Animation Tool for ZOOM-S Notation

Howard Dittmer
SE690/696 Initial Presentation
May 30, 2003
What is ZOOM?

- ZOOM stands for Z-based Object Oriented Modeling notation
- ZOOM includes notations for the 3 Phases of OO Development
  - Specification - ZOOM-S
  - Design - ZOOM-D
  - Implementation - ZOOM-I/Java or ZOOM-I/C++
- ZOOM provides a consistent language syntax for all aspects of OO Development
Why ZOOM?

- Existing notations and methods lack consistency and cohesion
  - “Z” / UML / Java

- Existing notations provide loose ties between phase of development process
  - “Z” - coding syntax based on LaTeX is not intuitive
  - UML - primarily graphical format

- ZOOM provides Java based coding syntax with strong linkage between development phases
ZOOM Provides Cohesion Between Development Phases

An overview of the ZOOM notation from “An Introduction to ZOOM” by Xiaoping Jia
ZOOM-S Makes Formal Method Notation Easier to Develop

- ZOOM-S is based on Java Syntax
  - Syntax programmers are already familiar with
  - Less like higher math / more like code
- ZOOM-S is easier for developer to create
  - Code directly in ZOOM-S syntax
  - “Z” specification are coded in LaTeX based format
Z = Easy to Understand
But Hard to Write

"Z" native format

\[ \text{Title, Person} \]

<table>
<thead>
<tr>
<th>size : ( \mathbb{N} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>size = 6</td>
</tr>
</tbody>
</table>

\( \text{MDBResponse ::= movie\_added} \)
\( \quad | \quad \text{movie\_already\_in\_db} \)

\( \text{MovieDB} \)

\begin{array}{l}
\text{movies : } \mathcal{P} \text{ Title} \\
\text{people : } \mathcal{P} \text{ Person} \\
\text{director : Title } \rightarrow \text{ Person} \\
\end{array}

\begin{enumerate}
\item movies = dom director \\
\item ran director \subseteq people
\end{enumerate}
ZOOM-S Replaces Mathematical Syntax of Z With Java-like

*“Z” native format*

```
[Title, Person]

| size : N
| size = 6

MDBResponse ::= movie_added | movie_already_in_db

MovieDB

movies : P Title
people : P Person
director : Title \rightarrow Person

movies = dom director
ran director \subseteq people
```

*ZOOM native format*

```
module examples.movie2;
type Title, Person;
const int size = 6;

enum MDBResponse { movie_added, movie_already_in_db }

struct MovieDB {
    Set[Title] movies;
    Set[Person] people;
    Person[Title] director;
    invariant {
        dom(director) == movies;
        ran(director) in people;
    }
    init{
        movies == {};
        people == {};
    }
}
Why Animate ZOOM Specifications?

- Validate specification through animating
  - “… method is systematic and fully automated, and represents a significant improvement over manual safety validation processes”
    (Safety Validation of Embedded Control Software using Z Animation, Atchison & Lindsay, 2000)

- Teaching aid for Formal Methods
  - “… may errors in Z specifications can be discovered and eliminated by the students themselves…”
    (Experience Teaching Z with Tool and Web Support, ACM SIGSOFT, Bowen, 2001)

- Develop understanding of System Behavior
  - “Animation has been used as an aid to validation…”
    (Logical Animation, Costa, Cunningham and Booth, 1990)
  - “…animation can be very effective at detecting problems with the specification…”
    (Verifying Model Oriented Specifications through Animation, Kazmierczak, Winikoff and Dart)
Animation Tool Developed to Support ZOOM System of Tools

- ZOOM-D Tools
- ZOOM-I Tools
- Core Animation Objects
- Command Line UI
- Swing Based UI
- Other UIs
- Other ZOOM Tools
Core Animation Objects Role

- Actions/Inputs
- Specification
- ZOOM-S Specification
- Core Animation Objects
- Current State Info
- Specification Checking Results
- New State Info
# ZOOM-S Animation Tool Development Schedule

<table>
<thead>
<tr>
<th>Activity Name</th>
<th>Start Date</th>
<th>Finish Date</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1 - Project identification and planning...</td>
<td>1/1/03</td>
<td>5/29/03</td>
<td></td>
</tr>
<tr>
<td>Initial Presentation</td>
<td>5/30/03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 2 - Initial review of ZOOM-S syntax...</td>
<td>4/7/03</td>
<td>7/14/03</td>
<td></td>
</tr>
<tr>
<td>Phase 3 - Animation tool requirements definition...</td>
<td>4/28/03</td>
<td>7/11/03</td>
<td></td>
</tr>
<tr>
<td>Phase 4 - Animation tool design...</td>
<td>6/23/03</td>
<td>8/1/03</td>
<td></td>
</tr>
<tr>
<td>Phase 5 - Implement animation tool core objects...</td>
<td>8/4/03</td>
<td>9/19/03</td>
<td></td>
</tr>
<tr>
<td>Midpoint presentation</td>
<td>9/12/03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 6 - Implement animation tool initial UI</td>
<td>9/22/03</td>
<td>10/24/03</td>
<td></td>
</tr>
<tr>
<td>Phase 7 - Tool evaluation</td>
<td>10/27/03</td>
<td>11/7/03</td>
<td></td>
</tr>
<tr>
<td>Phase 8 - Final Report...</td>
<td>11/3/03</td>
<td>11/14/03</td>
<td></td>
</tr>
<tr>
<td>Final presentation</td>
<td>11/14/03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>