

Special Issue on the Exploration of Cognitive Architectures

Editorial

Christian Lebiere

*Baker Hall 345A
Carnegie Mellon University
Pittsburgh, PA 15213, USA*

CL@CMU.EDU

This special issue article is an unusual mix of biographical, technical and scientific content. But it is a singular illustration of a famous quote by Allen Newell in his last lecture at Carnegie Mellon:

“You need to realize, if you haven't before, that there is this collection of ultimate scientific questions, and if you are lucky to get grabbed by one of these, that will just do you for the rest of your life. Why does the universe exist? When did it start? What's the nature of life? All of these are questions of a depth about the nature of our universe that they can hold you for an entire life and you are just a little ways into them.”

Understanding how the pursuit of such an ultimate scientific question impacts one's life decisions and is in turn influenced by life's circumstances is a unique contribution of this manuscript. Of course, the specific question matters profoundly as well. To quote Newell in the same lecture:

“The question for me is, how can the human mind occur in the physical universe? We now know that the world is governed by physics. We now understand the way biology nestles comfortably within that. The issue is, how will the mind do that as well? The answer must have the details. I have got to know how the gears clank and how the pistons go and all the rest of that detail. My question leads me down to worry about the architecture.”

Unlike fundamental problems in more settled disciplines, the question of the nature of the human mind and its mechanisms is notoriously ill-defined, which in turn involves several dimensions. The first concerns methodological approaches, illustrating the need for the unification of experimental, computational and theoretical approaches in the form of cognitive architectures that Newell memorably originated in his famous “You Can't Play 20 Questions with Nature and Win” paper.

Another contribution is to demonstrate how one need not choose between basic and applied work or live solely in Pasteur's quadrant. Instead, the proper research framework can productively integrate efforts ranging from basic inquiries into the origins of the power law to complex projects such as constructing computer-generated forces for large-scale training simulations and show the fundamental dependencies between them.

In a time when people too often believe in silver bullet solutions to every problem, an invaluable lesson learned from this research trajectory is the need to focus on problems and avoid becoming too committed to a specific solution but instead follow Newell's exhortation to "Listen to the architecture". Pivoting from a symbolic architecture (Soar) to a graphical architecture (Sigma) while remaining committed to the basic insights learned over decades of research requires both steadfastness of disposition and flexibility of mind.

The career evolution described in this manuscript illustrates that a scientific path crossing traditional disciplines often involves significant difficulties. Breaking down the walls of academic silos by integrating and applying knowledge from distinct fields and paradigms requires an uncommon breadth of perspective. The guiding figure in this paper illustrating the tiers of architectural exploration echoes Newell's concept of the bands of cognition in its scope and ambition. Even within the bounds of a particular research program such as cognitive architectures, attempts such as the Common Model of Cognition to learn from and unify distinct frameworks adopted by separate communities are unusual and riven with social, technical and scientific difficulties.

A final lesson is the need to seize opportunities to get out of the laboratory and impact institutions. It is unusual to excel at both scientific research and institution-building, but this manuscript provides a case study of how to achieve both objectives.

Finally, the reader should under no circumstances skip the appendix. The maxims discussed in that final section are well worth reflecting upon and should be mandatory reading for young scientists embarking upon their career.