



## PAC-Bayesian theory and deep learning

**TL;DR.** Design a Python implementation of PAC-Bayesian algorithms for deep learning.

**Keywords :** PAC-Bayes, machine learning, deep learning, Python.

### Context

The [MODAL team](#) is active in both statistics and machine learning communities. One main research topic is to provide theoretical justifications on learning procedures. To this end, a part of the team (brought together by the researchers Pascal Germain and Benjamin Guedj) is fond of the PAC-Bayesian theory, which allows to express statistical guarantees on the quality of machine learning algorithms. These guarantees are typically stated as probabilistic upper bounds on the generalization loss, known as generalization bounds. There are two appealing characteristics of these bounds : (i) the bounds are computable from the training loss, that is, without relying on a testing set (ii) one can derive efficient algorithms to optimize them.

This project will be part of the ANR-funded project APRIORI (2019–2023), which applies the PAC-Bayesian theory to neural networks, deep learning and representation learning.

### Tasks

The core of the project consists in implementing (in Python) the algorithm introduced by Dziugaite and Roy (UAI 2017, <https://arxiv.org/pdf/1703.11008.pdf>).

For a better knowledge of the proposed research subject : Pascal Germain and Benjamin Guedj have organized a NIPS workshop on PAC-Bayesian learning, called "(Almost) 50 Shades of Bayesian Learning : PAC-Bayesian trends and insights". The material (slides, videos) may be found here :

<https://bguedj.github.io/nips2017/50shadesbayesian.html>

In particular, the tutorial by François Laviolette and the talk by Dan Roy are relevant to the project topics and goals.

### Contact

Le projet sera co-encadré par [Pascal Germain](#) (chargé de recherche chez Inria) et [Benjamin Guedj](#) (chargé de recherche chez Inria).

### Candidature

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