An Approach for Interoperable and Customizable Web-based Mathematics Education

David Chiu
Department of Computer Science and Engineering
The Ohio State University

Paul S. Wang
Department of Computer Science
Kent State University
The Problem

- The Web contains much content suitable for math education
  - National Library of Virtual Manipulatives
  - Calc101
  - MathForum
  - ...

Problem 1:
Finding some content of interest and ones that could be incorporated into a lesson takes non-trivial time
Problem 2:
It is difficult for any teacher to incorporate these materials effectively into a lesson.

Why?
- Little interoperability between these components
- Lack of customization
What is WME?

- A distributed system for Web-based mathematics education
What is WME? (2)

1. WME Site (Model)
2. Download Install Configure
3. WME Site (Teachers and Classes Defined)
4. Organize any TMs, Customize any ALs, as needed
5. WME Site (Classroom Ready)
6. Initialize Localize
So What?

- WME offers classroom-ready lessons that abide national proficiency standards

- WME’s lesson modules and components are *searchable, reusable, interoperable*, and *customizable* among any other WME site
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Table of Contents

- Introduction and Overview
- The WME Approach
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WME Interoperability

- Goal: To make WME components “plug-and-play”

- 2-Step Approach:
  - Separation of Components
  - Define Connection Interface
WME Interoperability
Step 1: Separation of Components

- Exploit the hierarchical nature of these components to make them independent from each other
WME Interoperability
Step 1: Separation of Components
Step 2: Define Connection Interface

WME Interoperability

Every "separated" component contains an XML-based configuration file. Each configuration file exposes information relating to components so that the connecting counterpart understands its interface and allows it to work properly.
WME Interoperability
Step 2: Define Connection Interface

- Once the interface is understood, the WME site “installs” the component under the proper level in the hierarchy.

- The newly installed component becomes immediately available and usable.
WME Customization

- Goal: To allow intuitive methods for customizing/tailoring a WME site and all WME components

- 2 Levels of Customization:
  - School-wide Administration
  - Lesson Management
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Manipulative Customization

- Manipulation
- Instantiation
- Encapsulation

Object-Oriented Approach:
Manipulative Customization (2)

- **Encapsulation**: The manipulative’s object class is defined in a JavaScript file

- **Instantiation**: Deployed by object instantiation(s) into a web page via DOM

- **Manipulation**: Its behavior and appearance can be controlled by the set of parameters used to instantiate the object
Manipulative Customization (3)

- “A manipulative object class must be written in such a way that the designer anticipates which aspects can be customized”

- Parameters are passed to exploit these aspects the manipulative
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Manipulative Parameter Files

- Manipulative parameters defined per-class and per-teacher in MPXML

Active Lesson (AL)
Manipulative
Interface (Parameters Input)

MPXML $\rightarrow$ JavaScript Conversion

WME Database
Decide whose AL the Manipulative belongs to

Param File 0
Param File 1
Param File 2
...

These are MPXML files containing parameter values.
(One per teacher, per class)
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Summary

- WME is a distributed web-based system that specializes in mathematics education
- WME offers classroom-ready lesson content that can be customized
- Any component written to specifications is expected to interoperate with any WME system
Future Opportunities

- Other WME Projects
  - Interactive Geometry (GeoSVG)
  - Assessment Database (DMAD)
  - ...

- Other WME Advances
  - Further expansion and collaboration

**Ultimately, WME seeks to create a Web for Mathematics Education**
Questions/Comments?

- WME Project Site
  http://wme.cs.kent.edu

- WME contact list:
  wme@cs.kent.edu