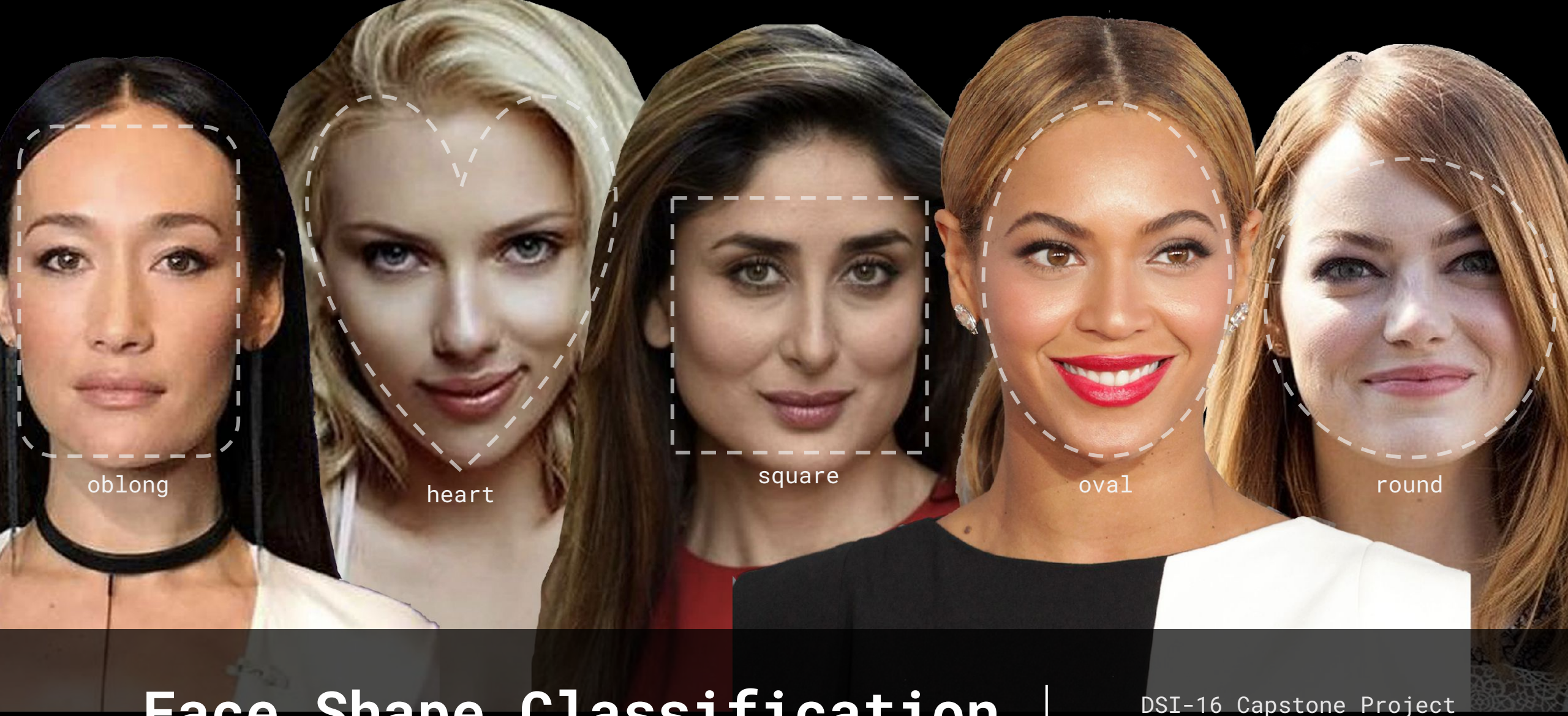


Face Shape Classification

using Convolutional Neural Network

DSI-16 Capstone Project

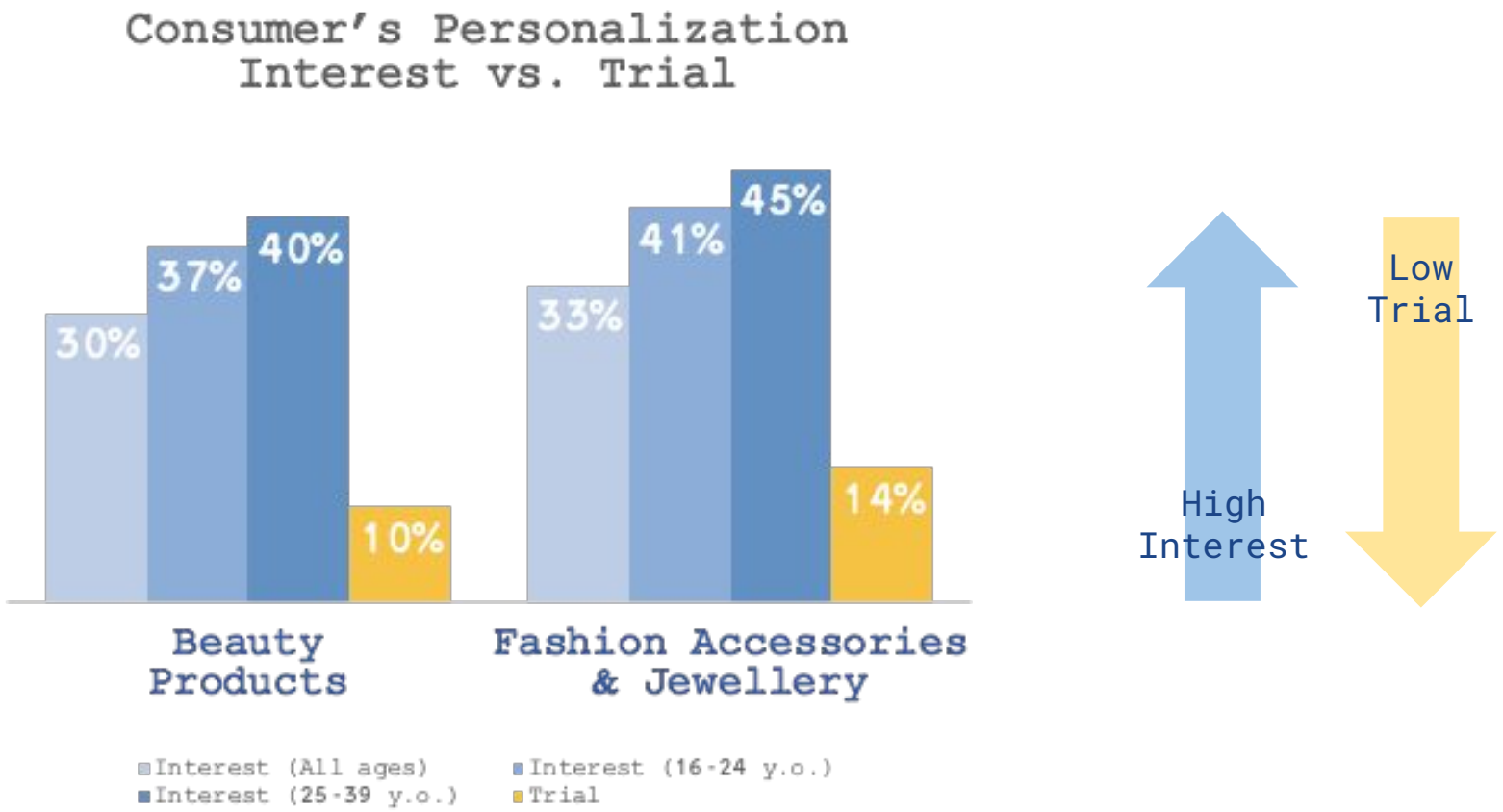
Pratchayanee Luepuwapitakkul

Agenda

- **Problem Statement**
- **Project Approach**
- **Data Exploration & Pre-processing**
- **Modelling & Evaluation**
  - CNN built from scratch
  - CNN with transfer learning (VGG-Face)
- **Conclusions**
- **Next Steps**

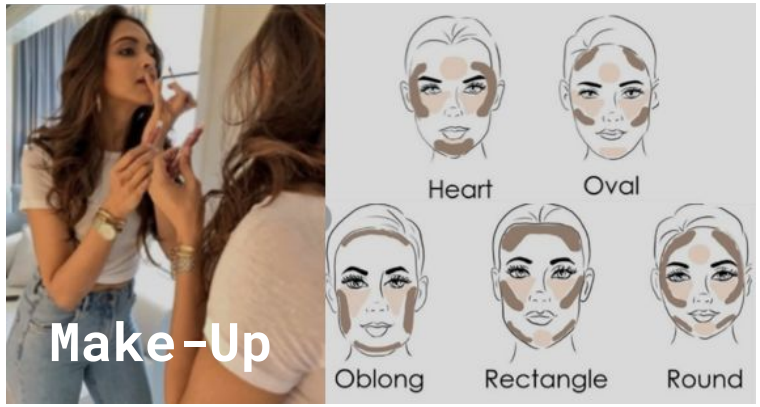
Problem Statement:

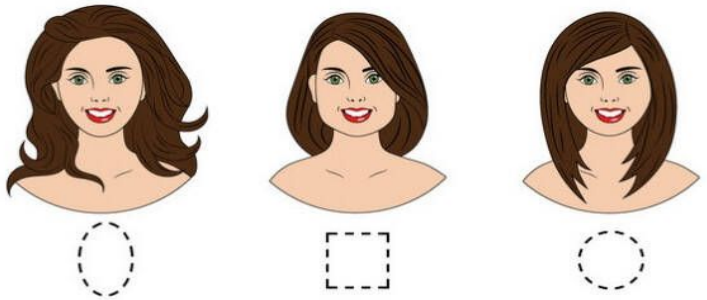
To enable personalization in beauty & fashion



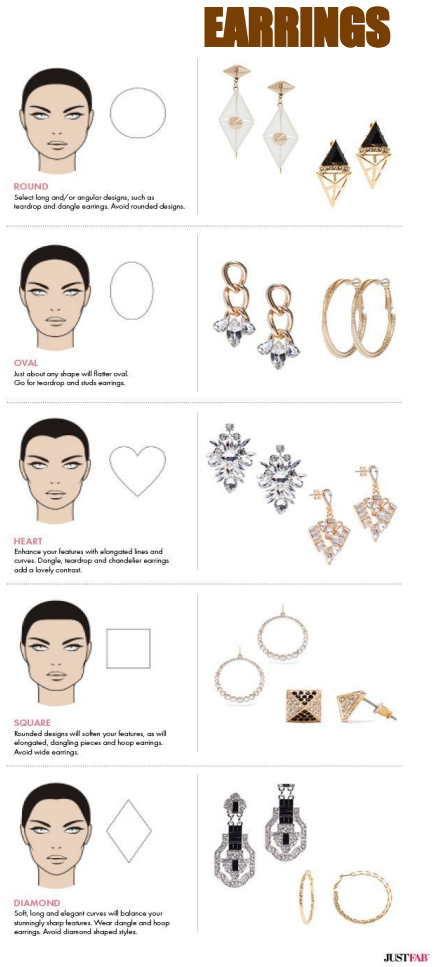
Source: The Deloitte Consumer Review: Made-to-order The rise of mass personalization.
https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/consumer-business/ch-en-consumer-business-made-to-order-consumer-review.pdf

Develop Personalised Products & Recommendations in Beauty & Fashion



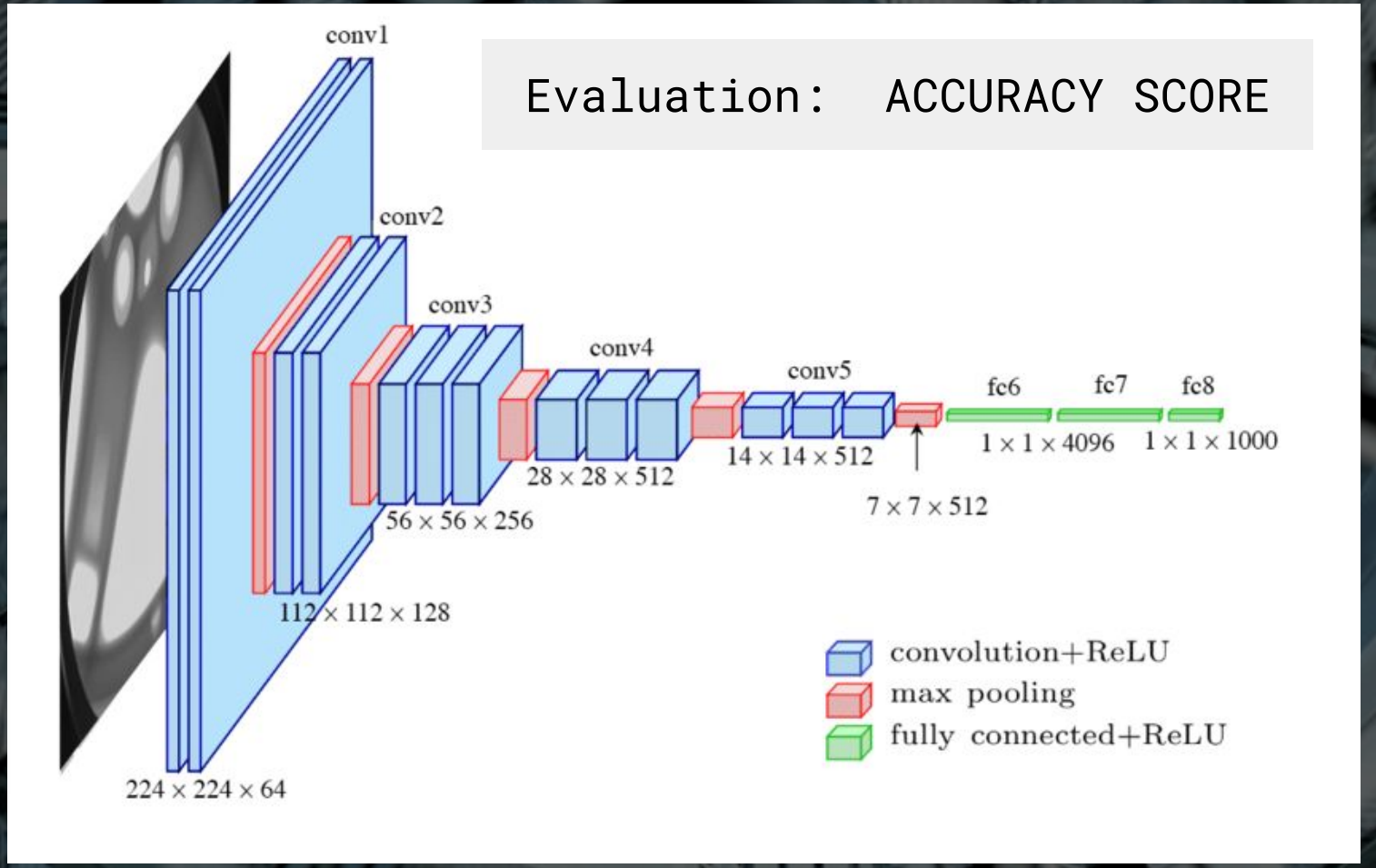


Hair Style

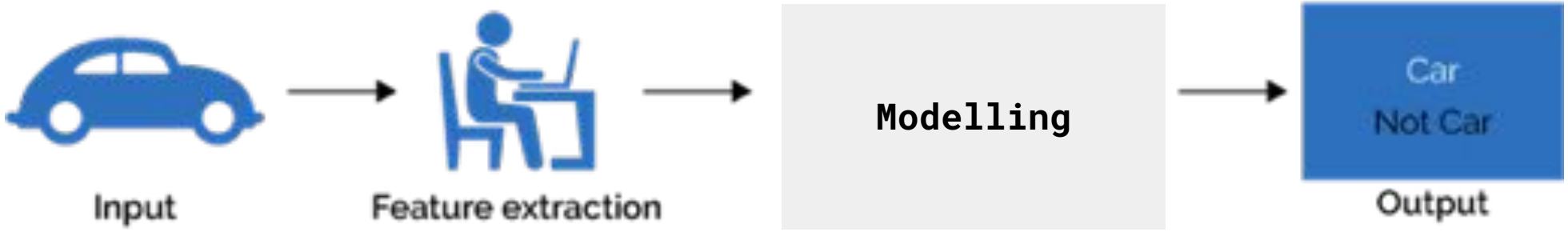


Deep Learning

with Convolutional Neural Network (CNN)

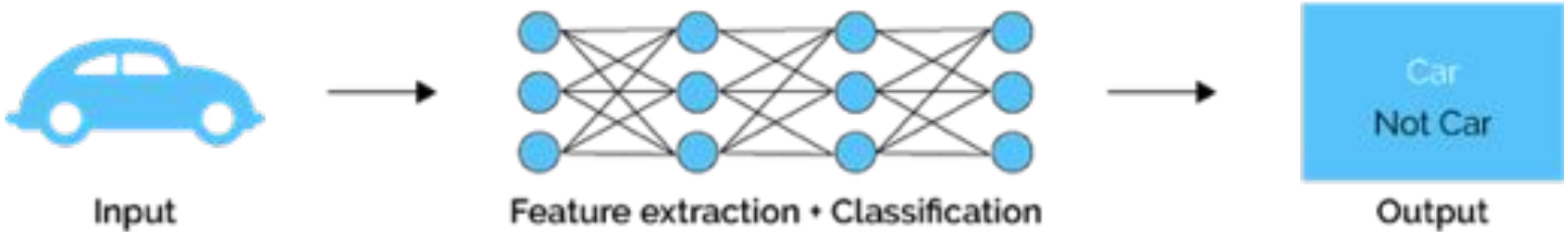


Machine Learning

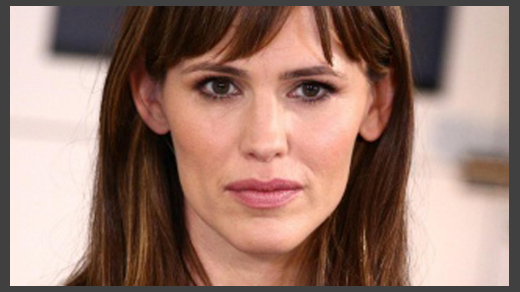


Input → Feature extraction → Modelling → Output

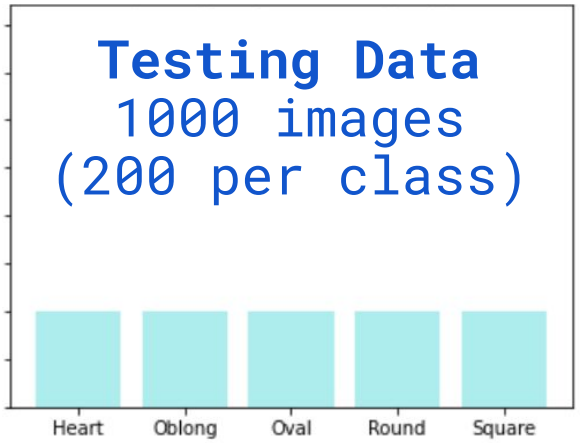
Deep Learning



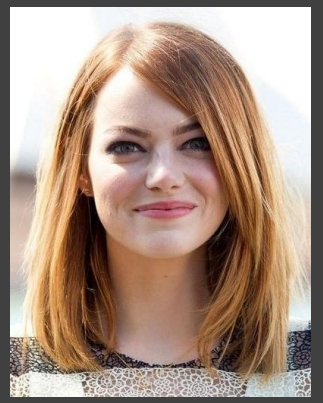
Input → Feature extraction + Classification → Output



Testing Data
1000 images
(200 per class)



Data Exploratory Analysis

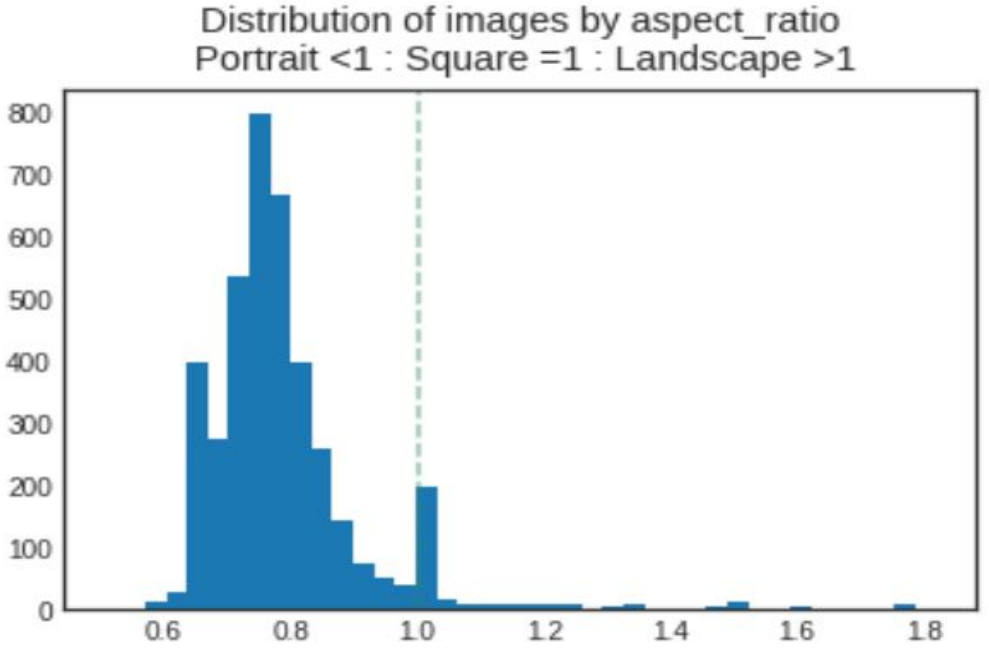


Training Data
4000 images
(800 per class)

https://www.kaggle.com/niten19/face-shape-dataset

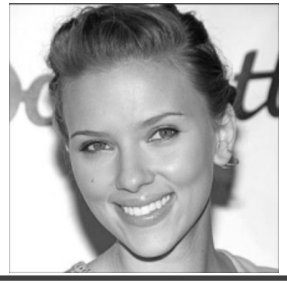
Images are mostly taken as portrait (aspect ratio < 1)

Portrait



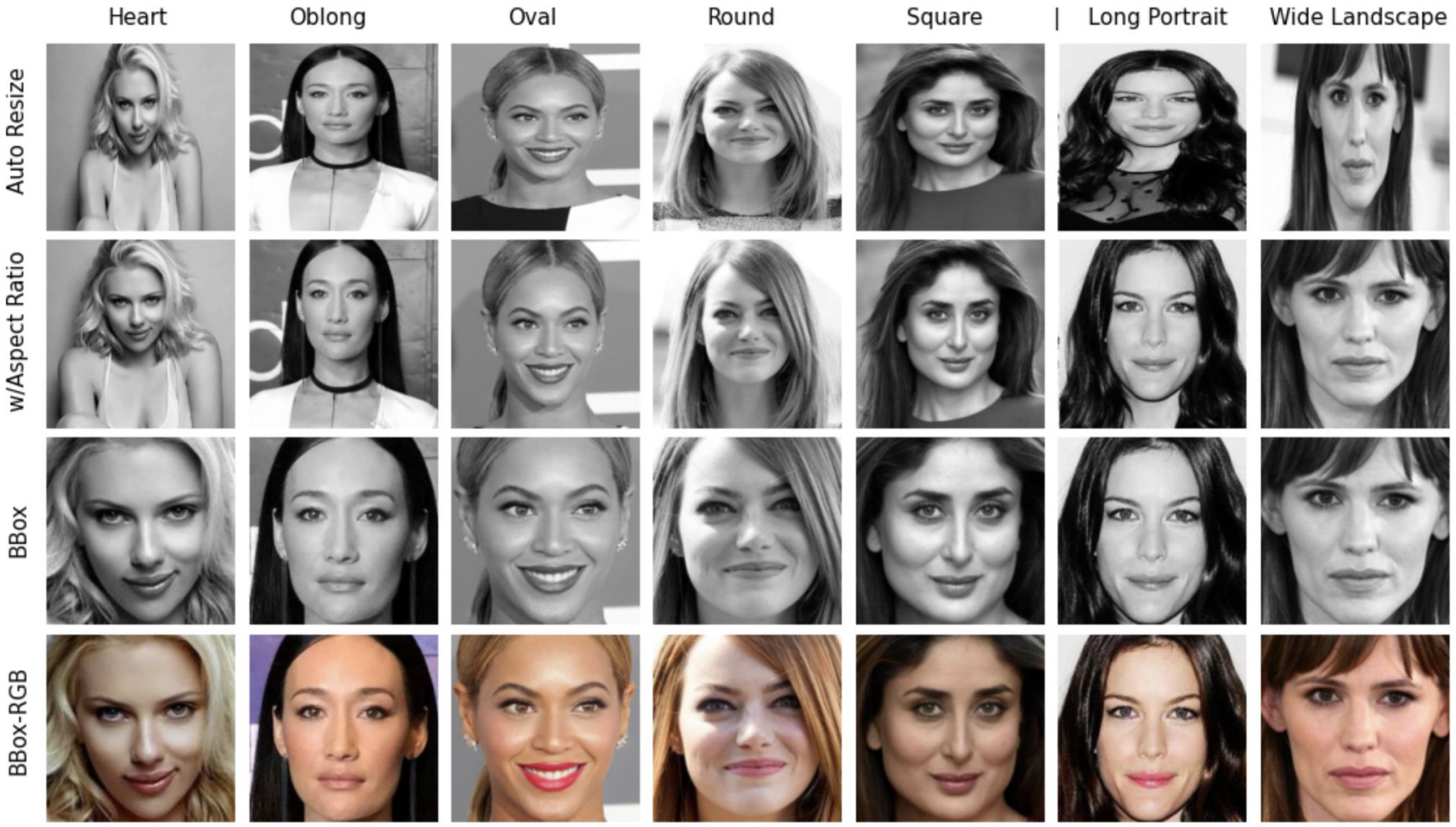
Landscape

Square = 1



Baseline Accuracy = 20%

Image Preprocessing | Modelling

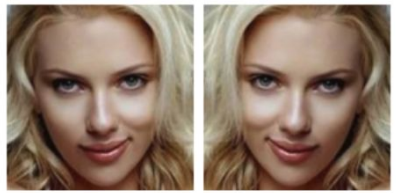


	Training Accuracy	Validation Accuracy
Auto Resize	73.90%	42.70%
w/Aspect Ratio	72.50%	47.30%
BBox	76.73%	68.60%
BBox-RGB	94.17%	71.20%

Baseline Accuracy = 20%

Image Preprocessing | Modelling

Flipping

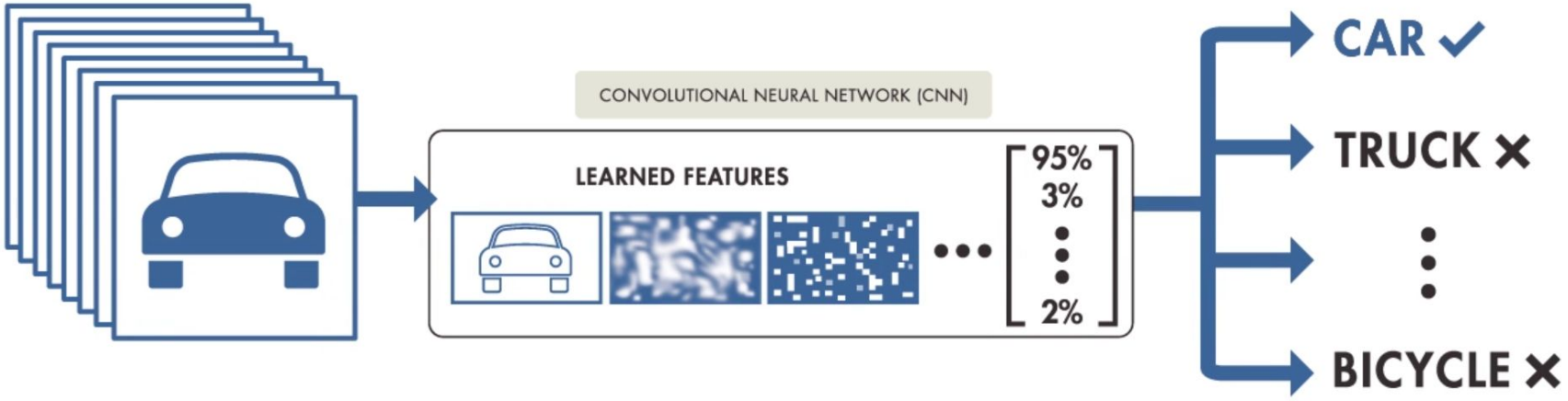


Rotating

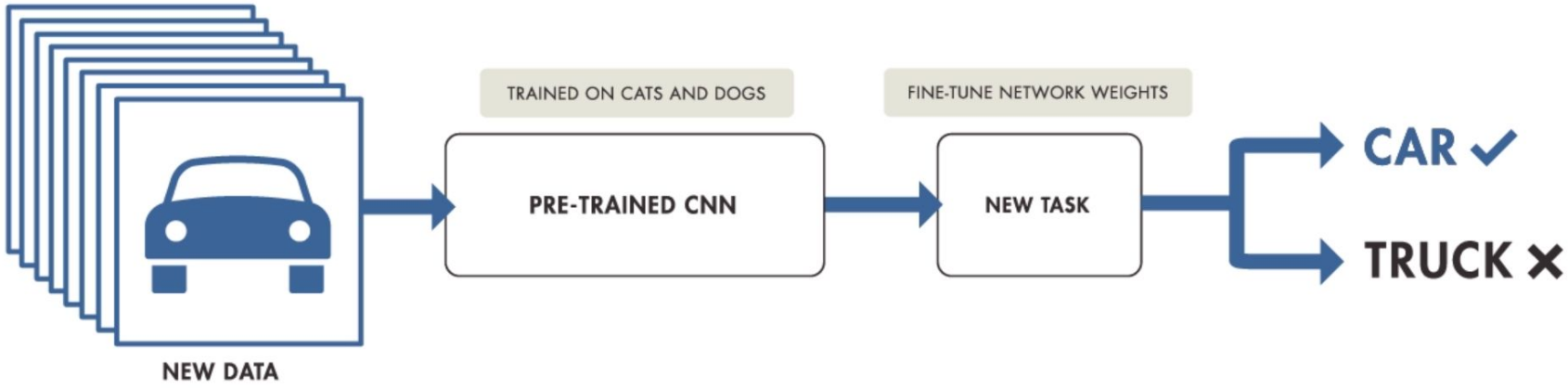
BBox-RGB

Training Accuracy	Validation Accuracy
80.20%	76.90%
94.17%	71.20%

TRAINING FROM SCRATCH

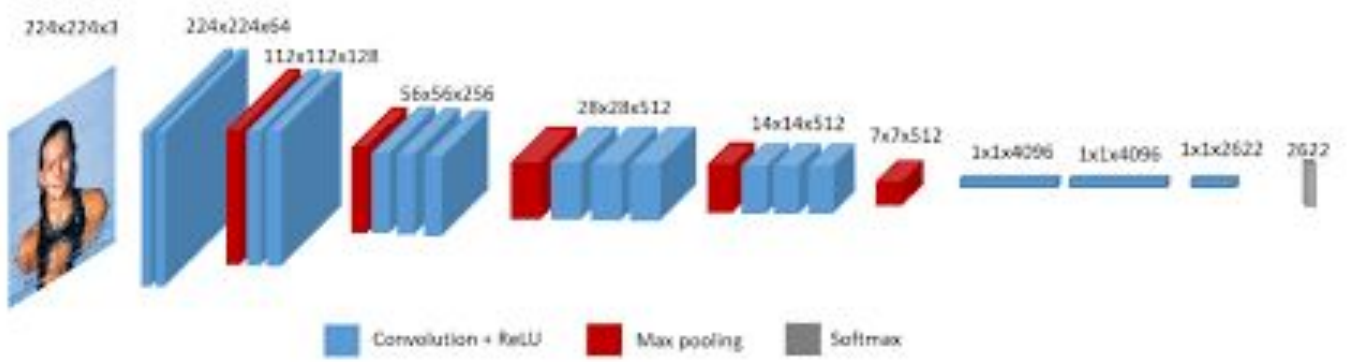


TRANSFER LEARNING

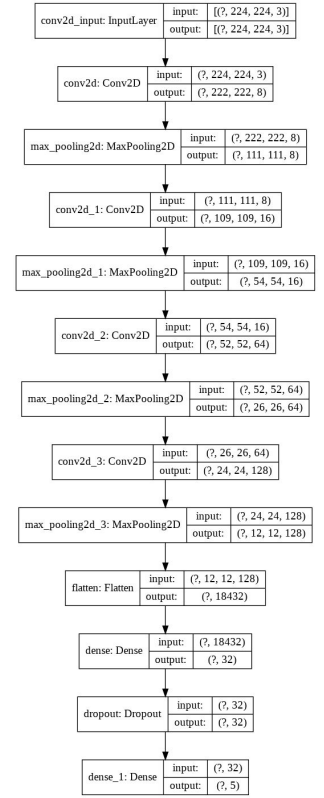


Transfer Learning VGG-FACE | Architecture

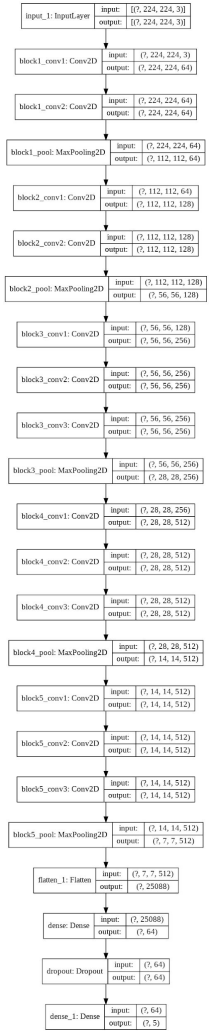
VGG-Face pre-trained weights
(trained on 2.6 Million images)



From Scratch

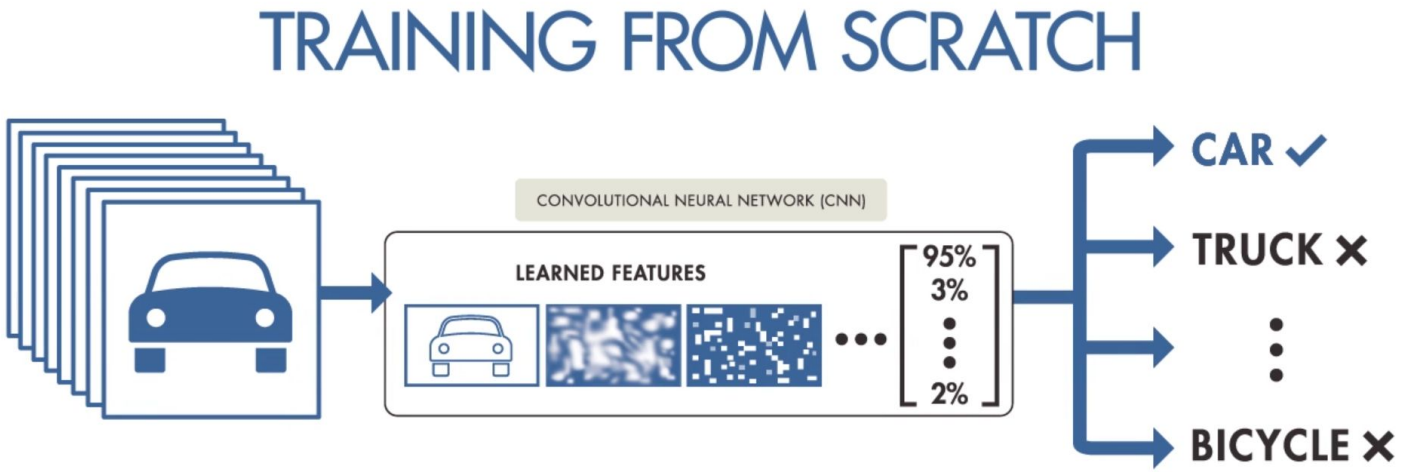


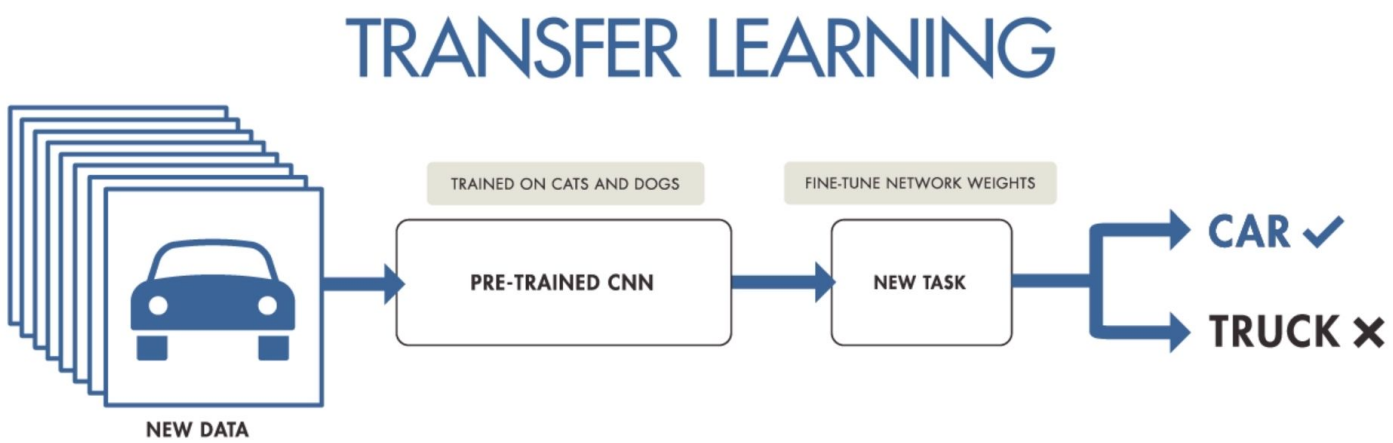
VGG-16



Baseline Accuracy = 20%

Modelling

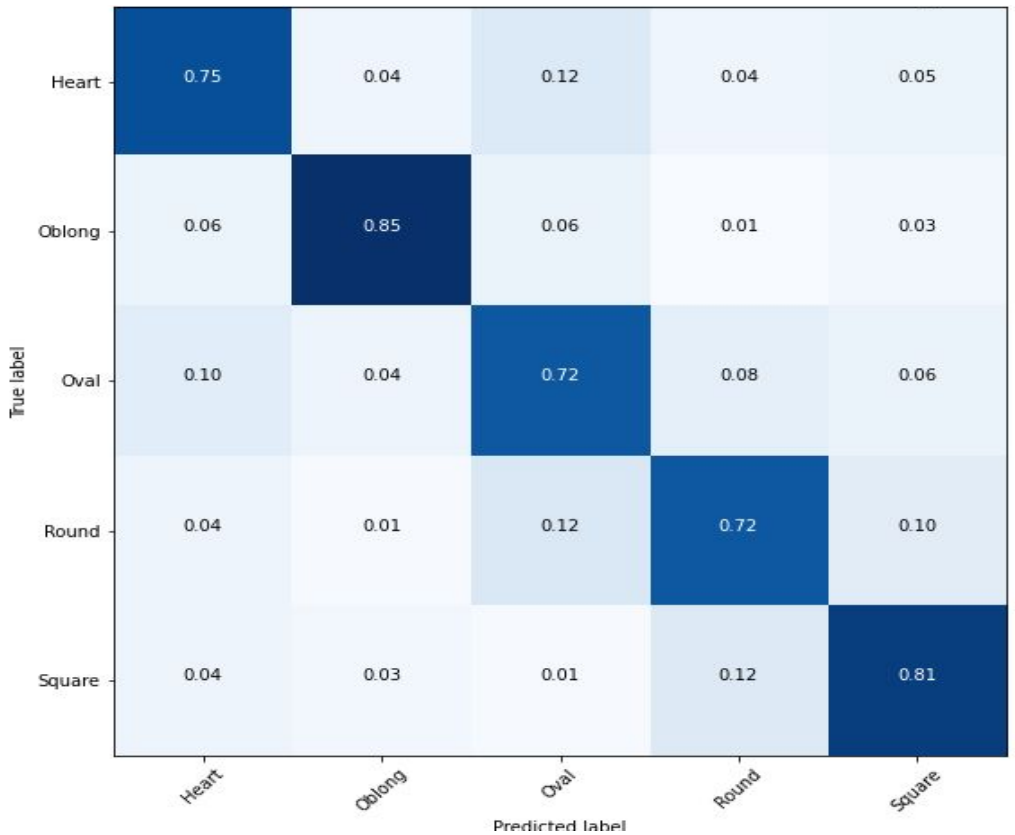




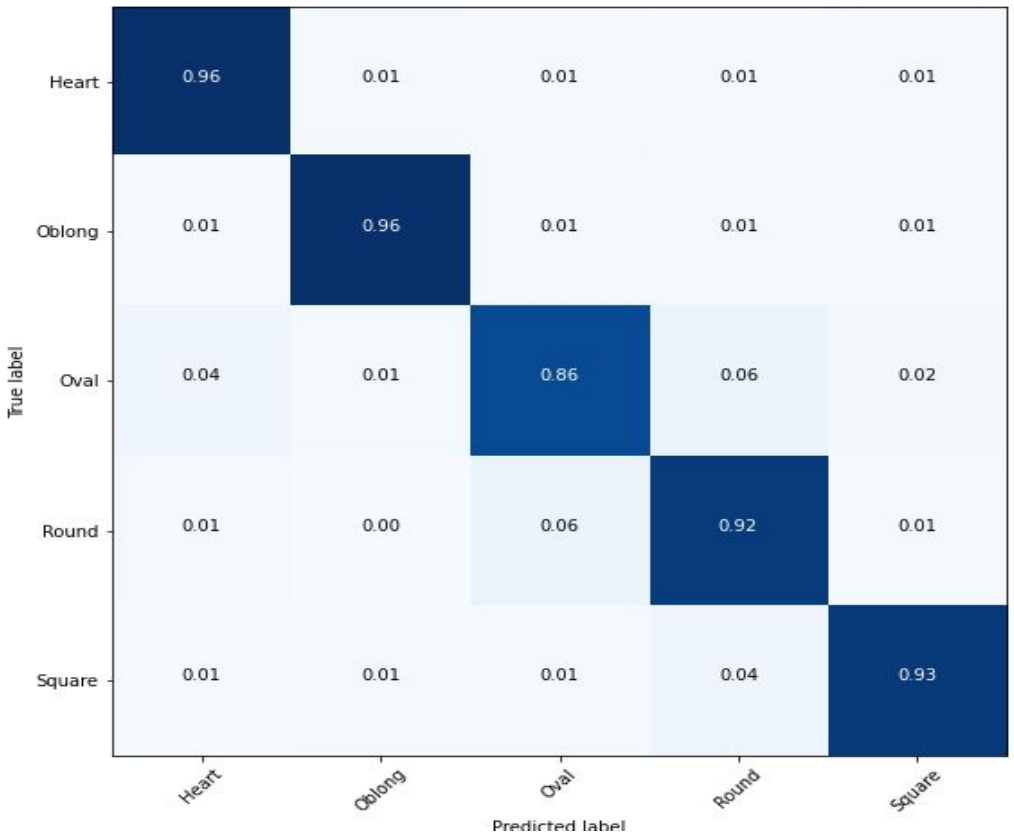
Training Accuracy	Validation Accuracy
80.20%	76.90%
96.47%	92.70%

Confusion Matrix

TRAINING FROM SCRATCH

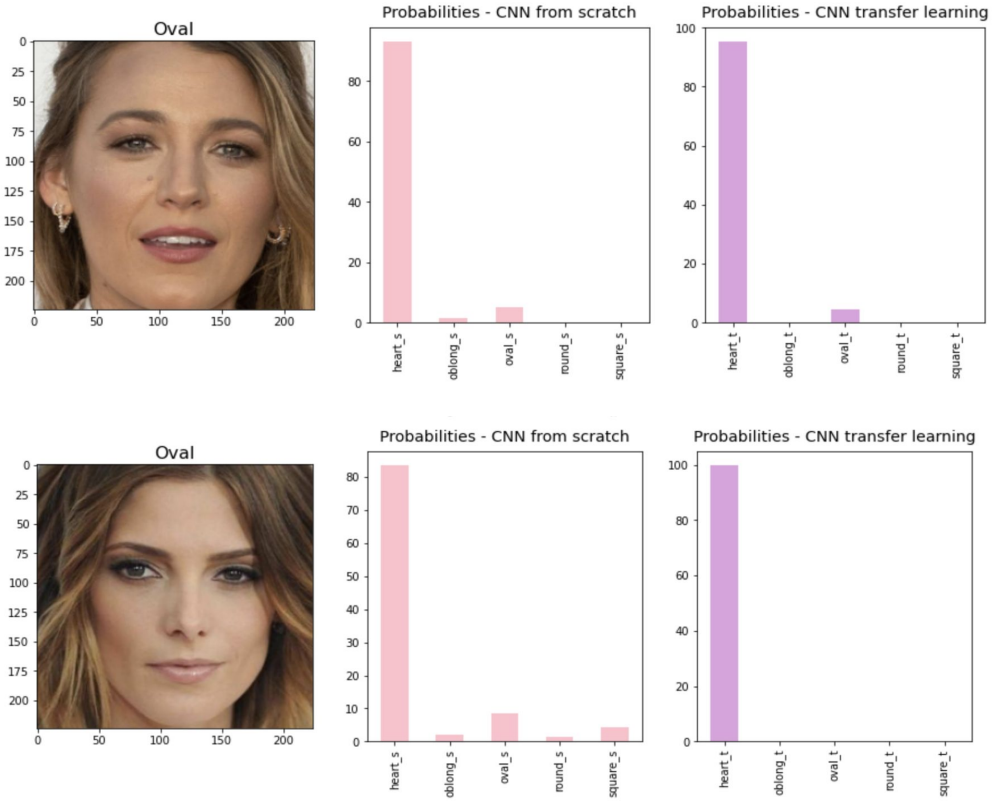


TRANSFER LEARNING

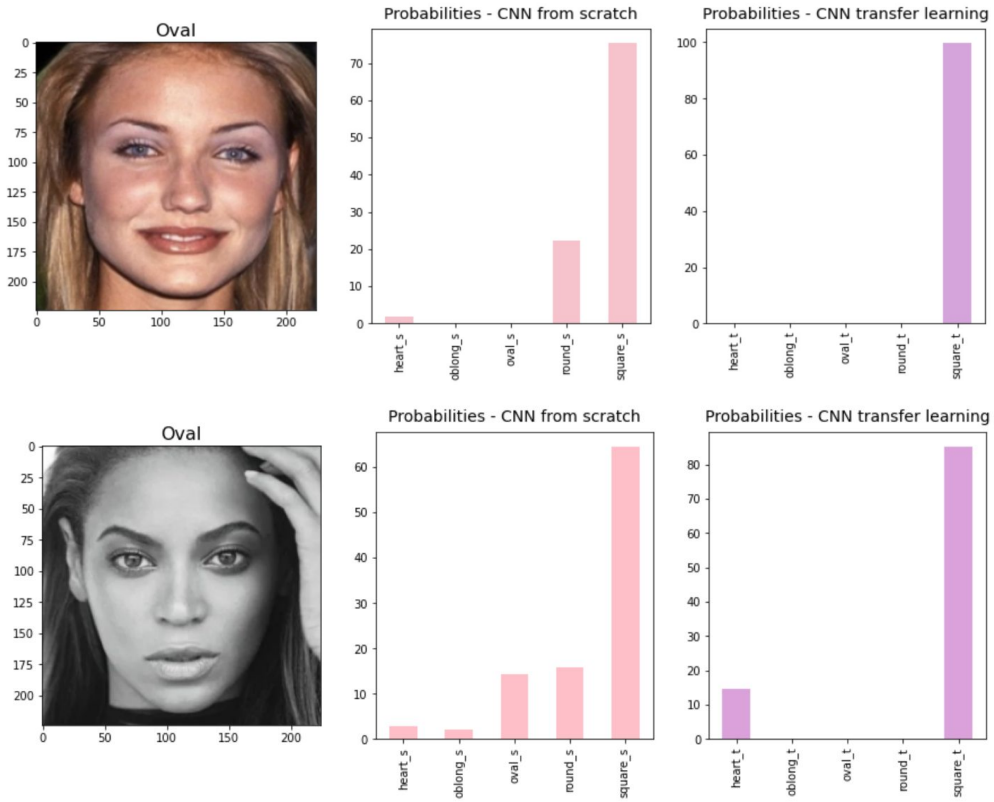


“Difficult” images misclassified by both models

Oval misclassified as Heart

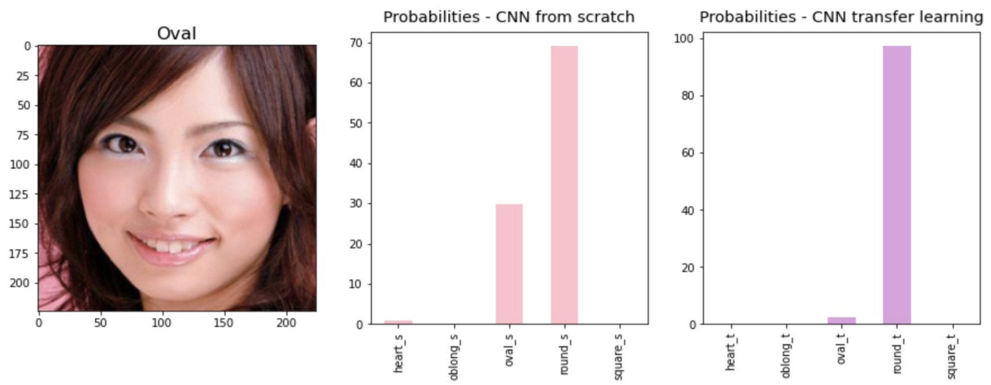


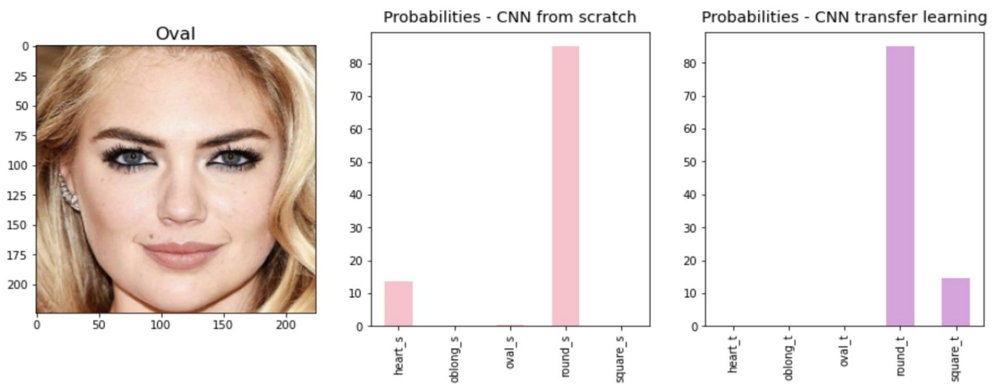
Oval misclassified as Square

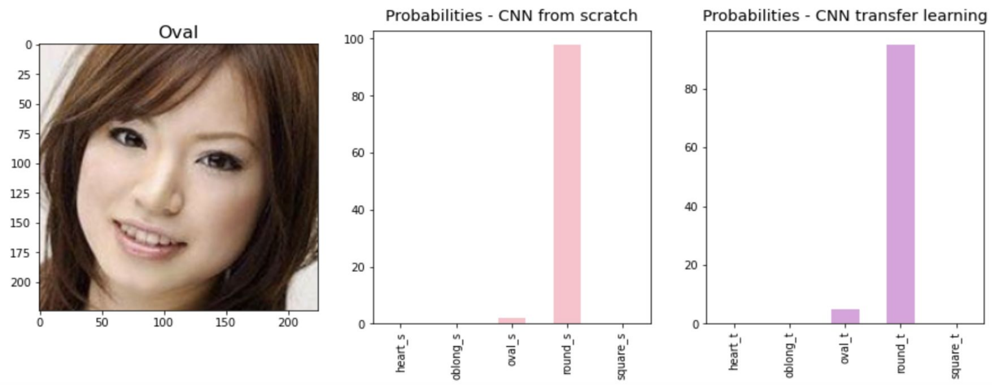


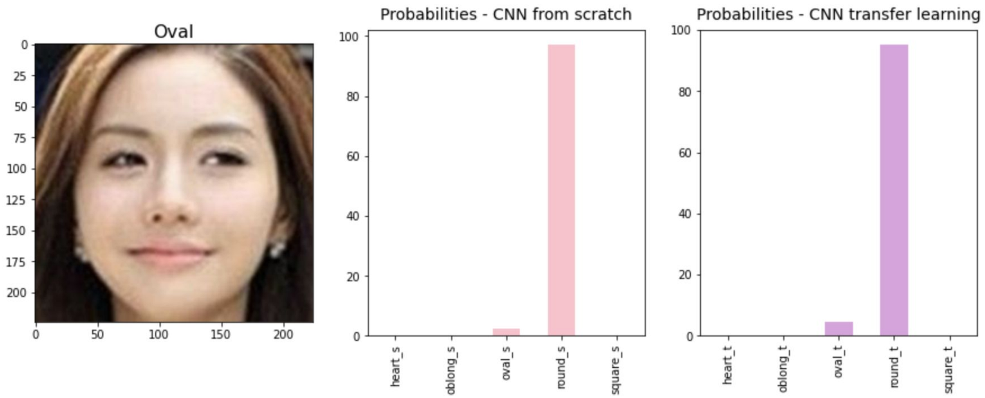
Mostly “Asian” Oval more mistaken as Round

Oval misclassified as Round

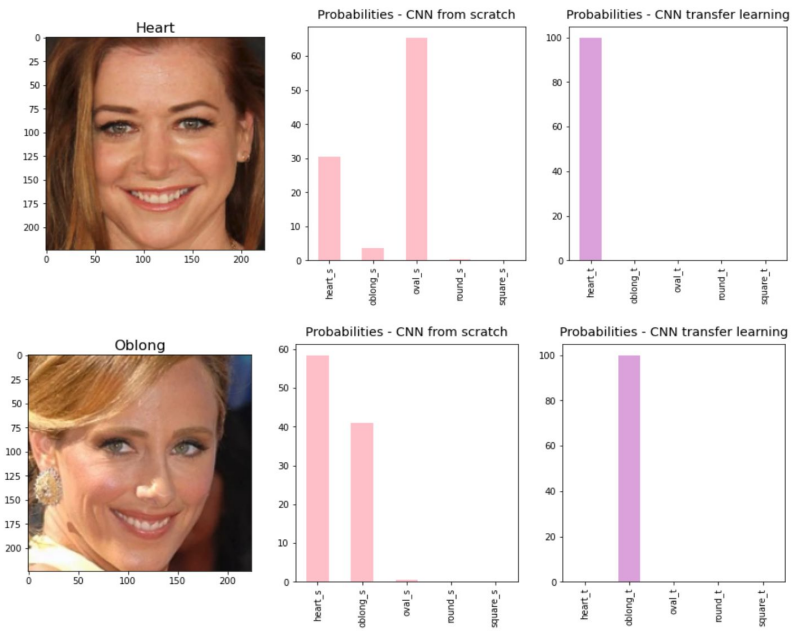


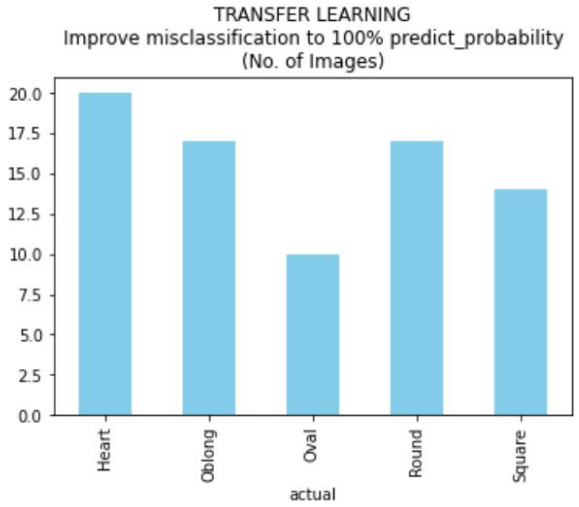


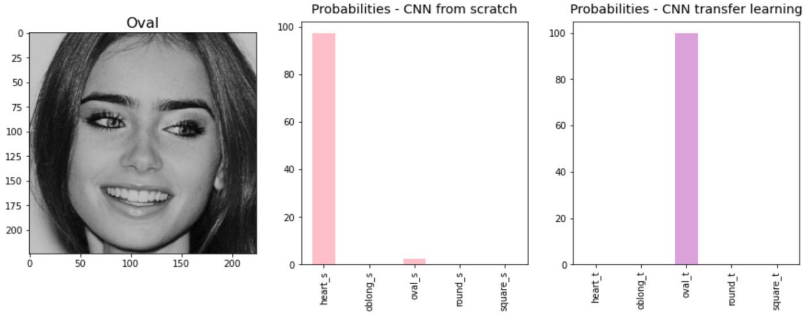


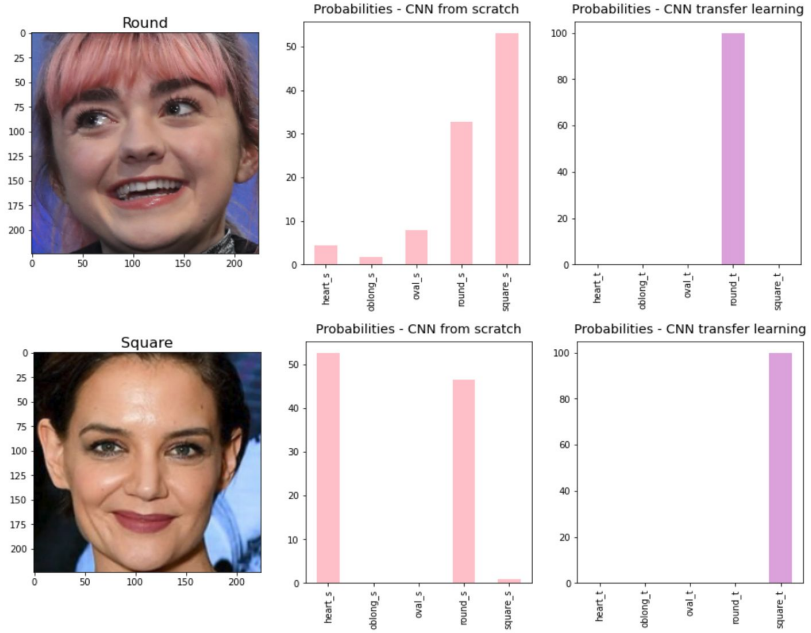


Improvement from Transfer Learning:
100% probability of the predicted class

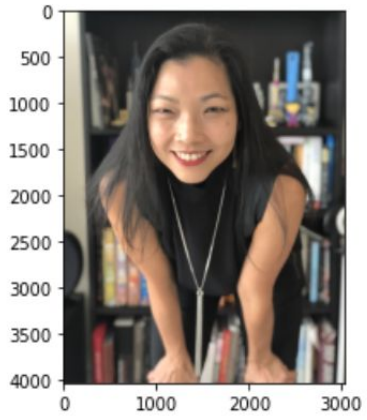


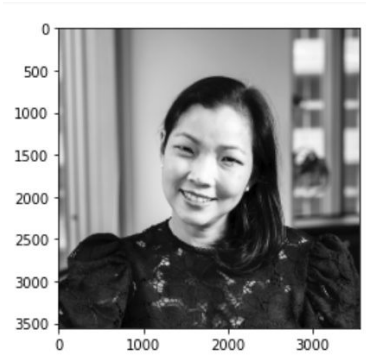




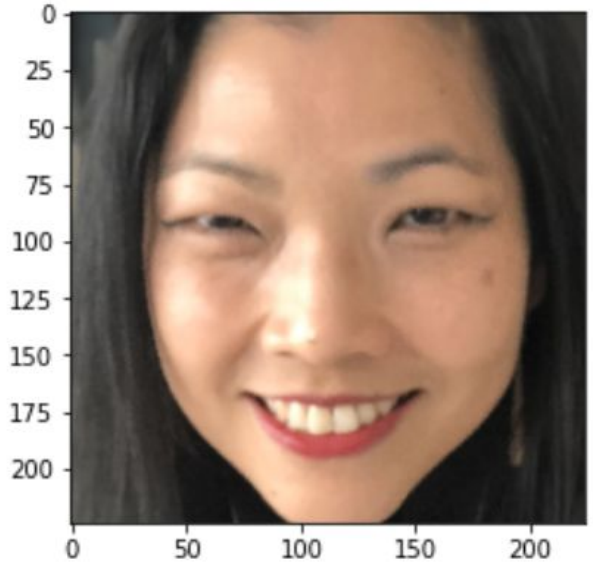


Predictions

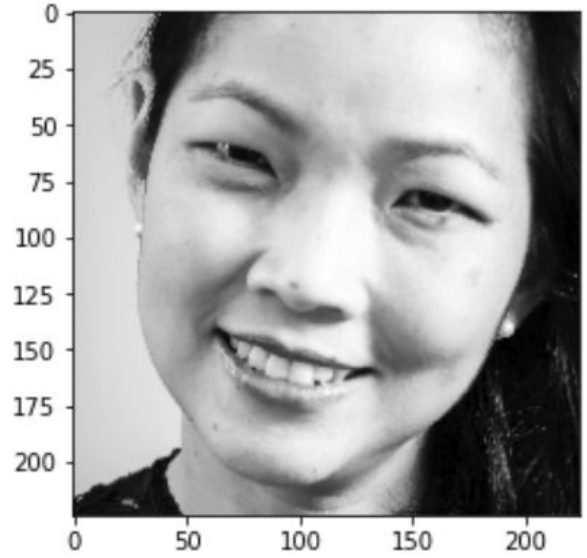




Your face shape is Heart
Probability 94.93



Your face shape is Round
Probability 99.99



Conclusion

- The model predicted the 5 face shapes well with 92.7% accuracy.
- Key drivers are:
  - Face Detection (Bounding Box)
  - Image Augmentation with flip & rotation
  - Pretrained weights from VGG-Face

Limitations & Way Forward

- Trained on adult female faces
- Lower accuracy on OVAL faces
- Predictions depend on input image (angle, pose, cropping)

Extend training to:

- Male Face Shapes
- Different ages and races
- With/Without Glasses

Consistent input source (i.e. guide/bounding box in app)

1-EDA.ipynb

Capstone Project: Face Shape Classification - Part 1

This notebook consists of the following processes:

- Define the Problem Statement
- Gather Data
- Explore Data
- Prepare and save the first set of data for modelling

Problem Statement

1-EDA.ipynb

2-IMAGE_PREPROCESSING.ipynb

Capstone Project: Face Shape Classification - Part 2

This notebook further Explore Data and Image Preprocessing prior to modelling. This includes the following:

1. Image cropping & resizing by maintaining aspect ratio.
2. Face Detection with Bounding Box
3. Explore different image colors & filters
4. Prepare data and export files for modelling

2-IMAGE_PREPROCESSING....

3-CNN_MODELLING-updated.ipynb

Capstone Project: Face Shape Classification - Part 3

This notebook explores Convolutional Neural Network (CNN) Models on different image datasets based on the following image preprocessing:

- Model 1: Auto resized to 224 x 224
- Model 2: Images are cropped & resized by maintaining aspect ratio
- Model 3: Face Detection with Bounding Box in Grayscale

3-CNN_MODELLING-update...

4-IMAGE_AUGMENTATION_updated.ipynb

Capstone Project: Face Shape Classification - Part 4

This notebook explores image augmentation, including:

- Exploratory Data Analysis to identify the right variables (flip, degrees of rotation)
- Preprocessing & Modelling

```
from google.colab import drive
drive.mount('/content/drive')
```

4-IMAGE_AUGMENTATION_...

5-TRANSFER_LEARNING_VGGFACE.ipynb

Capstone Project: Face Shape Classification - Part 5

This notebook explores transfer learning from a pre-trained Oxford VGGFace model.

As the VGGFace model was built on older versions of Keras (v2.2.4) and Tensorflow (v1.14.0), hence we will only use the weights from the model and apply to VGG-16 architecture.

More details on VGGFace can be found on keras-vggface-project by Refik Can Malli.

5-TRANSFER_LEARNING_V...

6-MODEL_EVALUATION.ipynb

Capstone Project: Face Shape Classification - Part 6

This notebook evaluates the 2 best CNN models (built from scratch vs. VGG-Face). Analysis on confusion matrix, misclassification, and prediction probabilities.

```
from google.colab import drive
drive.mount('/content/drive')
```

Import Libraries

6-MODEL_EVALUATION.ipynb

7-PREDICT_AND_DEPLOY.ipynb

Capstone Project: Face Shape Classification - Part 7

This notebook loads the model to predict on new data, and saves the model for web interface.

```
from google.colab import drive
drive.mount('/content/drive')
```

Import Libraries

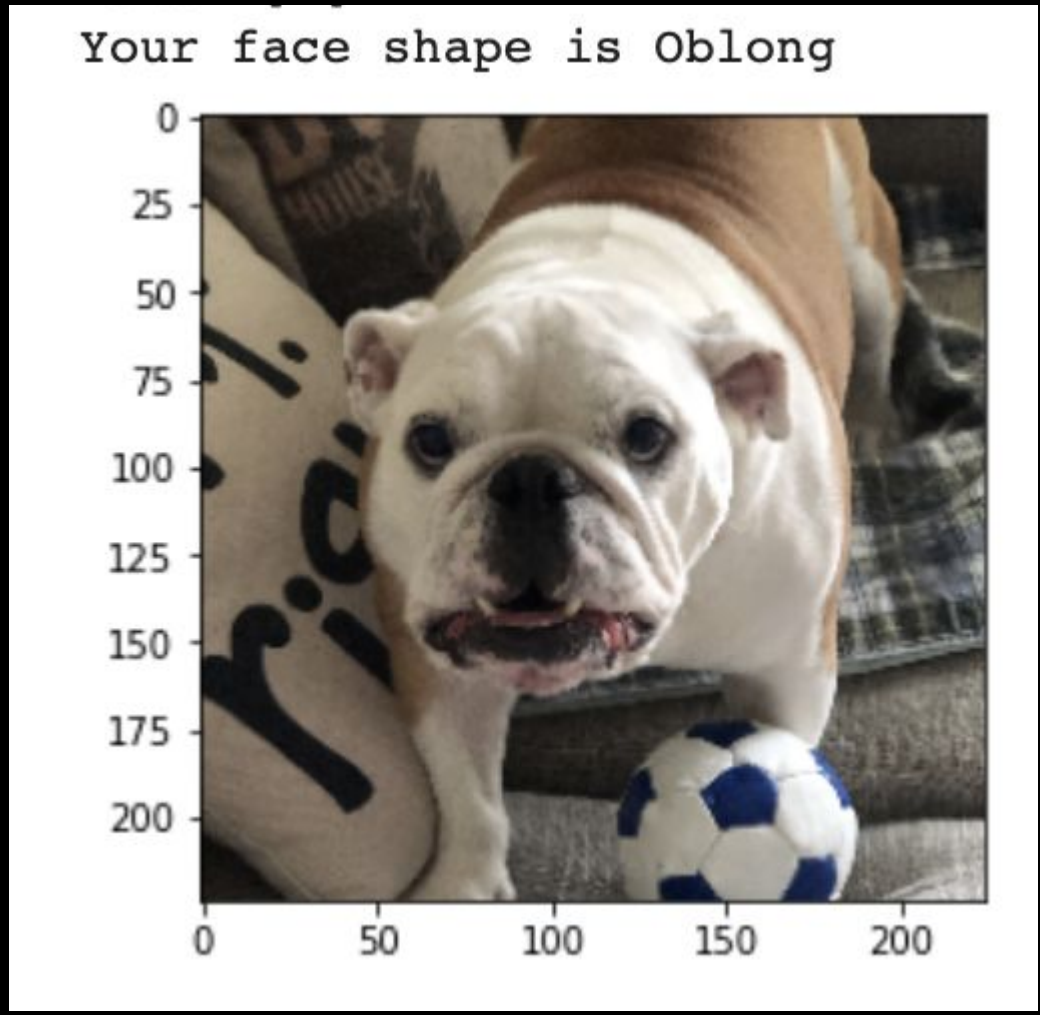
```
!pip install mtcnn
```

7-PREDICT_AND_DEPLOY.ip...

Capstone Presentation_Prat...

https://github.com/Pratch-yani/Face_Shape_Classification
https://drive.google.com/drive/folders/1r5cwyD55d33jSVSIJuZ2IguWynQ26Dq2?usp=sharing

Thank you :)


Your face shape is Oblong
0
25
50
75
100
125
150
175
200
0
50
100
150
200