

End-to-End Urban Driving by Imitating a Reinforcement Learning Coach

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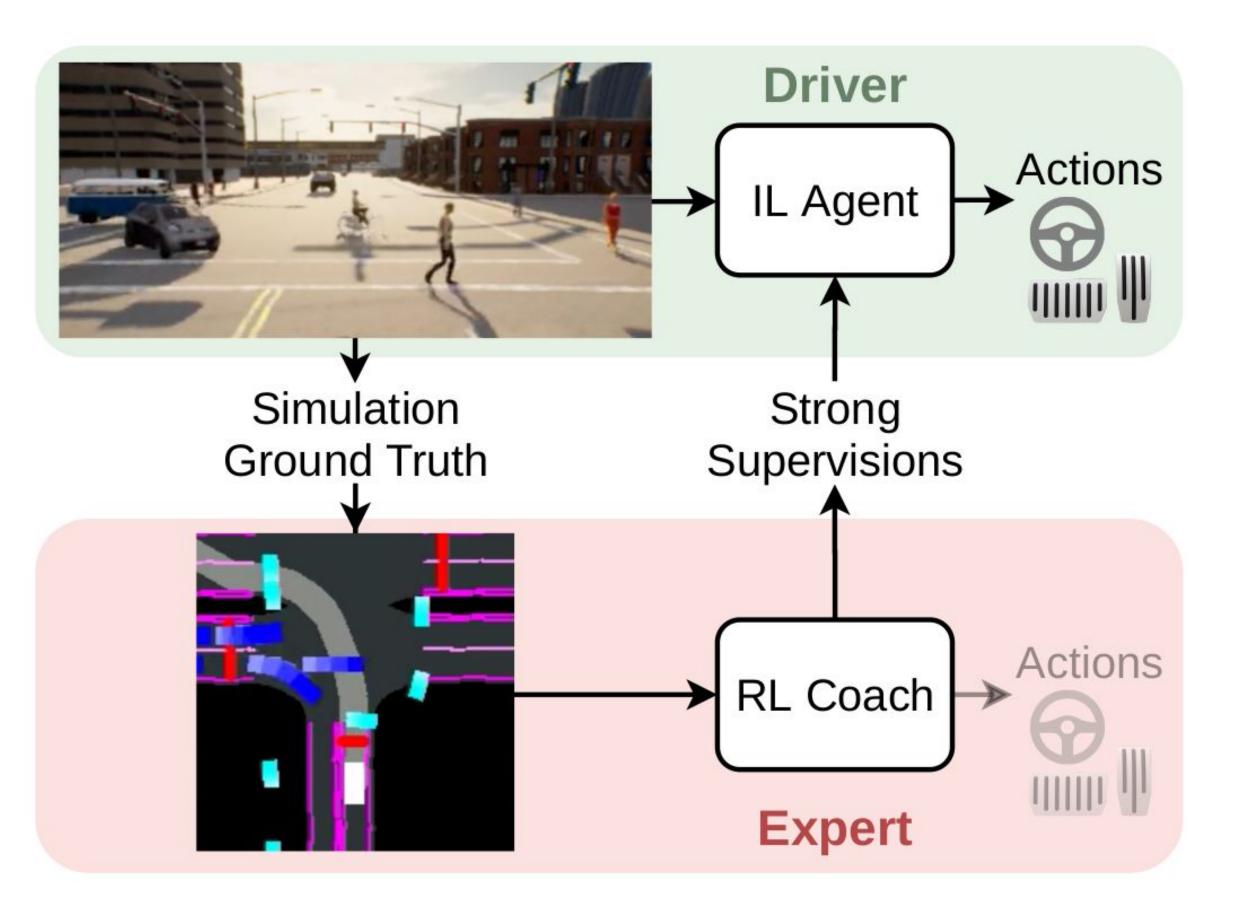


Motivation

Data aggregation (DAgger) alleviates covariate shift by training imitation learning (IL) agents using **on-policy** data.

- Human experts can provide sparse on-policy supervision.
- Automated experts can provide dense on-policy supervision.

Prior automated experts on CARLA rely on ground-truth information and hand-crafted rules and they perform suboptimally. This limits the performance of all IL agents.



Roach (RL Coach) is an automated expert **end-to-end trained** using reinforcement learning (RL).

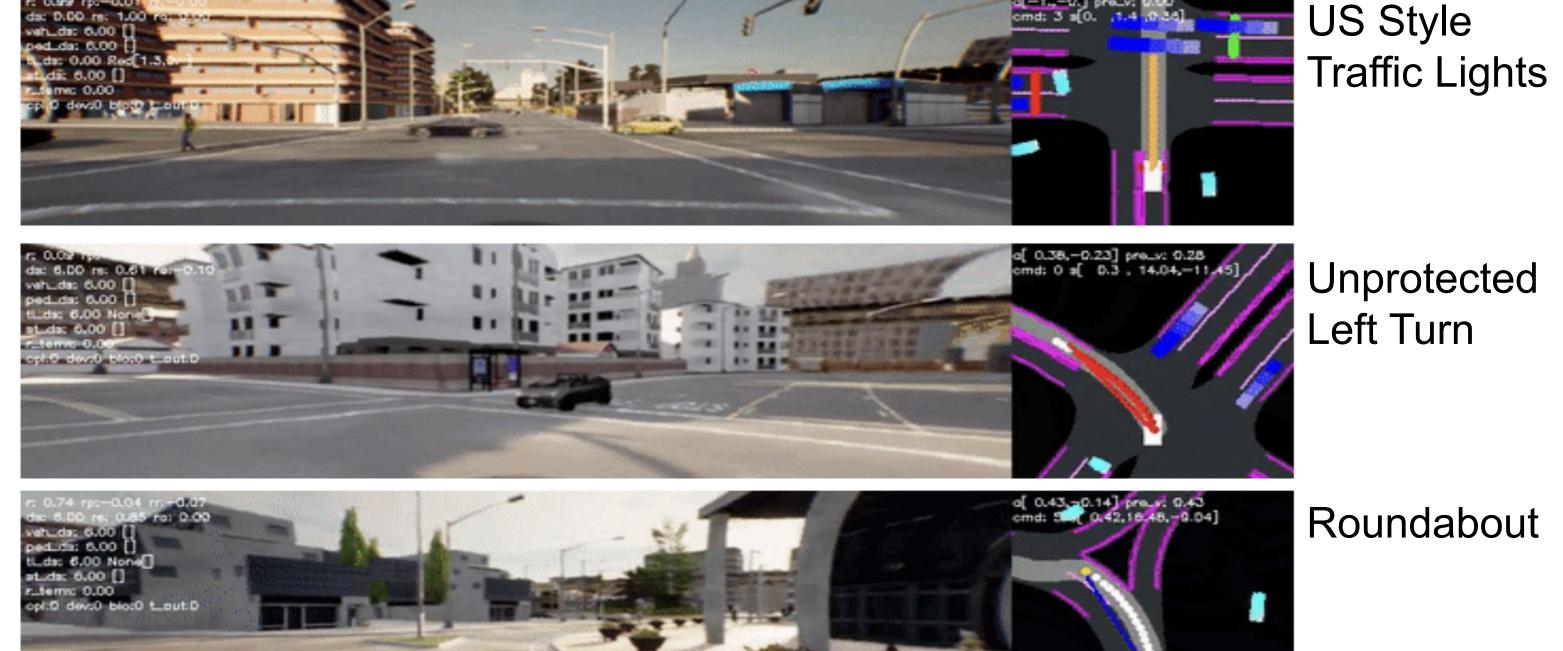
Roach can boost the performance of IL methods on CARLA because

- it raises the performance upper-bound of IL by achieving better driving performance than other experts,
- it allows more effective IL by providing dense and informative on-policy supervision.

Our Method STEP 1: Train Roach using Proximal Policy Optimization (PPO) with bird's-eye view as input, • Beta distribution as output, • exploration suggest, a generalized entropy loss that encodes basic traffic rules. Image Encoder Measurement ___ (a) Roach Command Image Encoder Measurement ___ $|Speed| \Rightarrow s$ Encoder $| | \overline{\mathsf{Value}} | \Rightarrow v |$ (b) CILRS STEP 2: Train IL agents using DAGGER and strong supervisions from Roach. The improved training scheme uses action distribution as a more informative target, regress value estimation as an auxiliary task,

matches latent feature for knowledge distillation.

Performance Driving Score (↑) on NoCrash-Busy, New Town, New Weather Expert IL with Standard Sueprvision IL with Strong Sueprvision 100% 75% 50% 25% 0% Autopilot (AP) Roach Imitating AP with Standard Supervision Imitating Roach with Strong Supervision NoCrash-busy Train Town, Train Weather NoCrash New Town, New Weather Complex Driving Scenarios



More videos are found at: https://www.trace.ethz.ch/publications/2021/roach