Scenario 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

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

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

Scenario 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

Scenario 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.

Scenario 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

Scenario 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

Scenario Analysis

A simple spreadsheet - script example

Script Name Modification.1.example

Precondition spreadsheet exists and displayed

Postcondition modified spreadsheet exists

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
user	type number 55000	B3	set content to number

Scenario Analysis

Scripts may have a hierarchical structure.
Notice Pattern in spreadsheet script.

Select
Operation
Select
Operation

We should associate a pre-condition and a post-condition with each
Select
Operation
pair if the effect of the operation is significant.

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

Specification of Preconditions for Operations

Initiator	precondition	action	participant	service
user	selection exists	type text NEW	D1	set content to text
user	text exists	set type style to bold	D1	set text type style to bold

Scenario 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
......	....	......	.....

Scenario 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

Scenario 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	"

Scenario Analysis

ATTRIBUTE GLOSSARY - ROW

NAME	DEFINITION	CONTRACT	ACCESSOR	MUTATOR	RANGE OF VALUES	STATE DEFINITION
height	height of the row in number of pixels	none	none	resize the row height	integer	no
format	interpretation of the contents	none	none	none	$xx.xx	no
style	presentation of contents	none	none	set style	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
state-definition	is the attribute used to define states of the party

Scenario Analysis

Defining objects from scripts

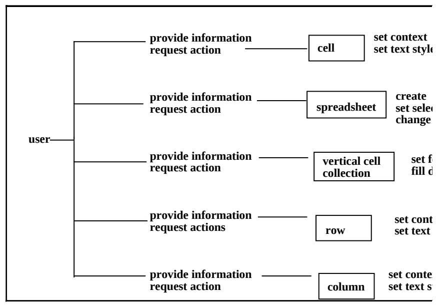
Identify participants - use parties glossaries

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

Row
height format style
setStyle() setFormat() setHeight()

OBJECT BEHAVIOR ANALYSIS

CONTRACTUAL RELATIONSHIPS

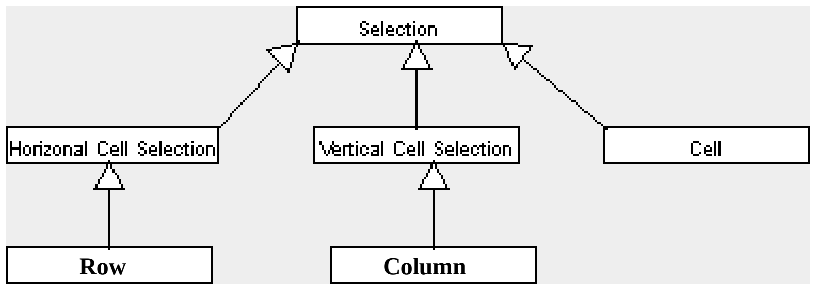


Structure objects through specialization, abstraction and factorization
Factorization - objects with multiple responsibilities

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

Inheritance Hierarchical for Spreadsheet



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 Scenario Analysis.

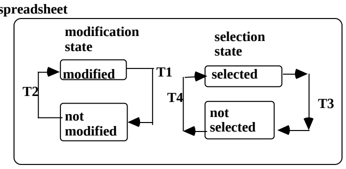
OBJECT BEHAVIOR ANALYSIS

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."

Scenario 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

Scenario Analysis

Complements Lexical Analysis

Identifies operations/methods

Identifies states and state transitions