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# Context

- Mr Rainbow died before he could access the hospital, stuck in the traffic jam
- He donated all his fortune to improve the transport in his city (just in time !)
- We were in charge of finding a model to build solutions to avoid those kinds of tragedies



Figure 1.1 : Mr Rainbow right before his heart attack

## Research question

How could we build a model to help Mr Rainbow and all the inhabitants of Too-Loose city to have less congestion?



## Objectives

- Build the road network of the city
- Make individuals choose a mode of transport according to their destination
- Make individuals move on the network according to their schedule
- Visualize different solutions for transport network



Figure 1.2 : Decision process

# Existing Networks

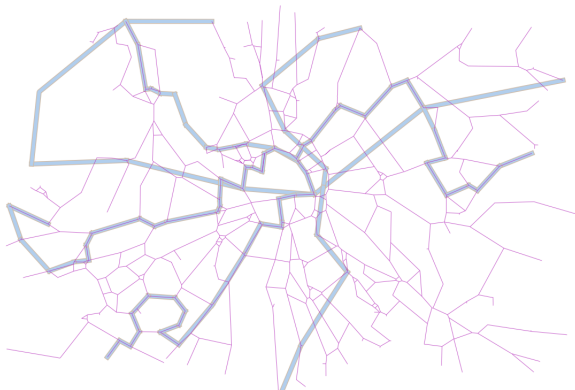


Figure 2.1 : Roads and public transport network

# Alternative Networks

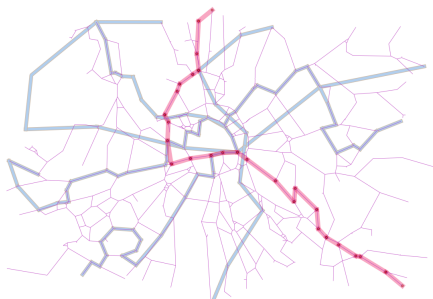


Figure 2.2 : New bus line

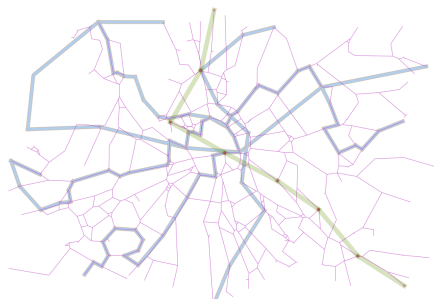


Figure 2.3 : New tramway line

# Agents Creation

- 3 kinds of agents
  - students (turtles)
  - workers (sheeps)
  - inactives (fish)
- Some of them own cars
  - 10% of students
  - 70% of workers
  - 20% of inactives



Figure 2.4 : Agents



## Agents Creation

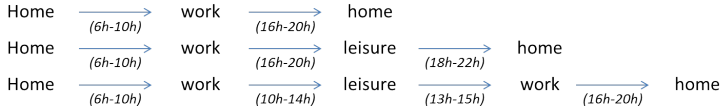
- Agents are dispatched on the map according to residential areas
- Cars are distributed by the same means taking into account where agents live



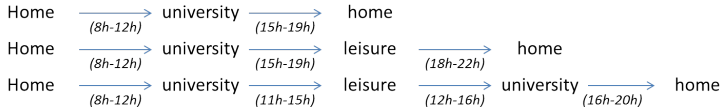
Figure 2.5 : Cars distribution and density in city (the lighter, the less)

## Agents Schedule

**WORKER**



## STUDENT



**INACTIVE**

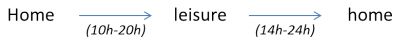
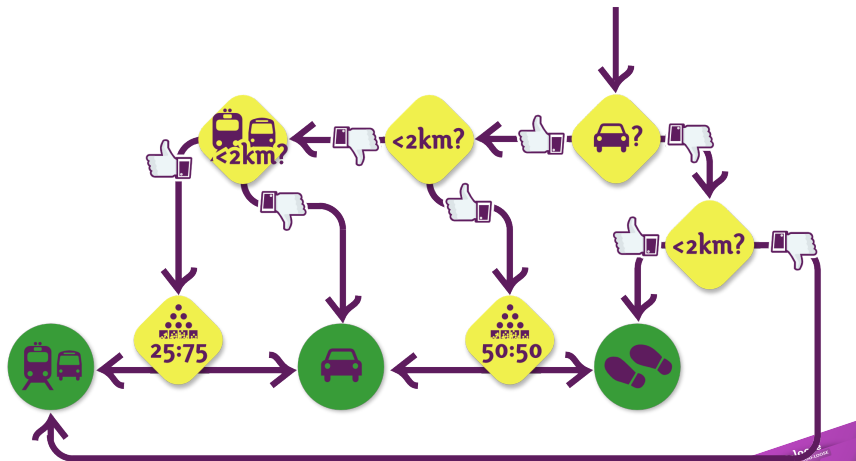


Figure 2.6 : Schedules according to the agents activity

# Agents Decision Process



## Agents Displacement

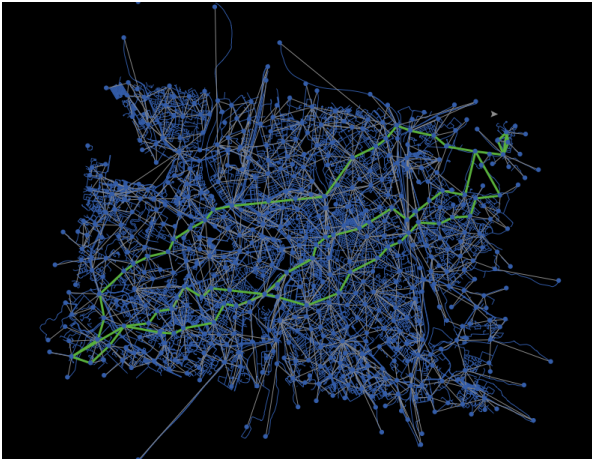


Figure 2.8 : The 3 possible paths known by agents

# Evaluating the model and comparing several configurations

## Simple indicators

- Congestion rate per edge
- Travel time of agents
- Share of agents using public transportations

## Graph based indicator

Study the correlation between congestion and betweenness edge centrality

## District indicators

K-means to split the city in several districts

- Average congestion per cluster
- Standard deviation of congestion between clusters

⇒ Study the traffic balance between districts

## Graph based indicator

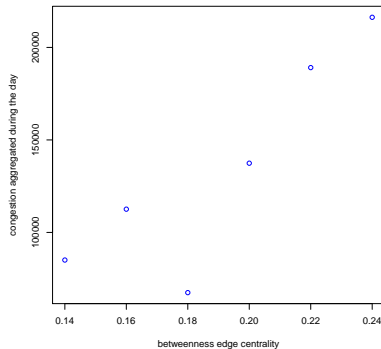


Figure 3.1 : Correlation between congestion and centrality betweenness

# Results : Demonstration

See netlogo file.

# Sensitivity analysis : Demonstration

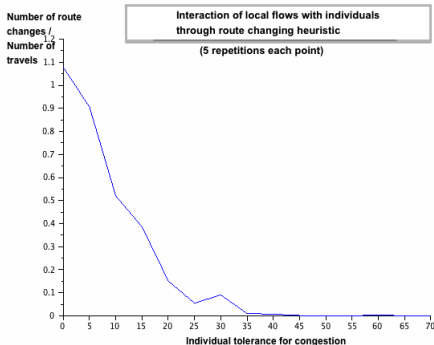


Figure 4.1 : Number of route changes according to individual tolerance to congestion



# Sensitivity analysis : Demonstration

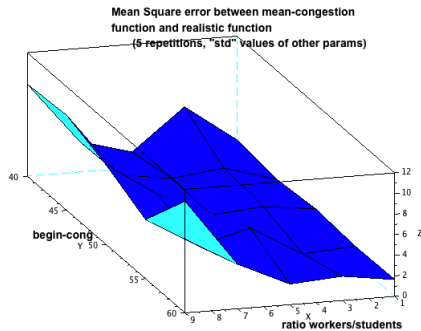


Figure 4.2 : Preliminary work for calibration

# Influence of ratio between workers and students

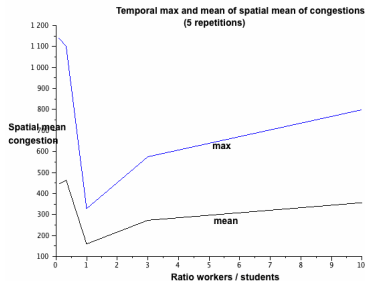


Figure 4.3 : Congestions day

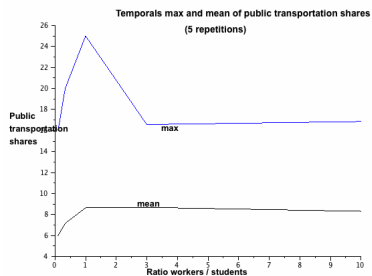


Figure 4.4 : Transportation shares

# Answer to the research question

Over-all congestion rate

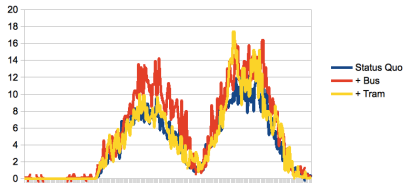


Figure 4.5 : Congestion

Difference in the over-all congestion rate

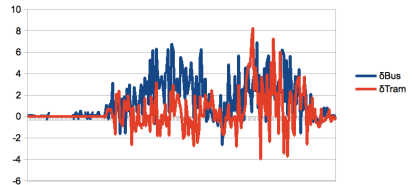


Figure 4.6 : Change in congestion

# Answer to the research question

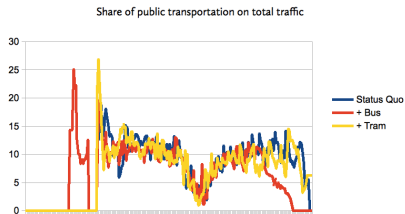


Figure 4.7 : Public transportation share

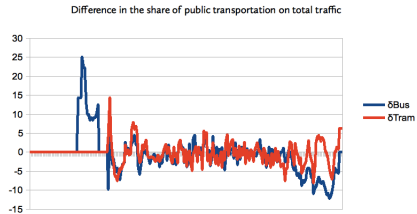


Figure 4.8 : Change in public transportation share

# Conclusion

- Mr Rainbow didn't die for nothing
- It has been a learning process for us !

Introduce bus :

- Increases public transport share in morning rush hour
- Reduces users in evening (!)
- Increases congestion (!)

Introduce tram :

- Fluctuations throughout the day with overall increase in congestion



Figure 5.1 :  
Confused  
Too-Loose's  
mayor

## What's next ?

- Finish debugging (!)
- Use the model to consider the impact of land use change on traffic congestion
- Consider impacts on air quality, noise, achieving environmental targets
- Deeper analysis is tram taking commuters from cars or those travelling on foot?

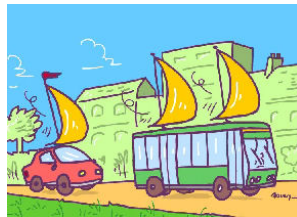


Figure 5.2 : Ideas of future

# Do you have questions ?

