Digital Archives, Digital Forensics, and Open Source Search: Developing Together

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Open Source Search Conference

Chantilly, VA

October 2, 2012

About Me

- I am an archivist
- Occasionally I develop software
- I am not a digital forensics "expert"

Digital Archives at Yale


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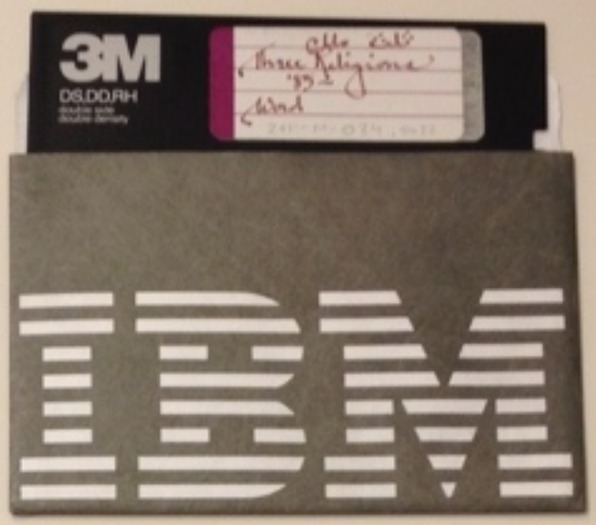
3M
DS.DD.RH
IBM


zip
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Iomega


12/3-14 seq. 3
Verbatim
DataLife
2HD


JENNIFER NEWSOM
YALE UNIVERSITY ARCHIVES
PORTFOLIO
05-16-05
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FD-2D-WP
diskettes
JD
IBM
Diskette

Digital Forensics in the Archival Domain

- Increasing use of digital forensics tools/methodologies within the context of digital archives programs (Kirschenbaum et al. 2010)
- Barriers to adoption: cost, complexity, need for additional tool development (Kirschenbaum et al. 2010; Daigle 2012; Lee et al. 2012)
- BitCurator project: http://bitcurator.net

Initial Goals

- Focus on implementation of and development with open source digital forensics software at Yale University Library
- Work must support accessioning, arrangement, description, and management of born-digital archival material
- Material received on physical media as primary focus

Design Principles

- Digital objects needing management are both disk images themselves (Woods, Lee, and Garfinkel 2011) and bitstreams that they contain

- Intention of forensic soundness, but assumption that much of the state is lost

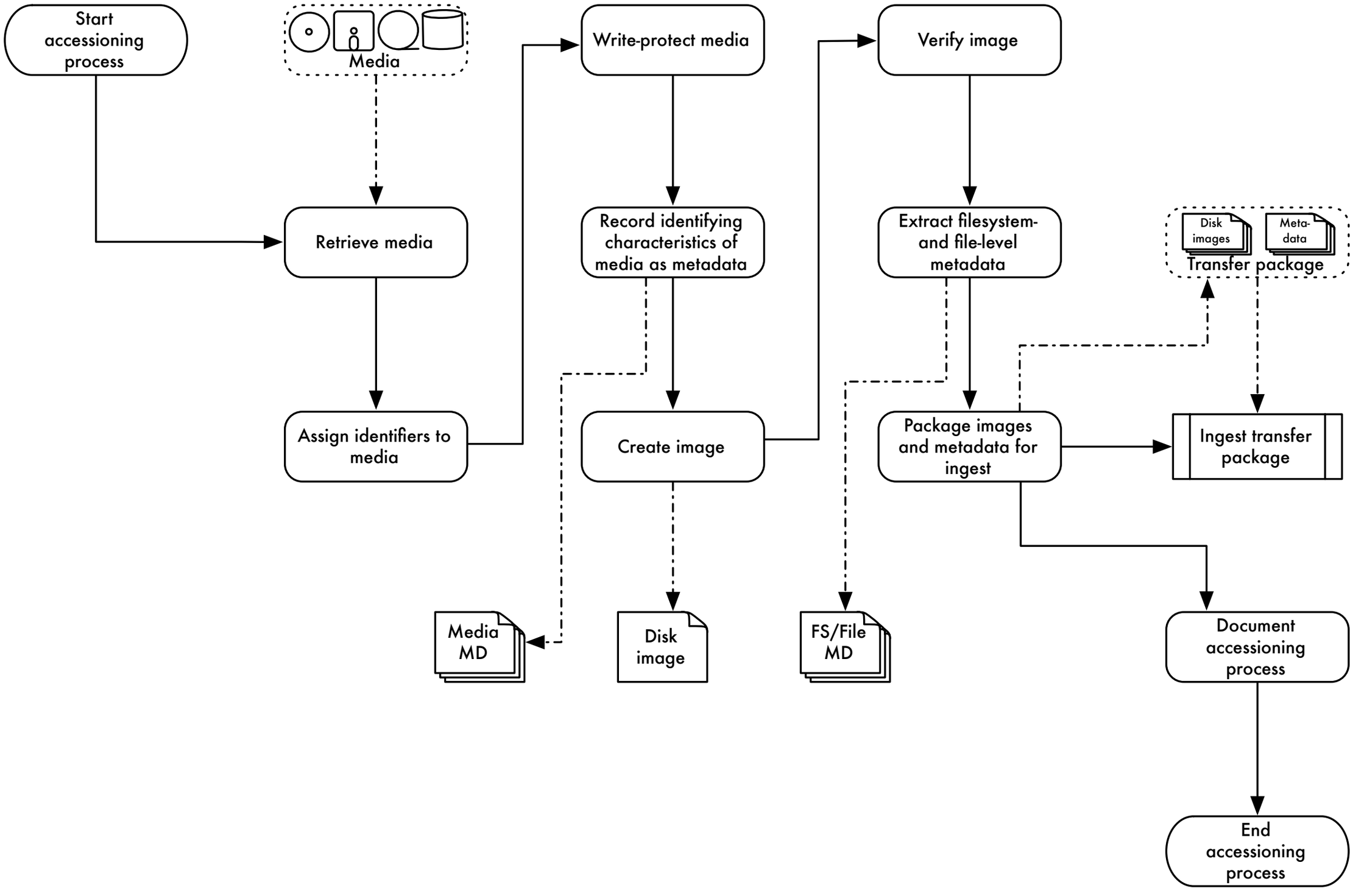
- Curation micro-services (Abrams, et al. 2010) as philosophical basis to guide our thinking

Micro-services as Design Philosophy*

Principles	Preferences	Practices
• Granularity	• Small and simple over large and complex	• Define, decompose, recurse
• Orthogonality	• Minimally sufficient over feature-laden	• Top down design, bottom up implementation
• Parsimony	• Configurable over the prescribed	• Code to interfaces
• Evolution	• The proven over the merely novel	• Sufficiency through a series of incrementally necessary steps
	• Outcomes over means	

*UC Curation Center/California Digital Library, 2010

Workflow


Start accessioning process
Media
Write-protect media
Verify image
Retrieve media
Record identifying characteristics of media as metadata
Extract filesystem- and file-level metadata
Disk images
Meta-data
Transfer package
Assign identifiers to media
Create image
Package images and metadata for ingest
Ingest transfer package
Media MD
Disk image
FS/File MD
Document accessioning process
End accessioning process

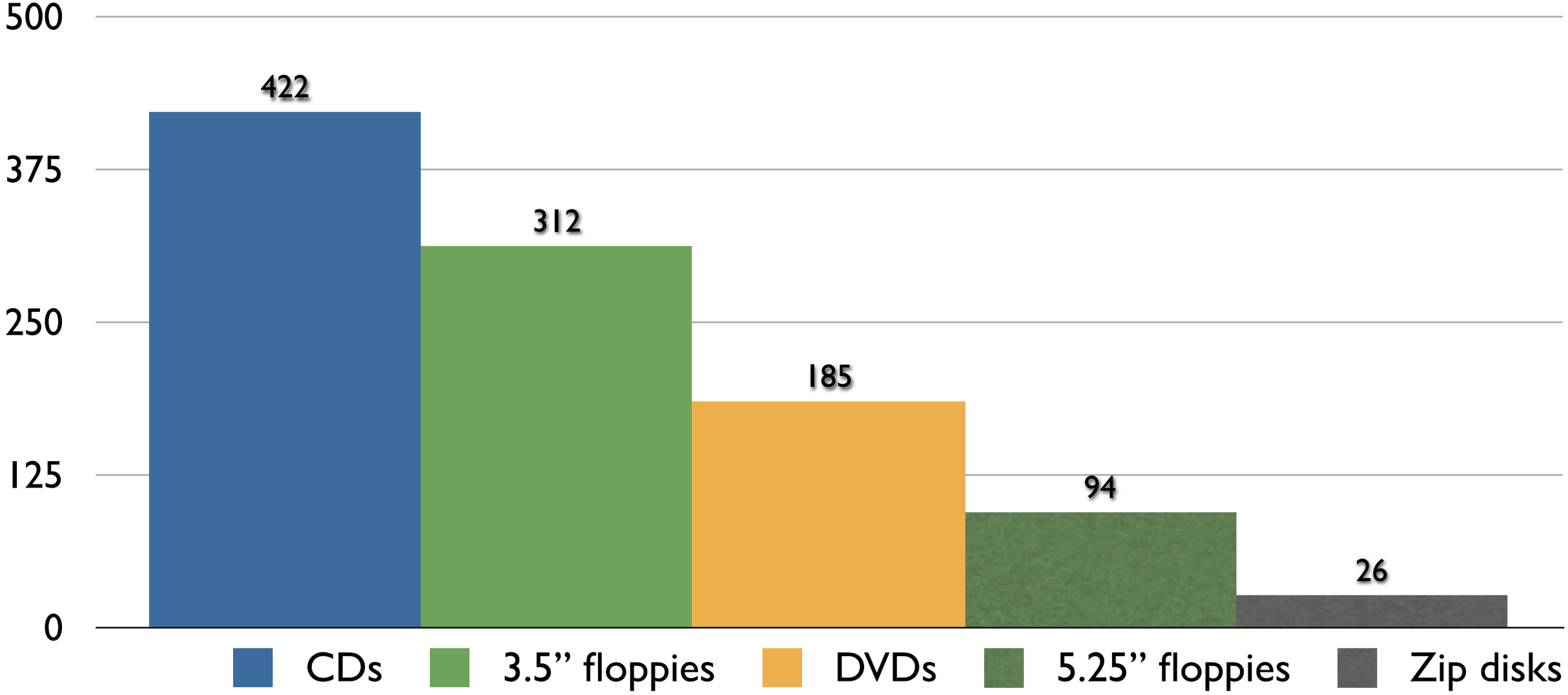
Disk Image Acquisition

- Requires a combination of hardware (drives/media readers, controller cards, write blockers) and software
- In some cases, hardware requires specific software (e.g. floppy disk controller cards that sample magnetic flux transitions)
- Goal: sector image interpretable by multiple tools


MSSA100
TABLEAU
T3458is Forensic Bridge
ASUS

Disk Images

- Acquired 1,039 disk images from across 69 accessions at Manuscripts and Archives



Initial Work with Disk Images

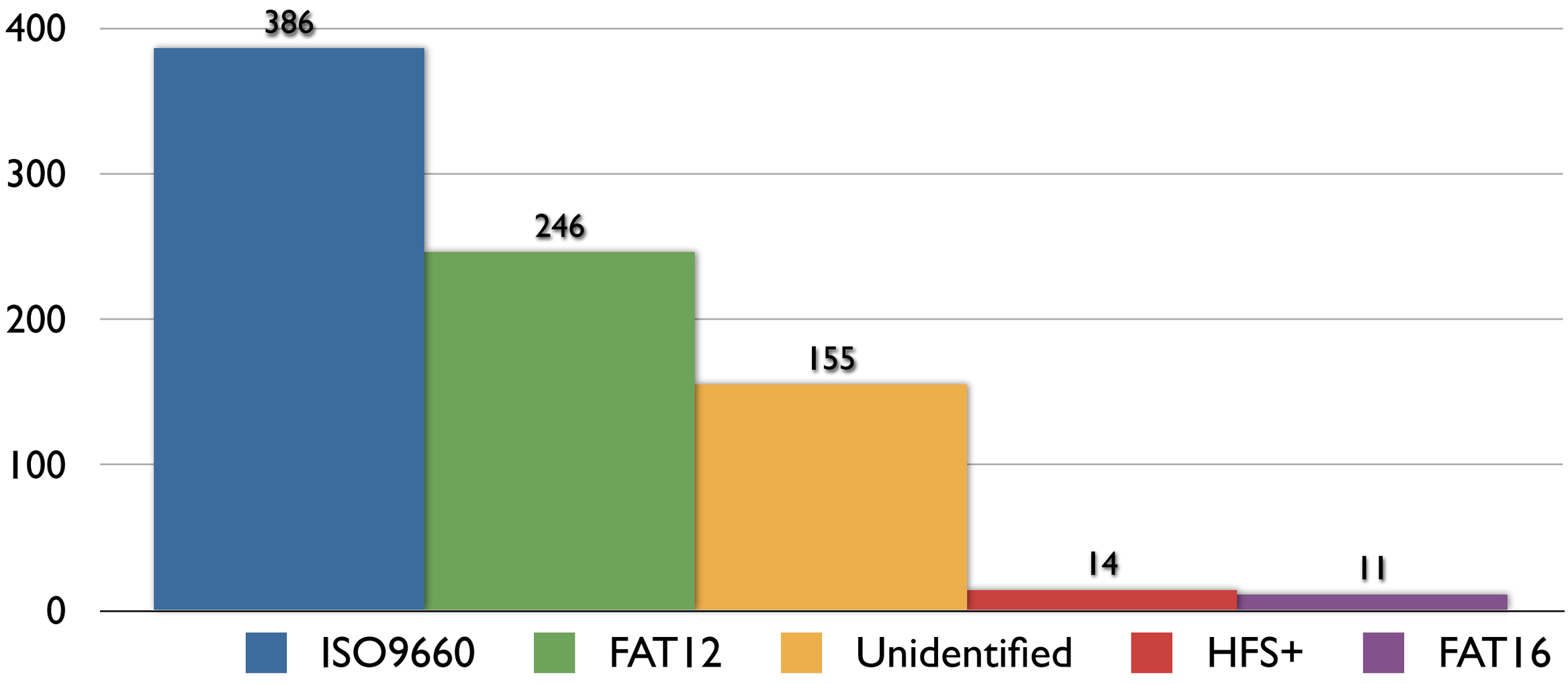
- Experimentation with various tools: The Sleuth Kit (3.1+), Autopsy, Pyflag, bulk_extractor …
- Basic integration/processing with shell scripts or Python
- Discovering fiwalk was my "eureka" moment

Metadata Extraction

- Used fiwalk and other open source tools to characterize media, volume, file system, and file information
- Attempt to repurpose this information as descriptive, structural, and/or technical metadata to support accessioning, appraisal, and processing
- Extracted metadata expressed in Digital Forensics XML
- Easily extensible and straightforward to process

File Systems

- Ran metadata extraction on 812 images



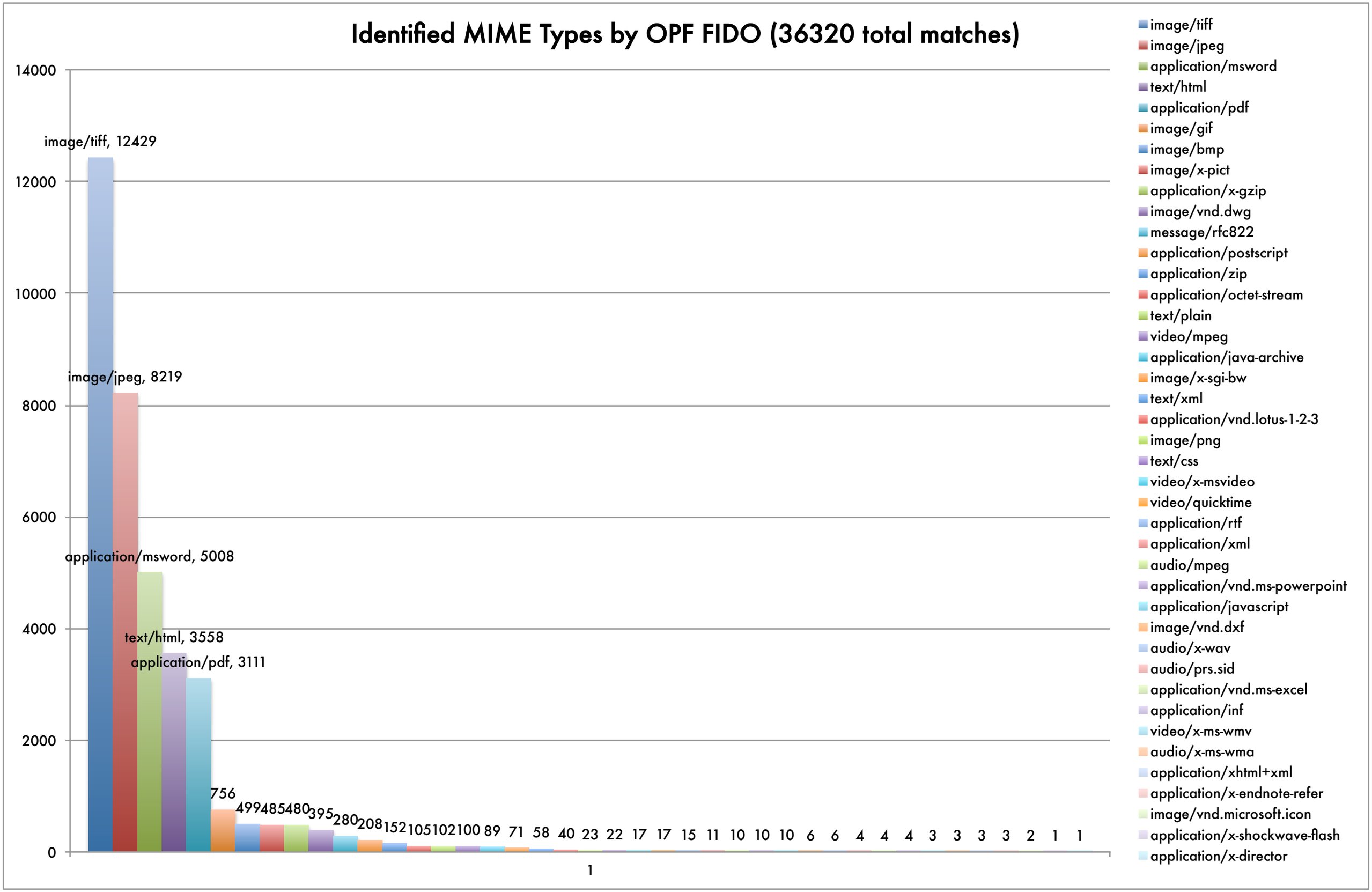
Extraction Plugins

- Created fiwalk plugins to perform additional analysis and evaluation of files/bitstreams within disk images
- Virus identification plugin using ClamAV/pyclamd
- File format identification against PRONOM format registry using Open Planets Foundation's FIDO
- Code (including additional plugins) available online: https://github.com/anarchivist/fiwalk-dgi/

File Analysis

- Ran enhanced metadata extraction on 619 images (using our plugins)
- Performed analysis on 49,724 files within images
- Successfully identified 43,729 files (147 unique file types) against PRONOM format registry
- Identified 9 files as containing virus signatures (2 unique virus signatures)

Identified MIME Types by OPF FIDO (36320 total matches)



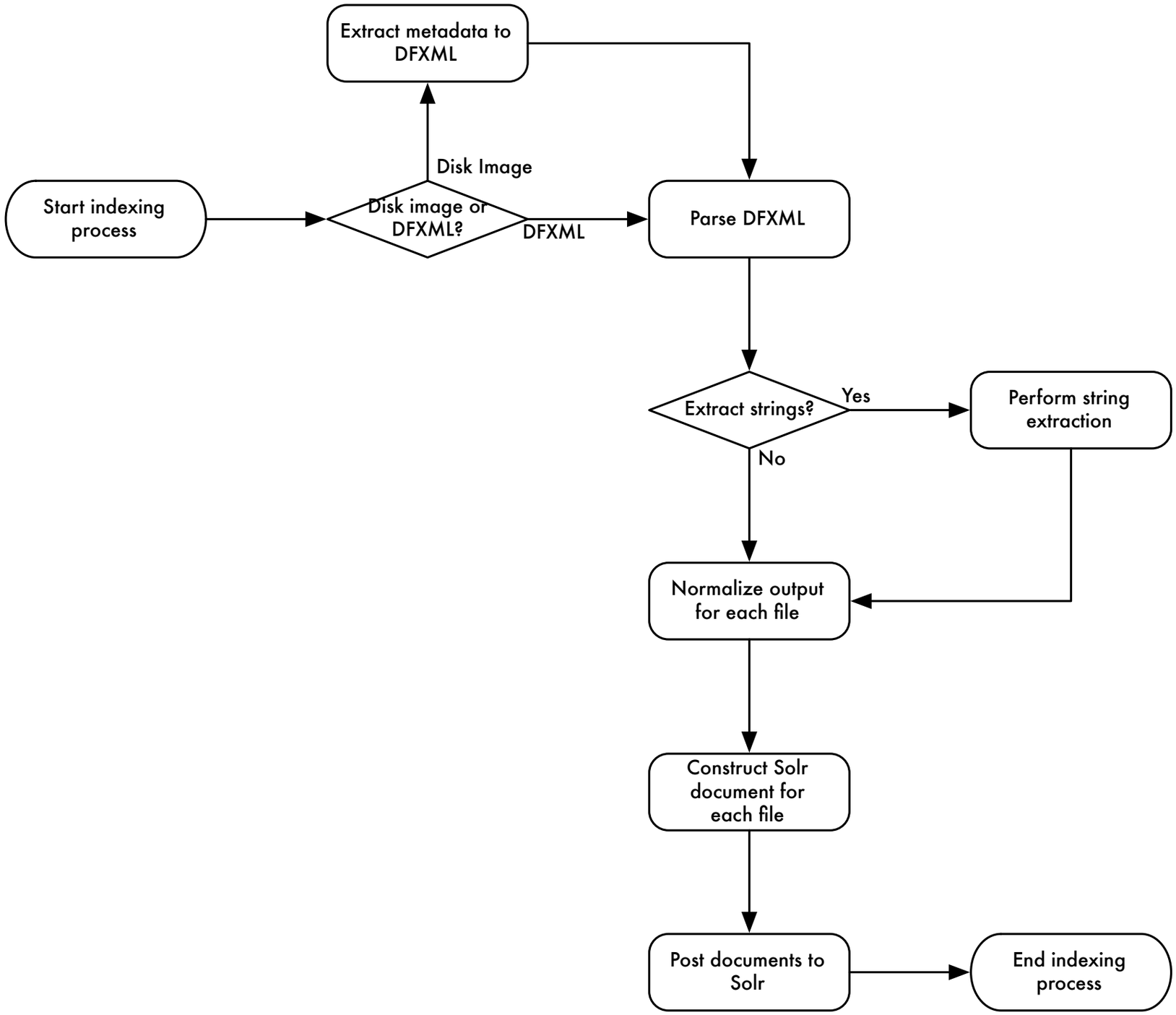
Gumshoe

- Prototype web application to provide search/browse interface to metadata extracted from disk images
- Built as a Ruby on Rails application using Blacklight
- http://github.com/anarchivist/gumshoe

Blacklight

- http://projectblacklight.org
- Ruby gem for use in Rails applications
- Provides discovery layer over Solr indexes, with support for faceting, bookmarking, etc.
- Use is fairly common in library community
- Implementers include Stanford, Columbia, NC State, UVA, WGBH, National Agricultural Library (AGNIC) ...

Indexing Process



Data Normalization

- Depends on DFXML gem
- Translate metadata-layer data to more easily searchable or human-readable version (e.g. file type/file system codes to text labels; certain flags to booleans)
- Data type conversion (e.g. integers-as-strings to integers)
- Prepend full path data to filename
- Transform timestamps to ISO8601

Features

- Basic browse view, with sorting by filename, size, modification/access/creation times
- Faceting by disk image, extension, file format, file type
- Basic bookmarking
- Searching based on metadata values (e.g. checksums), file content (still under development; somewhat slow)

Gumshoe

Search History

Fork me on GitHub

Limit your search

Image File

ubnist1_casper_rw_gen2 (1,210)

ntfs1_gen2 (39)

Extension

Format

data (453)

empty (139)

ASCII text (112)

XML document text (58)

JPEG image data, JFIF standard 1.02 (48)

JPEG image data, JFIF standard 1.01 (34)

ASCII English text (29)

GNU dbm 1.x or ndbm database, little endian (26)

HTML document, ASCII text, with very long lines, with CRLF, LF line terminators (22)

PDF document, version 1.4 (22)

more »

Type

Regular file (793)

Directory (381)

Shadow (28)

Symbolic link (24)

Unknown type (22)

Named FIFO (1)

in All Fields Search

Displaying items **1 - 10** of **1,249**

Start over

Sort by size

Show 10 per page

« Previous 1 2 3 4 5 6 7 8 9 ... 124 125 Next »

1. /home/ubuntu/Desktop/MyStuff/SEC Documents/spch121708cc-idata.wmv

Filename	spch121708cc-idata.wmv
Full Path	/home/ubuntu/Desktop/MyStuff/SEC Documents
Image file	ubnist1_casper_rw_gen2
Type	Regular file
Size (bytes)	37887210
Inode number	15697
MD5	8e7d1611c0b870f658529d94556f9a21
Format (libmagic)	Microsoft ASF
Modification Time	2008-12-17T17:10:00Z
Access Time	2008-12-29T05:35:21Z
Change Time	2008-12-29T05:35:21Z

2. /Compressed/logfile1.txt

Filename	logfile1.txt
Full Path	/Compressed
Image file	ntfs1_gen2
Type	Regular file
Size (bytes)	21888890
Inode number	48

Advantages

- Faster (and more forensically sound) to extract metadata once rather than having to keep processing an image

- Possibility of developing better assessments during accessioning process (significance of directory structure, accuracy of timestamps)

- Integrating additional extraction processes and building supplemental tools is simple

Limitations

- Use of tools limited to specific types of file systems
- Requires additional integration and data normalization to work with additional tools
- DFXML is not (currently) a metadata format common within domains of archives/libraries; somewhat in flux
- Extracted metadata harder for archivists to repurpose in some cases based on level of granularity
- Still struggling with how to best present data to archivists

Work in Progress

- BitCurator project under development; early release available for testing: http://wiki.bitcurator.net
- Additional testing, development integration under work at Yale and NYPL

Thanks!

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@anarchivist

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