IIIT KOTA

CSD300(PROJECT-1)

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Submitted by-
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PROBLEM STATEMENT-

EEG SIGNAL-GRASP AND LIFT OF OBJECT BY USING ROBOTIC ARM

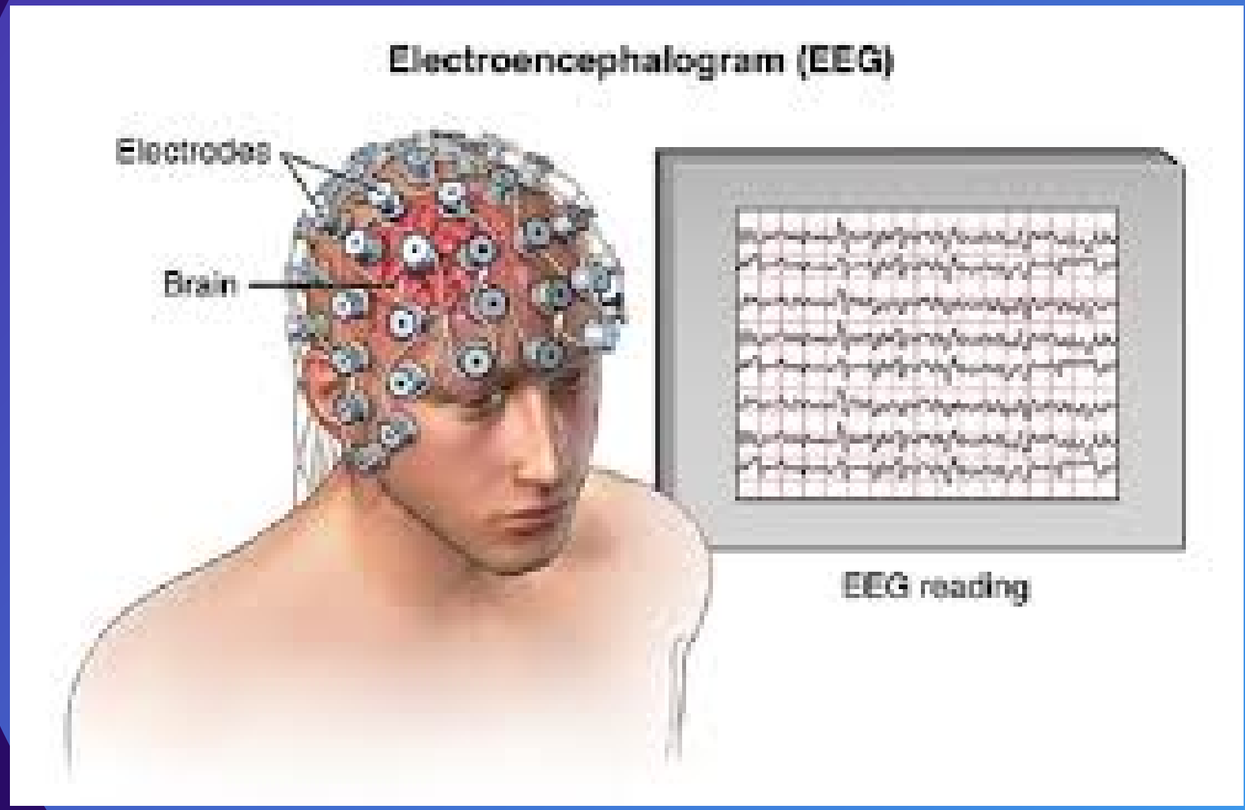
RECAP

- Introduction
- Operations
- Dataset
- Methodology
- Feature extraction techniques
- Classification techniques
- Future goal

INTRODUCTION

Electroencephalography (EEG) signals-

- Electroencephalography is a non-invasive brain recording technique that records electric activites in cortex spontaneously
- Bandwidth:0.5-128Hz; amplitude:0.02-0.4mv
- During an EEG test,small electrodes like cup or disc type are placed on the scalp.



GRASP AND LIFT OPERATIONS-

- HAND START
- FIRST DIGIT TOUCH
- BOTH START LOAD PHASE
- LIFT OFF
- REPLACE
- BOTH-RELEASE

Dataset-

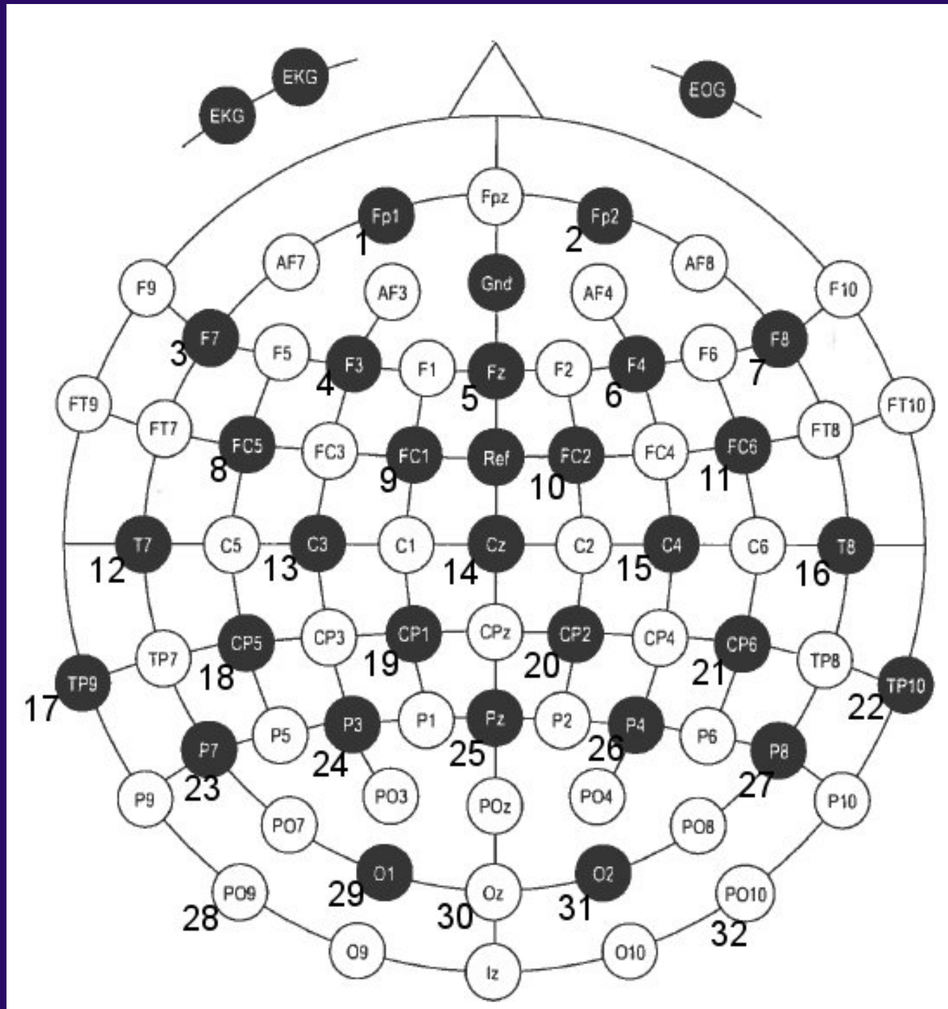
- 32 attributes(electrodes)
- 12 subjects
- 10 series
- 30 trails in each series

Traing dataset-

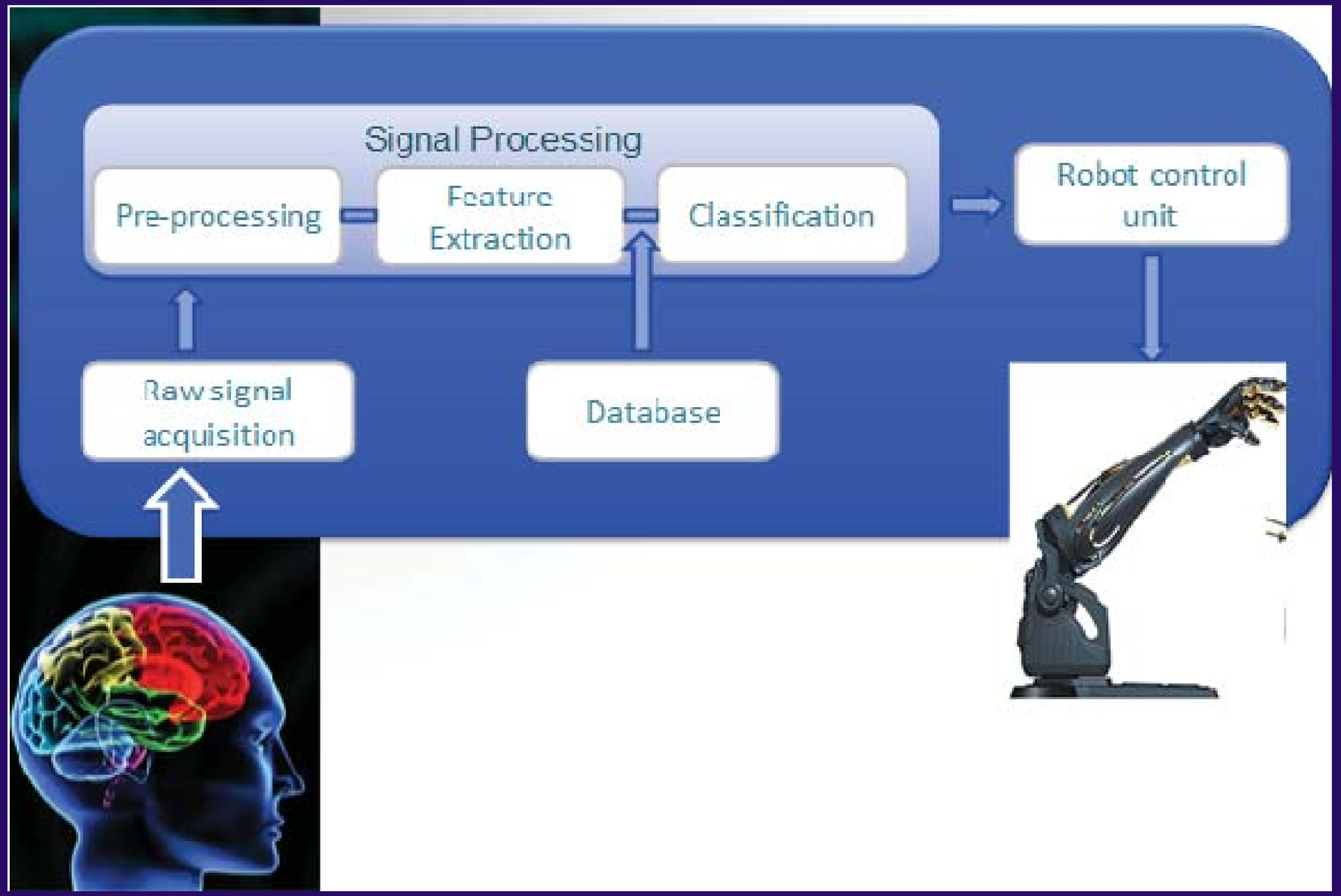
- First 8 series for each subject

Test dataset-

- 9th and 10th series

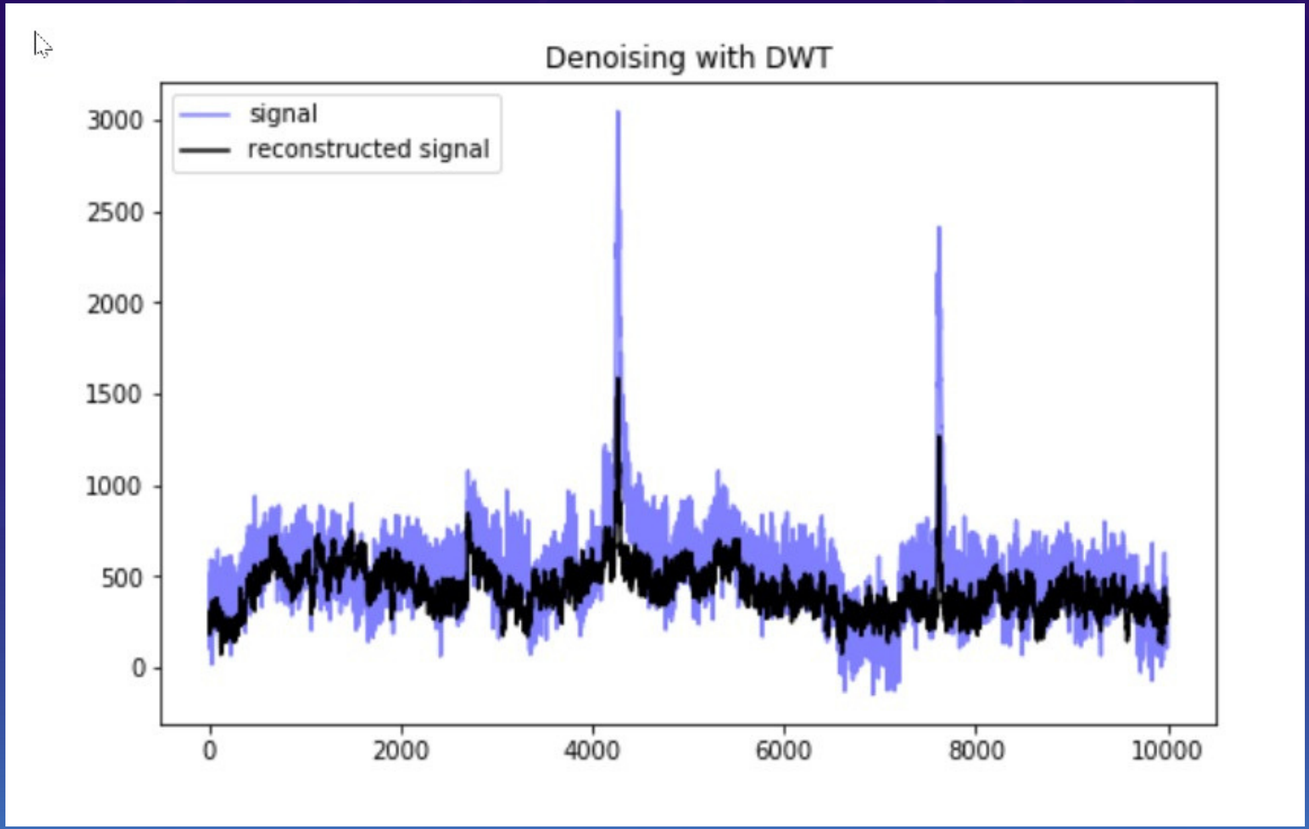


METHODOLOGY -



Wavelet Transformation

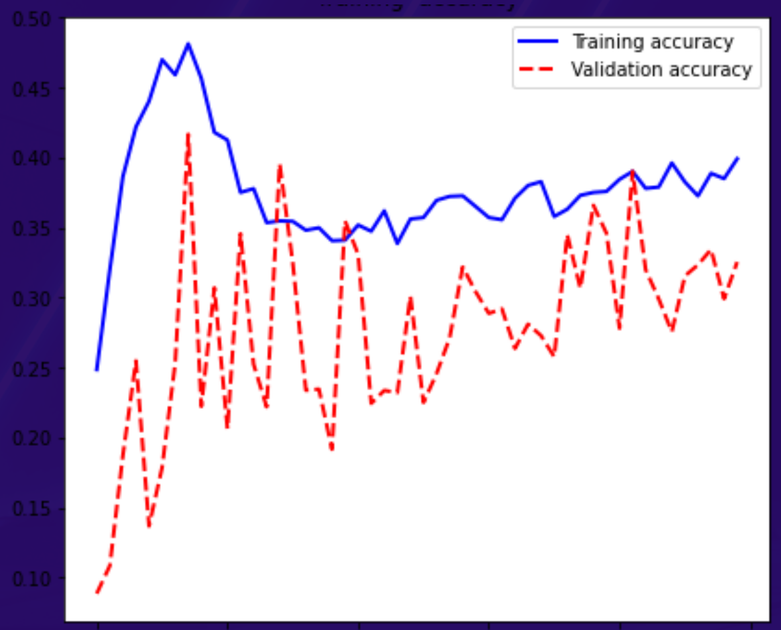
- Used for analyzing signals and extracting information
- Represent a signal in terms of localized wavelet
- Captures both time and frequency information

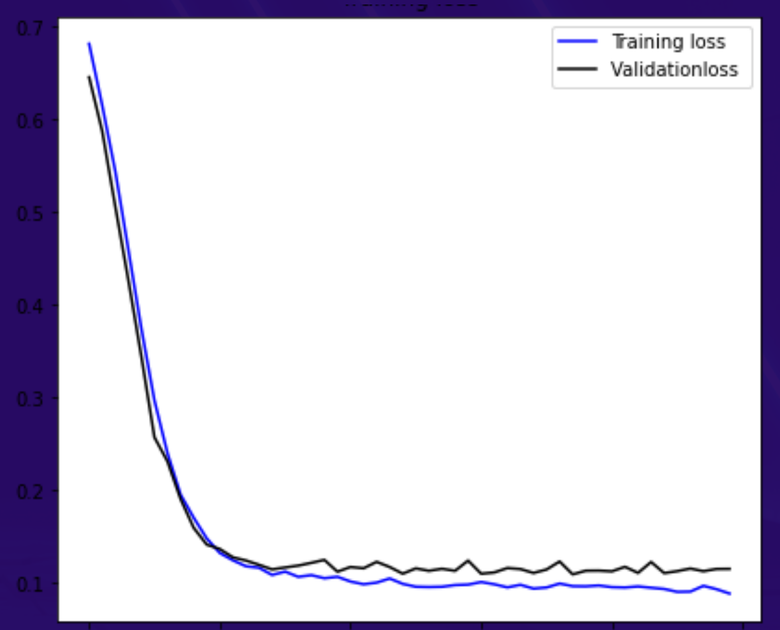


Convolutional Neural Network (CNN)

- Convolutional layer
- Polling layer
- Fully connected layer

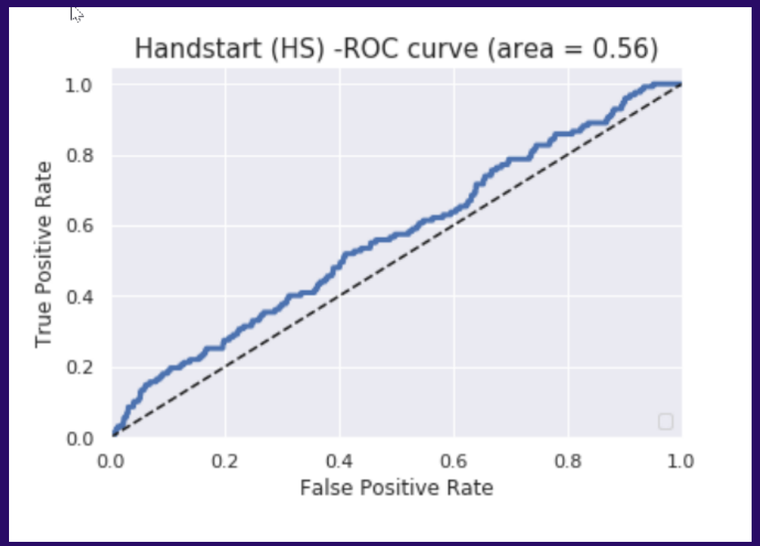
- Activation Function:relu,sigmoid
- filters:64,kernal size:7x7
- optimizer:adam
- loss=binary _crossentrophy
- steps_oer_echo:300,epochs=50



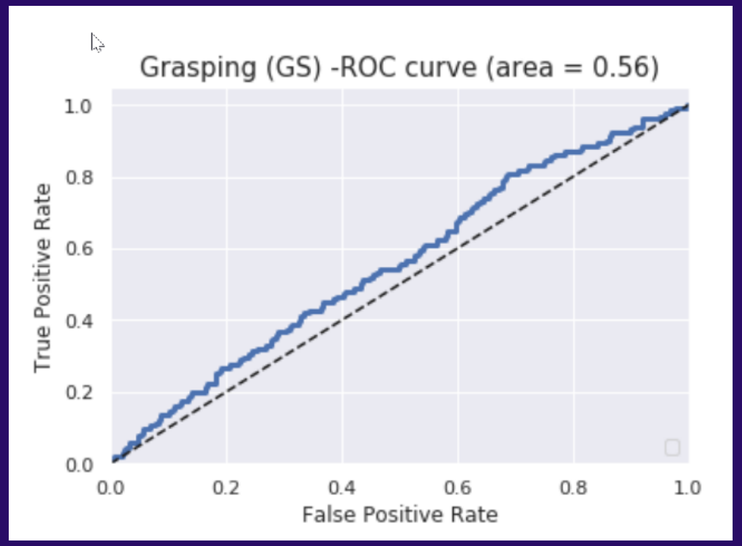


Training and Validation Accuracy and Loss

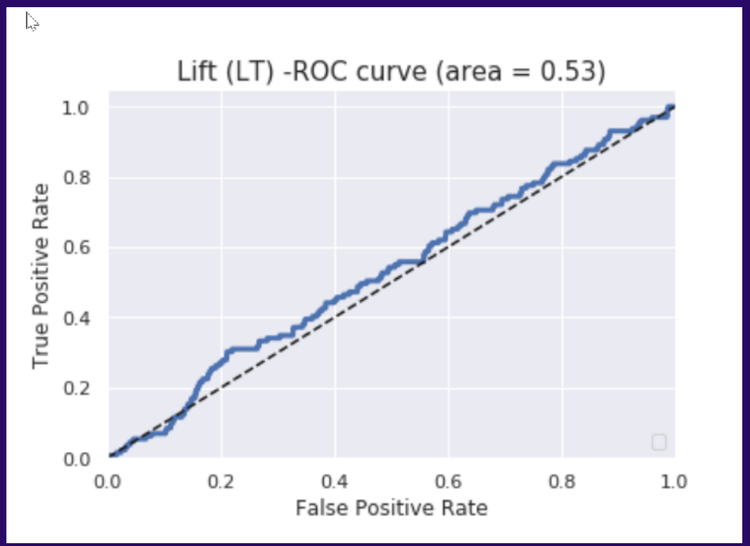
Results:



Handstart

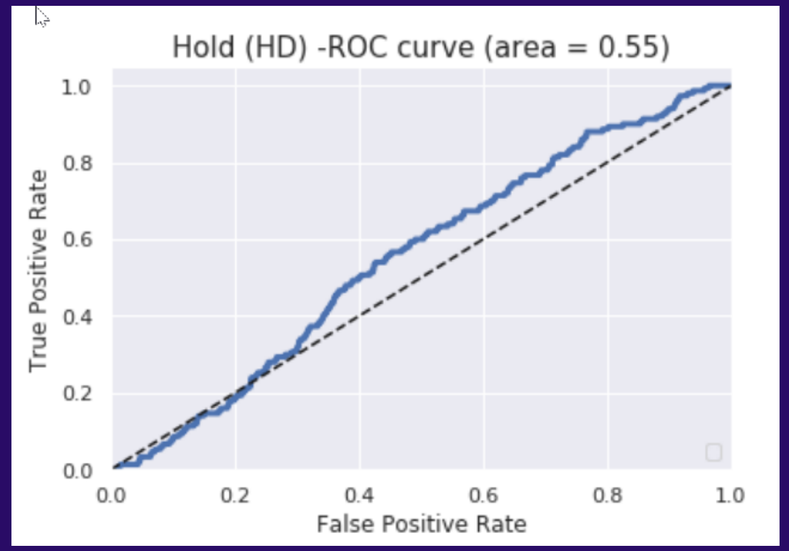


Grasping

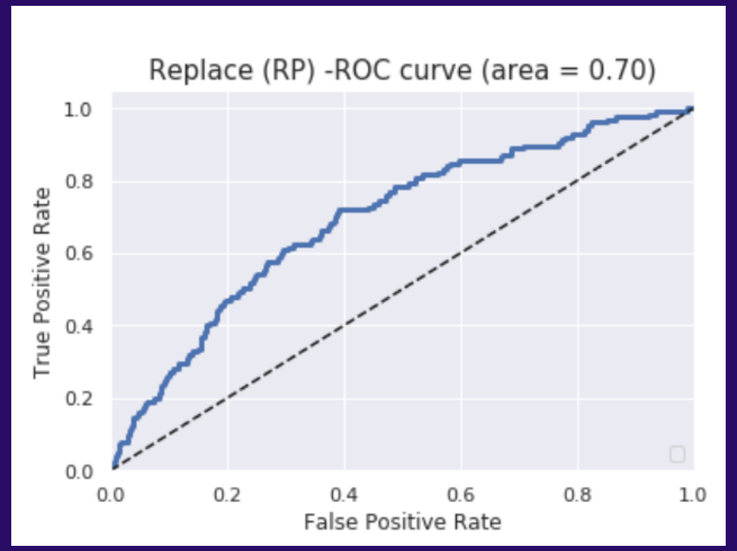


liftoff

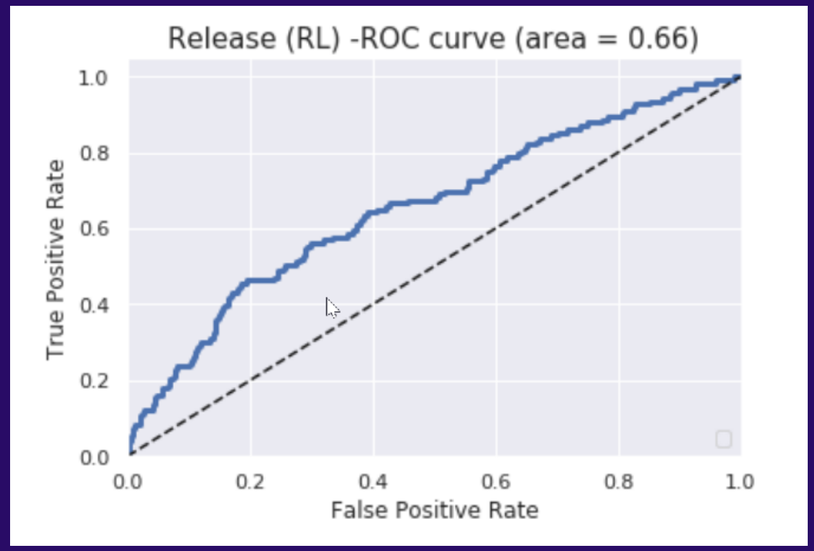
Results:



Hold



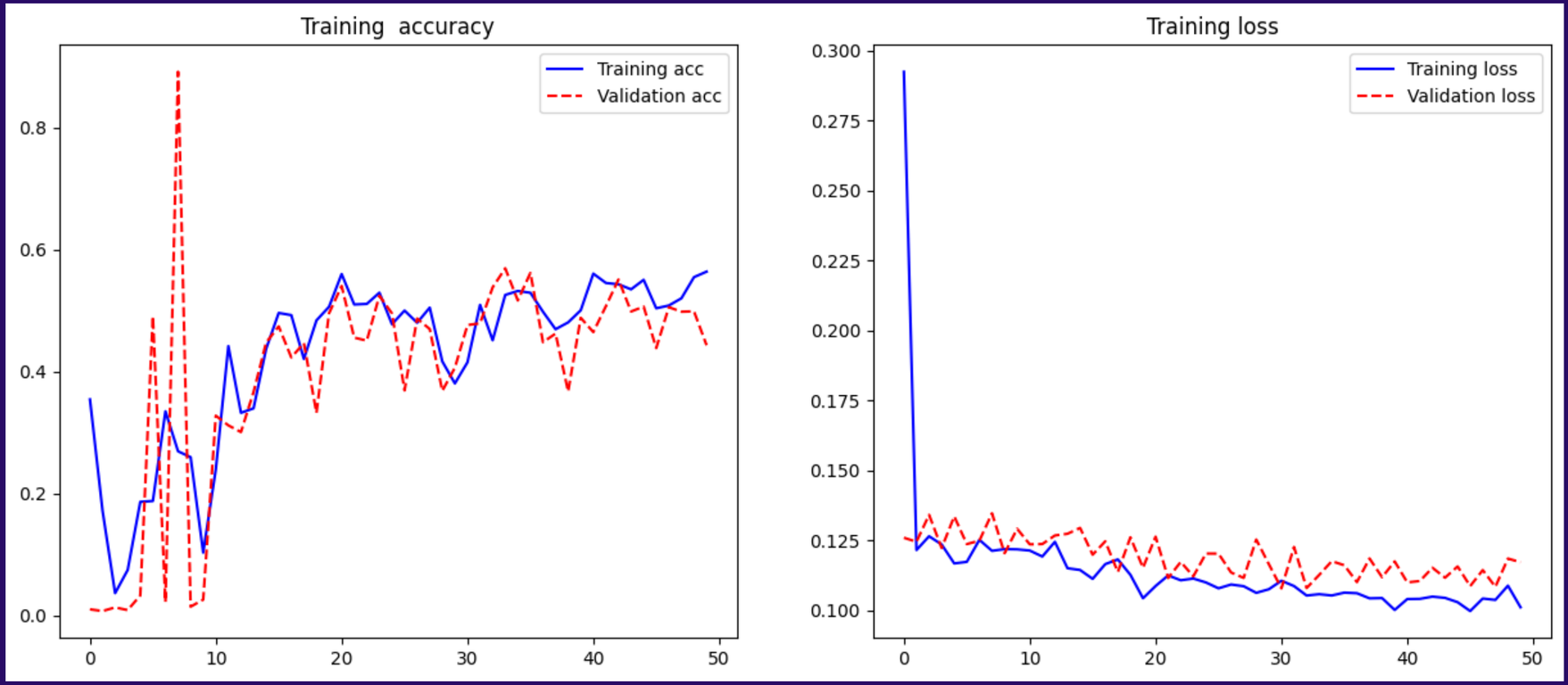
Replace



Release

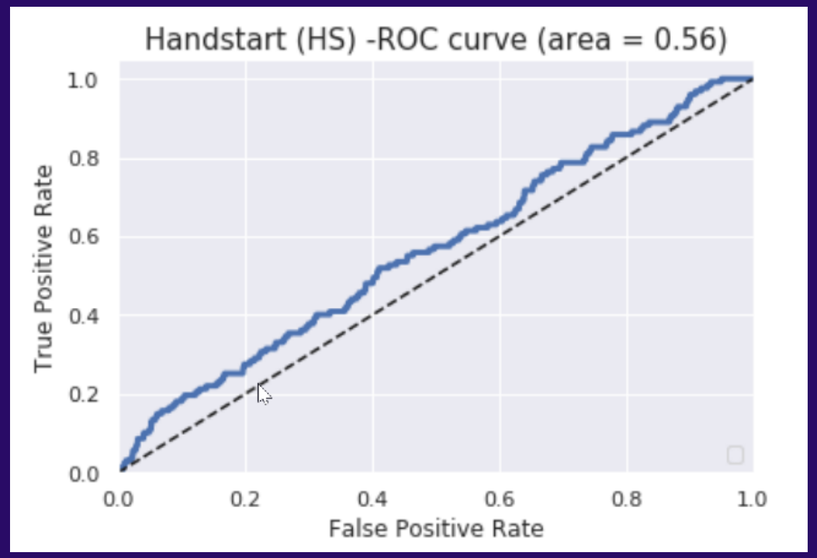
Long Short-Term Memory (LSTM) networks):-

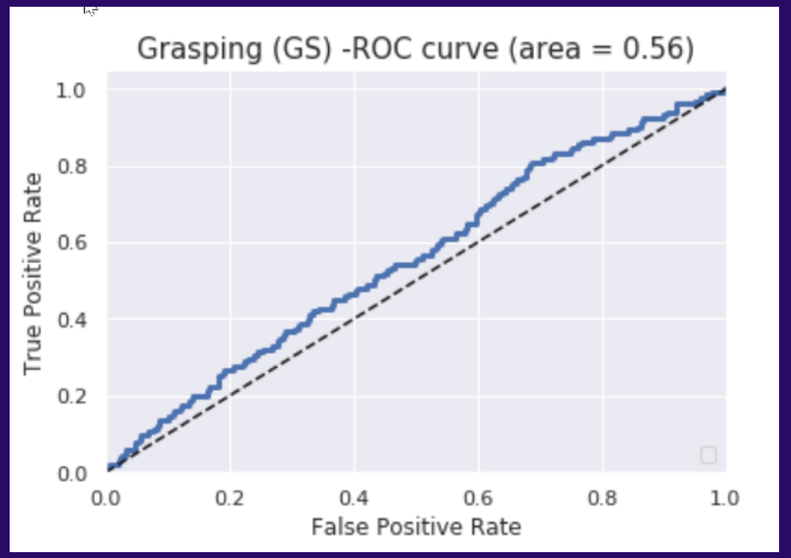
- sequence input layer
- an LSTM layer,
- a fully connected layer
- classification output layer

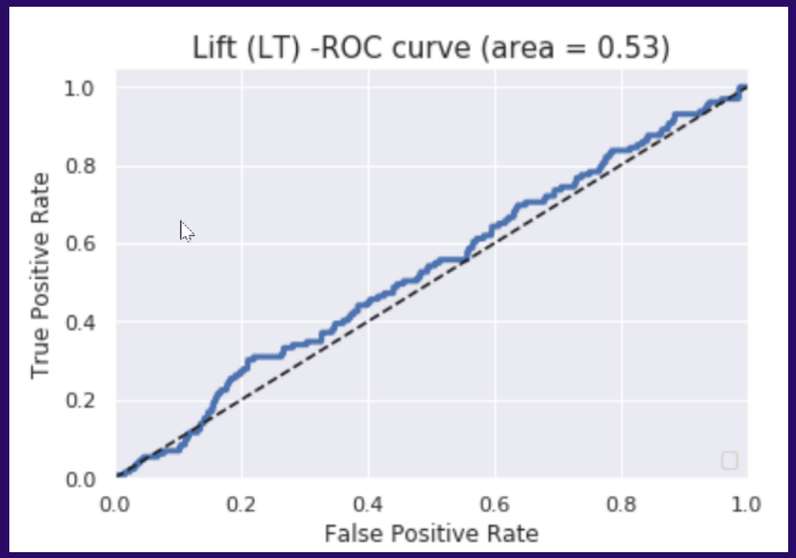


Training and Validation Loss and Accuracy

Results:- ROC curves for Six GAL Events





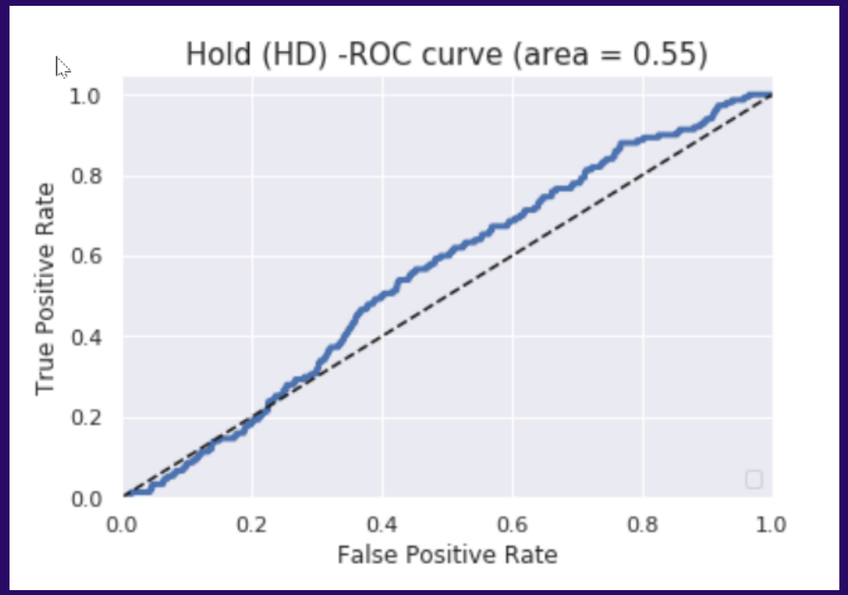


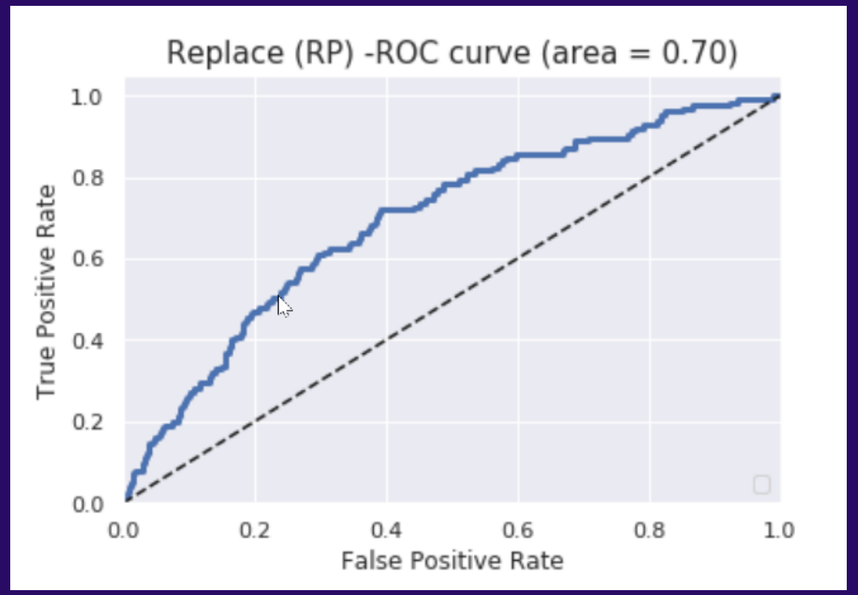
1.Handstart

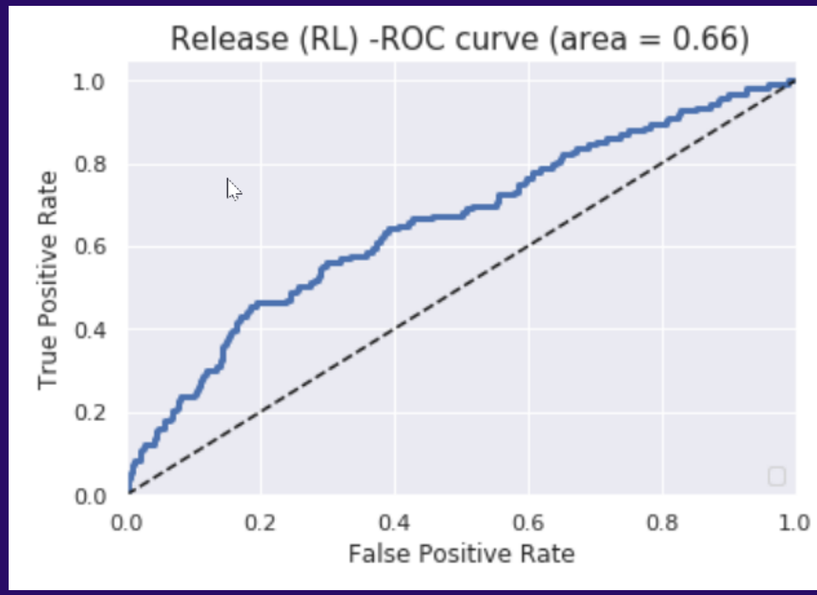
2.Grasping

3.Liftofff

Results:





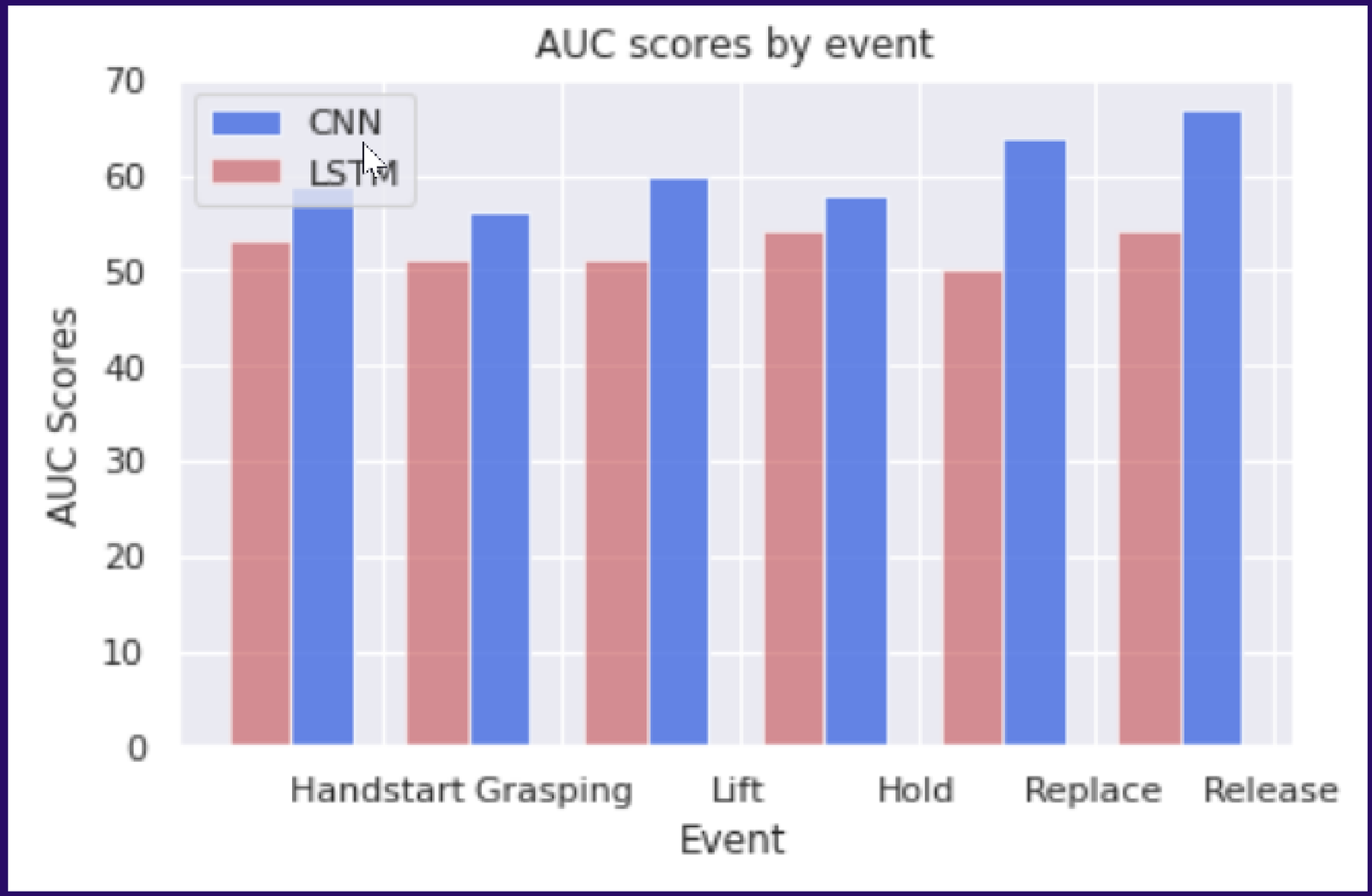


4. Hold

5.Replace

6.Release

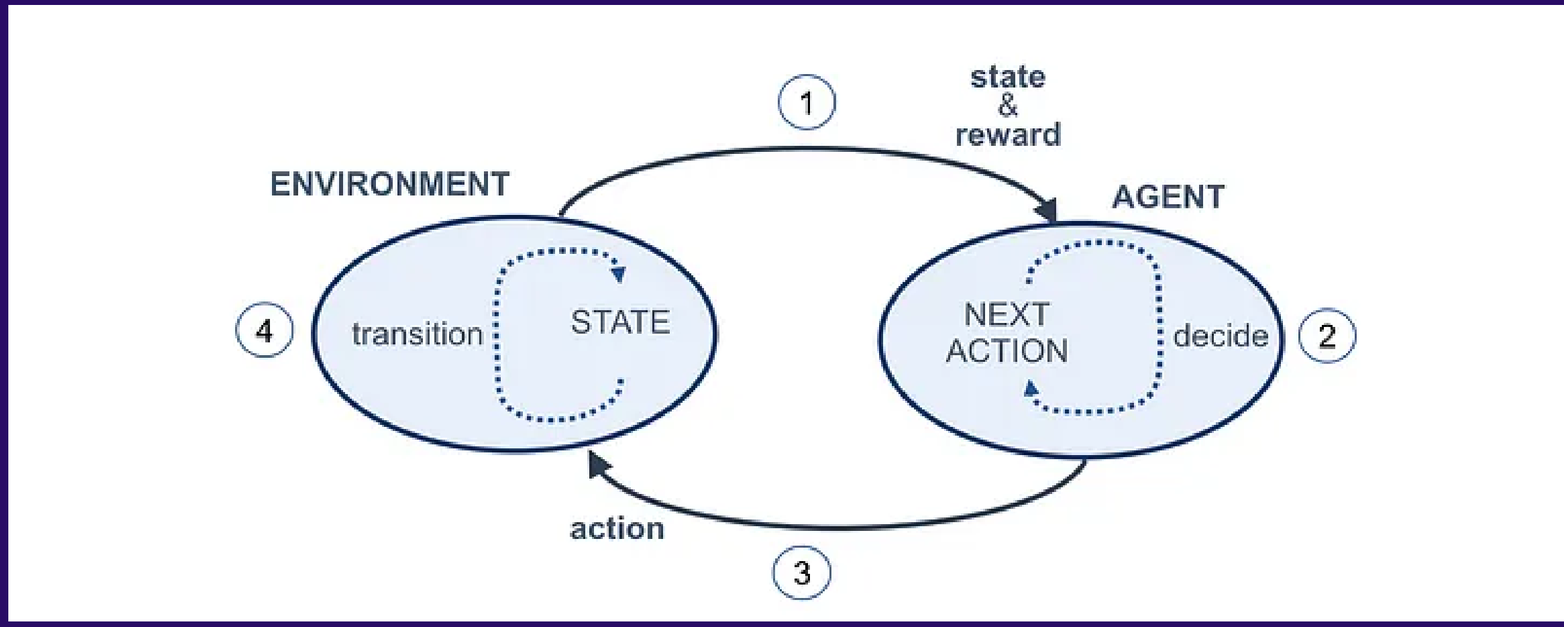
Comparison


AUC scores by event
CNN
LSTM
AUC Scores
70
60
50
40
30
20
10
0
Handstart
Grasping
Lift
Hold
Replace
Release
Event

Deep Reinforcement learning

- DRL (Deep Reinforcement Learning) is an AI approach that combines deep learning techniques with reinforcement learning .
- Enabling agents to learn and make decisions in complex environments

- Agent: The learning entity that interacts with the environment and makes decisions.
- Environment: The external world or system
- State: the environment at a particular moment
- Reward: The feedback or numerical signal



Main steps of Deep Reinforcement Learning (DRL)

- Problem Formulation: Define problem environment.
- Agent Design: Create intelligent agent.
- Neural Network Architecture: Design deep neural network.
- Training: Train agent iteratively.
- Exploration and Exploitation: Balance exploration and exploitation.
- Evaluation and Refinement: Assess and improve performance.
- Hyperparameter Tuning: Optimize algorithm parameters.
- Testing and Deployment: Test in real-world scenarios.
- Iterative Improvement: Continuous refinement process.

Deep Q-Network (DQN)

- Algorithm used by the agent to learn the optimal policy or value function.
- The agent interacts with the environment by observing the current state, selecting actions based on its policy, executing the actions in the environment, and receiving rewards.
- The agent's objective is to learn the optimal policy or value function . which involves updating its neural network based on the observed rewards
- The DQN algorithm enables the agent to learn from experiences, update its neural network parameters, and improve its decision-making over time.

REFRENCES -

Dataset link-

Multi-channel EEG recordings during 3,936 grasp and lift trials with varying weight and friction Matthew D. Luciw1,2, Ewa Jarocka3,4 & Benoni B. Edin3 , 09 April 2014

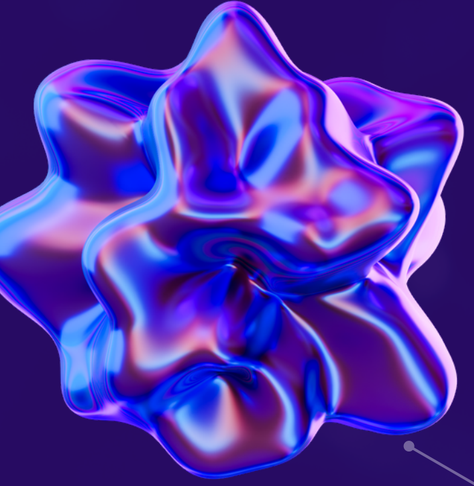
[1] https://towardsdatascience.com/a-comparison-of-dnn-cnn-and-lstm-using-tf-keras-2191f8c77bbe , Prasanna Sethuraman

[2] . B.M. Aowlad Hossain, Md. Wasiur Rahman, Manjurul Ahsan Riheen **Left and Right Hand Movements EEG Signals Classification Using Wavelet Transform and Probabilistic Neural Network** Vol. 5, No. 1, February 2015,

[3] Howida A. Shedeed, Mohamed F. Issa,**Brain EEG signal processing for controlling a robotic arm**November 2013 Conference: Computer Engineering & Systems (ICCES), 2013 8th International Conference on

[4] Md. Kamrul Hasan ; Sifat Redwan Wahid ; Faria Rahman ; Shanjida Khan Maliha ; Sauda Binte Rahman A Grasp-and-Lift Detection from EEG Signal Using Convolutional Neural Network 24-26 February 2022

[5] .Reinforcement learning-based feature selection for improving the performance of the brain–computer interface systemJamal Jabri, Saeid Hassanhosseini, Abbas Kamali & Farhad Bahadori-Jahromi Published: 10 September 2022



Thank You