

Coda to CS405 - December 8th 2006

- Educational technology:
 - sqleddi as a sample development with role integration [079]
- EM as a methodology for modelling with dependency [096]
- paper from ICALT 2006 on WEB-EM-01 [090]
- Software development:
 - Concurrent development and conceptual integrity
- Interactive situation models [052]
- SEMI aspects of state [069]
- Translation into conventional programs
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- Philosophy:
 - Foundations of AI paper [050]
- RE, EM and the nature of knowing [078]
- TEDC 2006 ("understanding forwards" theme) [092]
- Models:
 - sqleddiWard2003
- digitalwatchRoe2001
- vimodesBeynon2006 (+ supplementary script accessible from CS133)
- scicsYung1995

Abstracts of relevant papers

Educational Technology

079 - A computer-based environment for the study of relational query languages

In this paper, we describe an environment developed to support a rich learning experience in which practice and theory in relational databases are better integrated, enabling students from various backgrounds to appreciate the significance of relational theory and the logical flaws in SQL. Our lightweight open source software includes the aspects of a commercial database system that are most relevant to teaching relational databases and can be run on several platforms.

See also: sqleddiWard2003 and sqleddiWard2003/presentation.

096 - Computing technology for learning - in need of a radical new conception

Many have had high expectations for the impact of computer-based technology on educational practice. By and large, these expectations have not been realised. It has become evident that innovative technology alone does not necessarily guarantee progress - nor perhaps even significant change - in educational practice. This has led educational researchers to place greater emphasis on cultural issues that could account for the unexpectedly limited influence of technology-enhanced

learning. Candidate issues relate to: the political context surrounding education; technical and social obstacles to technology adoption by teachers; a failure to identify appropriate models of learning and teaching. This paper attributes the primary problems faced in applying technology in education to a quite different source: to the accepted conception of computing itself. This perception of the relationship between technology and learning is elaborated in the first section of the paper. It is complemented by a review of an alternative conception of computing, rooted in a methodology for modelling with dependency directed at the development of construals rather than programs, that is far better aligned to the demands of developing environments for learning. The paper concludes with a brief discussion of the potential implications of this approach.

090 - Learning about and through Empirical Modelling

Empirical Modelling is a body of principles and tools that has been developed for the construction of interactive environments. Our previous research has indicated respects in which Empirical Modelling is intimately linked with learning activity of many different varieties. In this paper, we recount informal evidence in support of this claim that can be drawn from the assessment exercise attached to the 'Introduction to Empirical Modelling' module offered in Computer Science at the University of Warwick. This assessment takes the form of an open-ended modelling and paper-writing exercise. Such an exercise is shown to be effective for learning about Empirical Modelling. It also promotes self-motivated exploration in unknown domains that is one of the key skills for life-long learning. The extent to which students not only learnt about Empirical Modelling, but also about the domain which they chose to model was unexpected. This leads us to suggest that Empirical Modelling could be effective in facilitating learning in other domains.

Software development

052 - Interactive Situation Models for Information Systems Development

An interactive situation model (ISM) is a new kind of artefact to support information systems development. An ISM is particularly well-suited for use in the early stages of the development process. Computer-based ISMs can be constructed using Empirical Modelling (EM) principles and software tools that have been developed at Warwick. The developer construes system behaviour in terms of three key fundamental concepts of EM: observables, dependencies and agents. Observation-oriented analysis is used to formulate an explanatory account of system using a novel notation called LSD. A special-purpose software tool, such as the EDEN interpreter, is used to develop an associated ISM. In the environment supplied by this ISM, the developer can explore the implications of different contexts and scenarios for interaction between agents.

This paper outlines the principles of EM, and illustrates the ISM concept with reference to a digital watch and statechart simulation. The use of ISMs as a means of shaping state and agent interaction is compared and contrasted with the use of statecharts. Recently published work by Horrocks on the application of statecharts to the design of user-interface software provides the context for this study. A refinement of Horrocks's event-state-action paradigm for user-interface specification and implementation is proposed.

See also [digitalwatchCartwright1995](#) and [digitalwatchFischer1999](#).

069 - Interactive Situation Models for Cognitive Aspects of User-Artefact Interaction

Cognitive aspects of human interaction with artefacts is a central concern for Cognitive Technology. Techniques to investigate them will gain greater significance as new products and technologies more closely customised to specific users are introduced. The study of Cognitive Dimensions is a well-established technique that can be used to support and direct empirical investigation of cognitive aspects of artefact use. This paper proposes a complementary technique, based on constructing 'interactive situation models', that applies to the study of specific user-artefact interactions. It interprets the cognitive activities of the user through interrelating situational, explicit, mental and internal aspects of state. The application of this approach in analysing, recording and classifying such activities is illustrated with reference to a simple case study based on modelling the use of an actual digital watch. The paper concludes with a brief discussion of possible connections with Cognitive Dimensions and implications for 'invisible computing'.

See also [digitalwatchRoe2001](#).

Philosophical aspects

050 - Empirical Modelling and the Foundations of Artificial Intelligence

This paper proposes Empirical Modelling (EM) as a possible foundation for AI research outside the logicist framework. EM offers principles for constructing physical models, typically computer-based, by construing experience in terms of three fundamental concepts: observables, dependency and agency. EM is discussed in the context of critiques of logicism drawn from a variety of sources, with particular reference to the five foundational issues raised by Kirsh in his paper *Foundations of AI: the Big Issues* (AI, 47:3-30, 1991), William James's *Essays on Radical Empiricism* (Bison Books, 1996), and the controversy surrounding formal definitions for primitive concepts such as metaphor and agent that are recognised as fundamental for AI. EM principles are motivated and illustrated with reference to a historic railway accident that occurred at the Clayton Tunnel in 1861.

The principal thesis of the paper is that logicist and non-logicist approaches to AI presume radically different ontologies. Specifically, EM points to a fundamental framework for AI in which experimentally guided construction of physical artefacts is the primary mode of knowledge representation. In this context, propositional knowledge is associated with phenomena that are perceived as circumscribed and reliable from an objective 'third-person' perspective. The essential need to incorporate subjective 'first-person' elements in an account of AI, and the role that commitment plays in attaching an objective meaning to phenomena, are seen to preclude a hybrid approach to AI in the conventional sense.

078 - Radical Empiricism, Empirical Modelling and the nature of knowing

This paper explores connections between Radical Empiricism (RE), a philosophic attitude developed by William James at the beginning of the 20th century, and Empirical Modelling (EM), an approach to computer-based modelling that has been developed by the author and his collaborators over a number of years. It focuses in particular on how both RE and EM promote a perspective on the nature of knowing that is radically different from that typically invoked in contemporary approaches to knowledge representation in computing. This is illustrated in detail with reference to the modelling of several scenarios of lift use. Some potential implications for knowledge management are briefly reviewed.

See also [liftBeynon2003](#).

092 - Towards Technology for Learning in a Developing World

This paper addresses a significant concern in relation to educational technology to support developing countries: the impact of the developed world's notion of *development* upon its notion of *learning*. It argues that the very factors that lead us to regard a country as developed conspire to marginalize certain characteristic features of authentic learning, and naturally promote a more limited and circumscribed concept of learning ("closed learning"). Information and communications technology - when cast in its traditional role - is itself viewed as a major indicator of development, and at the same time contributes to the promotion of closed learning. To privilege closed learning is to attribute a significance to 'understanding backwards' that is deprecated by William James in his philosophic attitude of Radical Empiricism. Empirical Modelling is briefly reviewed as an alternative conception of technology for developing worlds that also enables 'understanding forwards'.