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

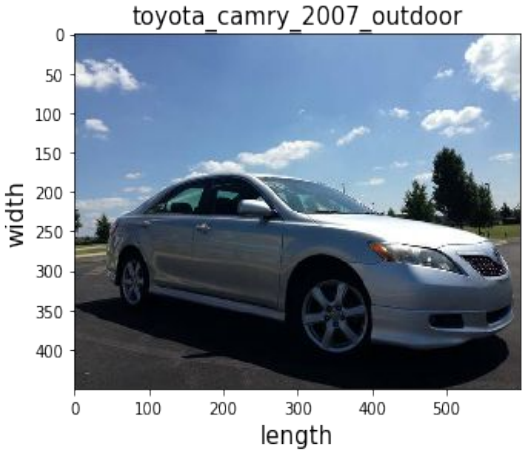
- Modeling and Metric

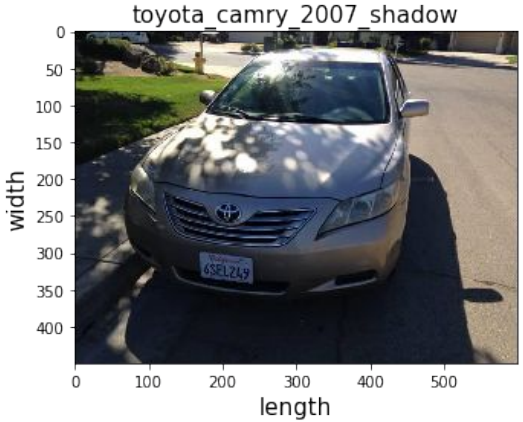
Workflow

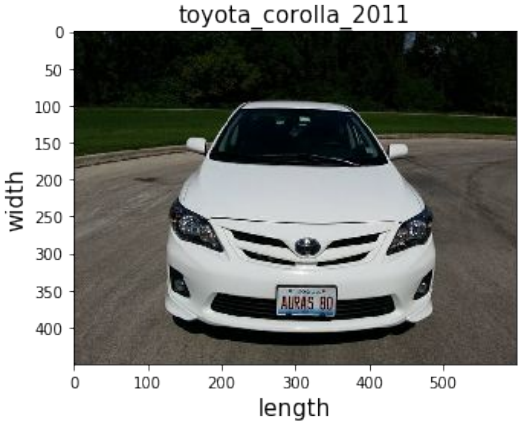
- **Image Collection**
  - Toyota Camry 2007 base model (1174)
  - Random Car models (906)
- **Exploratory Data Analysis**
- **Model preparation**
- **Modeling**
  - Baseline model
  - CNN model 1 (Original images)
  - CNN model 2 (Augmented images)
- **Model selection**
  - Accuracy
- **Model Evaluation**
  - Misclassification
  - Visual Activation layers
- **Conclusion**
- **Recommendation**
- **Prediction**

Glimpse of Images

Car images with challenges

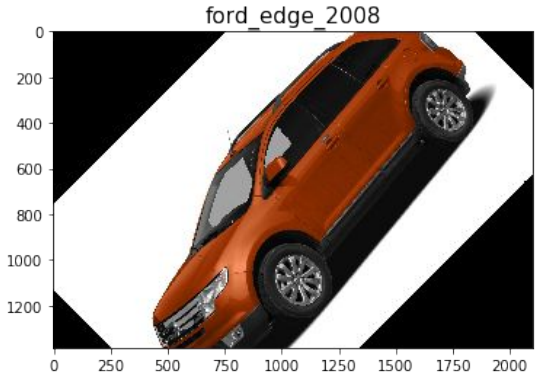


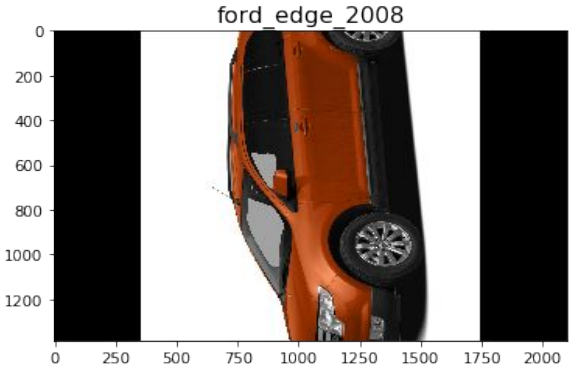


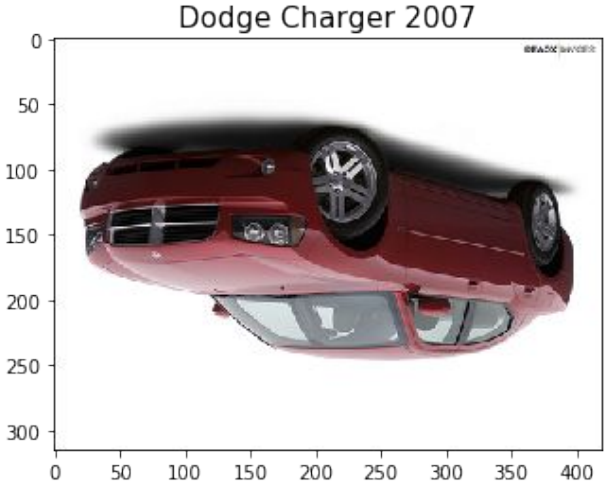


Glimpse of Images

Rotation and Flipping





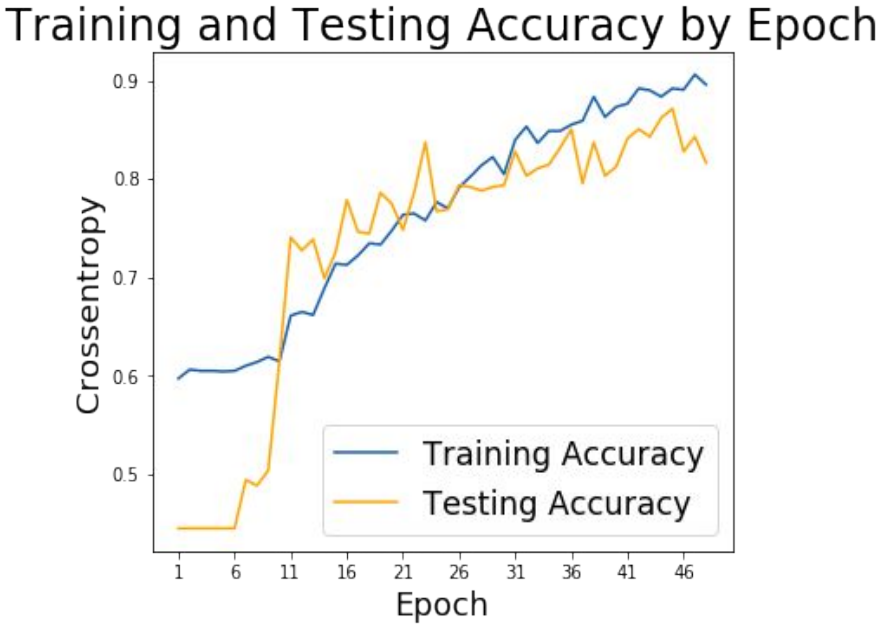


Modeling

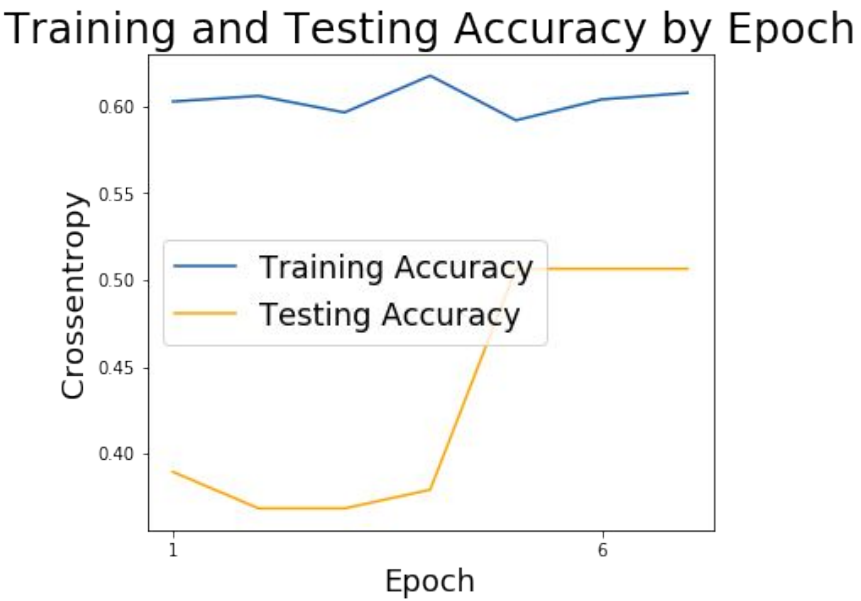
1. **Baseline Model**
2. **Convolutional Neural Network (CNN) Model 1: with original images**
3. **Convolutional Neural Network (CNN) Model 2: With augmented images**

- 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



CNN Model 1 (original images)



CNN Model 2 (Augmented images)

CNN Model with Augmented Images

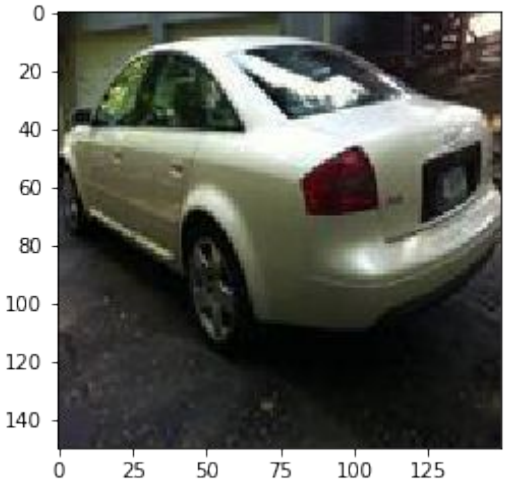
Model Selection

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

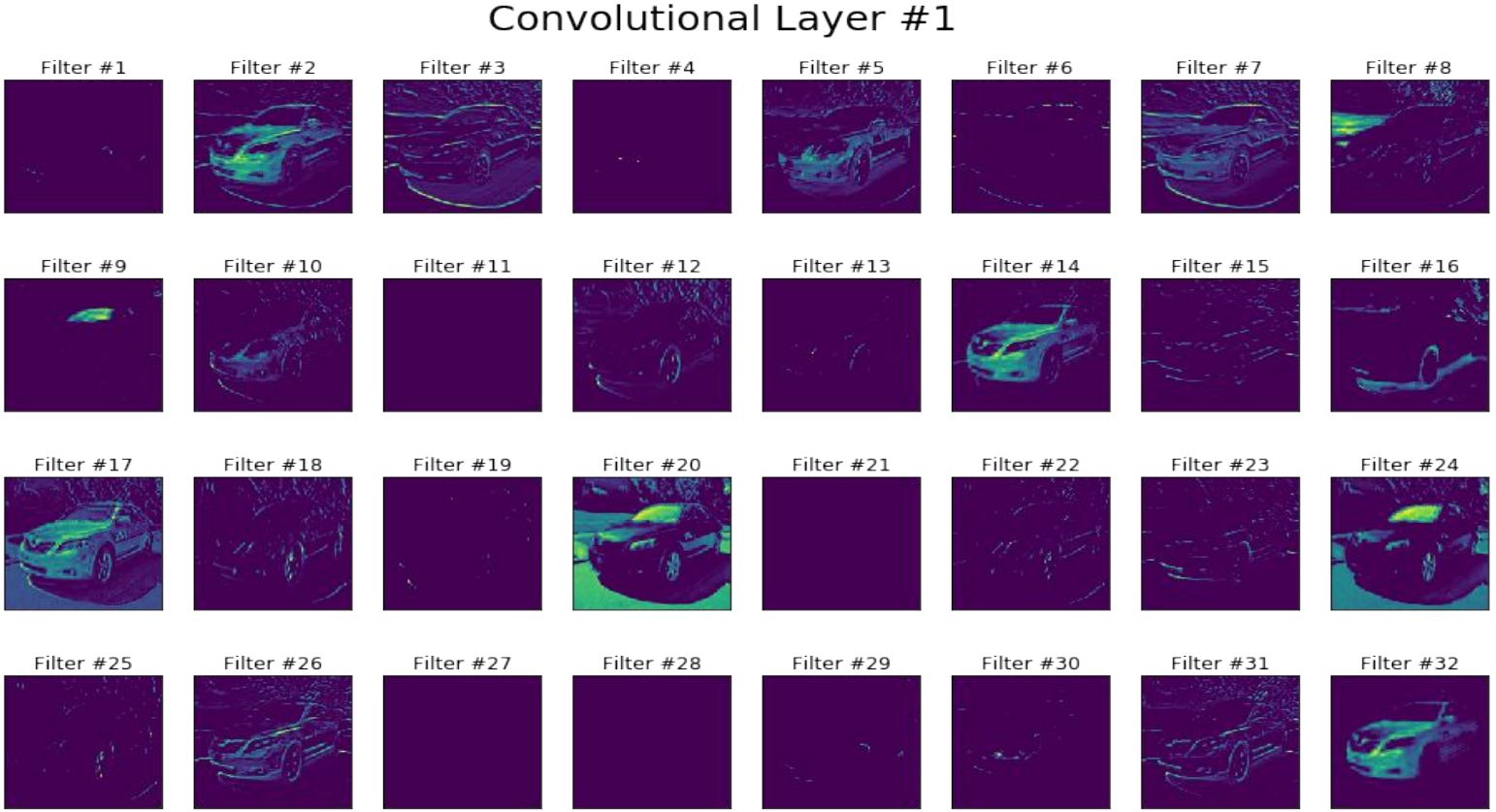
Investigating misclassified images:

False Positive:

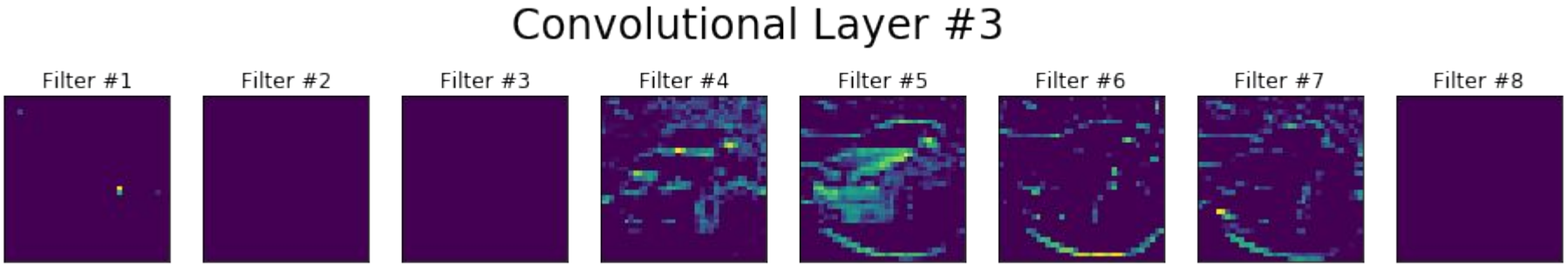


False Negative:

CNN Activation Visualization



CNN Activation Visualization

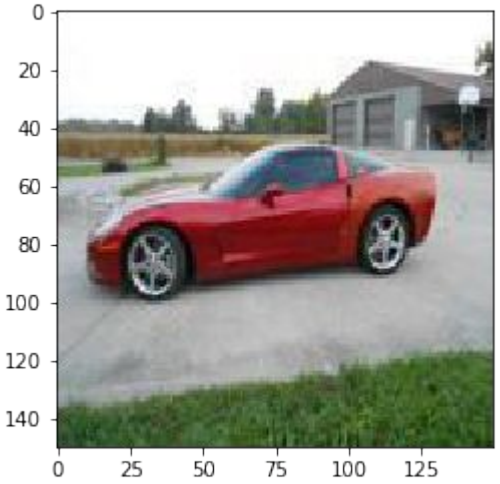


Conclusion and Recommendation

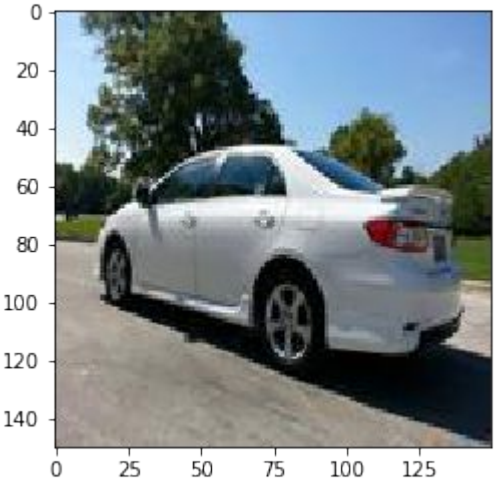
- ★ **Best model : CNN Model with original images**
- ★ **Future Steps**
  - ○ **Multi Classifications**
  - ○ **Improve accuracy**
    - ■ What we need to achieve that?
      - More Images
      - More Images
      - More Images
      - High resolution images
      - Images with different surroundings

Predictions

Predicted Class [1]



Predicted Class [0]



Predicted Class [0]

Thank you