



NASA PDS IMG: Accessing Your Planetary Image Data

Kevin Grimes – kevin.m.grimes@jpl.nasa.gov

Co-Authors: Jordan Padams, Galen Hollins, Sue Lavoie,
Alice Stanboli, Kiri Wagstaff

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Jet Propulsion Laboratory
California Institute of Technology

Accessing Your Planetary Image Data

Overview

- What is PDS IMG?
- Image Atlas
 - Web interface – <https://pds-imaging.jpl.nasa.gov/search>
 - Search service – <https://pds-imaging.jpl.nasa.gov/solr>
- Questions
- References

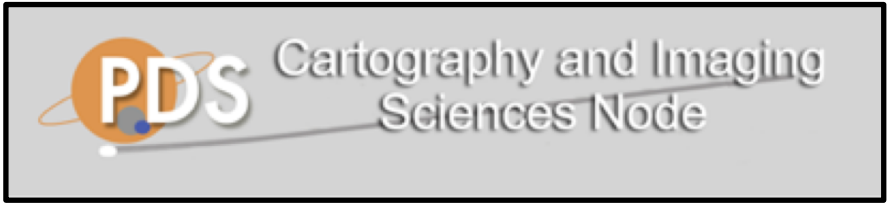
Accessing Your Planetary Image Data

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Overview

What is PDS IMG?

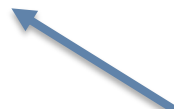


- Cartography and Imaging Sciences Node (IMG) of the NASA Planetary Data System (PDS)
- Home to over 700 TB of digital image archives
- Diverse collection of images
 - Orbital and landed missions
 - Original, raw experiment data and derived products
 - Differing coordinate systems
- Customers include both scientists and the space-enthusiast community
 - Cassini ISS team
 - Amateur image processing engineers

Overview

What is PDS IMG?

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Problem: how can we effectively and efficiently find the images we want?

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Perform a text search like "mars crater" or "cassini rings", or a more advanced search like "TARGET_NAME:enceladus"

Search

Show results for

(click to remove filter)

Share

Narrow your search by selecting a facet below

Mission

- 2001 mars odyssey (2649714)
- cassini (903412)
- chandrayaan-1 (21645)
- clementine (1996197)
- galileo (20123)
- icross (5308)
- lunar orbiter (2991)
- lunar reconnaissance orbiter (4120765)
- magellan (72818)
- mars exploration rover (6949475)
- mars global surveyor (243227)
- mars pathfinder (17899)
- mars reconnaissance orbiter (1651653)
- mars science laboratory (10461579)
- messenger (1309800)
- new horizons (15179)
- phoenix (256433)
- viking lander (6585)
- viking orbiter (61693)
- voyager (538538)

Spacecraft

Instrument

Target

Product Type

Lighting Geometry

Filters

Lat/Lon Bounding Box

Time Constraints

Orbital Mission Constraints

Results: 24

Page:

< 1 2 3 ... 1304376 1304377 > displaying 1 to 24 of 31305034



Grid View



Sort View

Add field to sort by:

START_TIME

Clear

Select All Images: On Page In Query



1869MD0007540000200800E01_DRCL



1869MD0007540000200800E01_DRCX



1869MD0007540000200800E01_DRLX

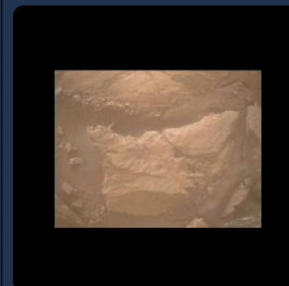


Image Atlas

Web Interface

- Intuitive user interface
- Autocomplete search bar
- Share your search
- Pop-up image viewer
- Interactive maps
- Download capability

Image Atlas

Web Interface

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Image Atlas

Web Interface

- Intuitive user interface
 - Filter search results using PDS keyword constraints, including mission, instrument, target, product type
 - View image results as either grid or list with field values
 - Sort results by field values in either ascending or descending order

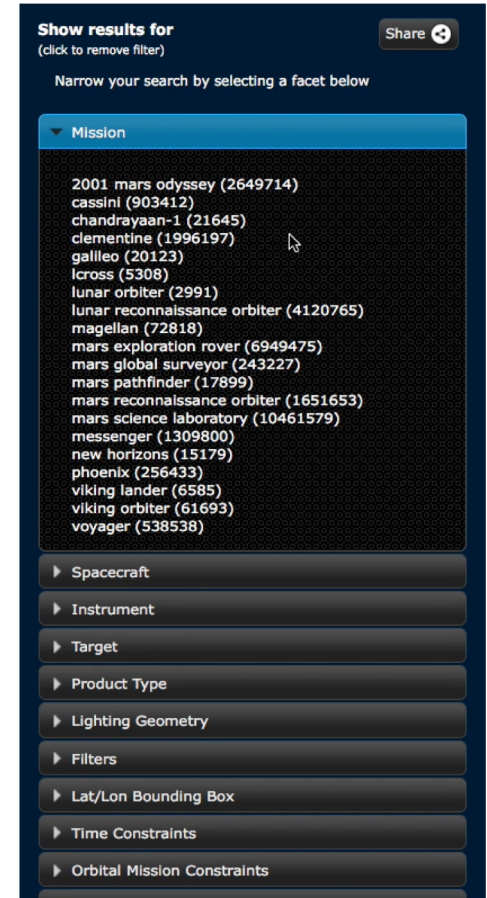


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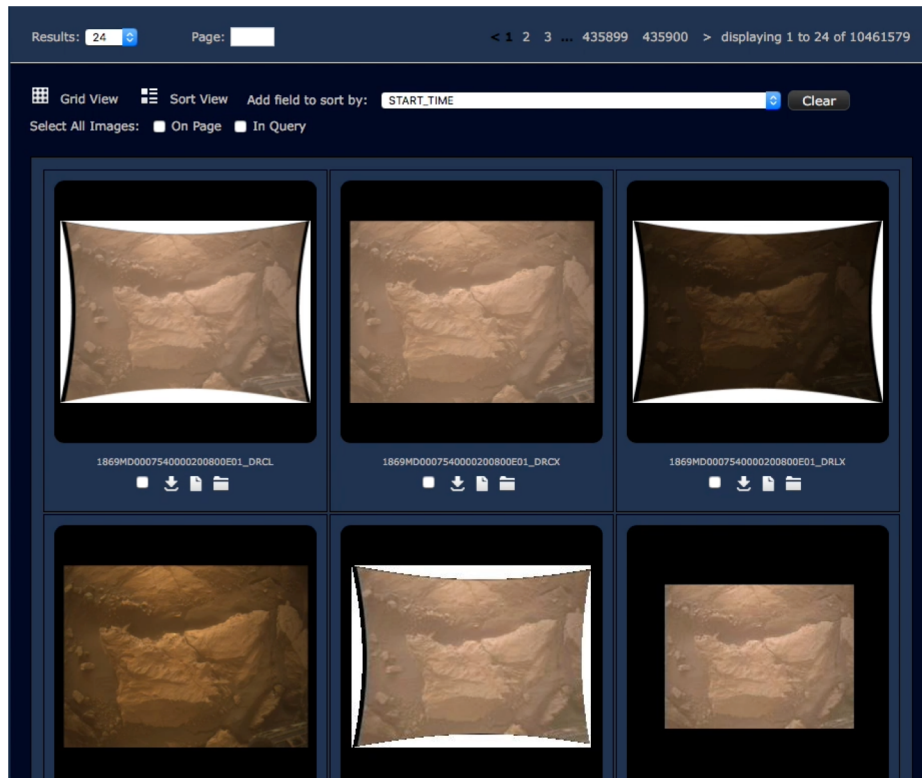


Image Atlas

Web Interface

- *Intuitive user interface*
- **Autocomplete search bar**
- *Share your search*
- *Pop-up image viewer*
- *Interactive maps*
- *Download capability*

Image Atlas

Web Interface

- Intuitive search interface
- Autocomplete search bar
 - Supports free-text searching, such as “mars crater” or “cassini rings”
 - Also supports Lucene query syntax for more specific queries
 - `ATLAS_MISSION_NAME:“cassini” OR PRODUCT_TYPE:“edr” AND - TARGET:“mars”`
 - `START_TIME:[1999-02-14T00:00:00.000Z TO 2013-12-24T00:00:00.000Z}`

Image Atlas

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Image Atlas: Web Interface

ATLAS_MISSION_NAME:"cassini" OR PRODUCT_TYPE:"edr" AND -TARGET:"mars"

The screenshot displays the PDS Image Atlas web interface. At the top left is the NASA Jet Propulsion Laboratory logo. The main title is "PDS Image Atlas". A search bar contains the query: "ATLAS_MISSION_NAME:cassini OR PRODUCT_TYPE:edr AND -TARGET_NAME:mars". Below the search bar, the results are displayed in a table format. The left sidebar shows a list of missions, with "cassini (899985)" selected. The main table has columns for "Start Time", "Mission Name", and "Target Name". The first row shows a small image of a planet, the start time "2017-11-07T12:01:27.354Z", the mission name "Mars Science Laboratory", and the target name "SKY".

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PDS Image Atlas

ATLAS_MISSION_NAME:cassini OR PRODUCT_TYPE:edr AND -TARGET_NAME:mars Search

Show results for (click to remove filter) Share

Results: 24 Page: displaying 1 to 24 of 5214113

Narrow your search by selecting a facet below

Mission

- cassini (899985)
- clementine (1900483)
- galileo (16246)
- lunar reconnaissance orbiter (1961800)
- mars global surveyor (81)
- mars pathfinder (11150)
- mars reconnaissance orbiter (13099)
- mars science laboratory (22069)
- messenger (290999)
- new horizons (7590)
- vikings lander (1618)
- vikings orbiter (2075)
- voyager (86918)

Spacecraft

Instrument

Target

Product Type

Lighting Geometry

Filters

Grid View Sort View Add field to sort by: START TIME Clear

Select All Images: On Page In Query


	Start Time ↑ ↓	Mission Name ↑ ↓	Target Name ↑ ↓
 1868ML0097640010703216D01_XXXX	2017-11-07T12:01:27.354Z	Mars Science Laboratory	SKY

Image Atlas

Web Interface

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Image Atlas: Web Interface

START_TIME: [1999-02-14T00:00:00.000Z TO 2013-12-24T00:00:00.000Z]

The screenshot displays the PDS Image Atlas web interface. At the top, the NASA Jet Propulsion Laboratory logo and the title "PDS Image Atlas" are visible. A search bar contains the text "Perform a text search like 'mars crater' or 'cassini rings', or a more advanced search like 'TARGET_NAME:enceladus'". Below the search bar, the interface shows search results for "24" items on page 1. A sidebar on the left lists various missions, with "Mission" selected. The main content area shows a grid view of search results. The first result is a square image of Mars, with the following details:

Start Time	Mission Name	Target Name
2017-11-08T17:18:53.349Z	Mars Science Laboratory	MARS

The image ID is 1869MD0007540000200800E01_DACL. Below the image are icons for download, print, and share.

Image Atlas

Web Interface

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- *Pop-up image viewer*
- *Interactive maps*
- *Download capability*

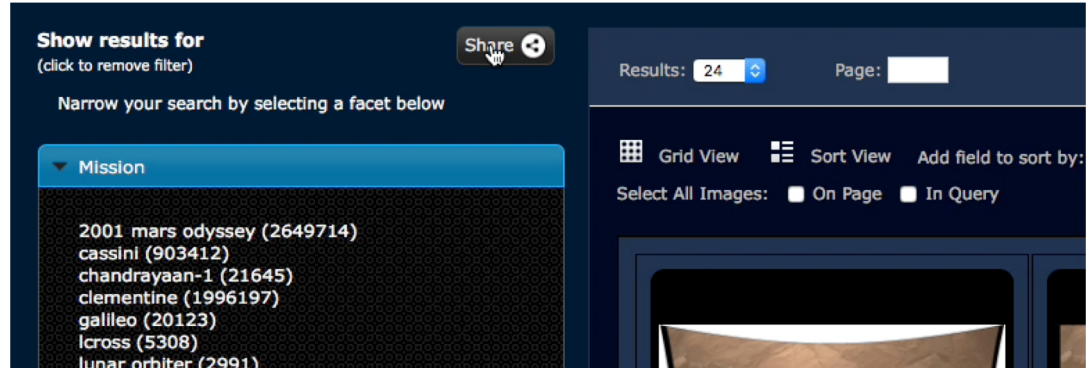


Image Atlas

Web Interface

- *Intuitive search interface*
- *Autocomplete search bar*
- *Share your search*
- **Pop-up image viewer**
 - **Dynamic range/histogram/stretch**
 - **Supplementary images**
 - **Downloading**
 - **Machine learning-enabled overlays**
- *Interactive maps*
- *Download capability*

Image Atlas

Web Interface

- Pop-up image viewer
 - Dynamic range/histogram/stretch
 - Supplementary images
 - Downloading

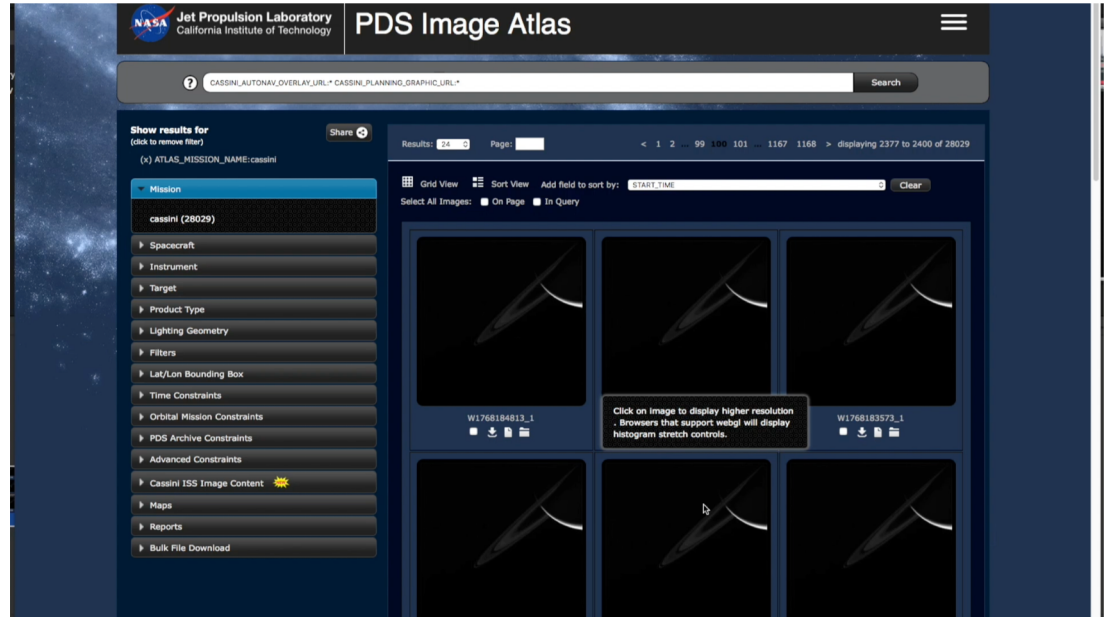


Image Atlas

Web Interface

- Pop-up image viewer
 - Machine learning-enabled overlays

The screenshot displays the PDS Image Atlas web interface. At the top, the NASA Jet Propulsion Laboratory logo and the title "PDS Image Atlas" are visible. A search bar contains the text "Perform a text search like 'mars crater' or 'cassini rings', or a more advanced search like '*TARGET_NAME=enceladus'". Below the search bar, the interface shows "Show results for" with a list of filters: "remove all", "(x) MRO_IMAGE_CLASS:'bright dune'", "(x) MRO_IMAGE_CLASS:'crater'", "(x) MRO_IMAGE_CLASS:'dark dune'", and "(x) MRO_IMAGE_CLASS:'streak'". A sidebar on the left lists various filter categories such as Mission, Spacecraft, Instrument, Target, Product Type, Lighting Geometry, Filters, Lat/Lon Bounding Box, Time Constraints, Orbital Mission Constraints, Landed Mission Constraints, PDS Archive Constraints, and Advanced Constraints. The main content area displays a grid of six image thumbnails, each with a green diagonal banner that says "CLICK FOR OVERLAYS". Below each thumbnail is a caption and a set of icons for downloading and sharing. The interface also includes a "Results: 24" indicator, a "Page:" field, and a "Sort View" dropdown menu set to "START TIME".

Image Atlas

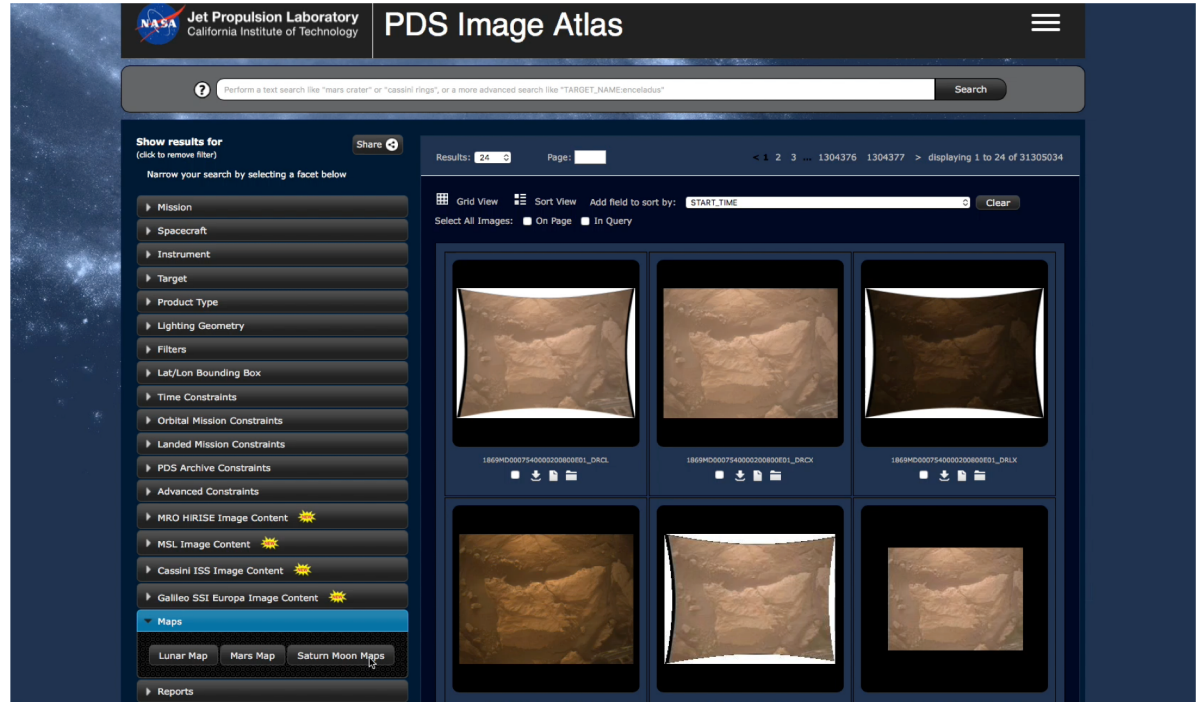
Web Interface

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- **Interactive maps**
- *Download capability*

Image Atlas

Web Interface

- Interactive maps
 - Selection of latitude and longitude ranges
- Available maps: Saturn's moons, Mars, Earth's moon



The screenshot displays the PDS Image Atlas web interface. At the top, the NASA logo and "Jet Propulsion Laboratory California Institute of Technology" are visible, along with the title "PDS Image Atlas". A search bar contains the text "Perform a text search like 'mars crater' or 'cassini ring', or a more advanced search like 'TARGET_NAME:enceladus'". Below the search bar, the "Show results for" section indicates 24 results. A sidebar on the left lists various filters, with "Maps" selected and expanded to show "Lunar Map", "Mars Map", and "Saturn Moon Maps". The main content area shows a grid of six image thumbnails, each with a download icon and a file ID. The interface is dark-themed with a blue background.

Image Atlas

Web Interface

- *Intuitive user interface*
- *Autocomplete search bar*
- *Share your search*
- *Pop-up image viewer*
- *Interactive maps*
- **Download capability**

Image Atlas

Web Interface

- Download capability
 - Select individual images on page or all in query
 - Generates download script that can be run on macOS, Windows, and Linux
 - Downloaded products include the image and its PDS label
 - Other images may be downloaded as well for some products

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Image Atlas

Search Service

- Apache Solr Overview
- Configuration
- Sample Queries

Image Atlas

Search Service

- **Apache Solr Overview**
- *Configuration*
- *Sample Queries*

Image Atlas

Search Service

- Apache Solr Overview
 - Open source enterprise search platform
 - Requires a *schema* in which *fields* are defined of various *types*, such as *strings*, *multi-values* (arrays), and *floats*
 - A *data import* file maps data from an external source to fields in the schema
 - Powerful *faceting* functionality
 - Queries are made to Solr via its RESTful API
- Configuration
- Sample Queries



Image Atlas

Search Service

- *Apache Solr Overview*
- Configuration
 - Ingestion scripts
 - MySQL databases
 - Managed schema
 - Data Import files
 - Update processors
- *Sample Queries*

Image Atlas

Search Service

- *Apache Solr Overview*
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 - **Ingestion scripts**
 - *MySQL databases*
 - *Managed schema*
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- *Sample Queries*

Image Atlas

Search Service Configuration

- Ingestion pipeline
 - Data is stored on disk at PDS IMG and elsewhere
 - The PDS labels of each image are parsed for image metadata
 - If applicable, raw images are converted to browser-friendly formats
 - Neural networks are run on some datasets, including MSL and Europa

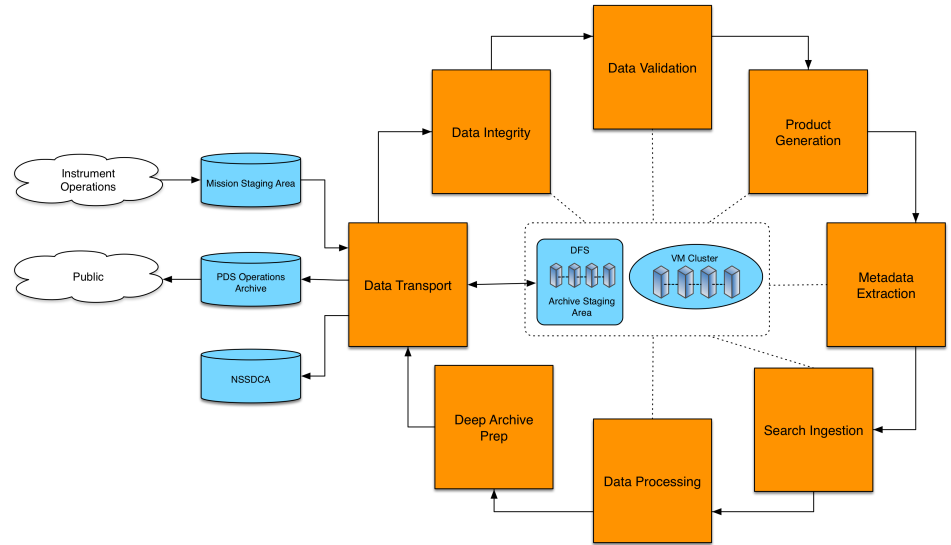


Image Atlas

Search Service

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 - *Managed schema*
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Image Atlas

Search Service Configuration

- MySQL databases
 - Each data set is given its own database
 - Data within databases are broken into tables by instrument, product type, etc.
 - Additional neural network classification information is appended to tables as relevant



Image Atlas

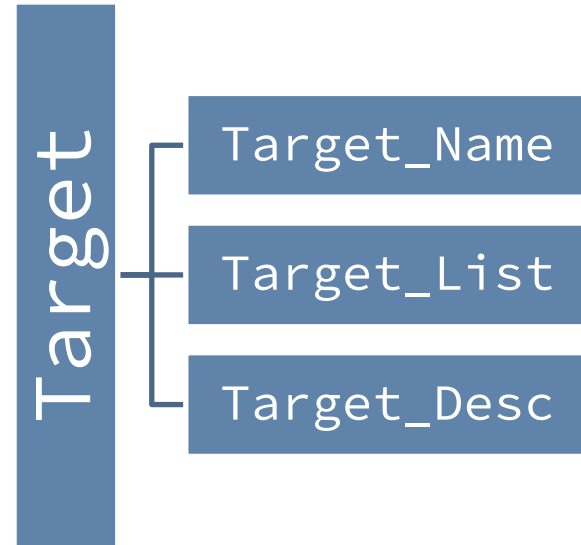
Search Service

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Image Atlas

Search Service Configuration

- Managed schema
 - XML file listing PDS keywords as *fields*
 - *Copy fields* allow individual fields to represent multiple fields



Example. A query for field Target will search the Target_Name, Target_List, and Target_Desc fields of image metadata.

Image Atlas

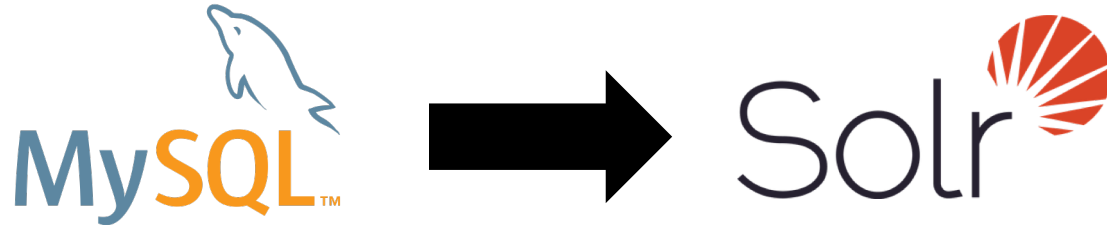
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- *Sample Queries*

Image Atlas

Search Service Configuration

- Data import files



Provide mapping from PDS keywords in MySQL data source to fields in Solr schema

Image Atlas

Search Service

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 - **Update processors**
- *Sample Queries*

Image Atlas

Search Service Configuration

- Update processors
 - Run code before modifications are made to the index
 - Can be implemented in Java, Python (via Jython), and many other languages
 - Useful for sanitizing/amending documents before they are added to the index, e.g.:
 - Converting all times to conform to ISO-8601
 - Removing quotation marks around values
 - Removing trailing/leading whitespace

Image Atlas

Search Service

- *Apache Solr Overview*
- *Configuration*
- **Sample Queries**

Image Atlas

Search Service Sample queries

- Request 100 images in JSON format
 - `https://pds-imaging.jpl.nasa.gov/solr/pds_archives/select?q=*:*&rows=100&wt=json`
 - `q=*:*`, queries for all data
 - `rows=100`, limits the number of images returned to 100
 - `wt=json`, requests response in JSON

Image Atlas

Search Service Sample queries

- Request all the different product types for Cassini mission data
 - `https://pds-imaging.jpl.nasa.gov/solr/pds_archives/select?q=ATLAS_MISSION_NAME:cassini&facet=true&facet.field=PRODUCT_TYPE&wt=json`
 - `q=ATLAS_MISSION_NAME:cassini`, queries for only Cassini mission data
 - `facet=true`, turns on faceting
 - `facet.field=PRODUCT_TYPE`, requests all the different values (“constraints”) for `PRODUCT_TYPE` among Cassini mission data

Image Atlas

Search Service Sample queries

- Request all images taken during the Mars Science Laboratory mission from spacecraft clock counts greater than or equal to 397,000,000 that contain wheels in them
 - `https://pds-imaging.jpl.nasa.gov/solr/pds_archives/select?q=ATLAS_MISSION_NAME:"mars science laboratory" AND SPACECRAFT_CLOCK:[397000000 TO *] AND MSL_IMAGE_CLASS:wheel`
 - `q=ATLAS_MISSION_NAME:"mars science laboratory" AND SPACECRAFT_CLOCK:[397000000 TO *]`, queries for all data taken by MSL in the specified timeframe with wheels in the frame

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References

Content

- NASA Planetary Data System: <https://pds.nasa.gov/>
- PDS Imaging Node: <https://pds-imaging.jpl.nasa.gov/>
- NASA: <https://nasa.gov/>
- Apache Solr: <http://lucene.apache.org/solr/>
- Image Atlas: <https://pds-imaging.jpl.nasa.gov/search/>

Image Credits

- Slides 4, 5: “NASA Planetary Data System”. <https://pds-imaging.jpl.nasa.gov/>
- Slide 29, 38: “Apache Solr”. <http://lucene.apache.org/solr/>
- Slide 32: “PDS Archiving Pipeline” – JPL proprietary. <https://jpl.nasa.gov/>
- Slides 34, 38: “MySQL”. <https://oracle.com/mysql/>



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- **Backup**

Backup

- Webification (w10n)
- Servicification (serv10n)

Backup

- **Webification (w10n)**
- *Servicification (serv10n)*

Webification (w10n)

<https://ammos.jpl.nasa.gov>

- Multi-mission technology that enables piecewise retrieval of components of data products via a RESTful API
- Subsets of raw raster data can be retrieved directly from the source, eliminating the need to download the entire original product
 - Saves bandwidth
 - Reduces download time
- Additional server-side operations are supported
 - PDS/VICAR to GIF conversion
 - Cropping and resizing
- No software for clients to install

Backup

- *Webification (w10n)*
- **Servicification (serv10n)**

Servicification (serv10n)

<https://ammos.jpl.nasa.gov>

- Multi-mission technology that allows applications (“tools”) installed on remote hosts to be executed over a network via a RESTful API
- “REST API wrapper”
- Implementation exists in Tools Service
- Tool support
 - Command line executables
 - systemctl
 - apt-get
 - Java classes
 - ImageIO
- A&A
- No software for clients to install

Webification (w10n) & Servicification (serv10n)

<https://ammos.jpl.nasa.gov>

- PDS IMG usage
 - Perform run-time conversion of raw image files to browser-friendly equivalents in different formats (e.g. GIF)
 - GIFs are used by image stretching/filtering/histogram software (JPLFX)
- For more information
 - Visit: <https://ammos.jpl.nasa.gov>
 - E-mail: ammos_info@jpl.nasa.gov
 - Phone: 818-393-0686



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