Sebastian OLIER & Matthias RAUTERBERG

Dynamic representations – building knowledge through an active representational process based on deep generative models

Abstract:

Where is meaning coming from? To address this question we propose Machine Learning methods for creating knowledge from the observation of sequential data. Our methods are evaluated regarding how adequate and interpretable the representations, mental concepts resp. learned are; particularly for video data concerning the actions of natural or artificial agents.

To build a theoretical framework for the problem, the process of building knowledge is analysed regarding the definition and understanding of conceptual representations, the way in which such definition influences the understanding of reasoning and learning, and how that relates to the design and implementations of artificial agents and learning algorithms. Then, the ideas of Active Inference are used as the basis for proposing generative models implemented through Deep Neural Networks.

It is explored how to design Deep Learning approaches to build representations that infer the causes of data content and its dynamics; that is done under the assumption that in the data utilized changes of content over time are highly related to the behaviour of the learning agent. This new approach allows to link the result to relevant ideas in cognitive science.

Furthermore, given that the learning structures proposed are based on a very general action-content relation, the methods presented are potentially extensible to many application domains. Similarly, that allows to explore data from which not much knowledge is available, by constructing it directly from observations.

Such process is evaluated regarding the organization of information coherently into representations that aligns with the action-context of data, and where temporal information is segmented in relevant sections associated to the specific action-contexts. The methods presented provide a form to learn from data in a more natural way, with interpretable representations and learning processes, which addresses a relevant challenge for unsupervised learning.

Reference:

Olier JS., Barakova E., Regazzoni CS., Rauterberg M. (2017). Re-framing the characteristics of concepts and their relation to learning and cognition in artificial agents. *Cognitive Systems Research*, vol. 44, pp. 50-68.