Lab Assignment 6
Single-Agent Search

T-622-ARTI,Artificial Intelligence, 2023-1

Reykjavik University - School of Computer Science, Menntavegi 1, IS-101 Reykjavík, Iceland

Jonas Hagg `jonash22@ru.is`
Philipp Zimmermann `philipp22@ru.is`
Jonathan Lutz `jonathan22@ru.is`

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Abstract

This is the report for the sixth lab assignment of the artificial intelligence course.

1 Task 1

See the submitted python code

2 Task 2

2.1 Monks-1

Description The test accuracy over an increased training size is shown in figure 1. The accuracy improves with an increasing number of trainings data. We also observe a high variation between different training sizes (i.e. the curve is less stable). For a big amount of trainig data (>80) we achieve accuracy of about 90%.

Interpretation Since the learning curve improves with an increasing size of the training set, this is an optimal example. The training set allows the algorithm to approximate the actual equation very well.

2.2 Monks-2

Description The test accuracy over an increased training size is shown in figure 2. The test accuracy over an increased training The accuracy improves with an increasing number of trainings data. However, the variation of the accuracy is lower and the curve is more stable compared to the results of `monks-1`. Overall, the test accuracy stays under 90% even if all test data is applied.

Interpretation Due to the shape of the learning curve and the slow convergence, we think this is an example of redundant expressiveness, meaning that the dataset contains many irrelevant attributes. The training set does not allow the algorithm to approximate the actual equation very well.

2.3 Monks-3

Description The test accuracy over an increased training size is shown in figure 3. We reach higher accuracy much faster than compared to `monks-1`. If the training set contains more than 40 elements we reach an accuracy of more than 90%. However, it seems that the accuracy is reduced if the size of the training set is bigger than 100.

Interpretation The decision tree is allowed to grow without any constraints, which is why the accuracy on the training data is always at 100%. In the worst case, the decision tree will create a separate leaf for each observation. However, this can lead to overfitting, which negatively affects the accuracy of the model when making predictions on new data that was not included in the training set. Because the testing accuracy decreases for large training sizes, we believe this is an example of overfitting.

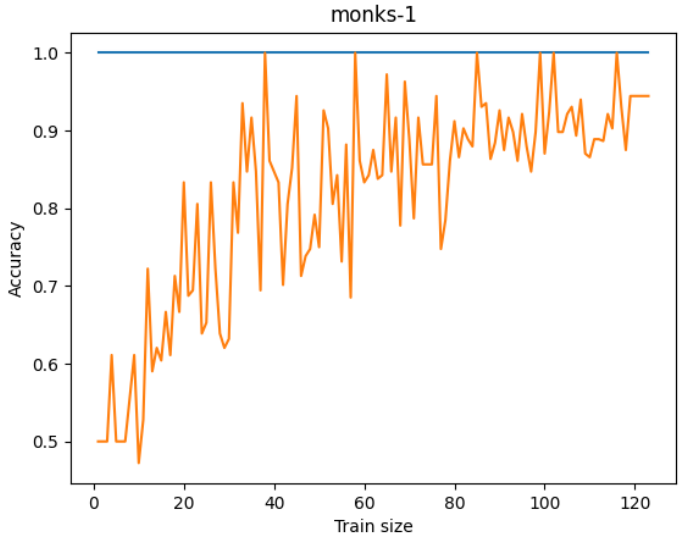

Figure 1: Monks-1 test accuracy over the training size

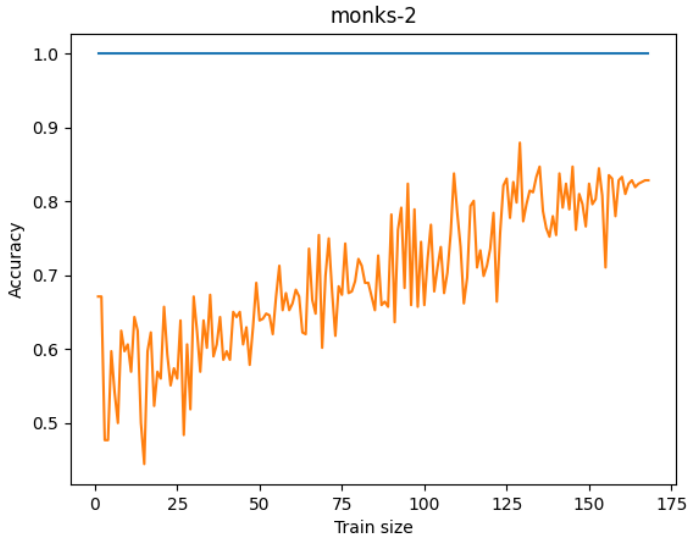

Figure 2: Monks-2 test accuracy over the training size

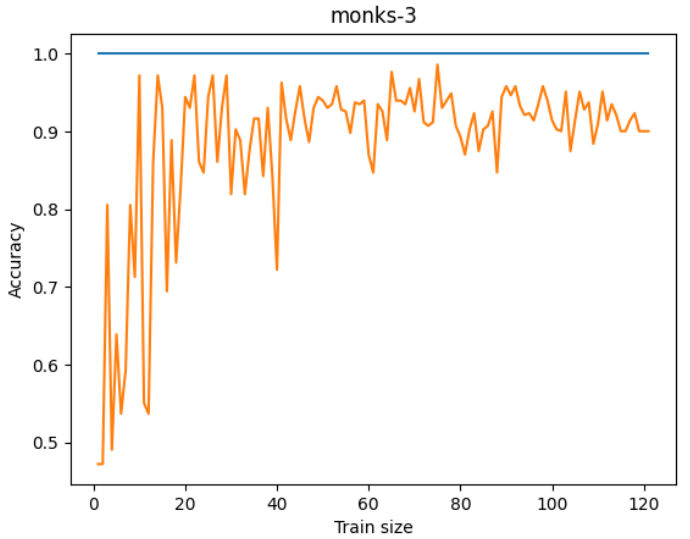

Figure 3: Monks-3 test accuracy over the training size

3 Task 3

Yes, the accuracy of the training data was 100% for all data sets.

4 Task 4

The decision tree is shown in figure 4

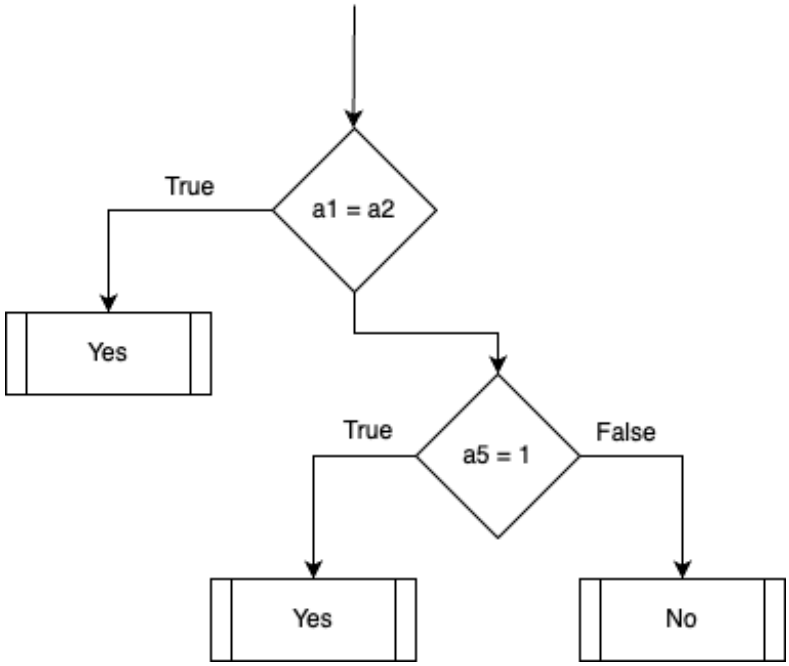

Figure 4: Decision tree drawn for monks-1 using the knowledge of the function.

5 Task 5

The decision tree generated by the algorithm using the whole monks-1 training set is shown in figure 5. The tree generated by the algorithm is much more complex than the tree we generated based on the logical expression $(a1 = a2) \vee (a2 = 5)$. The knowledge of this expressions allows us to create a small and precise decision tree. The algorithm, however, must go through the whole training set and updates the tree based on the seen data. Thus, tree generated by the algorithm builds up with each data point provided by the training set. The more data available, the more complex the tree becomes. Because the CART (Classification and Regression Trees) algorithm used for decision trees by the `sklearn` library is a greedy algorithm, the algorithm makes locally optimal choices at each step, without considering the global optimal solution.

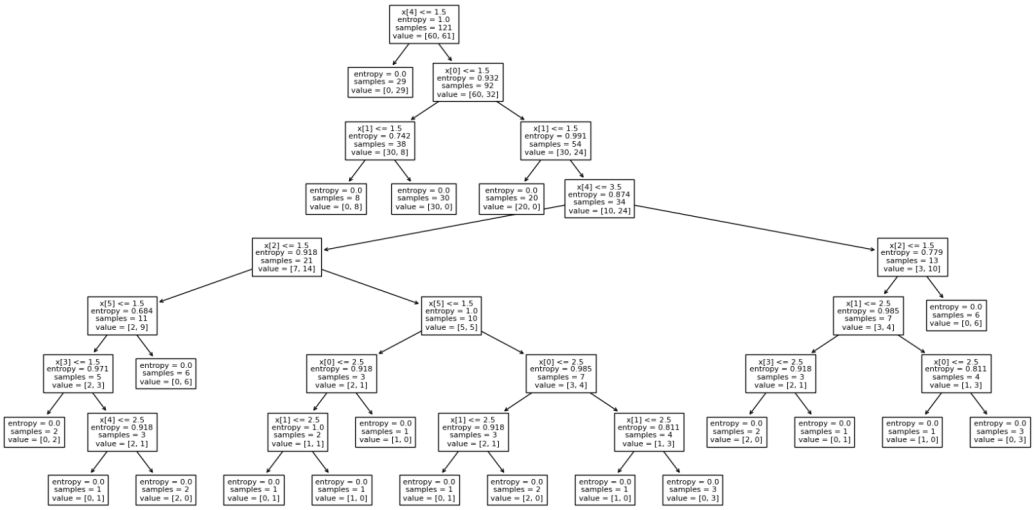

Figure 5: Decision tree generated for monks-1.