

OBJECT BEHAVIOR ANALYSIS

Rubin and Goldberg - CACM September, 1992 (Special Issue on Modeling and Analysis)

Rubin/Goldberg - base all of the definition of attributes, objects and state models on development and creation of scripts.

Structure and behavior are both derived from analysis of scripts.

MOTIVATION FOR R/G METHOD

- 1. Data modeling methods assume existence of complete and correct requirements specification.**
- 2. Data modeling has a bias towards the tangible as contrasted to the conceptual.**
- 3. Behaviors are fundamental, not data or data states.**

NOTES

- 1. It is actually the case that the scripts are used to derive glossaries that summarize information which is then used as a requirements analysis.**
- 2. Attributes are defined before objects.**

Relation to Linguistics Analysis Method

- **The Rubin/Goldberg model requires assumption of an initial class diagram in order to generate scripts.**
- **We use linguistics analysis to generate a class diagram and then use the script method to derive the behaviors on the basis of the scripts.**
- **Using the R/G method with the linguistics analysis method as a starting point may result in insights leading to a better class diagram as well as behaviors.**
- **We ask for both sets of derivations.**

Lecture Format

- This lecture follows the R/G paper closely with respect to both notation and content.
- We will subsequently suggest a somewhat different formats for scripts which make a better connection with the linguistics analysis approach. These script formats are extensions of those used in the last lecture.

OBJECT BEHAVIOR ANALYSIS

Alternative process for design of objects

0. Requirements Analysis

1. Construct example objects for script generation

2. Construct execution scripts

3. Build glossaries from scripts

4. Derive attributes from analysis of scripts (services glossary)

5. Define objects from parties glossary; create Object Modeling Cards

6. Re-structure objects according to common behavior and common attributes.

7. Define object states and attribute domains from analysis of scripts.

OBJECT BEHAVIOR ANALYSIS

Important Concepts

- 1. contracts - agreements among initiators and participants**
- 2. Initiator - executes actions which require services**
- 3. Participant - provides services through an interface to initiators**
- 4. Service - Behavior of a participant in response to a request**
- 5. Glossary - list of occurrences of elements**
- 6. Attribute - name/value set in which states are described.**
- 7. Script - specification of flow of actions initiated by outside agent.**
- 8. Event - phase change in script**

OBJECT BEHAVIOR ANALYSIS

A spreadsheet example

System Features

- 1. grid of cells with external borders**
- 2. label rows with integers**
- 3. label columns with letters**
- 4. cells can hold strings with styles, typed numbers, expressions, etc.**
- 5. expressions cannot contain strings**
- 6. currency type has fp arithmetic properties**
- 7. expressions cannot contain cycles**
- 8. evaluation and display is continuous**
- 9. main commands are: create, read from file, save to file, select arbitrary subgrid, modify cell or selection, print, etc.**

Core Activities

- 1. creation**
- 2. modification**
- 3. calculation**
- 4. save and load**

Performance Requirements

- 1. no command to take more than 20 seconds**

Analysis Plan

- 1. use salary example**
- 2. scripts for creates, modifies, etc.**

OBJECT BEHAVIOR ANALYSIS

An Example Spreadsheet

	A	B	C	D
1				NEW
2	NAME	SALARY	%RAISE	SALARY
3	joe	\$55,000	4	\$57,000
4	mary	\$60,000	4	\$62,400
5	henry	\$30,000	4	\$31,200
---	---	---	---	---
12	totals	\$295,000		\$307,695
13	average raise		4.2	\$1,524
14	expense increase			\$12,195

OBJECT BEHAVIOR ANALYSIS

SCRIPT NOTATION

INITIATOR	ACTION	PARTICIPANT	SERVICE
thing 1	notifies	thing 2	thing 2 can be notified
thing1	provides info to	thing 2	thing 2 can accept info
thing 1	requests info from	thing 2	thing 2 can provide info
thing 1	requests service from	thing 2	thing 2 can provide service

OBJECT BEHAVIOR ANALYSIS

A SIMPLE SPREADSHEET - SCRIPT EXAMPLE

Script Name **Modification.1.example**
Author **Donna**
Precondition **spreadsheet exists and displayed**
Postcondition **modified spreadsheet exists**
Trace **Core Activity**

INITIATOR	ACTION	PARTICIPANT	SERVICE
user	select D1	spreadsheet	select a cell
user	type text NEW	D1	set content to text
user	set type style to bold	D1	set text type style to bold
user	select A2	spreadsheet	select a cell
user	type text NAME	A2	set content to text
user	further selections		
user	select row 2	spreadsheet	select a row
user	set text type to bold	row 2	set text type to bold
user	extend row height to be 34 pixels	row 2	resize height
user	select A12	spreadsheet	select a cell
user	type text TOTALS	A12	set content to text
user	(repeat select and type)	A13,A14	
user	select A12:A14	spreadsheet	select vertical collection of cells
user	set text type to bold	A12:A14	set text style to bold
user	select B3	spreadsheet	select a cell

OBJECT BEHAVIOR ANALYSIS

Scripts may have a hierarchical structure.

Notice Pattern in spreadsheet script.

Select

Operation

Select

Operation

We could associate a pre-condition and a post-condition with each

Select

Operation

pair if the effect of the operation is significant.

We could associate a pre-condition and a post-condition with elementary operation (Select, Operation) if the effect of the elementary operation is significant.

OBJECT BEHAVIOR ANALYSIS

PARTIES GLOSSARY

PARTY	DEFINITION	TRACES	ROLE
user		modification.1.example	I
spreadsheet			P
D1		modification.1.example	P
A2		modification.1.example	P
A12		modification.1.example	P
row 1		"	P
A12:A14		"	P
B3		"	P
.....
column A		"	P
.....

OBJECT BEHAVIOR ANALYSIS

ABSTRACTED GLOSSARY

PARTY	DEFINITION	TRACES	ROLE
user	human or other driver of application	modification.1.example	I
spreadsheet	2D grid of cells that can contain data and formula for noncircular computations	"	P
cell	container for an element that has a value	modification.1.example	P
vertical cell collection	contiguous set of cells from the same column	modification.1.example	P
row	collection of cells occupying the full horizontal dimension of the grid	"	P
column	collection of cells occupying the full vertical dimension of the grid	"	P

OBJECT BEHAVIOR ANALYSIS

ALIAS TABLE

GENERAL OR PREFERRED NAME	ALIASES
cell	A2,A12,D1, etc.
vertical cell collection	A12:A14, B5:B10, etc.
row	row 1, row 2
column	column A, column D,etc.

SERVICES GLOSSARY

SERVICE	DEFINITION	PARTICIPANTS	TRACES
select a cell	select a single cell and make it the current selection	spreadsheet	Modification .1.example
set content to text	set the contents of a cell to be text	cell	"
set content to number	set the contents of a cell to be a typed number	cell	"
select a row	select a row of cells and make it current	spreadsheet	"
set text style to bold	set the text style to bold	cell or row	"
resize height	change the height of a given row	row	"
select a vertical collection of cells	select a partial column of cells and make it the current selection	spreadsheet	"
set format to currency	set the format as current	cell	"
fill down	replace the remaining contents of each cell in current vertical selection with the value of the first cell in the selection	vertical cell selection	"
select a column	select a column of cells and make it the current selection	spreadsheet	"
resize width	change the width of a given column	column	"

Identify attributes from services glossary as targets of services or as required for actions

OBJECT BEHAVIOR ANALYSIS

ATTRIBUTE GLOSSARY - ROW

NAME	DEFINITION	CONTRACT	ACCESSOR	MUTATOR	MULTI/SINGLE VALUE	RANGE OF VALUES	STATE DEFINITION
height	height of the row in number of pixels	none	none	resize the row height	single	integer	no
format	interpretation of the contents	none	none	none	single	\$xx.xx	no
style	presentation of contents	none	none	set style	single	bold	no

DESCRIPTION OF THE COLUMNS IN AN ATTRIBUTE GLOSSARY

COLUMN	DESCRIPTION
name	a unique name for the attribute in the context of the party
definition	an unambiguous definition of the attribute in the context of the containing party
contract	does the party have any contracts with the attribute
accessor	does the party provide a service for accessing the attributes
mutator	does the party provide a service for mutating the attribute
multi/single value	does the attribute denote a collection of values in the context of the attribute
state-definition	is the attribute used to define states of the party

OBJECT BEHAVIOR ANALYSIS

DEFINING OBJECTS FROM SCRIPTS

1. Identify participants - use parties glossaries

providers of services
names of collections
participants which are also initiators
(use parties glossary)

2. Structure objects through specialization, abstraction and factorization factorization - objects with multiple responsibilities

Object Modeling Card

name of object--- row
inherits from-----

attributes/logical traces
properties

style	modification.1.example
height	"

provided services traces

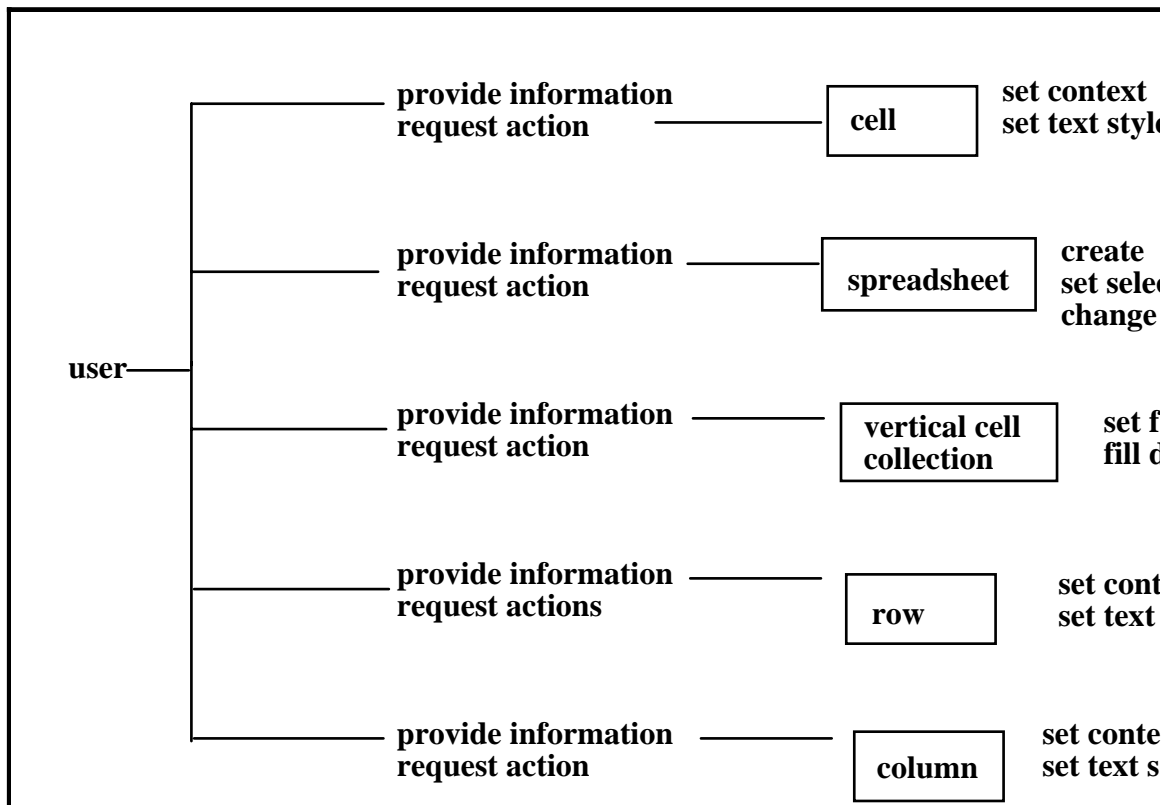
set text style to bold	modification.1.example
resize height	"

contracted services objects services

card trace _____

OBJECT BEHAVIOR ANALYSIS

CONTRACTUAL RELATIONSHIPS



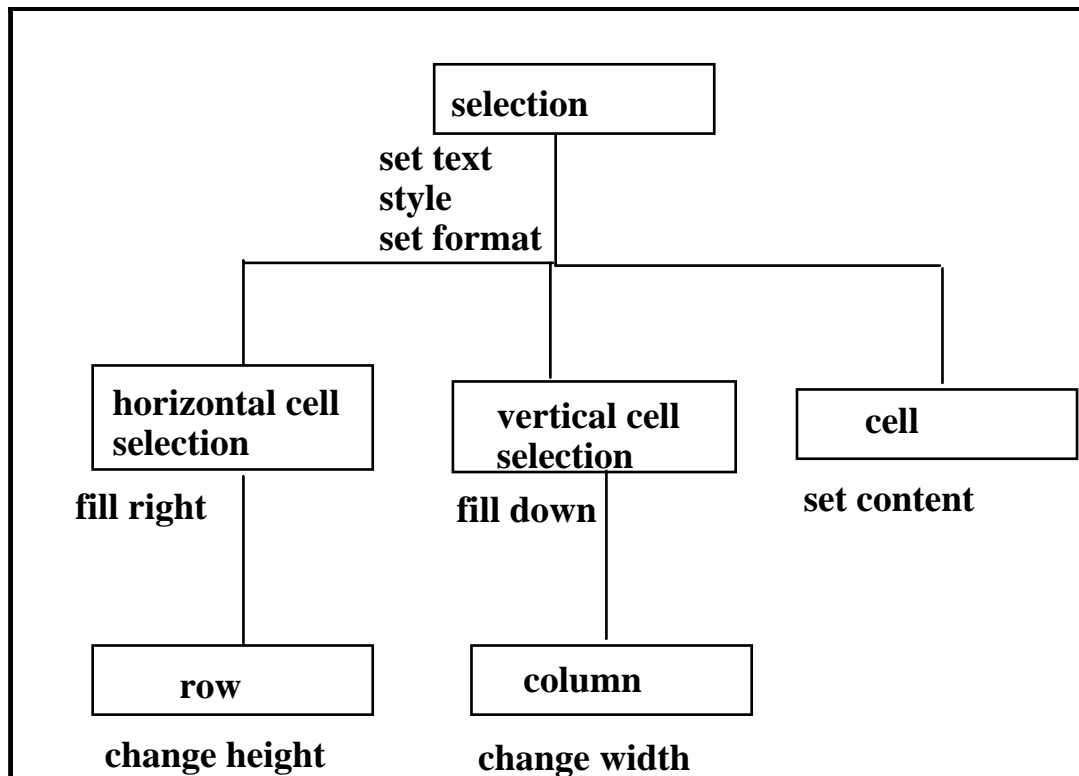
OBJECT BEHAVIOR ANALYSIS

Summary of Object Re-organizations

ID	Inputs	Outputs	Traces	Type of Technique
1	column, ver 1 vertical cell collection, ver 1	column, ver 2 vertical cell collection, ver 1	column is a kind of vertical cell collection	specialization
2	row, ver 1	row, ver 2 horizontal cell collection, ver 2	row is a kind of horizontal cell collection	specialization
3	cell, ver 1 vertical cell collection, ver 2 horizontal cell collection, ver 2	selection, ver 1 cell, ver2 vertical cell collection, ver 2 horizontal cell collection, ver 2	selection holds common services for cell or cell collection	abstraction

OBJECT BEHAVIOR ANALYSIS

ORGANIZATIONAL RELATIONSHIP DIAGRAM



Object Behavior Analysis

Definition of State Models

Definition of Object States

**Pre- and Post Conditions of Scripts
define states**

**Recall that Scripts may be hierarchically defined.
State definitions are typically iteratively
derived.**

**A script with multiple actions associated
with a pre-condition/post-condition pair
is decomposed into several subscripts
each of which has an associated pre- and
post-condition.**

Definition of State Changing Events

**Action sequences in scripts or subscripts
define the occurrence of events.**

Choice of Event Sequence

**A script selects one of many possible sequences
which can can a transition among a given
pre-condition:post-condition pair.**

**This issue is not covered in this paper but is
not important for the use to which we will put
OBA.**

OBJECT BEHAVIOR ANALYSIS

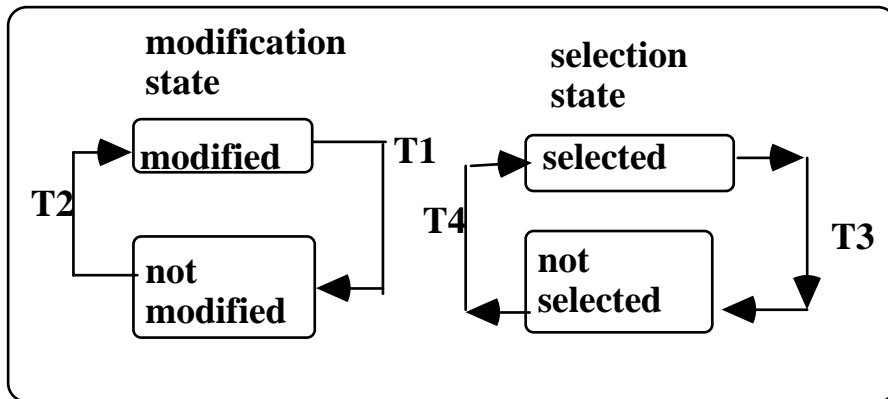
State Models

Define States

Attributes and Events - from partitioning of scripts

Domains of attributes - from pre- and post- conditions of scripts.

Harel Statechart for spreadsheet



T1 - all scripts whose postconditions contain a clause of the form "not modified."

T2 - all scripts whose postconditions contain a clause of the form "modified."

T3 - all scripts whose postconditions contain a clause of the form "not selected."

T4 - all scripts whose postconditions contain a clause of the form "selected."

OBJECT BEHAVIOR ANALYSIS

State Definition Glossary

STATE	DEFINITION	DESCRIPTION	TRACES
has selection	create selection not equal to nil	used to indicate when a selection has been made	modification.9.example
modified	for all cells there exists at least one cell which has been modified	used to indicate that some aspect of the spreadsheet has been modified since the last save	modification.9.example

OBJECT BEHAVIOR ANALYSIS

Evaluation of OBA

Strengths

unified approach - everything derived from scripts

good traceability

well-defined work products

Weaknesses

**weak approach to information modeling
may fail on information rich applications**

excessive emphasis on services

when is a set of scripts "complete?"