Potential use of JAS/JAIDA etc.
SAS J2EE Review

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(standing in for Max Turri)

SLAC Java Tools Group
Outline

- Review of existing tools developed for GLAST
  - GLAST System Tests Interface
  - Enhanced System Tests
  - JAS3 System Test plugin

- Technologies used
  - AIDA/JAIDA/Java Root IO
  - AIDATLD
  - Statistical Testing
  - JAS3

- Other potential areas for collaboration
  - WIRED4
System Tests goals

- Compare the quality of new software releases
  - Check quality of software by comparing produced data against known distributions
  - Easily assess which distributions fail
  - Easy access of results to collaboration
- Evaluate performance of new hardware modules during production
Glast System Tests (Version 1)

- First version of System Tests to incorporate some of our code developed two years ago
  - still works and in use, although not actively maintained since we expected it to be rapidly replaced by something better.

- Uses combination of
  - .ASP scripts (developed by Richard and Karen)
  - Oracle database
  - Java Root IO for reading root files
  - Java servlet for plot display.

Glast System Tests (Version 2)

- Developed during this year
- Java solution
  - Mostly reusable technologies, very little Glast specific code
    - Java IO + xrootd for accessing root files
    - AIDA for plotting, data manipulation
    - Tag Libraries for inserting plots into web pages (AIDATLD)
    - Driven by XML configuration file
      - Currently hand maintained
      - Designed to be dynamically generated from Glast database via JSP page.
- Not yet in production
  - Waiting decision on how to integrate with Matt’s stuff
  - Advanced features (user customization etc.) likewise require tighter integration with Glast infrastructure
Glast System Tests (Version 2)

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GLAST J2EE Review
Glast System Tests JAS Plugin

- Designed to be complementary to web based system tests
  - Web based system =
    - zero install
    - limited interactive capabilities
  - JAS Plugin =
    - Prior installation required (but easy to do)
    - Much easier to add interactive features, and allow users to perform one-off exploratory analysis.
- Both systems share common infrastructure
  - Configuration from same XML file
  - Read data files from same location and same (xrootd technology)
  - Both use AIDA for plotting and data analysis
  - Large amount of shared code
Glast System Tests JAS Plugin

Statistical comparison of data/reference histogram using various algorithms
The table can be sorted by clicking on the column headers.
You can display a set of plots by selecting rows of the table and using the popup menu.
Use View, Preferences to control which tests are displayed
Comparison from Tracker, recursive = false

<table>
<thead>
<tr>
<th>Histogram Name</th>
<th>AndersonDarling</th>
<th>KolmogorovSmirnov</th>
<th>FiszCramervon</th>
<th>Tiku</th>
<th>chi2</th>
<th>Goodman</th>
</tr>
</thead>
<tbody>
<tr>
<td>TKRTRQUALI</td>
<td>0.99984</td>
<td>0.058847</td>
<td>0.93935</td>
<td>0.4913E-3</td>
<td>0.99919</td>
<td>0.070262</td>
</tr>
<tr>
<td>TKRTRKSTART</td>
<td>0.33921</td>
<td>0.91318</td>
<td>0.064515</td>
<td>0.77564</td>
<td>1.0000</td>
<td>0.74075</td>
</tr>
<tr>
<td>TKRHITPLANEZ</td>
<td>4.7526</td>
<td>8.6503E-3</td>
<td>157.43</td>
<td>0</td>
<td>0.99947</td>
<td>0.012355</td>
</tr>
<tr>
<td>ENERGYMC</td>
<td>0</td>
<td>1.0000</td>
<td>0</td>
<td>0</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>TKRTRKENER</td>
<td>0.35227</td>
<td>0.99202</td>
<td>0.39761</td>
<td>0.075701</td>
<td>1.0000</td>
<td>0.86158</td>
</tr>
</tbody>
</table>

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Technologies used
AIDA
Abstract Interfaces for Data Analysis

- A standard set of interfaces for data analysis
  - Histograms, Tuples, Functions, Fitter, Plotter, etc.
- CERN-LAL-SLAC collaboration
  - Each lab providing an implementation
    - 2 in C++, 1 in Java and 1 in Python
- http://aida.freehep.org
JAIDA – AIDA in Java

- Full implementation of the AIDA interfaces
- Distributed as Part of FreeHEP Java library:
  - [http://java.freehep.org](http://java.freehep.org)
- Easy to extend and customize using Service Architecture
  - New factories, plotter, fitters, functions etc. can be added easily

- Histograms, Tuples, …
- Functions
  - Runtime compilation of expressions using JEL (Java Expression Library)
- Fitting
  - Support for multiple fitting engines: UNCMIN, MINUIT, JMinuit
  - Support for multiple fitting methods:
    - Binned (LeastSquares, Chi2,BinnedMaximumLikelihood)
    - Unbinned
- Stores
  - Read/Write support for AIDA XML format
  - Read support for ASCII, HBOOK, Root files
- Plotter
  - For batch and interactive data analysis
  - Plots update in real time as they are filled
  - Easy to embed in any Java GUI or Web application
  - High quality graphics export formats: PDF, EPS, SVG, SWF, PNG, GIF, JPG, …
Java Root IO and JAIDA Plugin

Java Root IO
- Pure Java Package for reading Root files
  - Will be extended to writing later
- Access to Root Data, not to C++ code
- Java proxies are dynamically generated for each Root object read
  - Built as Java bytecode using BCEL ([http://jakarta.apache.org/bcel](http://jakarta.apache.org/bcel))
  - Converted at runtime to machine code by HotSpot VM
  - Robust against changes
  - Backwards compatible with older root versions
- High performance
  - Standard java.nio package for binary IO
- Network Root IO
  - Compatible with either rootd or xrootd servers

JAIDA Root IO Plugin
- Read Root files via the AIDA interfaces
- Root objects are available as AIDA objects
AIDATLD – AIDA Tag Library

- Sets of HTML-like tags to embed AIDA functionality in Java Server Pages
  - `<aida:tree>`, `<aida:plotter>`, `<aida:style>` etc.
- Allows web developers to insert “live” plots into web pages with no knowledge of Java etc.
- Plots and data can be made easily accessible to a collaboration quickly
- Works with Java Server Pages 2.0
- [http://aidatld.freehep.org](http://aidatld.freehep.org)
AIDATLD - Example

```html
<%@taglib prefix="aida" uri="http://java.freehep.org/jsp/aida" %>
<%@taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<html>
<head><title>Single plot of a histogram accessed via rootd</title></head>
<body>
    <c:set var="rootDataURI" value="root://rh92.slac.stanford.edu/demo.root" />
    <c:set var="histoPath" value="/h110" />
    <aida:plotter>
        <aida:region>
            <aida:plot dataSourceURI="${rootDataURI}"
                plotObjectPath="${histoPath}" />
        </aida:region>
    </aida:plotter>
</body>
</html>
```
Statistical Testing

- JAIDA extension to AIDA:
  - Tests statistical significance of datasets
  - Used to statistically compare the shape of data distributions
  - Extensible set of algorithms:
    - Anderson-Darling, Kolmogorov-Smirnov, Fisz-Cramer-Von Mises, Goodman, Kuiper, Tiku, Chi2
JAS3 – Java Analysis Tool

- Data Analysis System
- Modular, Extensible, Data Format Independent
- Based on FreeHEP Application shell
- Analysis based on JAIDA
- Powerful GUI
- Editor for (Java) code
- Support scripting (Python, Pnuts, …)
Experiment independent
HepRep Event Display

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GLAST J2EE Review
Future Collaboration with GLAST

- Our group has:
  - Large amount of Java experience (including some J2EE)
  - Is charged with supporting experiments such as GLAST

- Particularly interested in projects where we can develop experiment independent tools which can be used by GLAST and others, e.g.
  - Complete Systems tests interface
    - with clean integration into GLAST J2EE infrastructures
  - Data Analysis and Data Visualization (AIDA, JAS3, WIRED4)
  - Distributed Data Analysis
  - Generic Distributed task scheduler
References

- GLAST System Tests

- AIDA
  - http://aida.freehep.org

- JAIDA

- Java Root IO

- AIDATLD
  - http://aidatld.freehep.org/

- Statistical Testing
  - http://java.freehep.org/jaida/v3.2.4/StatisticalComparison.html

- JAS3
  - http://jas.freehep.org/jas3

- WIRED4
  - http://wired.freehep.org

- Freehep Java Library
  - http://java.freehep.org/