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Model Of Models (MOM)

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1. Introduction

Deep Learning (DL) has invigorated AI approaches to parsing data in complex systems, often to develop control processes of these systems. A couple of decades ago, Neural Net AI approaches fell out of favor when concerns were apparent that such approaches offered little guidance to explain the "why" or "how" such algorithms worked to process data, e.g., contexts which was deemed important to deal with future events and outliers, etc.

The success of DL has overshadowed these concerns. However, that should not diminish their importance, especially if such systems are placed in positions to affect lives and Human concerns; Humans are, or at least they should be, ultimately morally and ethically responsible for structure they build.

An approach to dealing with these concerns can be called Model of Models (MOM). An argument in favor of MOM is that Humans over thousands of years have developed models of reality across many disciplines, e.g., ranging over Physics, Biology, Mathematics, Economics, etc.

2. Use of Deep Learning

A good use of DL might be to process data for a given system in terms of a collection of models, then again use DL to process the models over the same data to determine a superior model of models (MOM). Eventually, large DL (quantum) machines could possess a database of hundreds or thousands of models across many disciplines, and directly find the best (hybrid) MOM for a given system.

Note that this approach is quite orthogonal to the current push to develop machines to solve problems with intuition similar to Humans, starting with solving problems typically given to children. If such a process were applied to selecting the most important book ever written, the likely winner would be "Lord of the Flies"! This current approach clearly wants short-term projects that will deliver quick gains, at the expense of damaging losses to be suffered later. This is a Reactive approach, not a Proactive approach. For example, a machine may well duplicate "common sense" by algorithms not fathomable by Humans. Then, in an out-of-sample scenario, the machine could deliver horrible decisions. There is no audit trail back to models Humans use to understand the world.

3. Background

A project sympathetic to this context was proposed as Ideas by Statistical Mechanics (ISM) (Ingber, 2006; Ingber, 2007; Ingber, 2008). using Adaptive Simulated Annealing (ASA) (Ingber, 1989; Ingber, 1993a; Ingber, 2012) to fit parameters of a generic nonlinear multivariate colored-noise Gaussian-Markovian short-time conditional probability distribution to data, useful for many systems.

Models developed using ASA have been applied in many contexts across many systems (Ingber, 1993b), including applications to neural networks (Atiya *et al*, 2003).

Many of these ASA applications have used Ordinal representations of features, to permit parameterization of their inclusion into models, quite similar in spirit to DL.

4. Development Process

ASA can be used again in the expanded context of MOM. This is suggested as a first step in a new discipline to which MOM is to be applied, to help develop a range of parameters useful for DL, as DL by itself may get stuck in non-ideal local minima of the importance-sampled space. Then, after a reasonable range of models is found, DL can take over to permit much more efficient and accurate development of MOM for a given discipline/system.

5. References

References

Atiya et al, 2003.

A.F. Atiya, A.G. Parlos & L. Ingber, "A reinforcement learning method based on adaptive simulated annealing" in *Proceedings International Midwest Symposium on Circuits and Systems (MWCAS)*, *December 2003*, IEEE CAS, Cairo, Egypt (2003). URL https://www.ingber.com/asa03_reinforce.pdf.

Ingber, 1989.

L. Ingber, "Very fast simulated re-annealing," *Mathematical Computer Modelling* **12**(8), pp. 967-973 (1989). URL https://www.ingber.com/asa89_vfsr.pdf.

Ingber, 1993a.

L. Ingber, "Adaptive Simulated Annealing (ASA)," Global optimization C-code, Caltech Alumni Association, Pasadena, CA (1993a). URL https://www.ingber.com/#ASA-CODE.

Ingber, 1993b.

L. Ingber, "Simulated annealing: Practice versus theory," *Mathematical Computer Modelling* **18**(11), pp. 29-57 (1993b). URL https://www.ingber.com/asa93_sapvt.pdf.

Ingber, 2006.

L. Ingber, "Ideas by statistical mechanics (ISM)," Report 2006:ISM, Lester Ingber Research, Ashland, OR (2006). URL https://www.ingber.com/smni06_ism.pdf.

Ingber, 2007.

L. Ingber, "Ideas by Statistical Mechanics (ISM)," *Journal Integrated Systems Design and Process Science* **11**(3), pp. 31-54 (2007). Special Issue: Biologically Inspired Computing.

Ingber, 2008.

L. Ingber, "AI and Ideas by Statistical Mechanics (ISM)" in *Encyclopedia of Artificial Intelligence*, ed. J.R. Rabunal, J. Dorado & A.P. Pazos, pp. 58-64, Information Science Reference, New York (2008). ISBN 978-1-59904-849-9.

Ingber, 2012.

L. Ingber, "Adaptive Simulated Annealing" in *Stochastic global optimization and its applications with fuzzy adaptive simulated annealing*, ed. H.A. Oliveira, Jr., A. Petraglia, L. Ingber, M.A.S. Machado & M.R. Petraglia, pp. 33-61, Springer, New York (2012). Invited Paper. URL https://www.ingber.com/asa11_options.pdf.

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