

Information compression and the representation and processing of knowledge in the brain

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Abstract

The *SP System*, meaning the *SP Theory of Intelligence* and its realisation in the *SP Computer Model*, is the product of an extended programme of research seeking to simplify and integrate observations and concepts across AI, human learning, perception, and cognition, and related areas.

Information compression is a guiding principle in the SP research because of substantial evidence for its importance in human cognition.

A major discovery from this research is the concept of *SP-multiple-alignment*, borrowed and adapted from the concept of ‘multiple sequence alignment’ in bioinformatics. SP-multiple-alignment is largely responsible for the strengths of the SP System in several aspects of human intelligence: learning, perception, processing of natural language, planning, and more.

Of course there is more work to be done but the system provides a good foundation for the development of general human-level AI. In that respect, it has many advantages compared with ‘deep neural networks’ that have been receiving so much attention.

These ideas provide a conceptual framework for *SP-Neural*, a version of the SP Theory expressed in terms of neurons and their inter-connections and inter-communications. It turns out that SP-Neural, in a broad view, is quite similar to Donald Hebb’s concept of ‘cell assemblies’, but it differs in important ways, especially the overarching principle of information compression. Development that is planned of a computer model for SP-Neural is likely to yield more precision and more clarity in how SP-Neural would work.

Further information: www.cognitionresearch.org/sp.htm .

Image



Recent publications

1. Wolff J G (2016) Information compression, multiple alignment, and the representation and processing of knowledge in the brain. *Frontiers in Psychology*, 7, 1584, 2016, (bit.ly/2esmYyt). This paper describes *SP-Neural*, a version of the SP Theory expressed in terms of neurons and their inter-connections and inter-communications.

2. Wolff J G (2019) Information compression as a unifying principle in human learning, perception, and cognition. *Complexity*, vol. 2019, Article ID 1879746, 38 pages, 2019, DOI: doi.org/10.1155/2019/1879746 (bit.ly/2GdIqnY). This provides empirical foundations for the SP Theory as a theory of human learning, perception, and cognition.
3. Wolff J G (2006) *Unifying Computing and Cognition: the SP Theory and Its Applications*. This book provides the most comprehensive account of the SP System and its potential AI-related applications, where ‘SP System’ means the SP Theory of Intelligence and its realisation in the SP Computer Model. The book is a foundation for later publications.
4. Wolff J G (2013) The SP Theory of Intelligence: an overview. *Information*, 4 (3), 283-341, 2013 (bit.ly/1NOMJ6l). In effect, this is a shortened version of the book which provides a reasonably comprehensive view of the SP System but with less-important details omitted.
5. Wolff J G (submitted for publication) Unsolved problems in AI, described in the book ‘Architects of Intelligence’ by Martin Ford, and how they may be solved via the SP System (bit.ly/2th7Bze). This paper describes the clear potential of the SP System to solve 19 unsolved problems in the development of general, human-like AI. Those problems include 16 that are described by leading researchers in AI, reported by science writer Martin Ford in his book.
6. Wolff J G (2019) Mathematics as information compression via the matching and unification of patterns. *Complexity*, vol. 2019, Article ID 6427493, 25 pages, 2019, DOI: doi.org/10.1155/2019/6427493 (bit.ly/2LqUHIr). Somewhat unexpectedly, the principles of information compression at the heart of the SP System may also serve to show how much of mathematics, perhaps all of it, may be seen as a set of techniques for the compression of information, and their application.
7. Palade V, Wolff J G (2019) A roadmap for the development of the ‘SP Machine’ for artificial intelligence. *The Computer Journal*, Volume 62, Issue 11, November 2019, Pages 1584-1604, DOI: doi.org/10.1093/comjnl/bxy126, (bit.ly/2Vu0M9Q). As the title of this paper suggests, it provides a roadmap for the development of an *SP Machine*, derived from the SP Computer Model. This will provide a vehicle for further research by research groups and individuals anywhere. It is anticipated that ultimately, the SP Machine may serve a variety of roles in industry, commerce, science, and administration.

Photograph



Biography

Dr Gerry Wolff is Director of CognitionResearch.org. He has held academic posts in the University of Wales, Bangor, the University of Dundee, the University Hospital of Wales, Cardiff, and a one-year Research Fellowship with IBM in Winchester, UK. He has also worked as a Software Engineer with Praxis Systems plc in Bath, UK.

His first degree at Cambridge University was in Natural Sciences and his PhD at the University

of Wales, Cardiff, was in the area of Cognitive Science. He is a Chartered Engineer and a Member of the British Computer Society.

He has worked on the development of computer models of language learning, and later he has been concentrating on the development of the SP theory. Between early 2006 and late 2012 he was engaged full time in environmental campaigning (climate change).

Dr Wolff has numerous publications in a wide range of journals, collected papers and conference proceedings. *Email:* jgw@cognitionresearch.org.