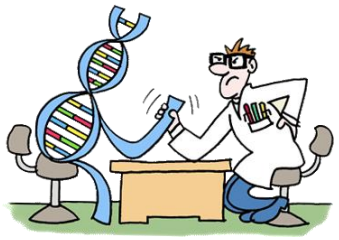

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Evolutionary Computation Research Group

21st Annual Humies Awards -- Melbourne, Australia

Learning Traffic Signal Control via Genetic Programming

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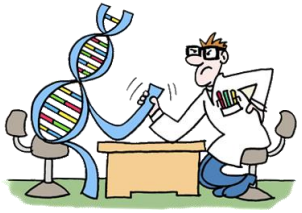
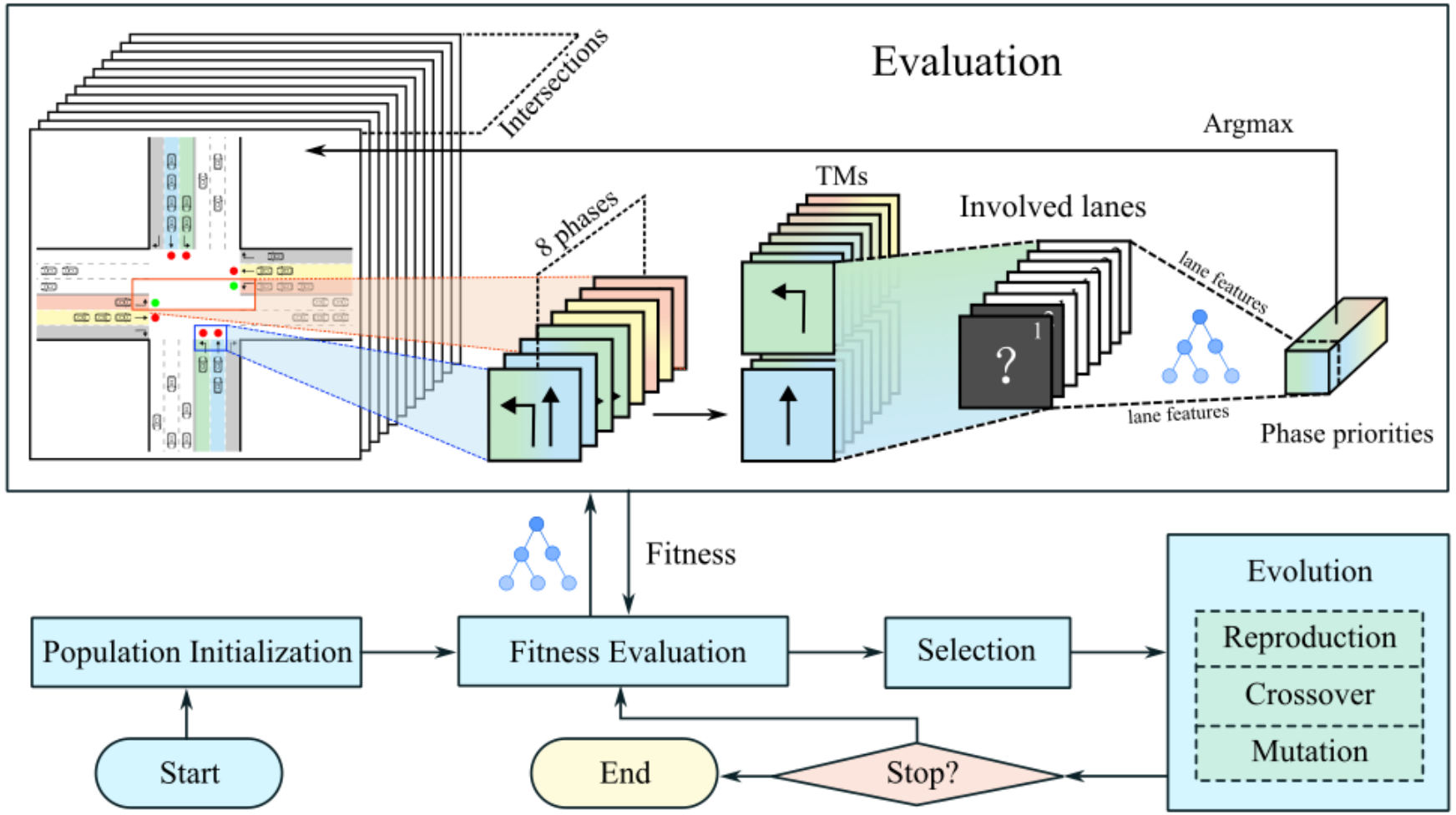
Victoria University of Wellington

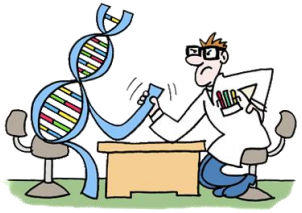
Summary of our method





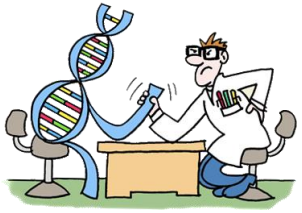
Overall framework of GPLight

1. Human-competitive



Our result advances the explainable theoretically supported state-of-the-art method developed by experts in the transportation field

1. Human-competitive



Advancing the expert-designed state-of-the-art and reinforcement learning method

- Max-Pressure method is a theoretically grounded and sota method designed by human experts in the transportation field

  Varaiya, Pravin. "Max pressure control of a network of signalized intersections." Transportation Research Part C: Emerging Technologies 36 (2013): 177-195.

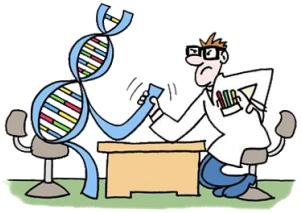
- MPLight combines the advantages of previous deep reinforcement learning (DRL)-based methods that utilizes only basic lane features, and is capable of stable convergence and scalable to large-scale traffic networks

  Chen, Chacha, et al. "Toward a thousand lights: Decentralized deep reinforcement learning for large-scale traffic signal control." Proceedings of the AAAI conference on artificial intelligence. Vol. 34. No. 04. 2020.

Our GP-evolved traffic signal control policy

- Further reduces the **average vehicle travel time** by 13.52% compared to the expert-designed method
- Has better **generalizability** and is **human-understandable** compared to DRL-based methods
- Can be deployed on **low-cost** and **resource-limited** edge devices while maintaining **excellent performance**

2. Why our entry



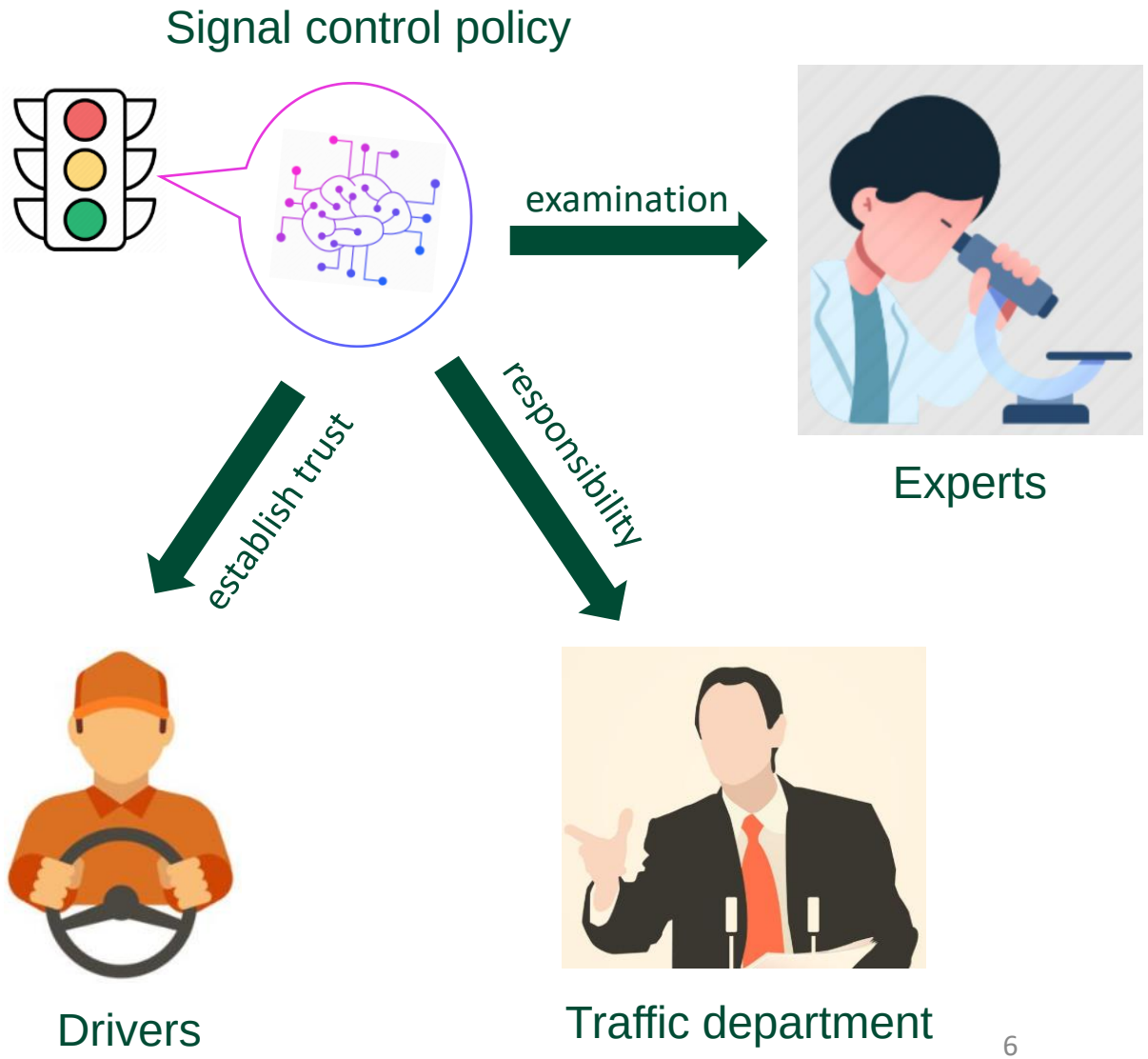
Our result solves problems of indisputable difficulty in its field

2. Why our entry (Explainability)

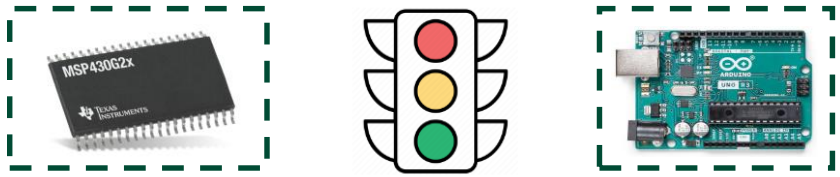
Explainable traffic signal control policy

- Experts in the traffic field are able to examine **potential shortcomings** in the signal control policy
- In the field of traffic, which involves **significant personal safety**, authoritative departments need to be **responsible** for the traffic light control strategies adopted.
- It is necessary to **provide drivers with explanations** of the control policy, otherwise it may lead to **traffic chaos**. Without such explanations, drivers might not be able to **anticipate the timing of a green light**, causing them to forcefully switch to the right-turn lane to cross the intersection.

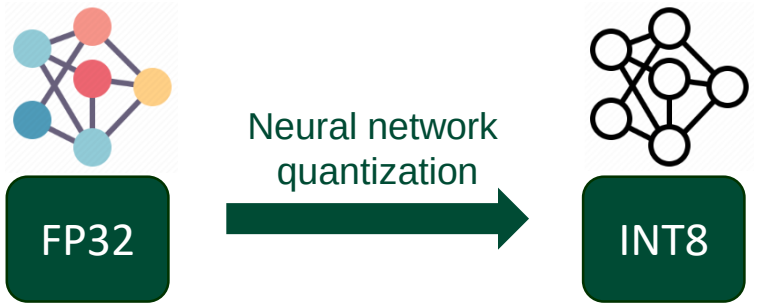
GPLight can evolve explainable traffic signal control strategies **without performance compromise** !



2. Why our entry (Deployment)



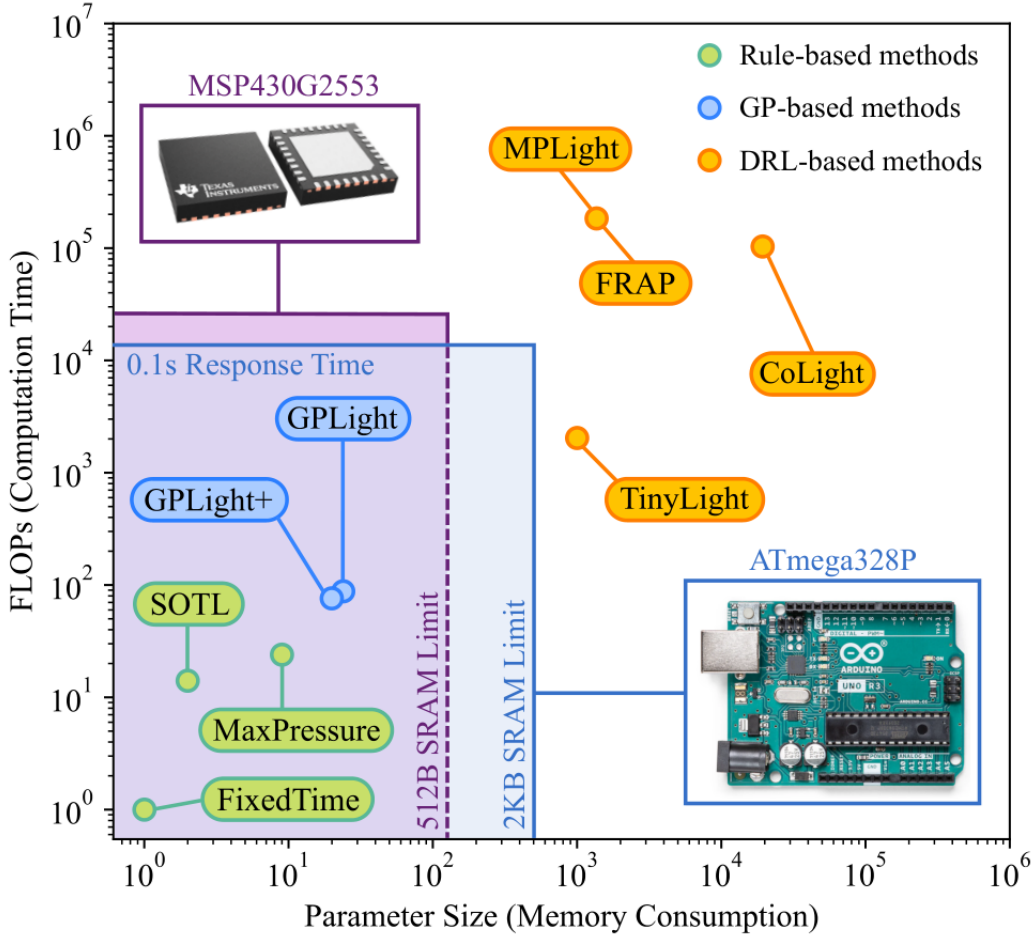
Resource-limited signal controllers



potential performance degradation

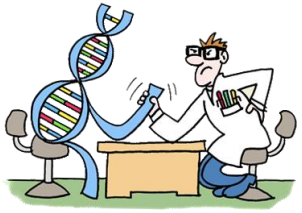
Deployment on edge devices

- Neural network typically have **large** FLOPs and parameter size
- Most of controllers **lack support** for neural networks. Quantization is needed to deploy them, leading **performance degradation**
- Our concise solutions can be easily implemented on commonly used[1,2] **chips** in traffic signal controllers

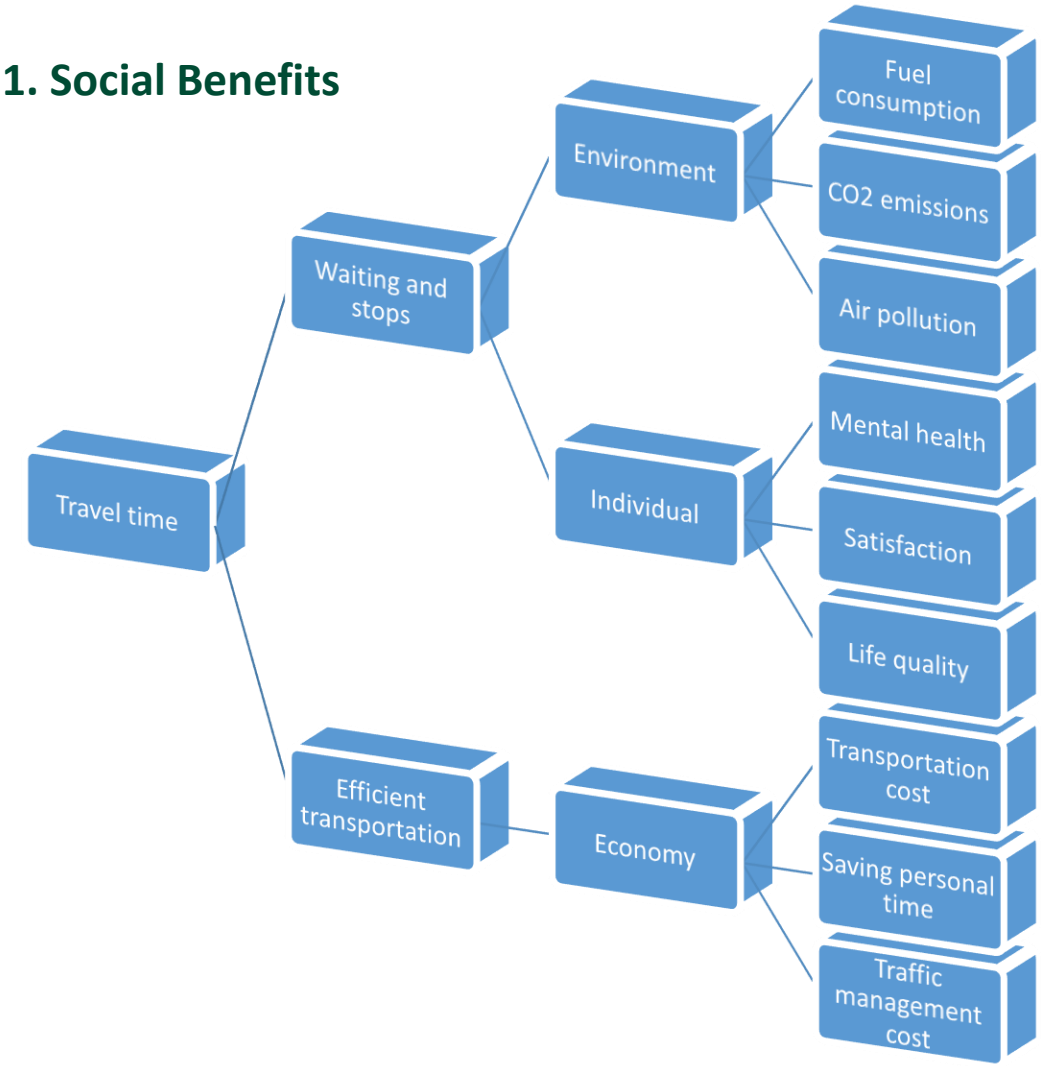


1. Jyothi, B. Naga. "Smart traffic control system using ATMEGA328 micro controller and arduino software." 2016 International Conference on Signal Processing, Communication, Power and Embedded System (SCOPES). IEEE, 2016.
2. https://github.com/ErnaneJ/digital-traffic-light-system

Why our entry stands out



1. Social Benefits



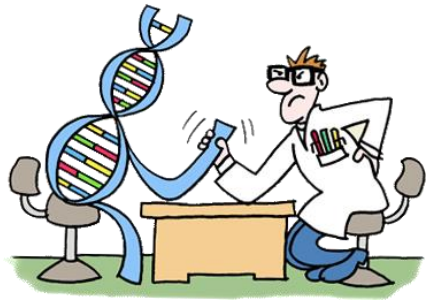
2. Explainable AI

3. Accessible to practitioner without expertise

4. Low resource consumption

5. Reproducible results

Our implementation is freely available and open source



Thank you

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