

# Master project proposal

## Instance selection for efficient algorithm comparison

### Introduction

The ADA research group (`ada.liacs.nl`), in collaboration with the LaBRI (University of Bordeaux, France), is looking for a master student to conduct the following project. The involved student is also welcome to attend group meetings and social activities. One becomes a full member of our group during the master project.

#### Recommended skills

Basic understanding of statistics

Proficiency in Python

#### Supervision

Marie Anastacio - Leiden University (Daily supervisor, `m.i.a.anastacio@liacs.leidenuniv.nl`)

Prof. Dr. Holger Hoos - Leiden University

Dr. Nathanael Fijalkow - CNRS Bordeaux

Prof. Dr. Laurent Simon - University of Bordeaux

### Context

This project aims at developing an approach to efficiently compare the expected performance of two algorithms by carefully selecting a few problem instances on which to run the new method. It could facilitate the development of new solving methods for computationally hard problems, such as the Boolean satisfiability problem (SAT), and improve current methods of automated algorithm configuration.

Computationally hard problems, particularly NP-hard problems, have motivated decades of research because they occur in all aspects of our society (*e.g.* bus routes, maintenance planning, hardware verification). Every such problem led to the development of several approaches to quickly find a solution and scale well. Each new solving method is formally compared to existing state-of-the-art methods, leading to extensive, time consuming and resource-intensive experimentations. If this comparison could run on a smaller set of instances, it would save time and computational resources, thus energy.

Such an approach would also benefit automated algorithm configuration whose purpose is to automate the choice of (hyper-)parameter values for a given algorithm. Coming up with the right values can be the key element between mediocre or state-of-the-art performance. Deciding which among two possible sets of parameter values is the best is crucial for such configuration methods. It could be significantly improved by smartly selecting the instances on which to compare them.

### Expected workflow and output

The student would start with reading and designing small experiments to get accustomed to the tools and methods, then propose a plan of action for the second part of the master project. The proposed approach would be implemented and rigorously compared with existing ones. In the eventuality of significant improvement, the student would write and publish their research results.