**Introduction**

- Driving distraction has always been a driving safety issue.
- With the goal of detecting driver distractions, we want to design a driver posture classification system—classify the input image into 10 classes, such as texting, drinking, etc.
- Fully Connected Neural Network (FC), Basic Convolutional Neural Network (CNN), Transfer learning using VGG-16 and Inception-v4 are compared in this classification problem.

**Models**

- **Fully Connected(FC)**
- **VGG-16**
- **Inception-v4**

**Data**

- Use the dataset provided by the State Farm in the Kaggle Challenge. Consists of mages (640x480 pixels RGB) with different drivers’ behaviors.
- Train set contains 22,400 labeled images, test set contains 79,727 unlabeled images.
- Use K-folds cross-validation method to split training data into training set and validation set.
- Resized the images from size 640x480x3 into 150x150x3.

**Method**

- We use the log loss function given as follow:

\[
\text{logloss} = \frac{1}{N} \sum_{i=1}^{N} \sum_{j=1}^{M} y_{ij} \log(p_{ij})
\]

**Summary**

- **Fully Connected Neural Network**: High bias with the lowest accuracy and Kaggle score. Deeper and more complicated model should be proposed.
- **Basic CNN**: Improve performance dramatically but still have serious overfitting problem. We use adam optimizer with learning rate 0.001 and trained the model with 20 epochs.
- **VGG-16**: Relatively low bias with high overfitting problem. We use adam optimizer with learning rate 0.001 and trained the model with 15 epochs.
- **VGG-16 + KNN**: Improve VGG-16 model a little bit but still need future improvement.

**Results & Analysis**

<table>
<thead>
<tr>
<th>Models</th>
<th>Epoch</th>
<th>Batch Size</th>
<th>Validation Accuracy</th>
<th>Validation Loss</th>
<th>Kaggle Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>VGG-16</td>
<td>15</td>
<td>16</td>
<td>85.01%</td>
<td>0.4954</td>
<td>0.64</td>
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<tr>
<td>Basic CNN</td>
<td>20</td>
<td>64</td>
<td>74.38%</td>
<td>1.2081</td>
<td>1.32</td>
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<tr>
<td>Fully Connected</td>
<td>20</td>
<td>64</td>
<td>11.4%</td>
<td>6.1</td>
<td>6.8</td>
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<tr>
<td>VGG-16 + KNN</td>
<td>15</td>
<td>16</td>
<td>86.23%</td>
<td>0.4523</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Table 1 Results comparison of different models

**Confusion Matrix**

Fig.6 Confusion matrix using basic CNN(left) and VGG-16(right)

**Ongoing & Future Work**

- Perform the data augmentation
- Currently training and debugging Inception-v4 model.
- Pseudo Labeling

**Reference**