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Capstone Project

Emotions Detection

Artificial Intelligence & Machine Learning for Business Applications

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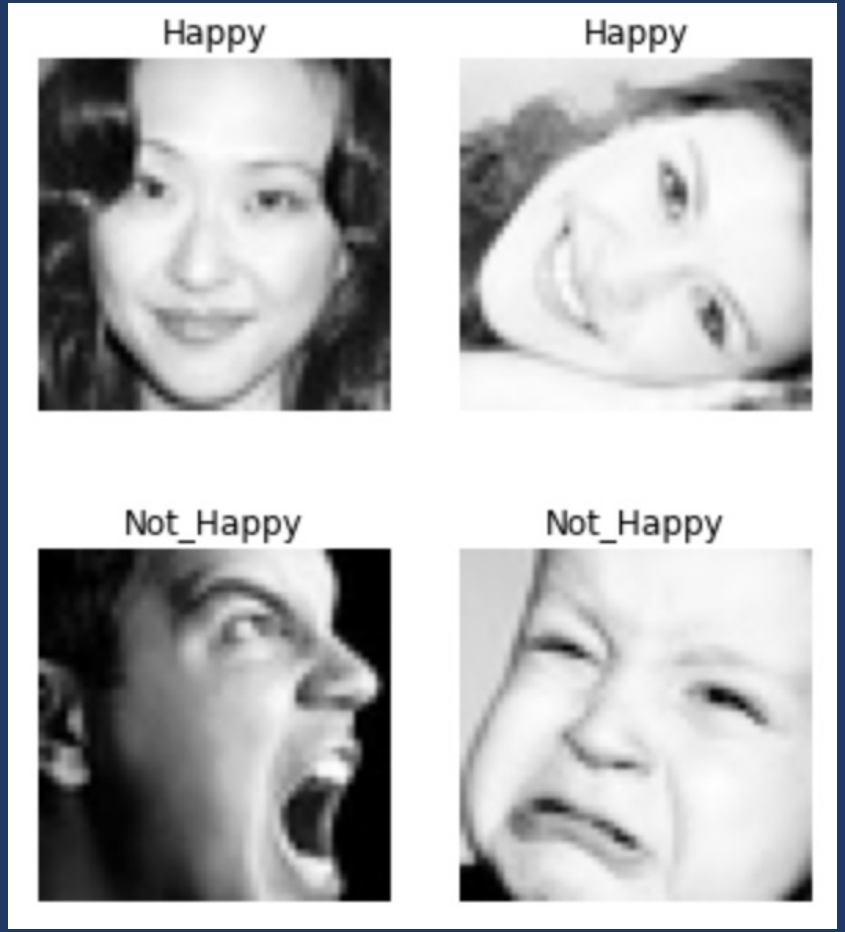
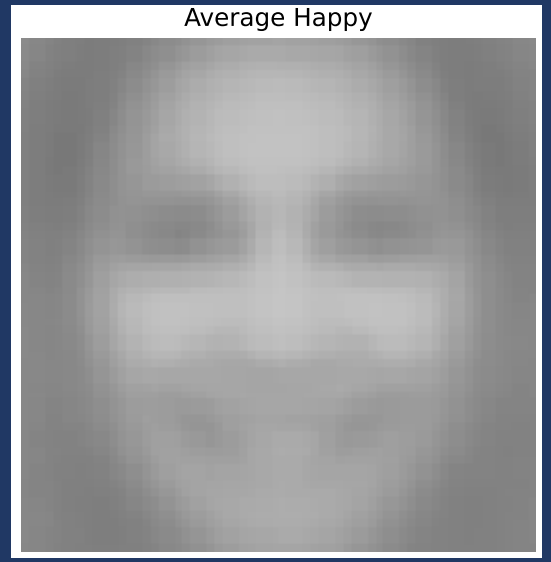
Problem and Solution

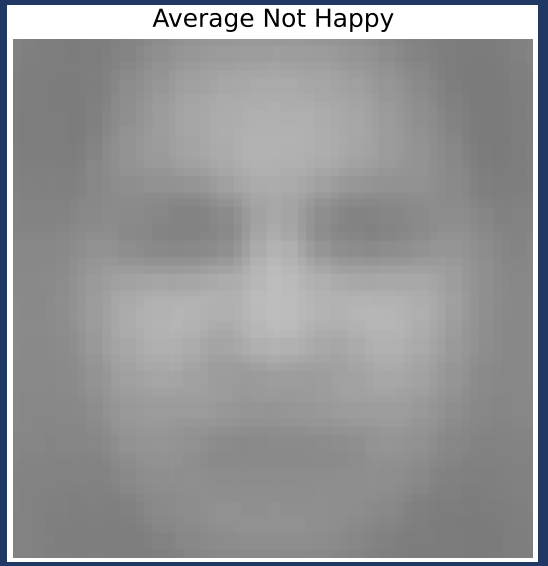
- Problem: Detect human emotion (happy or not) in images of faces
- How can we automatically detect human emotion with high accuracy?
- Solution: Machine Learning Models
  - which model and how to optimize?



Data Description

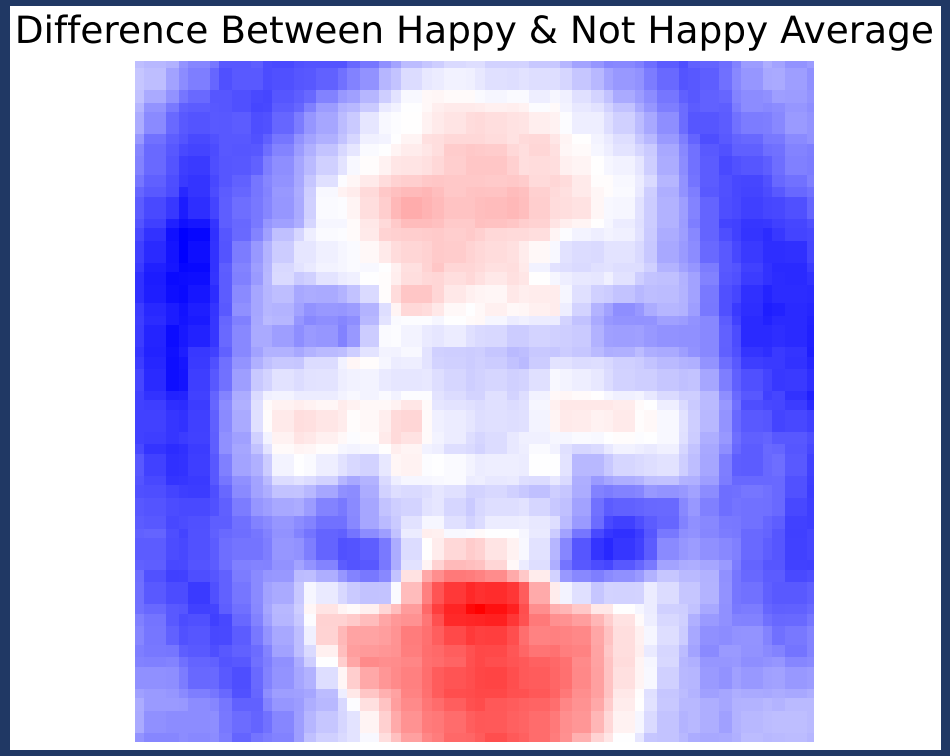
- 48x48 grayscale JPEG images (Kaggle)
- Train (2000 happy, 2022 not happy)
- Test (200 happy, 224 not happy)
- Noticeable differences between two classes





Exploratory Data Analysis

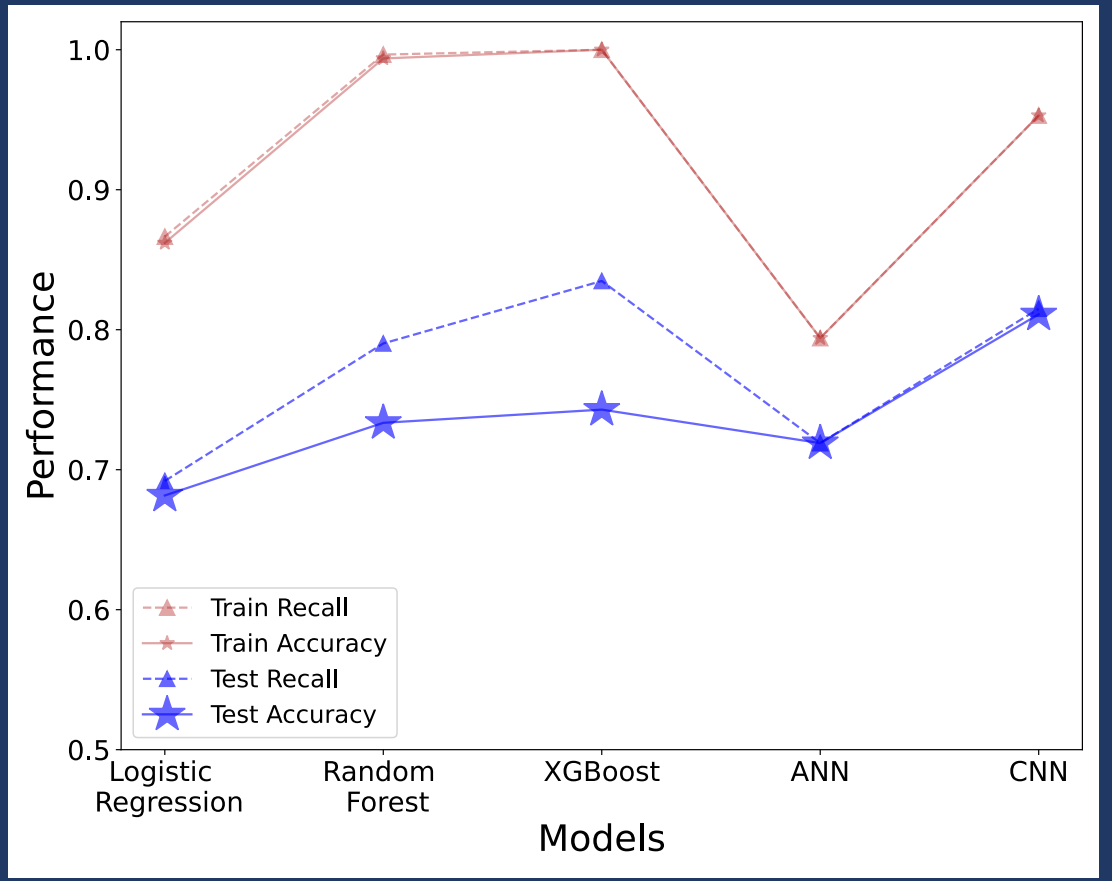
- Average images show smile evident in happy images and upper cheek more prominent
- Difference image shows contrasts between chin, forehead, and upper cheeks
- Standard deviation images show largest differences in mouth
- Blurring and resizing images tested



Machine Learning Models

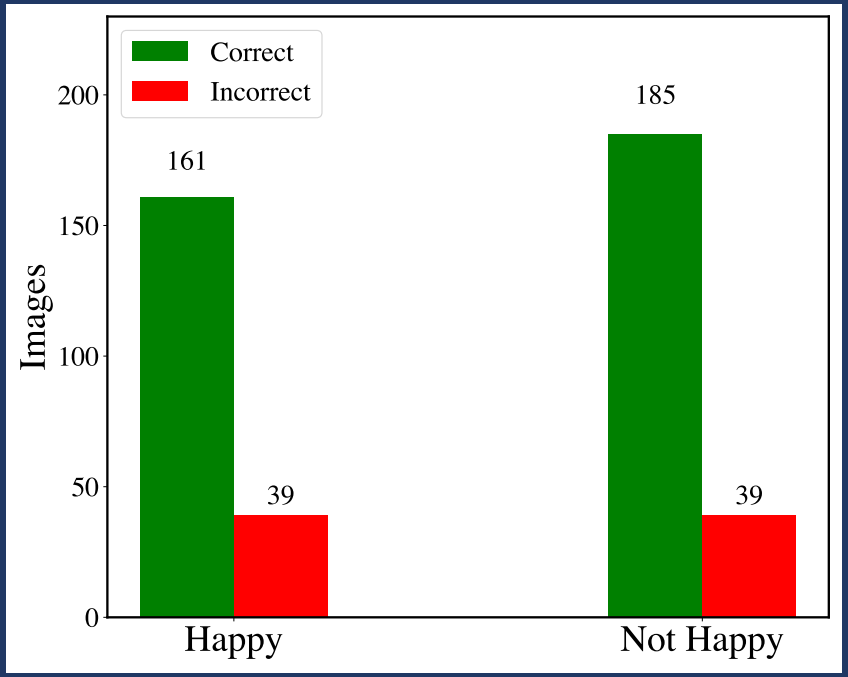
- Built 5 different types of models
  - Logistic Regression
  - Random Forest
  - XGBoost
  - Artificial Neural Network (ANN)
  - Convolutional Neural Network (CNN)

- Each model optimized
  - Model structure
  - Hyperparameters (model options)



Final Model: Convolutional Neural Network

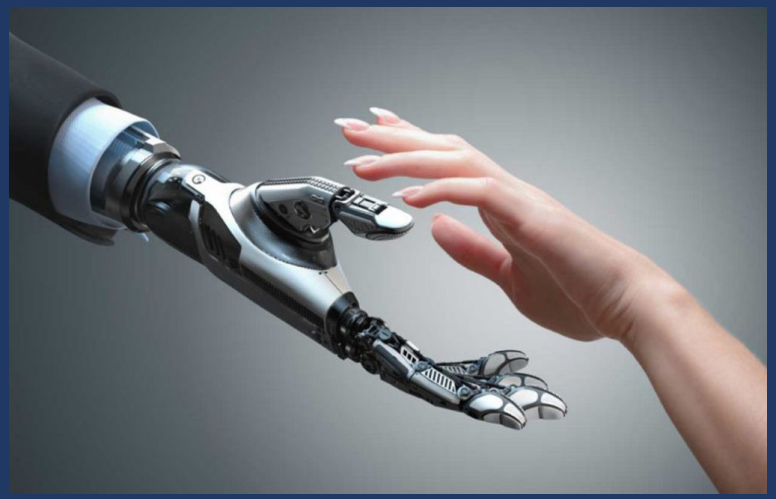
- >80% accuracy and recall on test data
- Optimized design for image processing
  - First uses filters on data
  - Pools results to reduce data size
  - Also uses layers of neurons like ANNs
- Previous studies find CNNs better at computer vision tasks
  - Better at capturing relevant features
  - Ignore spatial and translational transformations
  - ‘regularized’ to prevent overfitting



Business Recommendations

- CNN model can be applied to grayscale images to predict happy or not with ≳80% accuracy

- Emotional AI (affective computing) has numerous applications
  - **Improve human-machine interactions** (detect emotion – trigger response)
  - Advertising, marketing, customer support (gauge response)
  - Education (student comprehension)
  - Healthcare (emotional state in counseling)
  - Workplace (sentiment of meetings)
  - Interest of things (devices respond based on emotion)
  * Improved model could detect facial features or individuals



Stanford University

Summary & Further Improvements

- 5 types of machine learning models built
- CNN gives best performance (>80% test accuracy)
- Further Improvements
  - Applied CNN to full Kaggle data (7 emotions): 54% test accuracy
  - Test different structures of CNN (number and position of layers)
  - Methods to further reduce overfitting (e.g., size and position of dropout)
  - Data augmentation (e.g., image rotation)
  - Test other Transfer Learning models (further test VGG16 and others)
  - Further optimize hyperparameters

More training data: GPT-3
- 100s of billions of training words
- bigger model (175 billion parameters)