# Facial Expression Recognition

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# Facial Expression Recognition Summary

- The goal of this project is to determine if a person's facial expressions can be learned and predicted in real time.
- The data used for training the model includes over 26,000 labeled images depicting different facial expressions.
- The model produced is able to predict facial expressions with 70% accuracy.

# Problem Statement

Can a person’s mood be predicted from facial expressions in pictures? Can this prediction be used in real time to improve user interactions with utilities like digital assistants?

# Data Used

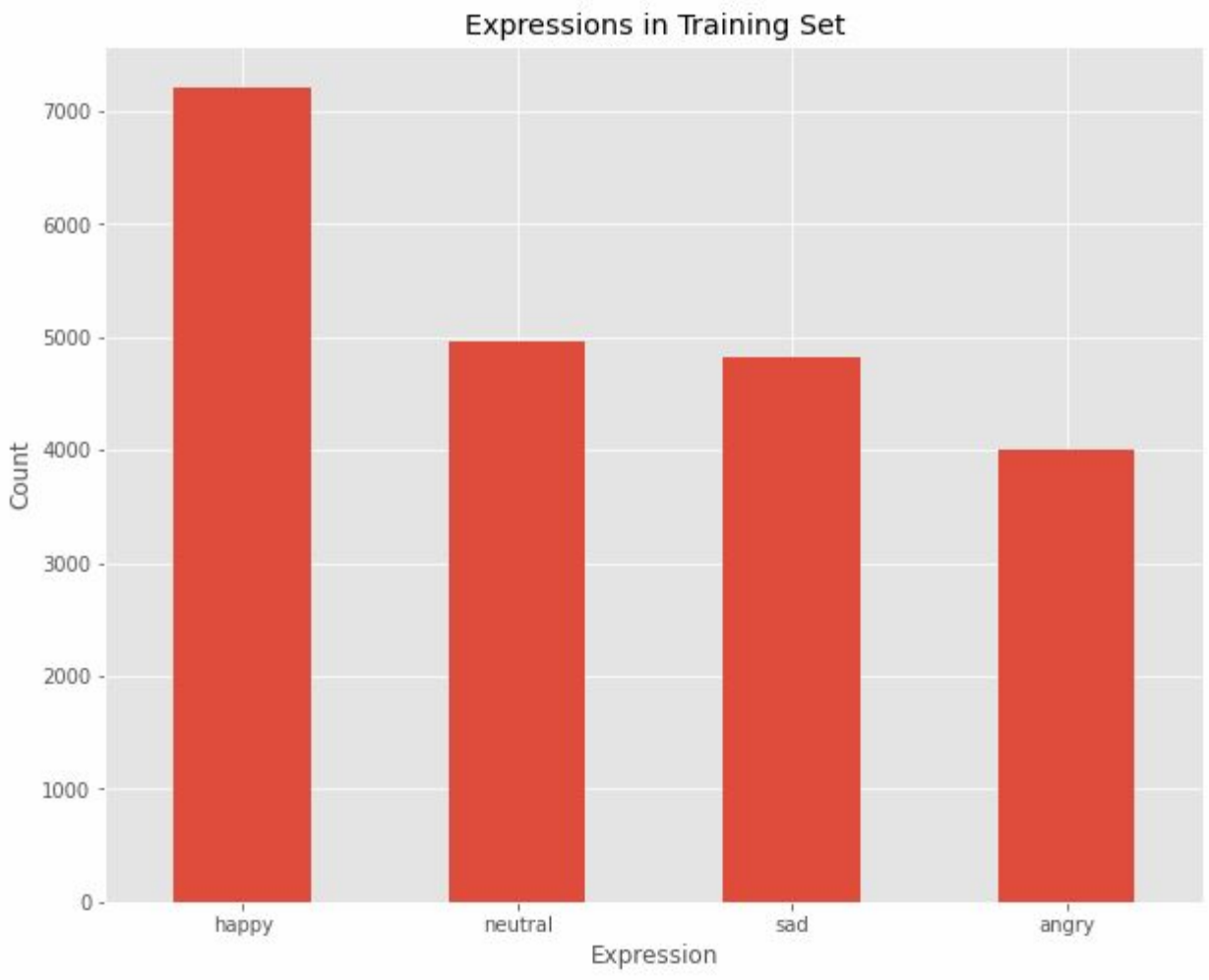
- The data used for this project is from the Facial Expression Recognition - 2013 dataset found on Kaggle
- Initial exploration was done one the full data, but later modeling involved limiting the data to just 4 expressions. The full dataset contains over 30,000 black and white images of different facial expressions which are all labeled.
  - ‘Disgust’, ‘fear’, ‘surprise’ were removed
- 4 expressions with 26,000+ total images

# Data Breakdown

| Expression | Train | Test | Total | Percentage |
|---|---|---|---|---|
| Angry | 3995 | 958 | 4953 | 18.89% |
| Happy | 7215 | 1774 | 8989 | 34.29% |
| Neutral | 4965 | 1233 | 6198 | 23.64% |
| Sad | 4830 | 1247 | 6077 | 23.18% |

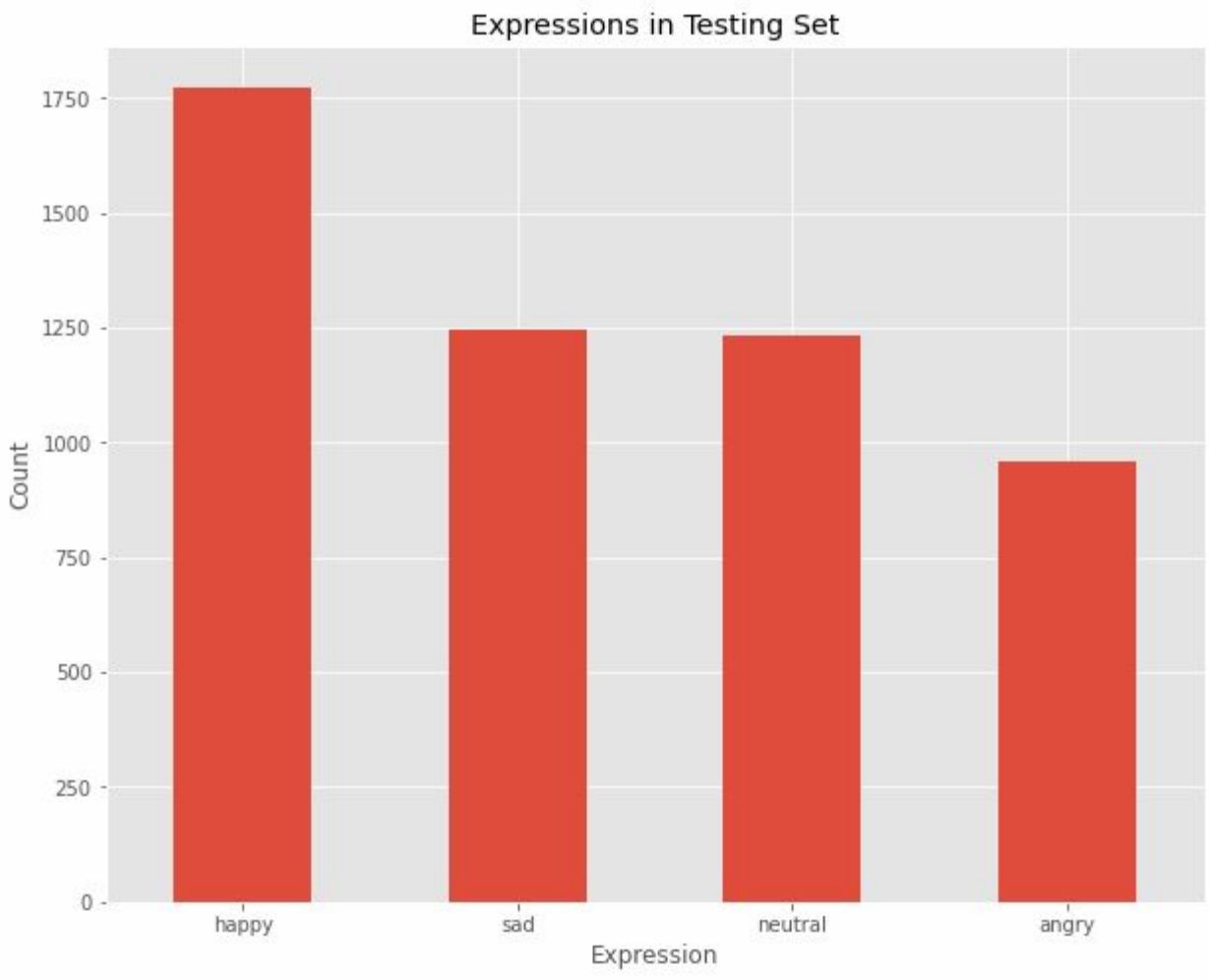
# Train Data Info

- Happy has 2,000 more examples in the training data than the next closest class



# Test Data Info

- Still more examples of happy than other classes, but distribution is very similar to the training data

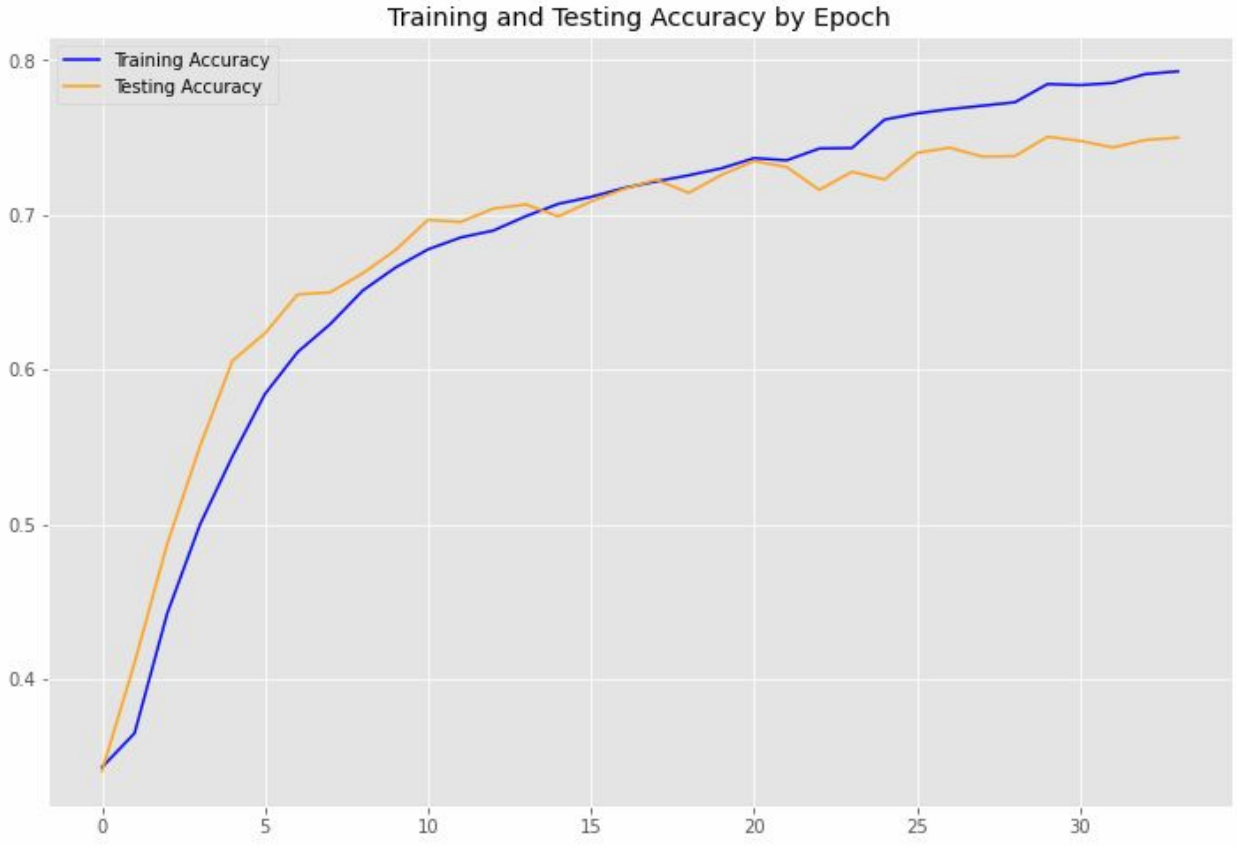


# Building the model

- Used a convolutional neural network to predict if a facial expression was happy, angry, sad, or neutral.
- Convolutional neural networks generate a feature map of an image to detect edges and recognize aspects of objects.

# Model Performance

# Model Performance



# Model Performance

- The model is very good at predicting happy expressions, but does tend to predict happy more than other expressions.
  - This is expected as there are quite a few more examples of happy expressions in the data
- The hardest expression for the model to detect is angry
  - This is expected as angry has the lowest number of examples in the data
- Neutral and sad see similar results, but the model is not quite as good at predicting these as it is with predicting happy

# Application of the Model

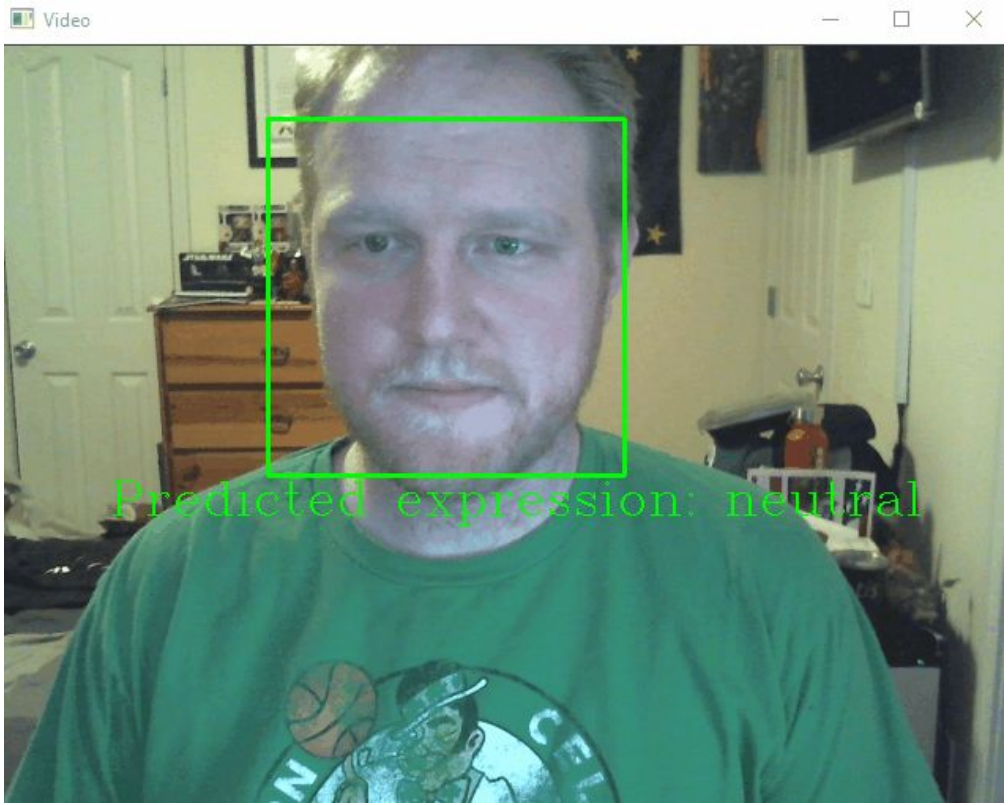
# Computer vision overview

- Computer vision combines cameras with machine learning models and artificial intelligence to detect aspects in images or video
  - Object recognition
  - Detect and recognize people
  - Track movement
- Computer vision is useful in a wide range of industries from medical imaging to manufacturing, retail, etc...

# Predicting Expressions in Real Time

- Using computer vision this model can predict a person's facial expression based on video feed from a webcam.
- OpenCV library in Python
- Face is detected and passed through the model to generate predictions frame by frame in real time

# Predicting Expressions in Real Time



# Limitations

- Only trained on 4 expressions
  - Could be refined further to be ‘positive’, ‘negative’, and ‘neutral’
- Limited subjects for live testing
  - Important to make sure that the model is not biased (generates similar predictions for male and female etc)

# Further Development

Ways to further refine the model:

- Gather more images with a wider variety of expressions and subjects
- Implement pretrained classification layers to improve accuracy

# Conclusions

- Convolutional neural networks can be used to recognize facial expressions and use that to predict a person's emotional state.
- This could be useful for tailoring interactions to users interacting with computer assistants like Cortana on Windows.
- Other uses could include security footage, predicting emotional states of people entering a store or bank, for example.

# Questions?