MODELLING AND GENERATING COMPLEX EMERGENT BEHAVIOUR

A thesis submitted for the degree of
Doctor of Philosophy

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Abstract

Despite a general recognition of the importance of complex systems, there is a dearth of general models capable of describing their dynamics. This is attributed to a complexity scale; the models are attempting to describe systems at different parts of the scale and are hence not compatible. We require new models capable of describing complex behaviour at different points of the complexity scale. This work identifies, and proceeds to examine systems at the high end of the complexity scale, those which have not to date been well understood by our current modelling methodology. It is shown that many such models exhibit what might be termed contextual dependency, and that it is precisely this feature which is not well understood by our current modelling methodology. A particular problem is discussed; our apparent inability to generate systems which display high end complexity, exhibited by for example the general failure of strong ALife. A new model, Process Physics, that has been developed at Flinders University is discussed, and arguments are presented that it exhibits high end complexity. The features of this model that lead to its displaying such behaviour are discussed, and the generalisation of this model to a broader range of complex systems is attempted.

Themes: contextuality and complexity; reductive failure; Process Physics; quantum theories as models of complexity

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Kirsty Kitto

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This work has involved a long, very interesting, but often rather torturous journey. What began as an examination of the quantum measurement problem quickly increased in scope to the foundations of quantum mechanics, then again to fundamental physics in general, before shifting its emphasis to complex systems. Before long even biology, ecology, economics and artificial life came into the scope of this project. As such, this work could not have been possible without the assistance of a large number of people from a wide range of fields, whose conversations, criticisms, witticisms and creativity has challenged and extended my knowledge.

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Finally, I would like to acknowledge the internet. Without the dramatic explosion of readily accessible ideas, theories, articles, preprints and tutorials that it provides, work such as this, at the boundaries of many substantially different disciplines would be difficult if not impossible; our theories are now in a position to evolve to new levels of complexity thanks to the creation of this vital resource. May it always remain free.

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