

Supervised Learning: Assignment 1

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In the scope of this assignment A statistical comparison of classifiers over multiple data sets was performed.

I. LIST OF THE USED CLASSIFIERS WITH THE CHOSEN HYPERPARAMETERS

1. Support Vector Machine (Linear Kernel)

- Kernel Function: Linear
- Kernel Scale: 1

2. Support Vector Machine (RBF Kernel)

- Kernel Function: Gaussian
- Kernel Scale: 0.1

3. K-Nearest Neighbors

- Distance Metric: Euclidean
- Number of Neighbors: 10

4. Decision Tree

- Split Criterion: Gini's Diversity Index (GDI)
- Maximum Number of Splits: 15

II. ACCURACY OF CLASSIFIERS AND RANKINGS

All models were trained and their accuracies on each dataset were obtained (Table I). The source code is uploaded to the elearning platform.

Table I. Accuracy of Models on each dataset

Dataset	Models			
	SVM (Linear)	SVM (RBF)	KNN	Decision Tree
1	1.0000	0.9973	1.0000	0.9947
2	0.8827	0.8060	0.8693	0.8140
3	0.6667	0.9187	0.9220	0.9073
4	0.5817	0.9517	0.9483	0.9563

Rankings were obtained (Table II). In case of ties, average ranks are assigned.

Table II. Ranking obtained by the classifiers on each dataset

Dataset	Models			
	SVM (Linear)	SVM (RBF)	KNN	Decision Tree
1	1.5	3	1.5	4
2	1	4	2	3
3	4	2	1	3
4	4	2	3	1

And average rankings were calculated (Table III).

Table III. Average rankings of Models

Models			
SVM (Linear)	SVM (RBF)	KNN	Decision Tree
2.625	2.750	1.875	2.750

III. CALCULATION OF CD VALUE AND OBSERVATIONS

Let's calculate F_F statistic with 3 and 9 degrees of freedom. The critical value in the case of significance level $\alpha = 0.05$ is 3.86.

$$\chi_F^2 = \frac{12 \cdot 4}{5 \cdot 4} \left[2.625^2 + 2.75^2 + 1.875^2 + 2.75^2 - \frac{4 \cdot 25}{4} \right] \approx 1.275$$

$$F_F = \frac{4 \cdot 1.275}{4 \cdot 3 - 1.275} \approx 0.48$$

Which is not sufficient to reject the null hypothesis (H_0 : the accuracy is the same for all four classifiers). However let's conduct the Nemenyi test for pairwise comparisons. The values $q_{.05}$ and $q_{.10}$ in the case of 4 models are equal to 2.569 and 2.291 respectively.

$$CD_{q_{.05}} = 2.569 \sqrt{\frac{4 \cdot 5}{6 \cdot 4}} \approx 2.35$$

$$CD_{q_{.10}} = 2.291 \sqrt{\frac{4 \cdot 5}{6 \cdot 4}} \approx 2.09$$

Highest difference between average rankings is equal to 0.875. We can conclude that our tests are not powerful enough to detect any significant differences between the models.