

Master's Internship: Bayesian Information Gain With Unspecified Likelihood

Keywords: Bayesian Optimal Experiment Design, user modeling,

Context of the internship Bayesian Information Gain (BIG) is an interaction method between a computer and a user. Traditionally, a computer simply executes user commands. In BIG, the computer runs an experiment on the user to progressively update a random variable's distribution that models the knowledge it maintains about the user's goal. Choosing the best experiment (most informative) can be written as an optimization problem where the information-theoretic concept of mutual information is maximized. The random variable that models knowledge about the user's goal is updated with Bayes rule, and therefore requires that the likelihood of the user's observed behavior for any experiment is known. Until now, BIG has only been applied to cases where a suitable likelihood existed to describe user behavior. But what if this is not the case?

The goal of this internship is precisely to extend BIG when the likelihood is not specified beforehand. Two cases of interest are when 1) a parametric likelihood is known, but its parameters have to be estimated on line 2) there is no known parametric likelihood known to reliably describe user behavior. Depending on the affinities of the student, the internship may push more towards theory, to quantify the effects of a mismatch between the true and used likelihood or implementation (*e.g.*, implementing functional prototypes, running controlled empirical studies).

Positioning in relation to the state of the art We previously introduced BIG in two navigation scenarios (maps and filesystems) [3, 4]. Since then, BIG has also been extended to exploration tasks [2, 5]. BIG is an instance of the general framework of Bayesian Optimal Experiment Design, which has received attention from researchers from various fields, in particular in machine learning and statistical communities (see [1] and references within).

About the Internship You will be mentored by a researcher in Human Computer Interaction and a researcher in information theory. This work can lead to a scientific publication and could be pursued by a PhD thesis.

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- Location: Institut des Systèmes Intelligents et de Robotique (ISIR), UMR 7222, Sorbonne Université. 4, place Jussieu, 75005 Paris, **or** Télécom Paris, Institut Polytechnique de Paris, 19 Pl. Marguerite Perey, 91120 Palaiseau
- 6 months internship, stipend \simeq 600€/month

Candidate Profile The candidate will have skills and interests in data science or a related field. Interest in user modeling and/or experimental work will also be appreciated but is not required. Please send a CV and your M1/M2 transcripts to both advisors.

References

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