JHOVE2

UC Curation Center CDL California Digital Library

PORTICO

Stanford University LIBRARIES & ACADEMIC INFORMATION RESOURCES

DLF Forum, Palo Alto, November 1-3 2010

JHOVE2 Next-Generation Characterization A Project Update

JHOVE2 Project Team

California Digital Library, Portico, Stanford University

Agenda

Introduction and concepts

Demonstration

Architecture and APIs

Assessment

Sustaining the JHOVE2 open source community

Discussion

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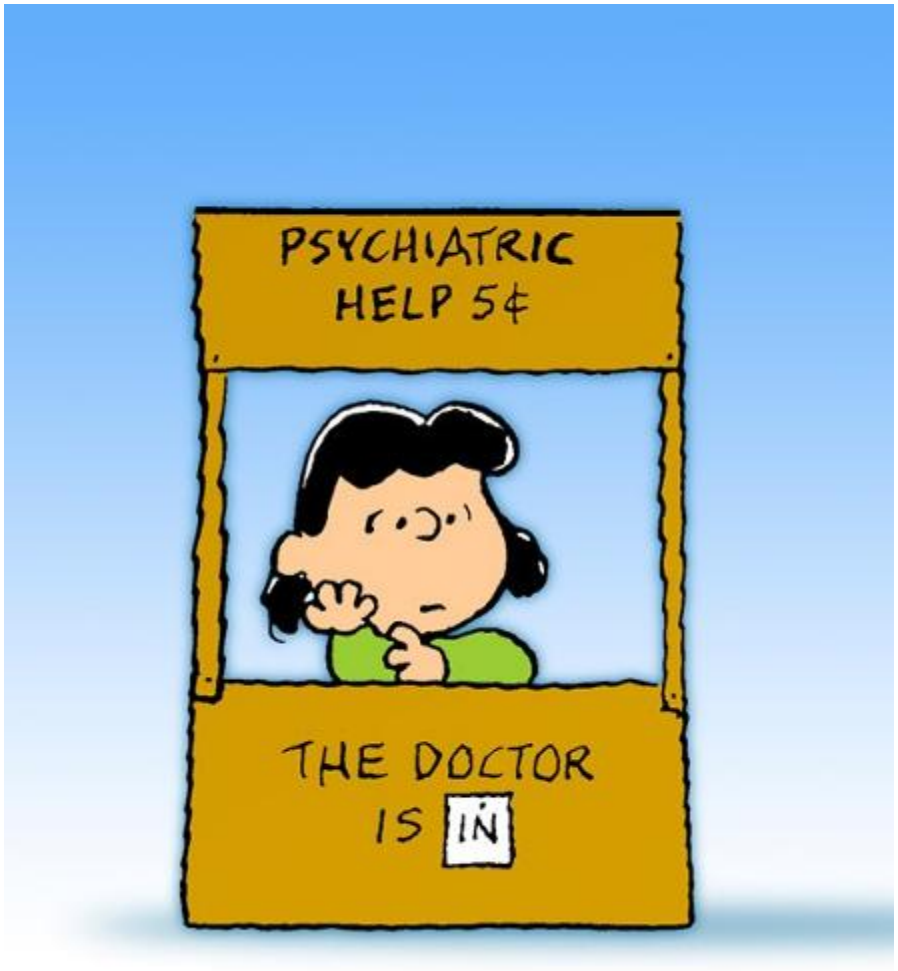
"Tell me about yourself…"



"What? So what?"

Characterization is the automated determination of the intrinsic and extrinsic properties of a formatted object

- Identification
- Feature extraction
- Validation
- Assessment





"We report, you decide…"

JHOVE2 feature set

Multi-stage processing

- Signature-based identification 
  - ✓ DROID
    http://droid.sourceforge.net/
- Feature extraction 
- Validation 
- Message digesting 
  - ✓ Adler-32, CRC-32, MD2, MD5, SHA-1, SHA-256, SHA-384, SHA-512
- Rules-based assessment 

JHOVE2 feature set

Processing of objects spanning files and objects that are subsets of files

Recursive processing of objects arbitrarily-nested within containers

Granular modularization with generic plug-ins

Clean APIs and common module design patterns

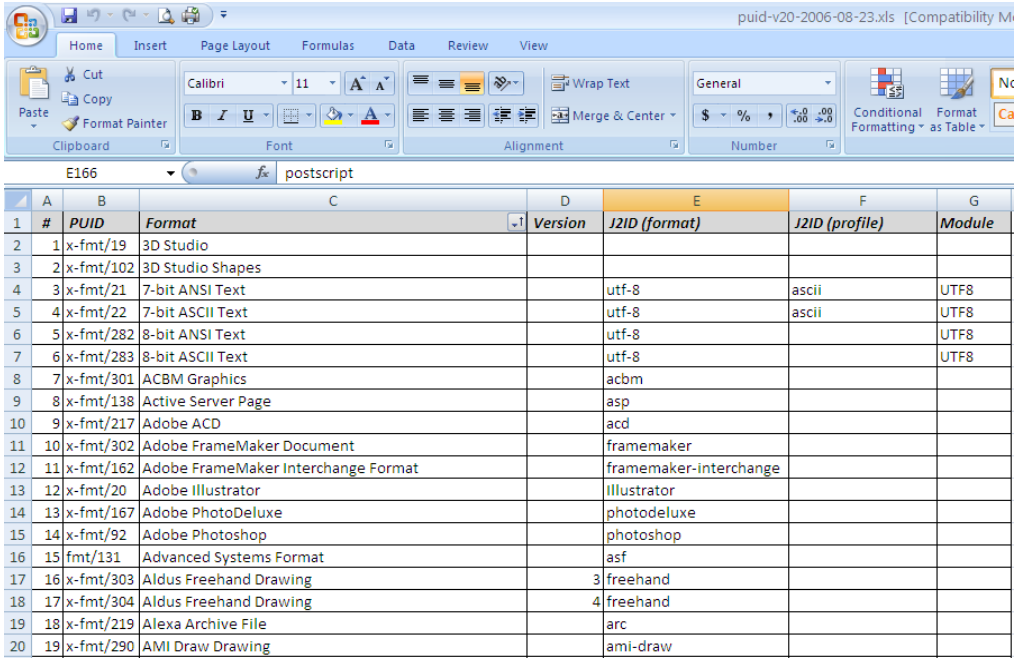
Buffered I/O

Internationalized output Je ne sais quoi !

Supported formats

JHOVE2 can identify (by DROID) many more formats than it can validate (by modules)

- PRONOM registry documents over 550 formats; approx. 220 with signatures http://www.nationalarchives.gov.uk/PRONOM



	A	B	C	D	E	F	G
1	#	PUID	Format	Version	J2ID (format)	J2ID (profile)	Module
2	1	x-fmt/19	3D Studio				
3	2	x-fmt/102	3D Studio Shapes				
4	3	x-fmt/21	7-bit ANSI Text		utf-8	ascii	UTF8
5	4	x-fmt/22	7-bit ASCII Text		utf-8	ascii	UTF8
6	5	x-fmt/282	8-bit ANSI Text		utf-8		UTF8
7	6	x-fmt/283	8-bit ASCII Text		utf-8		UTF8
8	7	x-fmt/301	ACBM Graphics		acbm		
9	8	x-fmt/138	Active Server Page		asp		
10	9	x-fmt/217	Adobe ACD		acd		
11	10	x-fmt/302	Adobe FrameMaker Document		framemaker		
12	11	x-fmt/162	Adobe FrameMaker Interchange Format		framemaker-interchange		
13	12	x-fmt/20	Adobe Illustrator		Illustrator		
14	13	x-fmt/167	Adobe PhotoDeluxe		photodeluxe		
15	14	x-fmt/92	Adobe Photoshop		photoshop		
16	15	fmt/131	Advanced Systems Format		asf		
17	16	x-fmt/303	Aldus Freehand Drawing	3	freehand		
18	17	x-fmt/304	Aldus Freehand Drawing	4	freehand		
19	18	x-fmt/219	Alexa Archive File		arc		
20	19	x-fmt/290	AMI Draw Drawing		ami-draw		

Supported formats

ICC color profile	(ICC.1:2004-10)
JPEG 2000	JP2 (ISO/IEC 15444-1), JPX (ISO/IEC 15444-2)
PDF	PDF 1.0 – 1.7, ISO 3200-1, PDF/A-1 (ISO 19005-1), PDF/X-1 (ISO 15920-1), -1a (ISO 15930-4), -2 (ISO 15930-5) -3 (ISO 15930-6)
SGML	
Shapefile	Main, Index, dBASE, …
TIFF	TIFF 4 – 6, Class B, F, G, P, R, Y, TIFF/EP (ISO 12234-2), TIFF/IT (ISO 12639), GeoTIFF, Exif (JEITA CP-3451), DNG
UTF-8	ASCII (ANSI X3.4)
WAVE	BWF (EBU N22-1997)
XML	
Zip	

Supported formats

netCDF

http://www.unidata.ucar.edu/software/netcdf

Grib

http://www.wmo.int/pages/prog/www/WDM/Guides/Guide-binary-2.html

- Developed by the Wegener Institute (Germany)
  http://www.awi-potsdam.de
- Widely used for meteorological data

(Un)supported formats

AIFF

GIF

HTML

JPEG

- HTML can be expressed in terms of SGML or XML
- We're investigating funding options for subsequent development of GIF and JPEG modules

Source units

A formatted object about which characterization information can be meaningfully reported

- Unitary
  - ✓ File — e.g. TIFF
  - ✓ File inside of a container — e.g. TIFF inside a Zip
  - ✓ Byte stream inside a file — e.g. ICC inside a TIFF
- Aggregate
  - ✓ Directory
  - ✓ Directory inside of a container
  - ✓ Clump — e.g. Shapefile
  - ✓ File set — e.g. command line arguments

For purposes of characterization, directories, file sets, and clumps are considered formats

Properties and reportables

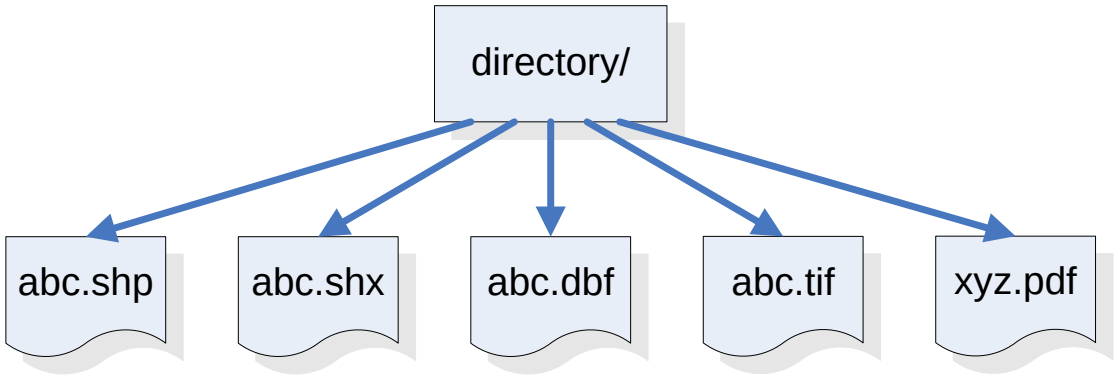
A *property* is a named, typed value

- Name (based on the terminology of the underlying format)
- Unique formal identifier
- Data type
  - ✓ Scalar or collection
  - ✓ Java types, JHOVE2 primitive types, or JHOVE2 *reportables*
- Typed value
- Description of correct semantic interpretation

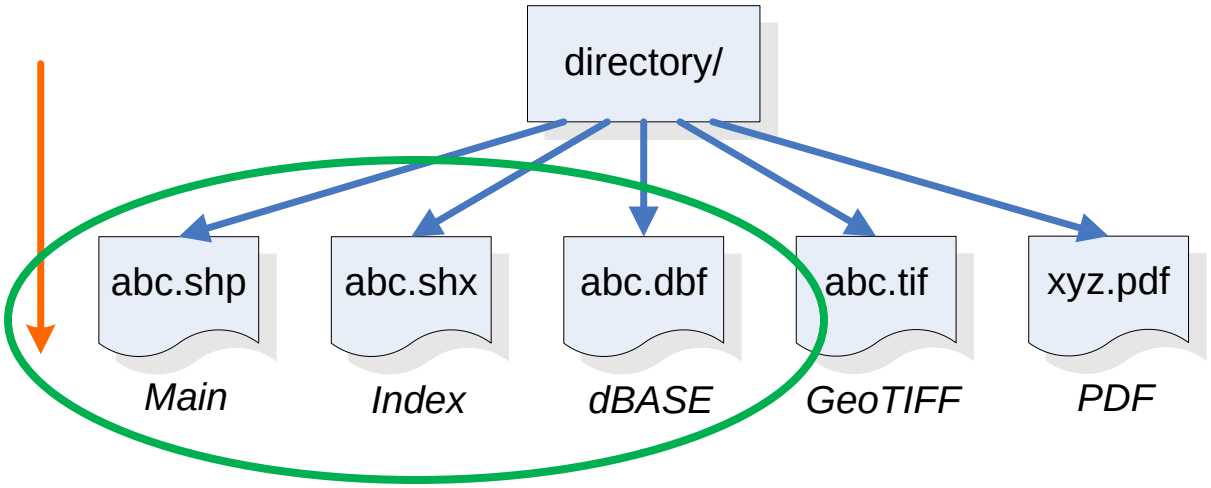
A *reportable* is a named set of properties

- Reportables correspond to Java *classes*
- Properties correspond to *fields*

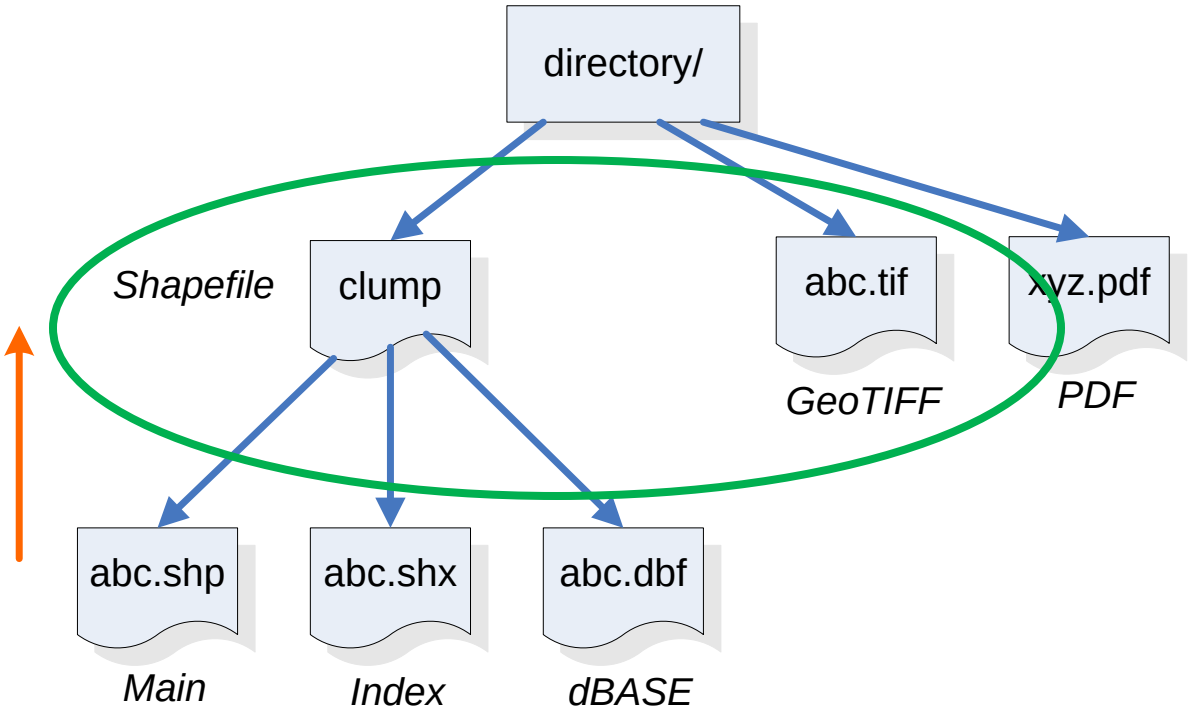
Characterization strategy



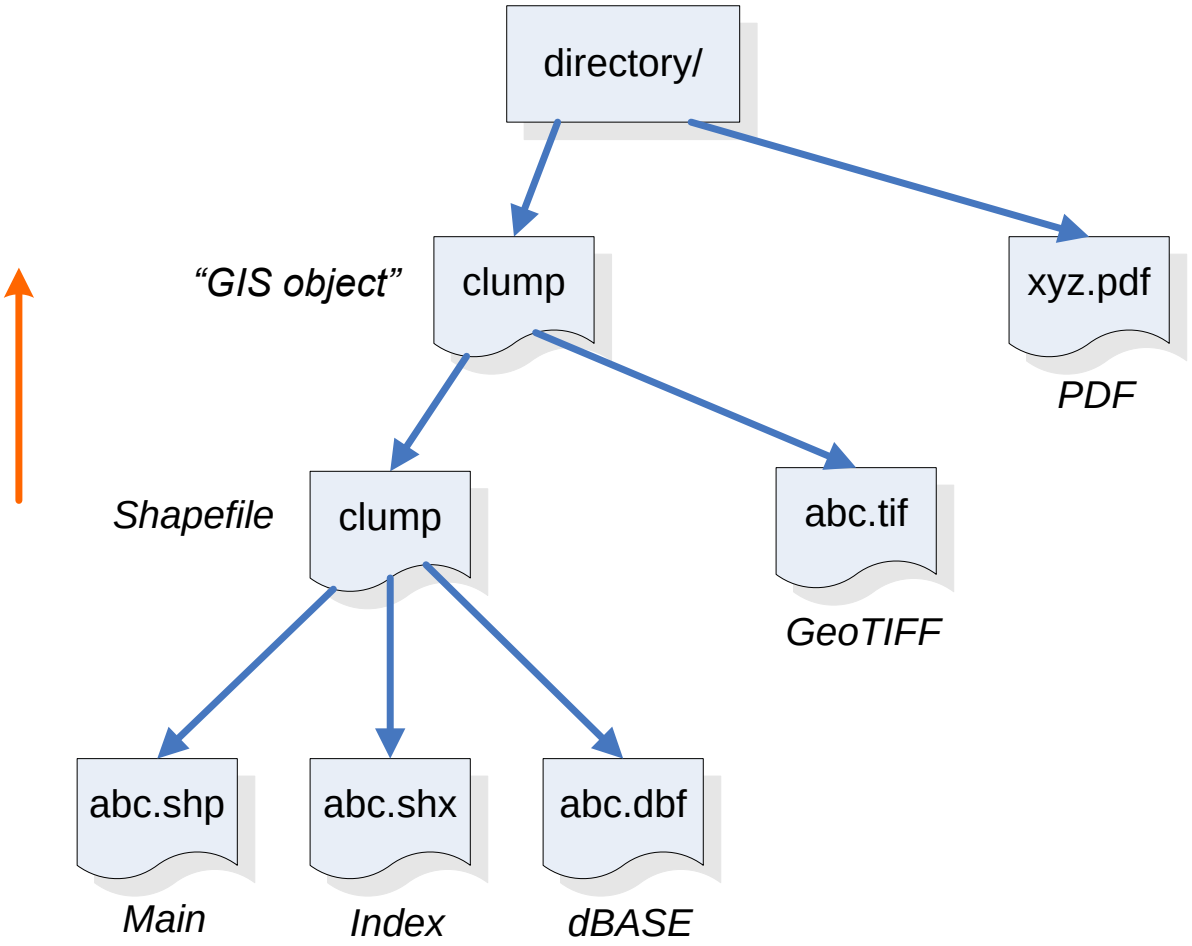
Characterization strategy



Characterization strategy



Characterization strategy



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API design idioms

Separation of concerns

- Annotation and reflection
  confluence.ucop.edu/display/JHOVE2Info/Background+Papers

Inversion of control (IOC) / dependency injection

- Martin Fowler
  martinfowler.com/articles/injection.html
- Spring framework
  www.springsource.org/

Separation of concerns

"Let POJOs be POJOs"

- Focus on modeling the format itself

"Let the code write itself"

- Reportables "know" how to expose their properties for display
- Reference documentation generated from the code
  - ✓ JHOVE2Doc application

```
Reportable: Name: UTF8Module
        Identifier: [JHOVE2]
          http://jhove2.org/terms/reportable/org/jhove2/module/format/utf8/UTF8Module
          Package: org.jhove2.module.format.utf8
From: Class UTF8Module
 Property: Name: NumCharacters
           Identifier: [JHOVE2]
http://jhove2.org/terms/property/org/jhove2/module/format/utf8/UTF8Module/NumCharacters
           Type: long
           Description: Number of UTF-8 characters
```

Annotation and Reflection: Reportable properties

Each reportable property is represented by a field and accessor and mutator methods

The accessor method *must* be marked with the @ReportableProperty annotation

```
public class MyReportable
  implements Reportable
{
  protected String myProperty;

  @ReportableProperty(order=1, desc="description", ref="reference")
  public String getMyProperty() {
    return this.myProperty;
  }
  public void setMyProperty(String property) {
    this.myProperty = property;
  }
}
```

Displayer directives

jhove2/src/main/resources/properties/
displayer.properties

```
<property-identifier>                                          <directive>

http\://jhove2.org/terms/property/org/jhove2/module/Agent      Never
http\://jhove2/property/.../DirectorySource/isExtant           IfFalse
...
```

- Always (*default*)
- IfTrue
- IfNegative
- IfPositive
- IfZero
- Never
- IfFalse
- IfNonNegative
- IfNonPositive
- IfNonZero

Results

JSON

```
"Path": "C:\\shapefiles"
```

Text

```
Path: C:\shapefiles
```

XML

```
<j2:feature name="Path"
            fid="http://jhove2.org/terms/property/org/
                 jhove2/core/source/DirectorySource/Path
fidns="JHOVE2">
  <j2:value>C:\shapefiles</j2:value>
<j2:feature>
```

- Intended as an intermediate form suitable for stylesheet transform to any desired final form (Transform to Mets provided)

Format Modules: Reflection as Facade

- Format module “from scratch” (TIFF, UTF-8, WAV)
- Format module as façade over Java tool (XML, Shapefile)
- Format module as façade over non-Java tool (SGML)

Dependency injection

All JHOVE2 function is embodied in pluggable modules

- Flexible customization
  - ✓ Re-sequencing of pre-existing modules
- Easy extensibility
  - ✓ Additional format modules and profiles
  - ✓ Additional aggregate identifiers
  - ✓ Additional displayers
  - ✓ New behaviors

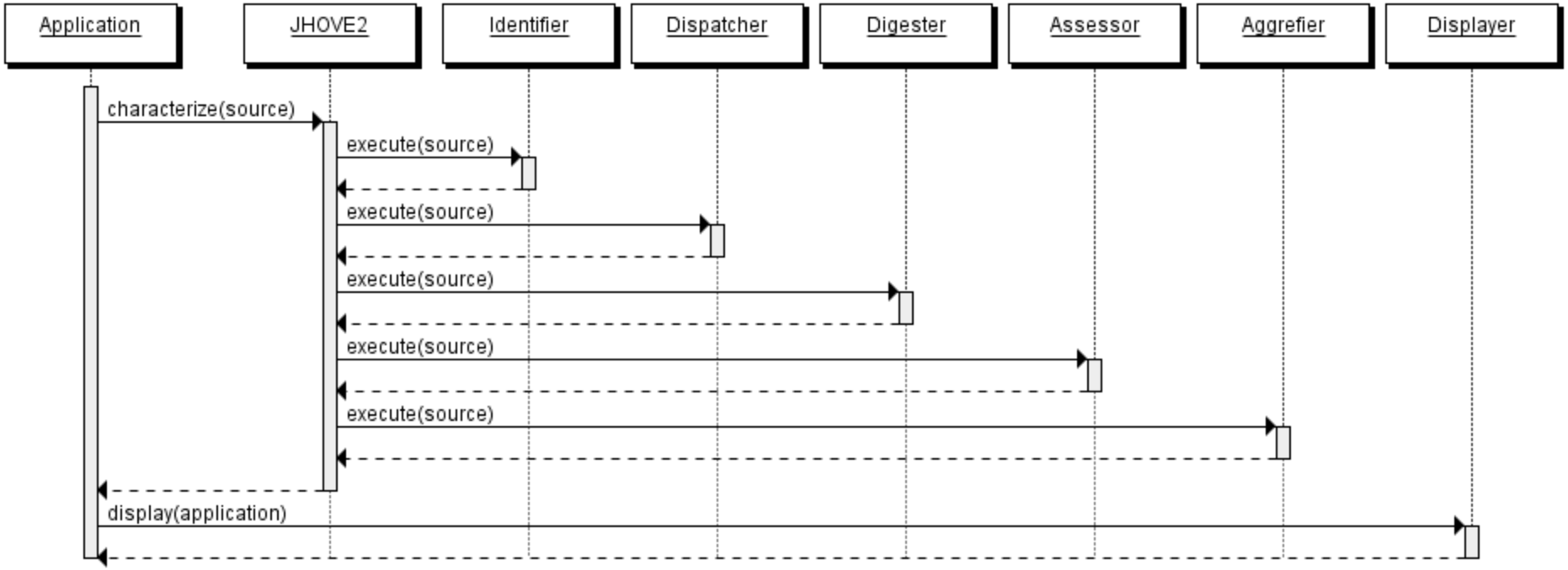
RenderabilityModule

JHOVE2 framework

Embodiment of a characterization strategy as a configurable sequence of command-invoked modules

```
public void characterize(Source source, Input input)
    throws IOException, JHOVE2Exception
{
    source.getTimerInfo().setStartTime();
/* Update summary counts of source units, by type. */
    this.sourceCounter.incrementSourceCounter(source);
    for (Command command : this.commands){
      TimerInfo time2 = command.getTimerInfo();
      time2.resetStartTime();
      try {
        command.execute(this, source, input);
      }
      finally {
        time2.setEndTime();
      }
    }    source.getTimerInfo().setEndTime();
}
```

Characterization



Key Interfaces

- Reportable
- Command
- Module
  - Identifier
  - FormatModule
  - Aggrefier
  - Digester
  - Assessor
  - Displayer

Spring configuration: Identification

```
<!-- Identifier module bean -->
<bean id="Identifier" class="org.jhove2.module.identify.IdentifierModule"
      scope="prototype">
     <property name="developers">
          <list value-type="org.jhove2.core.Agent">
               <ref bean="CDLAgent"/>
               <ref bean="PorticoAgent"/>
               <ref bean="StanfordAgent"/>
          </list>
     </property>
     <property name="fileSourceIdentifier" ref="droidIdentifier"/>
</bean>

<!-- DROID identifier bean -->
<bean id="droidIdentifier" class="org.jhove2.module.identify.DroidIdentifier"
      scope="prototype">
     <property name="developers">
          <list value-type="org.jhove2.core.Agent">
               <ref bean="CDLAgent"/>
               <ref bean="PorticoAgent"/>
               <ref bean="StanfordAgent"/>
          </list>
     </property>
     <property name="configFilePath"  ref="droidConfigFilePath"/>
     <property name="sigFilePath" ref="droidSigFilePath" />
</bean>
```

Spring configuration: Identification

```
<!-- Identifier module bean -->
<bean id="Identifier" class="org.jhove2.module.identify.IdentifierModule"
      scope="prototype">
     <property name="developers">
          <list value-type="org.jhove2.core.Agent">
               <ref bean="CDLAgent"/>
               <ref bean="PorticoAgent"/>
               <ref bean="StanfordAgent"/>
          </list>
     </property>
     <property name="fileSourceIdentifier" ref=" bsdIdentifier "/>
</bean>

<!- MYINSTITUION BSD-FILE-Based identifier bean -->
<bean id="bsdIdentifier" class="org.myinstitution.identify.BsdFileIdentifier"
      scope="prototype">
     <property name="developers">
          <list value-type="org.jhove2.core.Agent">
               <ref bean="MYINSTITUTIONAGENT"/>
          </list>
     </property>
     <property name="runtimepath"  ref="bsdFileRuntimePath"/>
</bean>
```

Documentation

http://www.jhove2.org/

Installation and Configuration

- JHOVE2 User's Guide

Technical information

- Architecture Document
- Format Module Specifications
- How to Write a Format Module

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Assessment

Evaluation of prior characterization information relative to local policy

Assessment results can inform preservation decision making

- Determine level of risk
- Assign level of service
- Take action now or later

Assessment rules

Assertions whose terms are logical expressions based on prior characterization properties

- Presence/absence of a property
- Constraints on property values
- Combinations of properties/values

The evaluation of the assertion results in new characterization properties

- Custom metadata that has significance in a local context

Assessment implementation

Each format module has a default rule set

Rules are configured using ARules

- Utility developed by CDL to create rule set in XML
- Future plans: a GUI

Predicates (conditions) are evaluated using MVEL

- http://mvel.codehaus.org/

Assessment rules

Logical expressions of the form:

If *condition* then *consequent* else *alternative*

- A condition is defined by either a universal or existential qualifier

  ∀ “for all”
  ∃ “for any”
  ¬ “not any”

  and an arbitrary set of predicates (logical assertions) of the form

  property relation value

- Supported relational operators

== != < > =< => contains exists

Assessment rule

JPEG 2000 example (*pseudo-code*)

```
If ALL_OF
    validity == true;
    exists(colourBox);
    exists(resolutionBox.capture)
Then
    Acceptable
Else
    Not acceptable
End If
```

Assessment rule

TIFF example

```
If ANY_OF
    validity == true ;
    ((ifh.messages contains
                    'offsetNotByteAligned') or
     (ifd.messages contains
                    'offsetNotByteAligned') or
     (ifd.messages contains
                    'dateNotWellFormed'))
Then
    Acceptable
Else
    Not acceptable
End If
```

Assessment rule

WAVE example

```
If ALL_OF
    validity == true ;
    exists(broadcastWaveExtensionChunk) ;
    waveFormatChunk.nSamplesPerSec == 96000 ;
    waveFormatChunk.nBitsPerSample == 24
Then
    Acceptable
Else
    Not acceptable
End If
```

Assessment rule

XML example

```
If ANY_OF
     validity   == true ;
    (validity   == undetermined) and
    (wellFormed == true)
Then
    Acceptable
Else
    Not acceptable
End If
```

ARules configuration

```
ruleset XmlRuleSet enabled org.jhove2.module.format.xml.XmlModule
desc Ruleset for XML module

rule XmlStandaloneRule enabled
desc Does XML Declaration specify standalone status?
cons Is Standalone
alt Is Not Standalone
quant all
pred xmlDeclaration.standalone == "yes"

rule XmlAcceptableRule enabled
desc Is the XML status acceptable?
cons Acceptable
alt Not Acceptable
quant any
pred valid.name() == "True"
pred (valid.name() == "Undetermined")
    && (wellFormed.name() == "True")
```

ARules utility output

```
<!-- RuleSet bean for the XmlModule -->
<bean id="XmlRuleSet" class="org.jhove2.module.assess.RuleSet"
            scope="singleton">
     <property name="name" value="XmlRuleSet"/>
     <property name="description"
            value="RuleSet for Xml Module"/>
     <property name="objectFilter"
            value="org.jhove2.module.format.xml.XmlModule"/>
    <property name="rules">
      <list value-type="org.jhove2.module.assess.Rule">
            <ref local="XmlStandaloneRule"/>
            <ref local="XmlValidityRule"/>
      </list>
    </property>
    <property name="enabled" value="true"/>
</bean>
```

ARules utility output

```
<!-- Rule bean for evaluating validity value -->
<bean id="XmlValidityRule"
        class="org.jhove2.module.assess.Rule" scope="singleton">
    <property name="name" value="XmlValidityRule"/>
    <property name="description"
        value="Is the XML validity status acceptable?"/>
    <property name="consequent" value="Acceptable"/>
    <property name="alternative" value="Not Acceptable"/>
    <property name="quantifier" value="ANY_OF"/>
    <property name="predicates">
      <list value-type="java.lang.String">
        <value><![CDATA[( >valid.toString() == 'true‘]]</value>
        <value><![CDATA[(valid.toString() == 'undetermined') &&
        (wellFormed.toString() == 'true')]]></value>
    </list>
    </property>
    <property name="enabled" value="true"/>
</bean>
```

JHOVE2 Assessment Output

Module {AssessmentModule}:
AssessmentResultSets:
AssessmentResultSet:
RuleSetName: XmlRuleSet
RuleSetDescription: Ruleset for XML module
ObjectFilter: org.jhove2.module.format.xml.XmlModule
BooleanResult: false
AssessmentResults:
AssessmentResult:
RuleName: XmlStandaloneRule
RuleDescription: Does XML Declaration specify standalone status?
BooleanResult: false
NarrativeResult: Is Not Standalone
AssessmentDetails: ALL_OF { xmlDeclaration.standalone == "yes" => false; }
AssessmentResult:
RuleName: XmlAcceptableRule
RuleDescription: Is the XML status acceptable?
BooleanResult: true
NarrativeResult: Acceptable
AssessmentDetails: ANY_OF { valid.name() == "True" => true;(valid.name() ==
"Undetermined") && (wellFormed.name() == "True") => false; }

Practical applications

Assessment has practical applications in

- Ingest workflows
- Migration workflows
- Digitization workflows
- Publishing workflows

It can be extended to build tools capable of more complex analyses

- Weighted scoring system
- “Institutional technology profiles”

Other Assessment Activities

- Archive Ingest and Handling Test
  Stanford University Libraries
- AONS II (Automated Obsolescence Notification System)
  National Library of Australia and APSR
- CIV (Configurable Image Validator)
  Library of Congress
- Institutional Technology Profiles
  National Library of New Zealand

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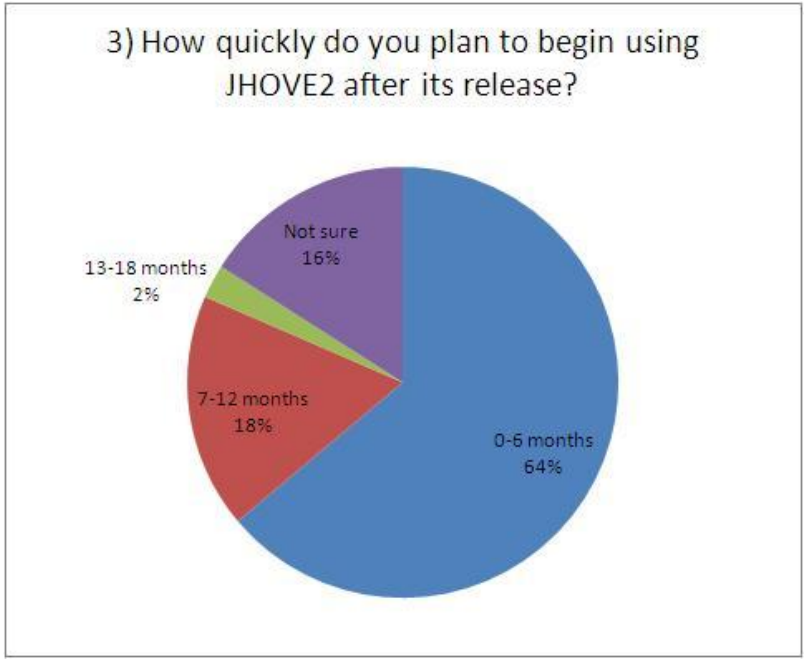
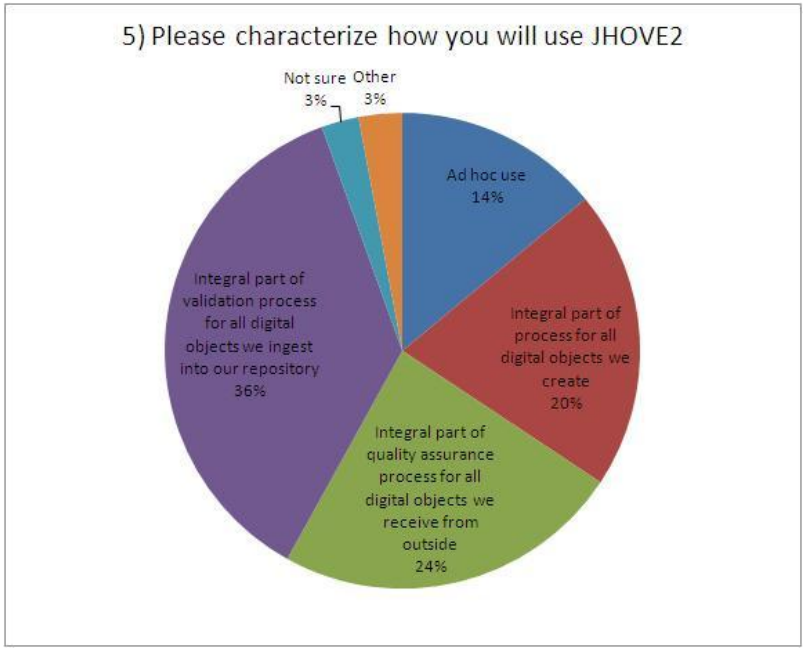
User survey

145 respondents, 88 institutions, 23 countries





Full results available at https://confluence.ucop.edu/display/JHOVE2Info/User+survey

Sustainability

Project partners will provide 3 years of self-funded maintenance (*but not development*)

- Support and maintain the core JHOVE2 code
- Provide training on integration and use
- Solicit and support 3rd party module development
- Solicit and support integration with other systems
- Grow a lightweight community structure to guide and foster JHOVE2 technical development

Define a long-term sustaining strategy

Community roles

Users	(read-only)
Contributors / Documenters	(read/submit)
Committers	(read/write/commit/release)
Sponsors	(fund/resource)
Steering group	(strategize/prioritize/incubate/outreach)
Educators	(support/train)

Workshops and training

Workshop possibilities

- Code4lib (Bloomington, Feb. 7-10, 2011)
- IS&T Archiving (Salt Lake City, May 16-19, 2011)
- Open Repositories (Austin, June 8-11, 2011)

Anticipate more trainings, more vehicles

- Train the trainer (Planets? Washington DC?)
- Webinars and videos

Suggestions welcome, volunteers encouraged

Future developments

3rd party development activities

- Integration with DuraCloud (DuraSpace)
- ARC module (Bibliothèque nationale de France)
- GIF, HTML, JPEG, PNG, virus, WARC modules (CDL / Deutsche Nationalbibliothek)

Possible development efforts

- Additional format modules
- Configuration GUIs
- JHOVE2-as-a-service
- Integration with DAITTS, DSpace, Fedora, FITS, etc.

Suggestions, volunteers and funders welcome

Questions / Discussion

http://jhove2.org

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