Visualization and analysis of medical data through the Internet

MIDAS - The Digital Archiving System

Charles Marion – CrEDIBLE 2013

Kitware

- Founded in 1998
  - Support VTK (Visualization Toolkit) software
  - Five founders from GE Research
- Now ~120 employees
  - 75+ PhD and Masters
  - Research-quality staff
- $20 million revenue
  - Privately owned
  - No debt
- Offices
  - Clifton Park, NY (USA)
  - Chapel Hill, NC (USA)
  - Santa Fe, NM (USA)
  - Lyon (France)

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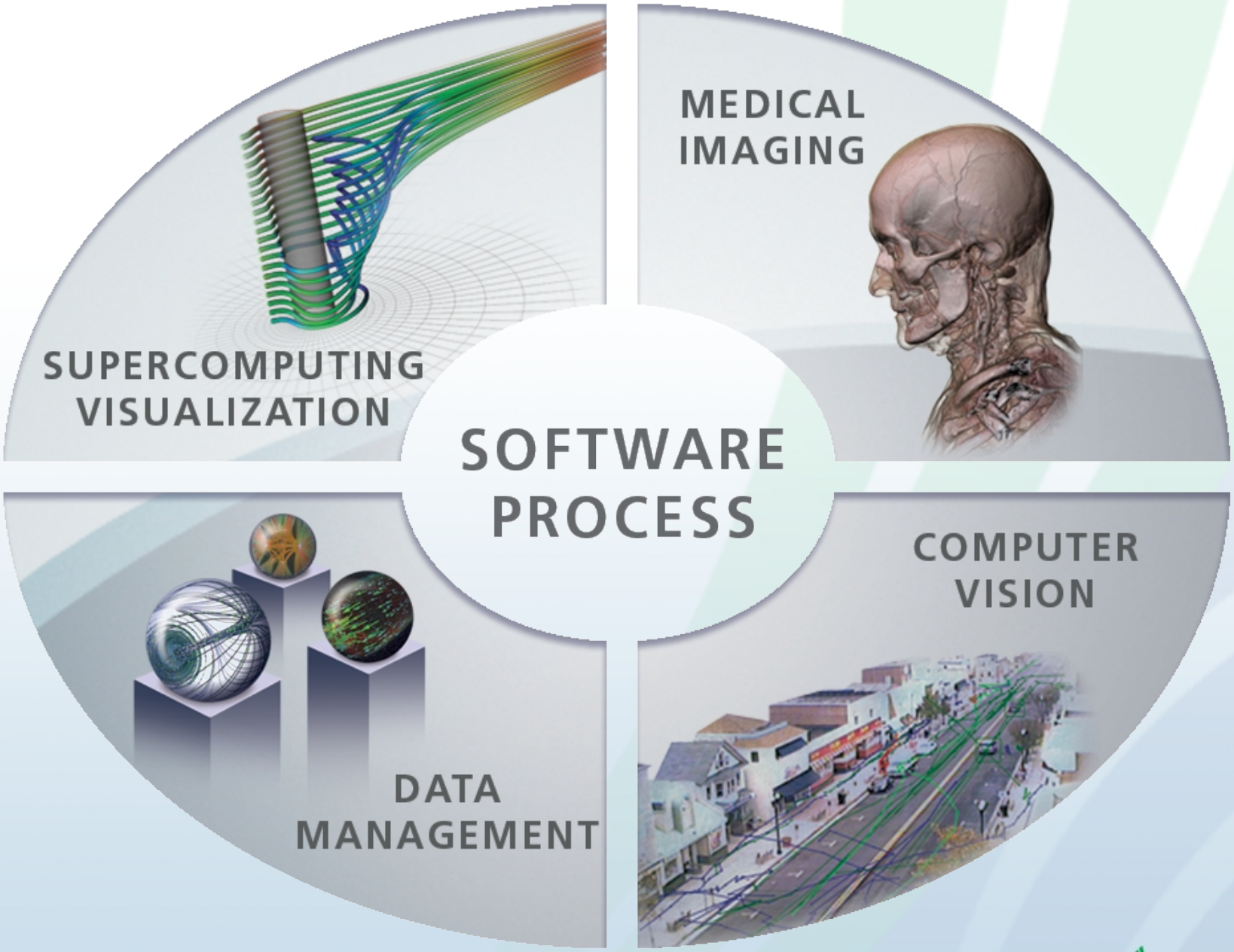
SUPERCOMPUTING
VISUALIZATION
MEDICAL
IMAGING
SOFTWARE
PROCESS
DATA
MANAGEMENT
COMPUTER
VISION

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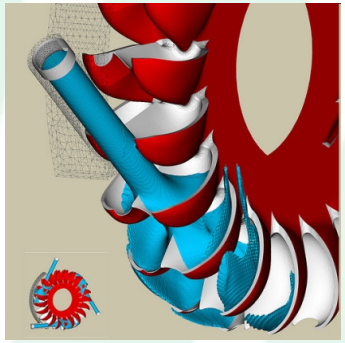
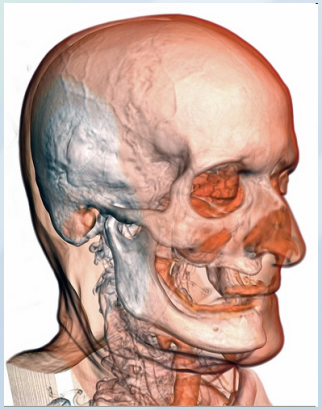
Open Source Systems

- **VTK** – Visualization Toolkit
- **ParaView** – Large data visualization
- **Titan** – Informatics Toolkit
- **ITK** – Insight image analysis toolkit
- **3D Slicer** – Medical research platform
- **CMake** – Cross-Platform Build
- **IGSTK, CTK, VXL, Avogadro,** more….





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Motivation

- Scientific datasets are becoming larger and larger (increasing resolution, new modalities, …)
- **Storing** datasets is the first step but **querying** and **retrieving** them is even more important
- Related documents should be stored along with the corresponding datasets
- Data without **metadata** information are useless
- Distributed and remote computing is becoming a necessity
- Distributed visualization is an emerging technology
- Goal is to increase **collaboration** between research teams

What is Midas?

- An **open source** platform for building **data management systems**
- Built on:
  - Apache2
  - MySQL (or PostgreSQL)
  - PHP 5.3+
- Easy to Install
- Easy to Use

History

- Midas 1.0 **started in 2005**
- Initially based on DSpace
- Designed to host publications and companion data
- Up until 2.8 Midas used CakePHP as its MVC Framework
- Midas 2.X powers:
  - Give A Scan
  - The Insight Journal
  - The Retrospective Image Registration Evaluation (RIRE)
  - Many others…

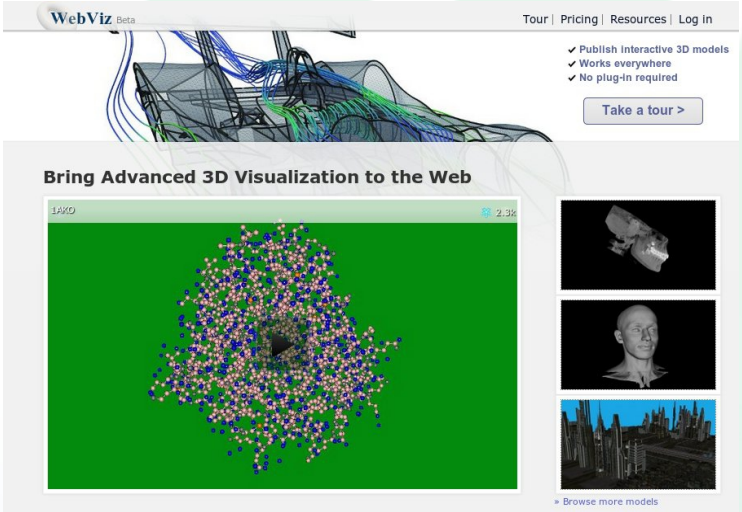
Funding and Support

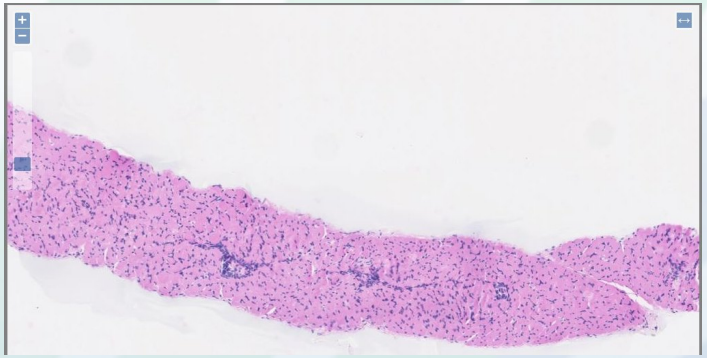
- Public Sector Support
  - NCI
  - NLM
  - NIBIB
  - NIST
  - DARPA
  - IARPA
  - TSA
  - VA
- Private Sector Support
  - Medical Device Manufacturing
  - Industrial Quality Assurance
  - Industrial Research and Development
  - Scientific Publishing

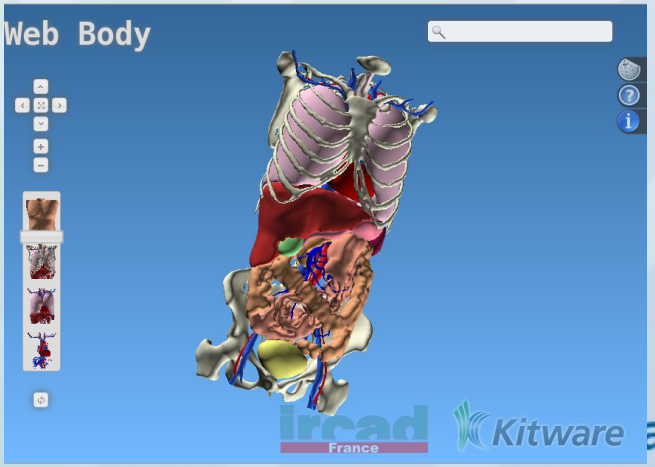
- Current Midas-Supporting Projects
  - iDASH
  - NA-MIC
  - COVALIC (Phase I SBIR)
  - Phase II Rodent Imaging STTR with UNC
  - OSEHRA
  - QIBA (Committee for Open Image Archives)
  - NIST (QI-Bench)
  - Kitware Internal Projects

Midas' main features

- Upload/Download
- Sharing
- Search
- **Extensibility**







Alternative open source solutions

- Supports all common imaging methods (e.g. MRI, CT, PET)
- Organize and Share Data
- Search and Explore Large Data Sets
- Demo: https://central.xnat.org/

- Support multi-centric research studies
- Organize and Share Data
- Search and Explore Large Data Sets
- Demo: https://shanoir-demo.irisa.fr:8643/Shanoir

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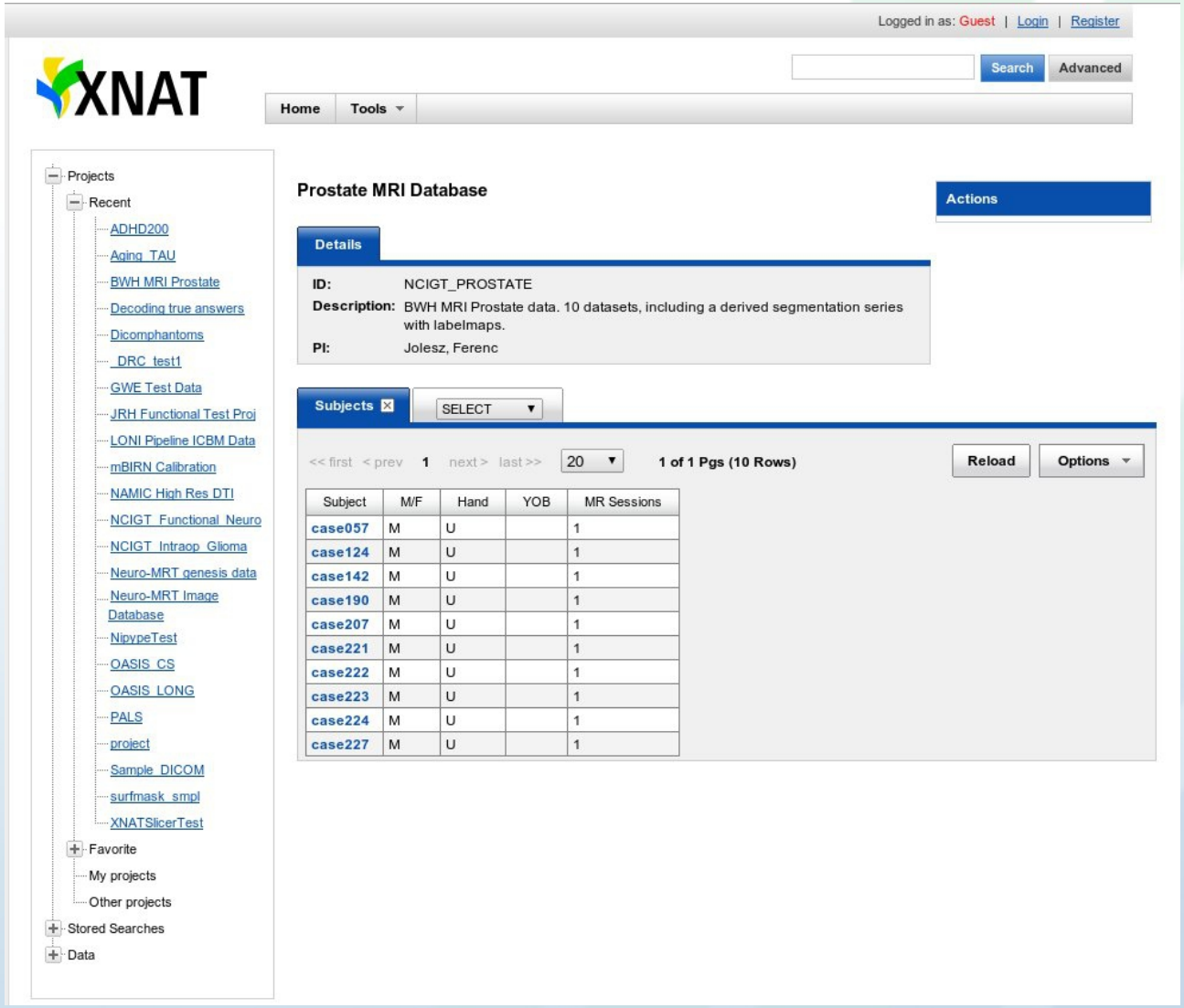
XNat



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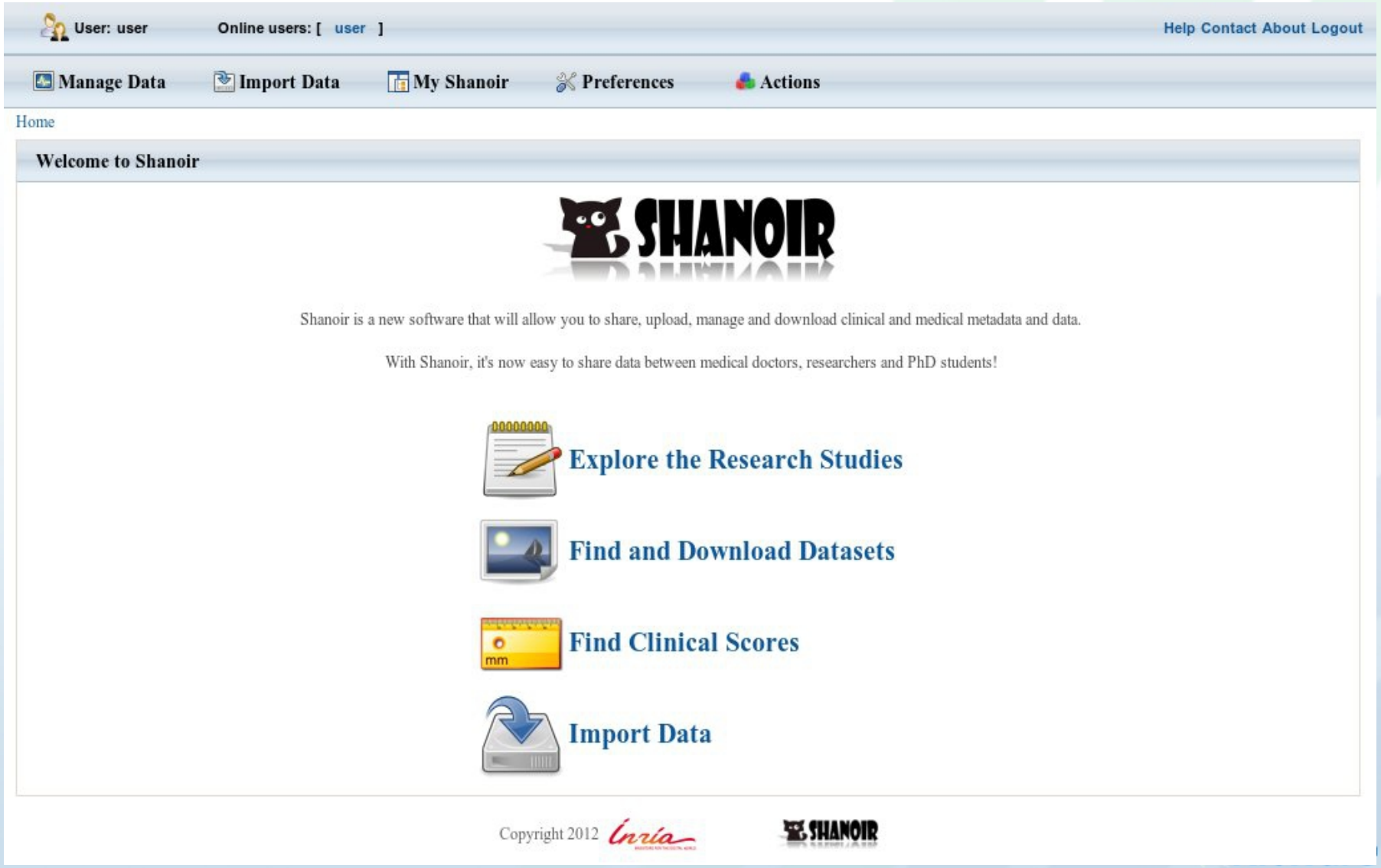
Shanoir


User: user
Online users: [user]
Help Contact About Logout
Manage Data
Import Data
My Shanoir
Preferences
Actions
Home
Welcome to Shanoir
SHANOIR
Shanoir is a new software that will allow you to share, upload, manage and download clinical and medical metadata and data.
With Shanoir, it's now easy to share data between medical doctors, researchers and PhD students!
Explore the Research Studies
Find and Download Datasets
Find Clinical Scores
Import Data
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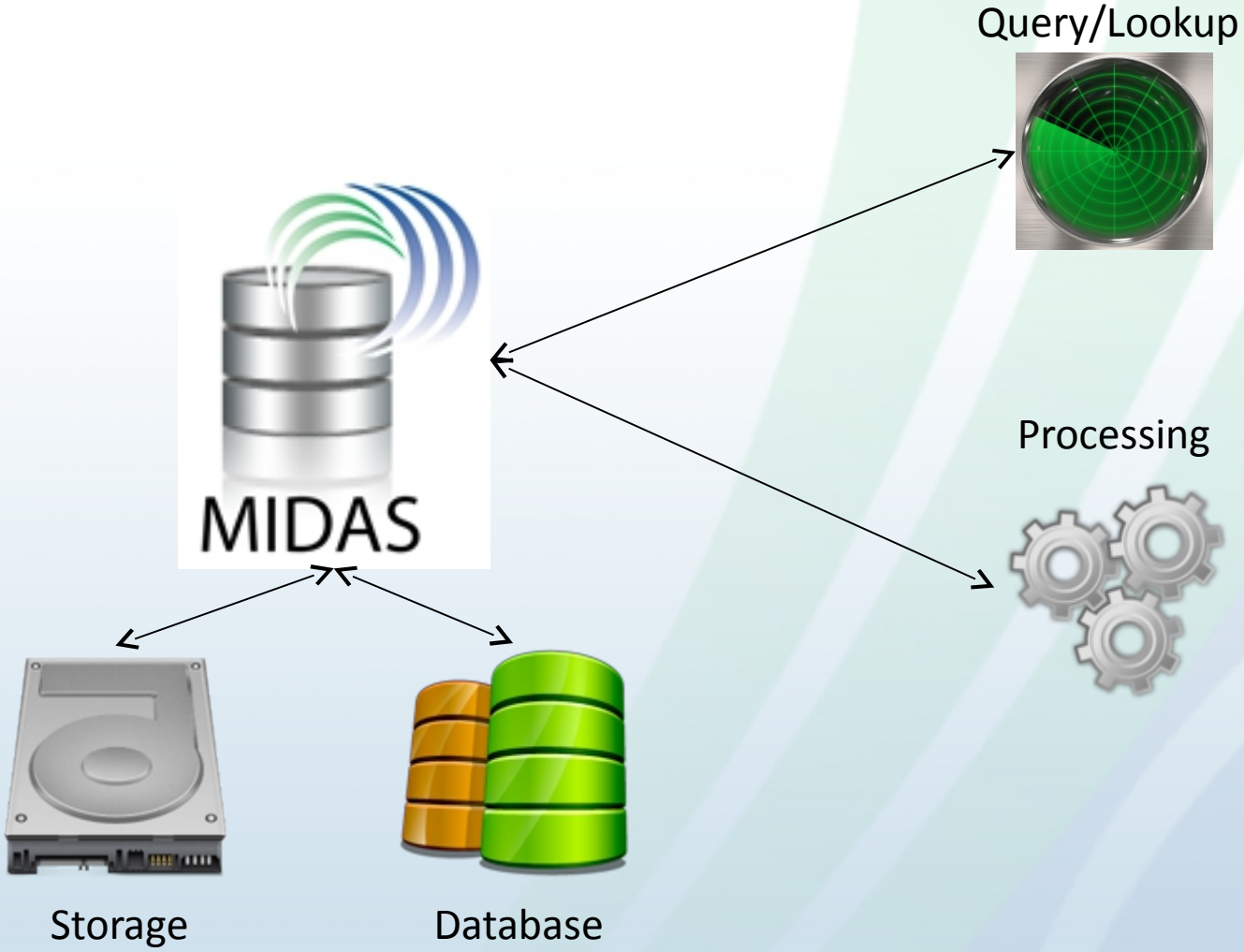
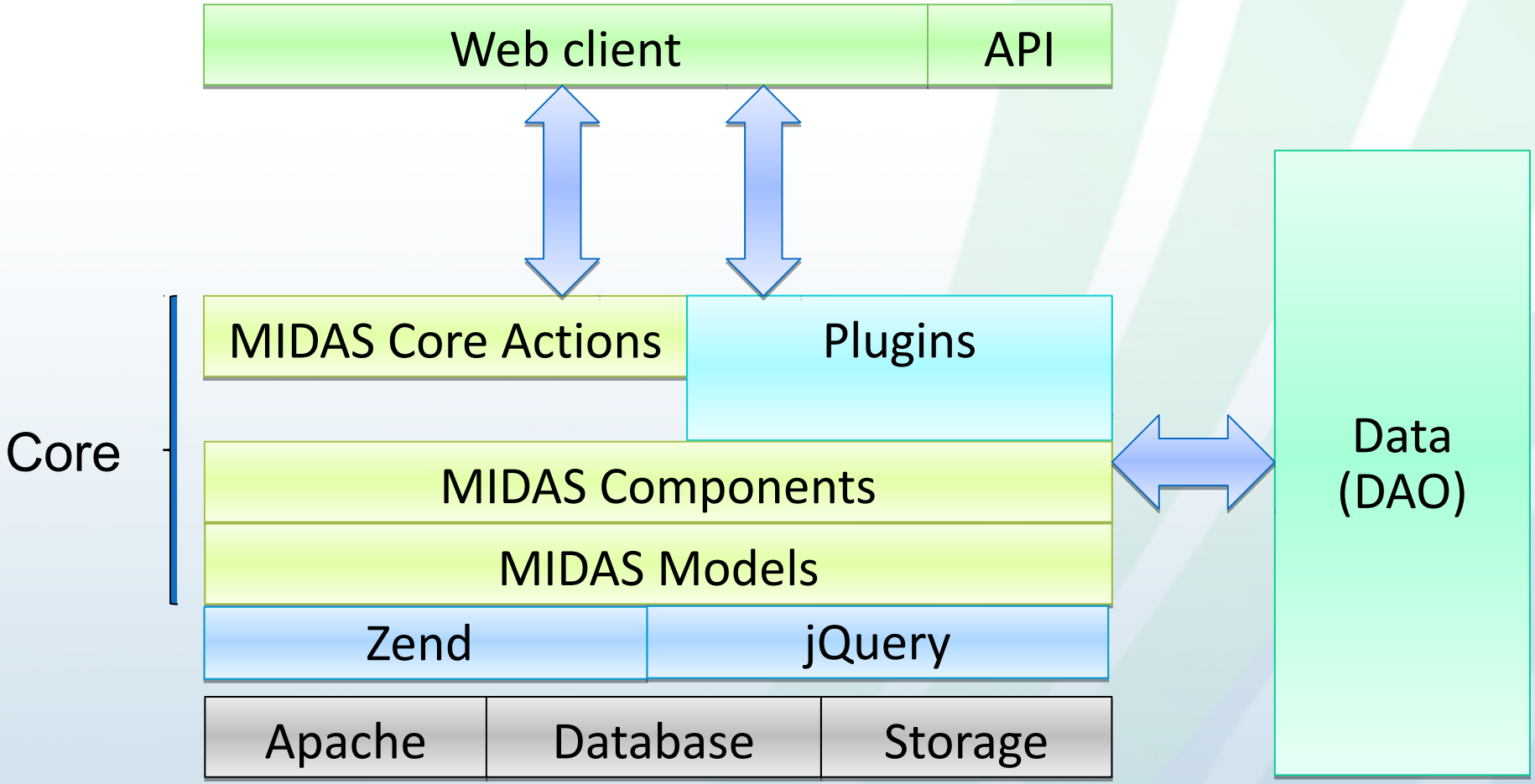
MIDAS Architecture



MIDAS Architecture



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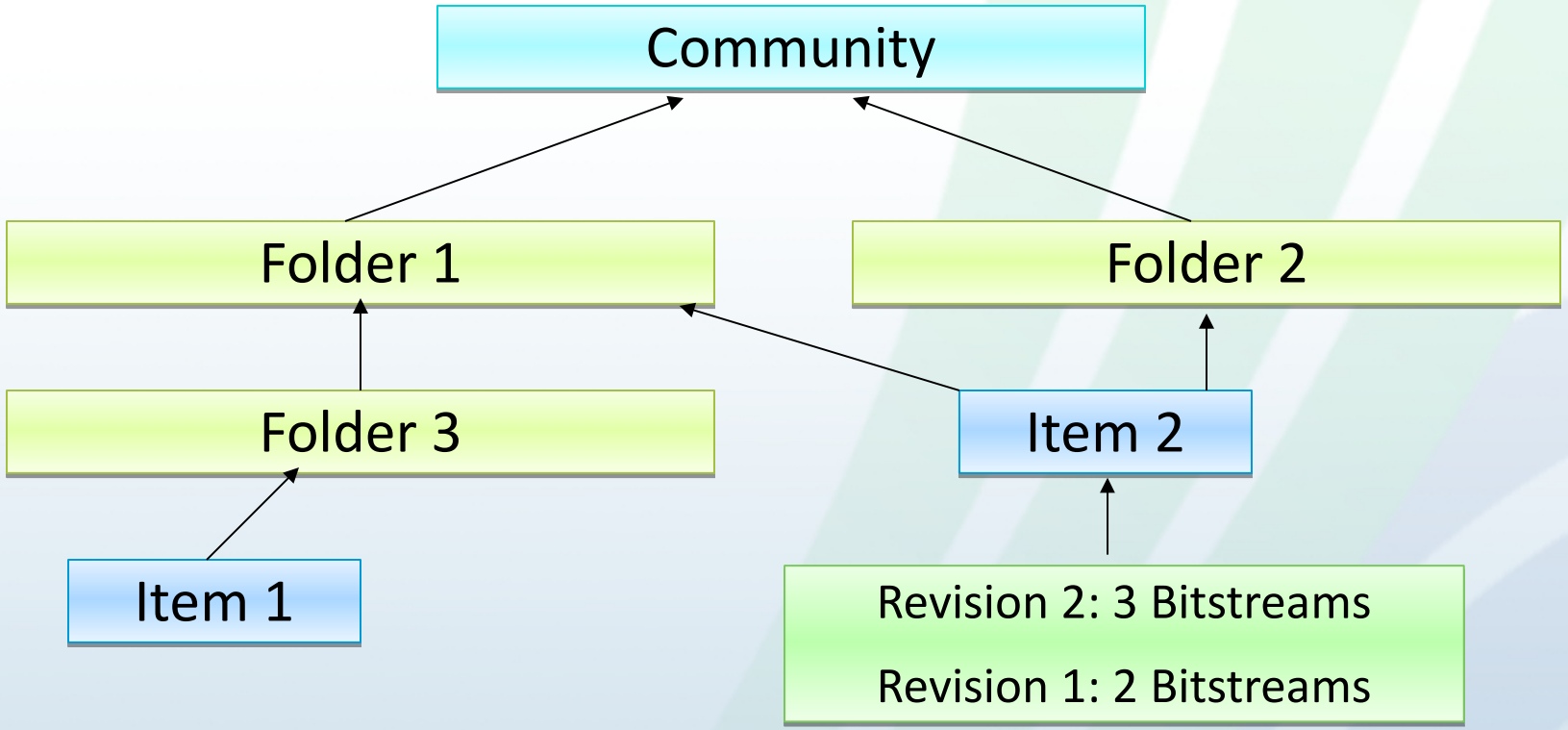
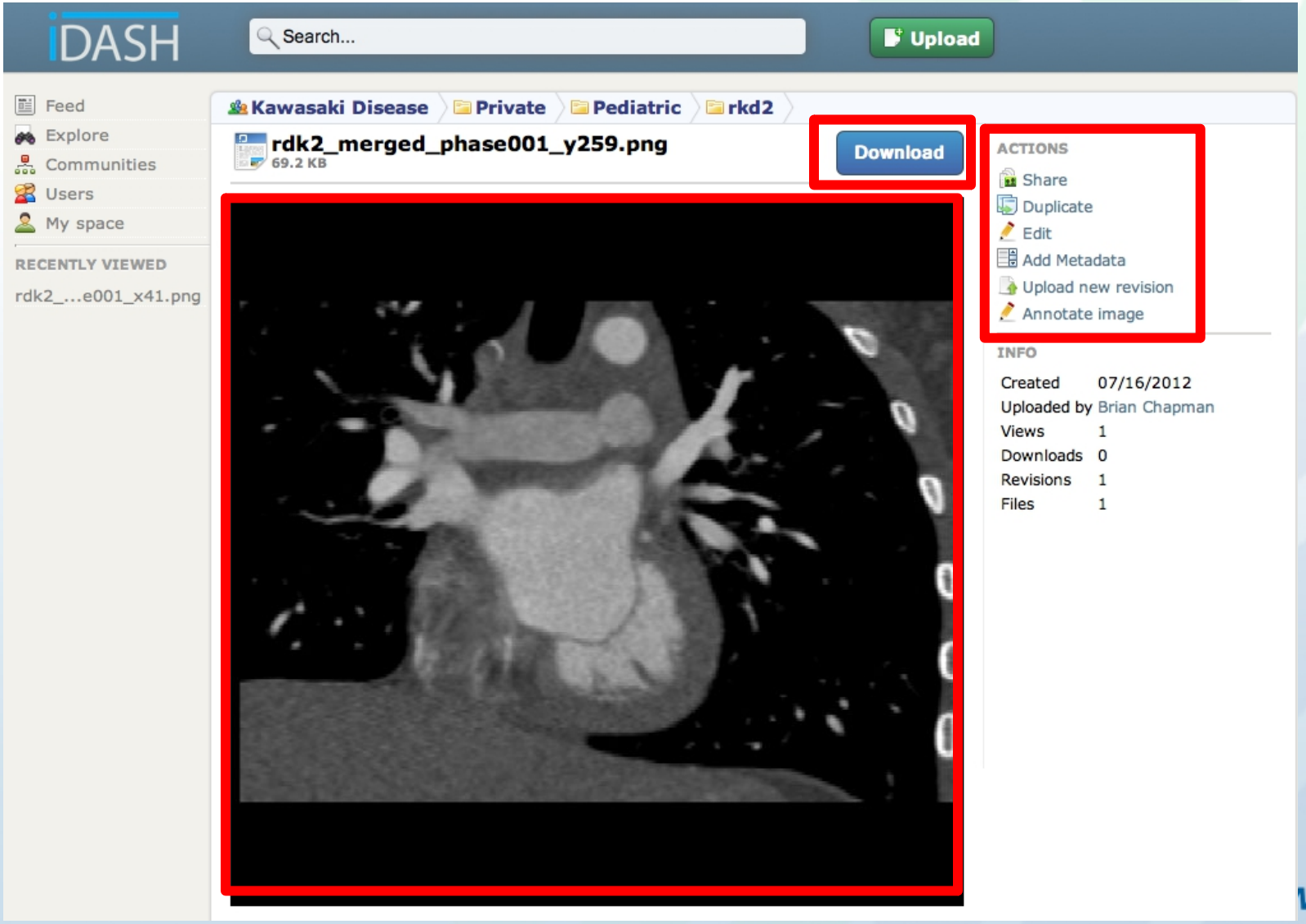
Data Hierarchy



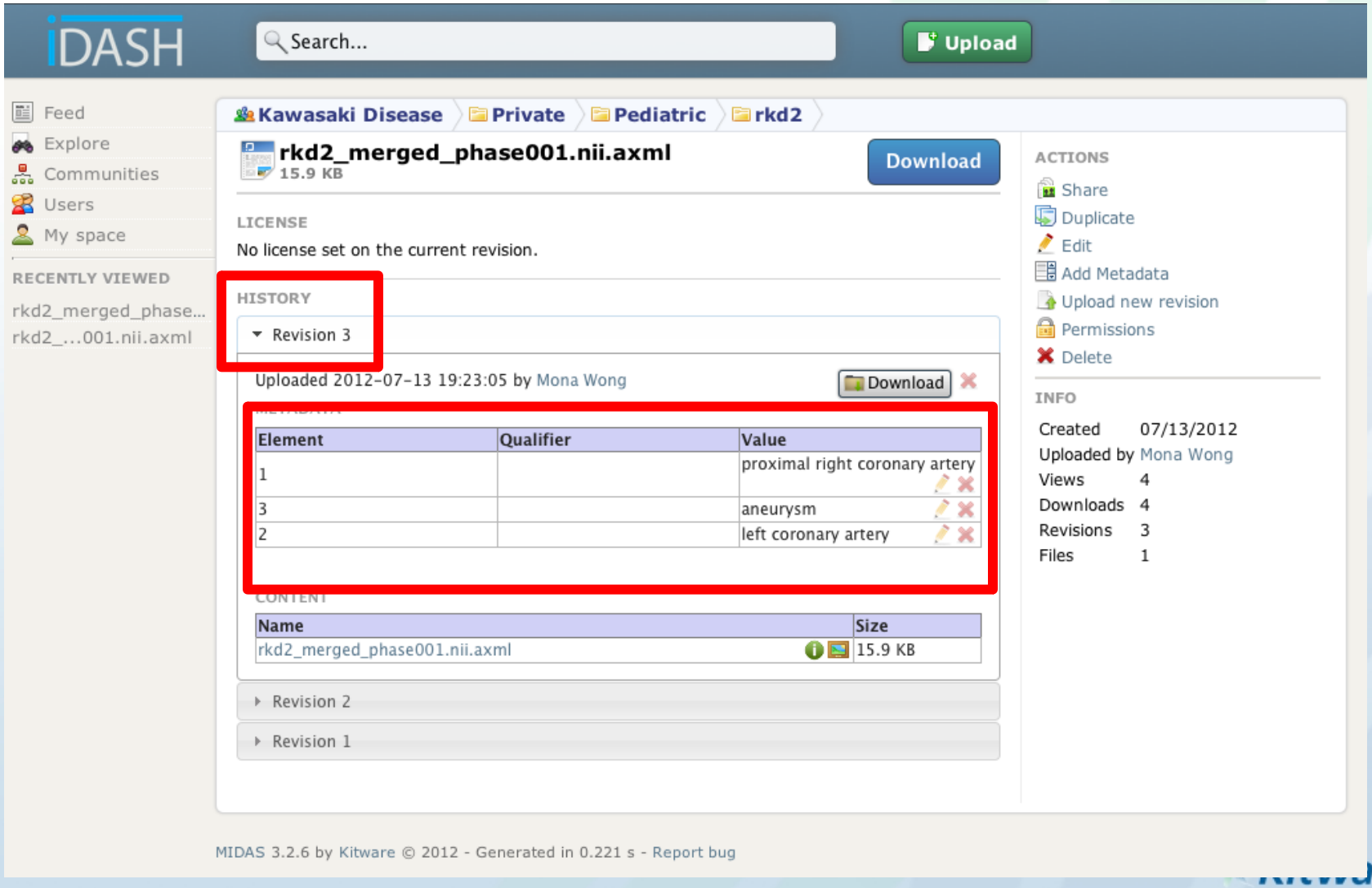
Item View


iDASH
Search...
Upload
Feed
Explore
Communities
Users
My space
RECENTLY VIEWED
rdk2_...e001_x41.png
Kawasaki Disease
Private
Pediatric
rkd2
rdk2_merged_phase001_y259.png
69.2 KB
Download
ACTIONS
Share
Duplicate
Edit
Add Metadata
Upload new revision
Annotate image
INFO
Created 07/16/2012
Uploaded by Brian Chapman
Views 1
Downloads 0
Revisions 1
Files 1

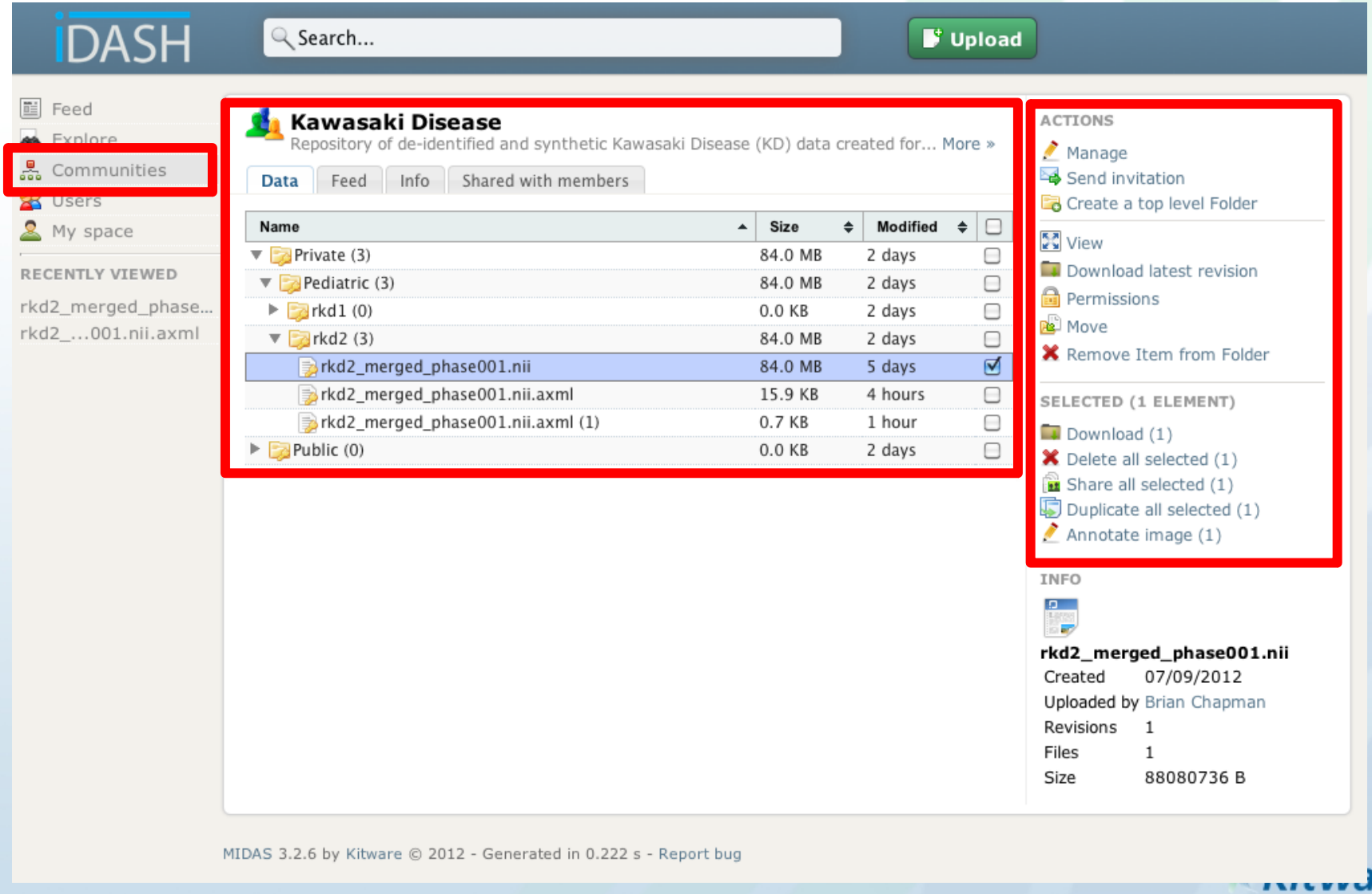
Metadata and Search in Midas

- Midas has support for arbitrary **key-value metadata**
- There are several modules for **automatic extraction of metadata** for known data types:
  - PDF
  - DICOM
  - JPEG
  - Many more…
- Search can use either native SQL or **Apache Solr** for indexing and search of data
- Solr allows users to query massive sets of data with a convenient syntax

Built-in meta data & version control



Share Data with Communities



Security Features

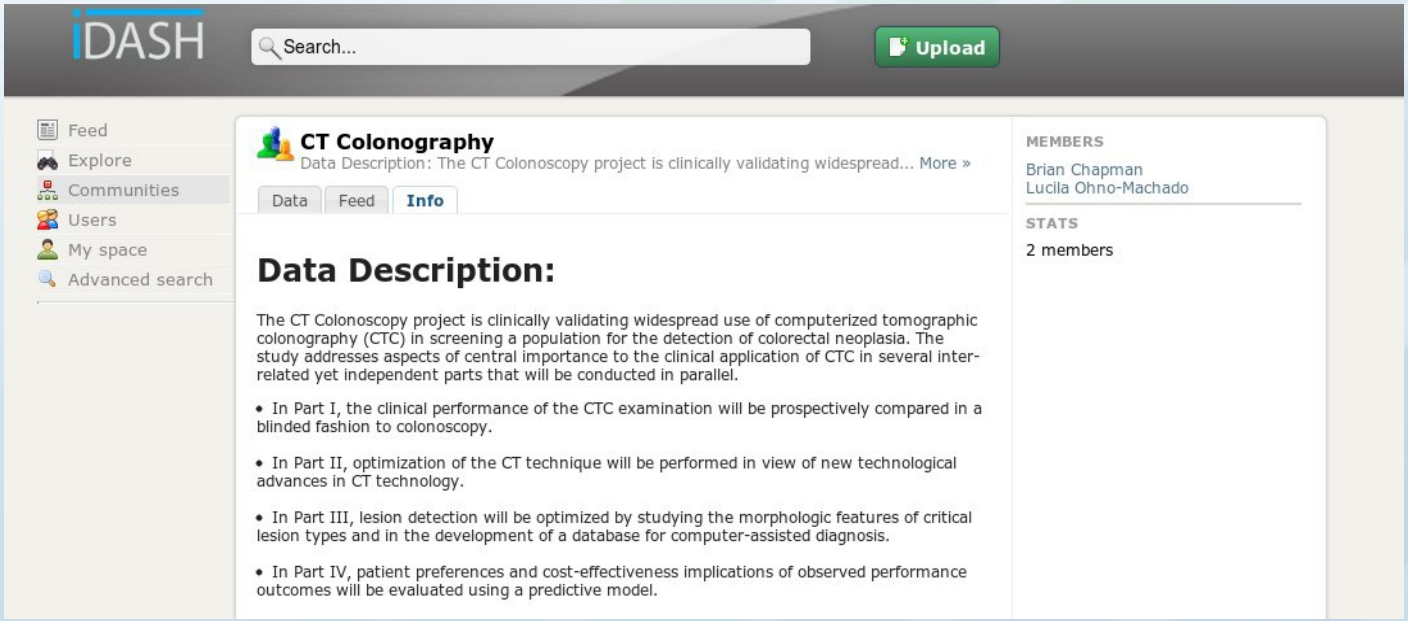
- Conformant in terms of HIPAA and FISMA for storing PHI/PII
  - LDAP authentication
  - Two Factor authentication
  - Trace Logging
- Permissions are assigned using policies on a per-item and per-folder basis.
- Three states:
  - Own
  - Edit
  - Read
- Things are public when they have anonymous read permissions.

Use Case - iDash

- Integrating Data for Analysis, Anonymization and SHaring (iDASH)
- Enables global collaborations anywhere and anytime.
- Conformant in terms of HIPAA and FISMA for storing PHI/PII
- One public instance containing anonymized dataset
- One private instance containing Patient-Identifying information

Use Case - iDash

- Motion sensor data of 16 physical activities (walking, jogging, stair climbing, etc.)
  - https://idash-data.ucsd.edu/community/7#
- The CT Colonoscopy project
  - https://idash-data.ucsd.edu/community/10



Use Case – 3D Slicer DataStore

- The Data Store extension allows an user to easily **upload and download dataset** files from **3D Slicer**
- Supports public and private datasets
- Sceneviews are hosted using a MIDAS instance

What is 3D Slicer?

- Visualization and image analysis
- Interactive Segmentation
- Volume Rendering
- Rigid and Nonrigid Registration
- Multiple platforms
  - Windows, OSX, Linux…
- Open source (BSD-like)
  - No restrictions on use

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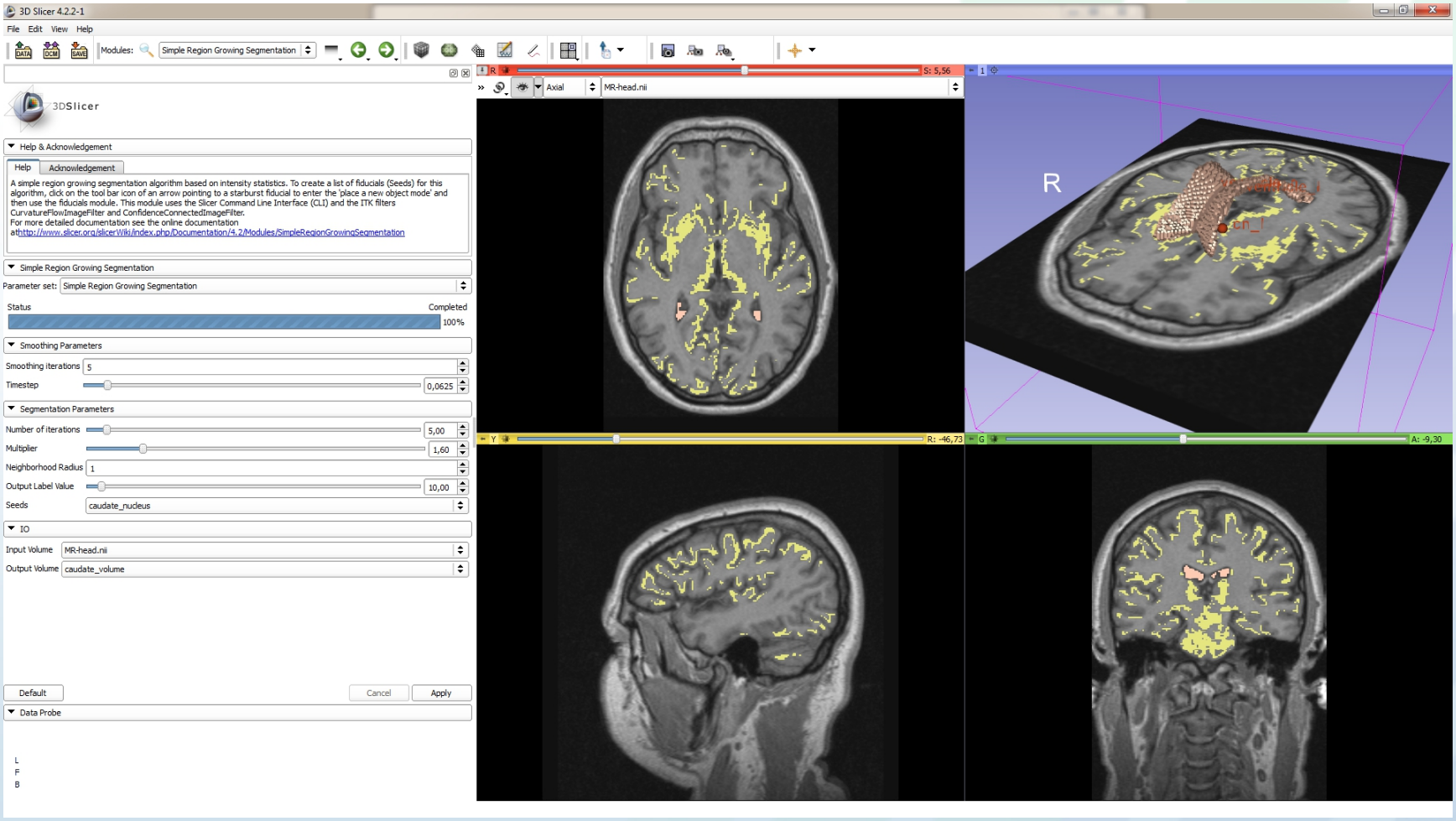
3D Slicer - Region Growing



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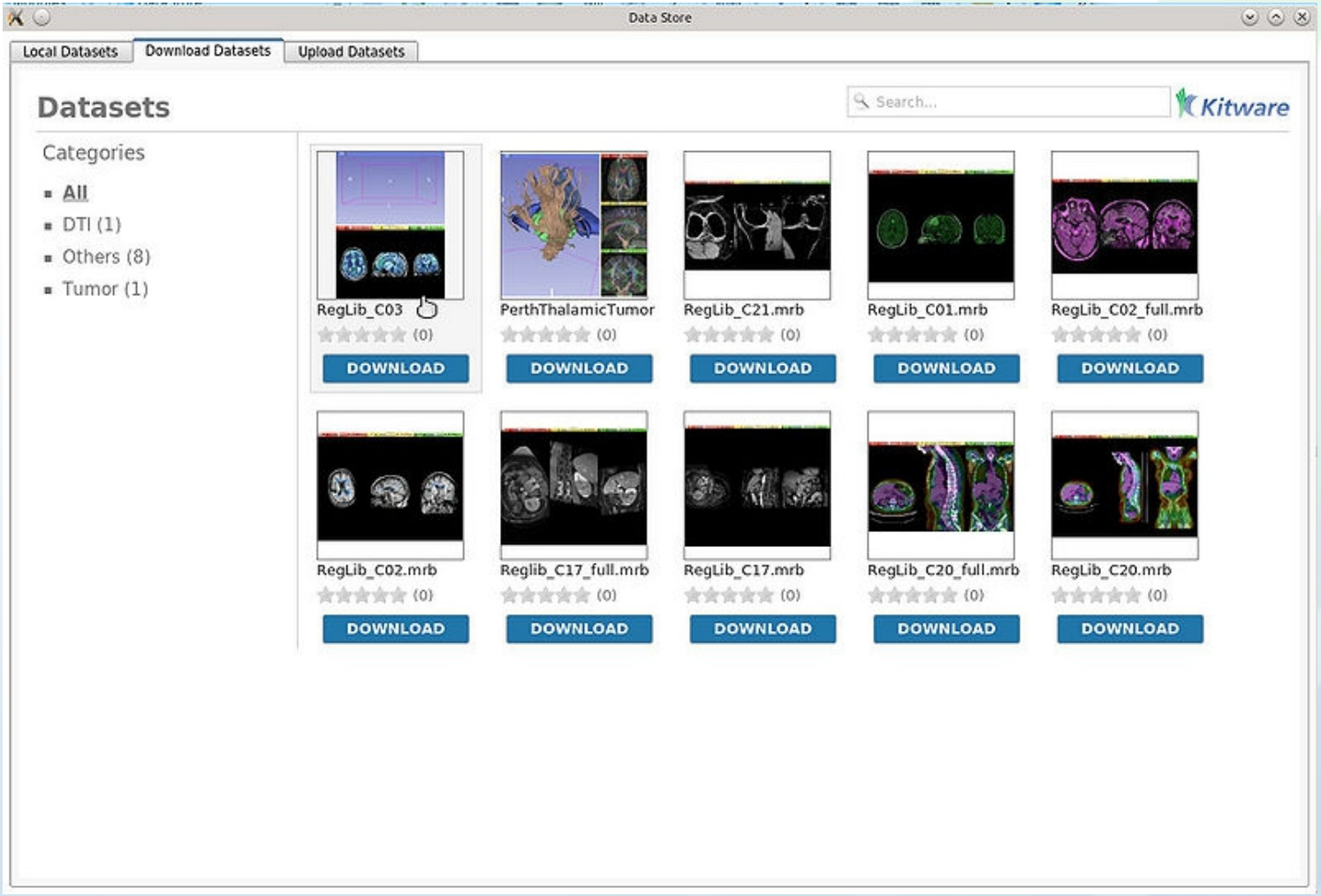
Use Case - DataStore



http://slicer.kitware.com/midas3/slicerdatastore

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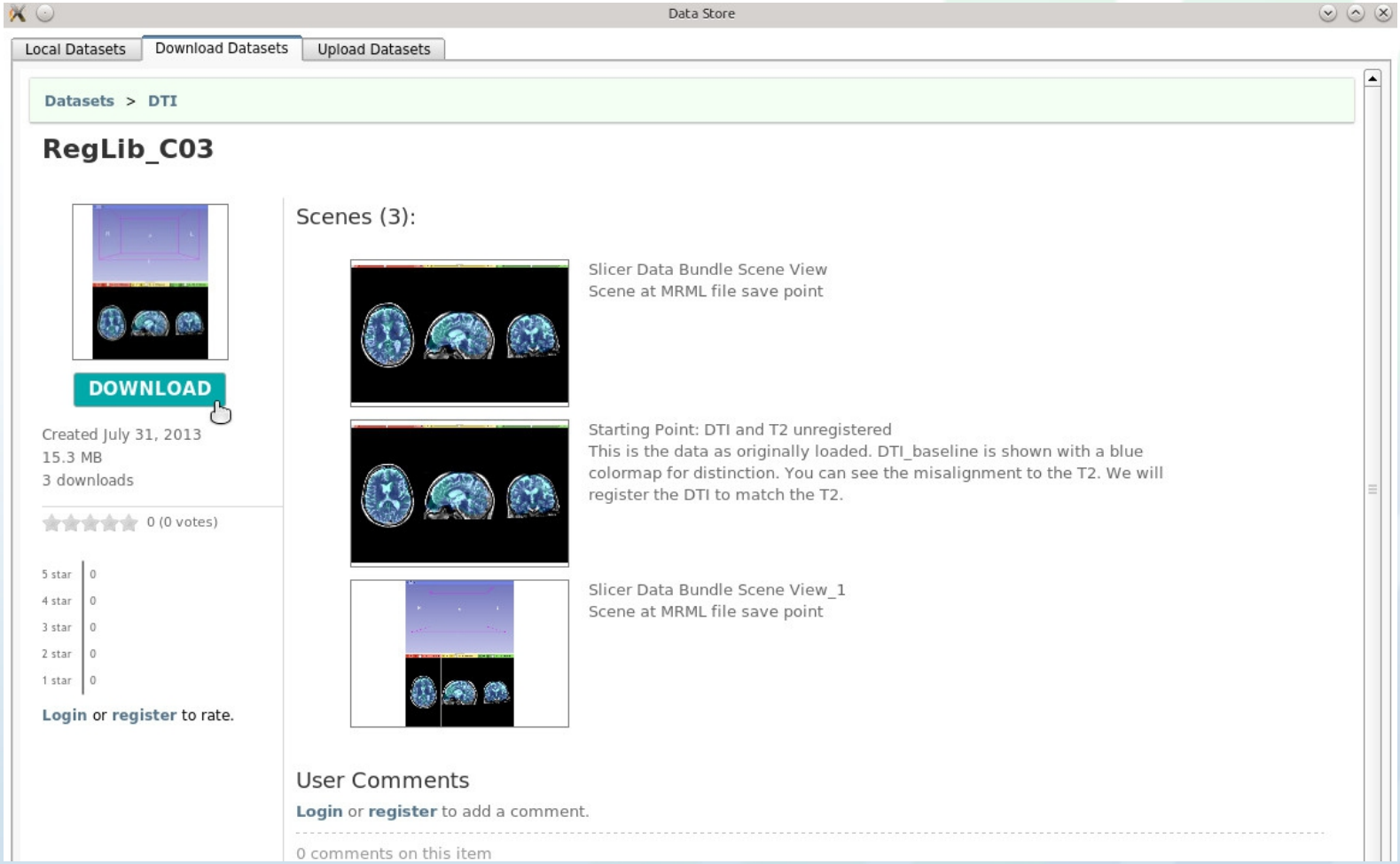
Use Case - DataStore



http://slicer.kitware.com/midas3/slicerdatastore

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Use Case - pySlicer

- Provide a medical visualization tool running on every web connected devices (Including Internet explorer and mobile browsers)
- Support for advanced medical visualization technics using a client/server architecture
- Process the datasets online

Use Case - pySlicer

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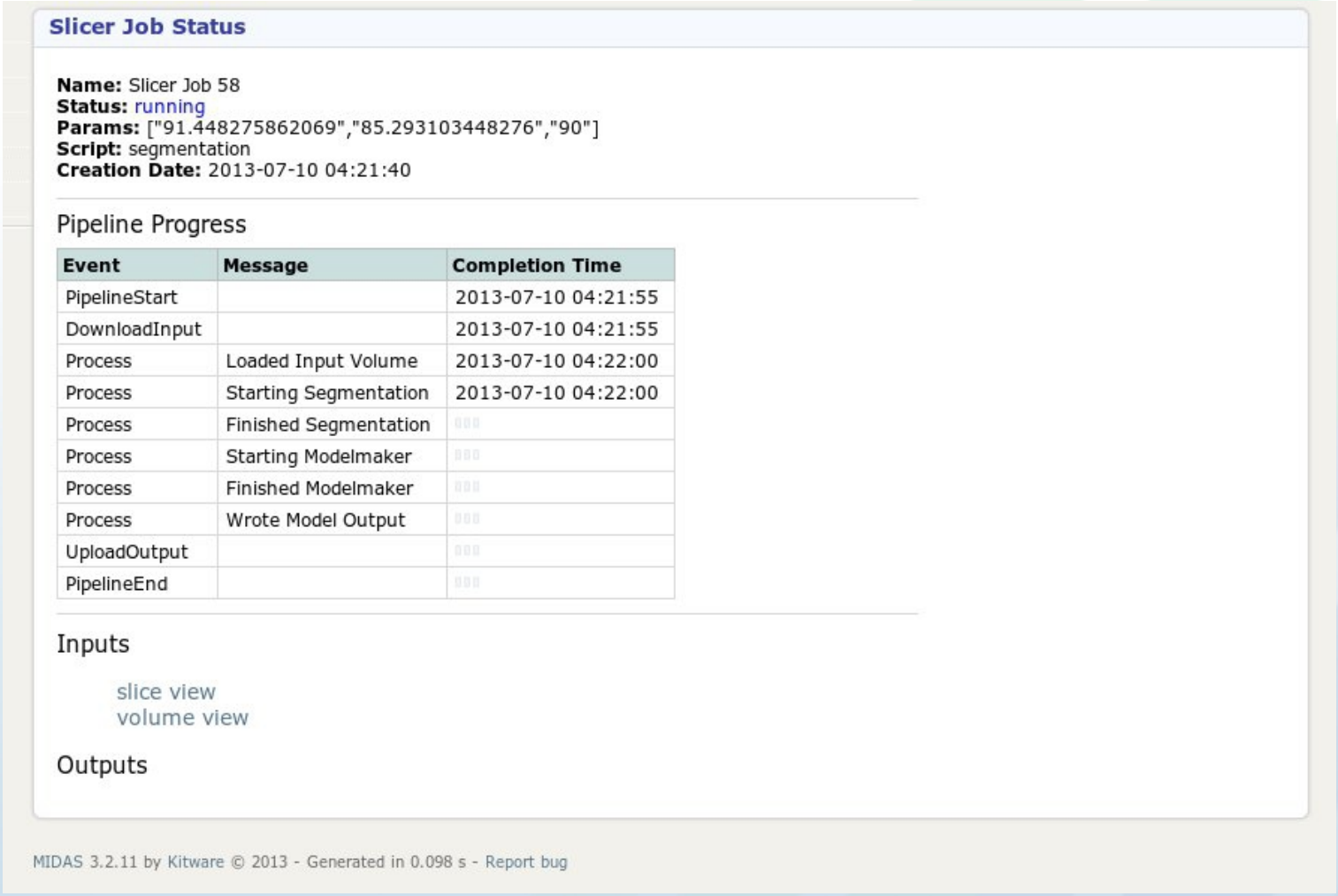
Use Case - pySlicer



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Resources

- Midas & 3D Slicer
  - http://midasplatform.org/
  - http://www.slicer.org
  - Tutorials
  - Download
  - User/Developer manual
  - Mailing lists

- iDash Project: http://idash.ucsd.edu/
- DataStore: https://github.com/Slicer/Slicer-DataStore
- pySlicer: https://github.com/midasplatform/pyslicer

- Kitware offers Support and Training

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Thank you!


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