Yoga Poses - Classified

Using Deep Learning

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INTRODUCTION

Since the beginning of the Covid-19 pandemic, the online fitness trend has exploded. Our client would like to add an AI coach to their app that will view the user's pose alignment and recommend adjustments to create an interactive experience and to prevent user injuries.

PROJECT GOAL

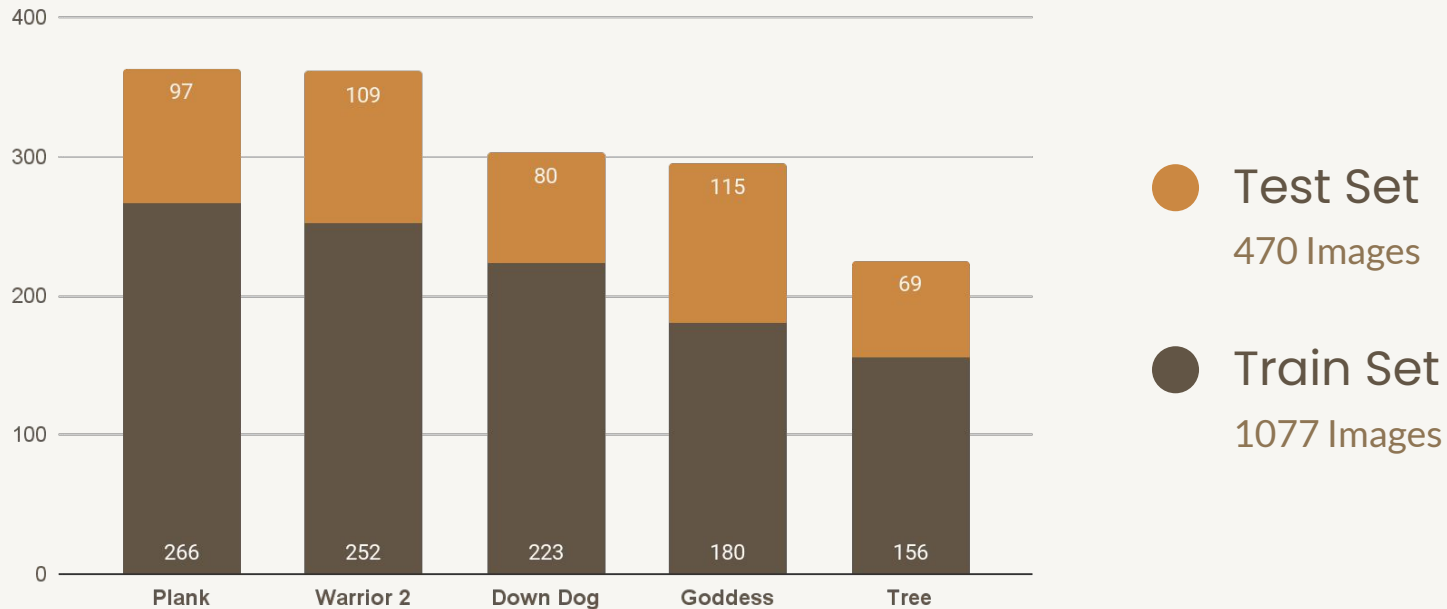| First Phase |
| --- |
| Create model to correctly classify five yoga poses |

DATASET

The dataset obtained from Kaggle contained the following:

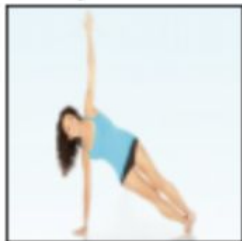- **1,547 Total Images**
- **5 Poses/Classes**

The dataset can be found at: https://www.kaggle.com/datasets/niharika41298/yoga-poses-dataset
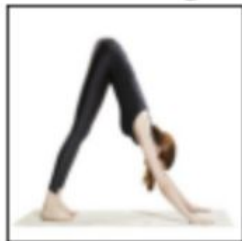
Yoga Pose Image Distribution

	Test Set
●	470 Images
●	Train Set
	1077 Images

Plank: 97 / 266
Warrior 2: 109 / 252
Down Dog: 80 / 223
Goddess: 115 / 180
Tree: 69 / 156

Sample Images from the Dataset
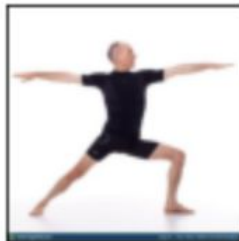
Logistic Regression Baseline Model

01

PCA

Decreased number of features down to 2

02

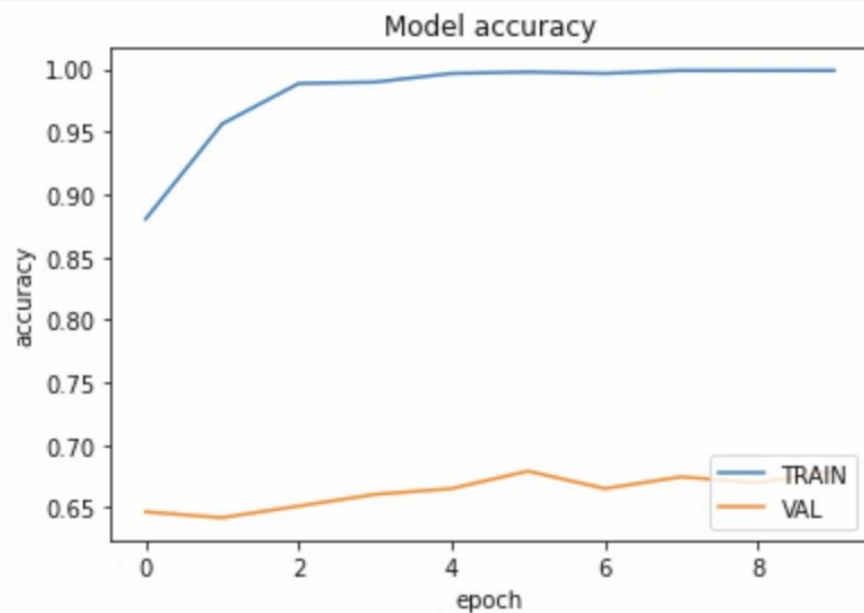## Logistic Regression

Using 2 principal components and 5 classes

03

Results

Accuracy = .23

04

Discussion
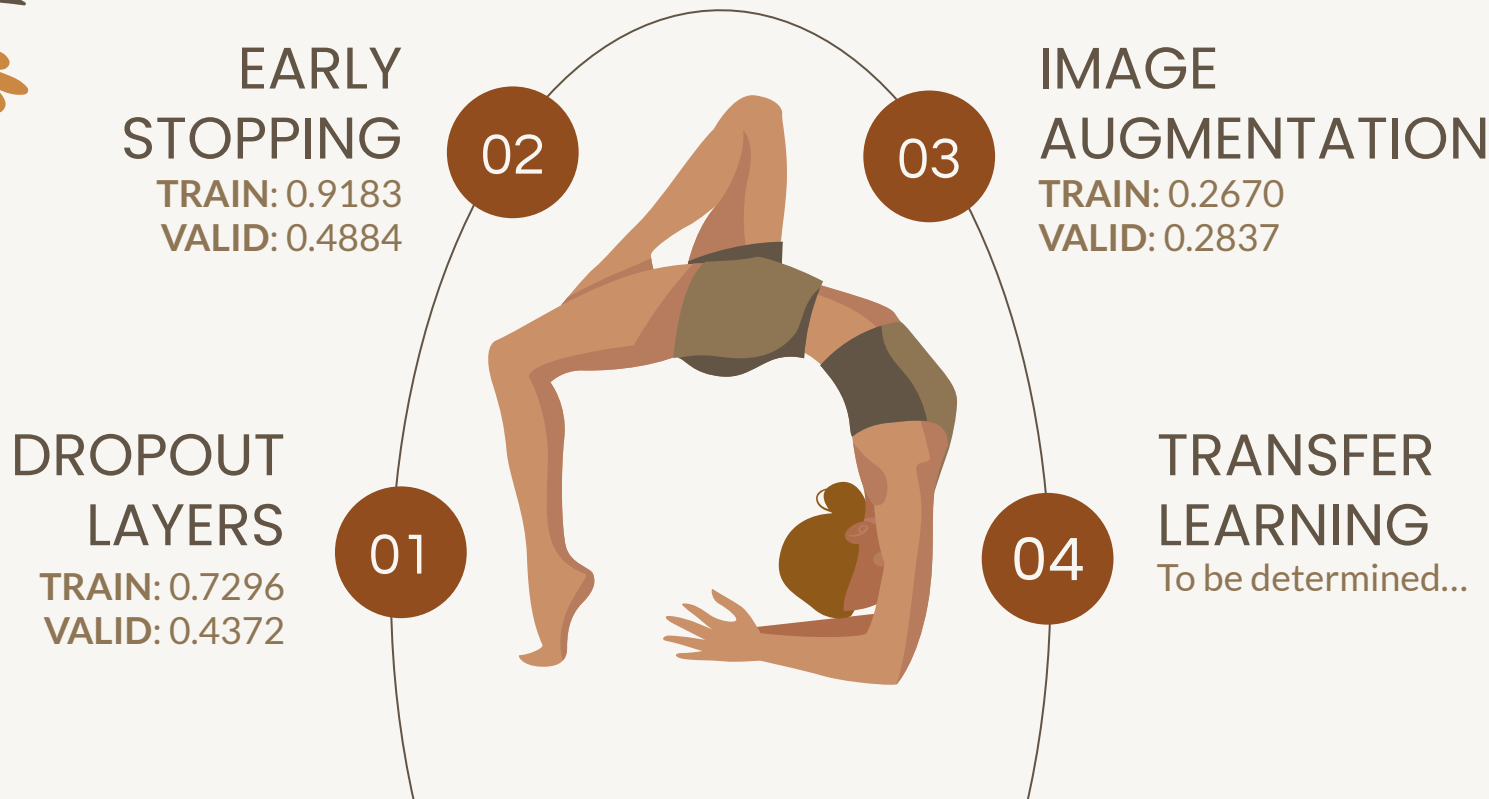
Deep learning using neural networks should produce better results.

Convolutional Neural Network

Model accuracy

Baseline CNN

- Training Accuracy: 0.9908

- Validation Accuracy: 0.6355

- **Model is overfitting**

- Improved accuracy over logistic regression model.

OVERFITTING SOLUTIONS

02

EARLY STOPPING
TRAIN: 0.9183
VALID: 0.4884

03

IMAGE AUGMENTATION
TRAIN: 0.2670
VALID: 0.2837

01

DROPOUT LAYERS
TRAIN: 0.7296
VALID: 0.4372

04

TRANSFER LEARNING
To be determined...

TRANSFER LEARNING

Using the VGG16 model

Transfer Learning Results

CNN with VGG16

- Training Accuracy: 0.8462

- Validation Accuracy: 0.7991

- Improved accuracy over CNN without transfer learning
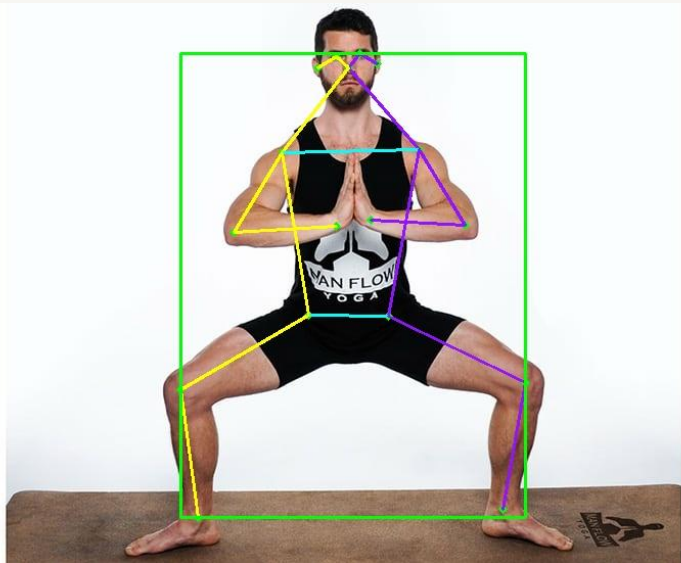
- Can we do better?

TRANSFER LEARNING
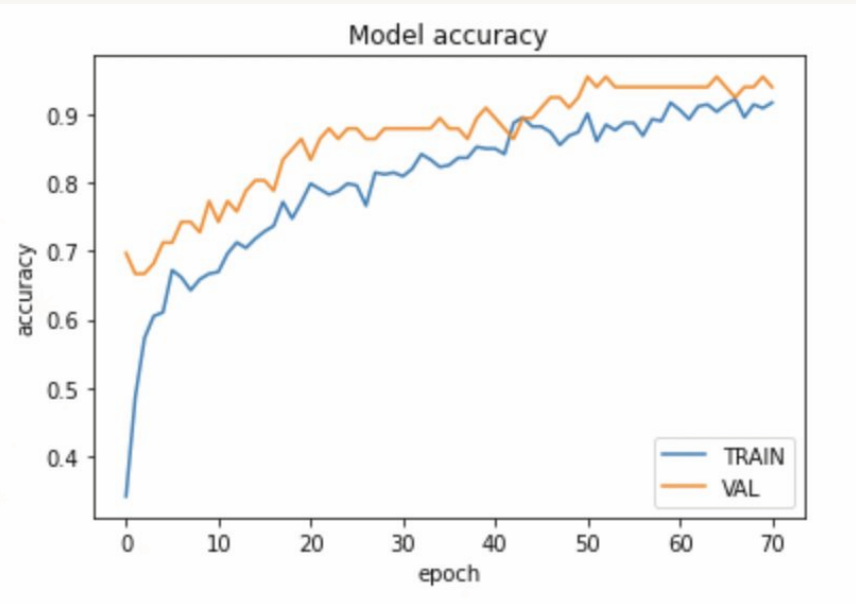
Using TensorFlow's MoveNet Model

Transfer Learning

MoveNet Model

- Pose detection model

- Maps 17 keypoints of body positioning

- Trained on COCO and an internal Google Dataset called Active

- Uses TensorFlow.js and TensorFlow.lite for deployment across many applications

Transfer Learning Results

Model accuracy
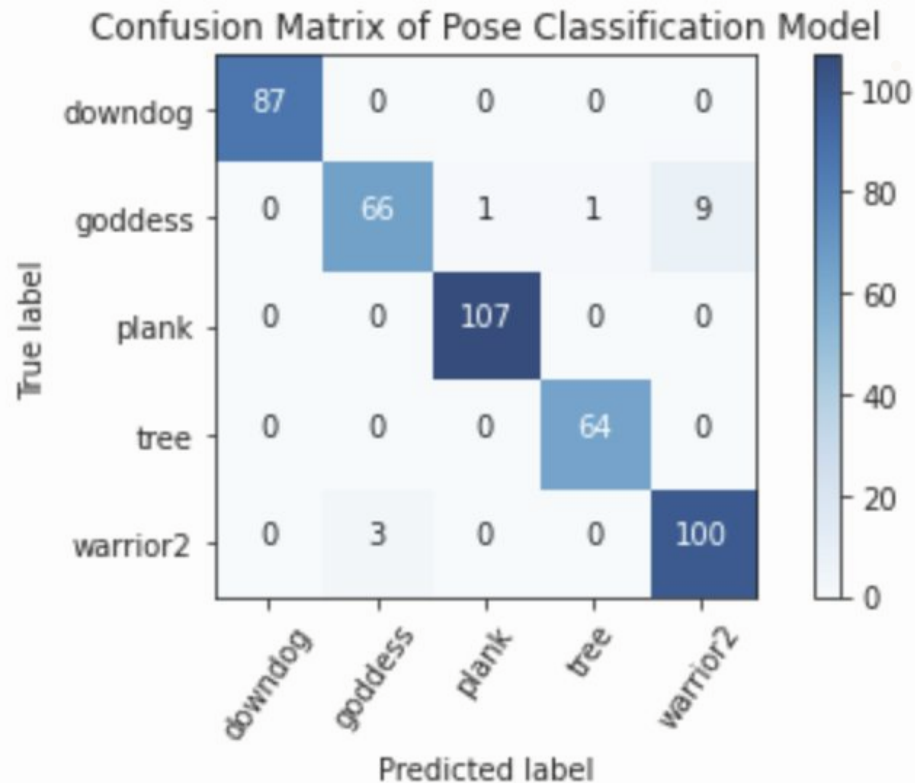
CNN with MoveNet

- Testing Accuracy: 0.9680

- Improved accuracy over all previous models

- Warrior 2 & Goddess caused majority of incorrect classifications

Transfer Learning Results

Confusion Matrix:

Shows nearly perfect results with the only exception of Goddess Pose

Confusion Matrix of Pose Classification Model

Incorrectly Classified Images

Predict: goddess; Actual: warrior2

Predict: warrior2; Actual: goddess

FUTURE WORK

01

DEPLOY APPLICATION

Using Flutter and TensorFlow Lite
to detect pose from user's webcam

02

EXTEND CLASSES/POSES

Train model on more yoga poses

03

SHOW EXPECTED FORM

Highlight expected keypoint locations
for selected pose

04

PROVIDE FEEDBACK

Inform user how to improve
alignment

THANKS

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LinkedIn: www.linkedin.com/in/leah-j-nagy/

APPENDIX

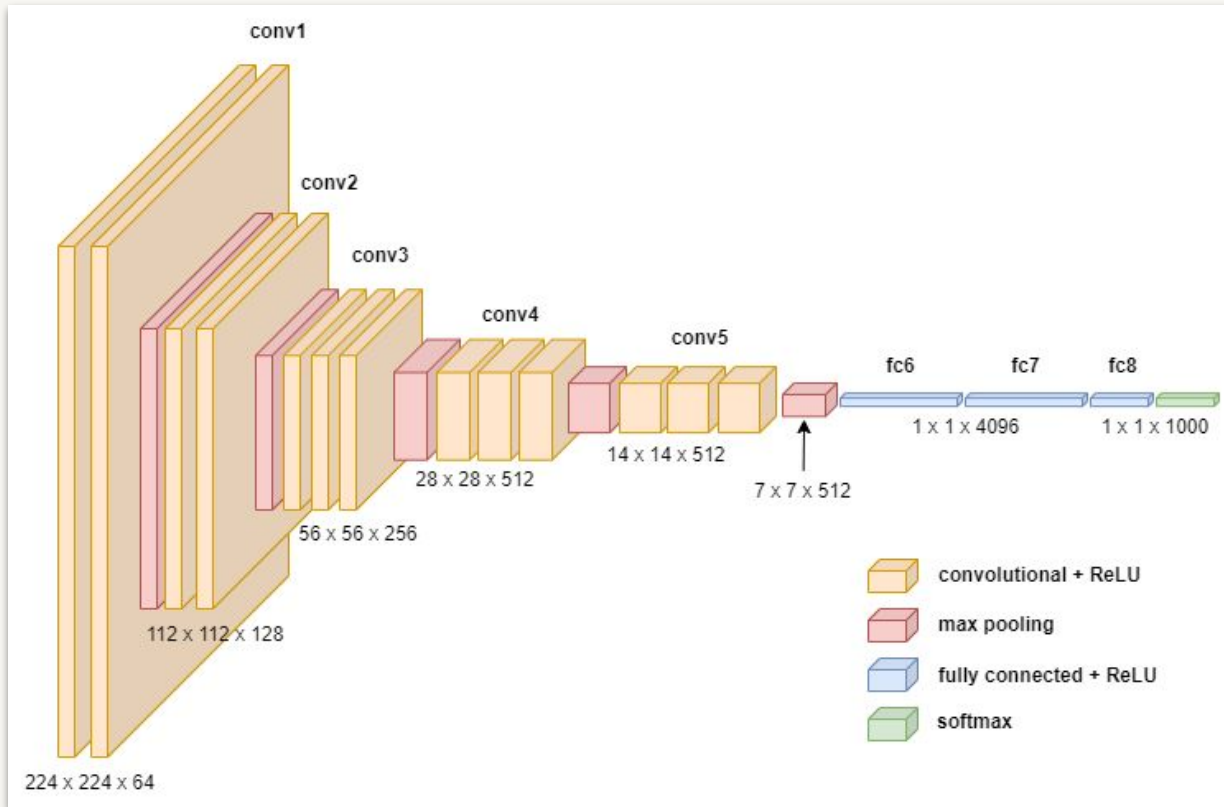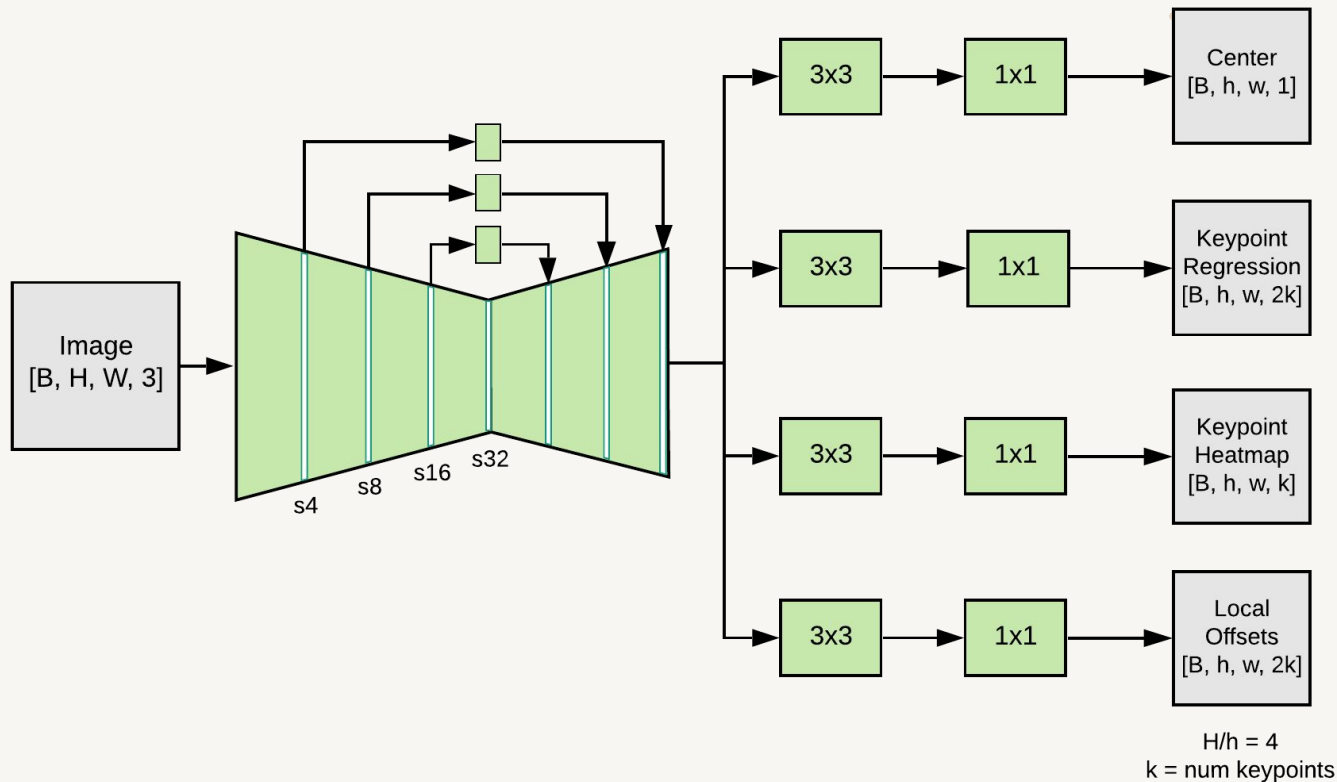# Reference Sources

- TensorFlow SinglePose Demo:
  https://colab.research.google.com/github/tensorflow/hub/blob/master/examples/colab/movenet.ipynb#scrollTo=zeGHgANcT7a1
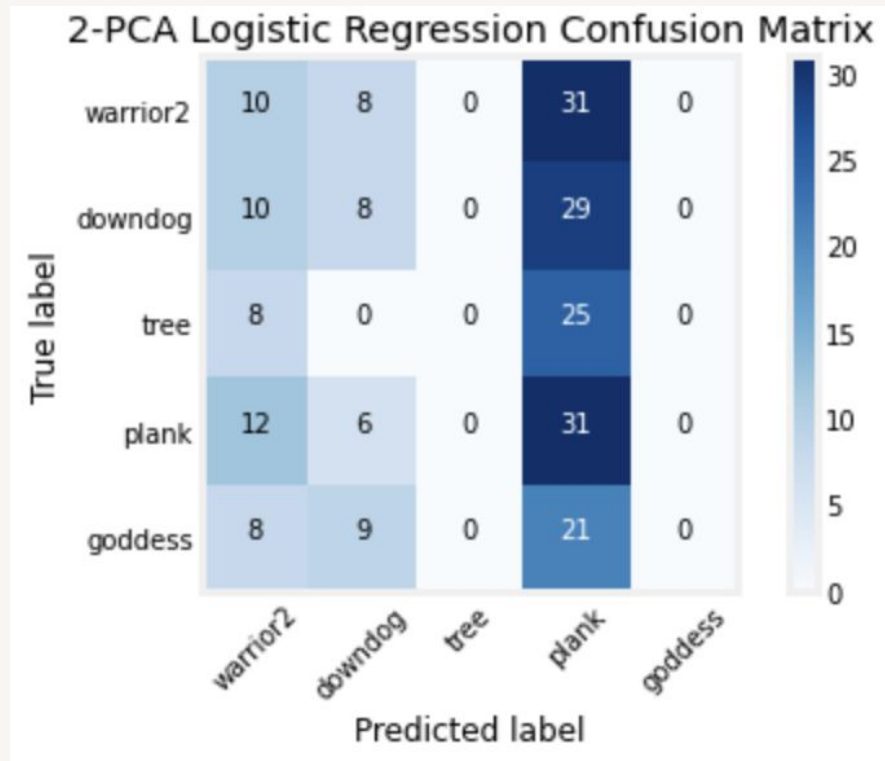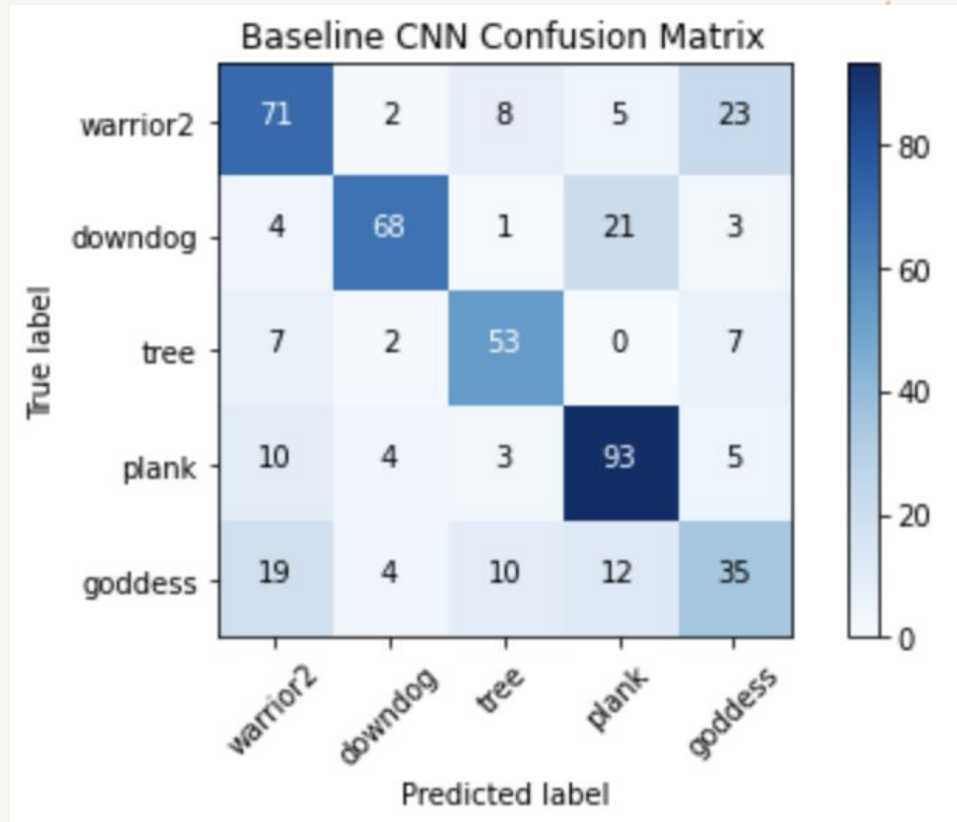
- DeepLizard Transfer Learning with VGG16:
  https://deeplizard.com/learn/video/oDHpqu52soI

VGG16 Architecture

MoveNet Architecture

Logistic Regression Confusion Matrix

2-PCA Logistic Regression Confusion Matrix

CNN - Baseline Confusion Matrix

CNN - VGG16 Confusion Matrix