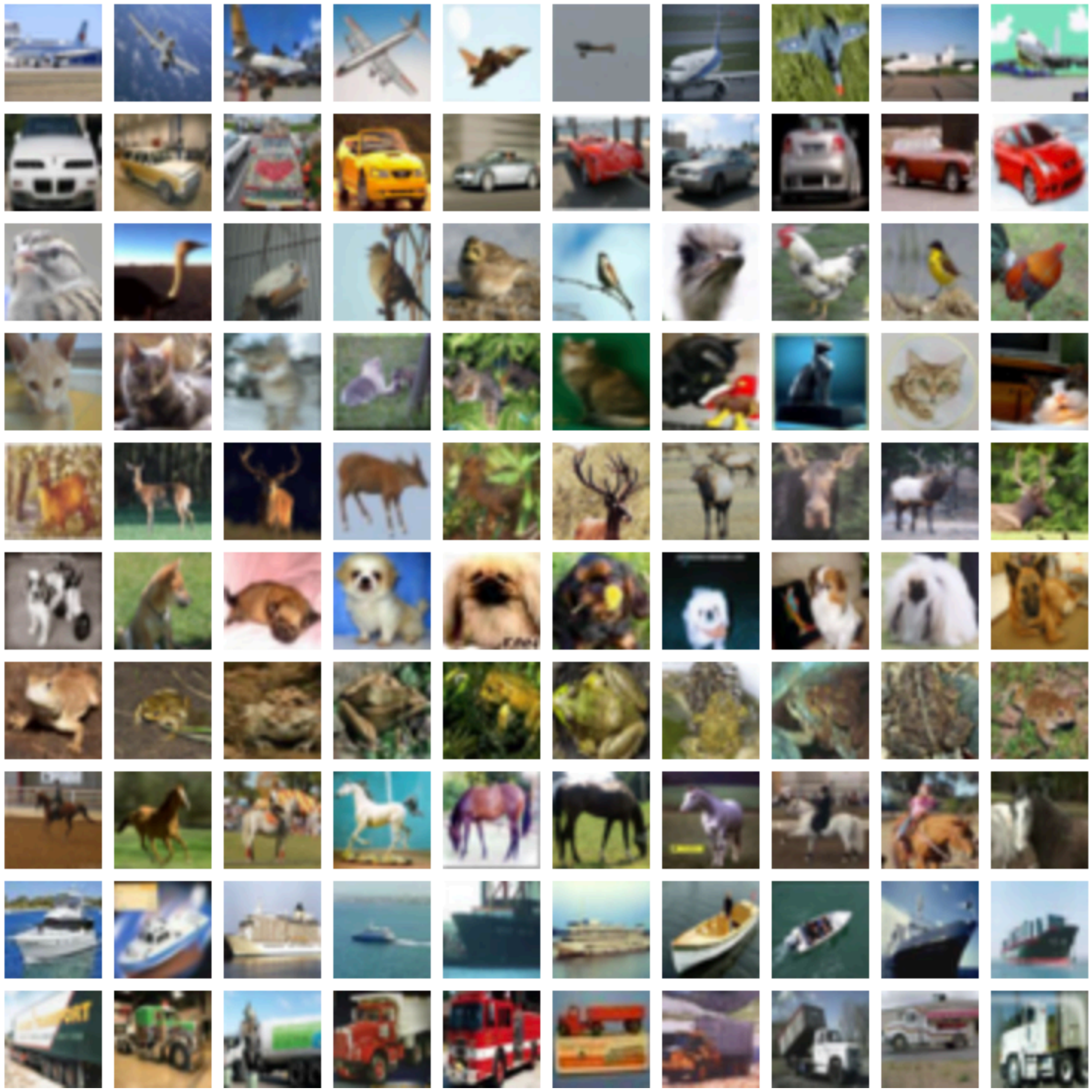
IMAGE CLASSIFICATION



Project Proposal

Prepared for: Metis Staff Instructors(Richard Chiou, Brian McGarry)

Prepared by: Rahul Raju

September 22, 2021

EXECUTIVE SUMMARY

Opportunity

The applications of deep learning are extensive and ever growing. They include virtual assistants, chatbots, fraud detection, NLP, image recognition and text generation to name a few. One area related to deep learning that has received a fair amount of media attention recently is the development of driverless cars. Though the safety and efficacy of driverless vehicles continues to be debated, its advantages are vast. These advantages can be summed up in a series of tweets and quotes by one of the greatest innovators in the field, Elon Musk.

> **Elon Musk** @elonmusk
>
> Humans drive using 2 cameras on a slow gimbal & are often distracted. A Tesla with 8 cameras, radar, sonar & always being alert can definitely be superhuman.
>
> 9:18 PM · Apr 7, 2020

> **ALEX** 🚀 @ajtourville · Apr 7, 2020
>
> Replying to @elonmusk and @thirdrowtesla
>
> Humans react in the second timescale whereas computers operate at the nanosecond timescale
>
> A nanosecond to a second is like a second to 32 years... for a computer, a few seconds are literally lifetimes
>
> **Elon Musk** @elonmusk
>
> Certainly no problem for a 144 trillion operations per second computer to make ~15 steering/acceleration/braking maneuvers per second. That's a trillion calculations between each output command.
>
> 10:43 PM · Apr 7, 2020

The challenges facing this momentous endeavor, however, are far reaching. This can also be represented by another tweet by Musk himself just 1 year after the above tweets.

> **Elon Musk** @elonmusk
>
> Replying to @BLKMDL3
>
> Generalized self-driving is a hard problem, as it requires solving a large part of real-world AI. Didn't expect it to be so hard, but the difficulty is obvious in retrospect.
>
> Nothing has more degrees of freedom than reality.
>
> 7:06 AM · Jul 3, 2021

The fundamental challenge of driverless vehicles, as mentioned by Musk, is taking real-world activities that are designed for *biological* neural networks and transferring them to *artificial* neural networks. The most important component of this challenge is the ability of driverless software to recognize and differentiate objects encountered during daily operations.

Impact/Solution

Image classification via deep learning has had a powerful impact on tackling the challenges facing driver-less vehicle's recognition of objects. Image recognition technology makes use of powerful artificial neural networks to recognize simple and complex patterns in labeled digital images. Automated feature extraction, an important advantage to deep learning, makes it relatively easy to accurately classify unseen data(to varying degrees). This project will exhibit how this process takes place from beginning to end, including its iterative nature through the use of back propagation. The model will be trained on labeled data, that in order to simulate the real world, will include objects commonly and uncommonly encountered during every day driving. Various metrics will be used to evaluate the effectiveness of the modeling, including accuracy, precision and recall. Evaluations can also be conducted for each class of image. The choice of metric would depend on the type of object involved, for example, it would be far important that a vehicle recognizes another vehicle versus correctly recognizing a bird or frog.

Project Data

Source: University of Toronto, https://www.cs.toronto.edu/~kriz/cifar.html

Dataset: Canadian Institute for Advanced Research(CIFAR-10)

Num. Images: 60,000

Num Labels: 10(6,000 images/label)

Labels: airplane, automobile(ex-truck), truck, ship, bird, cat, deer, frog, horse, dog

Project Tools

Analysis: Keras

Visualization: Seaborn

Minimum Viable Product

A minimum viable product would consist of a baseline neural network, using default model parameters.