TRAFFIC JUNCTION TUNER

AN EVOLUTIONARY SOLUTION FOR TRAFFIC JUNCTION OPTIMIZATION

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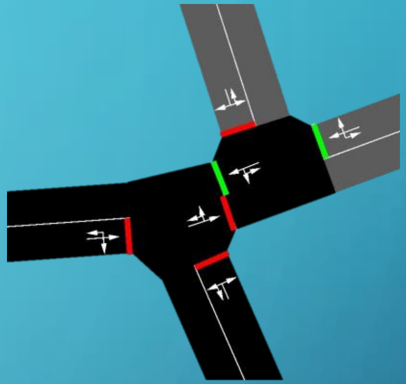
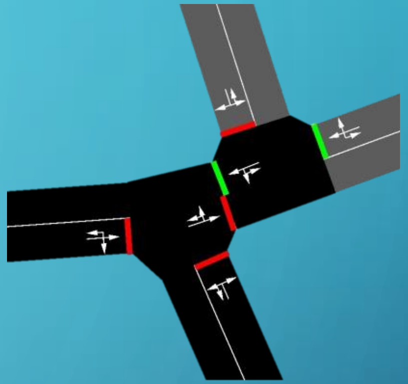
THE PROBLEM



- Crossroads have a big impact on traffic
- Traffic lights should be adjusted depending on traffic
- Both marked and traffic light controlled crossroads have pros and cons

HOW TO HANDLE THE PROBLEM



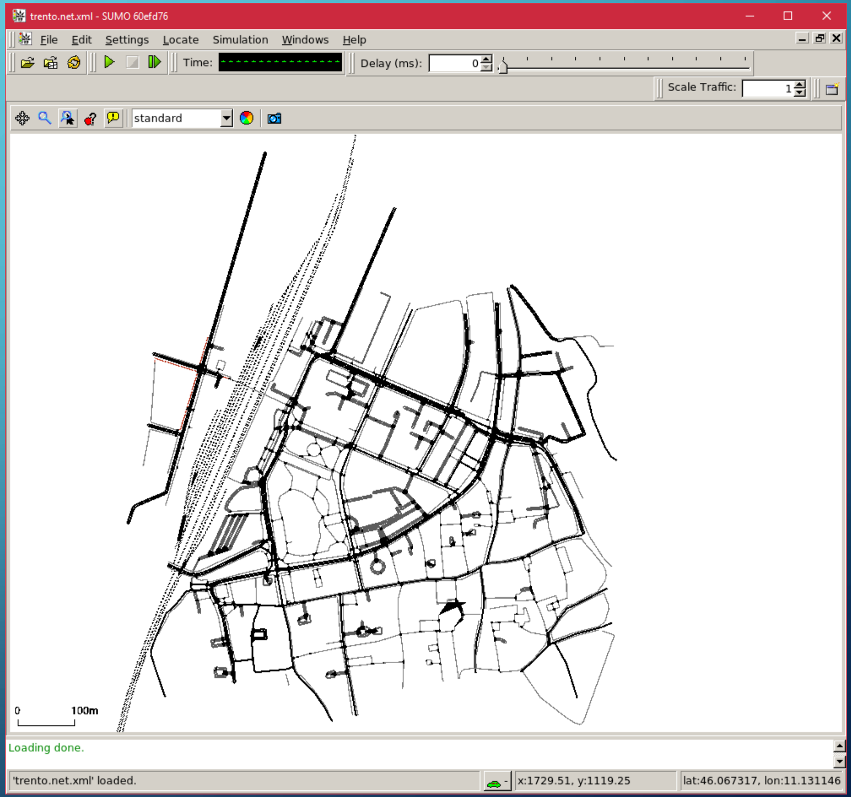
- Change crossroads types
- Fine tune traffic light timings
- Try out different combinations for a specific zone

Usually, local authorities apply changes to real roads in order to evaluate them:

EXPENSIVE AND TIME CONSUMING

SUMO: Simulation of Urban Mobility

- Open source road simulation framework
- Query system via TCP socket (TraCI interface)
  - TraCI python library
- Random route generation tool
- Editable xml map files
- Partial map of Trento city centre



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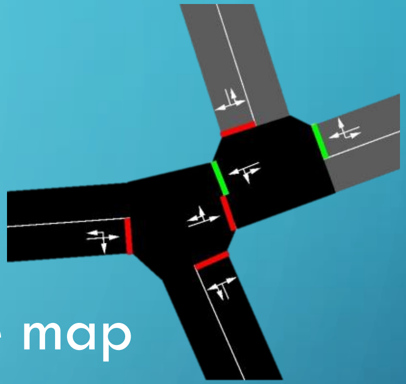
'trento.net.xml' loaded.

x:1729.51, y:1119.25

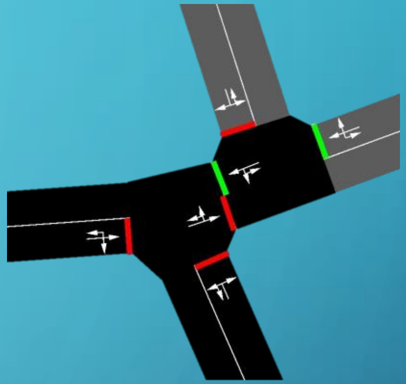
lat:46.067317, lon:11.131146

EVOLUTIONARY MODEL



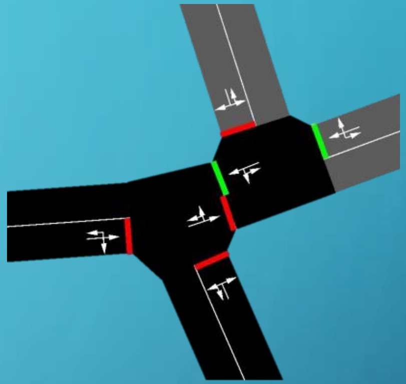
- Each individual is a setting combination for all crossroads in the map
    - Fixed genome
- Evolutionary Algorithm:
    - NSGA-II, Non dominating Sorting Algorithm
    - Multi objective

INSPYRED BENCHMARK DESIGN (1)



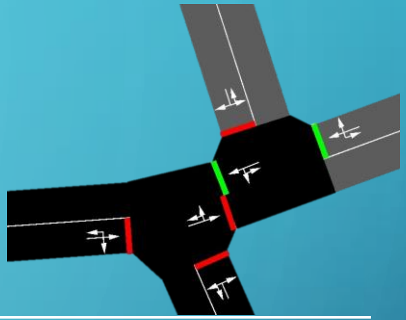
- Initialization
  - Random setting in the boundaries for each crossroad
- Evaluation
  - Generation of custom maps based on individuals of the population
  - Perform the simulation in Sumo, with data collection
  - Pareto front
- Boundaries
  - Customizable parameters for traffic lights timings limits

INSPYRED BENCHMARK DESIGN (2)



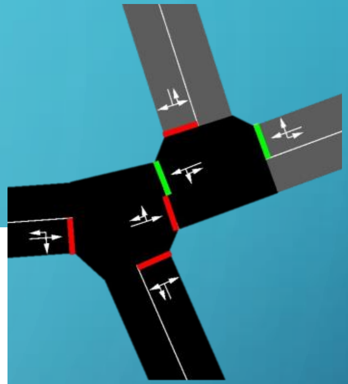
- Crossover
  - Random weighted average of traffic light timings
  - Random crossroad type between parents' types
- Mutation
  - Self adaptive uncorrelated mutation with one sigma
- Observer
  - Saves population to file for data analysis

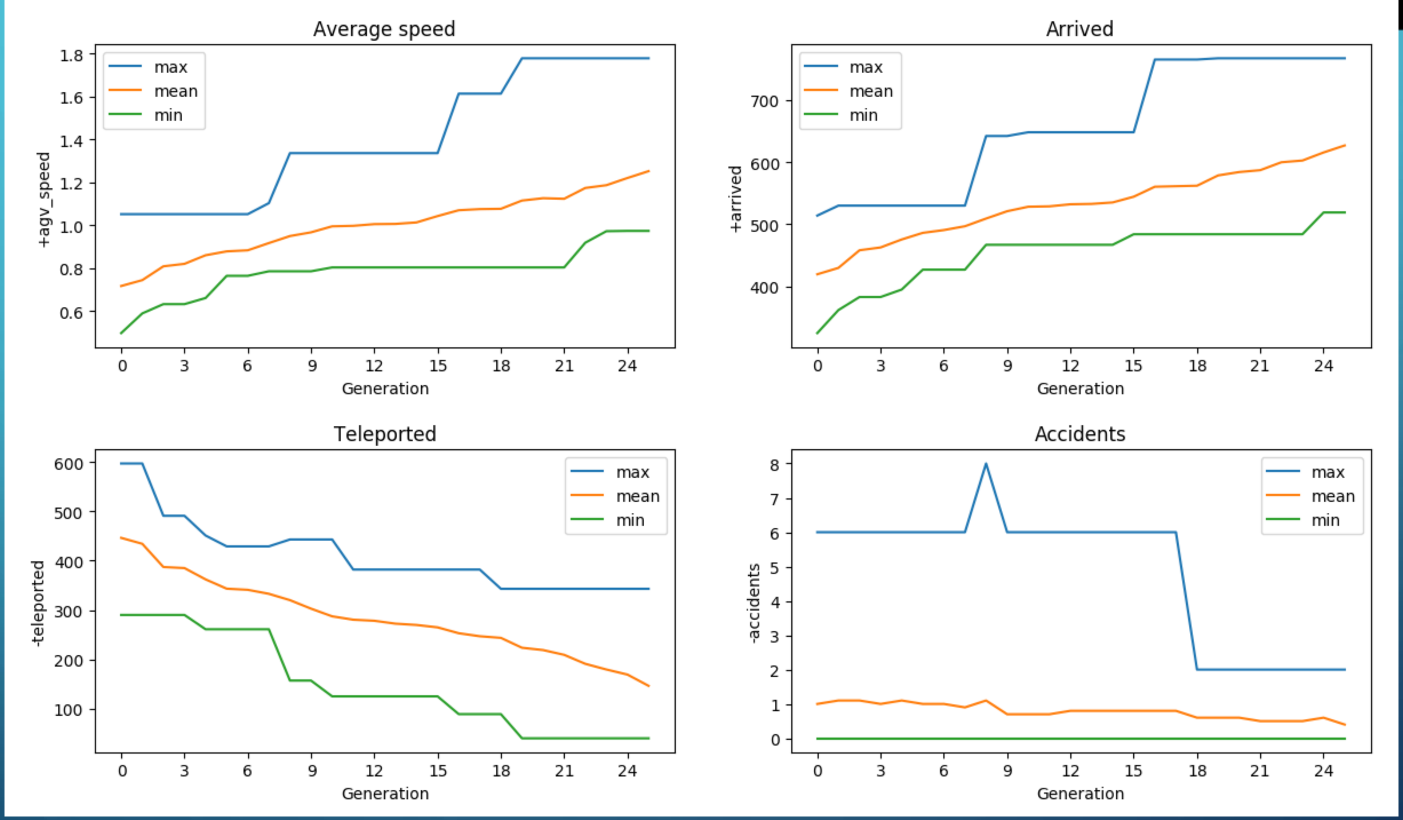
EXECUTED RUNS



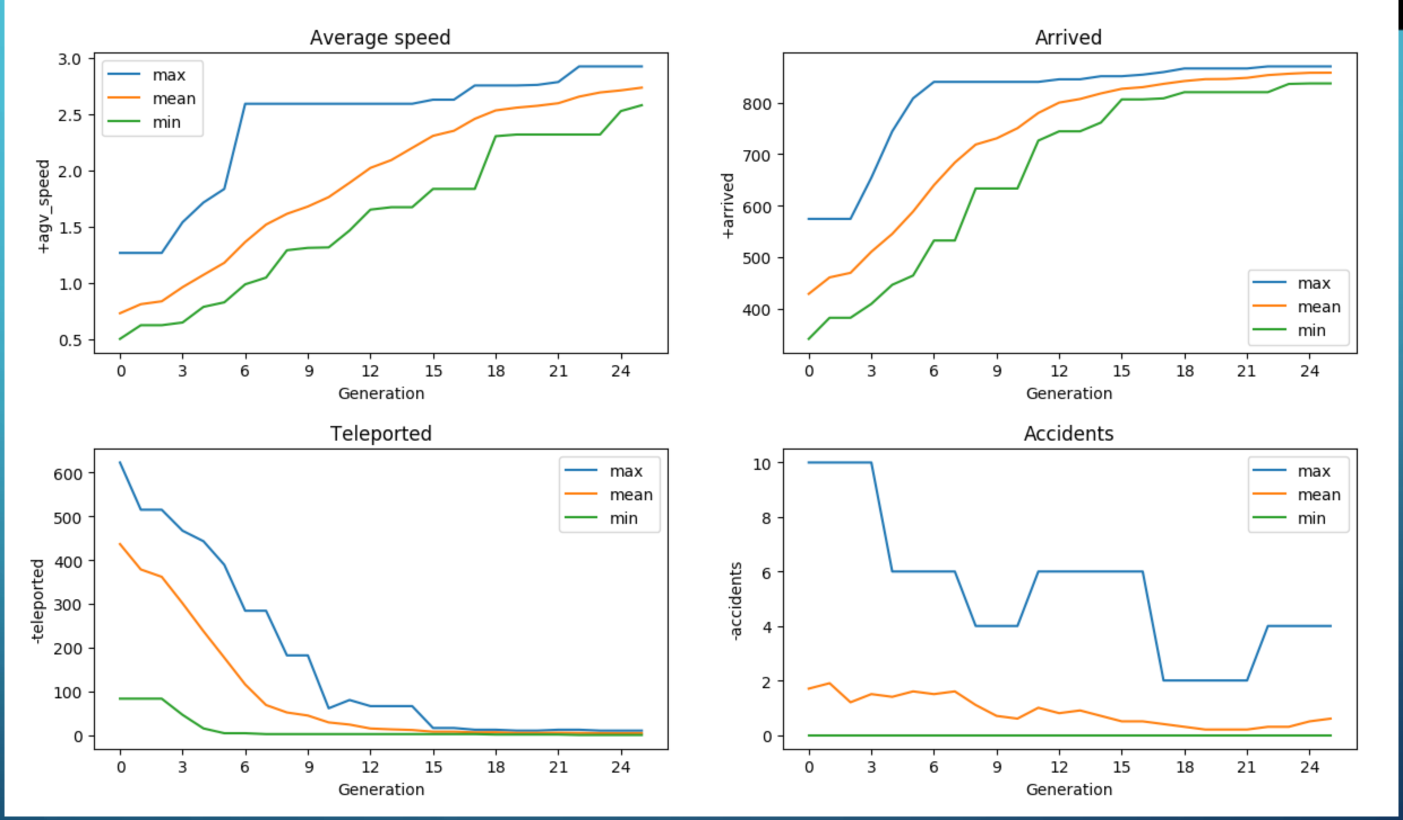
	Run 1	Run 2	Run 3
Objectives	Average speed, arrived at destination, un-jamming teleports, accidents		
Generations	25		
Population Size	20		
Offspring	10		
Mutation Rate	0,5	0,15	0,5
Crossover Rate	0,5	0,8	0,8
Simulation Time	1 hour (NB: for each individual)		
Red/green light boundaries	1÷40 seconds		
Yellow light boundaries	1÷10 seconds		

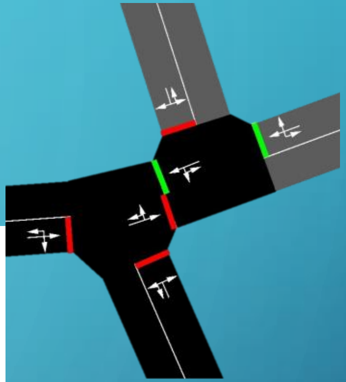
RUN 1: MR=0.5 and CR=0.5



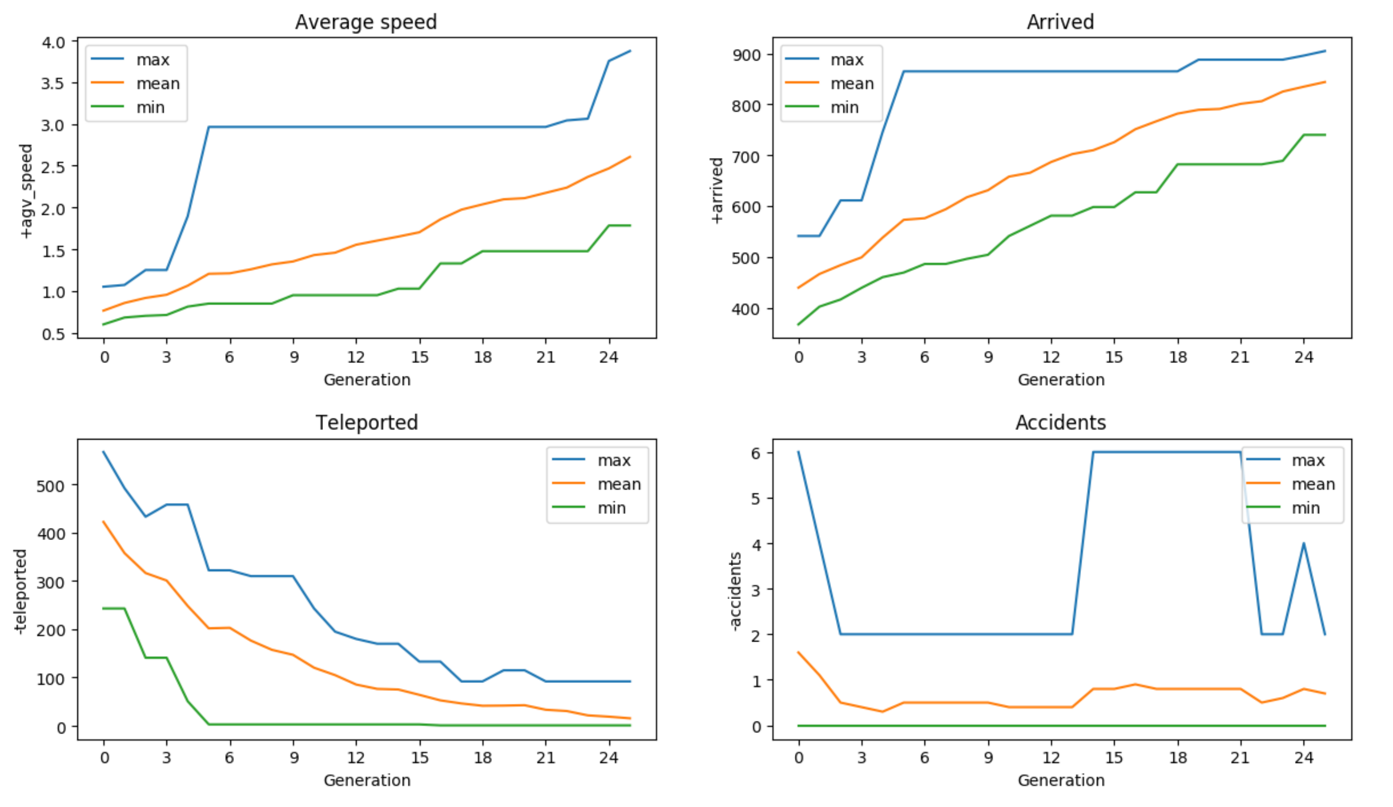


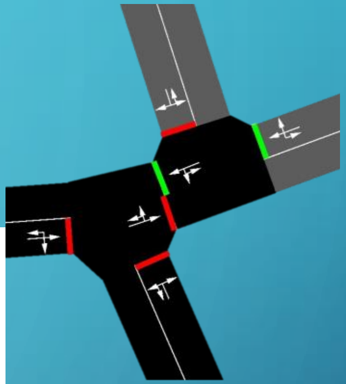
RUN 2: MR=0.15 and CR=0.8

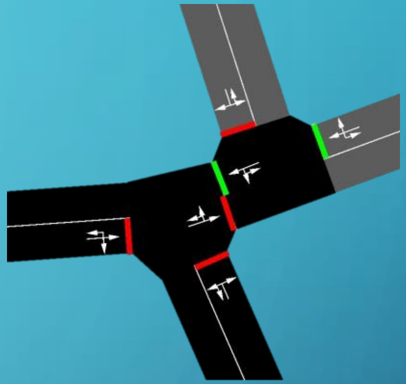




RUN 3: MR=0.5 and CR=0.8

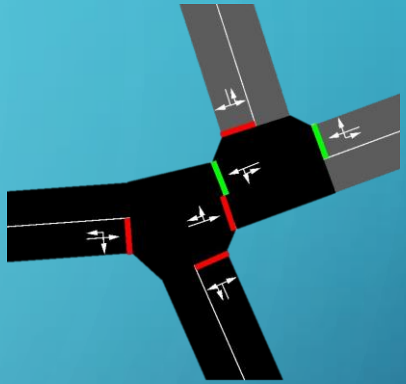






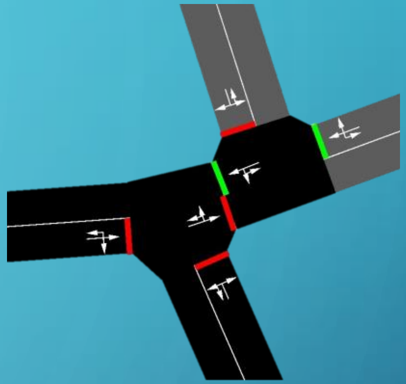
DEMO TIME!

PROBLEMS OF THE MODEL



- Traffic Lights programs:
  - Hard to build
  - High complexity if considering simultaneous green lights on the same junction
- OpenStreetMap maps:
  - Imprecise
  - Assumption on road types, wrong number of lanes
  - Frequent duplicated edges
  - Sumo doesn’t have any automatic map-cleaning tool

MODEL SIMPLIFICATIONS



- Traffic lights:
  - Traffic light turns green only on single edges: no combinations
  - The traffic light is the same for each lane of an edge entering a junction: e.g. no right-turn lanes
- Map errors:
  - We expect the algorithm to get around errors by itself with more generation to develop
- Vehicle type:
  - We only considered normal cars, no long-vehicles, motorcyles, cycles and pedestrians

THANKS FOR YOUR ATTENTION!

Andrea & Alessandro