**Neural Networks Project - Gesture Recognition**

**CONCLUSIONS:**

* **NOTE:** The model was built on a personal laptop with a NVIDIA GeForce MX450 2GB Graphics Card. Due to constraints on the available compute resources, model parameters were restricted.
* Model training time increased with the number of frames and size of image. Due to compute resource restrictions, frames = 20 and image (75, 75) were used to build the model. Any value higher than these threw an OOM error.
* Conv3D with Adam Optimizer performed slightly better than Conv3D with SGD Optimizer and hence, Adam Optimizer was used for further models
* Conv3D model with smaller filter(2x2x2) and reduced parameters performed a bit better than the Conv3D model with a (3x3x3) filter due to the filter size.
* Conv2D with LSTM/GRU model had to be built with frames =18 to prevent OOM error.
* CONV3D model performed better than Conv2D model for similar parameters.
* Transfer learning model has performed the best and is the final model.
* **NOTE:** Uploaded h5 for the top 2 Models
  + Conv3D with Adam Optimizer (Reduced Parameters) 🡪 **model-00020-0.87244-0.71569-0.72458-0.77000.h5**
  + Transfer Learning with LSTM 🡪 **model-00020-0.16450-0.98039-0.75175-0.73000.h5**

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| **Experiment Number** | **Model** | **Result** | **Decision + Explanation** |
| **1** | **Conv3D**  **100x100 image**  **batch size > 20** | **Throws Out of Memory (OOM) error** | **Images were resized to 75x75 and a batch size = 20 was chosen** |
| **2** | **Conv3D with SGD Optimizer**  **75x75 image**  **batch size = 20**  **frames = 20**  **epochs = 20**  **filter size=2x2x2** | **Training Accuracy: 0.26**  **Validation Accuracy: 0.47** | **Model Accuracy low**  **Total params: 1,358,005**  **Trainable params: 1,357,397**  **Non-trainable params: 608** |
| **3** | **Conv3D with Adam Optimizer**  **75x75 image**  **batch size = 20**  **frames = 20**  **epochs = 20**  **filter size=2x2x2** | **Training Accuracy: 0.42**  **Validation Accuracy: 0.57** | **Model Accuracy improved compared to SGD Optimizer**  **Total params: 1,358,005**  **Trainable params: 1,357,397**  **Non-trainable params: 608** |
| **4** | **Conv3D with Adam Optimizer (Reduced Parameters)**  **75x75 image**  **batch size = 20**  **frames = 20**  **epochs = 20**  **filter size=2x2x2** | **Training Accuracy: 0.72**  **Validation Accuracy: 0.77** | **Model Accuracy improved with reduced parameters**  **Total params: 685,621**  **Trainable params: 685,269**  **Non-trainable params: 352** |
| **5** | **Conv3D with Adam Optimizer (Increased Filter Size)**  **75x75 image**  **batch size = 20**  **frames = 20**  **epochs = 20**  **filter size=3x3x3** | **Training Accuracy: 0.64**  **Validation Accuracy: 0.65** | **Model Accuracy reduced with increased filter size.**  **Total params: 735,173**  **Trainable params: 734,821**  **Non-trainable params: 352** |
| **6** | **Conv2D with LSTM**  **75x75 image**  **batch size = 18**  **frames = 20**  **epochs = 20**  **filter size=2x2x2** | **Training Accuracy: 0.55**  **Validation Accuracy: 0.62** | **Model Accuracy reduced compared to Conv3D**  **Total params: 643,813**  **Trainable params: 643,333**  **Non-trainable params: 480** |
| **6** | **Conv2D with GRU**  **75x75 image**  **batch size = 18**  **frames = 20**  **epochs = 20**  **filter size=2x2x2** | **Training Accuracy: 0.66**  **Validation Accuracy: 0.61** | **Model Accuracy reduced compared to Conv3D but better than LSTM**  **Total params: 508,773**  **Trainable params: 508,293**  **Non-trainable params: 480** |
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| **Final Model** | **Transfer Learning with LSTM**  **(Mobilenet)**  **75x75 image**  **batch size = 18**  **frames = 20**  **epochs = 20**  **filter size=2x2x2** | **Training Accuracy: 0.98**  **Validation Accuracy: 0.73** | **Best Model Accuracy which is expected due to transfer learning and higher training parameters. Training accuracy seems to be high.**  **Total params: 4,611,781**  **Trainable params: 1,380,869**  **Non-trainable params: 3,230,912** |