Workshop @ Constructionism 2010

Constructionist learning by computing for construal

Meurig Beynon and **Antony Harfield**
University of Warwick and Tessella plc, Oxford UK

Programming and constructionism

Constructionism makes an intimate connection between *making sense* and *making artefacts* …

Software development should be well-aligned to this perspective, with programming as the means of construction … *but* …

Software crises (and crisis in computer science?)
Software development isn't well-aligned to learning

Central problem

Task of conceiving software and maintaining it in intimate relation to the application domain unsolved

cf. *"I don't see any hard edges between creating, sharing, consuming and learning. I want a system that allows people to shift effortlessly between doing these things."*

Lack computer science *principles* to deliver this …

Construal by computer …

In practice, there are ways of using the computer effectively that are not endorsed by classical theory

e.g. a spreadsheet metaphorically represents the state of a domain *as experienced by the modeller*

Can't explain the qualities of software that exploit dependency, such as dynamic geometry, by abstract functionality and symbolic representations

Construals

A **construal**: a physical object with open-ended scope for exploratory interaction and interpretation that affords experiences significant for sense-making

Propose Empirical Modelling (EM) as a new conceptual framework for computer science …

... focusing on developing construals and on **not** "programs-in-the-classical-sense"

EM principles

Model-building as *construing*: creating artefacts that are experienced as relating to an external situation
cf. the spreadsheet

Key concepts …

- **observables** *cf. cells*
- **dependency relations** *cf. defns*
- **agency** *cf. which cells we can change*

From construals to programs …

Developing a program from a construal is like *developing a walk*, proceeding through 3 stages:

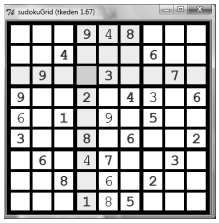
- initial personal exploration of environment
- tracks familiar to us that others can follow
- public footpaths where the way is objectively clear

cf. learning activities: can tell people how to follow a public footpath, but not how to devise a new walk

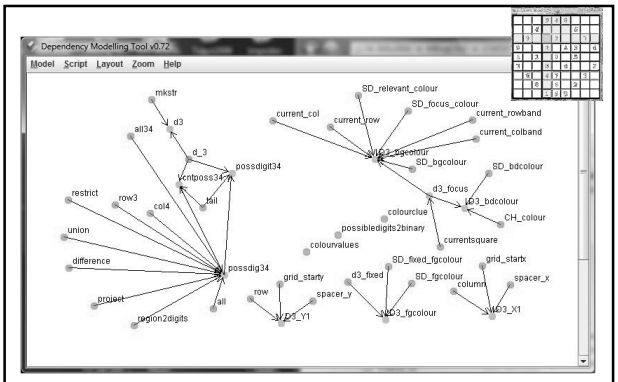
Illustrating EM construal

The Sudoku solving construal:

- built using the EDEN interpreter
- comprises c. 5000 observables
- can use to assist Sudoku solving
- can develop solution programs
- deployed informally with pupils



Why so many observables? … and is this a GOOD thing?



Observables associated with the grid cell D3 (lightblue)

Exercising the Sudoku solving construal

Network of dependencies as playground for exploration by many agents … pluralism

… every state change is captured by redefining the values of sets of observables … monism

… integrating roles of developer, teacher, learner

… tracing states of / in mind

Orientation

*Compare **a state of mind** with **all the possible interactions and interpretations that a computer artefact can offer to our experience***

Think of understanding human Sudoku solving not as trivial ("a computer can do it") but as defying analysis, personal, mysterious

What is possible in this present situation?
Exploring and creating potentialities cf. Faraday and the electric motor