POSTDOCTORAL PROPOSAL IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

From Machine Learning to Knowledge Compilation and Back

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Net salary: Negotiable with a minimum of 2600€ per month with some teaching (64 hours per year on average)

Duration: 2 years

DESCRIPTION

Machine Learning (ML) and Knowledge Compilation (KC) are two very rich research areas in Artificial Intelligence. Interactions between ML and KC have however been little explored; the objective of this post doc is to fill this gap.

In ML, the objective is to find a model that explains, and generalizes, some input data. The choice of a target language, that defines the class of models in which to search for the output model, is crucial: if the class is too small, there may be no model close enough to the unknown one from which the observed data have been generated; if the class is too large, the size of the input data required to precisely identify the output model may be unrealistically large. Research in ML has led to the design of powerful tools to characterize the expressivity of target languages for the output models, and their learnability, like the VC dimension, the Rademacher complexity, the PAC model [Blumer et al., 1989, [Bartlett and Mendelson, 2001]]. Besides, the need to learn complex, often graphical, models, like Bayesian Networks, has highlighted the importance of studying how the computational complexity of the output model can be caped; for instance recent works have proposed to constrain the learning process in order to output Bayesian Networks with a low tree-width.

In KC, the objective is to compile the fixed part F of a knowledge base, initially expressed in some very expressive but intractable language, so that the resulting model C(F) enables faster query answering modulo (with respect to) a set V of varying pieces of knowledge. Here again, the choice of the target language, with which the resulting model should be expressed, is crucial. It should be rich enough to enable the exact representation of the knowledge base (or an approximation of it if this is sufficient for some intended application); but small enough to guarantee fast inference, in particular in domains where the final application can be on-line. Besides efficient compilation methods, research in KC highlighted the need for KC maps, which provide multi-criteria analysis of target languages for KC. Rich KC maps have already been established for propositional languages. Current, promising research directions aim at extending these maps towards richer, valued languages; and at studying in more detail approximate compilation.

The objective or this 2 years post doc is to explore the potential interactions between KC maps and tools established to study the complexity of ML. In both KC and ML the expressivity of the

target languages, and the difficulty to infer or induce models in these languages, are of prime importance. But there is, to date, little work on this interaction. Directions of research include the study of what ML tools can add to KC maps for rich, valued languages necessary to deal with the processing of complex pieces of knowledge, like preferences; and, conversely, a study of how KC maps can be useful to choose target languages for ML problems.

The ideal candidate will have a strong background in machine learning and in knowledge representation. This research will be conducted within the stimulating environment of the Artificial and Natural Intelligence Toulouse Institute.

The monthly net salary is about 2 700 euros ; starting date : autumn 2019

References

- Adnan Darwiche, Pierre Marquis: A Knowledge Compilation Map. J. Artif. Intell. Res. 17: 229-264 (2002)
- A. Blumer , A. Ehrenfeucht, D. Haussler, and M. K. Warmuth: Learnability and the Vapnik-Chervonenkis dimension. Journal of the ACM, 36(4):929–965, 1989.
- P. L. Bartlett and S. Mendelson: Rademacher and Gaussian Complexities: Risk Bounds and Structural Results. In COLT/EuroCOLT, vol. 2111 of Lecture Notes in Computer Science, pp. 224–240. Springer, 2001.

APPLICATION PROCEDURE

Formal applications should include detailed cv including a list of publications, a motivation letter, samples of published research by the candidate, up to three recommendation letters stating your ability for research and a short research statement.
Applications should be sent by email to: advisor emails
More information about ANITI: https://aniti.univ-toulouse.fr/