Vehicle image classification using CNN to determine vehicle make & model

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Problem Statement

Vehicle image classification using CNN to determine vehicle make & model

- Aims to develop an effective and precise VMMR model

- Existing Challenges
    - Outdoor Environment
    - Shadow and Reflections
    - Visual similarities between model of same manufacturer
    - Visual similarities between model of different manufacturer

- Modeling and Metric

Workflow

- ➜ **Image Collection**
    - ◆ Toyota Camry 2007 base model (1174)
    - ◆ Random Car models (906)

- ➜ **Exploratory Data Analysis**
- ➜ **Model preparation**
- ➜ **Modeling**
    - ◆ Baseline model
    - ◆ CNN model 1 (Original images)
    - ◆ CNN model 2 (Augmented images)

- ➜ **Model selection**
    - ◆ Accuracy

- ➜ **Model Evaluation**
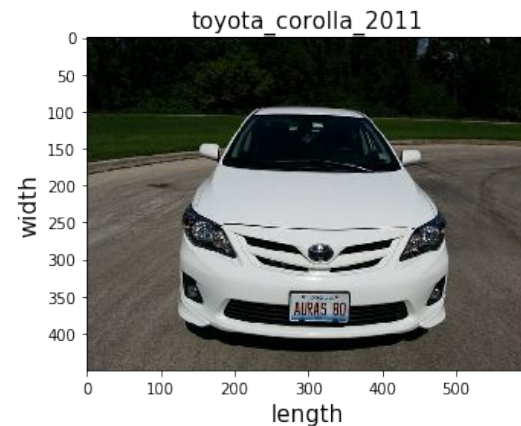   - ◆ Misclassification
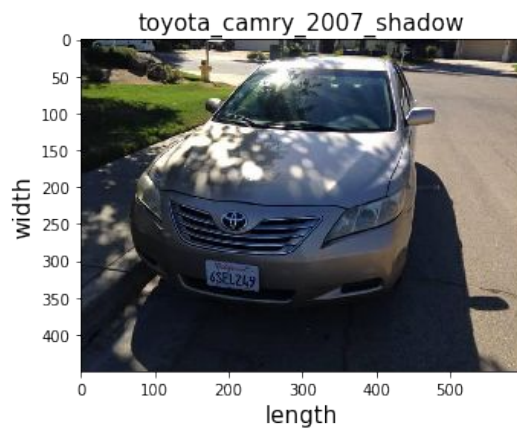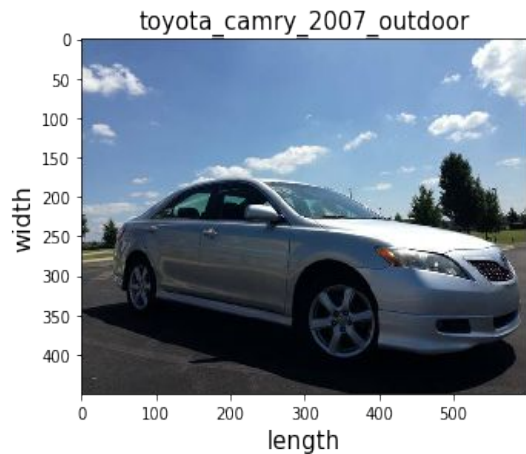   - ◆ Visual Activation layers

- ➜ **Conclusion**
- ➜ **Recommendation**
- ➜ **Prediction**

Glimpse of Images

Car images with challenges

toyota_camry_2007_outdoor

toyota_camry_2007_shadow

toyota_corolla_2011

# Glimpse of Images

Rotation and Flipping
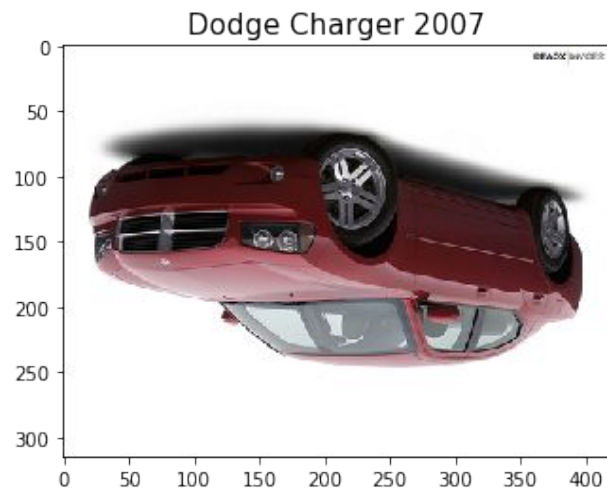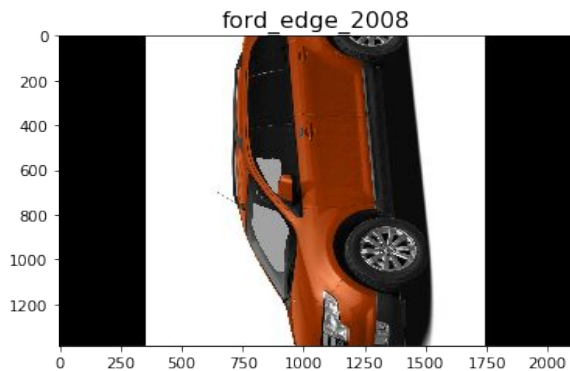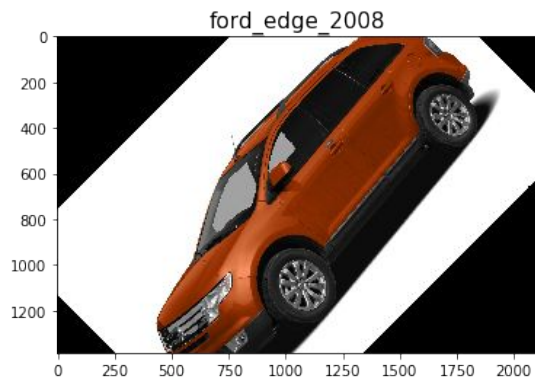
Modeling

1. **Baseline Model**
2. **Convolutional Neural Network (CNN) Model 1: with original images**
3. **Convolutional Neural Network (CNN) Model 2: With augmented images**

- Our CNN models have all together 20 layers including convolutional layers, pooling layers, dropouts, flatten layers and dense layers
- Our CNN model uses over 130,000 parameters. Most of the parameters come from the second convolutional layer.
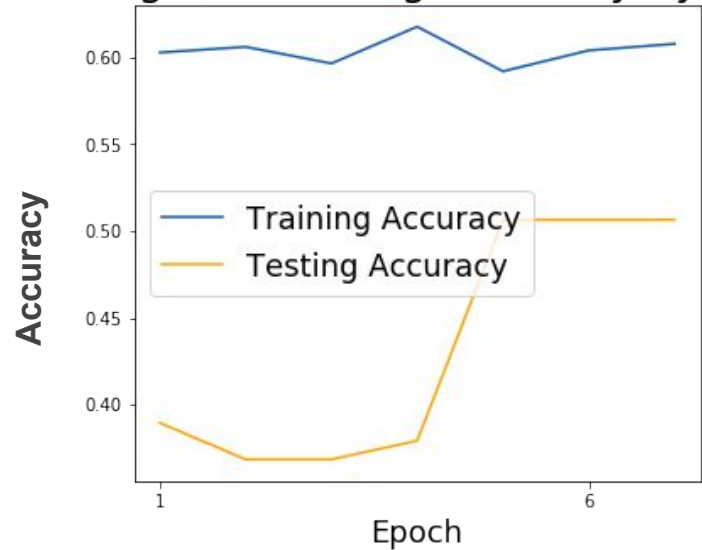
Accuracy Graphs

Training and Testing Accuracy by Epoch
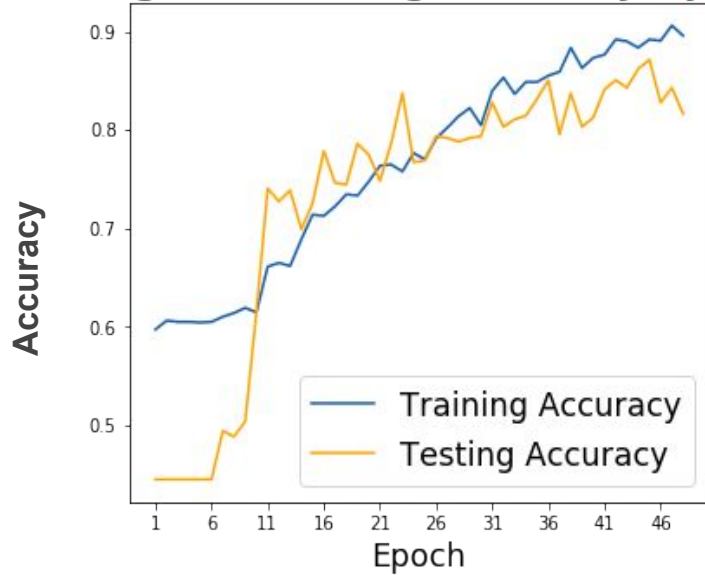
CNN Model 1 (original images)

Training and Testing Accuracy by Epoch

CNN Model 2 (Augmented images)

CNN Model with Augmented Images

Model Selection

Model	Accuracy on train set	Accuracy on test set
Baseline Model	60.5%	55.5%
CNN Model 1	**89.2%**	**87.1%**
CNN Model 2	60.8%	50.6%

Model Evaluation

Investigating misclassified images:

False Positive:

False Negative:

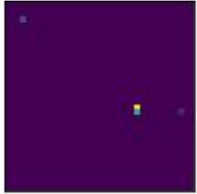# CNN Activation Visualization

Convolutional Layer #1
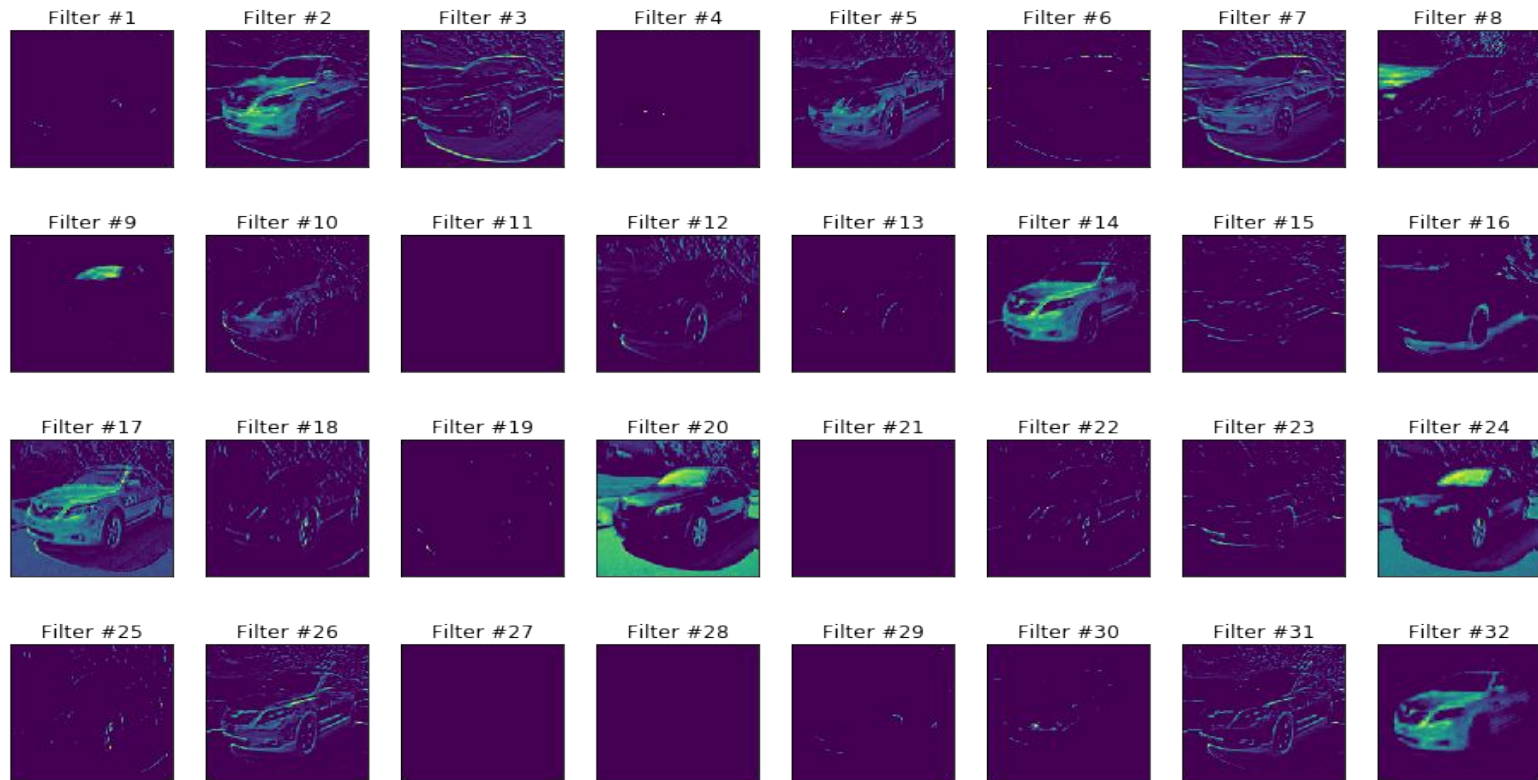
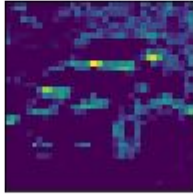# CNN Activation Visualization

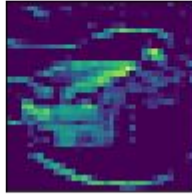## Convolutional Layer #3

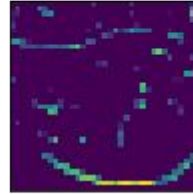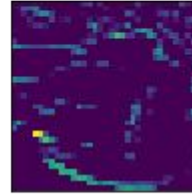| Filter #1 | Filter #2 | Filter #3 | Filter #4 | Filter #5 | Filter #6 | Filter #7 | Filter #8 |

Conclusion and Recommendation

★ **Best model : CNN Model with original images**
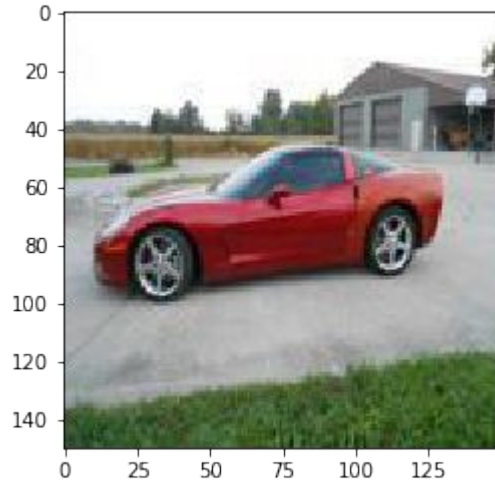★ **Future Steps**
  ○ **Multi Classifications**
  ○ **Improve accuracy**
    ■ What we need to achieve that?
      ● More Images
      ● More Images
      ● More Images
      ● High resolution images
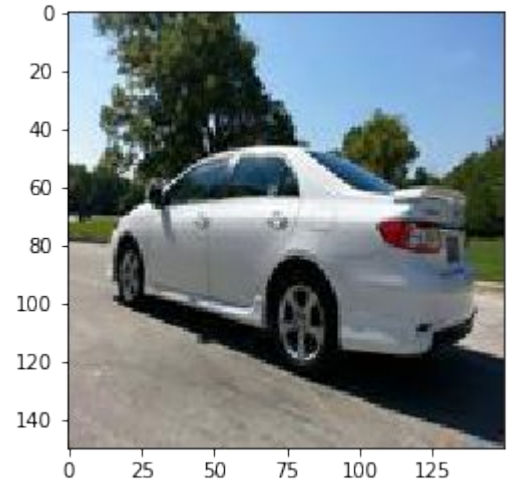   ● Images with different surroundings

Predictions

Predicted Class [1] **Predicted Class [0]** **Predicted Class [0]**

Thank you