Causal Networks in Neural Systems: from Brain-Based Devices to Consciousness

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Abstract

Neurons engage in causal interactions with one another and with the surrounding body and environment. Neural systems can therefore be analyzed in terms of causal networks, without assumptions about information processing, neural coding, and the like. Causal networks therefore provide a lingua franca for translating insights obtained from computer simulations or robots into predictions and interpretations relevant to biological systems. My talk will be in three parts. First, I will describe the theoretical basis for 'causal network analysis' which rests on a combination of time-series analysis ("Granger causality") and network theory. I will then describe its application to a series of "brain-based devices", drawing implications for possible causal pathways in the hippocampus and for the relation between synaptic plasticity and behavioural learning. Finally, I will explore how causal networks shed new light on the possible biological mechanisms underlying conscious experience, with reference to the nascent project of 'artificial' or 'machine' consciousness.

References

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