Research Data and Data Management Planning

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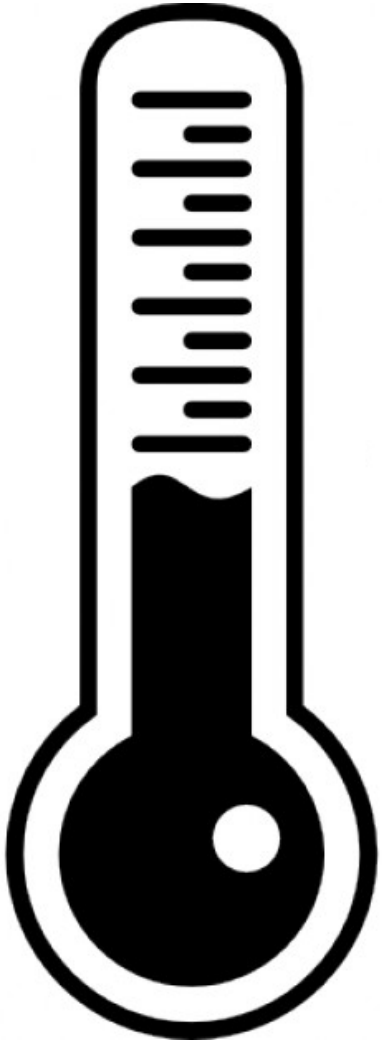
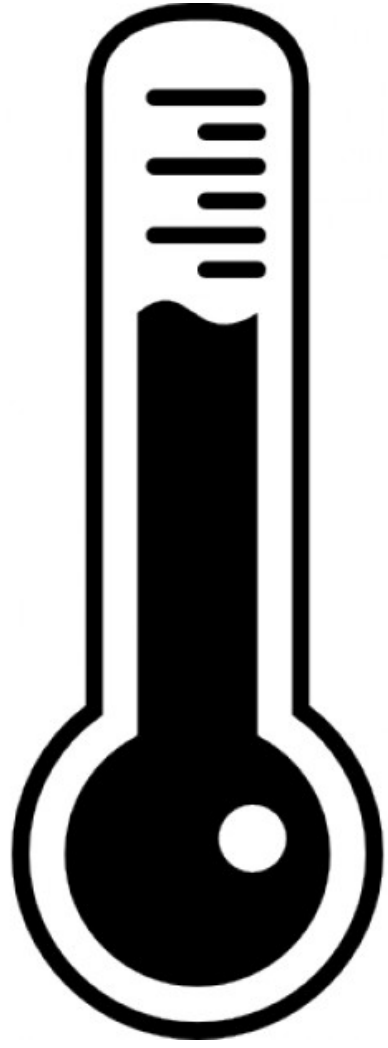
Outline

- What are research data
- Research data lifecycle
- Data types, formats, models and standards
- Metadata
- Data management, plans and planning tools

Datum is ultimately reducible to a lack of uniformity [1]





Define data

- Entities, physical or digital, used as evidence of phenomena [2]
- A reinterpretable representation of information [3]
- Items of recorded information
- There is no consensus definition
- Even institutions that curate data may not define what they curate

Data examples

- Not just spreadsheets of numbers, also
- Sequences of bits
- Characters on a page
- Recording of sounds
- Physical and biological specimens
- Images
- Software

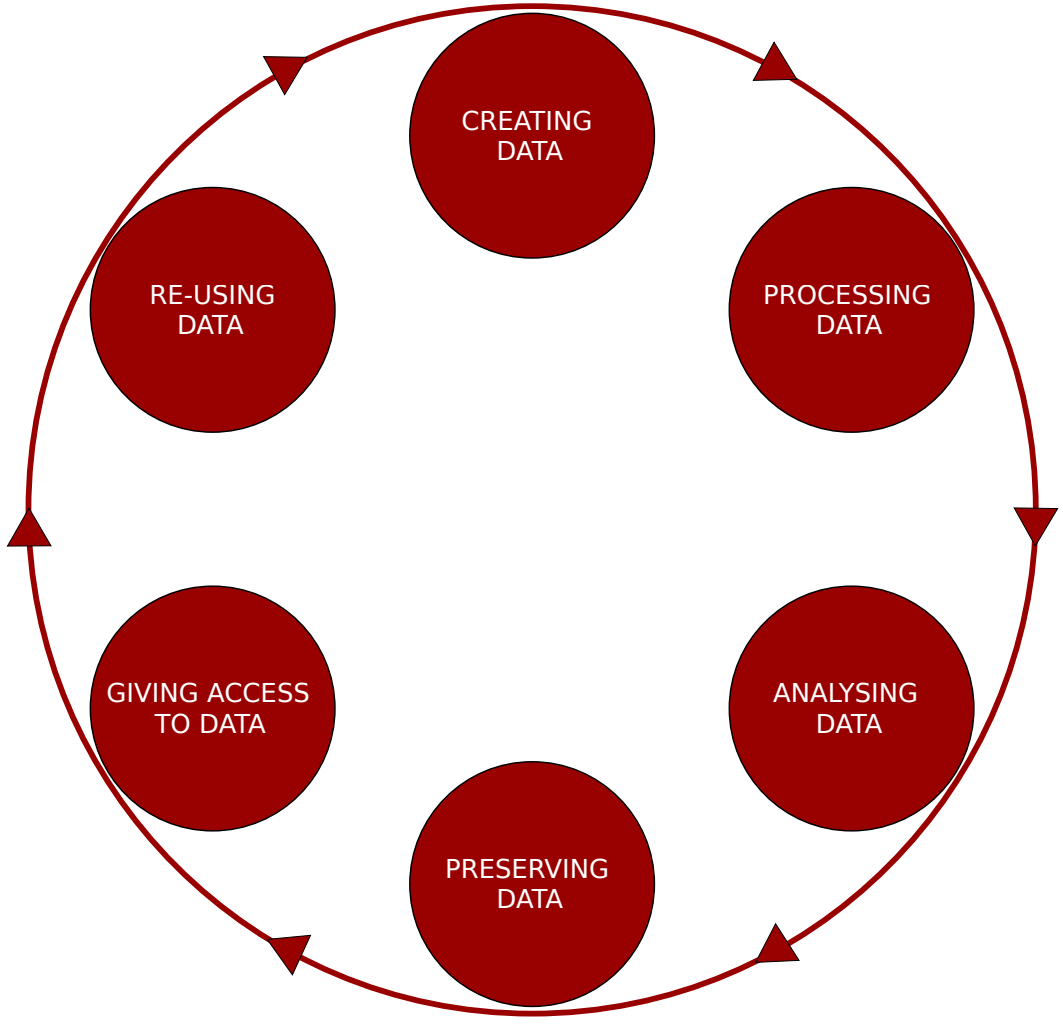
Define research data

- Unsurprisingly, there is no consensus on the definition
- Factual material [...] necessary to validate research findings [4]
- Everything needed to reproduce a given scientific output [5]

Research data examples

- In addition to the obvious, e.g. data files
- Notebooks, e.g. laboratory, field, diaries, ...
- Questionnaires, audio and video tapes
- Models and scripts
- Workflows and protocols

Research data lifecycle



Adapted from `http://www.data-archive.ac.uk/create-manage/life-cycle`

Research data types

- Observational data
  - Result from recognizing, noting or recording facts
  - Collected by human observation, surveys, instruments
  - Typically difficult or impossible to reproduce
  - Example: Ocean temperature measurements at spacetime locations
- Experimental data
  - Result of procedures in controlled conditions
  - In theory reproducible but may be expensive
  - Example: Results of chemical analysis in a laboratory
- Computational data
  - Result in executing computer models, simulations, or workflows
  - Reproducible if software and input available
  - Example: Output of a plant disease pressure model

Data formats

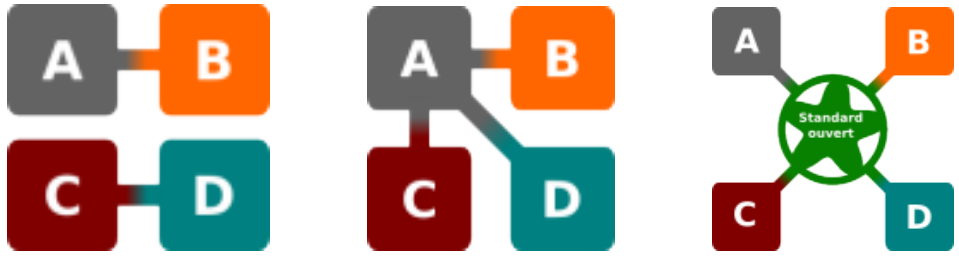
- Serialized representation of data
- Comma separated values (CSV) is a common format
- JPEG, TIFF, PNG, GIF for raster images
- SVG, EPS, PDF for vector graphics
- NetCDF, HDF5 for array scientific data

Data models

- Abstract formalization of objects and relationships in a domain
  - There are lakes, rivers, and mountains
  - Lakes and rivers have a depth
  - Mountains have an elevation
  - Rivers have a length
- Set of concepts used to define formalizations
  - Entity-relationship data model
  - Graph data model
  - Geographic data model

Standards

- Heterogeneity in data models and standards hinders interoperability
- Characteristic of system to work with other systems



definition-interoperabilite.info

- Syntactic and semantic interoperability
- If you can, use (de facto) standard, recommendation, wide acceptance
- Examples
  - ISO Date and time format, Country codes, Geographic information
  - W3C HTML, XML, RDF
  - IETF TCP/IP, URI

Metadata

- Metadata is data about other data
- Metadata describes, explains, locates data
- Supports discovery, retrieval, use, management of data
- May be created manually or automatically
- What is data for someone may be metadata for someone else
- Examples
  - Data about observational data, e.g. about sensor and property
  - Data about published data, e.g. title, authors, identifiers
  - Phone call content vs. phone number, call duration

Data management

- Organization, storage, preservation, and sharing of data
- Data collected and used in a research project
- Note: Data *and* metadata
- Data is complicated; good management imperative
- From issues such as consistent file naming conventions
- To safeguarding access over the next 10 years

Why data management

- Increasingly required by funders and publishers
- Saves time and resources in the long run
- Prevents errors and increases quality of research
- Enables replication and validation of results
- Potential for new discoveries, if shared with others

Planning data management

- Good data management needs to be carefully planned
- Write a Data Management Plan
- Consider
  - Data format and quantity of generated, collected, processed data
  - Is data going to be versioned
  - Data storage, archiving and backup policy and implementation
  - Creating and managing metadata that describe the data
  - Data access and sharing, license and security
  - Budgeting data management and preservation, after the project

FAIR Principles

- Findable
  - Persistently identified, described, indexed
- Accessible
  - Retrievable by identifier, open protocol, accessible metadata
- Interoperable
  - Represented using formal, accessible, shared FAIR vocabulary
- Re-usable
  - Meet community standards, associate with provenance, usage license

https://www.force11.org/group/fairgroup/fairprinciples

Online training material

- ESIP Federation Data Management Short Course for Scientists
  - `http://commons.esipfed.org/datamanagementshortcourse`
- University of Edinburgh, Research Data Management Training
  - `http://mantra.edina.ac.uk/`
- Coursera, Research Data Management and Sharing
  - `https://www.coursera.org/learn/data-management`
  - Starts September 11

Take aways

References

[1] Luciano Floridi. *The Philosophy of Information*. Oxford University Press, 2011. ISBN 978-0-19-923239-0.

[2] Christine L. Borgman. *Big Data, Little Data, No Data: Scholarship in the Networked World*. The MIT Press, 2015. ISBN 9780262028561.

[3] CCSDS. Reference Model for an Open Archival Information System (OAIS). Recommended Practice CCSDS 650.0-M-2, The Consultative Committee for Space Data Systems, Washington, DC, USA, June 2012. URL `https://public.ccsds.org/Pubs/650x0m2.pdf`.

[4] EPSRC. Research Data. URL `https://www.epsrc.ac.uk/about/standards/researchdata/scope/`.

[5] Alisa Surkis and Kevin Read. Research data management. *Journal of the Medical Library Association : JMLA*, 103(3): 154–156, jul 2015. doi: 10.3163/1536-5050.103.3.011. URL `https://doi.org/10.3163/1536-5050.103.3.011`.

Slide 3: Joan Miró (1968). Landscape. Acrylic on canvas. Fundación Joan Miró, Barcelona.
`https://www.fmirobcn.org/en/colection/catalog-works/5442/p-landscape-p`
Slide 5: On defining data, see `http://pitt.libguides.com/managedata`
Slide 14: On research data management, see `http://pitt.libguides.com/managedata`