DISTRACTED DRIVER DETECTION

Using Convolutional Neural Networks and Transfer Learning

By Luisa Rojas-Garcia
Alexandar Mihaylov

PROBLEM STATEMENT

Given a dataset of images, classify each driver's behavior.

Are they driving safely?

Talking on the phone?

Drinking from a cup?

https://www.kaggle.com/c/state-farm-distracted-driver-detection

MOTIVATION

In the U.S alone, **425,000** people are injured, and **3,000** are killed as a result of distracted driving according to the Centers for Disease Control and Prevention (CDC) in 2015.

These numbers only increase as the reliance on technology increases.

RESEARCH NOTE

U.S. Department of Transportation
March 2017

TRAFFIC SAFETY FACTS
Research Note

U.S. Department of Transportation

National Highway Traffic Safety Administration

NHTSA

DOT HS 812 381   Summary of Statistical Findings   March 2017

Distracted Driving 2015

The National Highway Traffic Safety Administration (NHTSA) works to reduce the occurrence of distracted driving and raise awareness of its dangers. This risky behavior poses a danger to vehicle occupants as well as pedestrians and bicyclists. Driver distraction is a specific type of driver inattention. Distraction occurs when drivers divert their attention from the driving task to focus on some other activity. Oftentimes, discussions regarding distracted driving center around cell phone use and texting, but distracted driving also includes other activities such as eating, talking to other passengers, or adjusting the radio or climate controls. A distraction-affected crash is any crash in which a driver was identified as distracted at the time of the crash.

- Ten percent of fatal crashes, 15 percent of injury crashes, and 14 percent of all police-reported motor vehicle traffic crashes in 2015 were reported as distraction-affected crashes.

- In 2015, there were 3,477 people killed and an estimated additional 391,000 injured in motor vehicle crashes involving distracted drivers.

- Nine percent of all drivers 15 to 19 years old involved in fatal crashes were reported as distracted at the time of the

As defined in the *Overview of the National Highway Traffic Safety Administration's Driver Distraction Program* (Report No. DOT HS 811 299), distraction is a specific type of inattention that occurs when drivers divert their attention from the driving task to focus on some other activity instead. The document describes distraction as a subset of inattention (which also includes fatigue, and physical and emotional conditions of the driver). However, while NHTSA may define the terms in this manner, inattention and distraction are often used interchangeably or simultaneously in other material, including police crash reports. It is important that NHTSA and NHTSA's data users be aware of these differences in definitions. It is also important to acknowledge the inherent limitations in the data collection for distraction-affected crashes and the resulting injuries and fatalities. The appendix of this document contains a table that describes the coding for distraction-affected crashes for FARS and GES as well as a discussion regarding limitations in the distracted driving data.

Data

Fatalities in Distraction-Affected Crashes

In 2015, there were a total of 32,166 fatal crashes in the United
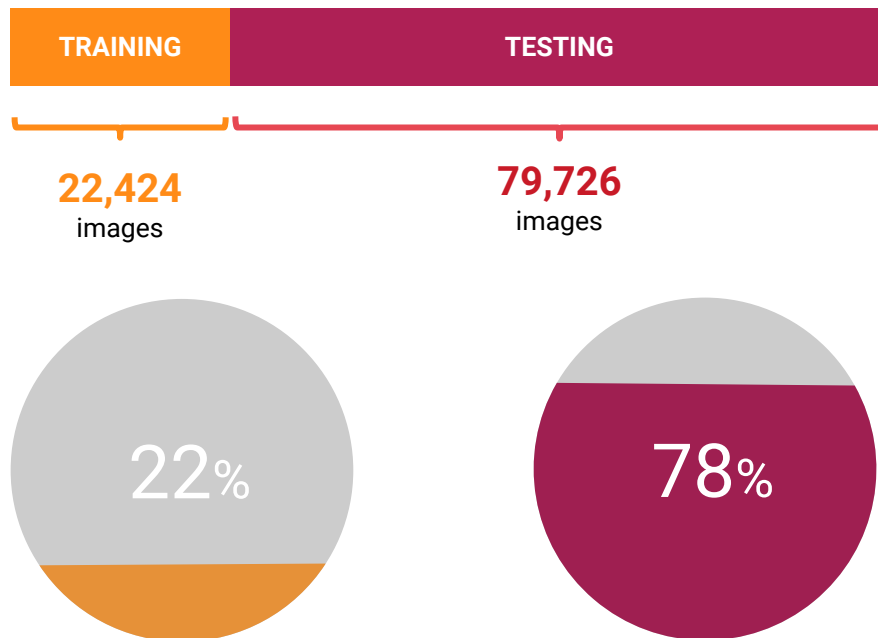
DATA

DISTRACTED DRIVER DETECTION COMPETITION

Platform for data science

competitions and tutorials

Provide a dataset of labeled and

unlabeled images of

(non)distracted drivers.

DATA

CLASS	DESCRIPTION
c0	Safe driving.
c1	Texting (right hand).
c2	Talking on the phone (right hand).
c3	Texting (left hand).
c4	Talking on the phone (left hand).
c5	Operating the radio.
c6	Drinking.
c7	Reaching behind.
c8	Hair and makeup.
c9	Talking to passenger(s).

TRAINING	TESTING

22,424
images

79,726
images

22%

78%

DATA

TESTING SET

Multi-class logarithmic loss

$$loglos = -\frac{1}{N} \sum_{i=1}^{N} \sum_{j=1}^{M} y_{ij} \log(p_{ij}),$$

Run the model on the test data	Submit Predictions to Kaggle	Obtain Score and a ranking on the leaderboards

https://www.kaggle.com/c/state-farm-distracted-driver-detection

DATA

TRAINING SET

Labeled data

TESTING	TRAINING
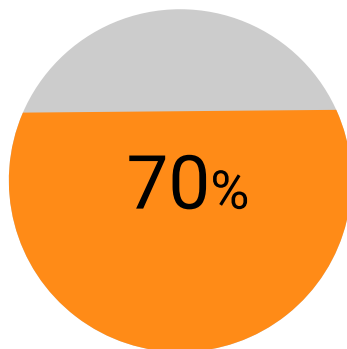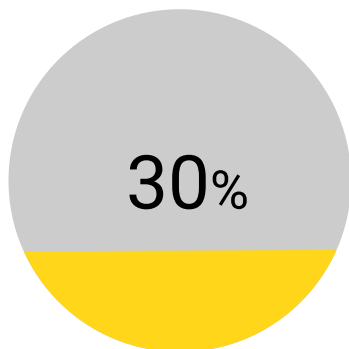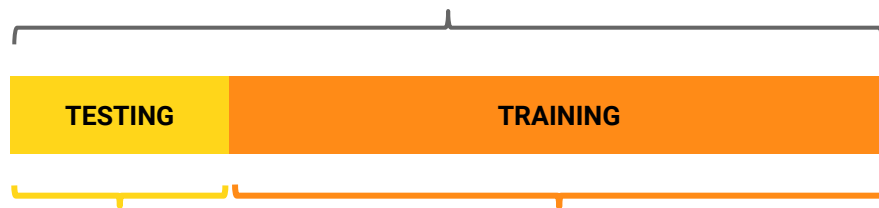
30%   70%   ➡   ACCURACY %

DATA

DRIVER IMAGE EXAMPLES

Safe driving
(c0)

Texting with right hand
(c1)

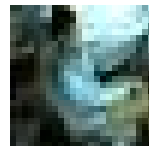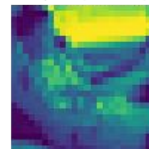Doing hair & makeup
(c8)

DATA MANIPULATION

AUGMENTATION

Original

(640 x 480)

Original

Rotated

DATA CLEANING

(640 x 480)
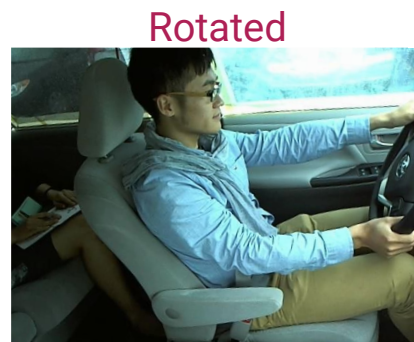
(24 x 24)

greyscale

IMPLEMENTATION

CONVOLUTIONAL NEURAL NETWORK

linear transformation to produce logits

fully connected layer with **rectified linear activation**

normalization

maxpool

convolution and **rectified linear activation**
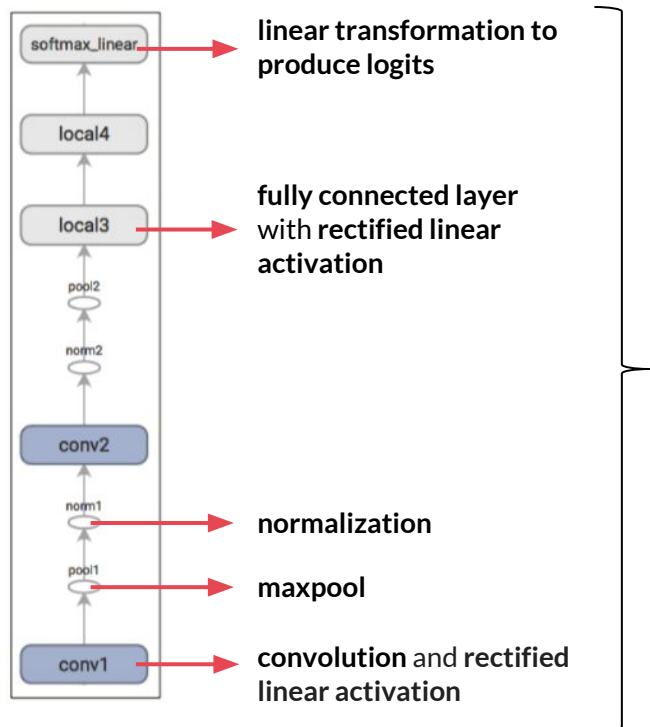
Alternating convolutions & nonlinearities

Softmax Classifier

86% accuracy on CIFAR-10, with few

hours of training (GPU)

DEMO

CONVOLUTIONAL NEURAL NETWORK

https://www.tensorflow.org/tutorials/deep_cnn
https://udemy-images.udemy.com/course/750x422/1326292_4dcf.jpg

CHALLENGES

- **HARDWARE**
  - Running on laptop CPU is not practical for training model
  - Need GPU Hardware
  - None immediately available at our disposal

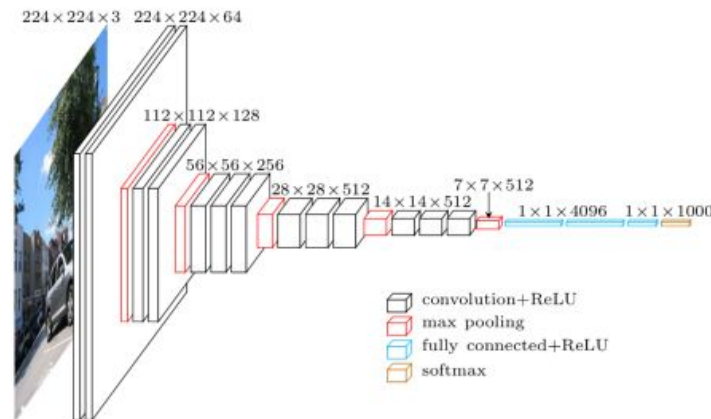- **CLOUD COMPUTING SERVICES**
  - Digital Ocean
  - Google Cloud Platform
  - GPUs on the cloud are very expensive

TRANSFER LEARNING

DEEP CONVOLUTIONAL NETWORK VGG16

- 16-layer Convoluted Network

- 3 fully connected Layers

- 92.7% top-5 test accuracy in ImageNet Challenge

- Pre-trained weights available

- Use to reduce training time

- Increase accuracy

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