PhD position in machine learning in Toulouse

Structured optimisation algorithms for training deep networks

Description of work

Deep neural networks models recently came to the forefront of the machine learning scene with a number of practical successes (LeCun et al., 2015). Training such models amounts to calibrate a large number of parameters based on risk minimisation. The most widely used solution to tackle this training problem are algorithms of *steepest descent* or *gradient* type. Indeed, despite the complicated compositional structure of the model, gradients of the risk can be estimated through a simple chain-rule procedure called *back propagation*, see Schmidhuber (2015) for an historical perspective. In this context, most research efforts to understand and improve training of deep models have focused on algorithms of steepest descent type.

The topic of the thesis is to propose new algorithms for training deep neural network models. On the one hand, gradient descent is a general algorithm which is, in principle, applicable to any smooth objective function. As such, it is somewhat blind to the intrinsic structure of this objective function. On the other hand deep models have a strong compositional structure which is reflected in the risk handled during the training phase. We propose to take this structure into account for the design of new algorithms for training deep models through risk minimisation. The starting point would be to borrow ideas which have proven successful in other learning problems such as majorization-minimization for nonnegative matrix factorisation (Févotte and Idier, 2011).

Advisors

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Place of work

The position is part of project **FACTORY** (*New paradigms for latent factor estimation*), funded by the **European Research Council** under a Consolidator Grant (2016-2021) and coordinated by Cédric Févotte (CNRS). FACTORY is hosted by the **Institut de Recherche en Informatique de Toulouse** (IRIT), a joint laboratory of CNRS and Toulouse universities & engineering schools. The physical location for the project is the ENSEEIHT campus, in a lively neighbourhood of the city center.

Candidate profile and application

Prospective applicants should have a MSc in **machine learning**, **applied mathematics**, **signal processing**, **statistics**, or a related discipline, good programming skills, and good communication skills in English, both written and oral.

Salary is ∼1400€ net per month and may be complemented with teaching or consulting activities (subject to availability). The targeted starting period is autumn 2018.

Applicants are requested to send a CV, academic transcripts and the contact details of one or two referees in a single PDF file. Applications and informal enquiries are to be emailed to the three advisors listed above. Applications will be collected until early June 2018 and then on until a suitable candidate is found.

References

Y. LeCun and Y. Bengio and G. Hinton (2015). *Deep learning.* Nature, 521(7553):436–444.

J. Schmidhuber (2015). *Deep learning in neural networks: An overview.* Neural Networks, 61:85–117.

C. Févotte and J. Idier (2011). *Algorithms for nonnegative matrix factorization with the β-divergence.* Neural Computation, 23(9):2421–2456.