Division of Statistics and Machine Learning
Department of Computer and Information Science

Machine Learning models for adaptive programme optimization

Efficiency of programme implementations is known to be dependent on a computer architecture. For example, the CPU time of sorting algorithms like QuickSort and HeapSort may be highly dependent on the underlying computer platform. In general, various implementations of the same task require various amount of CPU time, and for a given computer platform it is often not obvious which algorithm implementation will outperform the other implementations of a given task.

Because the actual CPU time of various implementations is often hard to estimate analytically, a data-driven approach is often preferred. It means that it is required to sample some amount of points from a parameter space and make a prediction of when one implementation outperforms the other one based on these sample points. Since the sampling is a costly process, it is also desired to minimize the sampling cost.

The main aim of this thesis is to investigate which Machine Learning model is capable of a platform-dependent recommendation for a user in an adaptive setting, i.e. when the model needs to be retrained after a new point is sampled. The thesis tasks are:

1. Investigate which machine learning methods are used in the areas of adaptive sampling, active learning and online Bayesian modelling, and study
    a. Which of them are capable of handling a multiple target.
    b. Which of them can estimate uncertainty
    c. Which of them can handle outliers
2. Apply a couple of the most promising machine learning methods to investigate the performance of various implementations working in a real GPU environment and investigate
    a. How the predictions and uncertainties change with an increasing amount of data points
    b. What is the amount of the computational time that is required to train these ML methods in the adaptive setting
    c. How efficient these ML methods are in the outlier detection

Prerequisites:

- A good understanding of ML methods
- Ambitions to learn new complex ML tools
- Very good skills of R programming

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