Driving Mission, Scenarios, and Behaviour

Course 4, Module 1, Lesson 1

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Learning Objectives

- Understand what the autonomous driving motion planning mission entails
- Identify important autonomous driving scenarios based on the road structure and obstacles present
- Identify useful driving behaviours to handle autonomous driving scenarios

Autonomous Driving Mission

- Mission is to navigate from point A to point B on the map
- Mission planning is higher-level planning
- Low-level details are abstracted away
- Goal is to find most efficient path (in terms of time or distance)

Road Structure Scenarios

- Road structure influences driving scenario through lane boundaries and regulatory elements
- Simplest case is driving straight, following the center of the lane
- Minimize deviation from centerline
- Attain reference speed for efficiency

Road Structure Scenarios (cont'd)

- Lane changes are more complex
- Different shapes for different situations
- Shape depends on vehicle speed, acceleration limitations
- Time horizon of execution affects the aggressiveness of the lane change

Road Structure Scenarios (cont'd)

- Left and right turn scenarios are common in intersections and drivelanes
- Shape of turn varies, similar to lane changes
- State of surrounding environment impacts the ability of the vehicle to make turns

Road Structure Scenarios (cont'd)

- U-turns are useful for efficient direction changes
- Shape of U-turn will depend on car's speed and acceleration limits
- Not always possible at all intersections
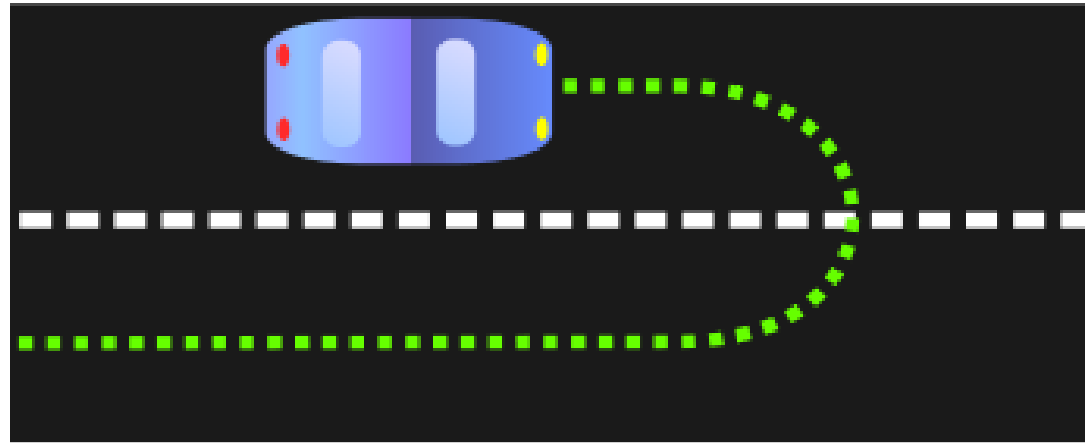
Obstacle Scenarios

- Static and dynamic obstacles also impact the driving scenario
- Static obstacles restrict which locations our path can occupy
- Most important dynamic obstacle is often the leading vehicle in front of the ego vehicle
  - Need to maintain time gap for safety

Obstacle Scenarios (cont'd)

- Dynamic obstacles impact turns/lane changes as well
- Depending on locations and speed, different time windows of execution are available for the autonomous vehicle
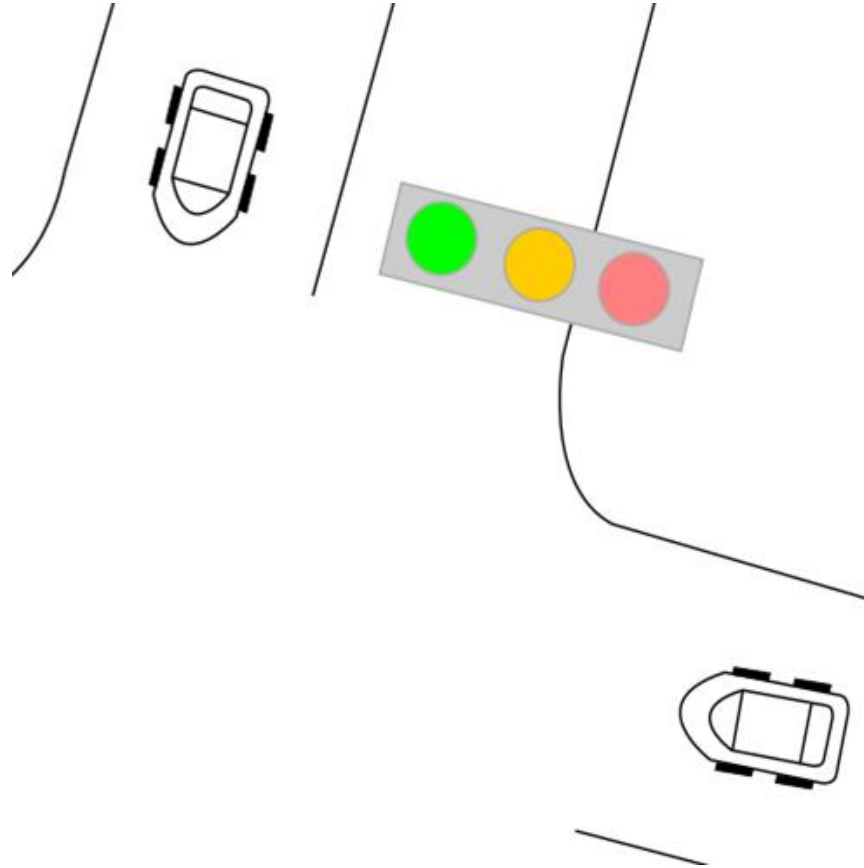- Need to use estimation and prediction to calculate these windows of opportunity

Obstacle Scenarios (cont'd)

- Different dynamic obstacles in the scenario have different characteristics and behaviours

Behaviours

- Speed Tracking
- Decelerate to Stop
- Stay Stopped
- Yield
- Emergency Stop
  - Not an exhaustive list

Challenges

- Only covered a small subset of scenarios
  - Focused on common cases that follow the rules of the road
- Edge cases make the driving task complex
  - e.g. lane splitting, jaywalking

Hierarchical Planning Introduction

- Driving mission and scenarios are complex problems
- Break them into a hierarchy of optimization problems
- Each optimization problem tailored to the correct scope and level of abstraction
- Higher in the hierarchy means more abstraction
- Each optimization problem will have constraints and objective functions
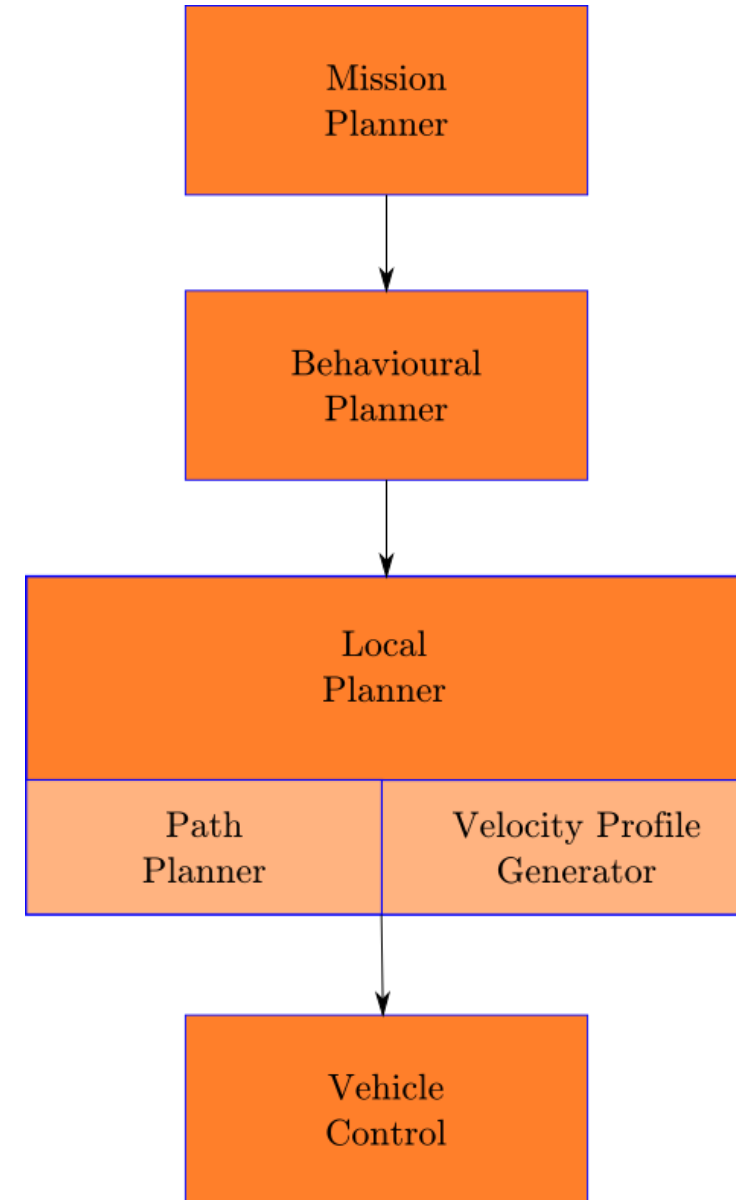
Summary

- Autonomous driving mission is to navigate from our current position to a destination
- Driving scenarios depend on the road structure (turns, lane changes) as well as the obstacles present
- Useful driving behaviours include speed tracking, deceleration, and yielding
- Complex autonomous driving task can be solved in a hierarchical manner