# Introduction to Research Data Management

File formats and metadata

http://hdl.handle.net/1969.1/164755

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# Workshops

1. Build an overview
2. Collect and document data
3. Store digital data
4. Work with data
5. **Share and preserve data**
6. Plan ahead

# Introduction

Focus: Understanding file formats for data, and taking advantage of your documentation to create metadata that describe your data files.

The goal is to ensure your data are usable when shared with others.

# Discussion

What kind of file formats you are likely to work with in your research?

# File formats

File formats are a way of encoding information within a computer file, the format specifies how bits are used to encode information.

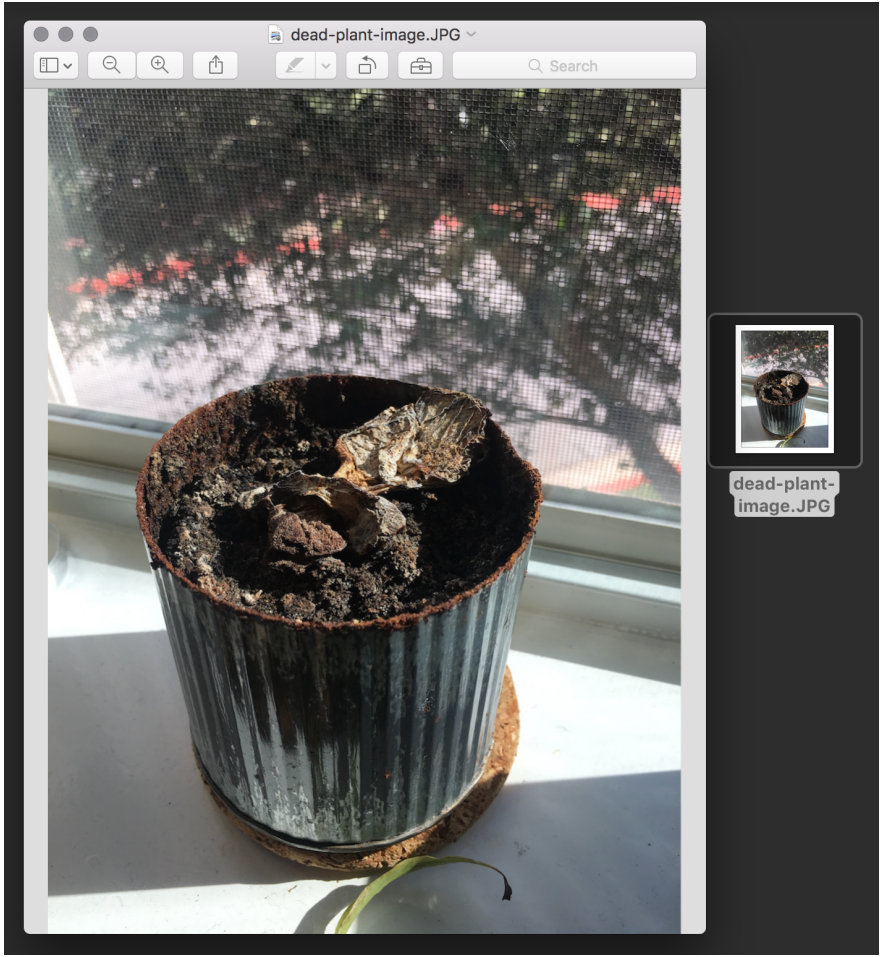
Two types of file formats:

- Binary
- Text

# Files with binary encodings

Can only be read by applicable software, and can contain formatting information, images, sounds, compressed versions of other files.

May use open or proprietary standards.


dead-plant-image.JPG
Search
dead-plant-image.JPG
dead-plant-image.JPG — Edited
dead-plant-image.JPG

# Files with character encodings

Text files use character encoding standards to make them machine-readable.

All text characters are encoded but many standards are in use, often depending on software and country.

# ASCII and UTF-8 text encoding standards

Use ASCII or Unicode UTF-8 for “plain text” file formats, TXT, CSV, HTML, XML.

**ASCII:** Used to represent the alphabetic, numeric, and punctuation characters commonly used in English.

**UTF-8:** Backward compatible with ASCII. Capable of encoding all valid code points in Unicode, covers the characters of nearly all alphabets.

# File formats for data

From the data lifecycle perspective, think about:

**Interoperability**: data files are usable with different software tools.

**Preservation**: data files can be accessed 10 or more years later.

# Features of formats that last

1. In common usage by the research community.
2. Non-proprietary.
3. Documented standards.
4. Uncompressed (space permitting).

# Recommended formats

| Content | File formats |
|---|---|
| Text | PDF/A, HTML, XML, TXT |
| Tabular data (spreadsheets and databases) | XML, CSV |
| Numbers and statistics | TXT, DTA, POR, SAS, SAV |
| Geospatial | SHP, DBF, GeoTIFF, NetCDF |
| Audio | WAVE, AIFF, MP3, MXF |
| Images | TIFF, JPG, JP2, PDF, PNG, GIF, BMP |
| Moving Images | MOV, MPEG-4, AVI, MXF |
| Web Archive | WARC |
| Containers | TAR, GZIP, ZIP |

# Alternatives

| Discouraged Format | Alternative Format |
| --- | --- |
| Excel (.xls, .xlsx) | Comma Separated Values (.csv) |
| Word (.doc, .docx) | plain text (.txt), or if formatting is needed, |
| PowerPoint (.ppt, .pptx) | PDF/A (.pdf) |
| Photoshop (.psd) | TIFF (.tif, .tiff) |
| Quicktime (.mov) | MPEG-4 (.mp4) |

# Tips for converting file formats

1. Go from proprietary (software-specific) to non-proprietary (open).

2. Use to standard character encodings.

3. Beware of lossiness and corruption.

**Lossiness**: file losses information or quality.

**Corruption**: file is no longer usable.

# Containers

**ZIP**: De facto standard (lossless) compression format used on Windows, Mac, and Linux platforms

**TAR**: Commonly used on Mac and Linux platforms to bundle a set of files.

# Break

# Metadata

Structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource.

Metadata is often called “data about data” or “information about information.”

# Discussion

Have you created or used metadata?

What is it good for?

# Metadata for data

From the data lifecycle perspective, information for:

**Discoverability**: data files can be located and identified correctly.

**Accessibility**: content within data files can be interpreted, assessed, and used.

# Distinguishing documentation and metadata

**Documentation**

- Can be informal.
- Created while working on a project.
- May cover many levels (project, datasets, data files, variables and values).
- May provide general context.

**Metadata**

- Formally describes a particular object (can be a data file or dataset).
- Often created upon “publication” and linked to an object.
- Formatted into a record and structured according to standards.
- May derive from the documentation.

# Types of metadata

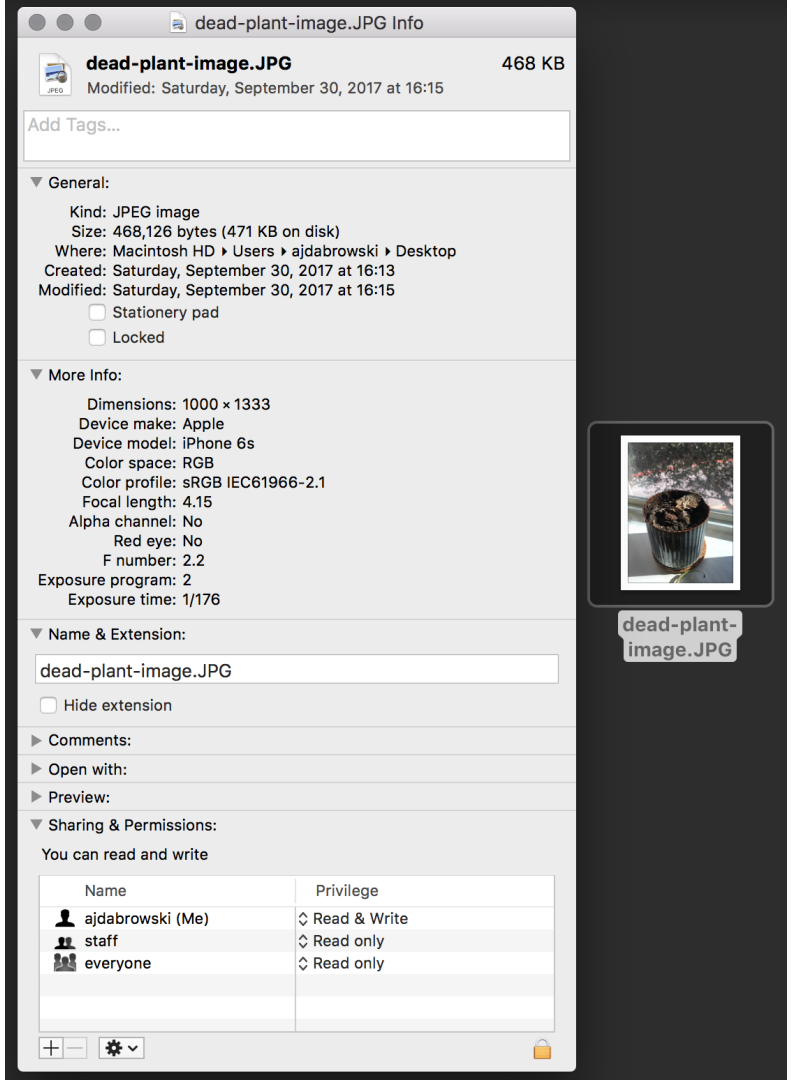
- **Descriptive**: Describes the object and gives the basic facts.
- **Structural**: Describes the structure of an object including its components and how they are related.
- **Administrative**: Contains information about the management of the object, e.g. terms of use, required software, provenance (history), and file integrity checks.

# Creating metadata

Machine generated.

User generated.

- Copy-pasted from documentation.
- Created on the spot.



# Metadata records

Core descriptive metadata:

- Title
- Creator
- Identifier
- Subject
- Dates

# Metadata standards

Guide the collection and structure of metadata so that data is collected, described, structured, and referred to consistently.

# Examples of metadata standards

Find disciplinary standards: http://www.dcc.ac.uk/resources/metadata-standards

| Discipline | Standard |
|---|---|
| Biology | Darwin Core |
| Ecology | EML - Ecological Metadata Language |
| Earth Sciences | AgMES - Agricultural Metadata Element Set |
| Physical Sciences | CIF - Crystallographic Information Framework |
| Social Sciences & Humanities | DDI - Data Documentation Initiative |
| General Research Data | DataCite Metadata Schema |
| General Research Data | Dublin Core |

# Creating metadata records

- Controlled vocabularies: lists of predefined terms that ensure consistency of use, and help to disambiguate similar concepts.

- Technical standards: ensure that the units such as date and time are entered consistently amongst different researchers.

# Examples of controlled vocabularies

- ERIC Thesaurus for education terms (http://www.eric.ed.gov/ERICWebPortal/resources/html/thesaurus/about_thesaurus.html)
- IEE INSPEC Thesaurus of the Scientific and Technical terms (http://www.theiet.org/resources/inspec/products/aids/index.cfm)
- Centre for Agricultural Bioscience international's CAB Thesaurus (http://www.cabi.org/cabthesaurus/mtwdk.exe?yi=home)
- Medical Subject Headings (MeSH) (http://www.nlm.nih.gov/mesh/)
- Library of Congress Subject Headings (LCSH) (http://authorities.loc.gov/)

# Date and time standard

**ISO 8601**

- Year: YYYY (e.g. 1997)
- Year and month: YYYY-MM (e.g. 1997-07)
- Complete date: YYYY-MM-DD (e.g. 1997-07-16)
- Complete date plus hours and minutes: YYYY-MM-DDThh:mmTZD
    - (e.g. 1997-07-16T19:20+01:00)
- Complete date plus hours, minutes and seconds: YYYY-MM-DDThh:mm:ssTZD
    - (e.g. 1997-07-16T19:20:30+01:00)

# Tips for metadata

- Consistent data entry is important.
- Avoid extraneous punctuation.
- Avoid most abbreviations.
- Use templates or copy-paste when possible.
- Extract metadata from your documentation.
- Keep a reference to elements, technical standards, and controlled vocabularies you use in your project.
- Always use an established metadata standard.

# Conclusion

- Identified appropriate file formats for sharing data.
- Reviewed basics of metadata standards

# References and resources


- Abrams, Stephen. "File Formats" [PDF](http://www.dcc.ac.uk/resources/curation-reference-manual/completed-chapters/file-formats)
- DataONE. "Document and Store Data Using Stable File Formats" [Website](http://www.dataone.org/best-practices/document-and-store-data-using-stable-file-formats)
- Library of Congress. "Sustainability of digital formats" [Website](https://www.loc.gov/preservation/digital/formats/index.shtml)
- NISO. "Understanding Metadata: What is metadata and what is it for?" [PDF](http://www.niso.org/apps/group_public/download.php/17446/Understanding%20Metadata.pdf)