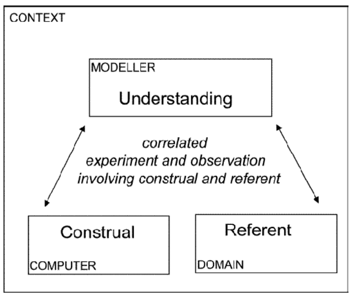
Empirical Modelling as *Construction*


CONTEXT
MODELLER
Understanding
correlated experiment and observation involving construal and referent
Construal
COMPUTER
Referent
DOMAIN

Background and History

A *definitive notation* = a simple formal language in which to express definitions

A set of definitions is called a *definitive script*

Definitive notations different according to
types of the variables that appear on the LHS of definitions and **operators** that can be used in formulae on the RHS. These are termed the *underlying algebra* for the notation.

The definitive notation concept

Todd relational algebra query language ISBL
Brian & Geoff Wyvill's interactive graphics languages
spreadsheets
style definition in word processors

The term "definitive notation“ first introduced by Beynon

“Modelling with Definitive Scripts” is fundamental to EM
[Rungrattanaubol’s PhD Thesis: **A treatise on MWDS**]

Related developments

spreadsheets with visualisation mechanisms

spreadsheet-style environments for end-user programming (e.g. AgentSheets)

generalised spreadsheet principles in application-builders (e.g. ACE), development tools (WPF)

“object-linked embedding" in Windows

What does *definitive* mean?

definition has a technical meaning in this module
definitive means "definition-based"

"definitive" means
more than informal use of a programming technique.

Definitive notations are
a means to *represent state* by definitive scripts
and *how* scripts are interpreted is highly significant.

Significance of interpretation …

Miranda *can* be viewed as a definitive notation over an underlying algebra of functions and constructors
BUT this interpretation emphasises
program design as a state-based activity
rather than
declarative techniques for *program specification*.

[cf. ‘admira’ application and contrast with KRC]

Definitive notations

The tkeden interpreter uses many definitive notations

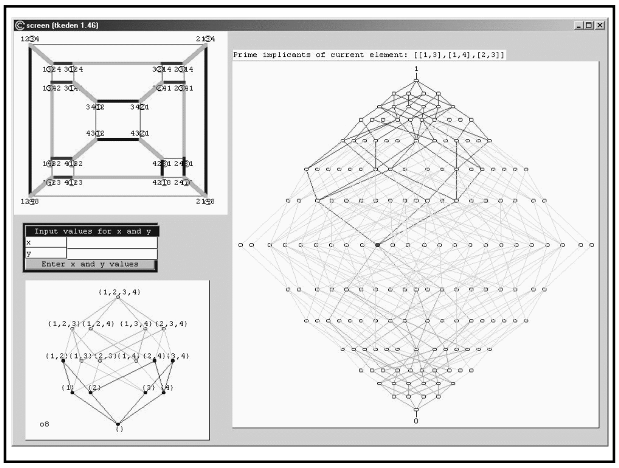
eden: scalars, strings, lists

DoNaLD: for 2-d line drawing

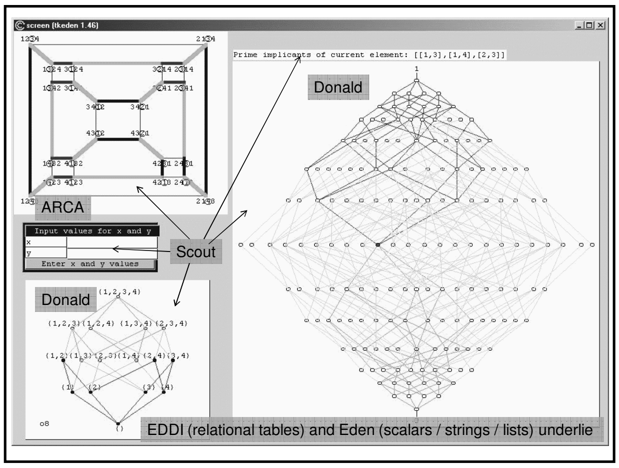
SCOUT: displays, windows, screen locations, attributes

EDDI: relational tables and operators

ARCA: edge-coloured digraphs in n-space



Prime implicants of current element: [[1,3],[1,4],[2,3]]



Prime implicants of current element: [[1,3],[1,4],[2,3]]

EDDI (relational tables) and Eden (scalars / strings / lists) underlie

DoNaLD: a definitive notation for line-drawing

Donald = a definitive notation for 2-d line-drawing

underlying algebra has 6 primary data types:
integer, **real**, **bool**ean, **point**, **line**, and **shape**

A **shape** = a set of points and lines

A **point** is represented by a pair of scalar values {x,y}.

Defining shapes in DoNaLD

Two kinds of shape variable in DoNaLD:
these are declared as **shape** and **openshape**

An **openshape** variable S is defined componentwise
as a collection of points, lines and subshapes

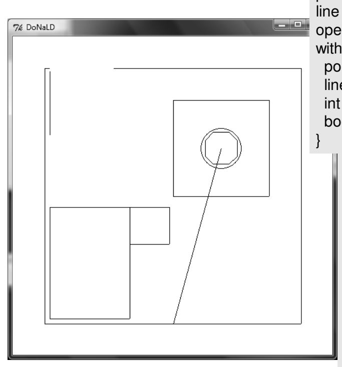
Other mode of definition of shape in DoNaLD is
shape RSQ
RSQ=rotate(SQ)
- illustrated in definition of vehicle in VCCS model.

Agents and semantics

Archetypal use of MWDS: human-computer interaction
"single-agent modelling"

Variables in a definitive script represent
- the values that the user can observe
- the parameters that the user can manipulate
- the way that these are linked indivisibly in change
definitive script can model physical experiments

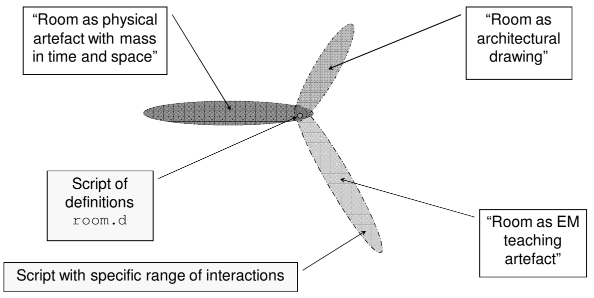
[cf the role of spreadsheets in describing and predicting]



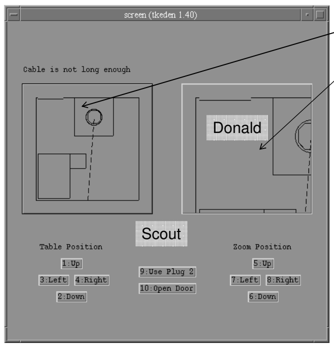
```
int width, length
point NW, NE, SW, SE
line N1, N2, S, E, W
openshape door
within door {
  point hinge, lock
  line door
  int width
  boolean open
}
openshape table
within table {
  int width, length
  point NW, NE, SW, SE
  line N, S, E, W
  openshape lamp
  within lamp {
    point centre
    int size, half
    circle base
    line L1, L2, L3, L4, L5, L6, L7, L8
  }
}
```

roomYung1989

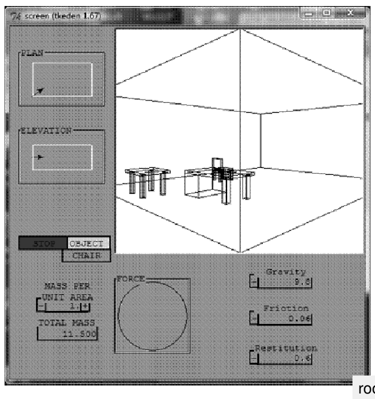
Modelling with different motivations


"Room as physical artefact with mass in time and space"
"Room as architectural drawing"
Script of definitions room.d
"Room as EM teaching artefact"
Script with specific range of interactions

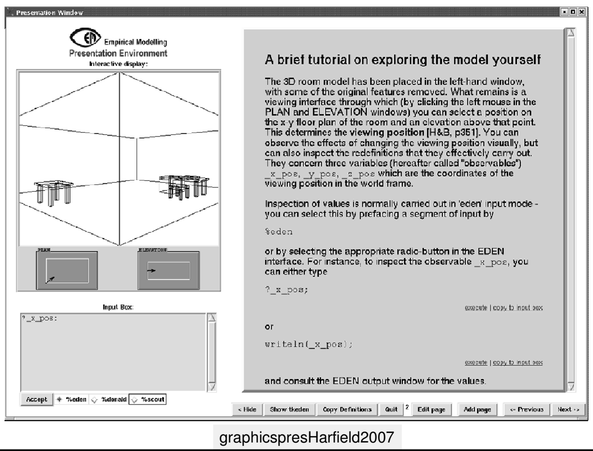
About Definitive Scripts



roomviewerYung1991



room3dMacDonald1998



A brief tutorial on exploring the model yourself

The 3D room model has been placed in the left-hand window, with some of the original features removed. What remains is a viewing interface through which (by clicking the left mouse in the PLAN and ELEVATION windows) you can select a position on the x-y floor plan of the room and an elevation above that point. This determines the viewing position [H&B, p351]. You can observe the effects of changing the viewing position visually, but can also inspect the redefinitions that they effectively carry out. They concern three variables (hereafter called "observables") `_x_pos, _y_pos, _z_pos` which are the coordinates of the viewing position in the world frame.

Inspection of values is normally carried out in 'eden' input mode - you can select this by prefacing a segment of input by

```
%eden
```

or by selecting the appropriate radio-button in the EDEN interface. For instance, to inspect the observable `_x_pos`, you can either type

```
?_x_pos;
```

execute | copy to input box

or

```
writeln(_x_pos);
```

execute | copy to input box

and consult the EDEN output window for the values.

graphicspresHarfield2007

tkeden 1.40: Sasami
screen (tkeden 1.40)
Main
Main
Desk
Desk
Desk
Desk

room3dsasamiCarter1999

Observables, Dependency, Agency

The observables, dependencies and agency that are topical relate to the situation and the way in which a script is being interpreted.

In the architectural drawing, don’t observe time.

In the physical room, observe mass, time, force.

In teaching EM, we observe the screen display itself and seek to interpret “absurd” definitions

Observables

Observables are entities

whose identity is established through experience

whose current status can be reliably captured by experiment

Can be physical, scientific, private, abstract, socially arbitrated, procedurally defined etc.

Dependency and Agency

An *agent* is an observable (typically composed of a family of co-existing observables) that is construed to be responsible for changes to the current status of observables

A *dependency* is a relationship between observables that - in the view of a state-changing agent - expresses how changes to observables are indivisibly linked in change

Single Agent modelling

In the primary and most primitive form of Empirical Modelling, the modeller is the only state-changing agent – though they may act *in the role* of different agents: e.g. room user or designer, architect, Empirical Modelling lecturer.

The dependencies between observables are then those that are experienced by the modeller acting in the situation: they express the way in which changes to observables are connected.

Negotiated and evolving interpretations

The situation surrounding the interpretation of a script is never completely closed or well-specified.

The modeller always has to exercise discretion to achieve a degree of closure. Situations can blend.

Definitions stabilise as meanings are negotiated.

Stable definitions reflect established experience.

Skills and insights can give rise to new definitions.

Illustrative examples

Definitions stabilise as meanings are negotiated.

The model of the desk drawer gets improved.

Stable definitions reflect established experience.

The door location and mechanism gets fixed.

Skills and insights can give rise to new definitions.

We connect the door opening with the light coming on, or learn to use a touch-sensitive switch.