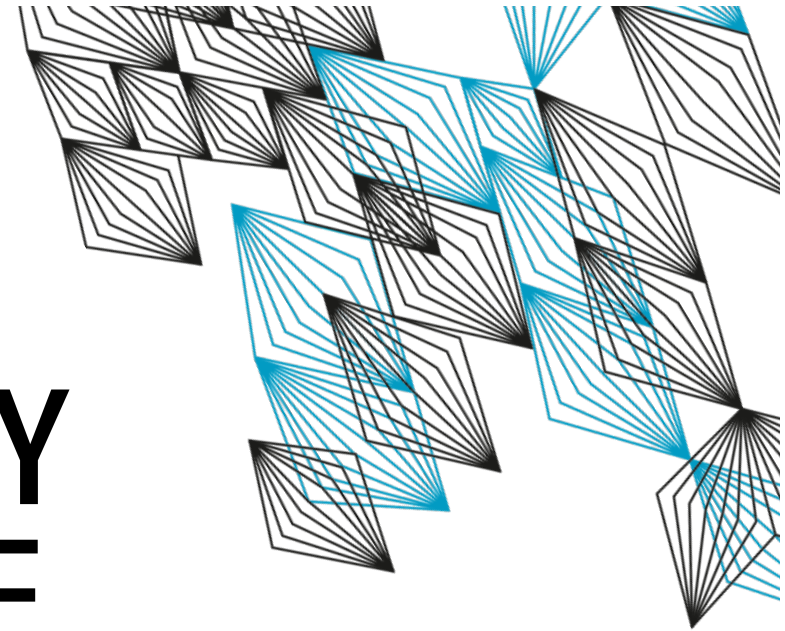


FACULTY OF ELECTRICAL ENGINEERING, MATHEMATICS AND COMPUTER SCIENCE
SERVICES AND CYBERSECURITY GROUP



UNIVERSITY OF TWENTE.

FAIR AND SEMANTIC ARTEFACTS, WHAT TO DO?

ONTOBRAS 2022 – TUTORIAL – NOV 22, 2022

LUIZ BONINO



SHORT INTRODUCTION TO THE FAIR INITIATIVE



THE FAIR PRINCIPLES

Findable:

- F1. (meta)data are assigned a globally unique and persistent identifier;
- F2. data are described with rich metadata;
- F3. metadata clearly and explicitly include the identifier of the data it describes;
- F4. (meta)data are registered or indexed in a searchable resource;

Interoperable:

- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
- I2. (meta)data use vocabularies that follow FAIR principles;
- I3. (meta)data include qualified references to other (meta)data;

Accessible:

- A1. (meta)data are retrievable by their identifier using a standardized communications protocol;
 - A1.1 the protocol is open, free, and universally implementable;
 - A1.2. the protocol allows for an authentication and authorization procedure, where necessary;
- A2. metadata are accessible, even when the data are no longer available;

Reusable:

- R1. (meta)data are richly described with a plurality of accurate and relevant attributes;
 - R1.1. (meta)data are released with a clear and accessible data usage license;
 - R1.2. (meta)data are associated with detailed provenance;
 - R1.3. (meta)data meet domain-relevant community standards;

<https://www.nature.com/articles/sdata201618>



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FAIR AND SEMANTIC ARTEFACTS

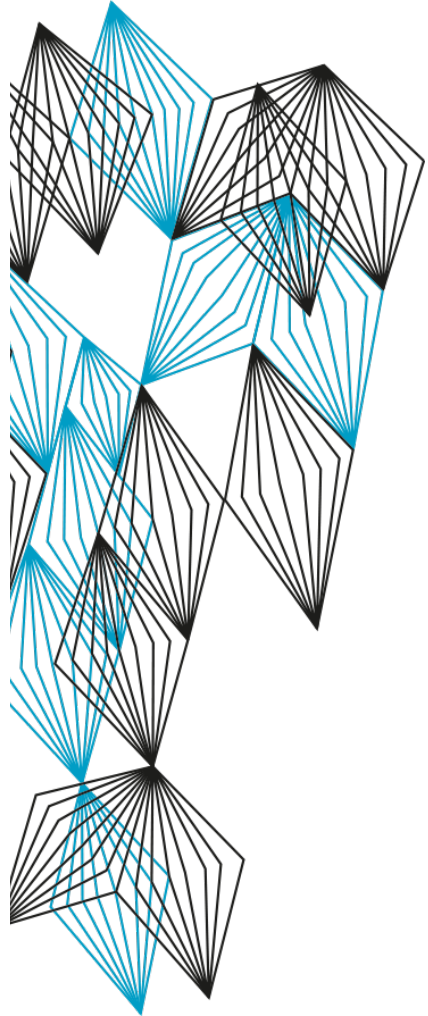
2-WAY CONTRIBUTIONS

- Semantic Artefacts → FAIR – how semantic artefacts help improve FAIR?
- FAIR → Semantic artefacts – how to make semantic artefacts FAIRer?

FAIR AND SEMANTIC ARTEFACTS

2-WAY CONTRIBUTIONS

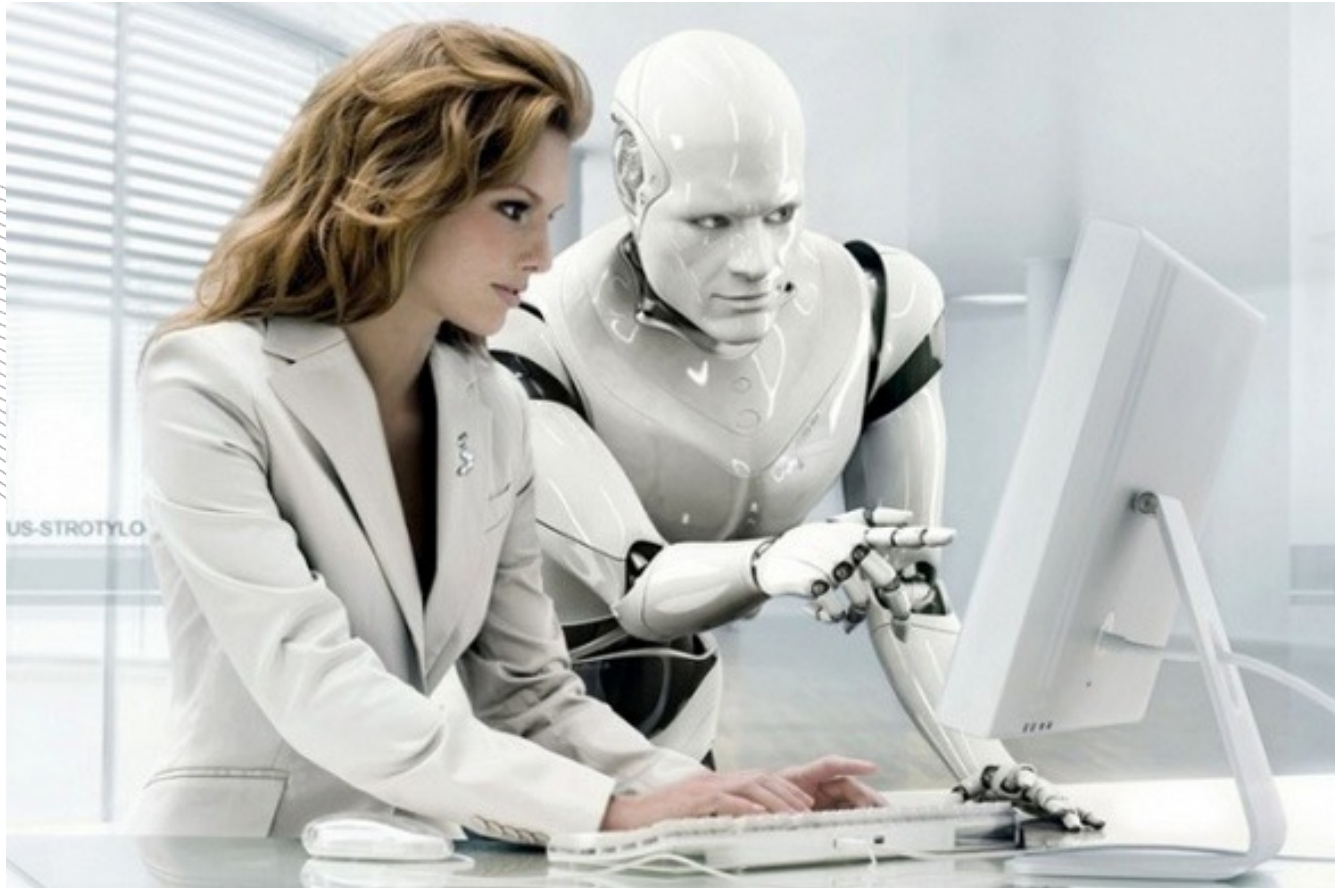
- **Semantic Artefacts → FAIR – how semantic artefacts help improve FAIR?**
- FAIR → Semantic artefacts – how to make semantic artefacts FAIRer?



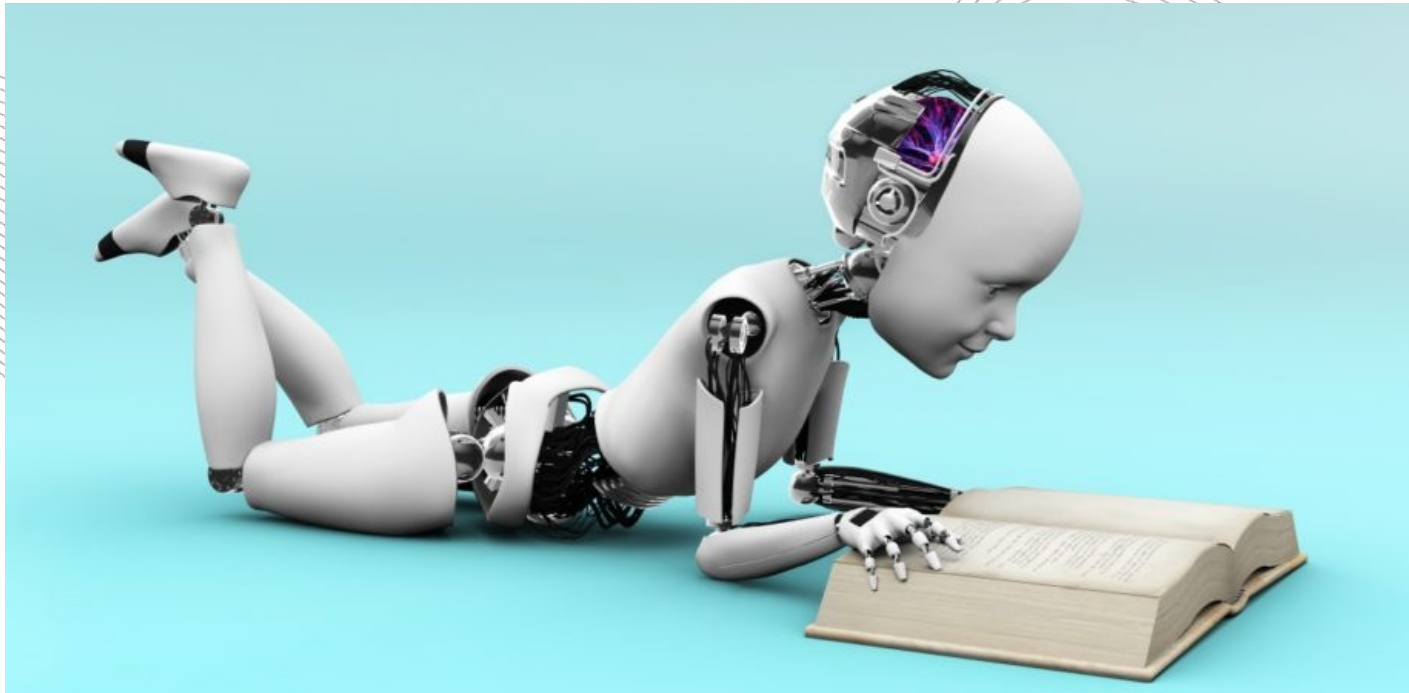
THE PRINCIPLES TARGET PRIMARILY MACHINES



THEN THE MACHINES CAN HELP US



**BUT FIRST THEY (AND US) NEED TO
“UNDERSTAND WHAT WE MEAN”**



The background features a series of thin, grey, wavy lines that create a sense of movement and depth. On the right side, there are several overlapping, semi-transparent geometric shapes, primarily squares and rectangles, rendered in a light blue color. These shapes are arranged in a way that suggests a 3D perspective, with some appearing to be stacked or layered on top of each other.

FAIR PRINCIPLES EXPLAINED

THE FAIR PRINCIPLES

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THE FAIR PRINCIPLES AND THEIR MULTIPLE FACETS

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FAIR PRINCIPLES – METADATA

Findable:

- F1. metadata are assigned a globally unique and persistent identifier;
- F2. data are described with rich metadata;
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- F4. metadata are registered or indexed in a searchable resource;

Interoperable:

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FAIR PRINCIPLES – DATA/DIGITAL OBJECTS

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Interoperable:

- I1. data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
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FAIR PRINCIPLES – SUPPORTING ELEMENTS

Findable:

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- F2. data are described with rich metadata;
- F3. metadata clearly and explicitly include the identifier of the data it describes;
- F4. (meta)data are registered or indexed in a **searchable resource**;

Interoperable:

- I1. (meta)data use a formal, accessible, shared, and broadly applicable **language for knowledge representation**;
- I2. (meta)data use **vocabularies** that follow FAIR principles;
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Accessible:

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FAIR PRINCIPLES – TECHNOLOGY-RELATED

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FAIR PRINCIPLES – SOCIAL-RELATED

Findable:

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Interoperable:

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- I2. **(meta)data use vocabularies that follow FAIR principles;**
- I3. (meta)data include qualified references to other (meta)data;

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FAIR PRINCIPLES - FINDABILITY

F1. (meta)data are assigned a globally unique and persistent identifier

What does it mean?

- We need an identification mechanism, e.g., PID, PURL, DOI, ...
- This mechanism needs to guarantee global uniqueness of the issued identifier, i.e., every time a given identifier is called, the same resource is pointed to is retrieved
- This mechanism needs to guarantee persistency of the issued identifier, i.e., what happens when the identifier scheme is changed?

What do we need to fulfill this principle?

- How to describe the used identification mechanism?
- How to properly identify the identifier service? I.e., what is the commonly agreed vocabulary that can represent that a given piece of information is the identifier of a digital resource?
- What is the uniqueness policy?
- How to represent the policy in a computer-actionable way?
- What is the required content of the policy, e.g., uniqueness mechanism?
- What is the persistency policy?
- How to represent the persistency policy in a computer-actionable way?
- What is the required content of the policy, e.g., persistency over updates of the mechanism?
- What is resolved by sending a request to the identifier, the actual digital resource, its metadata, etc.? I.e, what is the protocol for getting the actual digital resource from its identifier?

FAIR PRINCIPLES - FINDABILITY

F2. Data are described with rich metadata

What does it mean?

- If we don't have the identifier, the digital object should be described with rich enough metadata that we can find it through the combination of the items in this metadata

What do we need to fulfill this principle?

- For different types of digital objects, what are the minimal metadata elements that provide this richness?
- How to describe the metadata in a commonly agreed and computer-actionable way? By using a common way to represent metadata, tools can be made that are able to interpret metadata from any kind of digital object.

FAIR PRINCIPLES - FINDABILITY

F3. Metadata clearly and explicitly include the identifier of the data it describes

What does it mean?

- The discovery of a digital object should be possible from its metadata. For this to happen, the metadata must explicitly contain the identifier for the digital object it describes.

What do we need to fulfill this principle?

- How to differentiate the information about the digital object's identifier and the one about its metadata identifier? I.e., a metadata record contains two identifiers, of itself (the metadata record) and of the digital object it describes. What is the vocabulary that contains concepts to describe a metadata identifier and digital object it describes?

FAIR PRINCIPLES - FINDABILITY

F4. (meta)data are registered or indexed in a searchable resource

What does it mean?

- Most people use a search engine to initiate a search for a particular digital object. If the object or its metadata are not index in a searchable resource, the capability for an individual to find it is substantially reduced.

What do we need to fulfill this principle?

- For the data part, a full indexing is equivalent to allowing complete and direct querying on the data, which may not be feasible every time. An intermediate step would be to select a number of relevant parts of the data to be highlighted by their metadata, which would be indexed. E.g., in a dataset describing gene information, it may be relevant to allow the indexing of the unique genes that the dataset has information about.
- Search engines benefit from common interfaces (or at least interfaces that are described in a commonly agreed way) to allow the harvesting of the elements (metadata and/or data) to be indexed.
- A common representation format for the metadata also improves the possibility of different searchable resources to index the metadata records.

FAIR PRINCIPLES – ACCESSIBILITY

A1. (meta)data are retrievable by their identifier using a standardized communications protocol;

A1.1 the protocol is open, free and universally implementable;

A1.2 the protocol allows for an authentication and authorization procedure, where necessary;

What does it mean?

- In order to access a digital resource, the requestor needs to be able to implement the used communication protocol. Therefore, this protocol should be open, free and universally implementable. Moreover, the protocol should also describe whether authentication and authorization mechanisms are required.

What do we need to fulfill this principle?

- How to describe the communication (accessibility) protocol?
- What are the elements required in the description of the communication (accessibility) protocol, including the authentication and authorization procedure?
- How to demonstrate that the protocol is open, free and universally implementable?

FAIR PRINCIPLES – ACCESSIBILITY

A2. Metadata are accessible, even when the data are no longer available

What does it mean?

- Cross-reference to data from third-party's FAIR data and metadata will naturally degrade over time. Therefore, it is important for FAIR providers to continue to provide descriptors of what the data was to assist in the continued interpretation of those third-party data.

What do we need to fulfill this principle?

- How to guarantee long-term persistency of the metadata?
- How to describe that the data (digital resource) referred by the metadata are no longer accessible? Is it necessary to inform why?
- How to harmonize the persistency of the metadata with the GDPR's "right to be forgotten"?

FAIR PRINCIPLES – INTEROPERABILITY

I1. (meta)data use a formal, accessible, shared and broadly applicable language for knowledge representation

What does it mean?

- The digital resource is described using a formal, accessible, shared and broadly applicable language

What do we need to fulfill this principle?

- How to inform the language used to represent the digital object?
- How to provide this information for the metadata? In a meta-metadata?
- How to demonstrate the formality (BNF), accessibility (resolution of the language description document), shareability and broad applicability of the language (IANA media-type)?

FAIR PRINCIPLES – INTEROPERABILITY

I2. (Meta)data use vocabularies that follow the FAIR principles

What does it mean?

- The metadata values and qualified relations should themselves be FAIR

What do we need to fulfill this principle?

- Inform which vocabulary is used
- What is the minimal FAIRness for these vocabularies to be considered to follow FAIR principles?

FAIR PRINCIPLES – INTEROPERABILITY

I3. (Meta)data include qualified references to other (meta)data

What does it mean?

- Relationships within digital resources and between local and third-party data, have explicit and “useful” semantic meaning

What do we need to fulfill this principle?

- Qualify (provide proper semantics) the references to other digital resources
- As per I2, these references (and their qualifiers) should also be FAIR

FAIR PRINCIPLES – REUSABILITY

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What does it mean?

- Digital objects should inform who has which rights under which circumstances (license), what is their provenance and use relevant standards adopted by the community in which the object has been created/used

What do we need to fulfill this principle?

- Inform the usage license:
- What representation format can be used for a computer-actionable license description?
- What are the required concerns that should be present in this description (rights, conditions, ...)?

FAIR PRINCIPLES

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- **What do we need to fulfill this principle?**
- Inform the digital object's provenance information:
- What are the core provenance information?
- What are the community-specific provenance information?
- How to represent provenance? Which vocabularies to use?
- Inform the relevant community standards used by the digital resource (certification):
- How to describe which standards are used?
- How to describe compliance to these standards?
- How to demonstrate that the standards are accepted by a given community?



QUESTIONS?



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An abstract graphic design featuring a series of thin, wavy lines that create a sense of movement and depth. On the right side, there are several overlapping, semi-transparent geometric shapes, primarily squares and rectangles, rendered in a light blue color. These shapes are layered, creating a 3D effect. The overall composition is clean and modern, with a white background.

FAIR SUPPORTING TOOLS AND ACTIVITIES

FAIR TOOLING ECOSYSTEM

Plan

Model

Create

Publish

Find

Evaluate



Bring Your Own Data (BYOD) Hackathon

Ontology / Conceptual
Modeling

FAIR Designathon

Metadata design hackathon

FAIR Stewardship course

Training



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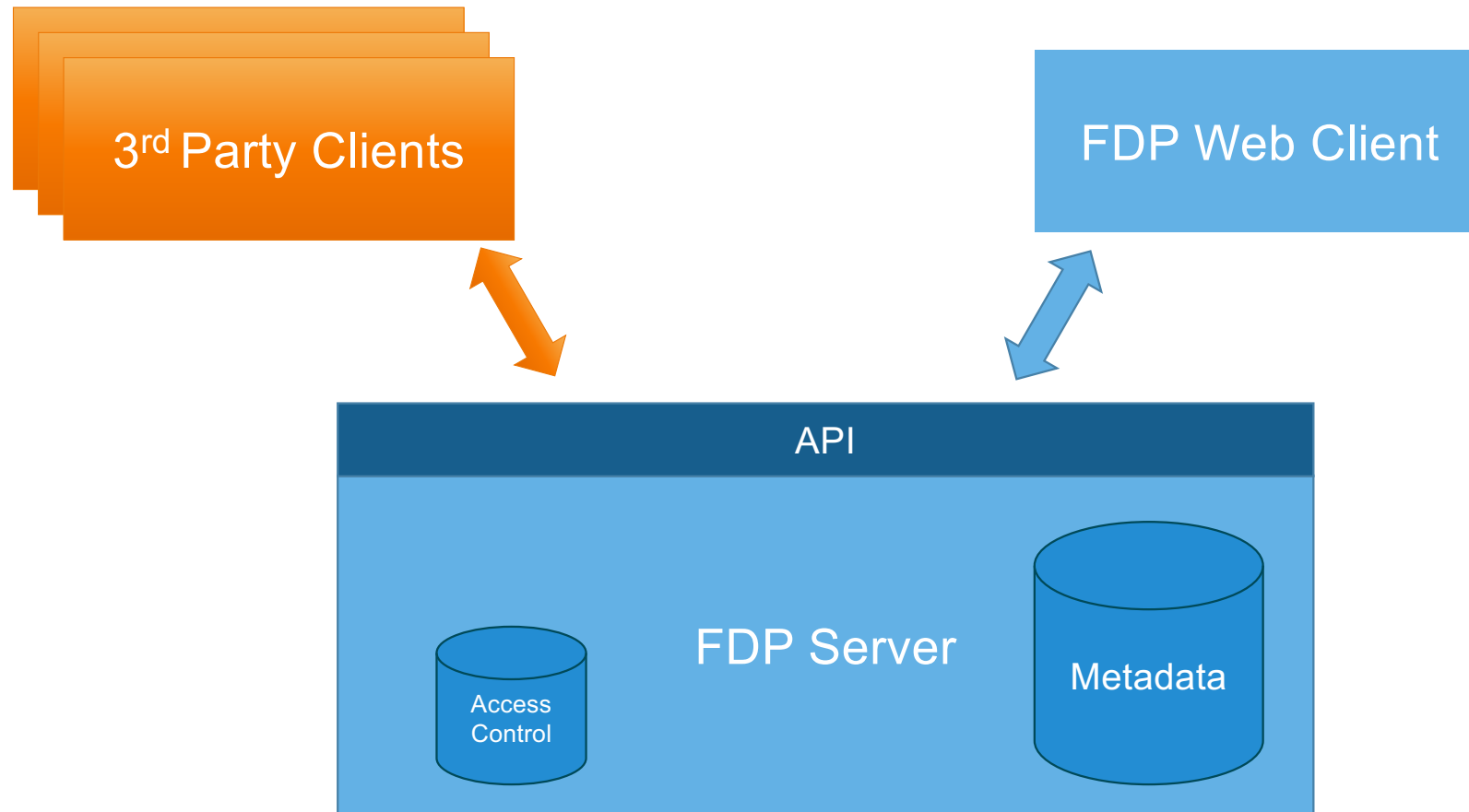


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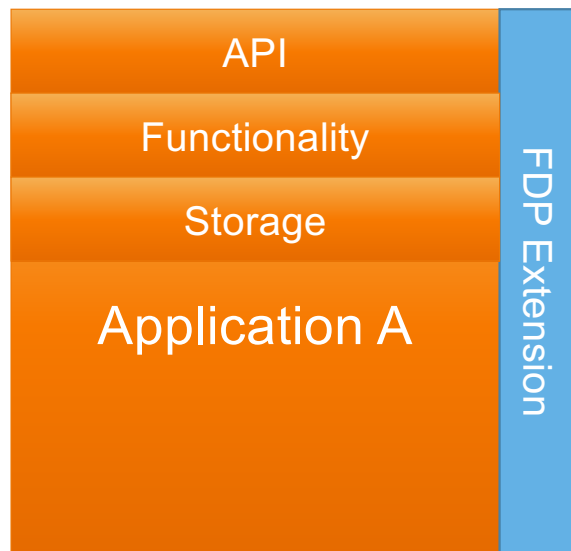
FAIR DATA POINT

- A metadata repository providing access to structured and semantically-rich, machine actionable metadata describing:
 - The repository itself;
 - The repository content, consisting of metadata about different types of resources such as catalog, dataset, distribution, software, ontologies, etc.;
- Common interface to access the metadata (REST API);
- MIT license;
- GitHub: <https://github.com/FAIRDataTeam/FAIRDataPoint>
- Specification: <https://github.com/FAIRDataTeam/FAIRDataPoint-Spec>
- Deployment documentation: <https://fairdatapoint.readthedocs.io/>

FAIR DATA POINT - ARCHITECTURE



FAIR DATA POINT – EXTENDING EXISTING APPLICATIONS



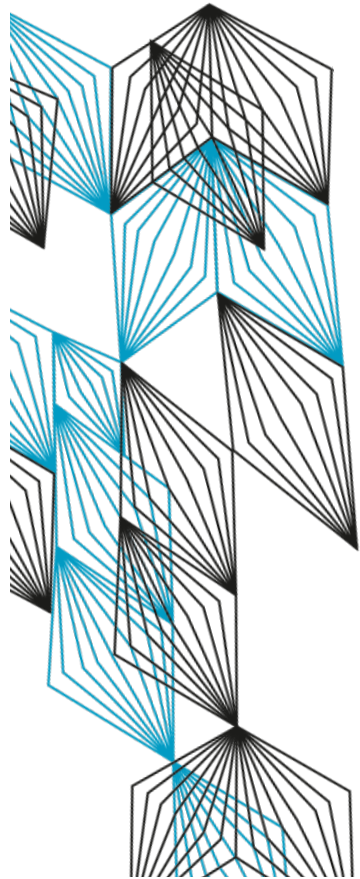
Extended current applications by adding:

- FDP API approach → metadata content navigation;
- Follow FDP's metadata structure (with necessary customization);

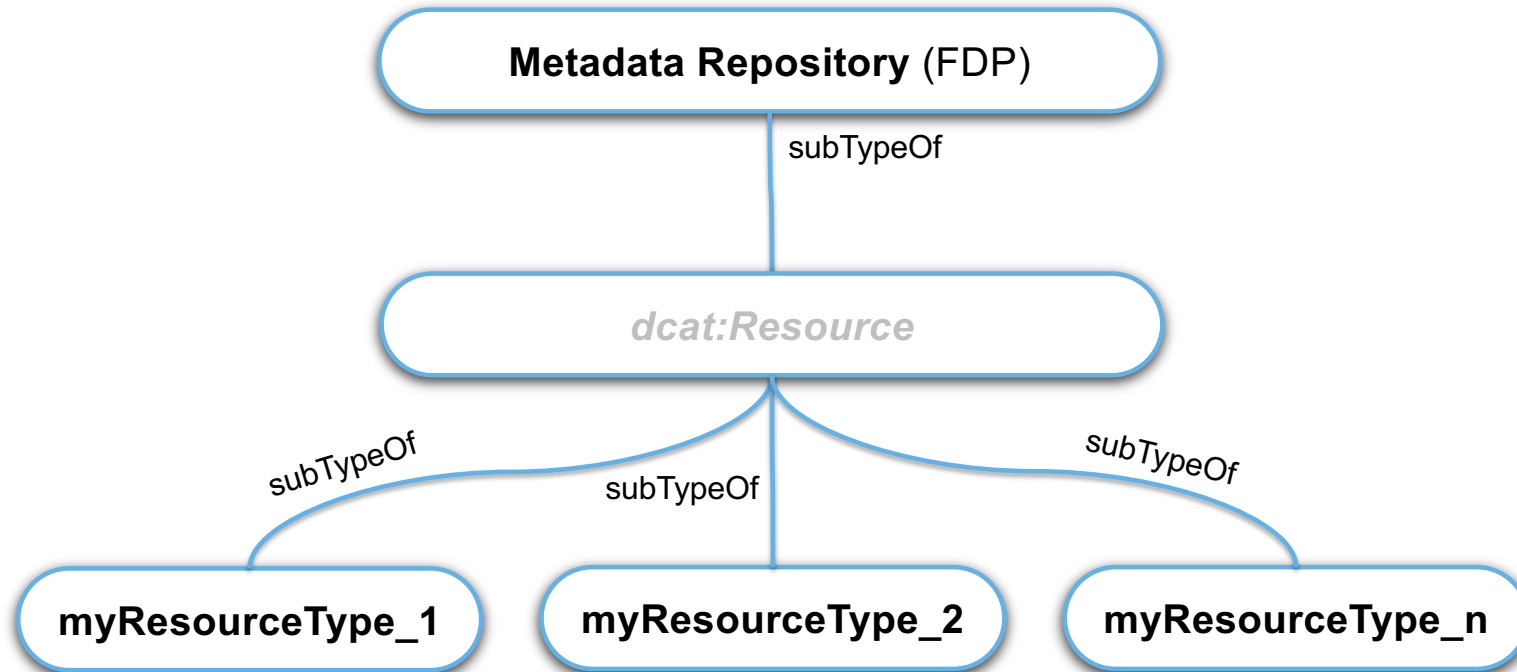
FAIR DATA POINT CHARACTERIZATION

Minimally, the FAIR Data Point should have:

- Its **root API** URL providing the Repository **metadata**;
- The **metadata** content **represented in RDF**;
- The metadata records comply with metadata schemas **expressed in SHACL**;
- Metadata records describe types of digital objects as **specializations of dcat:Resource**;
- The **navigation structure** of the metadata content, e.g.,
Repository → Catalog → Dataset → Distribution;
- The provision of the description of the **navigation structure** by using the **Linked Data Platform (LDP)** containment structure (ldp:contains or ldp:hasMemberRelation).



FAIR DATA POINT – EXTENSIBLE METADATA STRUCTURE



FAIR SEARCH ENGINE

<https://home.fairdatapoint.org>

- Indexes metadata content of FAIR Data Points;
- Provides search capabilities on harvested metadata;

FAIR FAIR Data Point Search FAIR Data Point... [Log in](#)

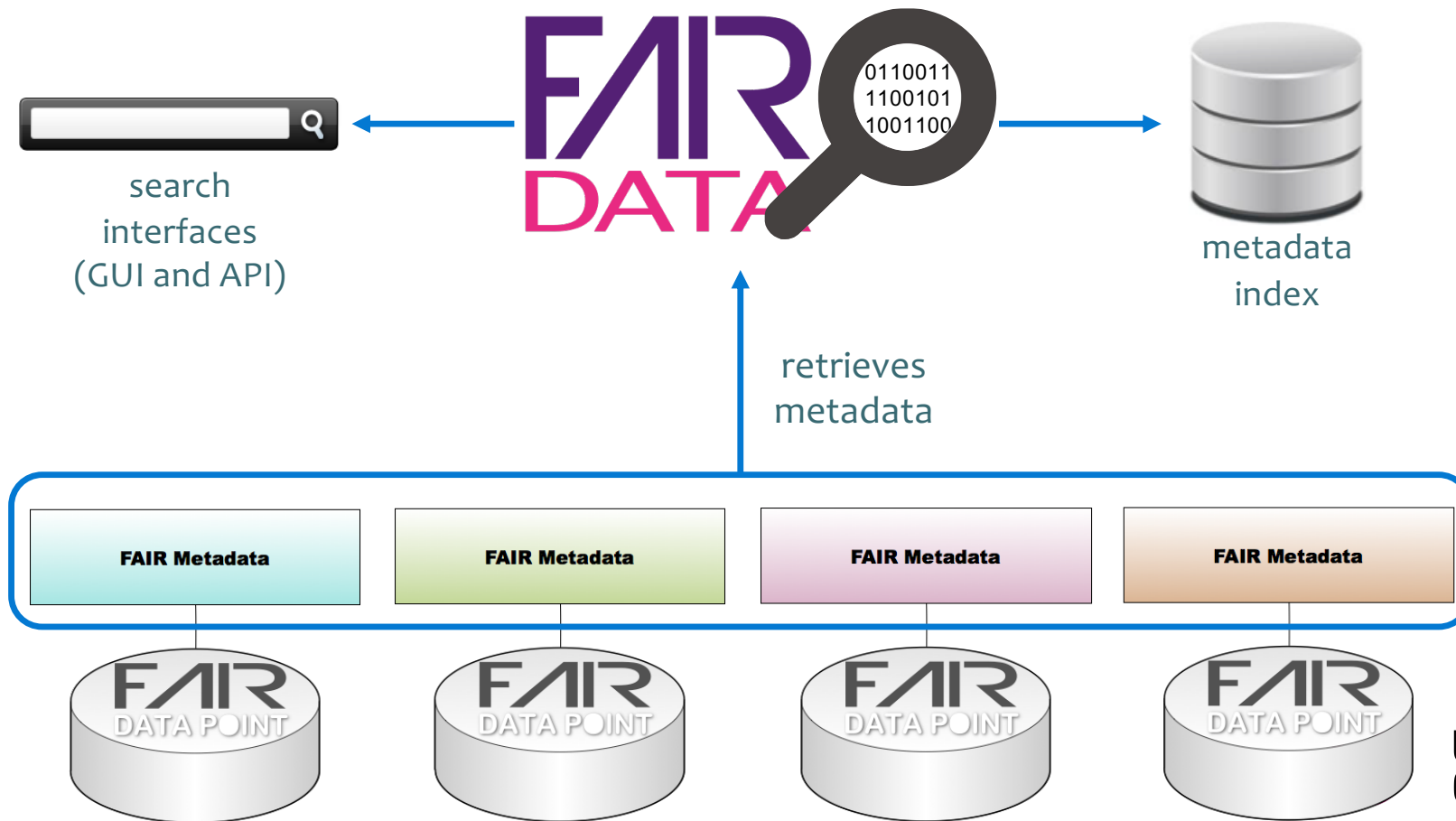
FAIR Data Points

Filter: All 86 Active 17 Inactive 14 Unreachable 46 Invalid 9 Unknown 0

Endpoint ▲ ▼	Registration ▲ ▼	Modification ▲ ▼	Status
https://directory.bbmri-eric.eu/api/udp	27-01-2021, 15:30:32	29-04-2021, 07:55:00	ACTIVE
https://home.fairdatapoint.org	20-01-2021, 21:56:42	28-04-2021, 16:53:54	ACTIVE
https://app.fairdatapoint.org	29-04-2020, 16:37:21	28-04-2021, 16:52:02	ACTIVE
https://fdps.kiu.ac.ug	22-07-2020, 13:52:08	28-04-2021, 16:05:55	ACTIVE
http://lumc-beat-covid.fair-dtis.surf-hosted.nl	03-06-2020, 16:33:03	28-04-2021, 13:49:56	ACTIVE
https://staging.fairdatapoint.org	29-04-2020, 15:23:20	28-04-2021, 13:16:48	ACTIVE
https://catalogue.bbmri.nl/api/udp	27-01-2021, 15:24:14	28-04-2021, 10:00:00	ACTIVE
https://twoc.fair-dtis.surf-hosted.nl	04-03-2021, 11:32:52	28-04-2021, 09:24:51	ACTIVE
https://fdp.ibbu.edu.ng	11-08-2020, 14:24:33	27-04-2021, 12:47:09	ACTIVE
https://fdp.aau.edu.et	09-08-2020, 20:06:46	27-04-2021, 11:31:46	ACTIVE
https://fdp.artificialintelligence.ng	11-08-2020, 15:44:30	27-04-2021, 00:04:56	ACTIVE
https://repository.surfsara.nl/udp	20-10-2020, 11:32:19	26-04-2021, 08:00:03	ACTIVE
https://fairdatapoint.semanticscience.org	10-11-2020, 18:45:39	23-04-2021, 16:47:17	ACTIVE
https://fdp.lumc.nl	26-08-2020, 14:58:14	23-04-2021, 15:21:02	ACTIVE
https://fdp.vodan.fairdatapoint.org	12-06-2020, 13:06:57	23-04-2021, 09:11:04	ACTIVE
https://fdp.mudhc.edu.et	12-08-2020, 14:00:59	23-04-2021, 01:27:24	ACTIVE
https://fdp.sdsc.edu	01-05-2020, 23:44:58	22-04-2021, 22:42:27	ACTIVE

FAIR SEARCH ENGINE

<https://home.fairdatapoint.org>



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FAIR SEARCH ENGINE

<https://home.fairdatapoint.org>

Search Results for "COVID"

NL COVID

NFU / ZonMw / COCON

Catalog

Covid-19 Case Report Form

Covid-19 case report forms following WHO standard.

Catalog

COVID-19 dataset in Nigeria

COVID-19 cases by the six geopolitical zones in Nigeria

Distribution

Synthetic Data

Dataset

Covid-19 Case Report Form

Covid-19 case report forms following WHO standard

Catalog

COVID-19 Line Case dataset

This dataset is the COVID-19 NCDC line case report data for Nigeria.

Distribution

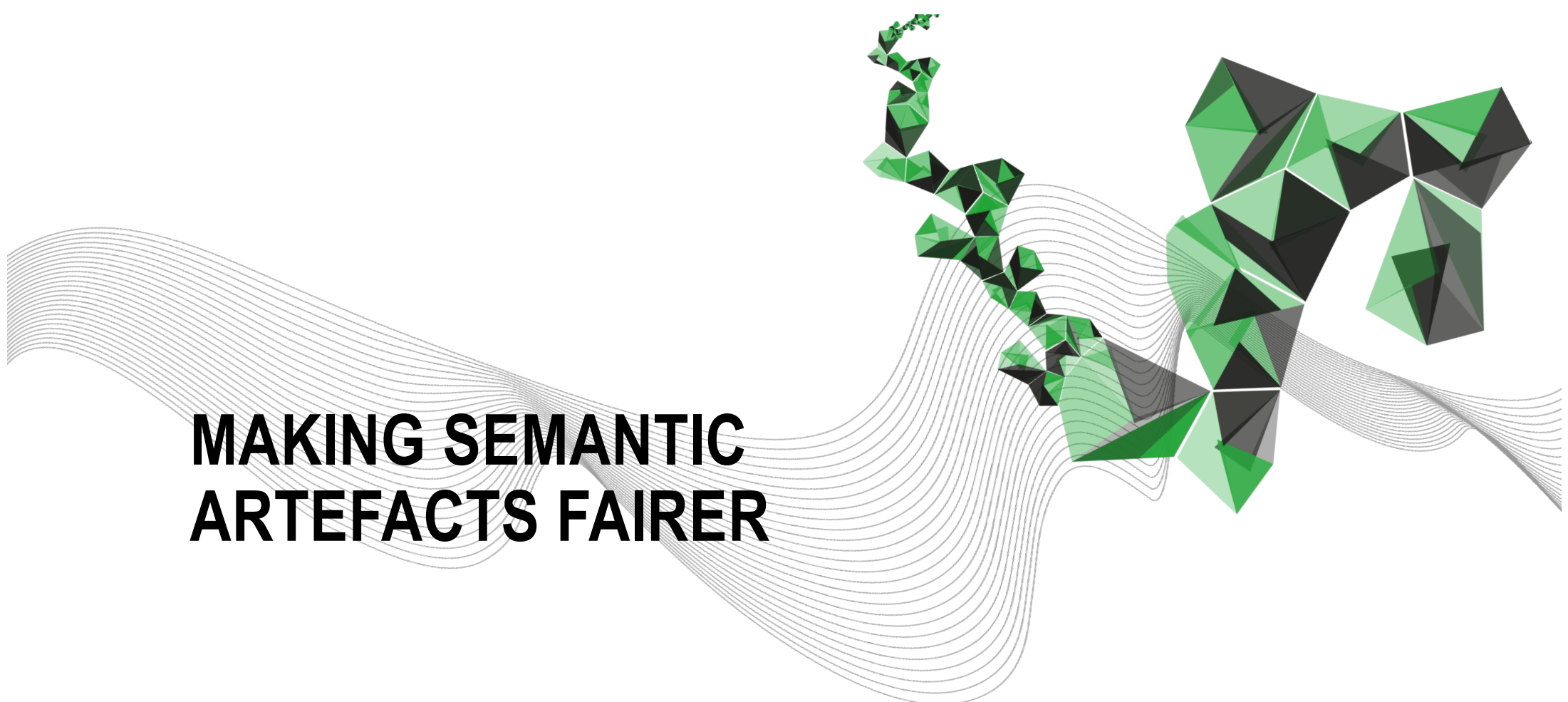
COVID crf

An exemple dataset of COVID's case report form

Dataset



QUESTIONS?



MAKING SEMANTIC ARTEFACTS FAIRER

FAIR principles vs SW & LD

Findable (Metadata)

- F1. metadata are assigned a globally unique and persistent identifier;
- F2. ontologies are described with rich metadata;
- F3. metadata clearly and explicitly include the identifier of the ontology it describes;
- F4. metadata are registered or indexed in a searchable resource;

Findable (Ontology)

- F1. ontologies are assigned a globally unique and persistent identifier;
- F2. data are described with rich metadata;
- F3. metadata clearly and explicitly include the identifier of the data it describes;
- F4. ontologies are registered or indexed in a searchable resource;

FAIR principles vs SW & LD

Accessible (Metadata)

A1. metadata are retrievable by their identifier using a standardized communications protocol;

A1.1 the protocol is open, free, and universally implementable;

A1.2. the protocol allows for an authentication and authorization procedure, where necessary;

A2. metadata are accessible, even when the data are no longer available;

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FAIR principles vs SW & LD

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12. metadata use vocabularies that follow FAIR principles;
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Reusable (Metadata)

R1. metadata are richly described with a plurality of accurate and relevant attributes;

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QUESTIONS?

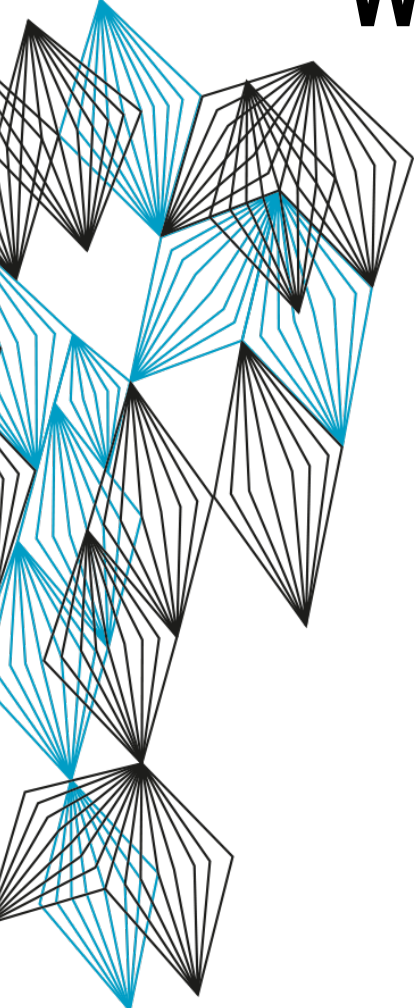


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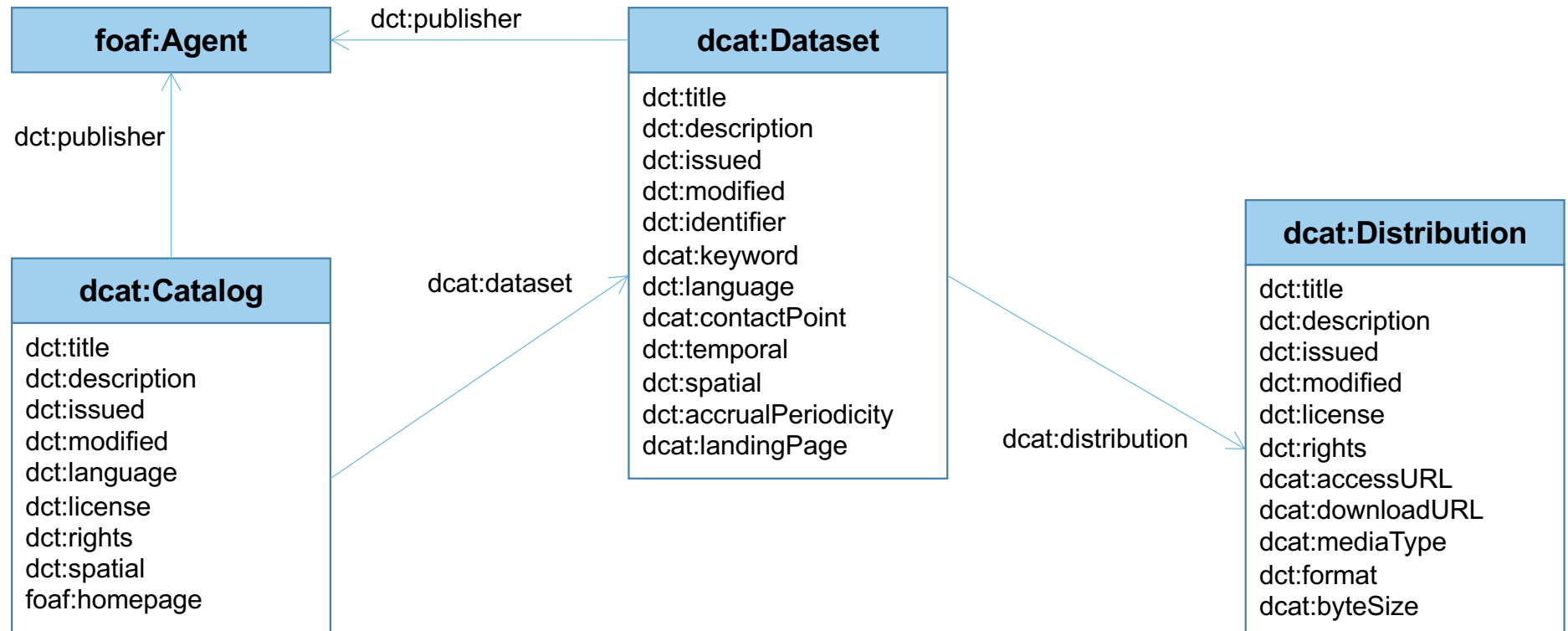
An abstract graphic featuring a series of thin, wavy lines that flow across the page. On the right side, there are several overlapping, semi-transparent geometric shapes, primarily squares and rectangles, some of which are filled with a light blue color. The overall composition is clean and modern, with a focus on lines and shapes.

LET'S TALK METADATA

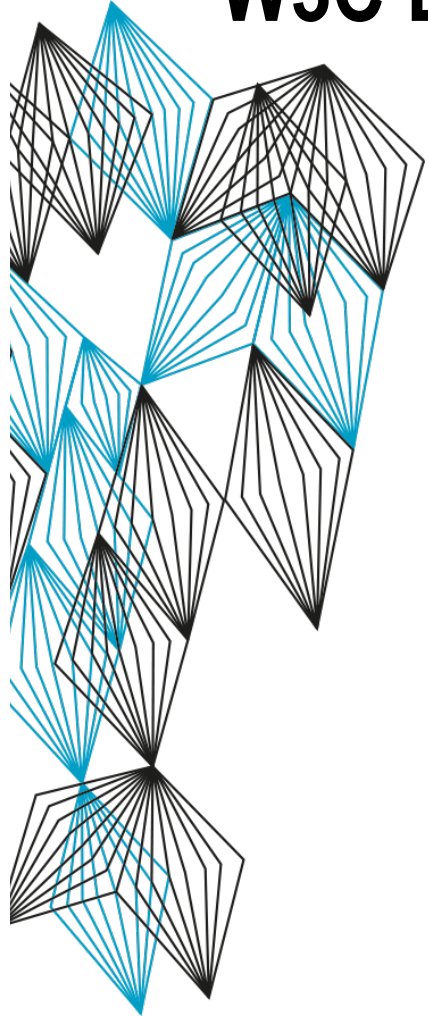
W3C Data Catalog Vocabulary (DCAT)

- 
- Published on 16 January 2014;
 - Main elements:
 - Catalog – curated collection of metadata about datasets;
 - Dataset – a collection of data, published or curated by a single agent and available for access or download in one or more formats;
 - Distribution – represents a specific available for of a dataset (e.g., serialization formats);

W3C DATA CATALOG VOCABULARY (DCAT)

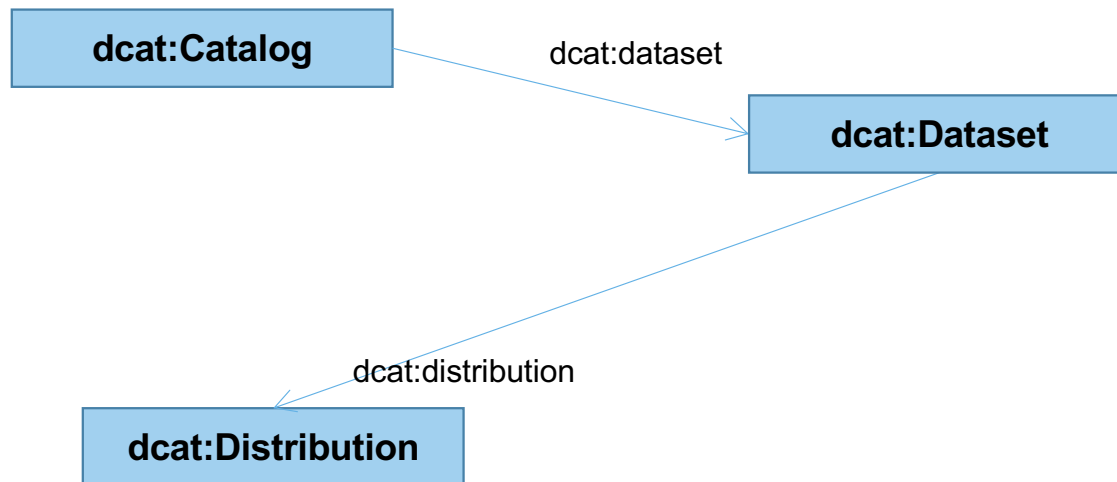


W3C Data Catalog Vocabulary (DCAT) version 2.0

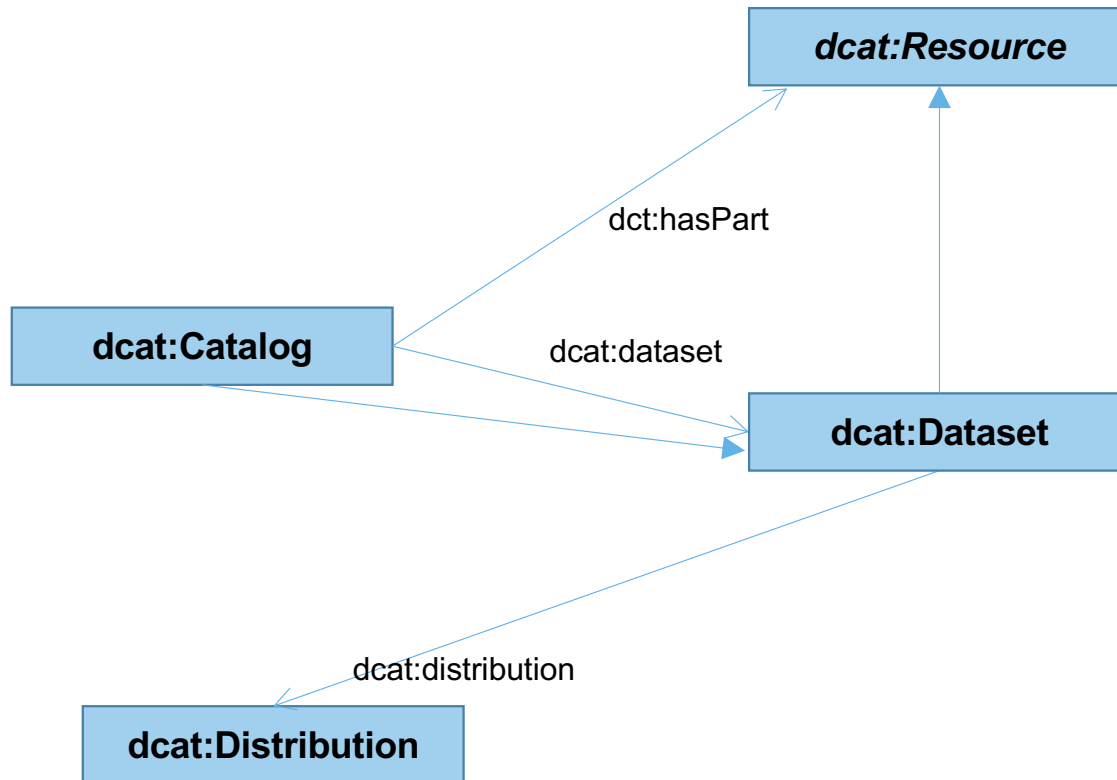


- Published on 04 February 2020;
- Main changes:
 - Introduced the concept of catalogued Resource representing any type of asset that can be described by a metadata record in a catalogue, including dataset;
 - Possibility to define different types of resources whose metadata can be catalogued, e.g., semantic artefact, workflow, websites, etc.

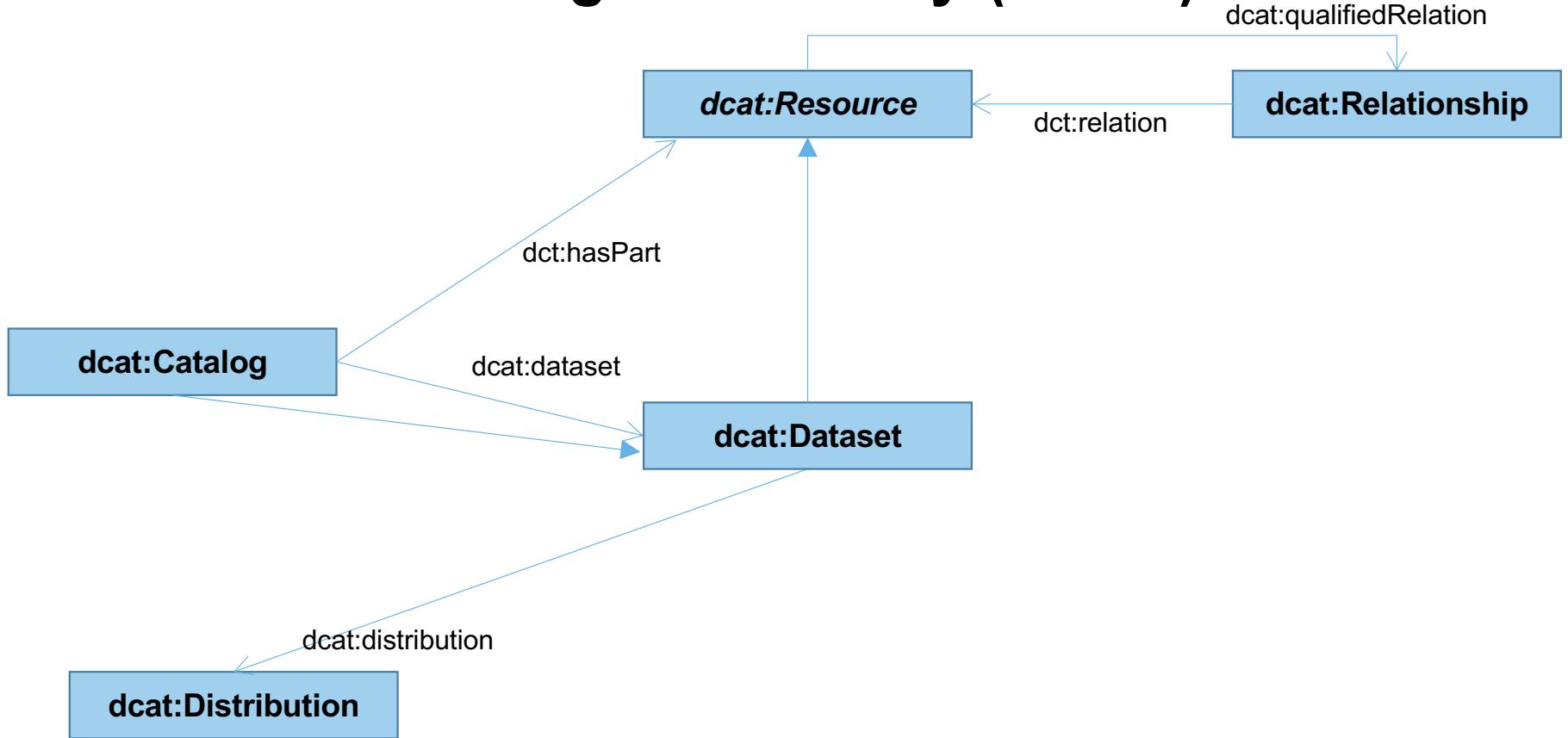
W3C Data Catalog Vocabulary (DCAT) version 2.0



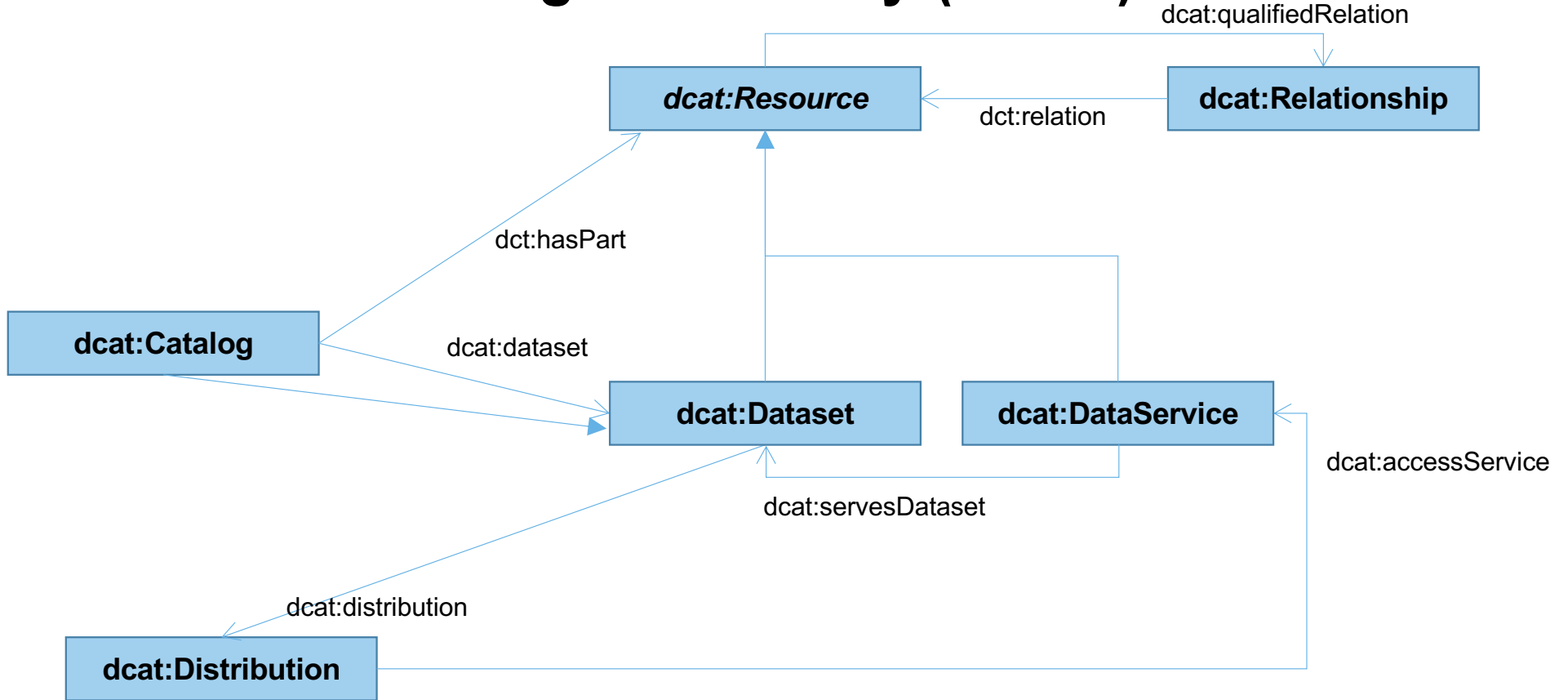
W3C Data Catalog Vocabulary (DCAT) version 2.0



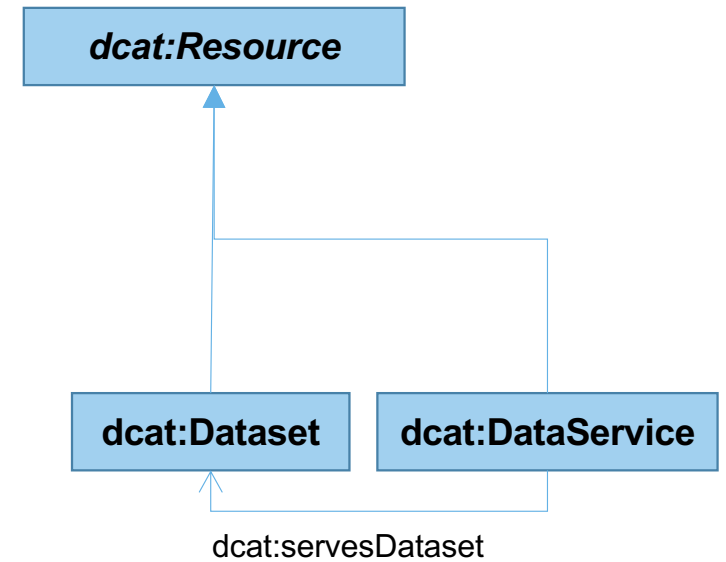
W3C Data Catalog Vocabulary (DCAT) version 2.0



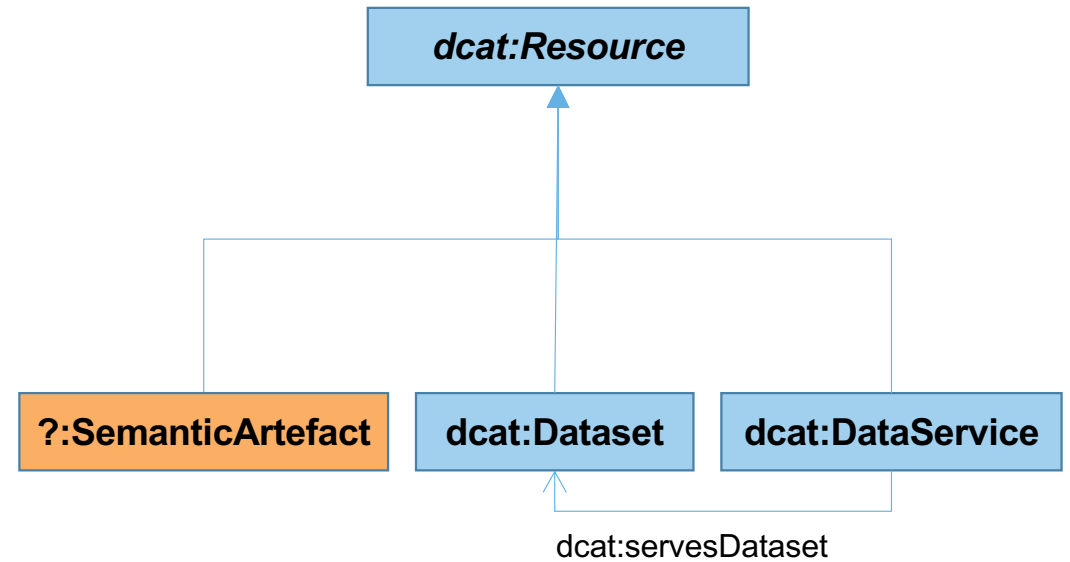
W3C Data Catalog Vocabulary (DCAT) version 2.0



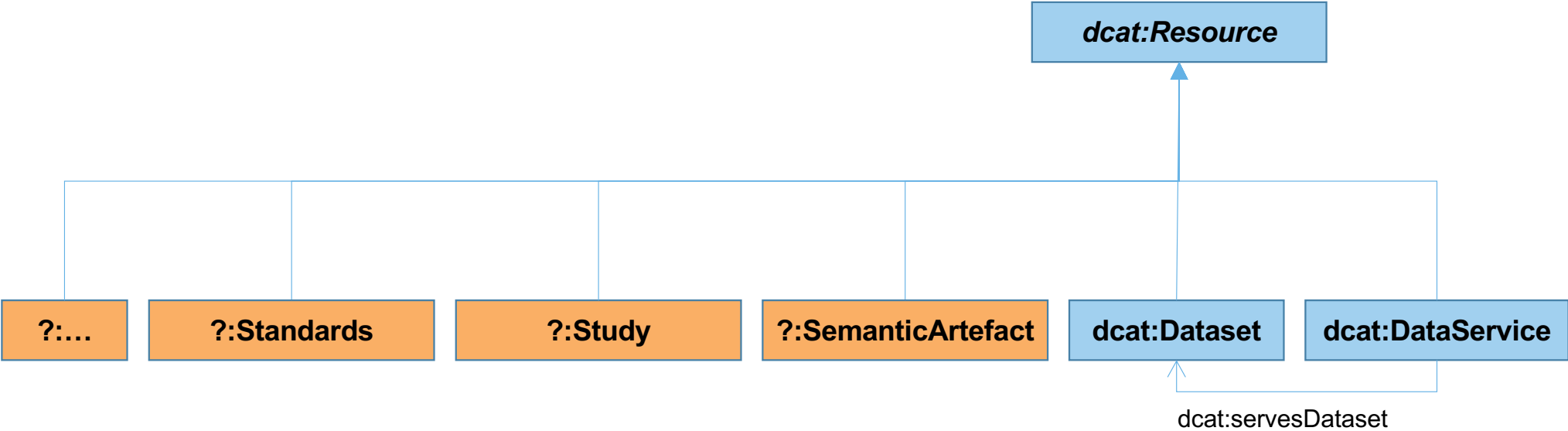
DCAT 2.0 and other types of resources



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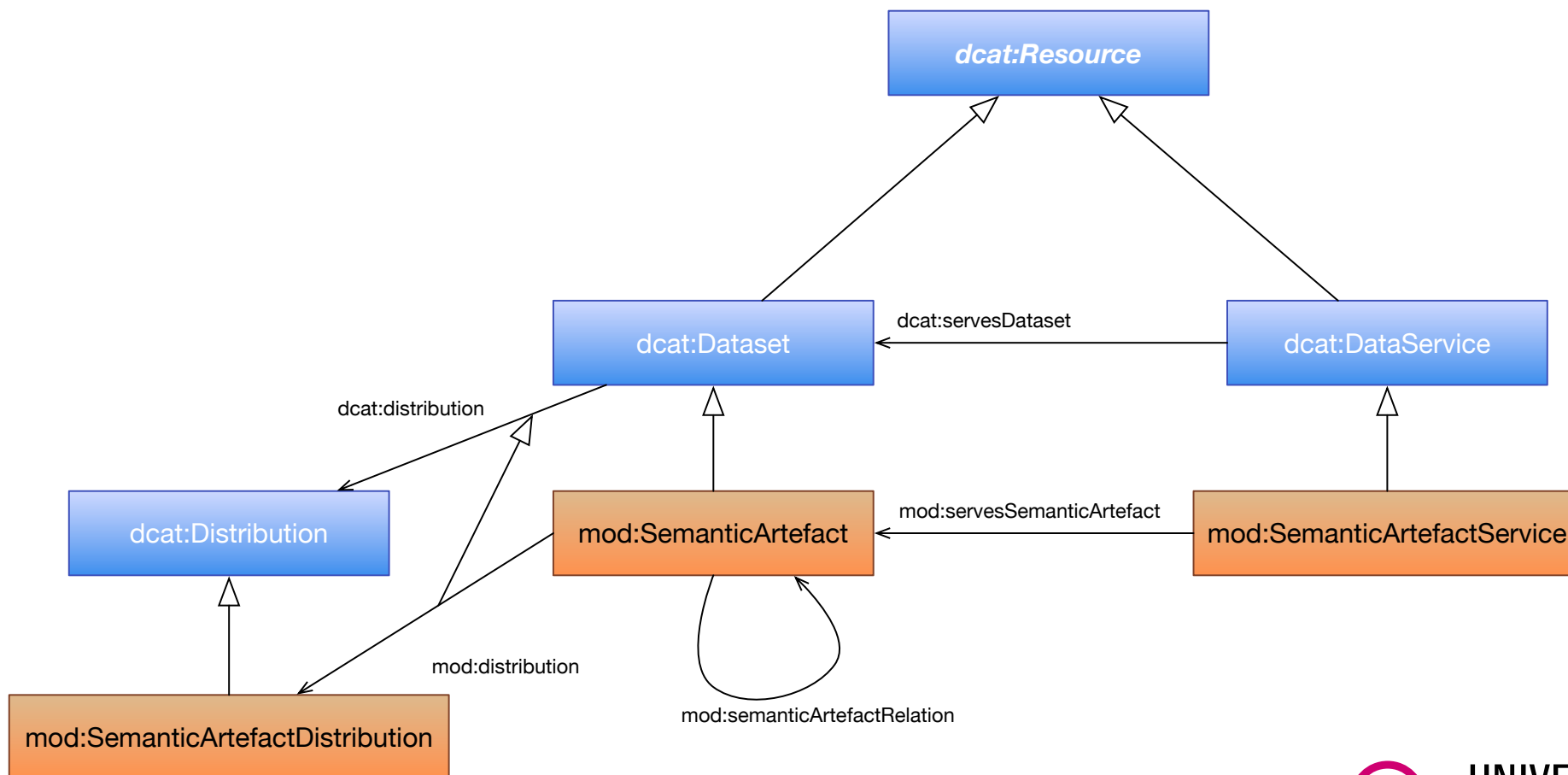
DCAT 2.0 and other types of resources



METADATA FOR ONTOLOGY DESCRIPTION AND PUBLICATION – MOD

- An OWL ontology to capture metadata information for ontologies, vocabularies or semantic artefacts in general;
- Version 1.4 – stable and with its own model;
- Version 2.0 – in development and adopting the DCAT 2 model;
- Currently discussed in the RDA's Vocabulary Services Interest Group and in the H2020 FAIRsFAIR project's FAIR semantics task;
- Github: <https://github.com/sifrproject/MOD-Ontology>

MOD Semantic Artefact Metadata (simplified)



MOD Semantic Artefact Metadata

MANDATORY PROPERTIES:

dct:title	dct:description	mod:acronym
dct:license	dcat:contactPoint	dcat:landingPage
dct:identifier	owl:versionIRI	dct:subject
dct:accessRights	dct:modified	dct:type
dct:creator	dcat:keyword	dct:issued
dct:created	dcat:theme	dcat:theme

MOD Semantic Artefact Distribution Metadata

MANDATORY PROPERTIES:

dcat:mediaType

dct:format

dct:title

dct:accessURL

mod:hasRepresentationLanguage

mod:hasSyntax

dct:accessRights



Questions?

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Associate Professor BioSemantics – LUMC

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