Statistical learning for Gibbsian random fields: ABC and stochastic gradient methods.

Master 2 Internship Proposal

Supervision: Madalina Deaconu and Radu Stoica

1 Description

Gibbsian random fields is a family of mathematical objects related to random graphs, Markov random fields or marked point processes. The stochastic simulation via Monte Carlo algorithms allows the construction of rigorous methodological tools in studying complex data based objects such as social networks, image contextual information, data catalogues containing environmental or astronomical data.

The first aim of this internship is to implement and study the mathematical properties of two statistical learning algorithms. The first algorithm is called ABC Shadow. Here ABC stands for Approximate Bayesian Computation, while Shadow indicates that the simulated Markov chain follows closely the distribution of interest. The second algorithm is the stochastic gradient. In principle, this algorithm is similar with a classical gradient descent algorithm, but the descent direction is chosen randomly in a certain sense. Both algorithms exhibit interesting convergence properties, that need to be better understood, better connected [3, 4, 5].

The second aim of this internship is to apply these algorithms to learn marked point processes parameters from cosmological data, digital images and environmental sciences data [1, 2, 6].

Depending on the obtained results, the internship may lead to a scientifical journey for a joint cooperation in one of the laboratories belonging to our European network of colaborators.

2 Prerequisites and Funding

The interested candidate should have a M1 level in mathematics or applied mathematics and prepare her/his M2 degree. Engineering students with a thorough level in mathematics are also the very welcome. The motivation of the student to continue with a PhD will be also considered. The internship provides also a grant (around 550 euros per month w.r.t. the French rules).

The internship is 6 months length, and it may start anytime during the period of 01/02 - 01/04/2019.

3 Place

Institut Elie Cartan de Nancy et l'Inria Nancy - Grand Est

4 Supervision

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References

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