

An aerial, high-angle view of a busy city intersection, likely in New York City. The scene is filled with yellow taxis, pedestrians crossing the street, and various city buildings. A semi-transparent dark blue overlay covers the entire image, with white text centered over it. The text is arranged in three lines: the first line is 'EcoLight: Reward Shaping in Deep', the second line is 'Reinforcement Learning for Environment', and the third line is 'Friendly Traffic Signal Control'. A thin orange horizontal line is positioned between the second and third lines of text. Below the main title, there is a teal rectangular box containing the text 'SUMO implementation' in a light orange, italicized font.

EcoLight: Reward Shaping in Deep Reinforcement Learning for Environment Friendly Traffic Signal Control

SUMO implementation

THE TEAM

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OUR MOTIVATION

- *124 B\$ per year for traffic congestion*
- *1% cost of European union's GDP*
- *3M death due to air pollution, 33% due to traffic*
- *3-4 days/year of time waste in traffic in NY, SF*
- *Better traffic control in china save 15.3% of delay*

INDUSTRY OUTLOOK

*Uniform
Fixed time*

*Actuated traffic
signal
controller*

Webster

SOTL

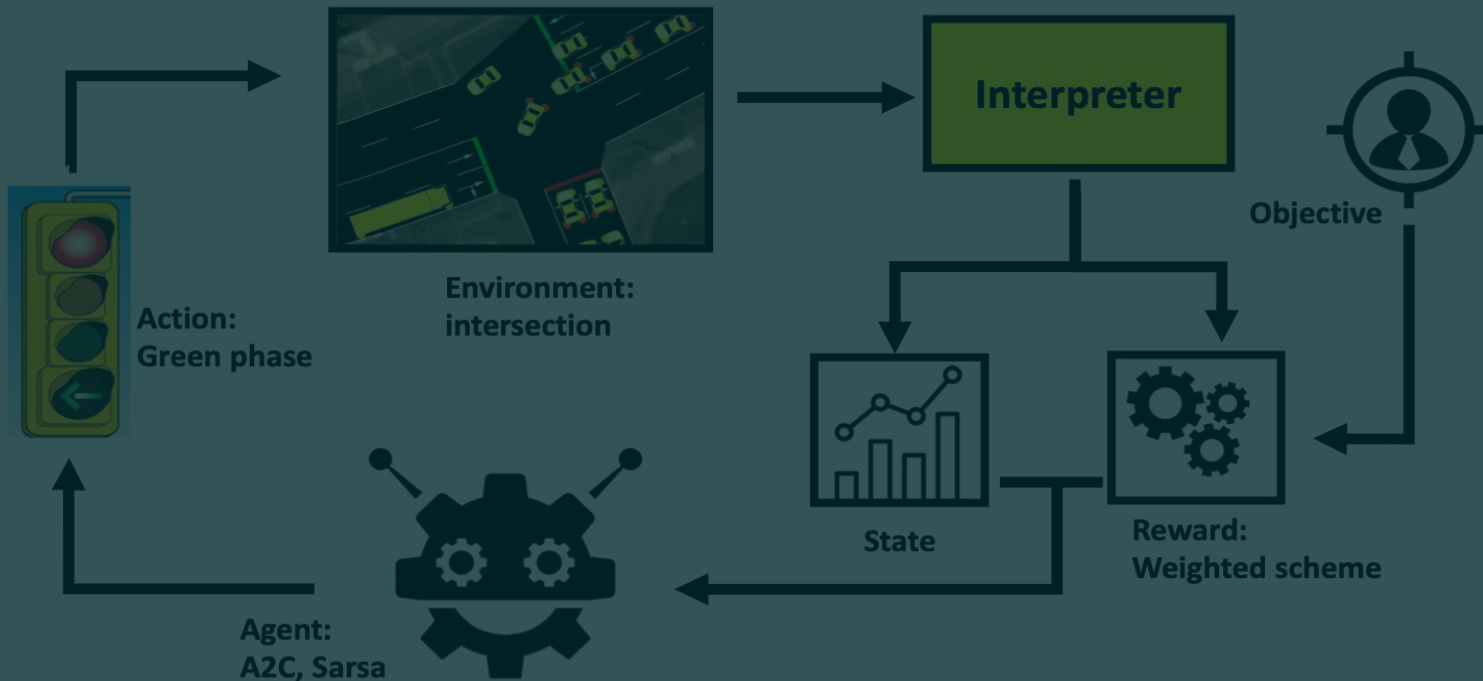
*Learning
approachs*

SUCCESS

Agent design

Deep RL

Algorithm: Sarsa, A2C



- **State:** most recent green phase, density, queue length, type of vehicle of incoming lane
- **Action:** the next green phase

Reward Shaping

✓ Queue length

$$R_q = -\left(\sum_{j \in L_{in}} N_{Hj}\right)^2$$

Weighted version:

$$R_{wq} = -\left(\sum_{j \in L_{in}} N_{wHj}\right)^2, \quad N_{wHj} = \sum_{k=1}^{N_{Hj}} W_k$$

✓ Waiting time

$$R_w = 0.01 \sum_{j \in L_{in}} (T_{j,t} - T_{j,t-1})$$

Weighted version:

$$R_{ww} = 0.01 \sum_{j \in L_{in}} (T_{wj,t} - T_{wj,t-1}), \quad T_{wj} = \sum_{k=1}^{N_j} W_k T_{jk}$$

✓ Pressure

$$R_p = -\left|\sum_{j \in L_{in}} N_j - \sum_{j \in L_{out}} N_j\right|$$

Weighted version:

$$R_{wp} = -\left|\sum_{j \in L_{in}} N_{wj} - \sum_{j \in L_{out}} N_{wj}\right|, \quad N_{wj} = \sum_{k=1}^{N_j} W_k$$

Weight selection



Constant

Optimize a constant multiplier based of the vehicle emission class type



Normalized emission

Adaptive weight for all vehicle in a lane based of their normalized emission

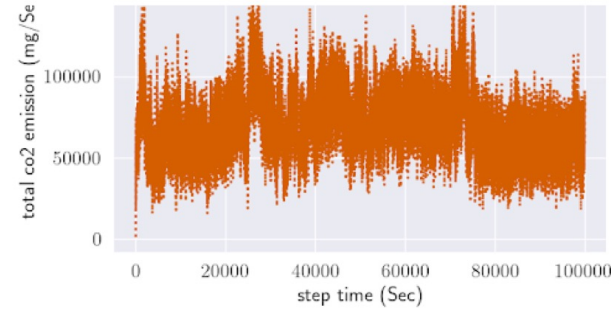
$$W_j = \frac{\mathcal{E}_j - \bar{\mathcal{E}}}{\mathcal{E}_{max} N_j}$$



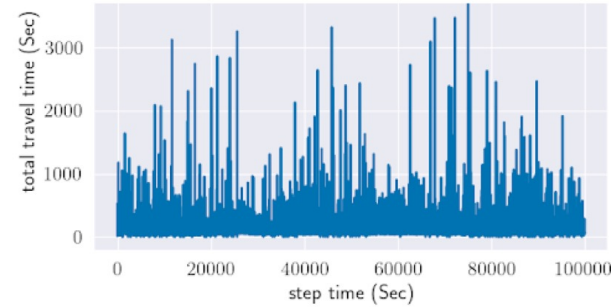
Adaptive weights

Adaptive weight for each vehicle based of its current emission

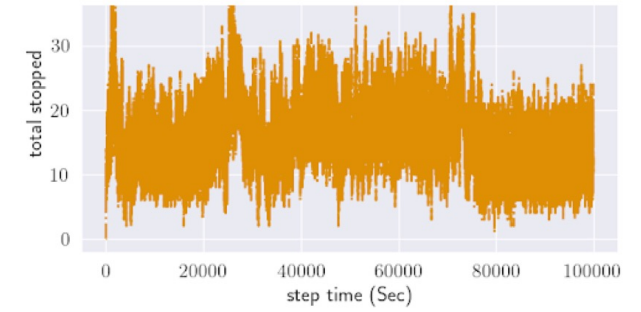
Experiment



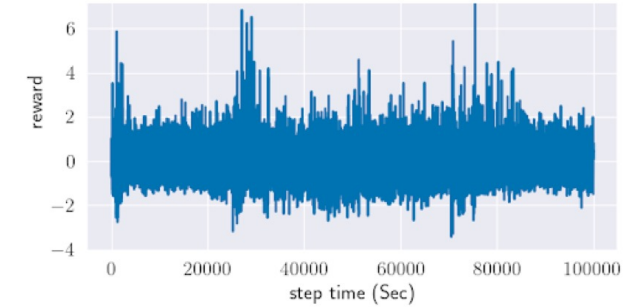
(a) CO2 emission



(c) travel time



(b) Stopped time

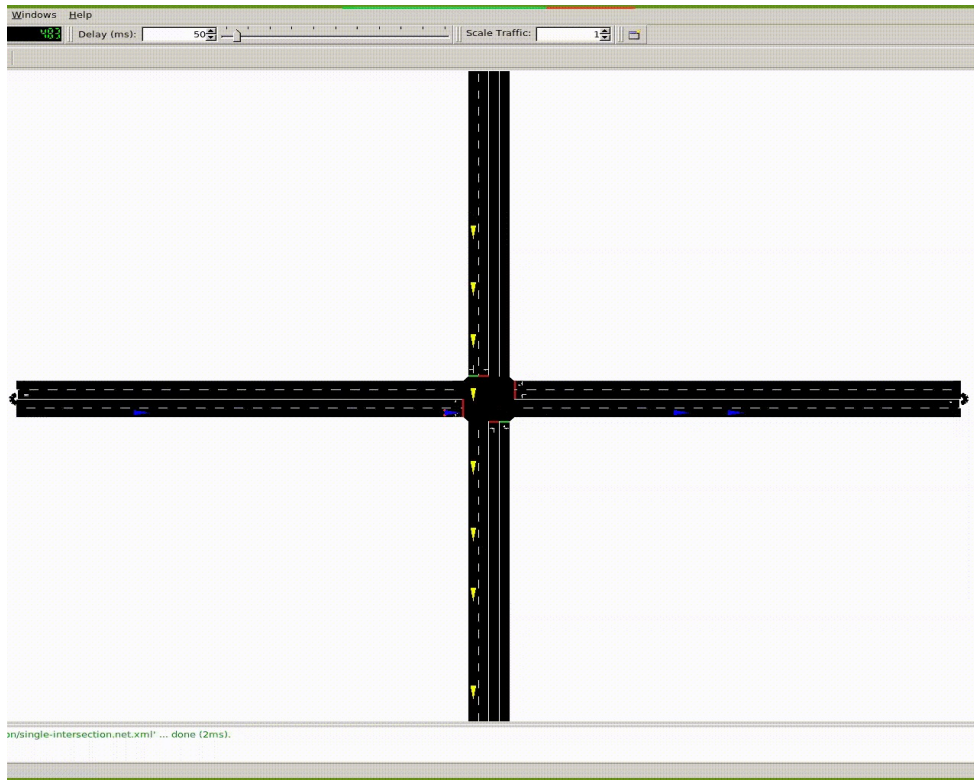


(d) Reward

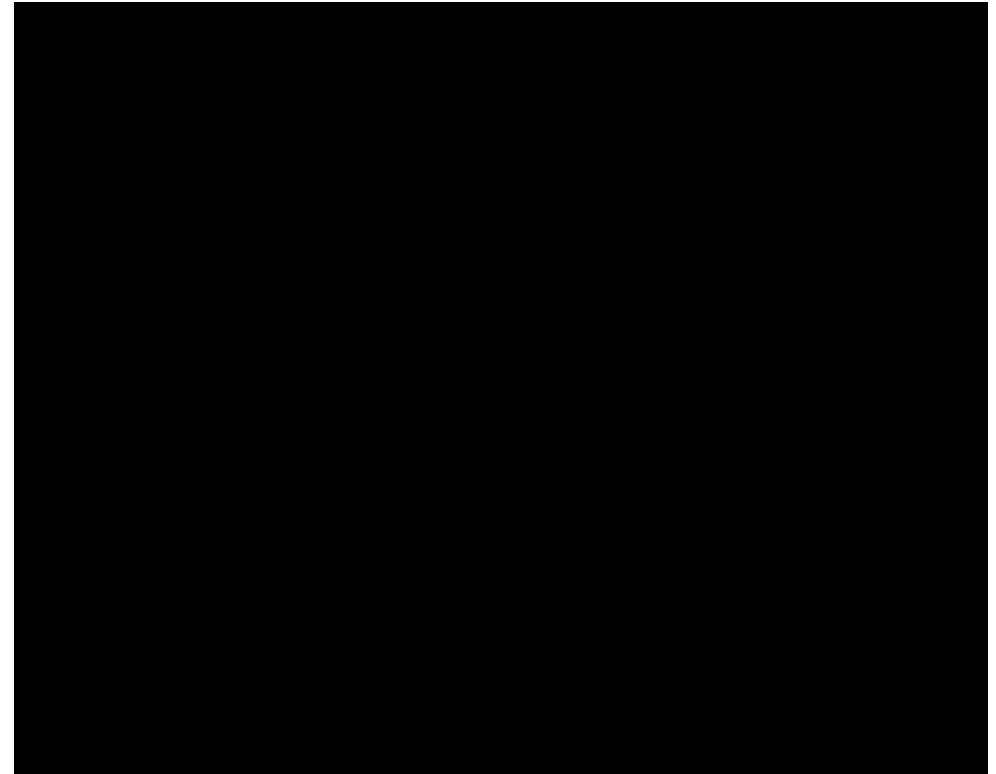
Metric	Type	Fixed time	Waiting time		Queue length		Pressure	
			a2c	sarsa	a2c	sarsa	a2c	sarsa
Travel	not weighted	226.34	162.40	125.67	224.11	157.38	248.43	210.06
	weighted		153.64	110.91	229.43	164.34	262.48	236.36
CO2	not weighted	149.76	113.48	84.11	145.45	111.26	135.85	128.35
	weighted		101.29	69.98	123.43	84.96	140.19	119.79
Wait	not weighted	15337	2371	1091	5365	7442	5025	15665
	weighted		2117	788.06	4878	5138	6544	11109
Stop	not weighted	32.70	24.24	17.55	31.62	22.08	31.95	30.16
	weighted		23.14	15.57	30.27	23.80	33.76	35.77

Comparison:

Weighted waiting time (Sarsa):



Fixed time:



The background of the slide is a screenshot of the SUMO (Simulation of Urban MObility) software interface. It shows a top-down view of a road network with several yellow cars and a green truck. The interface includes a menu bar at the top with options like File, Edit, Settings, Locate, Simulation, Windows, and Help. Below the menu bar is a toolbar with various icons for simulation control. A status bar at the bottom displays the text 'pretty.sumocfg loaded' and coordinates. A semi-transparent dark blue rectangle is overlaid on the left side of the image, containing the 'THANK YOU!' text and contact information.

THANK YOU!



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