Advanced Methods for Behavior Planning

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State Machine Behaviour Planning Issues

- Rule-explosion when Dealing with Complex Scenarios
- Dealing with a Noisy Environment
- Hyperparameter Tuning
- Incapable of Dealing with Unencountered Scenarios

Rule-Based Behaviour Planner

- Hierarchy of rules
  - Safety critical
  - Defensive driving
  - Ride comfort
  - Nominal behaviours
- Reduced need for duplication
  - Rules can apply throughout ODD

Operational design domain

- Suffer from same challenges as finite state machines
  - Common to all expert system designs

relies on expert users to design for all possible scenarios.

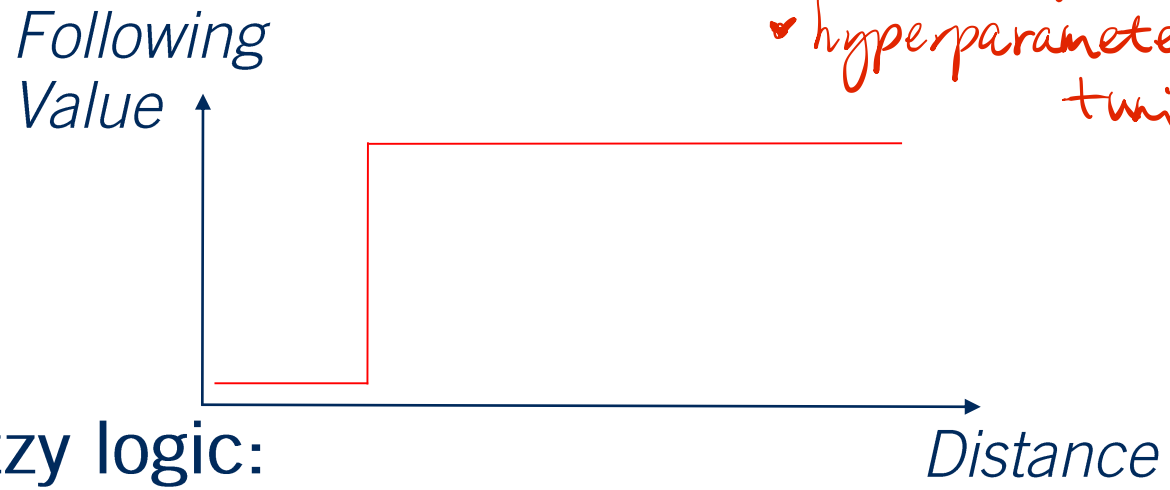
Fuzzy Logic

Human expert

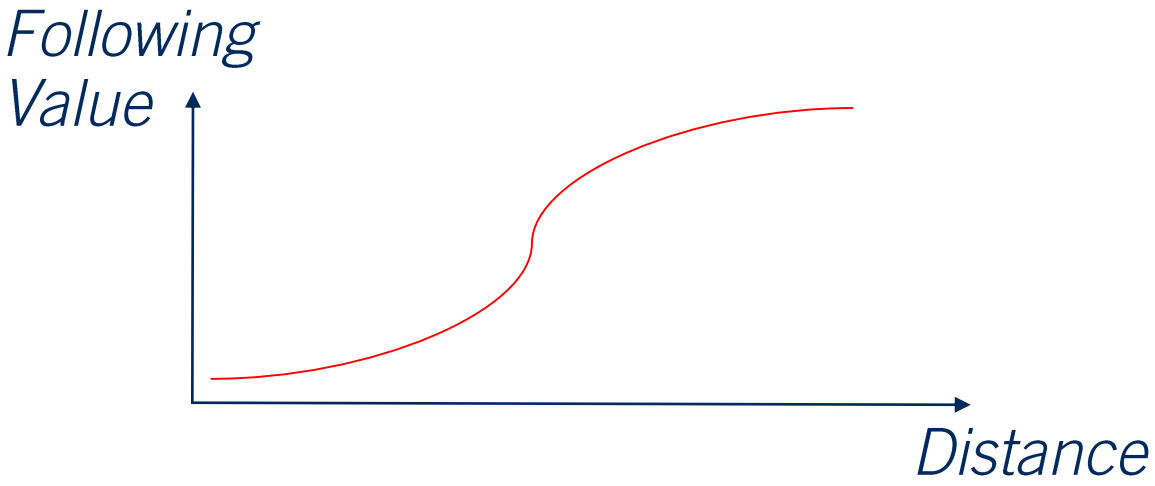
Pros: can deal with environmental noise somewhat

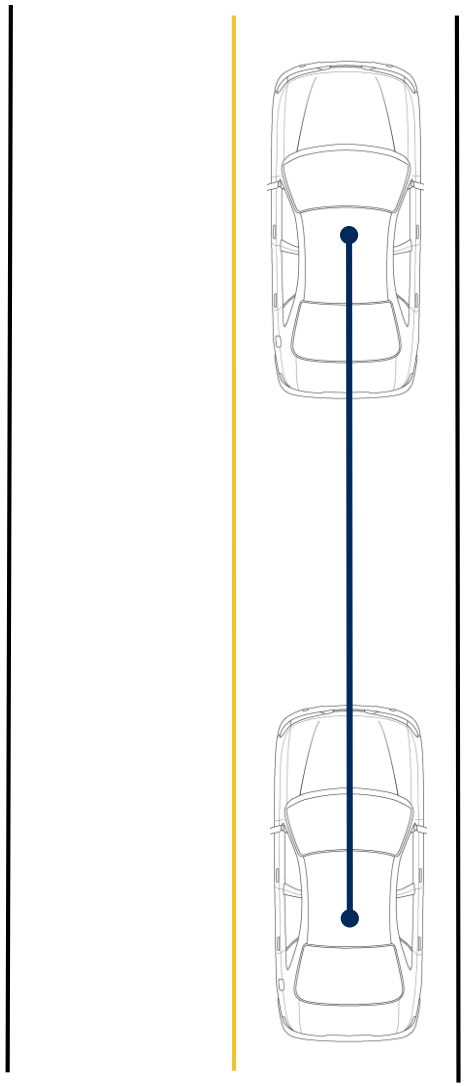
Cons: • rule explosion
• hyperparameter tuning.

Non Fuzzy logic:



Fuzzy logic:



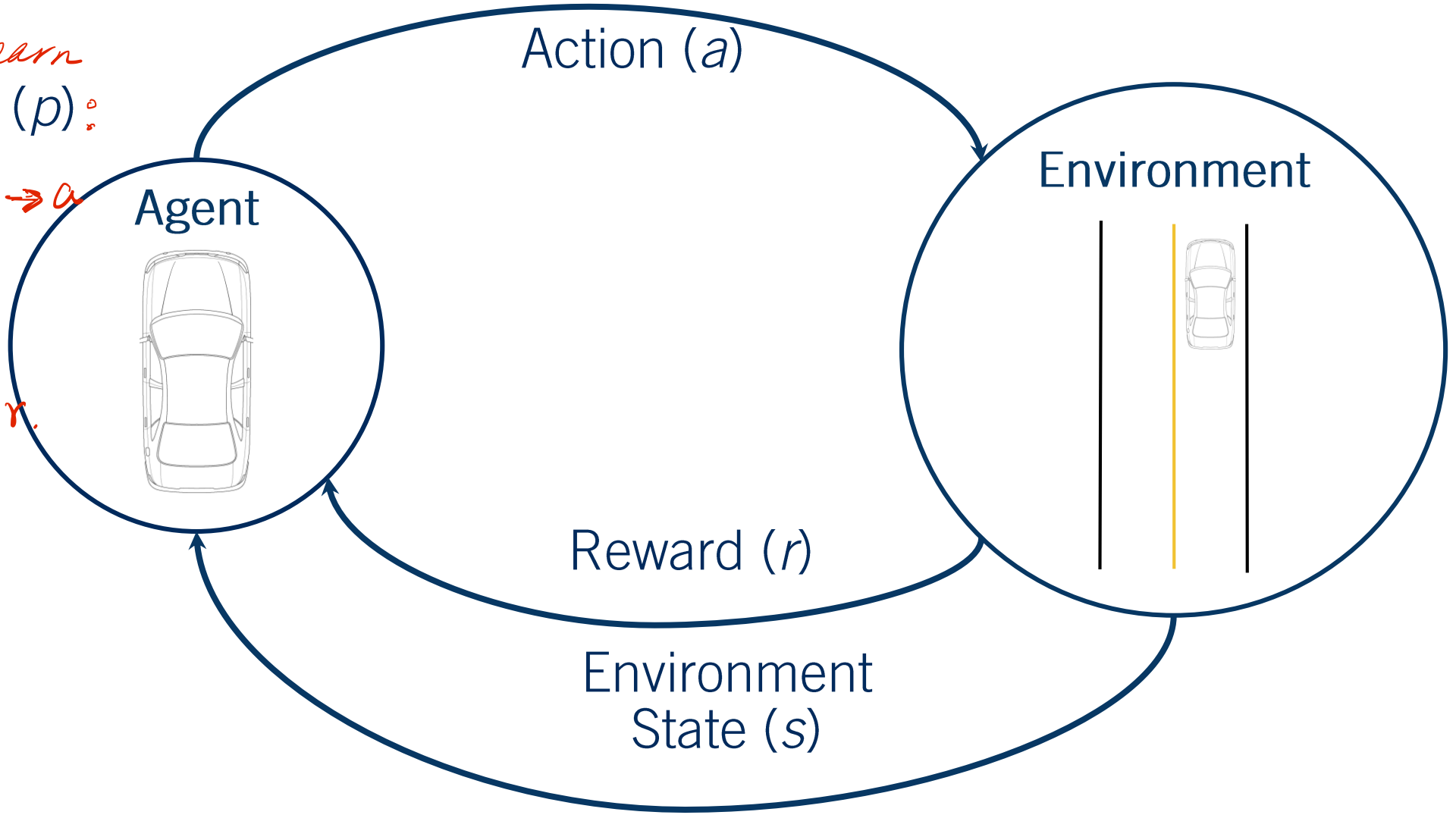


Reinforcement Learning

To learn
Policy (p):

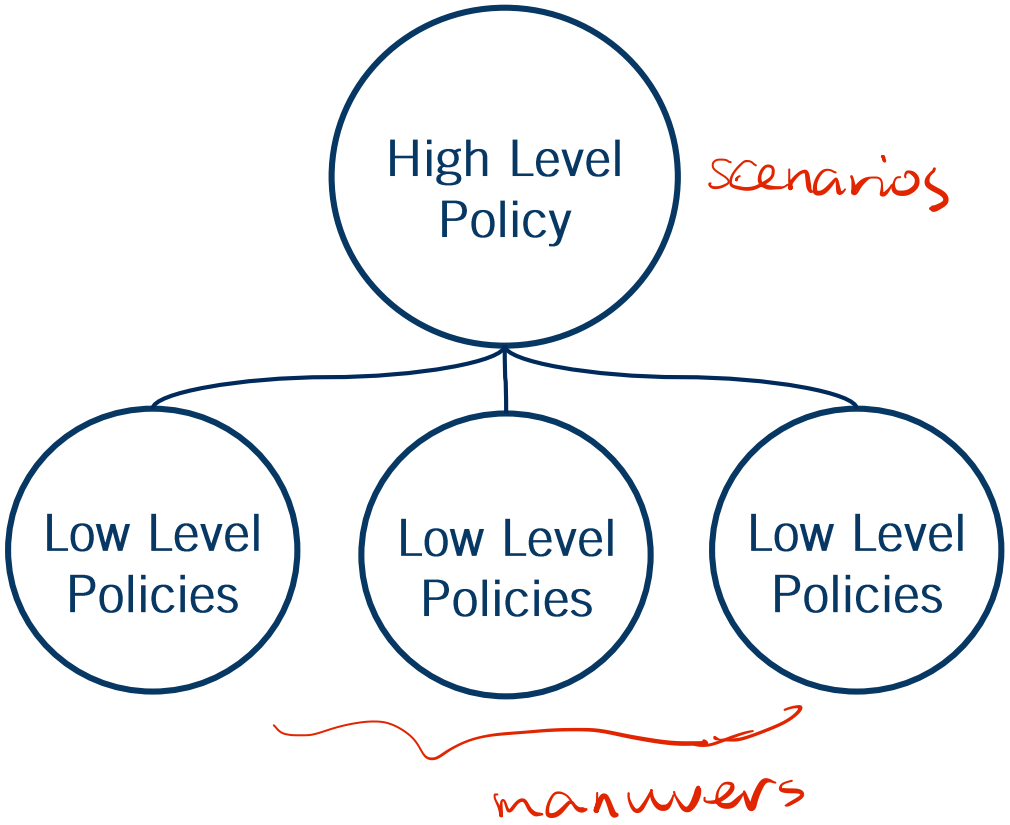
map $s \rightarrow a$

given
reward
function r.

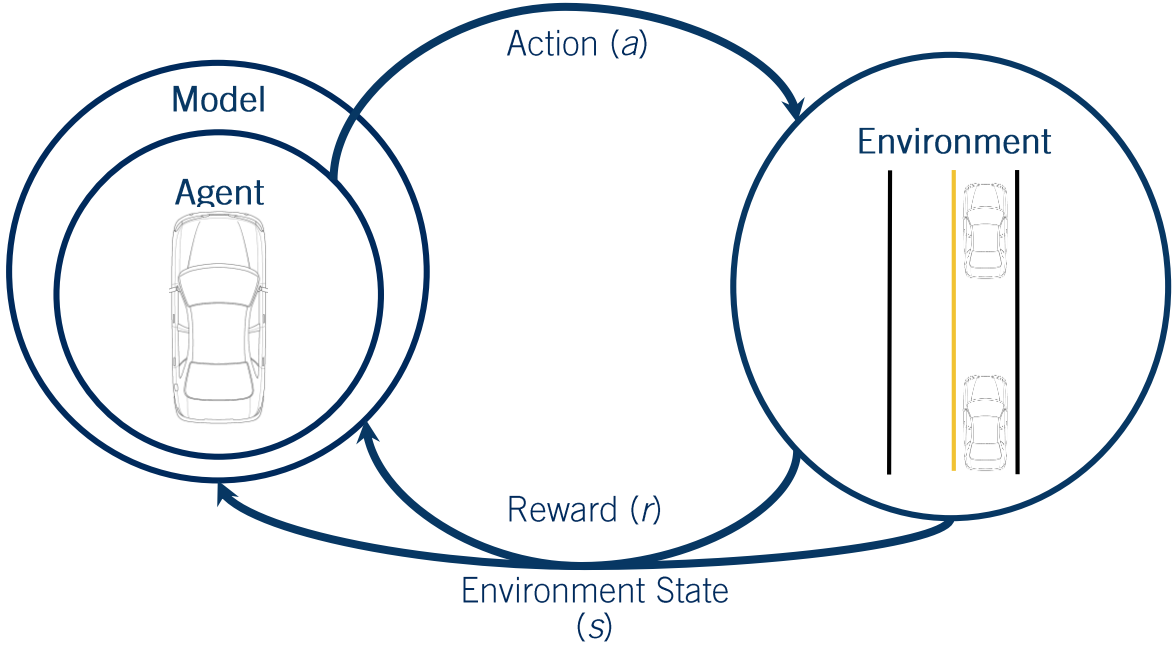


Reinforcement Learning

Hierarchical Reinforcement Learning



Model-based Reinforcement Learning



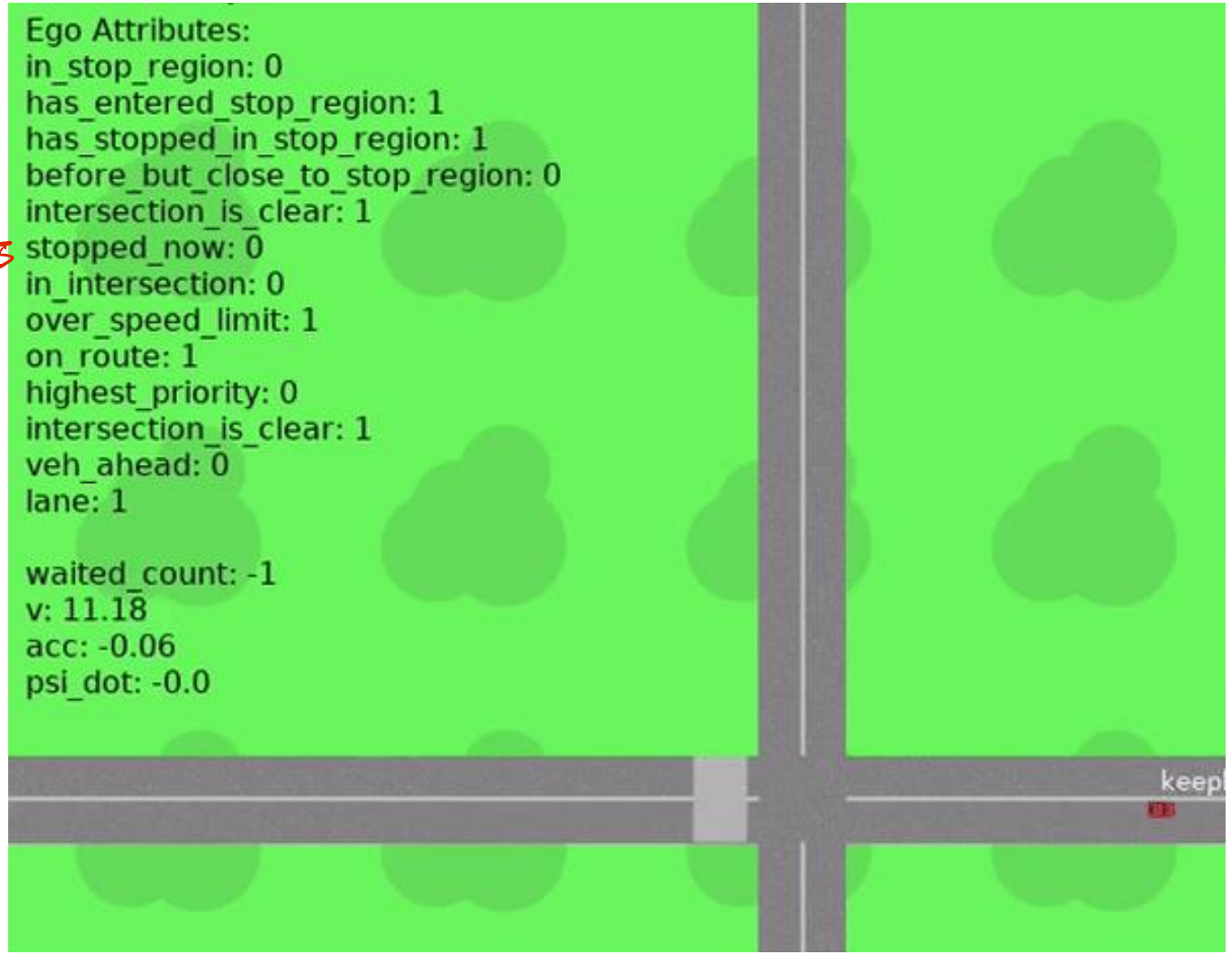
Reinforcement Learning Issues

- Simple Simulation Environments

may not be transferrable to real world environments

- Ensuring Safety

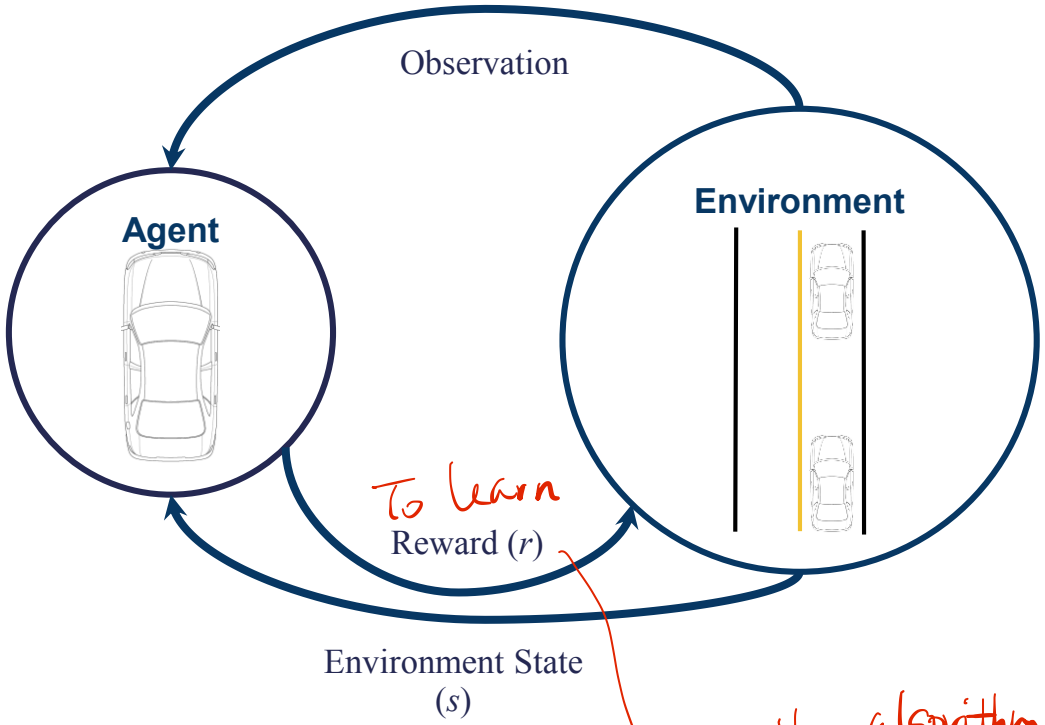
no rigorous safety assessment.



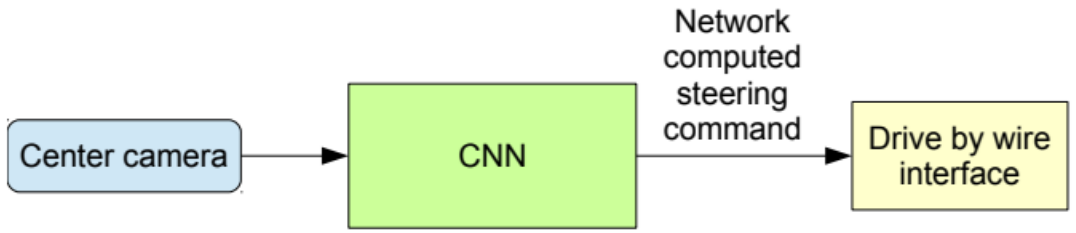
Machine Learning

Behavior planning bottleneck:
achieving real world level 5 autonomy.

Inverse Reinforcement Learning



End-to-End Approaches



after that, the algorithm can execute driving maneuvers similarly to a human driver.

Summary

- Identify issues with the state machine based behaviour planner
- Identify the open areas of research in behaviour planning

- **Next**: Building a full local planning solution