Behavior Planning

Course 4, Module 5, Lesson 1

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Learning Objectives

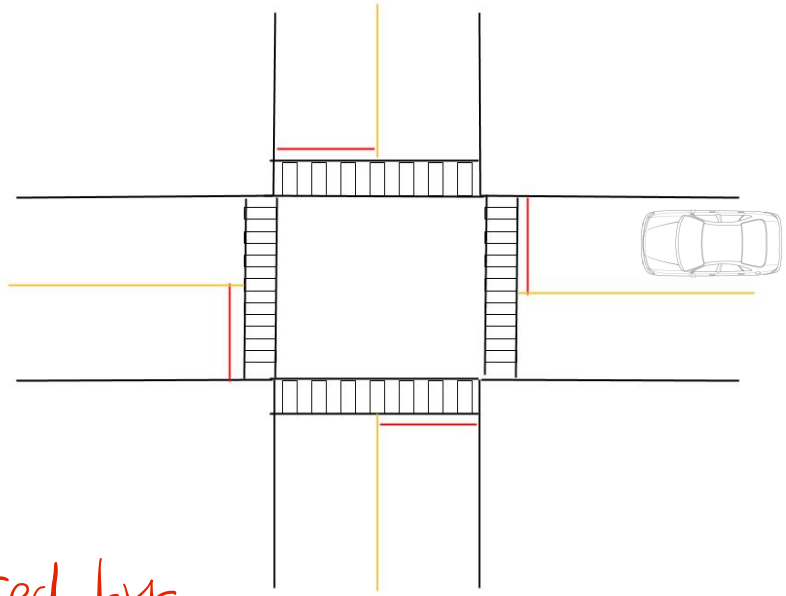
- Define a behaviour planning system
- Understand the standard input and output of a behaviour planner
- Understand state machines as they relate to behavior planning

Behavior Planning

- A behavior planning system plans the set of high level driving actions, or maneuvers to safely achieve the driving mission under various driving situations

- Behavior planner considers:
  - Rules of the road
  - Static objects around the vehicle
  - Dynamic objects around the vehicle

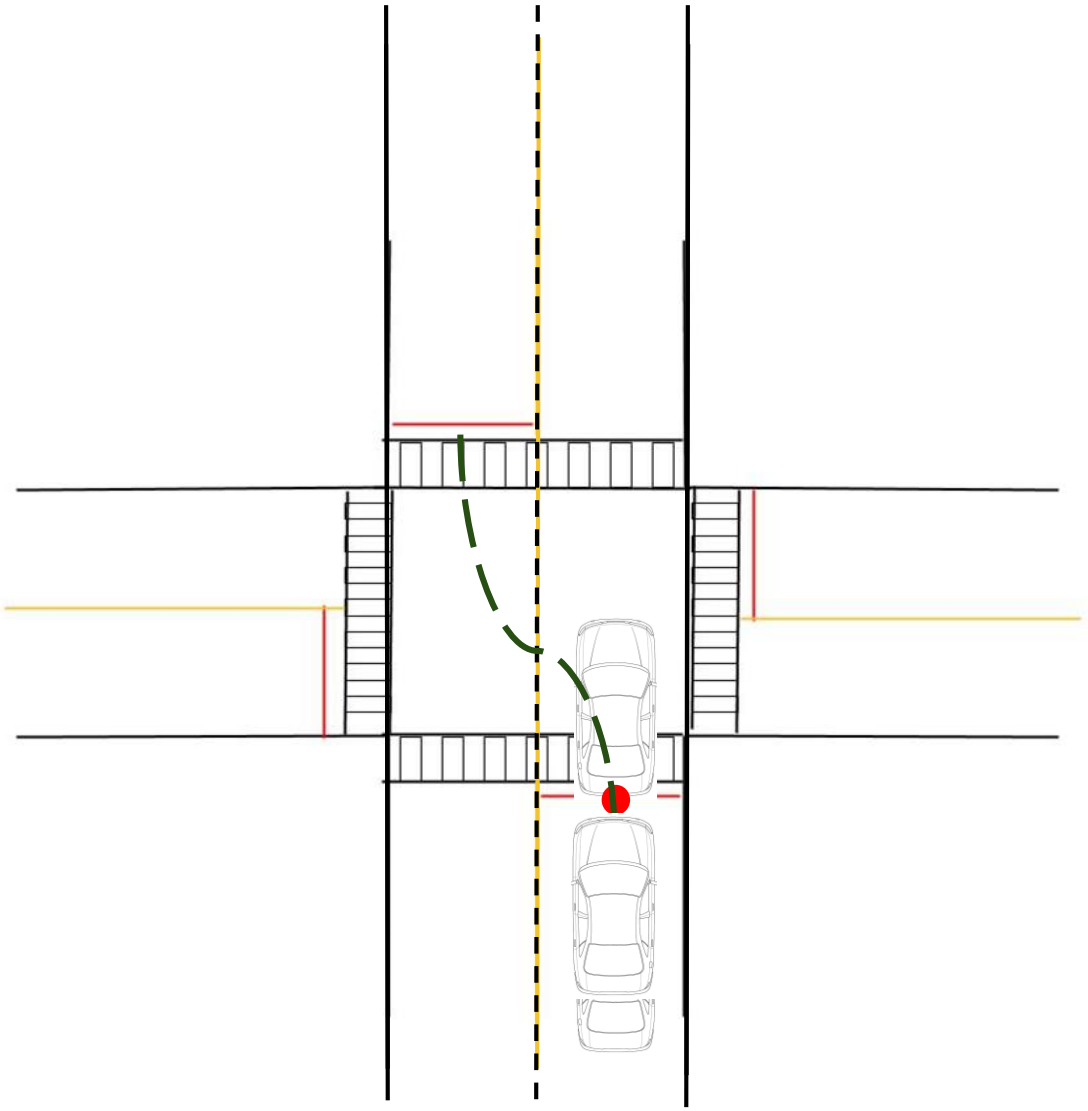
- Planned path must be safe and efficient



Can deal with inputs that are inaccurate (corrupted by measurement noise) & incorrect (perception errors eg FP or FN detections)

Driving maneuvers

- **Track Speed** - maintain current speed of the road
- **Follow leader** - match the speed of the leading vehicle and maintain a safe distance
- **Decelerate to stop** - begin decelerating and stop before a given space
- **Stop** - remain stopped in the current position
- **Merge** - join or switch onto a new drive lane

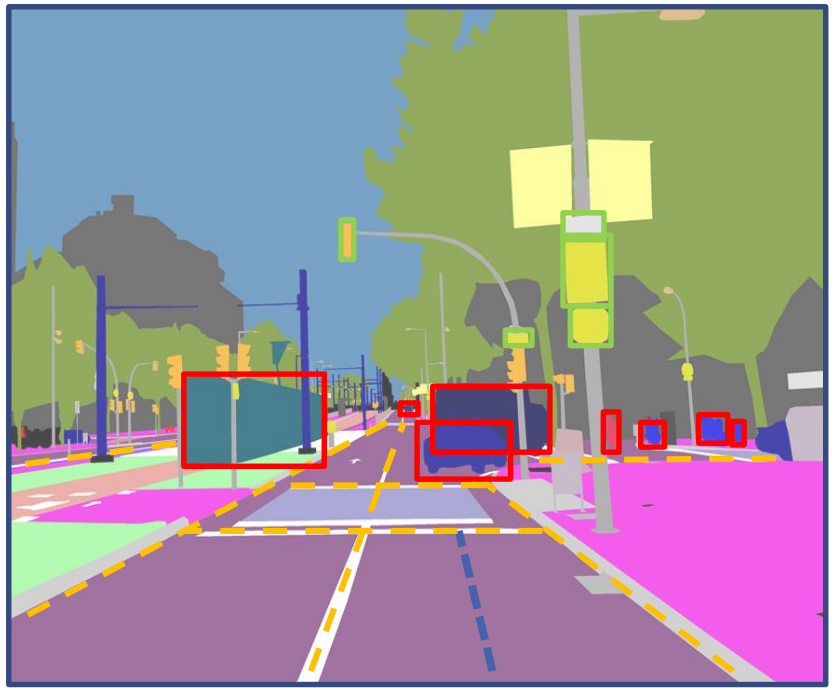


Output of Behavior Planner

- Driving maneuver to be executed
- Set of **constraints** which must be obeyed by the planned trajectory of the self driving car which include:
  - Ideal path center line of current lane.
  - Speed limit
  - Lane boundaries
  - Stop locations
  - Set of interest vehicles

Input Requirements

- High definition road map
- Mission path
- Localization information

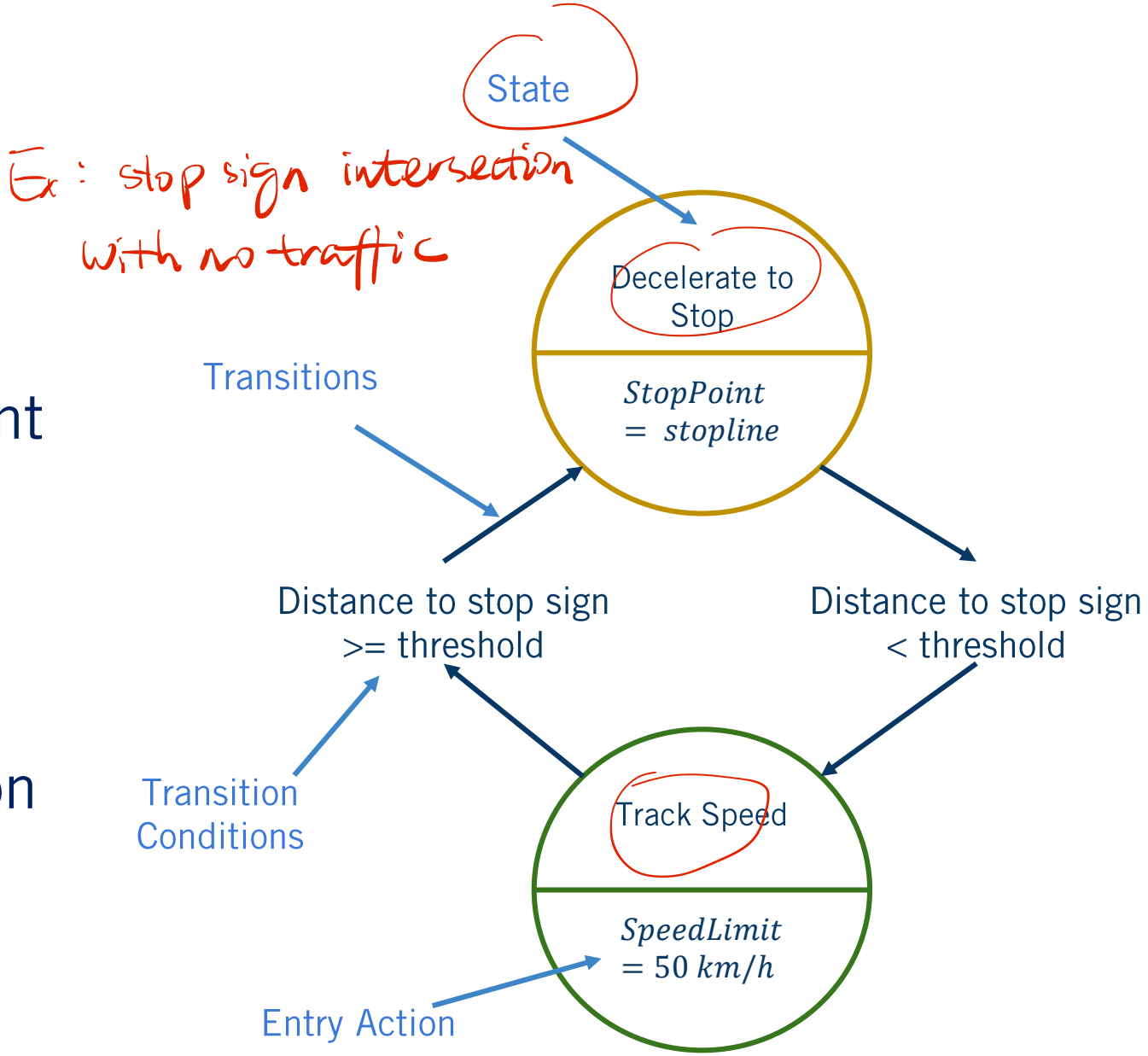


Perception Information:

- All observed dynamic objects
  - Prediction of future movement
  - Collision points and time to collision
- All observed static objects
  - Road signs
- Occupancy grid defining the safe areas to execute maneuvers

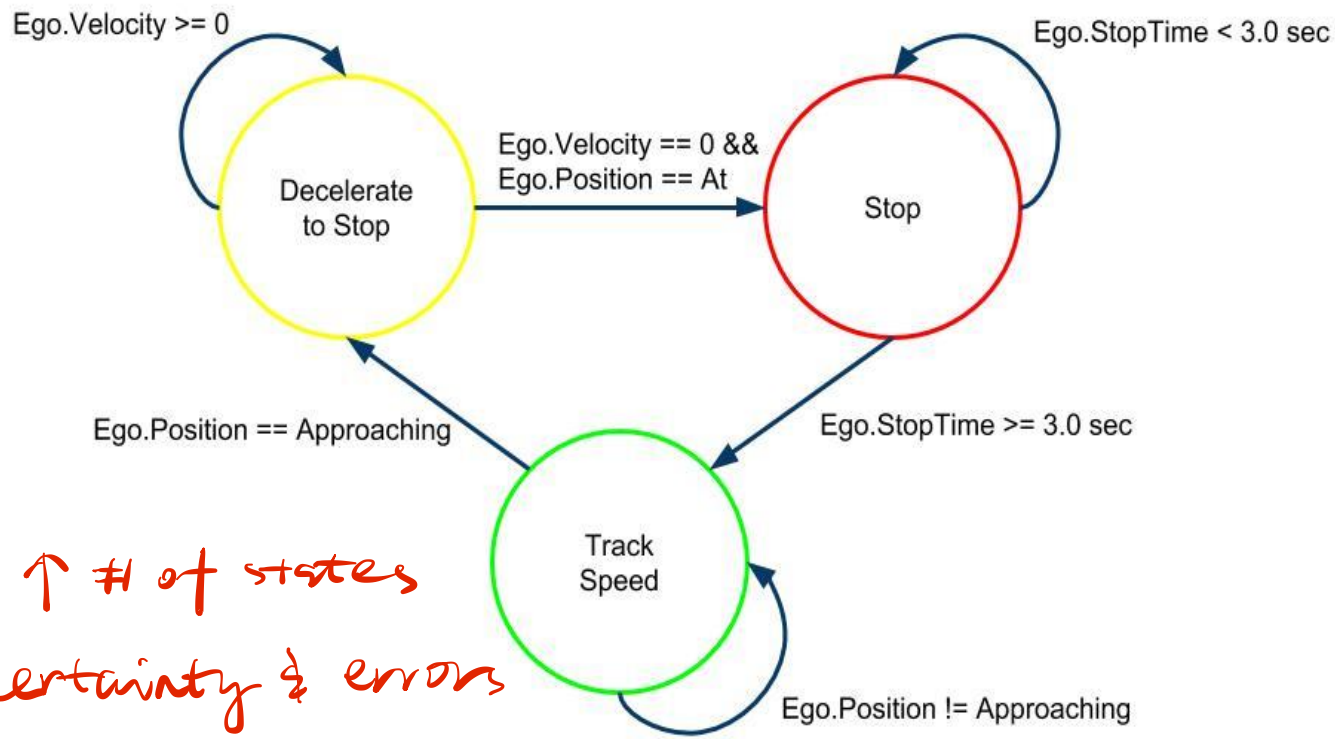
Finite State Machines

- Each state is a driving maneuver
- Transitions define movement from one maneuver to another
- Transitions define the rule implementation that needs to be met before a transition can occur
- Entry action are modification to the constraints



Advantages of Finite State Machines in Behaviour Planning

- Limiting number of rule checks
- Rule become more targeted and simple
- Implementation of the behavior planner becomes simpler



Cons: ◦ complexity↑ with ↑ # of states

◦ cannot handle uncertainty & errors in the input data

Summary

- Defined the role of a behaviour planning system
- Standard input and output of a behaviour planner
- Deploying State Machines as a Behavior Planning
  - Advantages of using a state machine for behavior planning

- **Next**: Building a state machine to handle an intersection scenario without dynamic objects