The HBP Calls for Expression of Interest for SGA3 "Integration of symbolic processing into the cognitive architectures"

Call Text

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This Call for Expressions of Interest (CEoI) aims to integrate expertise of neural network modelling of high-level symbolic processing for integration in developed biologically inspired cognitive architectures.

The CEoI is linked to the HBP SGA3 Work Package 3 (WP3): "Adaptive networks for cognitive architectures: From advanced learning to neurorobotics and neuromorphic applications". It targets researchers actively developing neural network models that learn to perform symbolic computation, preferentially via end-to-end training (e.g. via gradient descent). The goal is to develop modules and differentiable learning architectures that can perform higher cognitive tasks that involve cognitive control, reasoning, planning and symbolic communication, ideally by learning from high-dimensional inputs such as image pixels. These models should be biologically grounded as much as possible by incorporating relevant neuroscientific findings about high-level cognitive processes in prefrontal cortex and related areas.

A major goal of HBP is to advance our understanding how biological learning networks enable human cognitive functions. This perspective is pursued by emulating the architecture and operation of the brain that support these functions, and applying them to address cognitive problems. The approach is anchored in a direct relation between investigated cognitive architectures, and a physical reality that allows expression of the cognitive functions considered. This physical dimension may be numerically modelled (i.e. simulated), or correspond to an actual, experimental setup. This work is characterised by a close collaboration between cognitive neuroscientists, researchers in learning theory, Artificial Intelligence, and neurorobotics. It heavily relies on services provided by the HBP Research Infrastructure (RI).

The successful applicants will engage in close collaboration with HBP Partners who will provide expertise in cognitive neuroscience, learning, AI, and neurorobotics co-developing an embodied functional reference architecture. Together with HBP RI, a general modular framework will be developed that allows the integration of specialised neural models in the functional reference architecture. Basic models and modular architectures supporting visuo-motor and hierarchical cognitive processing will be provided by HBP Partners. The successful applicants will integrate symbol manipulation capabilities with the provided models of WP3 by adding or enhancing functional building blocks (e.g. working memory, attention, neural production (condition-action) system) in collaboration with HBP Partners. The working memory, attention and symbol manipulation capabilities should allow the modular and extensible neural network architectures developed in WP3 to store and follow task instructions (e.g. "grab the cup on the left side of the bottle"). The added components should allow to represent, maintain and modify task-related information online to select, guide and monitor execution of actions performed by controlled (virtual) robotic systems. WP3 will provide support to integrate developed network modules in the co-developed embodied functional reference cognitive architecture.

The successful applicants will complement the expertise already present within the project and will build on the developed visuo-motor and cognitive modular network architectures using tools and services provided by WP3 and the HBP RI in conducting the proposed work. Proposals focussing on simulating the execution of serial mental operations with variables and rules in a biologically plausible way are particularly welcome.