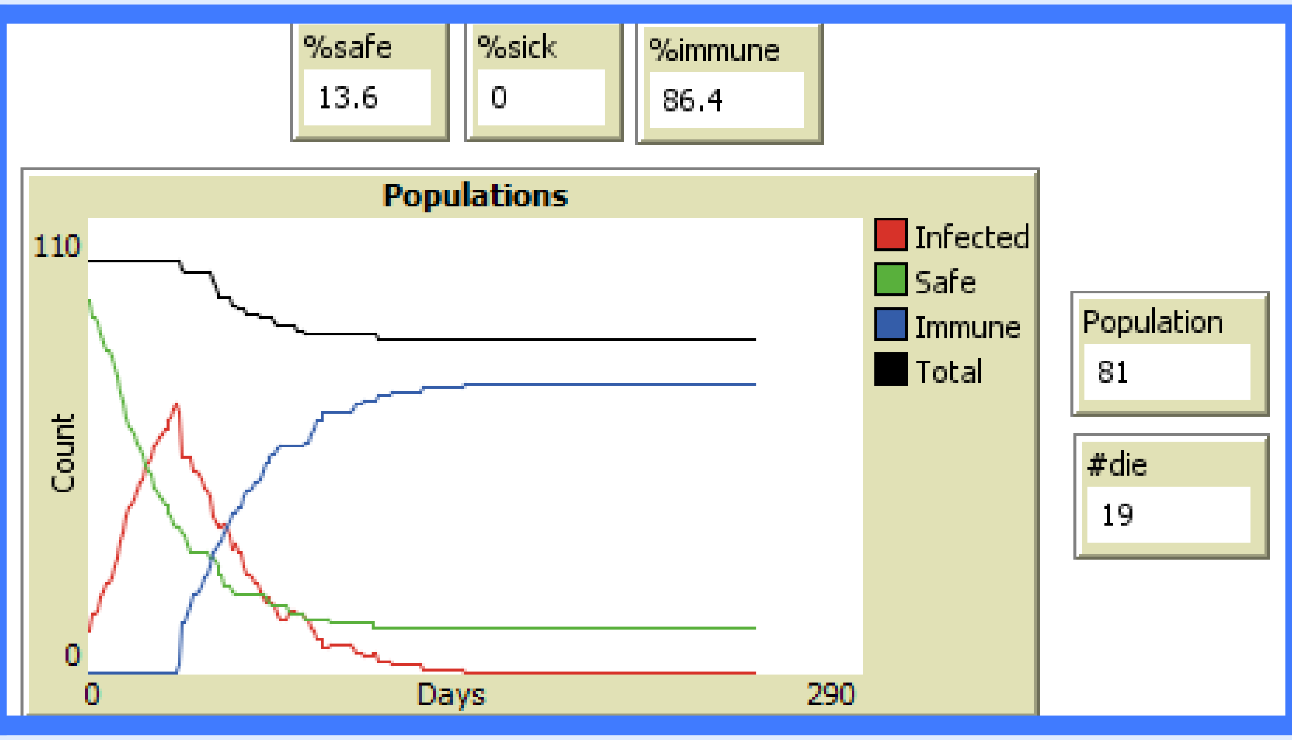

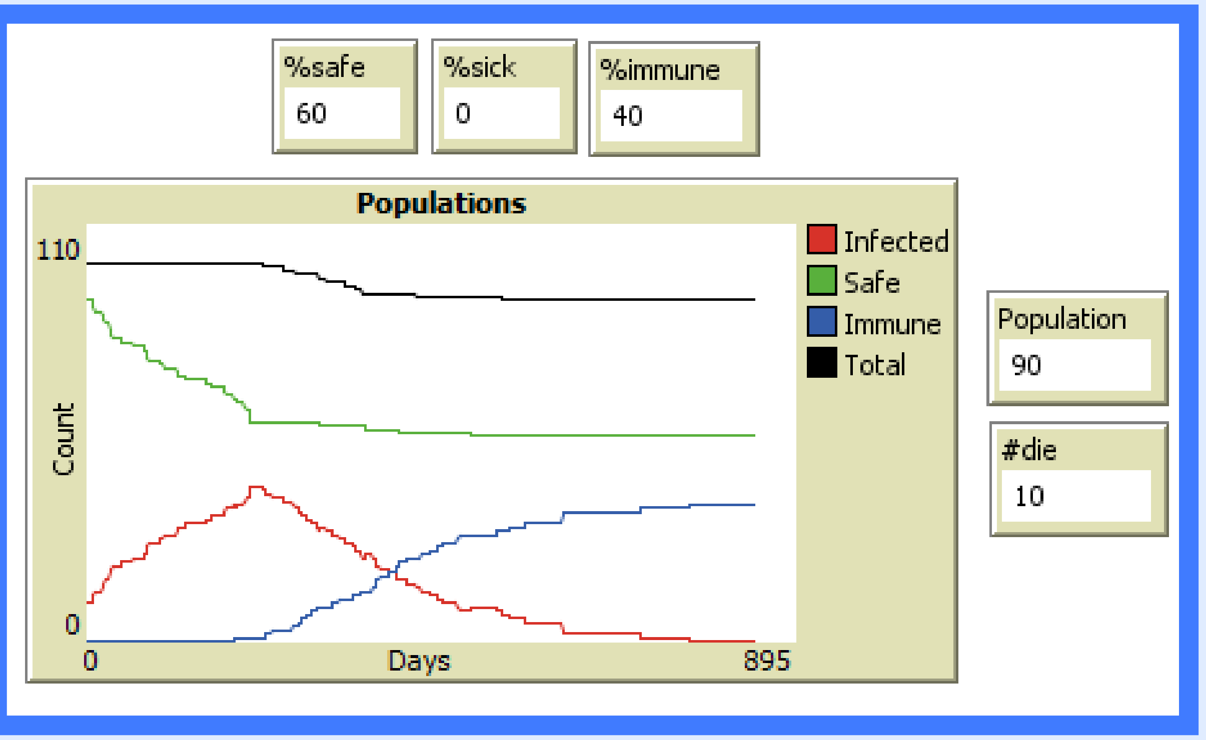

Without measures

- Nightclub
- Family gathering

With barrier gestures & mask

- School
- Shop

With barrier gestures, mask & lockdown

- Lockdown
- Curfew

We smooth the curve!

DEMONSTRATION

CONCLUSIONS

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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

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RESULTS

- Lockdown: the most effective measure
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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 ?