Fine-Tuning an LLM to Perform End-to-End Autonomous Planning

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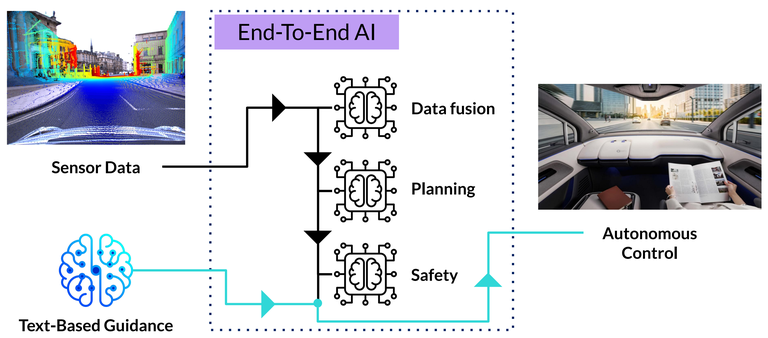
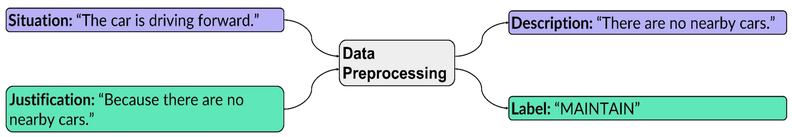
Motivation

- **Objective:** A key aspect of end-to-end planning is choosing what action to take given a current scenario
- **Intuition:** Text is simpler to process and requires less compute
- *Can we model this decision problem by fine-tuning a modern LLM like Mistral-7B?*
- We explore the potential of LLMs in End-to-End Self-Driving applications



Data

- The BDD-X dataset is designed to capture diverse driving conditions, including urban, suburban, and highway environments.

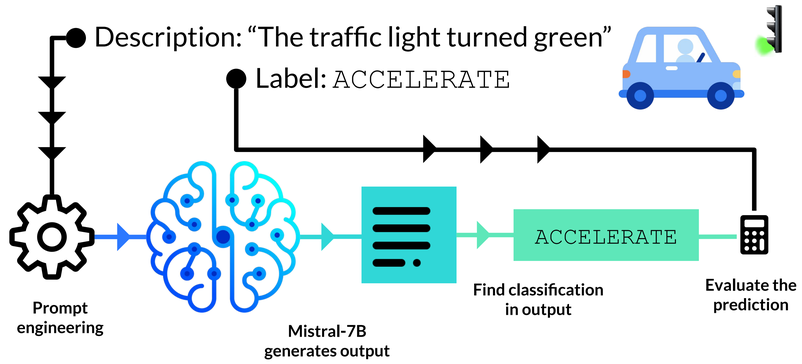


6618 Description-Label pairs after preprocessing

Train	70%
Valid	15%
Test	15%

Methods

- Use an LLM to assign each driving scenario an action label from the options `[SLOW,ACCELERATE, MAINTAIN,STOPPED,LEFT,RIGHT,REVERSE,OTHER]`



Approach 1: Out-of-Box

1. Load `Mistral-7B-Instruct-v0.3`
2. For each example in the validation/test set, we:
   - Set a system role (ie. "AI Driving Assistant)
   - Set a user prompt
     - Zero-shot or few-shot examples
     - Instructions for classification
     - Description of example's driving scenario

Approach 2 : Fine-Tuning

1. Load `Mistral-7B-v0.3`
2. Fine-tune (train) using ~2000 training examples
   - Format a prompt with scenario & label
3. For each example in the validation/test set, we:
   - Format a prompt with scenario & no label
     - The LLM generates the label for us after learning from the examples in the fine-tuning stage

Results

	Exact-Match Accuracy	Close-Match Accuracy
Out-of-Box	44.61%	61.43%
Fine-Tuned	61.18 %	73.06 %

- Exact-Match Accuracy: Every prediction must match the ground-truth label exactly
- Close-Match Accuracy: Certain labels go in the same bucket of similarity, (ie. `SLOW` and `STOPPED`)

Fine-Tuning Loss

The loss falls dramatically between 50 to 100 examples and nears 1.0 at 2000+ examples

Future Work

- Enhance the fine-tuning strategy to incorporate a more diverse set of possible decisions
- Utilize existing work such as DriveGPT to efficiently obtain text descriptions of the current scenario
- Integrate our text-based guidance system into a end-to-end self driving model
- Analyze how the integrated system performs on benchmarks such as CARLA