AI for Anticipation: a Possible Means, a Necessary Purpose

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Abstract

The state of the art in machine intelligence with respect to anticipation is both, quite advanced for short term focused capabilities, as well as very preliminary for more ambitious forms. Most robots today implement some *implicit prediction* capabilities, in terms of direct and inverse models for predictive control, sometime with feedforward mechanisms. In a few advanced robots, these sensory-motor mechanisms are extended with *explicit prediction* and goal–directed deliberation abilities to perform complex tasks in more open environments [1]. However, the challenges with respect to more ambitious, longer term and social aspects of anticipation are tremendous. They can be viewed at the two following levels.

AI as a possible means for anticipation. One of the earliest extensive use of computers for long term anticipation goes back to the early seventies in the context of the so-called *Club of Rome* [2]. While very impressive for that time (several hundred of thousands of state variables and equations), this pioneering approach would be regarded today as a bit naive. It basically boils down to simple simulation forecasts of linear deterministic models along a handful of scenarios. However, its basic principles remain effective, i.e., models of local elementary changes can conceivably be identified, coupled and combined into complex chains. These principles can be put to use today with the benefit of fifty year of research and contributions since the Club of Rome, in particular in the following directions:

- *Machine learning* techniques may help us acquire myriad of models of elementary changes over a very broad spectrum of physical, biological, environmental and social phenomena. Various types of models and representations can, in principle, be integrated: nonlinear, non-differentiable, discrete, and most importantly nondeterministic. The challenges here are, in particular, how to go beyond correlation toward causality, without which no anticipation is conceivable, and how to grasp very rare events that can trigger significant changes.
- *Automated planning* techniques may allow us to combine, using nondeterministic or probabilistic algorithms, numerous elementary changes into innumerable possible scenarios. The latter

will be analyzed for desirability and likeliness using a profusion of data. Among the main challenges here are how to address the *coupling* issues between dependent elementary steps, and how not to bias planning toward myopic goals or criteria. These challenges are possibly at the core of anticipation, with or without AI.

AI as necessary purpose of anticipation. AI, as our main mediator to networks and computational systems and as a huge accelerator of the information world, is clearly a disruptive technology. Its potential benefits are tremendous, e.g., for addressing the Sustainable Development Goals of the UN [3]. Its risks are as commensurate. They range over a broad spectrum of issues: political (e.g., easier manipulation of opinions and threats to democracy), economical (e.g., high frequency trading, algorithmic pricing), social (e.g., labor transformation, feeling of being unneeded, quest for social purpose, cohesion and tension problems), global relations (e.g., broad spreading of dual-use AI techniques in military systems) [4]. These risks are insufficiently assessed and studied. Furthermore, there is a too large gap between the pace of this disruptive technology and the normal dynamics of society to allow the latter to fully grasp, filter out undesirable outcomes and regulate developments. Hence there is a clear need for *proactive* approaches with respect to these risks. The possible effects of AI on society should be the purpose of social experiments and research. This is clearly a challenging and critical research agenda for anticipation studies.

References

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