BCL5

5th Workshop on Brain, Computation, and Learning

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Predictive Coding and the Primacy of Actions in Perception and Cognition

Abstract: Recent neurobiological experiments indicate that almost all areas of neocortex, even those traditionally labelled as sensory, are modulated by upcoming actions. Parallel evidence from neuroanatomical studies point to major outputs from neurons across cortical areas to subcortical motor centers. Active predictive coding (APC) is a new theory of predictive coding in the neocortex that combines actions and hierarchical sensory-motor dynamics. Simulation studies suggest that the same APC architecture can answer questions that at first blush seem to require very different solutions: (1) how do we recognize an object and its parts using eye movements? (2) why does perception seem stable despite eye movements? (3) how do we learn compositional representations, e.g., part-whole hierarchies, and nested reference frames? (4) how do we plan actions in a complex domain by composing sequences of sub-goals and simpler actions, and (5) how do we form episodic memories of our sensory-motor experiences and learn abstract concepts such as a family tree? Our results from the APC model illustrate the critical role played by actions, both external and internal to the brain, in mediating perception and cognition.