**NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES**

*SPRING SEMESTER – 2025*

**(CS-4090) MACHINE LEARNING**

**SEMESTER PROJECT**

**Submitted By:**

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**Introduction:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Models** | **Test Accuracy** | **Regularization** | **Overfitting Gap**  **(Train\_score – validation score)** | **Time (sec)** |
| Baseline NN **(Wania)** | 87.1% | Dropout (50%) | 2.0% | 29.95 |
| Baseline NN **(Wania)** | 88.2% | Dropout (20%) | 0.3% | 34.60 |
| Baseline NN **(Wania)** | 87.2% | L2 Regularization (0.001) | 0.7% | 28.00 |
| Baseline NN **(Wania)** | 78.8% | L2 Regularization (0.1) | -0.6% | 25.60 |
| Baseline NN + PCA **(Emaan)** | 89.4% | Dropout(20%, 50%)  Regularization (0.001) | 0.038% | 172 |
| Logistic Regression **(Emaan)** | 85.7% | Regularization (L2 / L1), Elastic net  (0.1) | 0.62% | 152 |
| Logistic Regression + PCA **(Emaan)** | 85.2% | Regularization (L2 / L1), Elastic net  (0.1) | 0.68% | 13 |
| SVM (RBF) **(Wania)** | 84.5% | C = 0.1 | 0.37% | 315.01 |
| SVM (RBF) **(Wania)** | 90.4% | C = 10 | 6.9% | 157.11 |
| SVM (RBF) + PCA **(Wania)** | 85.3% | C = 0.1 | 0.5% | 147.97 |
| SVM (RBF) + PCA **(Wania)** | 90.7% | C = 10 | 6.5% | 84.14 |
| Random Forest **(Emaan)** | 88.1% | max\_depth, min\_samples\_split | 0.56% | 1585.7 |
| Random Forest + PCA **(Emaan)** | 86.2% | max\_depth, min\_samples\_split | 0.13% | 157.8 |
| Gradient Boosting **(Wania)** | 86.0% | Learning Rate = 0.05, Estimators = 100 | 1.9% | 5410.18 |
| Gradient Boosting **(Wania)** | 84.6% | Learning Rate = 0.01, Estimators = 300 | 1.7% | 15756.04 |
| Gradient Boosting + PCA **(Wania)** | 82.6% | Learning Rate = 0.05, Estimators = 100 | 2.1% | 4806.85 |
| Gradient Boosting + PCA **(Wania)** | 80.5% | Learning Rate = 0.01, Estimators = 300 | 1.6% | 19224.58 |
| CNN **(Emaan)** | 91.6% | Dropout(20%, 50%)  Regularization (0.001) | 0.24% | 1111.40 |
| CNN + PCA **(Emaan)** | 88.2% | Dropout(20%, 50%)  Regularization (0.001) | 0.87% | 523.51 |
| ExtraTreesClassifier **(Wania)** | 87.2% | Number of Trees = 60, Max depth = 12, sample\_split = 8, max\_features = 0.5 | 5.3% | 74.90 |
| ExtraTreesClassifier + PCA **(Wania)** | 83.7% | Number of Trees = 60, Max depth = 12, sample\_split = 8, max\_features = 0.5 | 5.4% | 11.93 |