Section 3: Week 8: Autonomous Driving

Nate Bachmeier

TIM-8110: Programming Languages and Algorithms

May 19, 2019

North Central University

# Autonomous Driving

Some of the most challenging problems of algorithmic study can be found in autonomous vehicles. This is due to driving being less like chess and more like a conversation, in that the context is continuously evolving and formal rules are difficult to define (Fridman, 2017). To correctly maneuver through this conversation the vehicle needs to identify objects and their likely path. In addition to other cars, these vehicles need to react to the unexpected such as a child chasing a ball or debris falling onto the road way.

There is a huge potential to improve the safety, cost, and performance of transportation though autonomous driving. Many newer vehicles are already including ‘driver assisted technologies’ such as lane detection, adaptive cruise control, and automated parallel parking. Despite the advantages of pure autonomy, the broad adoption across mainstream consumer is likely several years out.

# Literature Review

In the meantime, autonomous racing is gaining traction within academia and the industry. This allows research to continue with fewer safety risks as the system under test is enclosed. To further reduce costs much of this research takes place within the context of physics simulators. These simulators are often controlled driven by reinforcement learning algorithms.

## Introduction to Deep Reinforcement Learning

A reinforcement algorithm is a supervised learning algorithm which tries to guide an *agent* through an *environment*. As the agent performs *actions* the *reward function* scores and behavior and signifies satisfaction through numerical values. The agent uses the reward values to construct a *policy*, that maps the expected value of transitioning from one *state* to another.

A baby (agent) might have the objective of walking across the room (environment). During each step (action) its brain is collecting sensor readings (state) and determining if that step moved them closer to dad or caused them to fall (reward function). Actions such as leaning to far forward cause them to tip over and are avoided later (policy). Through enough repetition (training) the baby eventually learns to complete the objective with a high degree of reliability.

## Introduction to Deep Learning and Self-Driving Cars

Computers can use a similar mechanism to learn complex skills such as how to drive a car. Often a