FAIR technical infrastructures currently in development

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FAIR technical infrastructures currently in development (with quite some personal bias)

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Outline

- The ***F*** in FAIR
- FAIR ≠ Open

Findability

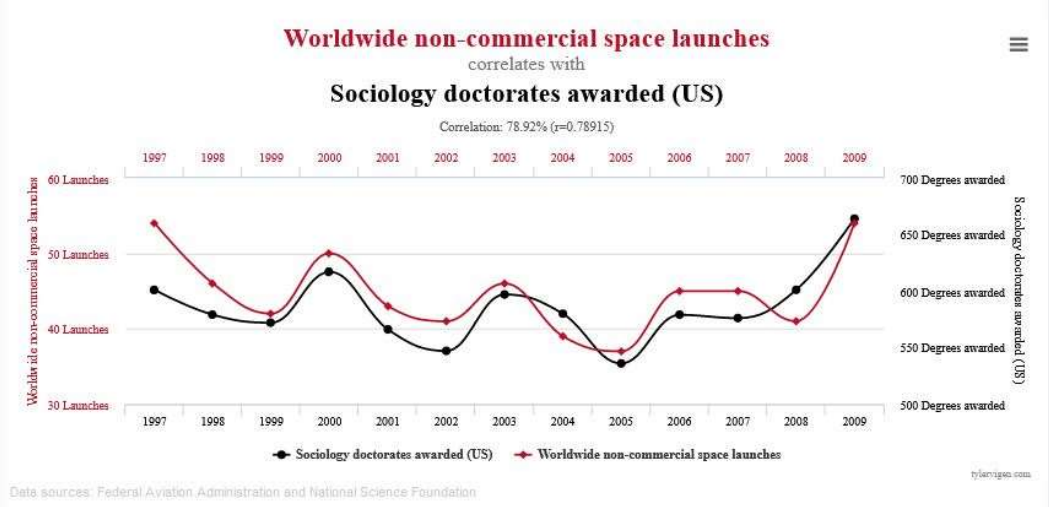
- Being able to find stuff (data)
- “Google for Data” – what do we need?
  - Description of the data
  - A full-text search engine (e.g. Elastic Search)
- Done?

Findability

- Being able to find stuff (data)
- “Google for Data” – what do we need?
  - Description of the data
  - A full-text search engine (e.g. Elastic Search)
- Done? – Well…
- FAIRness is predominantly for machines!
- Machines are not good in understanding full-text searches
- Results need to be machine-actionable
- Humans benefit from more structured approaches
- Especially when looking for interdisciplinary data
- Search for data is different…

Findability

- Example scenarios: Databases that have data on…
  - Temperature measurements
  - Temp./temperatuur/hitastig/lämpötila/θερμοκρασία/…
  - In the range of -40 to 45 Celsius; 18-22 millikelvin
  - Measured in locations above 66°34′N, along the Danube,…
  - That show a bi-modal distribution
  - That have a high correlation with the following dataset. (just for fun: https://www.tylervigen.com/spurious-correlations)
  - That has not been low-pass filtered…
  - That I may re-use…



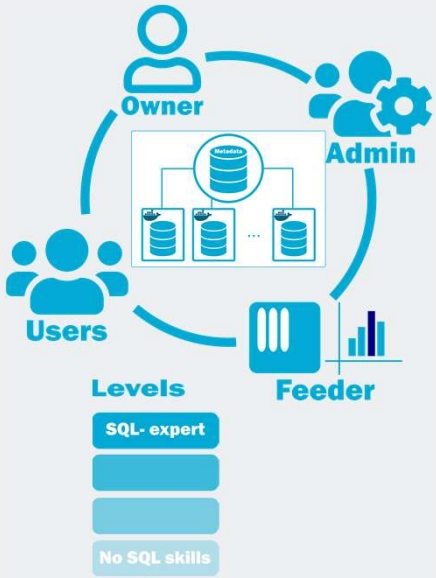
Findability

- Need comprehensive metadata on data
- In structured form
- Ideally generated automatically

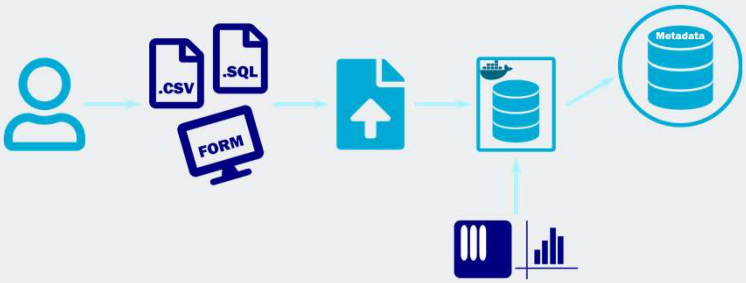
- Mapping to controlled vocabularies / ontologies
  - Attribute semantics
  - Measurement units
  - Conversion rules (primarily for ***I***, but also for ***F***)
- Assist user in mappings (semi-automatic)
- Statistical properties

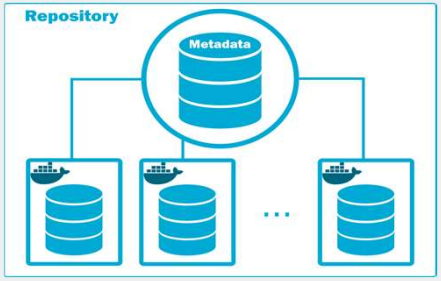
- Provenance
- Licenses (primarily for ***R***, but also for ***F***)

Findability for FDA DB-Repo: Vision



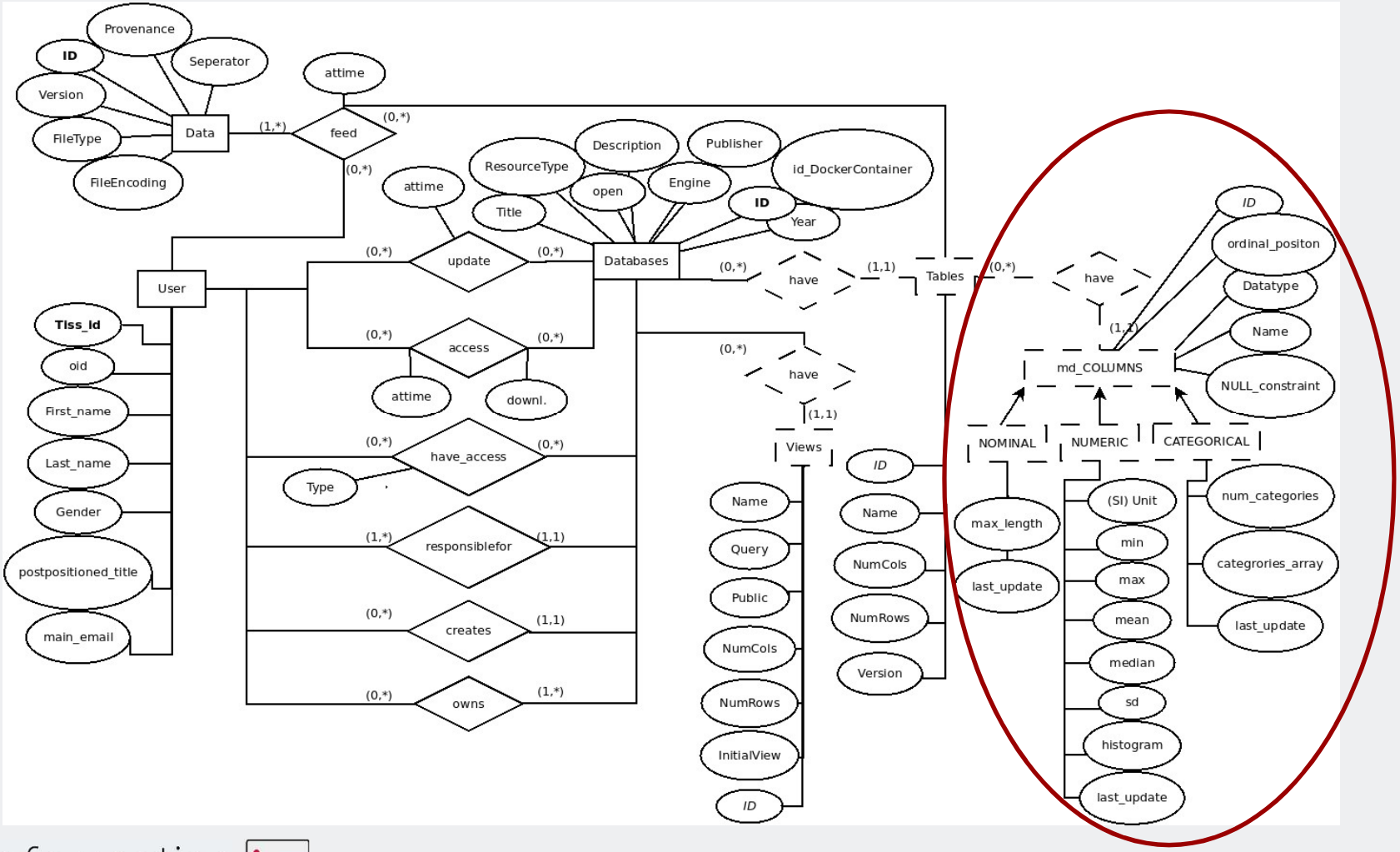
- Structured data
- Private cloud hosted relational databases
- DB is created directly in repository framework
- DB is populated and used within repository
- Metadata is generated and exposed
- Databases and data are searchable
- Data is versioned & time-stamped: reproducibility, re-use, provenance
- Data is cite-able at arbitrary levels of granularity (RDA WGDC recommendations)
- Data Management outsourced to repository infrastructure: easier for researchers, higher quality data mgt, higher security, …





Findability

- Metadata DB – initial schema (+ API, schema for responses, …)



Outline

- The ***F*** in FAIR
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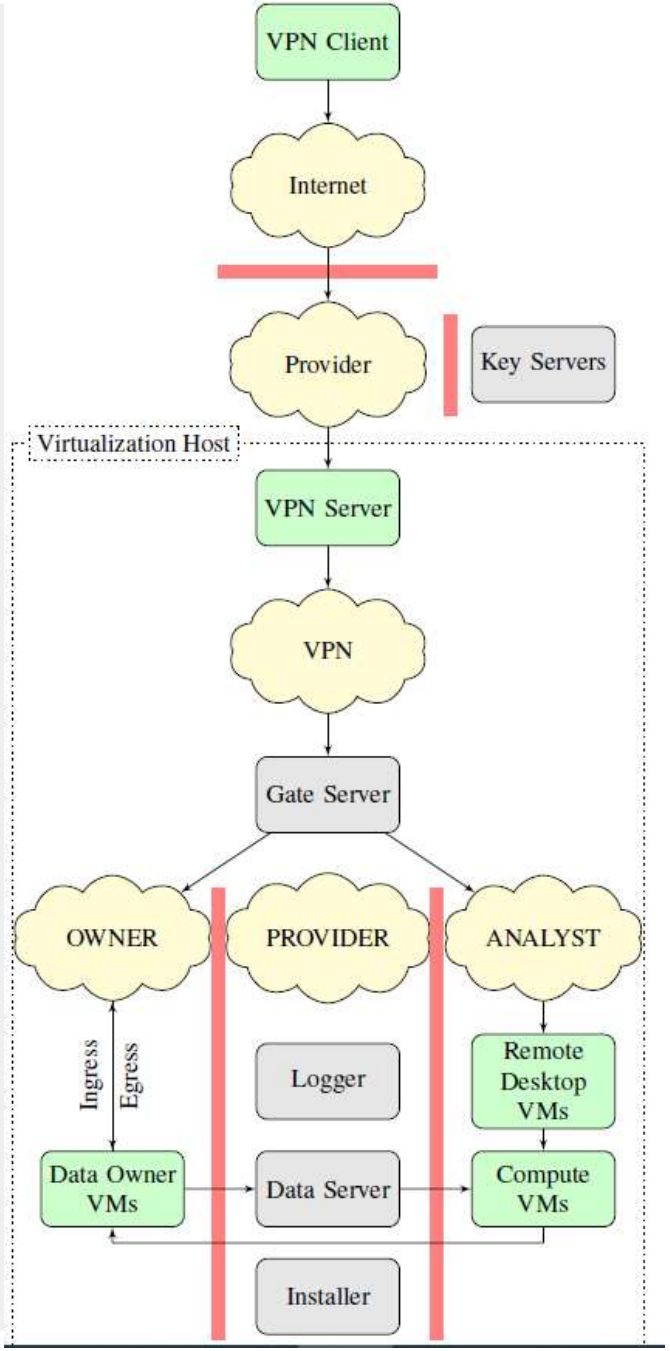
FAIR ≠ Open

- FAIR data does not imply/require Open data!
- Accessibility means it is clear HOW data can be accessed (again, ideally also for machines!)
- An extreme example: FAIRness for medical data (not anonymized, not pre-aggregated, …)
- Full control by data owner on WHO has access WHEN, for WHICH purpose
  - Only selected people may see the data
  - It may only be used for analysing pre-defined questions
  - Access only during limited periods of time
  - Data may not be transferred to anybody
- →Data visiting instead of data sharing

Secure Data Infrastructure

- **FAIRness for "closed" data!**
- Sensitive Data (privacy, IPR, …)
- **Data Visiting** instead of Data Sharing
- **Data owner maintains full control over data:**
  - Access by **whom**, for which period of **time**,
  - to which **subset** of data
  - for which analysis **goal** / research question
- Data infrastructure acts as data processor
- Secured IT system
  - Air-gapped (virtual) machines with data excerpts
  - Access solely via remote desktop
  - Complete monitoring of all interactions
- Controlled processes
- Data identification, dynamic citation, reproducibility
- Open source reference implementation (**OSSDIP**)



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Secure Data Infrastructure (OSSDIP) - Processes

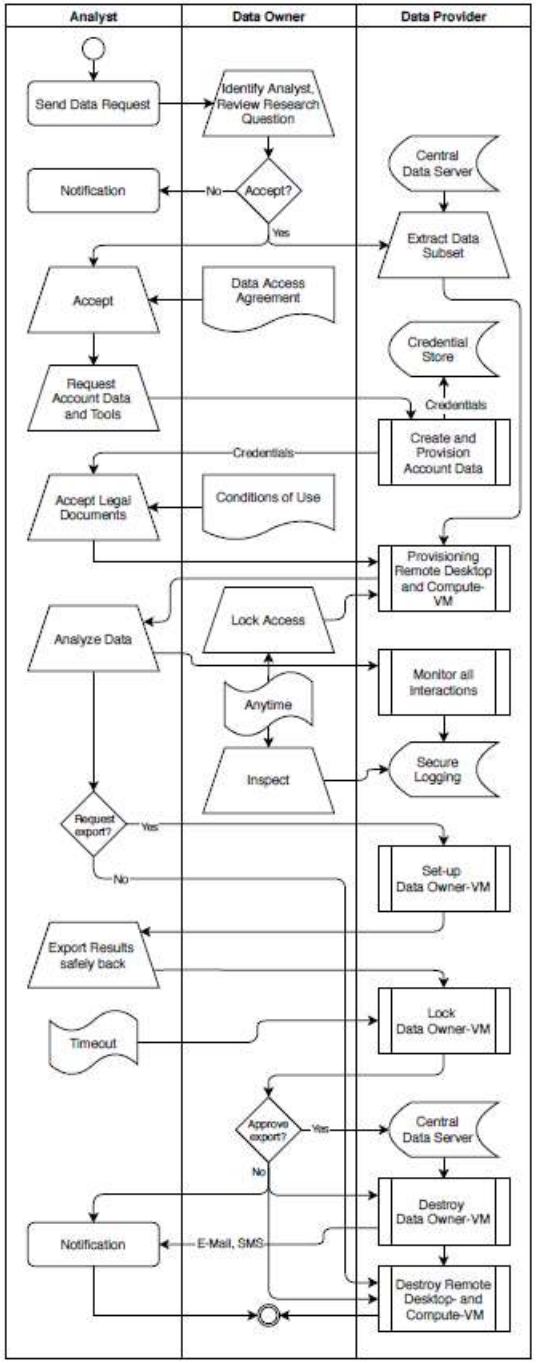
Data ingest

1. Agreement on data delivery (Data processing agreement) incl. metadata:
   - List of attributes incl. description, primary key (FAIR)
   - Number of records
   - Data format (CSV,Separator, NULL-encoding, Boolean-encoding, Date encoding, …)
   - Short description of data set
2. Request for account (name, e-Mail, mobile phone nr. for SMS)
3. Provisioning of account data by infrastructure to provider
4. Transfer of data to specific Provider-VM by provider
5. Notification of transfer concluded
6. Transfer / ingest of data from VM to server, destruction of VM
7. Provisioning of metadata on portal (“FAIRness”)

Secure Data Infrastructure (OSSDIP)

Access (selected subset of steps)

1. Researcher sends **request** to data owner (*Person, question, required data*)
2. In case of **permission** being **granted: subset of data**, at specific **aggregation level**, potentially with **fingerprint** is extracted onto a VM for a dedicated **researcher** for a dedicated **time period** to address the **question** posed
3. Legal agreement on data access permission
4. Provisioning of account info, conditions of use (no download, no de-anonymization, …)
5. Provisioning of VNC and Compute VMs with dedicated SW and data
6. Monitoring of all interactions on machine on secured logging server (log-files + video)
7. Transfer of results via dedicated Provider-VM
8. Destruction of VNC and Compute VMs



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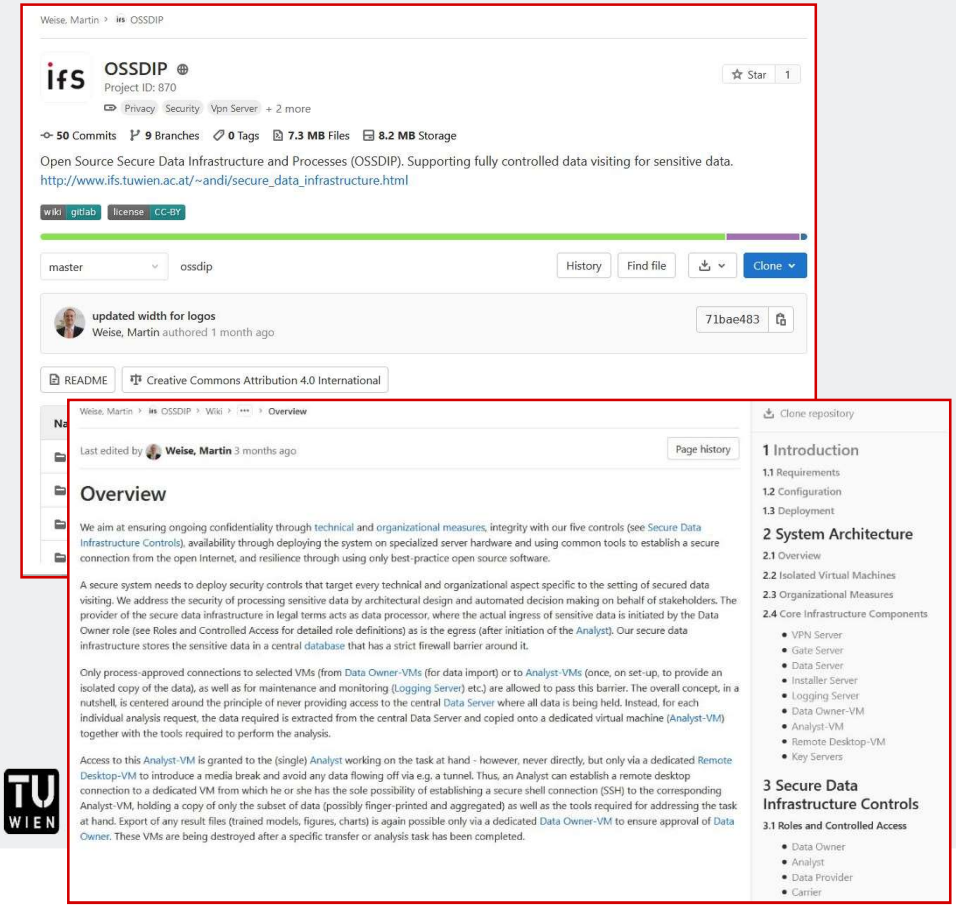
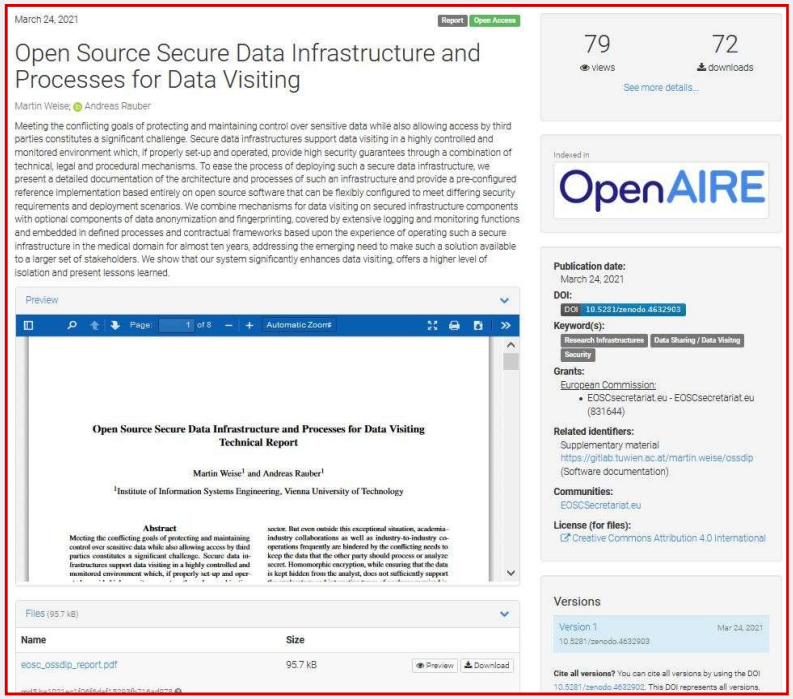
Secure Data Infrastructure (OSSDIP)

- (First version of) reference implementation:
  (Co-funded by EOSC-Secretariat, EOSC-Life)
  - Report: https://zenodo.org/record/4632903
  - Source: https://gitlab.tuwien.ac.at/martin.weise/ossdip





Secure Data Infrastructure (OSSDIP)

Deployment

- Easy deployment via Ansible Playbooks
- Proof-of-concept relying on virtualization

Next steps

- Exposure of Metadata DB
- Exposure of Query Store
- Different application scenarios
  - Medical / Industry settings
  - In-house settings
  - Archives, “DP-Settings”
- Further security aspects (logging, homomorphic encryption, secure multiparty computation, watermarking, …)

Conclusions

- The ***F*** in FAIR
  - Need to consider specifics of data search
  - Lots of structured information, automatically, for machines
- FAIR ≠ Open
  - Data visiting instead of data sharing
  - Non-open data can be made FAIR!
- The technical aspects are, basically, easy