### INF-2B Natural Image Classification Task 2 Report

Task 3.1:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Predicted Class** | | | | | | | | | |
| Class1 | Class2 | Class3 | Class4 | Class5 | Class6 | Class7 | Class8 | Class9 | Class10 |
| **Actual Class** | Class1 | 83 | 0 | 2 | 4 | 1 | 2 | 5 | 0 | 1 | 2 |
| Class2 | 2 | 84 | 2 | 3 | 0 | 1 | 4 | 1 | 2 | 1 |
| Class3 | 0 | 2 | 85 | 1 | 3 | 3 | 1 | 1 | 2 | 2 |
| Class4 | 2 | 2 | 1 | 92 | 1 | 0 | 1 | 1 | 0 | 0 |
| Class5 | 0 | 1 | 4 | 0 | 84 | 6 | 0 | 3 | 2 | 0 |
| Class6 | 0 | 0 | 3 | 1 | 0 | 83 | 0 | 5 | 1 | 7 |
| Class7 | 3 | 2 | 2 | 1 | 1 | 1 | 89 | 1 | 0 | 0 |
| Class8 | 0 | 1 | 5 | 0 | 4 | 10 | 0 | 75 | 3 | 2 |
| Class9 | 0 | 3 | 4 | 3 | 2 | 4 | 0 | 2 | 78 | 4 |
| Class10 | 3 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 2 | 91 |

Accuracy: 84.4%

Task 3.2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Determinant of covariance matrix | Class1 | 4.60989595796651e-234 | Class6 | 1.89603958244386e-241 |
| Class2 | 4.59278111007410e-270 | Class7 | 3.04673214719501e-258 |
| Class3 | 1.30689372954090e-237 | Class8 | 1.89330949333798e-238 |
| Class4 | 1.86676437981820e-238 | Class9 | 2.19296020773058e-244 |
| Class5 | 4.72930285263208e-257 | Class10 | 1.53042491859595e-253 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Predicted Class** | | | | | | | | | |
| Class1 | Class2 | Class3 | Class4 | Class5 | Class6 | Class7 | Class8 | Class9 | Class10 |
| **Actual Class** | Class1 | 92 | 0 | 0 | 5 | 0 | 0 | 3 | 0 | 0 | 0 |
| Class2 | 4 | 84 | 4 | 2 | 0 | 1 | 4 | 1 | 0 | 0 |
| Class3 | 2 | 3 | 78 | 2 | 3 | 0 | 6 | 2 | 4 | 0 |
| Class4 | 2 | 0 | 0 | 93 | 2 | 0 | 2 | 0 | 0 | 1 |
| Class5 | 0 | 0 | 1 | 1 | 88 | 4 | 0 | 1 | 4 | 1 |
| Class6 | 2 | 0 | 4 | 2 | 0 | 86 | 1 | 3 | 1 | 1 |
| Class7 | 2 | 1 | 0 | 1 | 0 | 0 | 95 | 1 | 0 | 0 |
| Class8 | 1 | 0 | 3 | 1 | 1 | 9 | 1 | 81 | 2 | 1 |
| Class9 | 0 | 2 | 2 | 2 | 1 | 0 | 1 | 0 | 88 | 4 |
| Class10 | 4 | 1 | 1 | 0 | 1 | 2 | 1 | 0 | 2 | 88 |

Accuracy: 87.3%

Task 3.3:

Determinant of full covariance matrix: 3.33794166858135e-169

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Predicted Class** | | | | | | | | | |
| Class1 | Class2 | Class3 | Class4 | Class5 | Class6 | Class7 | Class8 | Class9 | Class10 |
| **Actual Class** | Class1 | 85 | 0 | 1 | 2 | 2 | 1 | 8 | 0 | 0 | 1 |
| Class2 | 0 | 82 | 4 | 3 | 0 | 1 | 2 | 5 | 2 | 1 |
| Class3 | 1 | 3 | 85 | 0 | 1 | 2 | 1 | 5 | 2 | 0 |
| Class4 | 3 | 0 | 2 | 88 | 2 | 0 | 1 | 2 | 0 | 2 |
| Class5 | 0 | 0 | 8 | 0 | 78 | 4 | 0 | 8 | 2 | 0 |
| Class6 | 1 | 0 | 2 | 2 | 0 | 86 | 0 | 6 | 2 | 1 |
| Class7 | 1 | 4 | 2 | 1 | 0 | 1 | 88 | 2 | 0 | 1 |
| Class8 | 0 | 0 | 6 | 0 | 0 | 2 | 1 | 88 | 2 | 1 |
| Class9 | 0 | 2 | 3 | 2 | 1 | 1 | 0 | 3 | 85 | 3 |
| Class10 | 2 | 0 | 2 | 0 | 0 | 4 | 0 | 1 | 3 | 88 |

Accuracy: 85.3%

Task 3.4:

For knn-classification, it has the lowest classification accuracy, and the accuracy even decreases with higher k values, and the decision boundaries aren’t clear for low value of k.

The advantage is just easy to implement.

The disadvantage is huge on the other hand, it just compares the test with the train data, not only it’s not useful to distinguish features from similar classes, it is very slow when the train data is huge

The full-covariance and lda Gaussian method have the highest classification accuracy, with the longer runtime.

Advantage is that it have the highest accuracy when classifying data like this, giving less mistakes on similar classes, it uses the covariance matrix instead of whole data, making it more efficient.

But due to the large matrix multiplication, it makes the classification slow on high dimensions.