Bayesian Optimization On Trees

CentraleSupélec + EDF R&D

NICOLAS BAUDIN
INTERNSHIPS IN FRANCE INITIATIVE

Name of the hosting institution in France	CentraleSupélec
Name of the host laboratory / research team	Laboratoire des Signaux & Systèmes L2S
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Function	Professor
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Internship offer

Topic of the internship (title)	Bayesian Optimization On Trees				
Proposed dates of the internship	**Start:**	2019-09-02	**End**	2020-01-31	

Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):

Keywords: optimization, statistics, machine learning Bayesian optimization has been used in many domains of engineering for the design of systems based on heavy numerical simulations. The main principle of Bayesian optimization consists in modelling the objective function f by a random process, whose posterior distribution (given values of the objective function at some points) drives the search for the optimum. The scientific question addressed in this internship is the extension of Bayesian optimization for functions f defined on directed rooted trees. Contrarily to the classical application framework of Bayesian optimization, we shall not assume that f is expensive to evaluate. However, the exploration of the many children of a given node of the tree is expensive. The idea consists in estimating the distribution of the optimal value of f under each node of the tree. Then, we would select evaluations of f to decrease the uncertainty about the optimal configuration (as measured for instance by the Shannon entropy of the position of the optimal configuration in the tree, as in the IAGO algorithm; see, e.g. Villemonteix 2009). To this end, it is necessary to build a probabilistic model of f based on the construction of a distance between the nodes of the tree. To the best of our knowledge, there is no result in the literature of Bayesian optimization for this type of problem. However, this problem bears resemblance with that of multi-armed bandits, and more specifically Bandit Algorithms for Smooth Trees of P.-A. Coquelin and R. Munos, Monte-Carlo Tree Search (see Munos 2014), and reinforcement learning. The links between these approaches and what we have in mind will be investigated. We shall test the algorithms on the problem of nuclear power reactor fuel assembly (EDF R&D collaboration). The software developed during this project will be published under an open-source license on the GitHub development platform.

Name of industrial partner	EDF R&D
Role of the industrial partner in the internship project	We shall test our algorithms on the problem of fuel assembly in a nuclear power reactor. The case study is provided by EDF R&D
Main contact at the French industrial partner	Lou Charaudeau
Targeted Australian university	Any

Expected profile of applicant

Level of study	Bachelor's degree with honours or Master's student
Discipline	Applied Mathematics / Data Science
Required qualities, knowledge and skills	Statistics and/or Machine Learning, Python and/or Matlab programming
Other specific eligibility criteria (such as citizenship requirements, language requirements, …)	Preferably Australian citizenship Due to existing cooperation, preferably student from Flinders University, University of Queensland, University of Technology Sydney and University of Adelaide will be welcome

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