Development of a good cost-effective strategy for conducting experiments / tests while exploiting previous knowledge using metalearning

Ph.D. Thesis Proposal
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1. Context / Background

Many situations require that the best method be identified for a given case. Let us consider several scenarios of this type.

Imagine, for instance that there are N possible treatments to choose from. Normally each leads to certain quantifiable benefits, while incurring certain costs. The benefits and costs are, in general, different from case to case.

A similar situation arises also when employing software algorithms. Let us consider here classification algorithms whose aim is to classify new cases. The classifiers need to be trained and the time spent in training represents again costs. The trained versions provide then a classification of new cases. Different classifiers provide solutions of different quality. Some achieve higher accuracy rates than others.

Yet another situation arises when applying the operation in production. Often different options can be taken, depending on which production process is followed (choice of machine, parameters of machining, choice of materials etc.). The result of the process can again be characterized by different quality and costs.

In all these cases the knowledge of what happened in the past can be useful when deciding what to do in a new situation. It has been shown that (meta)learning methods can be useful to determine what to do in a new situation. One possibility is to identify promising candidates and then carry out a a limited series of tests. These in turn determine which strategy is to be followed in the end.

2. Objectives

The aim of this thesis work is to enhance the existing methodology concerning how to proceed when determining the best strategy for a new problem. The work can be oriented towards classification algorithms, but other domains mentioned above could also be considered. The aim is to exploit the knowledge of what happened in the past (often referred to as metaknowledge), when deciding what to do in a new situation, identify promising candidates and then carry out a a limited series of tests. The result of these tests would be used to determine which strategy is to be finally followed in a new problem.

The objective of this thesis work is to consider the existing strategies and adapt / improve it for the new setting. It is foreseen that the strategy could include o sequence of steps, or in general partial ordered sequences of steps.

The aim is to avoid conducting all possible experiments on the new problem, which is in principle is possible, but incurs high costs. The solution should seek a good compromise between exploration and exploitation.

The method should focus on what could be considered as “promising experiments”, that is those experiments that have a high probability of bringing new information in, useful in the process of making the best decision.

Instead of carrying out all experiments from scratch, the work could exploit the existing experimental

databases (e.g., the one at U. Leuven).

References

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