Constructionism through construal by computer

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Content of talk

- Programming and constructionism:
  a Computer Science perspective
- Construal by computer
  Conceptual: the "making walks" analogy
  Practical: a Sudoku solving construal
- Some informal feedback and evaluation

Workshop announcement and resources

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 …

Consider …
Logo, procedural programming, OOP
problems of revising requirements
agile programming …

Problematic issues

Formal programming predicated on knowledge of mechanism and functionality

Automated inference vs. informal initial proof

Construction = development? … or use?

Software crises (and crisis in computer science?)
Software development is not 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*

Its qualities, and that of other software that exploits dependency, such as GeoGebra, aren't explained 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

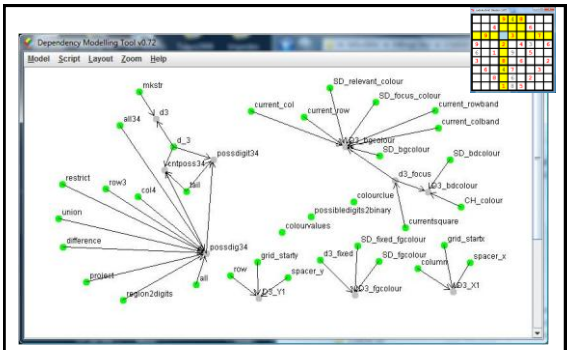
Cf. learning activities: can tell people how to follow a public footpath, but not how to devise a new walk

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?



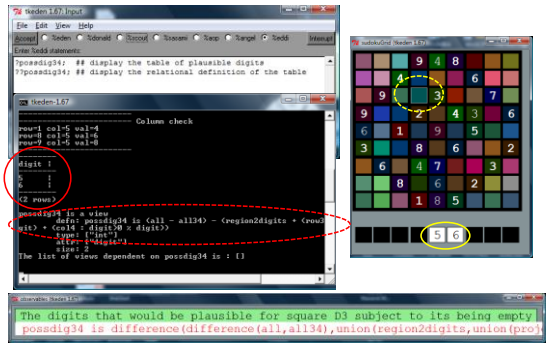
Observables associated with the grid cell D3 (lightblue)

Exercising the Sudoku solving construal

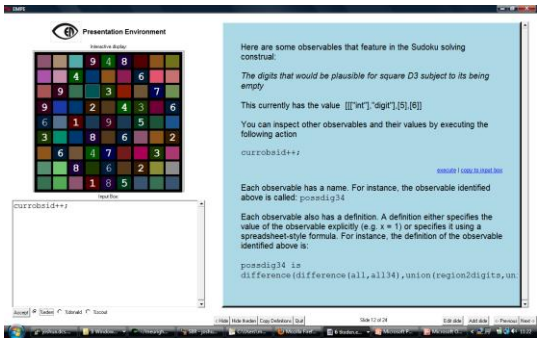
Network of dependencies as playground for exploration by many agents …

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

… integrates roles of developer, teacher, learner



Multiple representations suitable for different agents



Yet another view of the same environment

Applying the S-s construal …

Deployed in three contexts:

- ACE (Aiming for a College Education) visits, 2/07
- *The Sudoku Experience* (YGT, Warwick, 7/08)
- Daria Antonova *et al*, Toijala Centre, Nokia, Finland

Informal feedback from these sources …

ACE reconstructions from history of interaction

The *Sudoku Experience* workshops, online at
http://www.dcs.warwick.ac.uk/~wmb/sudokuExperience/workshops/

Feedback on the S-s construal …

Approval for the guided walk approach:

"It was amazing to see what we have actually done to the sudoku board and it was good that you said we could 'wonder (sic) off the path' a bit, e.g. changing colours and numbers, which was good fun."

Pupil on "The Sudoku Experience" online activity

Feedback on the S-s construal …

… not such an enthusiastic walker:

"I had difficulties to knowing how to do things, as I don't think it was explain very well. In the introduction I got confused straight away but then when I went onto workshop 2 I worked out what to do. I think it needs to be made clearer how to do things."

Pupil on "The Sudoku Experience" online activity

Antonova on the S-s construal …

"They turned out to be pretty interesting and dont really require programming skills or previous knowledge of programming language, just some logic. I had to think quite a while about some of exercises to find answers but after you find them, exercises don't seem hard."

Comment on "The Sudoku Experience" workshops

Concluding thoughts

- potential for novel kinds of empirical study
- cultural issues surrounding 'ease-of-use' (cf. apps)
- promise of linking construction to domain learning

Workshop announcement

Constructionist learning by computing for construal

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Friday 20th August : 9 am - 12 noon at AUP G23

Resources for the workshop …

Taster is available online: The "Sudoku Experience" workshops
http://www.dcs.warwick.ac.uk/~wmb/sudokuExperience/workshops/

Desktop version of tool **tkeden-1.67** to be used at AUP Workshop

Further resources can be accessed from the EM webpage at
http://www.dcs.warwick.ac.uk

Can download **tkeden-1.67** via the **Software/EDEN** link on EM webpage and **sudokuexperienceBeynon2008** via the **Projects archive** link

Further materials for use with **tkeden-1.67** issued at the Workshop