Evolution Background and Motivation

Machine learning is one of the most rapidly growing branches of computer science. Unlike many positions in the software engineering industry, where comprehensive foundational skills offered in our core curriculum are sufficient experience for an entry level job, most ML-focused positions require prior experience developing ML projects.

Upper level courses at Brown are focused on learning techniques to improve speed and accuracy of convergence of ML algorithms. They are often math-intensive and work on a very large scale, with gigabytes of training data, thousands of training inputs to a network, and countless mathematical operations performed on this data to calculate an output. From a high level we can pseudo-conceptualize what networks are doing, but it can be hard to really understand what is happening to the numbers as our model learns.

What is machine learning and why is it becoming such a relevant topic in the news and industry today? What is a neural network? What types of problems is machine learning used to solve? This project begins to answer these questions and offer a gentle introduction to machine learning techniques and workflow.

Context

Neural networks are designed to complete a task. Tasks are typically categorized as one of the following:

1. **Supervised Learning**: the learning of a function that maps an input to an output based on example input-output pairs. We show our function representative examples of cars and bikes; can it identify an unknown vehicle as a car or a bike?

2. **Unsupervised learning**: the learning of a function to find previously unknown patterns in data set without pre-existing labels. We show our function many examples of cars, bikes, trucks, etc, but we don’t define what a car, truck, or bike is. Can our function categorize vehicles into cars, trucks and bikes using patterns in the data?

3. **Reinforcement learning**: training software agents to take actions in an environment to maximize some reward. Can we teach a vehicle to drive itself if we tell it that traffic violations and running over pedestrians are bad and getting closer to our destination is good?

Supervised and unsupervised learning are typically used to classify objects, while reinforcement learning defines the behavior of objects. The transition from the hard coding of instructions of objects to the implementation of a function that can autonomously define these behaviors is the most fluid and intuitive transition from discrete programming to machine learning, as opposed to classification which is an entirely unique concept. After implementing this project, you will understand how an ML algorithm learns how to play a game, and how to create a model that can learn games that you’ve already implemented in this course like DoodleJump and Tetris!