Development, evolution and complex systems: the contexts of "intelligence"

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Artificial intelligence has been struggling with two major mistakes. First, it has conflated human capabilities to think, feel and act with a context-independent concept of "general intelligence". This is wrong from a biological and psychological point of view: like all animals, humans are equipped with cognitive mechanisms that are highly adapted to the families of changing environments in which they live. These mechanisms are powerful, but in no way "general": we are skilled at what we need in our ecosystem (e.g. interpreting social behavior), but poor at other things (e.g. numerically solving differential equations). Learning theory also tells us that general intelligence does not exist: solving difficult problems with limited time resources requires biases.

A second mistake is that researchers have been focusing on particular information-processing techniques at single levels of abstraction. But we know that even the non-general intelligence of humans cannot be understood through reductionist ethereal approaches. Sensorimotor, cognitive and social capabilities in the child self-organize out of dynamic interactions within and across the brain, the body, and the physical and social environment, and over multiple spatiotemporal scales. Adaptive thinking and acting is an embodied, situated and dynamic complex system.

Thus, identifying a precise target ecosystem and context of operation should be crucial to any attempt to build advanced cognitive machines. One possibility is to target the human-like capabilities in the human ecosystem, and to attempt modeling the interaction of multiple mechanisms (e.g. maturation, motivation, learning, physical dynamics, reasoning, ...) at different scales of time and abstraction to guide the progressive development of certain families of skills (e.g. co-development of language and action in a social context). This is what fuels the emerging fields of evolutionary and developmental robotics[1].

[1] http://en.wikipedia.org/wiki/Developmental_robotics