Gait Classification (2, 5 &10 Fold Subject - Wise : Acceleration Signal)

Group 4

Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

IAM Institut für Allgemeine Mechanik | RWTH AACHEN UNIVERSITY

Team Introduction

- Renuka Misal: - Data Rotation, Neural Network Design, PPT
- Soji Jacob: - Data Filtering, Data Trimming, Neural Network Design
- Rushikesh Shende: - Normalization, Code integration, Neural Network Design
- Soham Bhute: - Data Extraction, Data Cleaning
- Pratik Tatipamula: - Motion Sequencing, Data Sampling

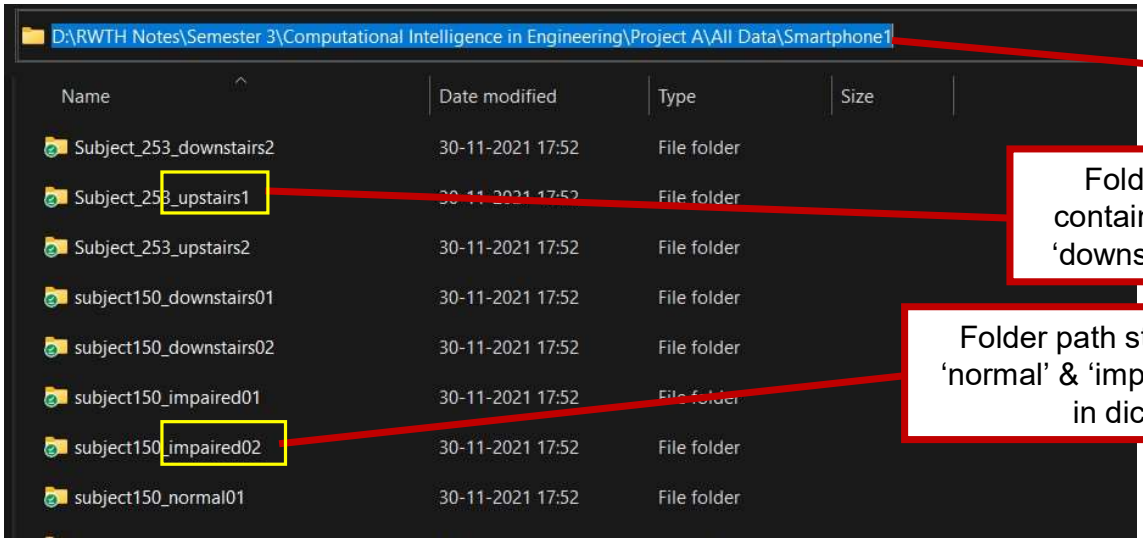
Motivation and Aim

- Motivation
  - Exploring deep learning techniques for classifying experimental data sets and developing complex functional relationship between the input and output parameters.
  - In our project we predicted the nature of the walking style by analyzing the Accelerometer data.
- Problem Statement
  - Aim of the experiment is to classify the gait.
  - The output of the neural network should predict whether the subject walked normally or with handicap.

Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

Data Preprocessing

‘Step 1’: Data Extraction



Folder path converted to string

Folder path string containing ‘upstairs’ & ‘downstairs’ is ignored

Folder path string containing ‘normal’ & ‘impaired’ are stored in dictionary

‘Step 2’: Cleaning Data

	A	B	C	D
1	Time (s)	X (m/s^2)	Y (m/s^2)	Z (m/s^2)
3922	39.313798500	-2.76E+00	-4.91E+00	-2.37E+00
3923	39.323827500	-2.40E+00	-5.59E+00	-2.40E+00
3924	39.333856500	-2.15E+00	-6.93E+00	-1.78E+00
3925	39.343884500	-2.21E+00	-7.77E+00	-9.74E-01
3926	39.343884500	-2.37E+00	-7.48E+00	-1.91E+00
3927	39.363942500	-2.65E+00	-7.37E+00	-2.91E+00
3928	39.373971500	-3.10E+00	-7.06E+00	-3.03E+00

Contradiction to function condition

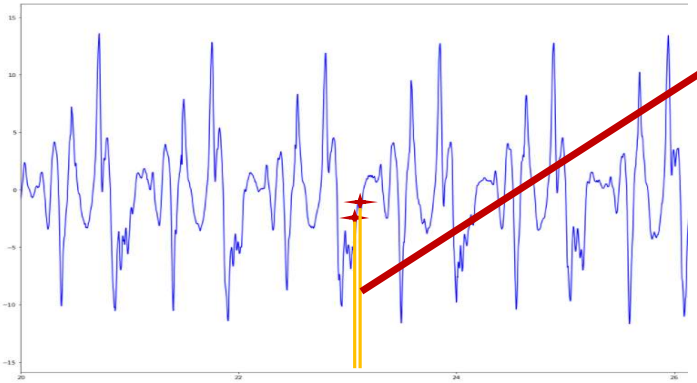
Learning Points:-

- Two recorded values at single time step were observed
- Error Identification: -
  - Exceptionally high data record frequency

Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

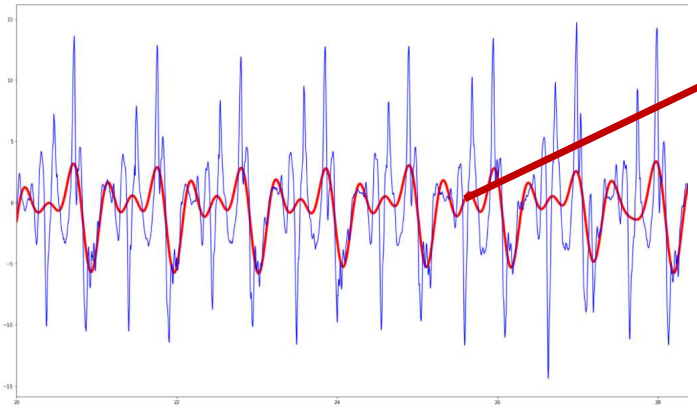
Data Preprocessing

‘Step 3’: Calculating Average Data Record Frequency



Consecutive time step average

‘Step 4’:Filtering



Physical intrepretation of the cut off frequency which is taken as twice the average walking frequency to include all phenomenas

Learning Points:-

- Sampling data record frequency not same
- Average data frequency used for: -
    - Cutting data
    - Motion sequence extraction
    - Filtering

Learning Points:-

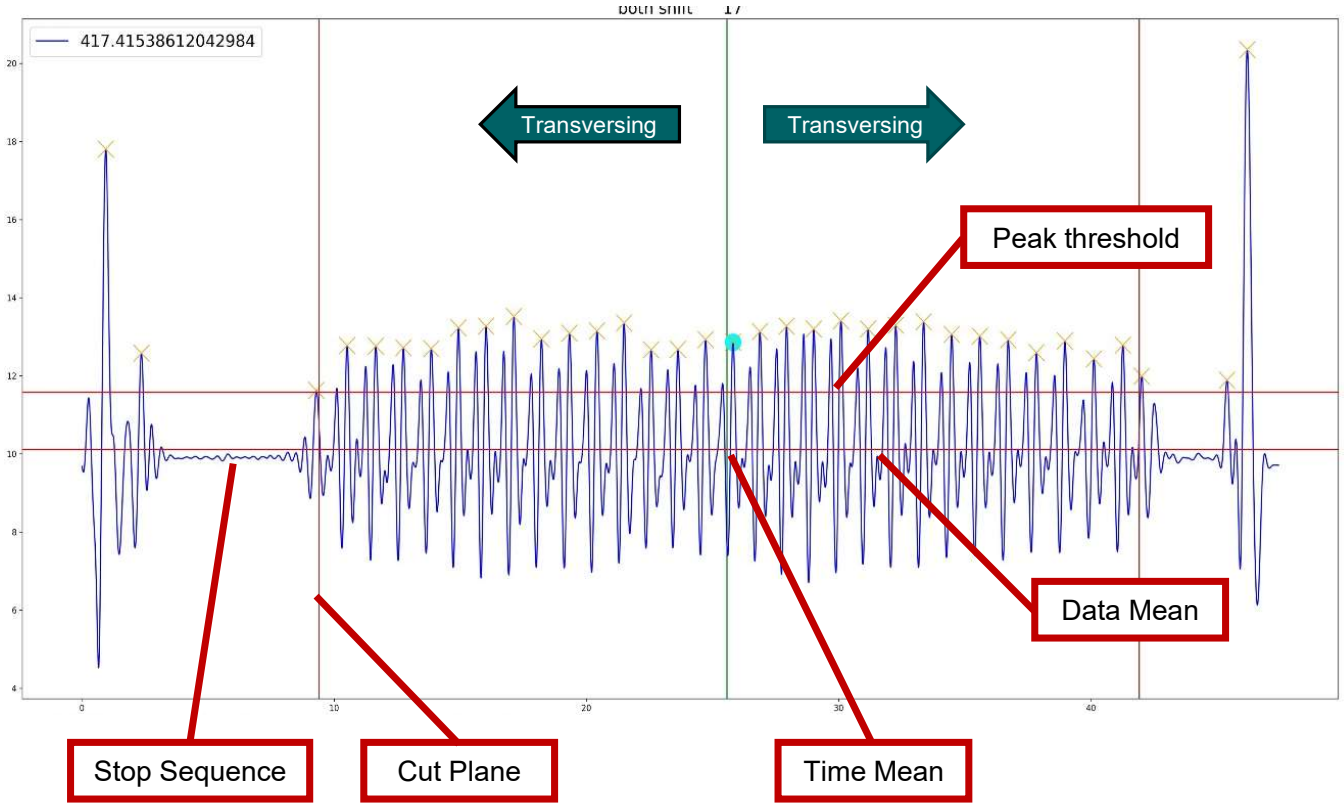
- Butter filter parameters:–
    - Order:- 8
    - Walking frquency: - 3
    - Low pass
    - Average data sampling frequency
- Why not Savitzky-Golay filter: -
    - Difficulty in interpreting the window and polynomial order for desired application of extracting walking sequence

Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

Institut für Allgemeine Mechanik | RWTH AACHEN UNIVERSITY

Data Preprocessing

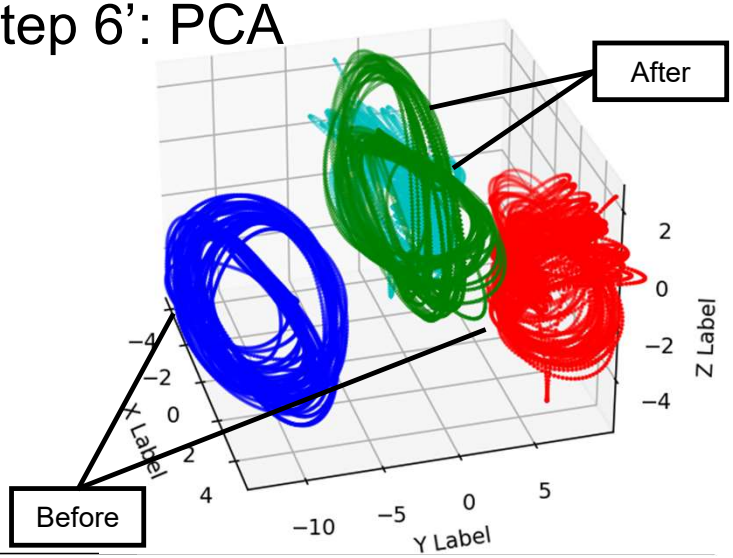
‘Step 5’: Cutting Data



Learning Points:-

- Data showed patterns of walking- stop-walking
- Data analysis starting from the mean time
- Threshold between two peaks kept at 2s
- Default option of checking 3 peak differences at the start and end of the sequence

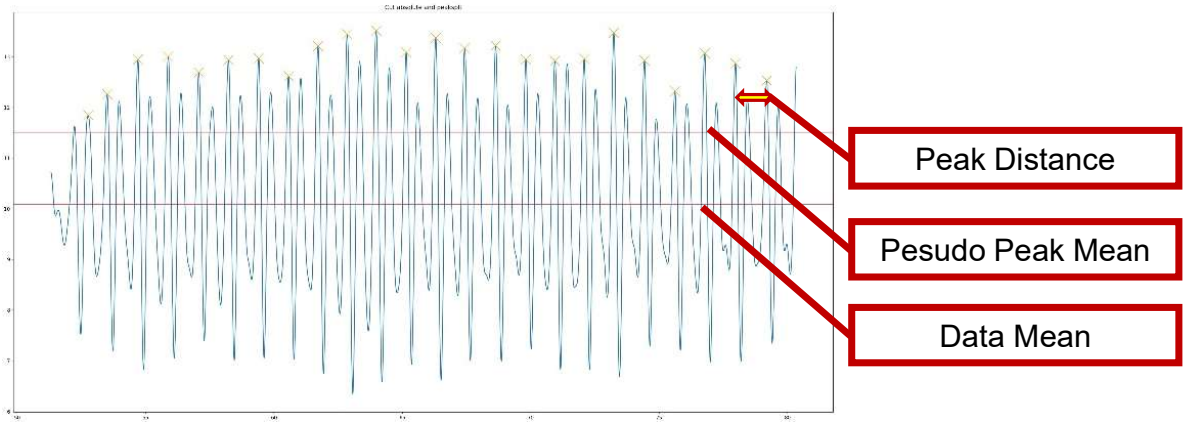
‘Step 6’: PCA



Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

Data Preprocessing

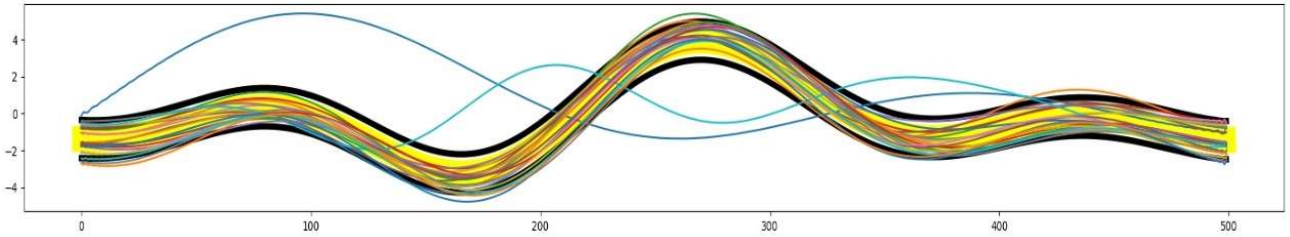
‘Step 7’: Motion Sequence Extraction and Sampling



Learning Points:-

- Parameters for Motion Extraction: -
  - Threshold peak height
  - Distance between two peaks
- Deciding the two parameters by observing the sampled data points

‘Step 8’: Malicious Sequence Removal

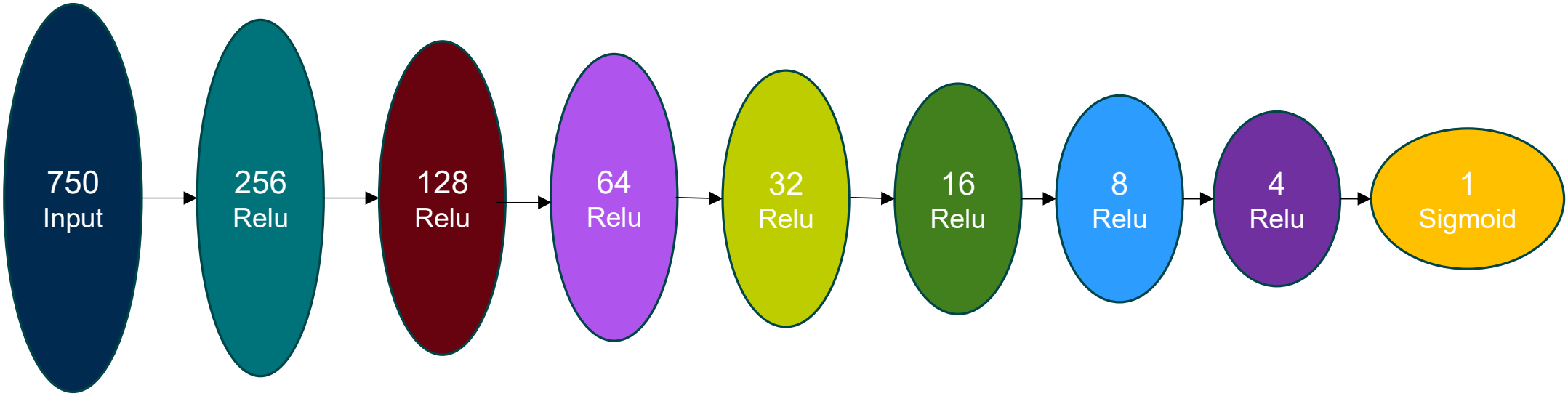


Learning Points:-

- Using moving average standard deviation to fit the trend of the step data
- Applying the process to X, Y, Z accelerations individually to increse neural netowrk accuracy
- No of resampling points: 250

Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

Neural Network

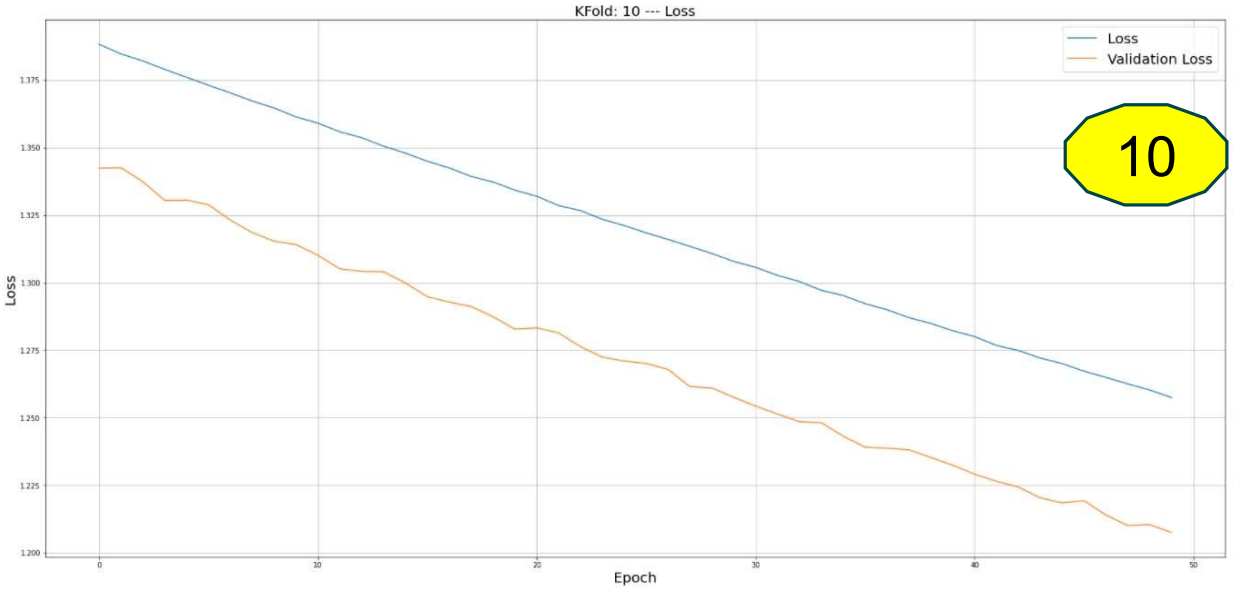


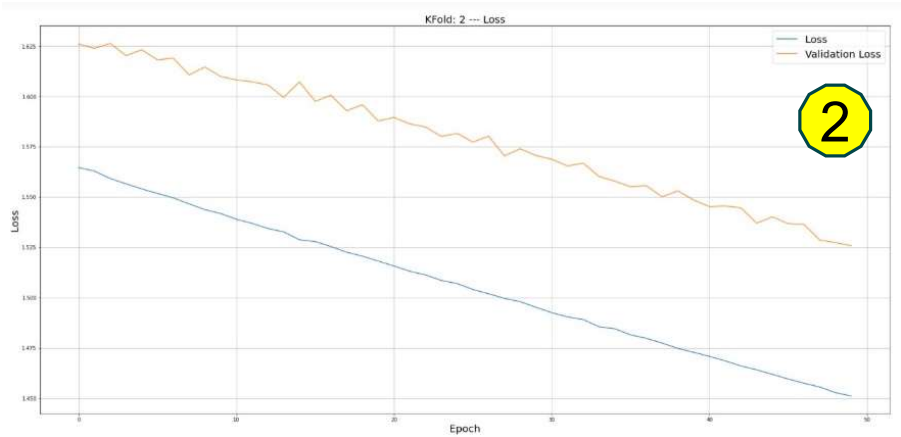
- **Exponential Learning Rate Decay**:– Decay rate:- 0.9, Decay steps: - 1000, Initialization: - 0.001
- **L1 regularization**: - alpha:- 0.1
- **Loss**: - Binary Cross Entropy
- **Optimization**: - Adam
- **K Fold**:- **Subject wise**:- 2, 5, 10
- **Number of parameters to train**: - 236,193
- **Epochs**:- 50

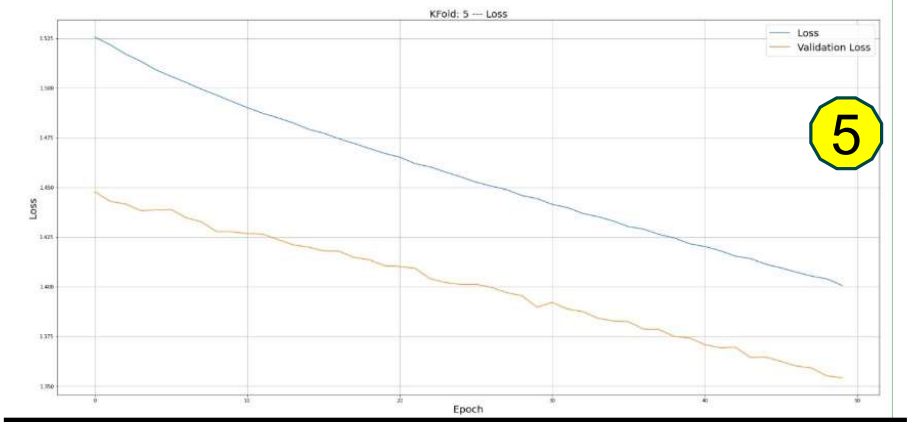
Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

Results

K Fold	Binary Accuracy (%)	
	Training	Validation
2	70.59%	61.66%
5	61.66%	70.59%
10	63.81%	72.81%







Run Time: 191.61s @ Intel i5, 1 GHz, 8 GB Ram

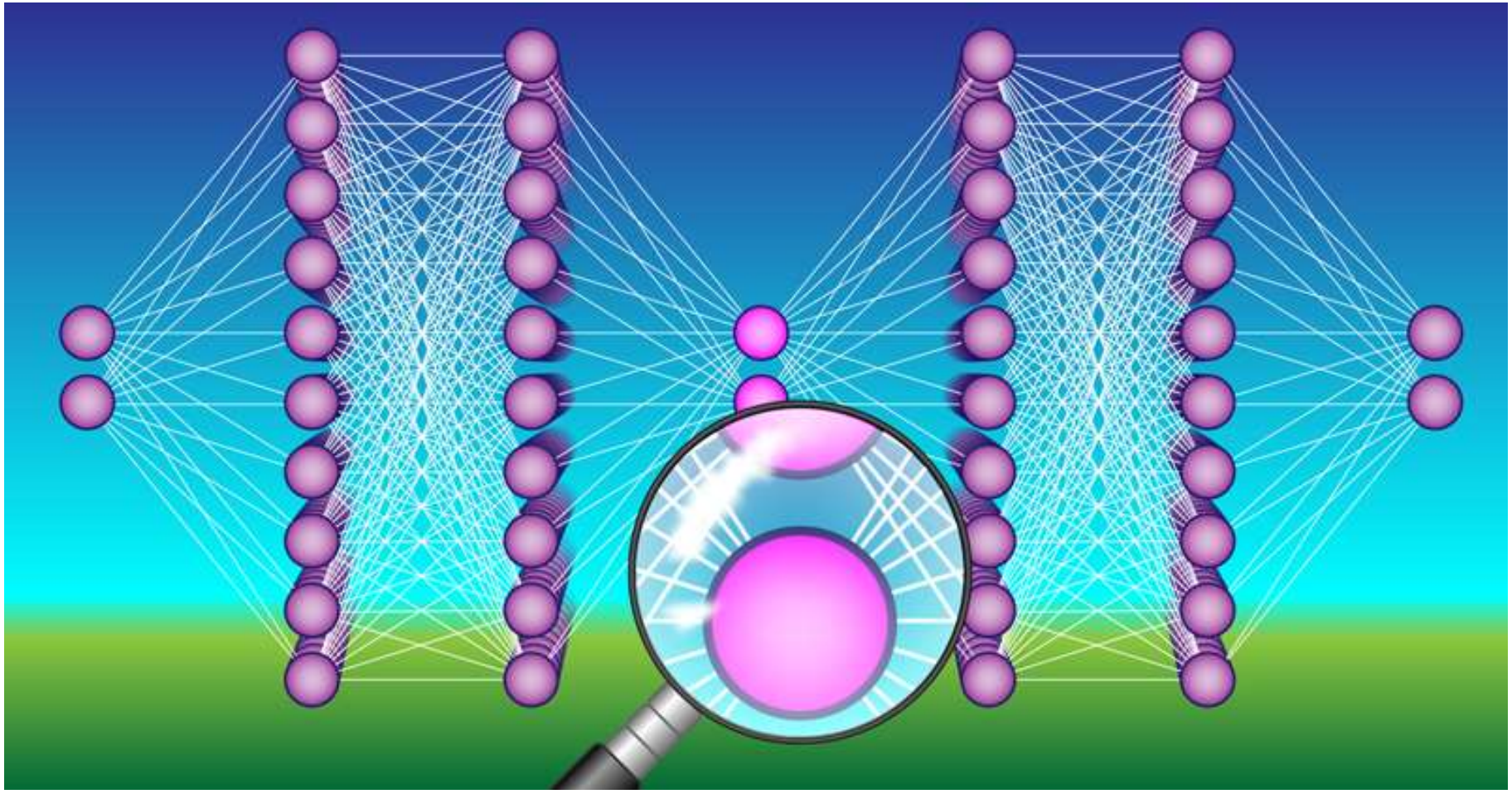
Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

Discussion and Conclusion

- Learning Points: -
  - Increasing the number of fold increases accuracy, since more data is available for training
  - Converging architecture with reducing the number of neurons in hidden layers by a factor of 2 gives better results
  - Increasing epochs decreases the loss for our network architecture
  - We encountered overfitting in these scenarios:–
    - Using L2 regularization for weights, and a lower value of regularizer hyperparameter
    - Increasing the number of dense layers introducing more parameters

    Hence, these settings were avoided.

Any Questions?



Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21

Thank You

Task: Aim 1 T01 | Group no: 4
Names: Renuka Misal, Soji Jacob, Rushikesh Shende, Soham Bhute, Pratik Tatipamula |
Date: 01.12.21