# Cardiac Electrophysiology

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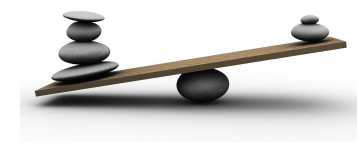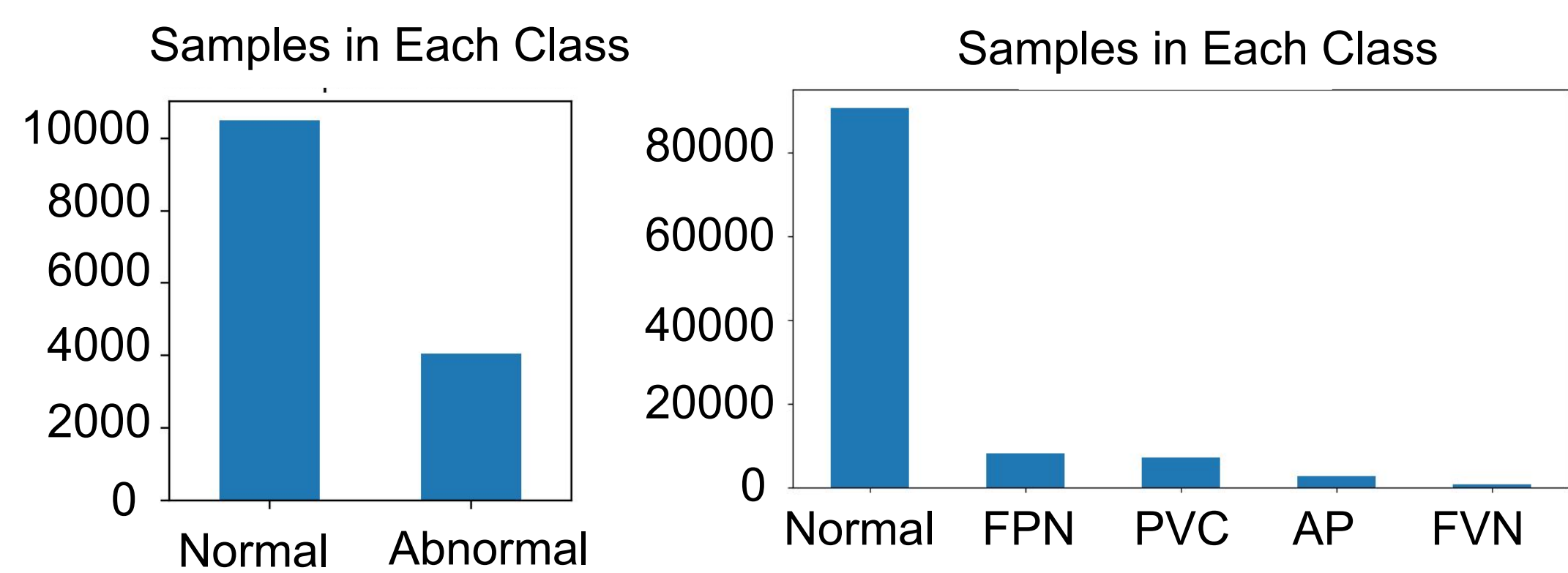
## Task 1 & 2: Heartbeat Classification (Binary & Multi-Class)
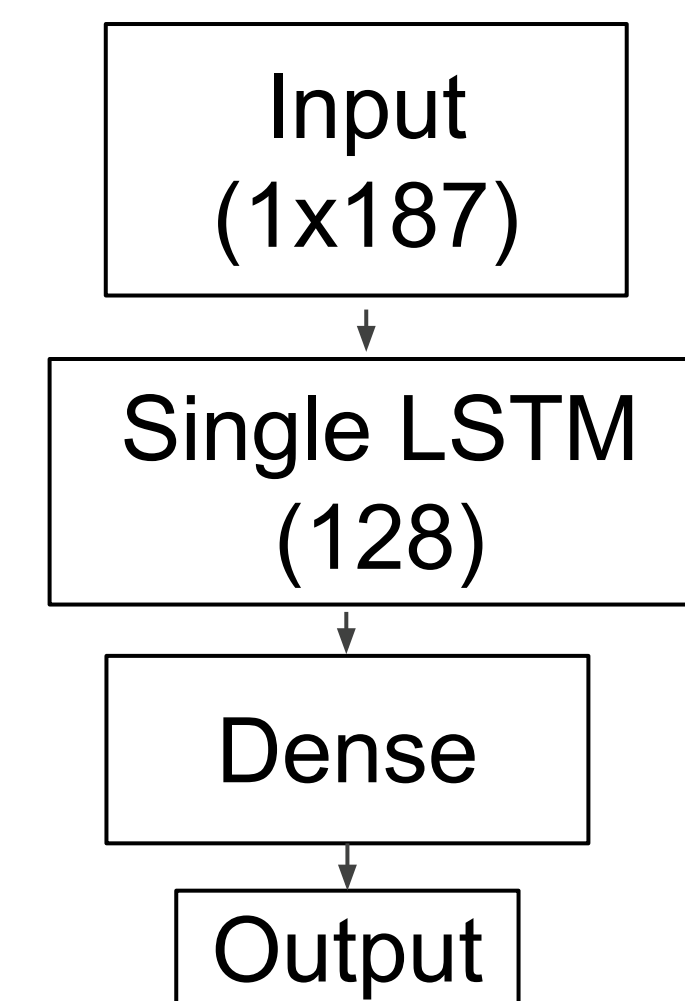
**Challenge:** Imbalanced Data

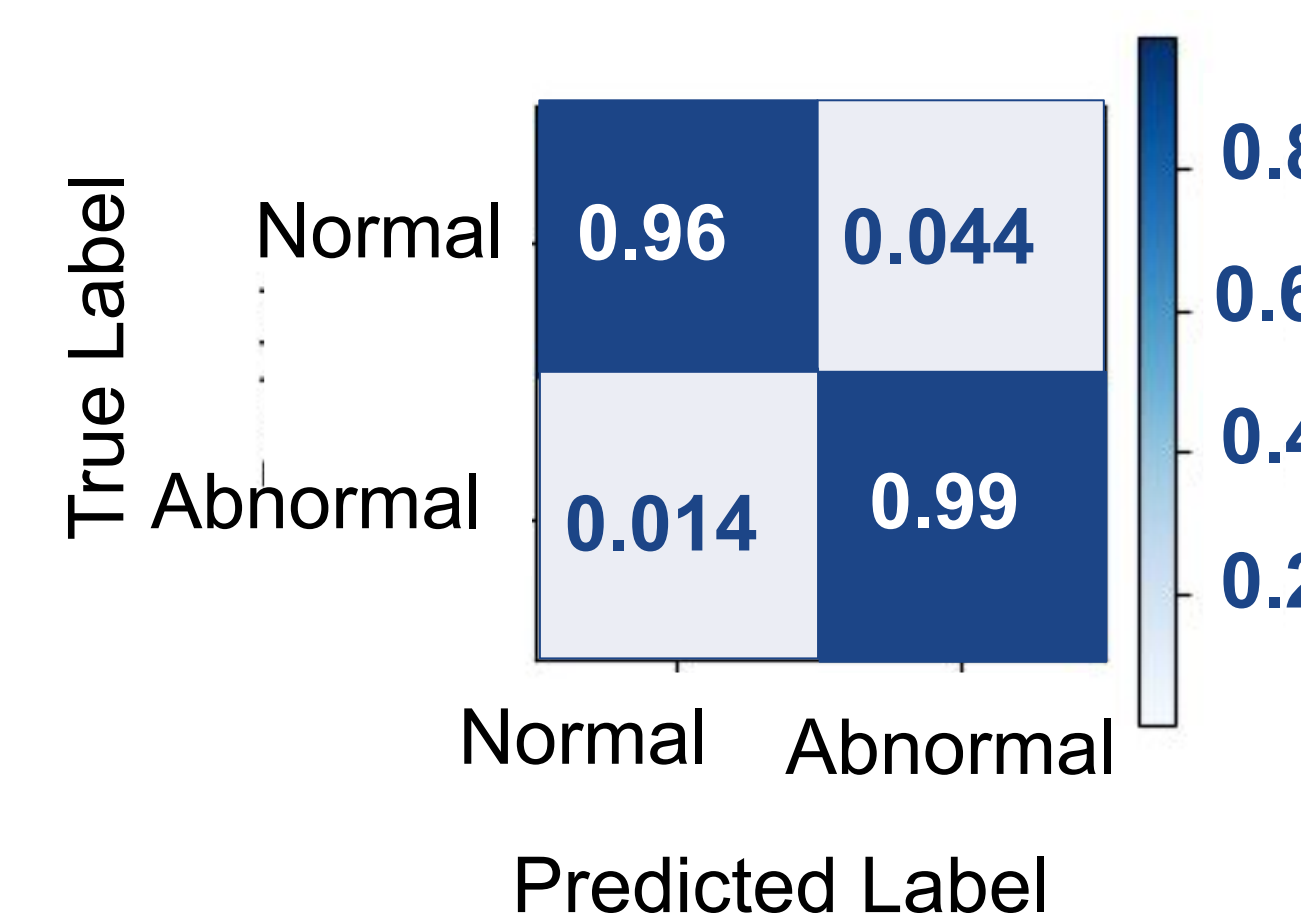**Approach:** 1. Stratified Split
2. Weighted Loss

Samples in Each Class

FPN: Fusion of Paced & Normal
PVC: Premature Ventricular Contraction
AP: Artial Premature
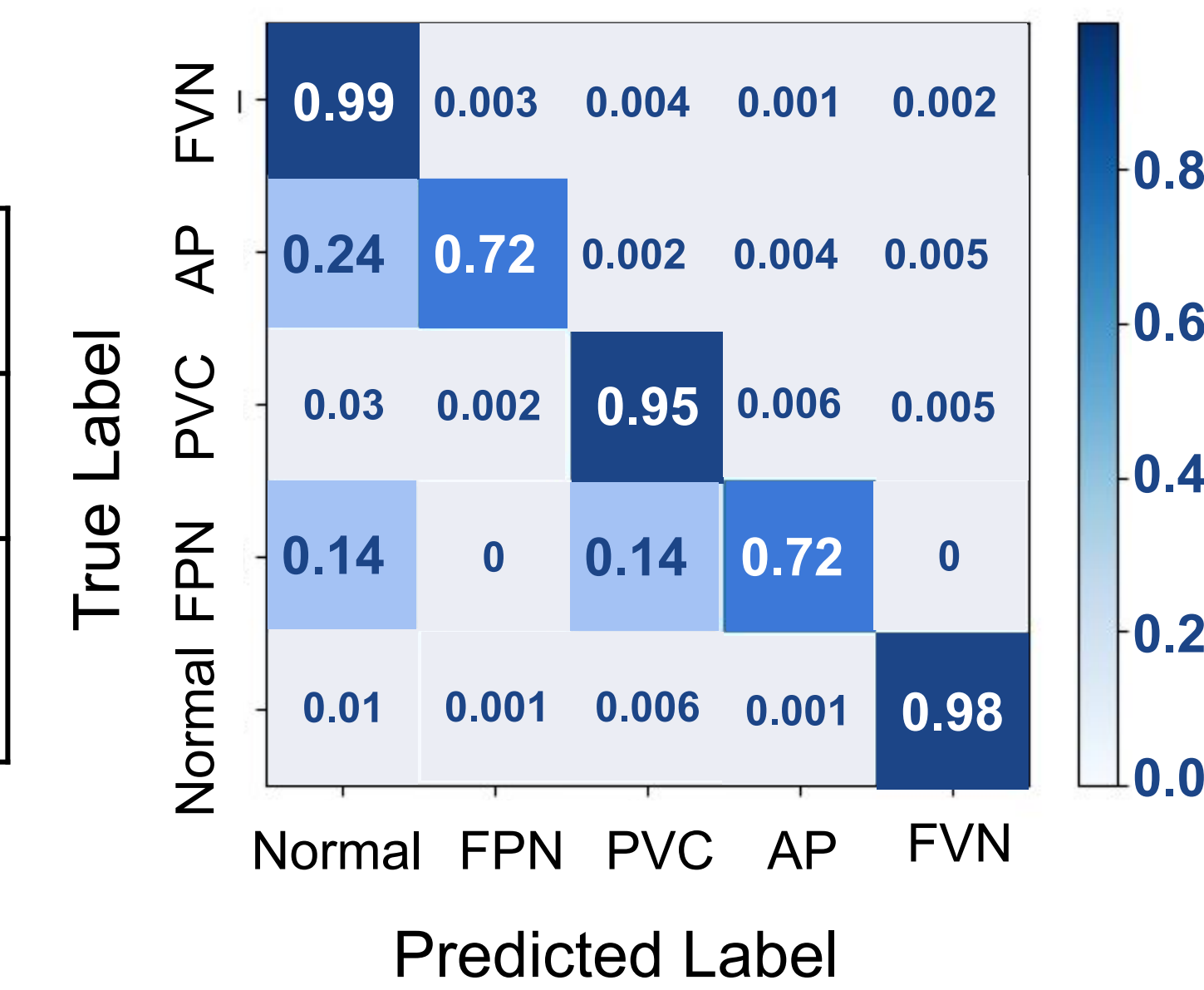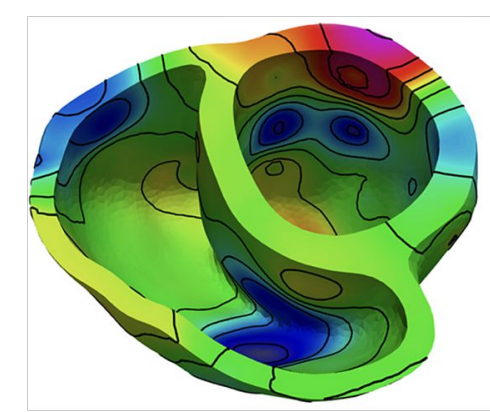FVN: Fusion of Ventricular & Normal

**Architecture:**

Input (1x187)

Single LSTM (128)

Dense

Output

**Experimental Results:**

Heartbeat Classification Task 1

|          | Precision | Recall |
|----------|-----------|--------|
| Normal   | 0.89      | 0.96   |
| Abnormal | 0.98      | 0.95   |

Confusion matrix (Task 1):
| True \ Predicted | Normal | Abnormal |
|------------------|--------|----------|
| Normal           | 0.96   | 0.044    |
| Abnormal         | 0.014  | 0.99     |

Irregular Heartbeat Classification Task 2

|        | Precision | Recall |
|--------|-----------|--------|
| Normal | 0.99      | 0.99   |
| AP     | 0.86      | 0.72   |
| PVC    | 0.92      | 0.95   |
| FVN    | 0.75      | 0.72   |
| FPN    | 0.98      | 0.98   |

Confusion matrix (Task 2):
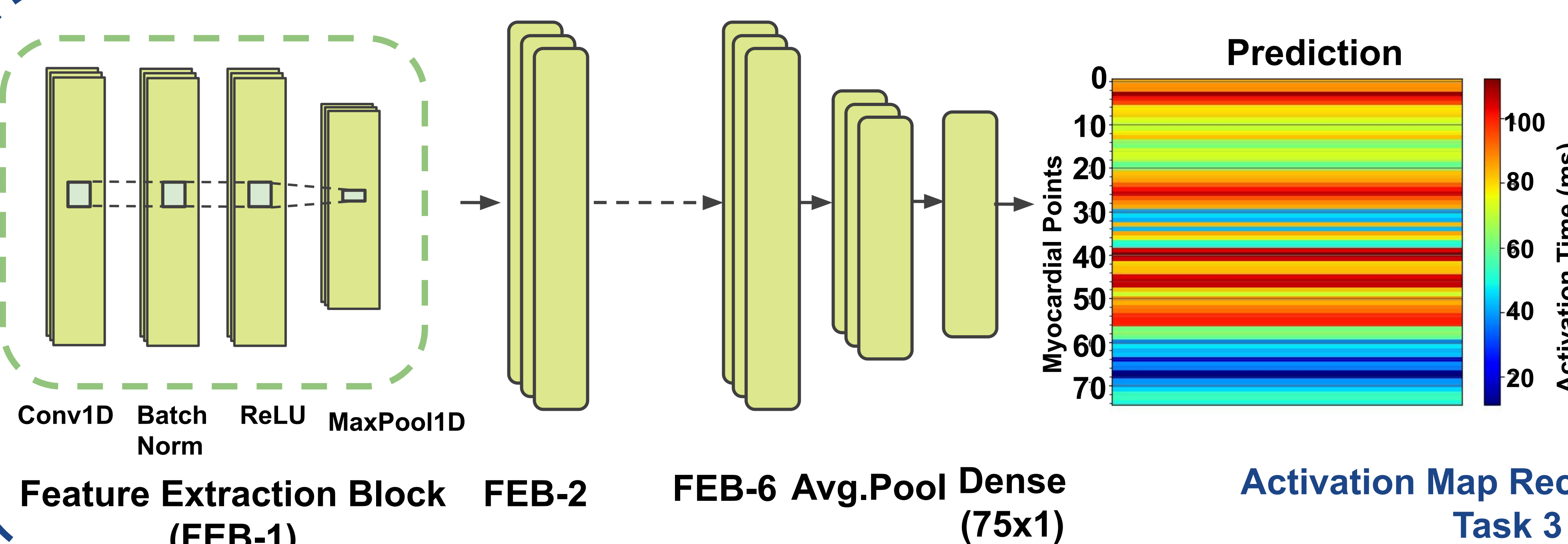| True \ Predicted | Normal | FPN   | PVC   | AP    | FVN   |
|------------------|--------|-------|-------|-------|-------|
| FVN              | 0.99   | 0.003 | 0.004 | 0.001 | 0.002 |
| AP               | 0.24   | 0.72  | 0.002 | 0.004 | 0.005 |
| PVC              | 0.03   | 0.002 | 0.95  | 0.006 | 0.005 |
| FPN              | 0.14   | 0     | 0.14  | 0.72  | 0     |
| Normal           | 0.01   | 0.001 | 0.006 | 0.001 | 0.98  |

## Task 3 & 4: Activation Map & Transmembrane Potential Reconstruction from ECG

**Challenge:** Gradient Calculation

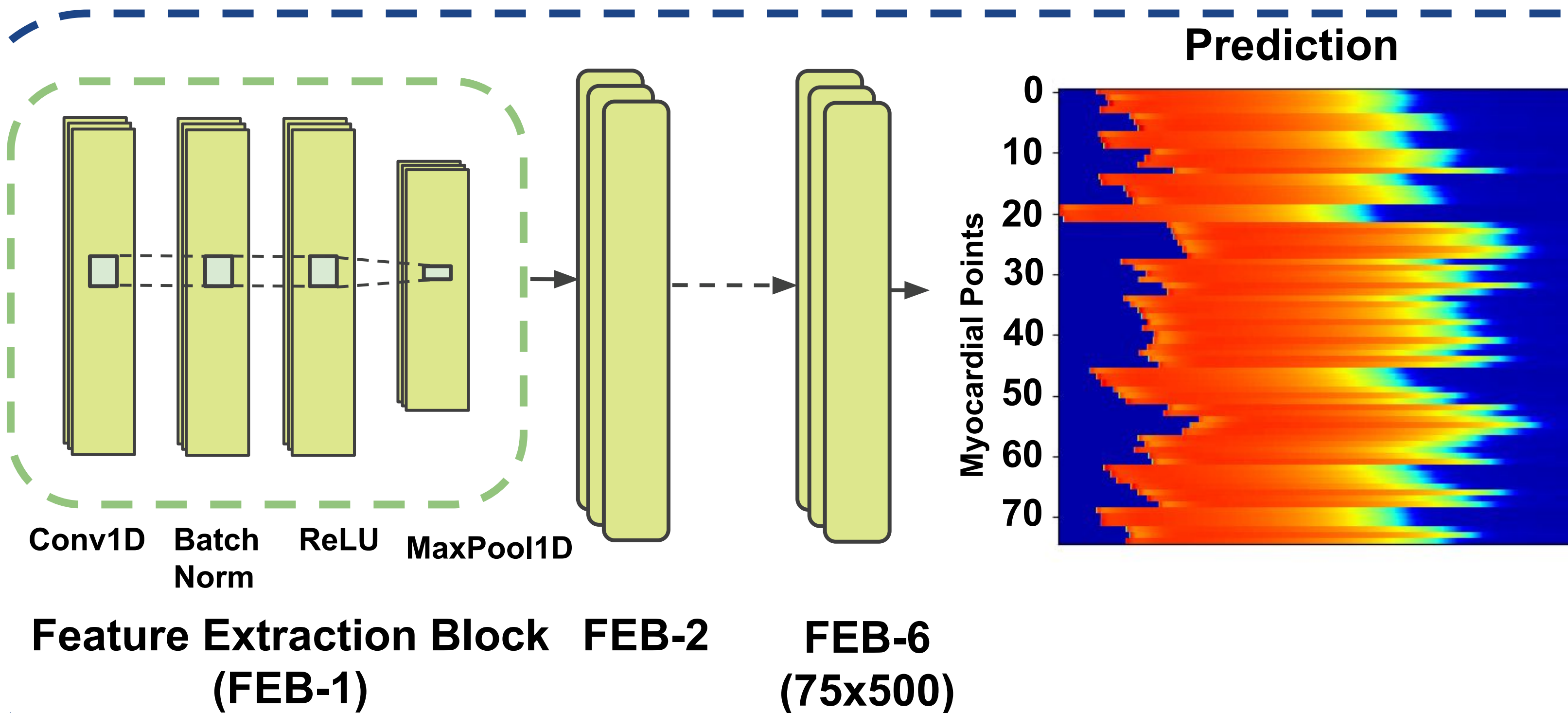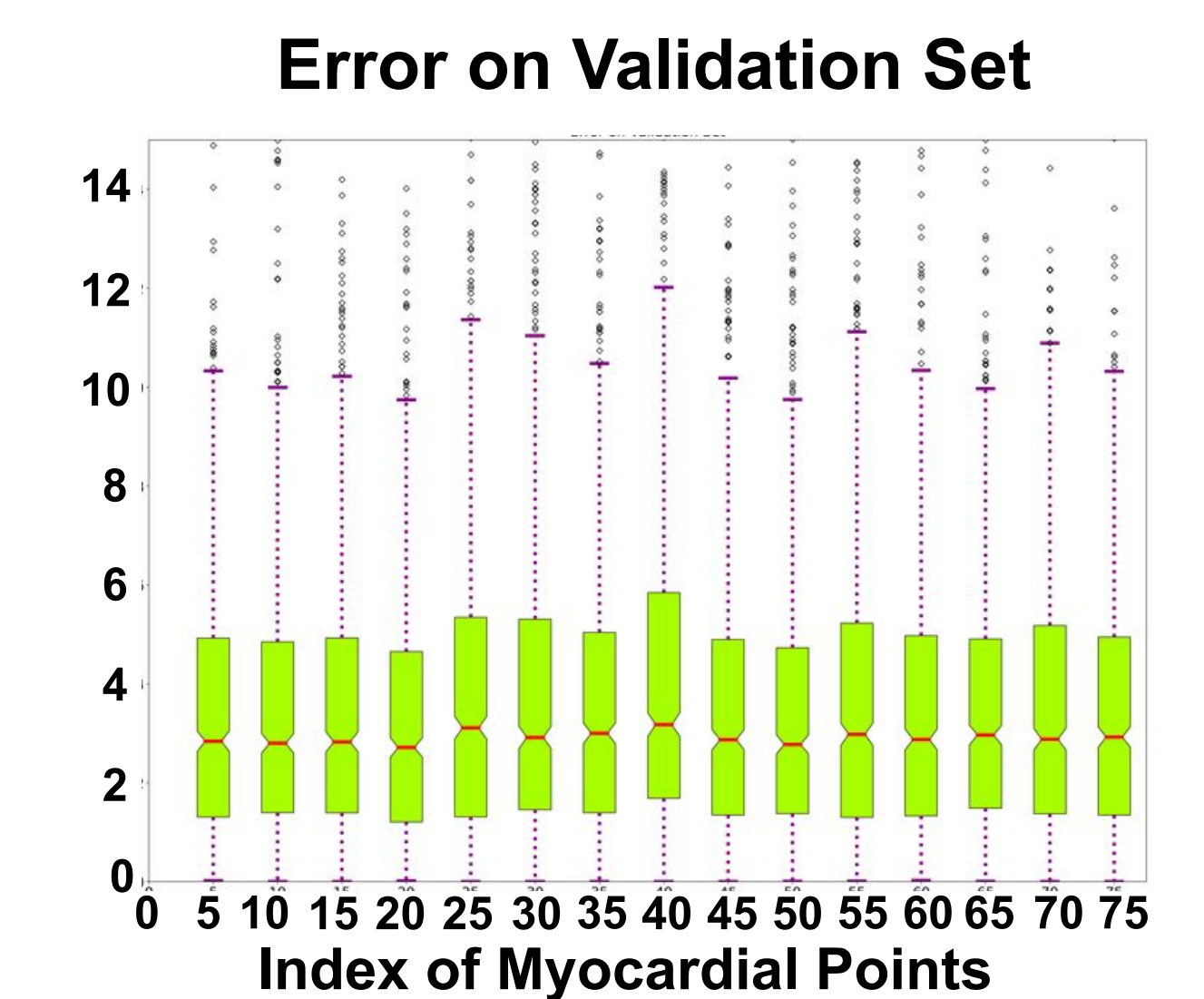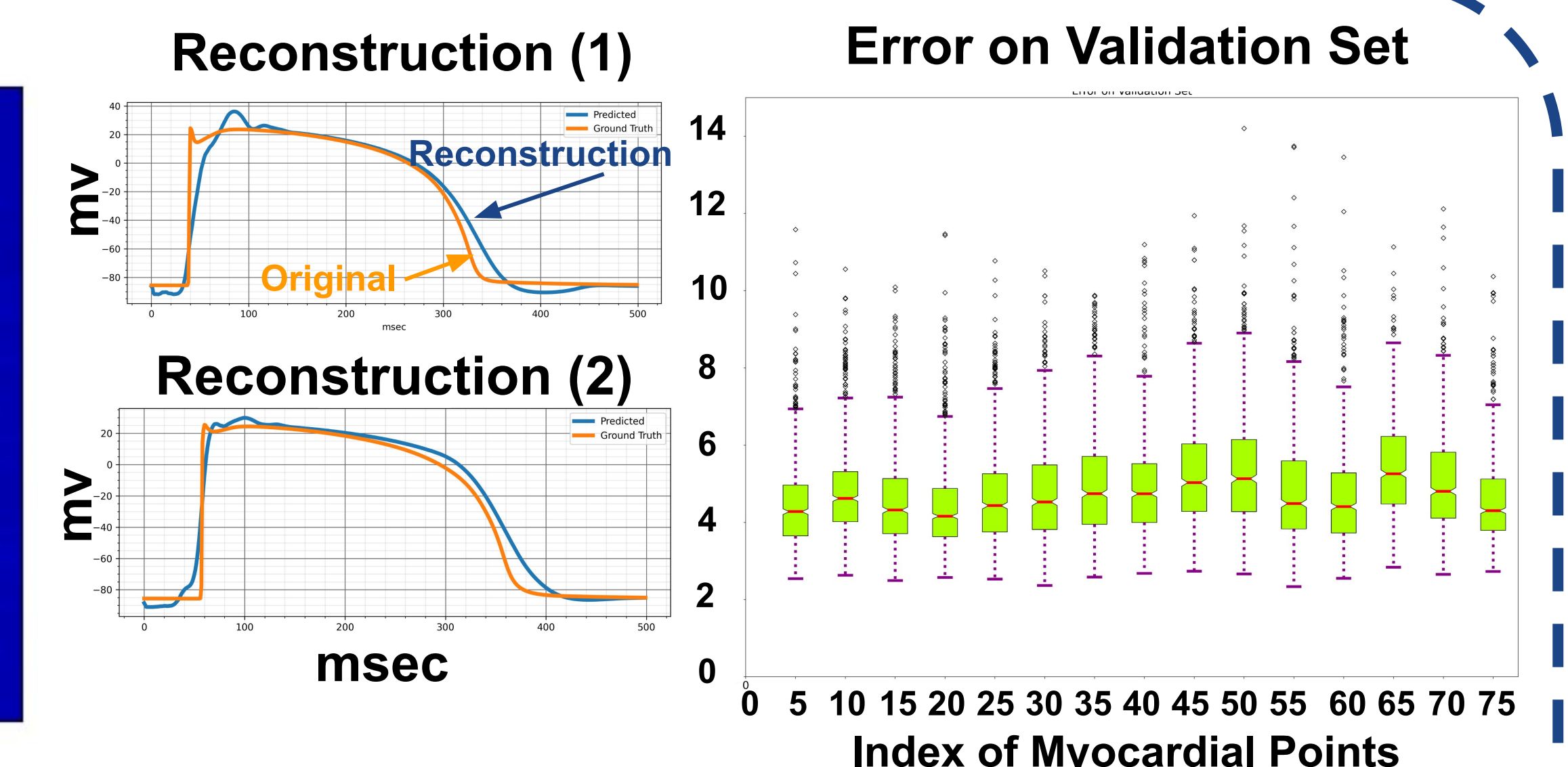**Approach:** 1. Squared Error Loss (Task 3)
2. RMSE Loss (Task 4)

**Input : 12 Lead ECG**

Leads: I, aVR, V1, V4, II, aVL, V2, V5, III, aVF, V3, V6

Normalize

Conv1D  Batch Norm  ReLU  MaxPool1D

Feature Extraction Block (FEB-1)   FEB-2   FEB-6  Avg.Pool  Dense (75x1)

**Prediction**

Activation Time (ms)

Myocardial Points

**Error on Validation Set**

Index of Myocardial Points
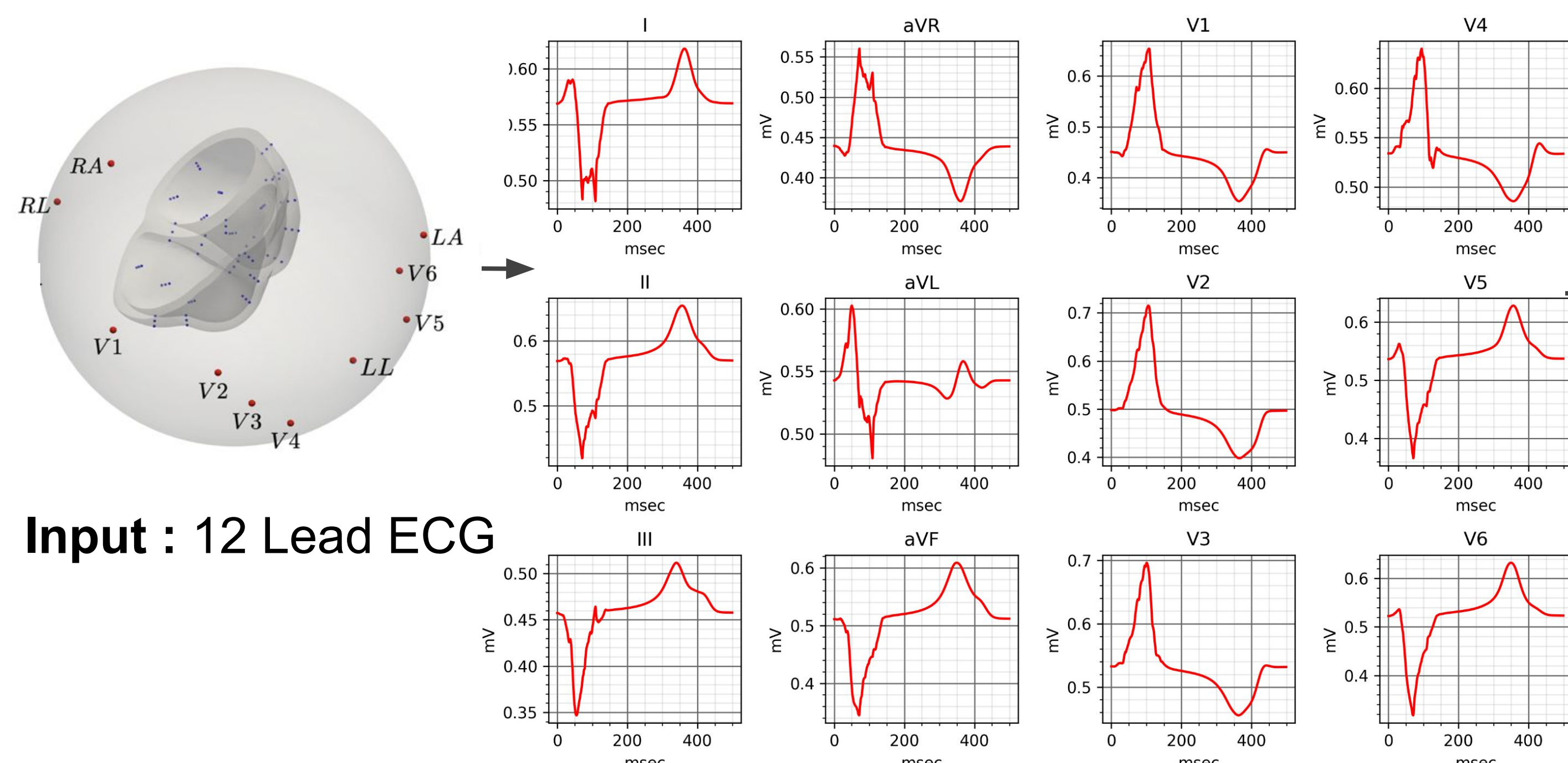
**Activation Map Reconstruction Task 3**

Feature Extraction Block (FEB-1)   FEB-2   FEB-6 (75x500)

**Prediction**

Myocardial Points

**Reconstruction (1)**

Reconstruction / Original

**Reconstruction (2)**

**Error on Validation Set**

Index of Myocardial Points

**Transmembrane Voltage Reconstruction Task 4**

*Thanks for the Hands On Experience with Real Data !!*