

# Unconventional reinforcement learning on traffic lights with SUMO

Master Degree in Computer Science

Francesco Refolli

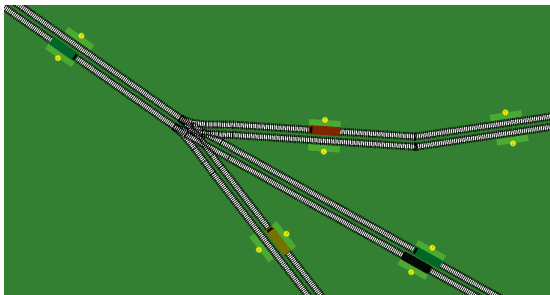
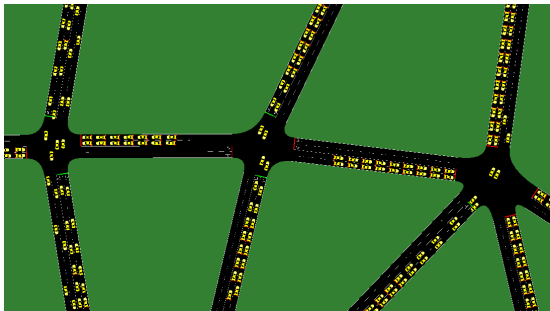
Supervisor: Prof. Giuseppe Vizzari





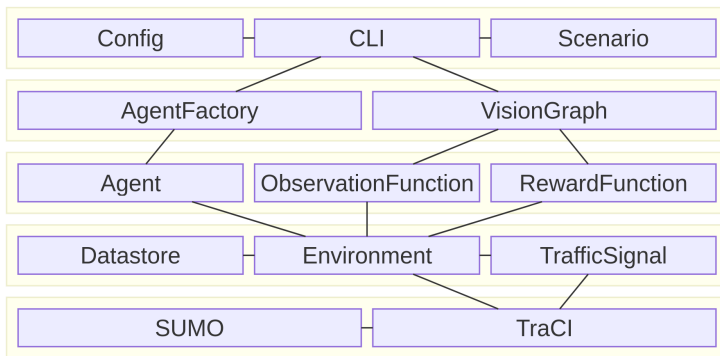
**SUMO**  
SIMULATION OF URBAN MOBILITY

- Free and Open Source microscopic traffic simulator
- Developed at German Aerospace Center (DLR)
- Multimodal: cars, trams, bikes, pedestrians ...
- Highly customizable



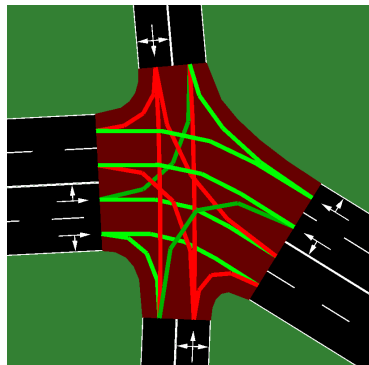
# SUMO-RF: SUMO + Reinforcement Learning

A FOSS framework for Reinforcement Learning with SUMO developed as fork of *LucasAlegre/sumo-rl* with a focus on modularity, flexibility and Multi Agent Learning. It also contains several utilities for format conversions, metrics analysis and plot, schematic-based demand generation and more.



# The Agent Model

- Each agent can control one intersection and at each step (every 5 seconds) it can choose the next phase of the intersection.
- Every action is automatically enforced by TrafficSignal with also an intermediate yellow phase.
- It receives an observation of the current condition and a reward proportional to the goodness of its behaviour.
- If the agent is "smart", it uses the collected data to improve itself!



# The Observation Functions

# The Reward Functions

# The Dataset

```
TOK = (£|\*|\~|%(,[0-9.]+)?(,[0-9.]+)?|[A-Z] [A-Z0-9]+)  
EXP = ^([0-9]+,)?([0-9]+,)?TOK(,TOK)*$
```

# Thank You