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Special Issue Book

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Complexity, Criticality and Computation (C³)

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Complex systems is a new approach to science, engineering, health and management that studies how relationships between parts give rise to the collective emergent behaviours of the entire system, and how the system interacts with its environment.

A system can be thought of as complex if its dynamics cannot be easily predicted, or explained, as a linear summation of the individual dynamics of its components. In other words, the many constituent microscopic parts bring about macroscopic phenomena that cannot be understood by considering a single part alone (“the whole is more than the sum of the parts”). There is a growing awareness that complexity is strongly related to criticality: the behaviour of dynamical spatiotemporal systems at an order/disorder phase transition where scale invariance prevails.

Complex systems can also be viewed as distributed information-processing systems. Consciousness emerging from neuronal activity and interactions, cell behaviour resultant from gene regulatory networks and swarming behaviour are all examples of global system behaviour emerging as a result of the local interactions of the individuals (neurons, genes, animals). Can these interactions be seen as a generic computational process? This question shapes the special issue, linking computation to complexity and criticality.



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