

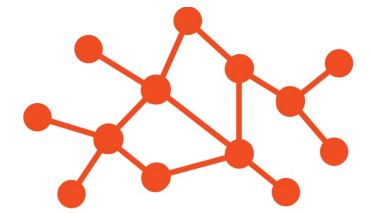


FarmCoiners

From Generic to Specific Metadata Template

Nikola Vasiljevic





FAIR
Data Collective

- A majority of slides curtesy of FAIR Data Collective with permission for adaptation



FarmConnors

<http://example.com/awesome-data>



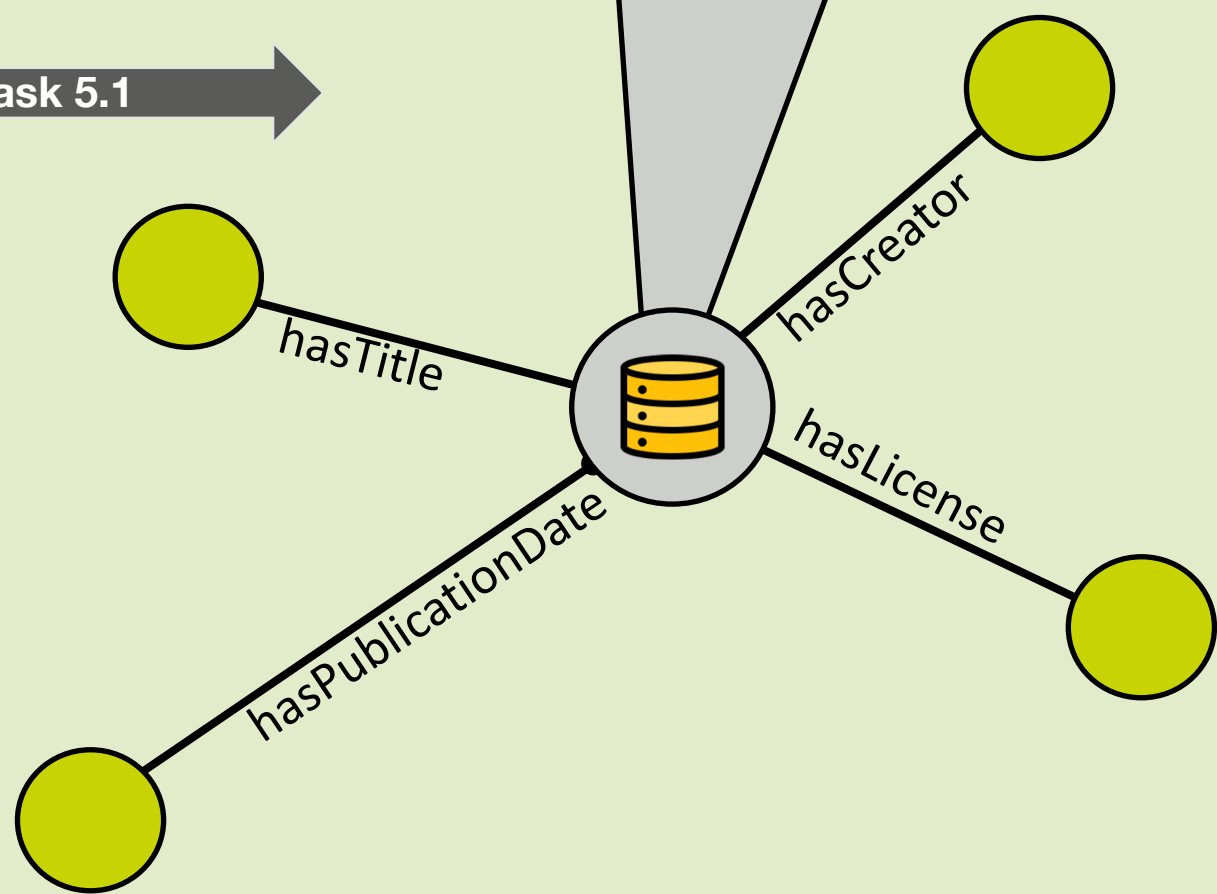
AWESOME JOURNAL ARTICLE



Human readable

<http://example.com/awesome-data>

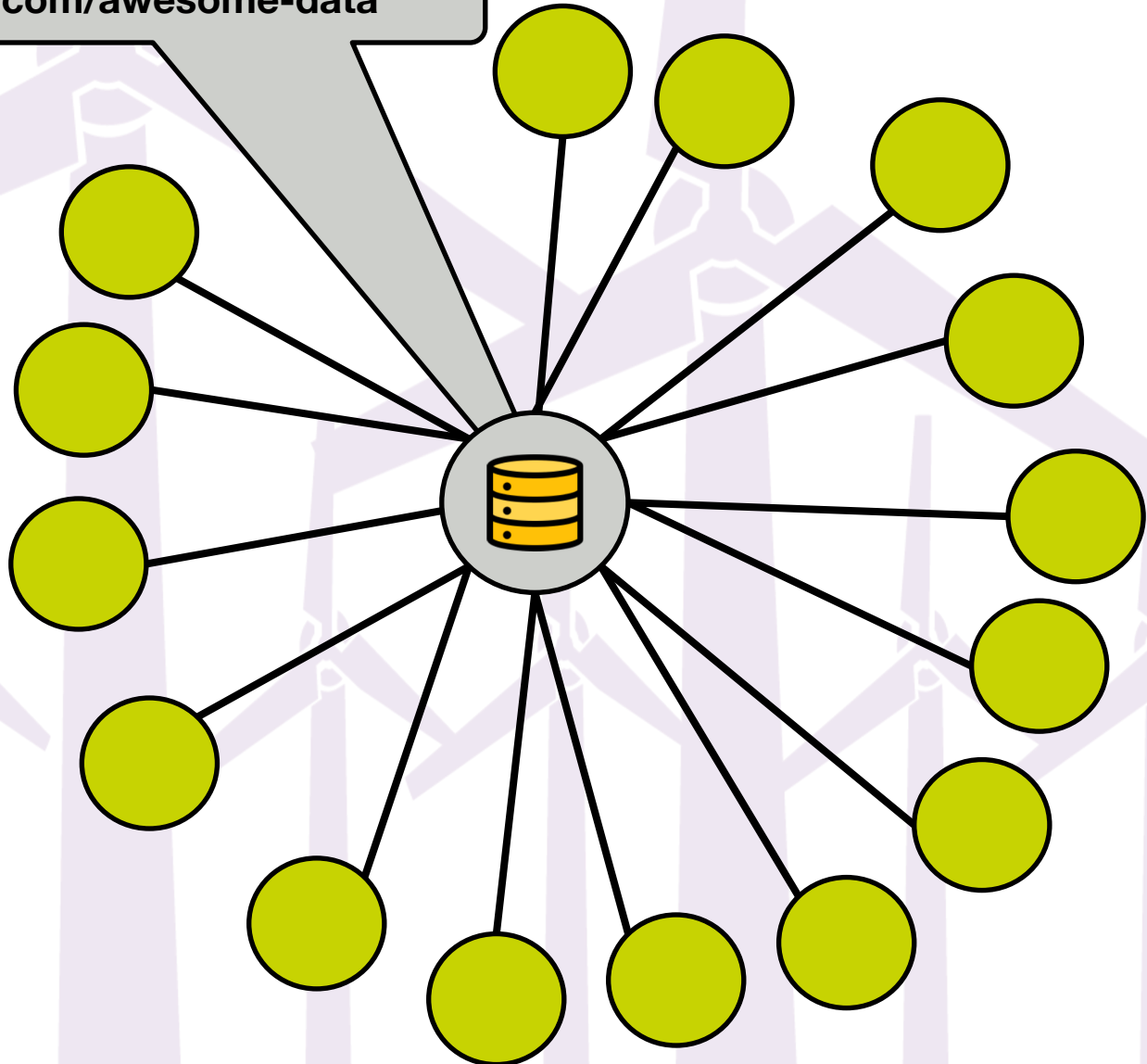
Transition in Task 5.1



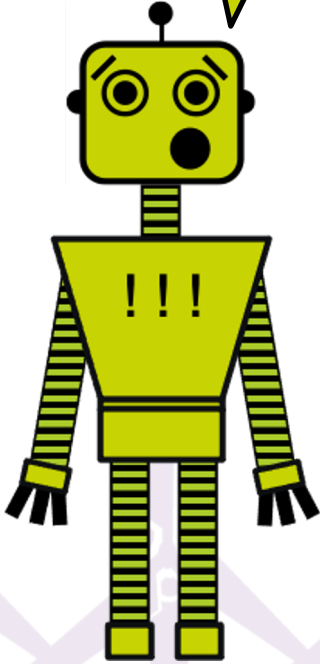
Human and machine readable

*<http://example.com/awesome-data> is resolvable PID for metadata describing data

<http://example.com/awesome-data>



Wow so rich!



FarmConnors

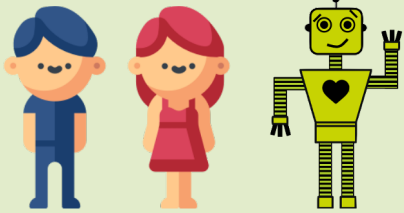
Enabling machine actionability

Field	Value
Title	<i>insert_title</i>
Creator	<i>insert_creator</i>
Publication date	<i>insert_publication_date</i>
License	<i>insert_license</i>
Subject	<i>insert_subject</i>
Variable	<i>insert_variable</i>
...	...



Human readable metadata template

Field	Value
http://purl.org/dc/elements/1.1/title	Free text
http://purl.org/dc/elements/1.1/creator	URL representing ORCID ID
http://purl.org/gdmt/hasDatasetDate	datetime string
http://purl.org/dc/elements/1.1/rights	https://spdx.org/licenses/
http://purl.org/dc/elements/1.1/subject	http://purl.org/neat
http://purl.org/gdmt/hasVariableInfo	http://purl.org/aspect
...	...



Human and machine readable metadata template

Enabling machine actionability

Field	Value
Title	<i>insert_title</i>
Creator	<i>insert_creator</i>
Publication date	<i>insert_publication_date</i>
License	<i>insert_license</i>
Subject	<i>insert_subject</i>
Variable	<i>insert_variable</i>
...	...

Field	Value
http://purl.org/dc/elements/1.1/title	Free text
http://purl.org/dc/terms/identifier	URL representing ORCID ID
http://purl.org/dc/terms/dctypename	datetime string
https://spdx.org/licenses/	SPDX License List
http://purl.org/neat	NEAT: wiNd Energy tAxiNomy of Topics
http://purl.org/aspect	ASPECT: wind energy vARiableS ParametERs ConstAnts
...	...

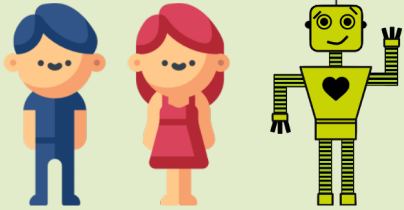
SPDX License List

NEAT: wiNd Energy tAxiNomy of Topics

ASPECT: wind energy vARiableS ParametERs ConstAnts



Human readable metadata template



Human and machine readable metadata template

Vocabularies built and maintained on GitHub using **sheet2rdf** by



The screenshot shows the GitHub repository page for `DTUWindEnergy/NEAT-taxonomy`. The browser address bar shows the URL `https://github.com/DTUWindEnergy/NEAT-taxonomy`. The repository name is `DTUWindEnergy/NEAT-taxonomy`. The page displays the `README.md` file content, which includes a `Sheet2RDF` badge indicating a passing status. The main heading is **NEAT: wiNd Energy tAxiNomy of Topics**. The text describes a controlled vocabulary for wind energy topics, mentioning its origin in 2017 and its update in 2018 and 2020. It also notes the use of `sheet2rdf` and `OntoStack` for conversion and hosting. A persistent URL `purl.org/neat` is mentioned. A progress bar on the right shows 70.9% Python and 29.1% Shell coverage.

<https://github.com/DTUWindEnergy/NEAT-taxonomy>

The screenshot shows the GitHub repository page for `DTUWindEnergy/ASPECT-taxonomy`. The browser address bar shows the URL `https://github.com/DTUWindEnergy/ASPECT-taxonomy`. The repository name is `DTUWindEnergy/ASPECT-taxonomy`. The page displays the `README.md` file content, which includes a `Sheet2RDF` badge indicating a passing status. The main heading is **ASPECT: wind energy vAriableS ParametErs and ConstAnts**. The text describes a controlled vocabulary for wind energy parameters and constants, mentioning its use in the wind energy community. It notes the use of `sheet2rdf` and `OntoStack` for building and serving the taxonomy, and `purl.org` for providing persistent URLs. A list of examples is provided: the entire taxonomy `purl.org/aspect` and an individual term such as `wind_speed` `purl.org/aspect/wind_speed`. A section titled `sheet2rdf` describes the automatic workflow using GitHub actions, which fetches a Google Sheet from Google Drive, converts it to `xlsx` and `csv` formats, and stores them in the repository. A progress bar on the right shows 70.9% Python and 29.1% Shell coverage.

<https://github.com/DTUWindEnergy/ASPECT-taxonomy>

Vocabularies resolved via OntoStack by



Ontology viewer: NEAT: wiNd Energy tAxiomy of Topics

Content language English

Alphabetical Hierarchy Groups

Vocabulary information

TITLE NEAT: wiNd Energy tAxiomy of Topics
NEAT: wiNd Energy tAxiomy of Topics

DESCRIPTION A taxonomical organization of research topics in wind energy which follows a typical lifecycle of wind farm development.

CREATOR <http://orcid.org/0000-0002-9381-9693>
<http://orcid.org/0000-0003-4124-9040>

TYPE <http://www.w3.org/2004/02/skos/core#ConceptScheme>

URI <http://data.windenergy.dtu.dk/controlled-terminology/neat/>

Resource counts by type

Type	Count
Concept	69

Term counts by language

Language	Preferred terms	Alternate terms	Hidden terms
English	69	8	0

Download this vocabulary: [TURTLE](#)

<http://purl.org/neat>

Ontology viewer: ASPECT: wind energy vARiableS ParamETers and ConstAnts

Content language English

Alphabetical Hierarchy Groups

Vocabulary information

TITLE ASPECT: wind energy vARiableS ParamETers and ConstAnts

DESCRIPTION Controlled vocabulary of variables, parameters and constants used in wind energy community.

CREATOR Technical University of Denmark, DTU Wind Energy

RIGHTS <https://spdx.org/licenses/CC0-1.0>

TYPE <http://www.w3.org/2004/02/skos/core#ConceptScheme>

URI <http://data.windenergy.dtu.dk/controlled-terminology/aspect/>

Resource counts by type

Type	Count
Concept	140

Term counts by language

Language	Preferred terms	Alternate terms	Hidden terms
English	140	35	0

<http://purl.org/aspect>

Vocabularies for review on Google Drive / simple representation

A1	Top Terms	Narrow Terms					
1	Top Terms						
2	Economics						
3		Business Models					
4		Levelized Cost of Energy Models					
5		Market Models					
6		Project Finance					
7		Support Schemes					
8	Operation & Maintenance						
9		Commissioning					
10		Decommissioning					
11			End-of-Life Extension				
12				Re-Certification			
13				Recycling			
14				Repowering			
15				Revamping			
16		Forecasting					
17		Health & Safety					
18		Installation					
19		Maintenance Scheduling					
20	Siting						
21		Design Conditions					
22			Turbulence				
23		Infrastructures					
24		Long-Term Extrapolation					
25		Resource Assessment					
26		Spatial Planning					

NEAT taxonomy

H12	Environmental Condition Terms									
1	Environmental Condition Terms									
2		air pressure								
3		air temperature								
4		crosswind								
5		flow inclination angle								
6		headwind								
7		number of particles classified								
8		particle diameter								
9		particle fall speed								
10		radar reflectivity								
11		radial velocity of scatterers toward instrument								
12		rain status								
13		rainfall amount								
14		rainfall kinetic energy								
15		rainfall rate								
16		relative humidity								
17		tailwind								
18		wind direction								
19		wind speed								
20	Generic Terms									
21		azimuth angle								
22		elevation angle								
23	Wind Power Plant Terms									
24		Wind Turbine Terms								
25			Wind Turbine Nacelle Terms							
26				gearbox displacement						

ASPECT taxonomy

Vocabularies for review on Google Drive / semantic representation

NEAT-taxonomy - Google Sheet

File Edit View Insert Format Data Tools Add-ons Help Last edit was 16 minutes ago

ConceptScheme URI				
1	ConceptScheme URI	http://data.windenergy.dtu.dk/controlled-terminology/neat/		
2	PREFIX	neat	http://data.windenergy.dtu.dk/controlled-terminology/neat/	
3	PREFIX	pav	http://purl.org/pav/	
4	PREFIX	dct	http://purl.org/dc/terms/	
5	PREFIX	rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#	
6	PREFIX	rdfs	http://www.w3.org/2000/01/rdf-schema#	
7	skos:prefLabel	NEAT		
8	dct:title	NEAT: wiNd Energy tAxiomy of Topics		
9	dct:description	A taxonomical organization of research topics in wind energy which follows a typical lifecycle of wi		
10	dct:creator	http://orcid.org/0000-0003-4124-9040		
11	dct:creator	http://orcid.org/0000-0002-9381-9693		
12	pav:version	0.1		
13	pav:createdOn	2020-12-01T00:00:00+01:00		
14	pav:lastUpdatedOn	2020-12-01T00:00:00+01:00		
15				
16	Identifier	skos:prefLabel	rdf:type	rdfs:label skos:definition@en
17	neat:IEVref	IEV ref	rdf:Property	IEV ref A code used to identify certain concept
18	neat:Economics	Economics		
19	neat:BusinessModels	Business Models		A conceptual structure that supports th
20	neat:LevelizedCostofEnergyModels	Levelized Cost of Energy Models		An expression of the production cost of
21	neat:ProjectFinance	Project Finance		
22	neat:MarketModels	Market Models		
23	neat:SupportSchemes	Support Schemes		
24	neat:OperationMaintenance	Operation & Maintenance		Combination of all technical and manag
25	neat:Commissioning	Commissioning		Activities undertaken to prepare a syste
26	neat:Decommissioning	Decommissioning		Administrative and technical actions tak

simple representation semantic representation

NEAT taxonomy

ASPECT-taxonomy - Google Sheet

File Edit View Insert Format Data Tools Add-ons Help Last edit was 15 minutes ago

ConceptScheme URI			
1	ConceptScheme URI	http://data.windenergy.dtu.dk/controlled-terminology/aspect/	
2	PREFIX	aspect	http://data.windenergy.dtu.dk/controlled-terminology/aspect/
3	PREFIX	pav	http://purl.org/pav/
4	PREFIX	dct	http://purl.org/dc/terms/
5	PREFIX	rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
6	PREFIX	rdfs	http://www.w3.org/2000/01/rdf-schema#
7	skos:prefLabel	ASPECT	
8	dct:title	ASPECT: wind energy vAriableS ParamETers and ConstTants	
9	dct:description	Controlled vocabulary of variables, parameters and constants used in wind energy com	
10	dct:creator	Technical University of Denmark, DTU Wind Energy	
11	dct:rights	https://spdx.org/licenses/CC0-1.0	
12	pav:version	0.1.0	
13	pav:createdOn	2020-10-22T22:00:00+01:00	
14	pav:lastUpdatedOn	2021-06-21T15:00:00+01:00	
15			
16	Identifier	skos:prefLabel	rdf:type
22	aspect:iec-61400-13-name	iec-61400-13-name	rdf:Property
23	aspect:iec-61400-25-2-name	iec-61400-25-2-name	rdf:Property
24	aspect:prefUnit	prefUnit	rdf:Property
25	aspect:altUnit	altUnit	rdf:Property
26	aspect:GenericTerms	Generic Terms	
27	aspect:azimuth_angle	azimuth_angle	
28	aspect:elevation_angle	elevation_angle	
29	aspect:EnvironmentalConditionTerms	Environmental Condition Terms	
30	aspect:wind_speed	wind_speed	

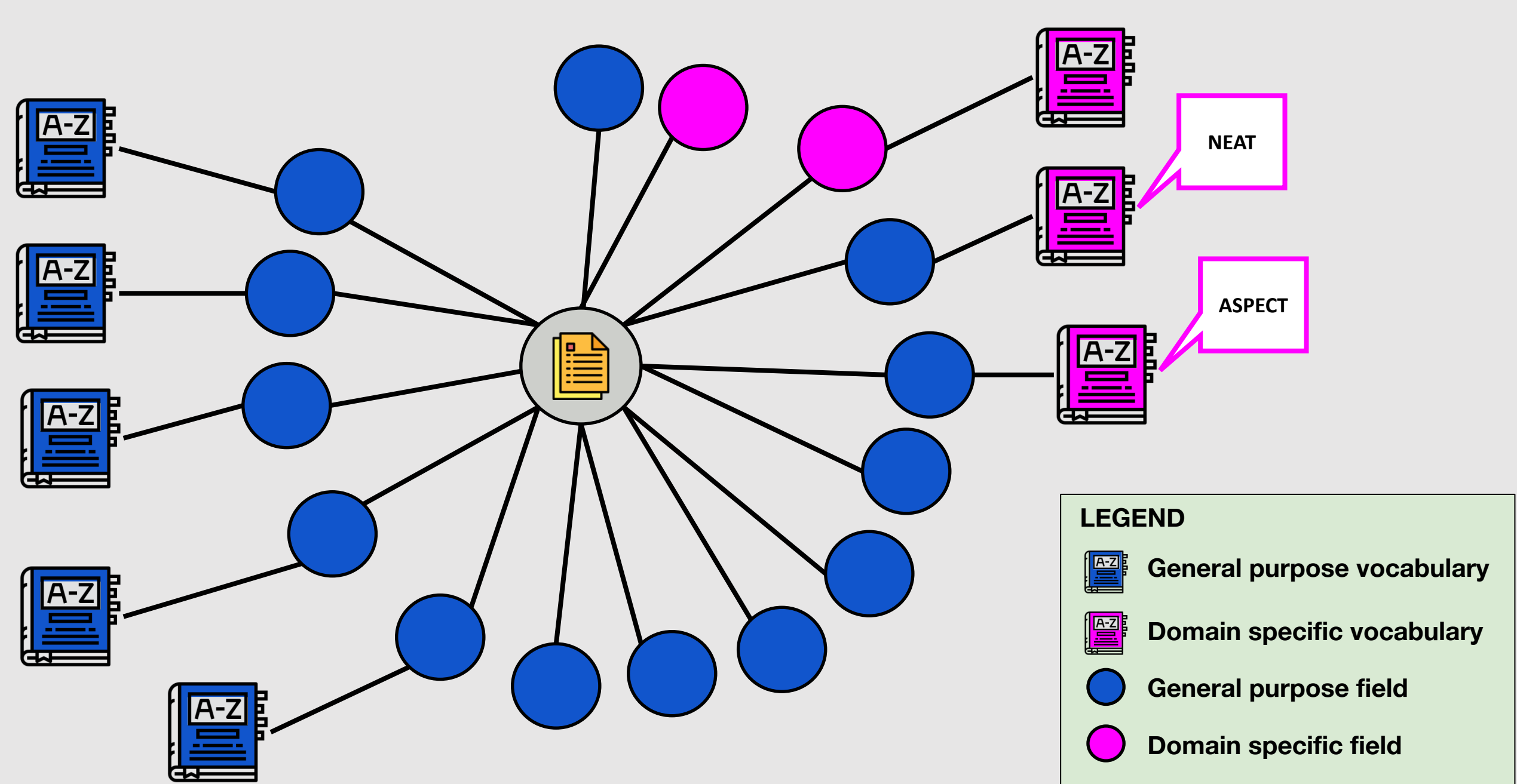
simple representation semantic representation

ASPECT taxonomy





WE NEED YOUR INPUTS ON EXTENDING NEAT AND ASPECT !!!

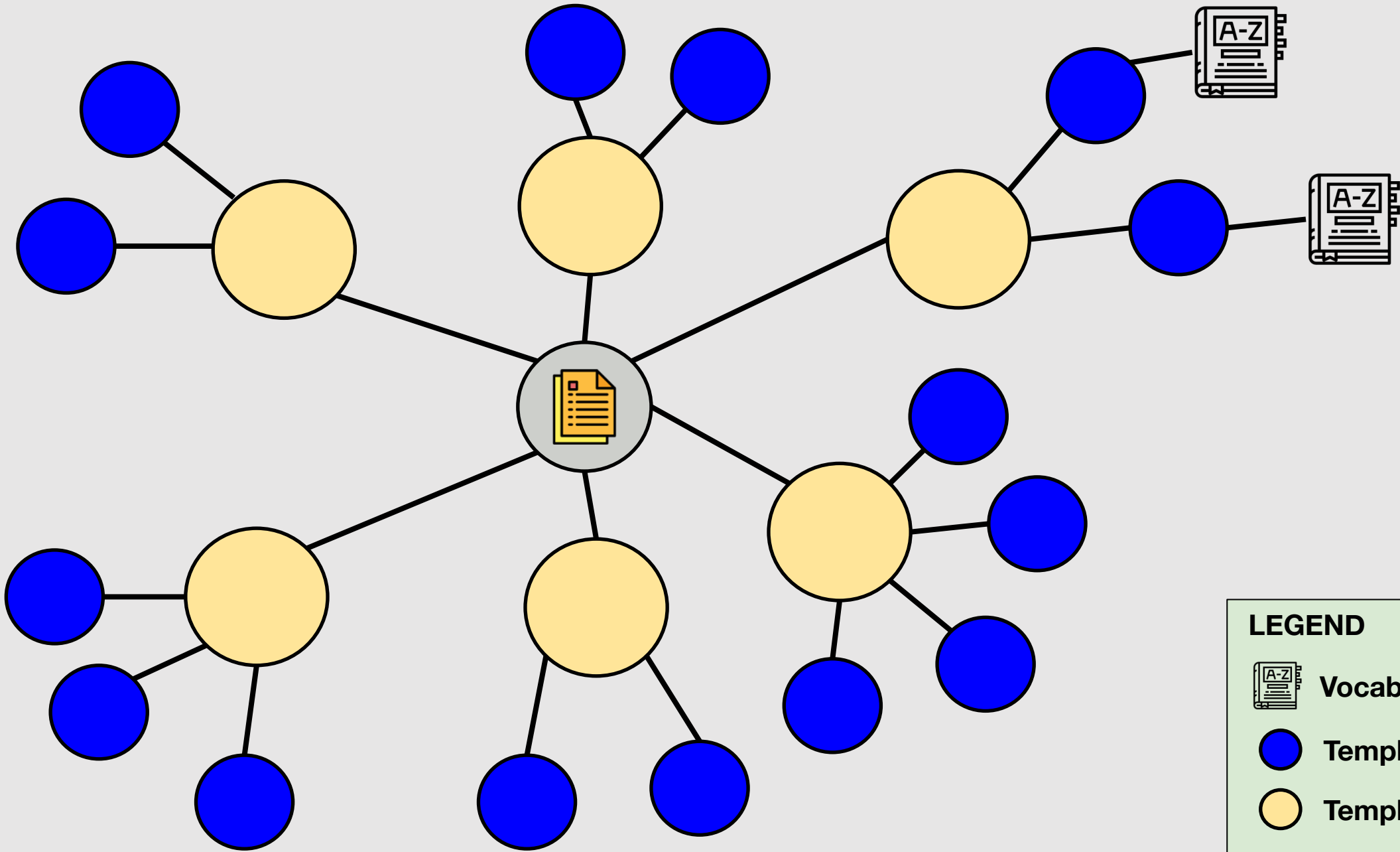
PLEASE COMMENT THE PREVIOUS GOOGLE SHEET DOCS!!!

START WITH SIMPLE REPRESENTATIONS AND OPTIONALLY LOOK AT SEMANTIC REPRESENTATION






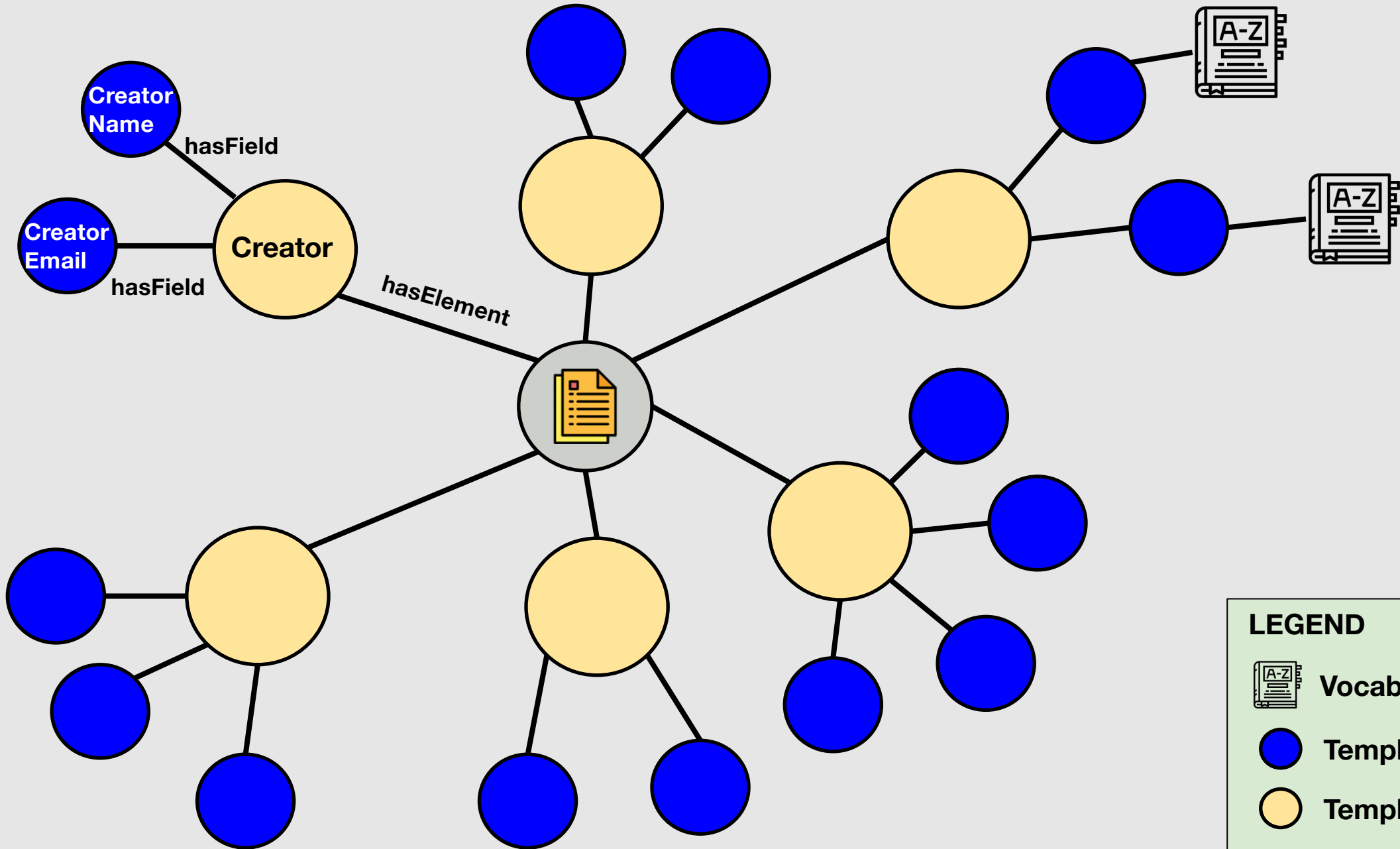
LEGEND

-  General purpose vocabulary
-  Domain specific vocabulary
-  General purpose field
-  Domain specific field






LEGEND

-  Vocabulary
-  Template field
-  Template element



LEGEND

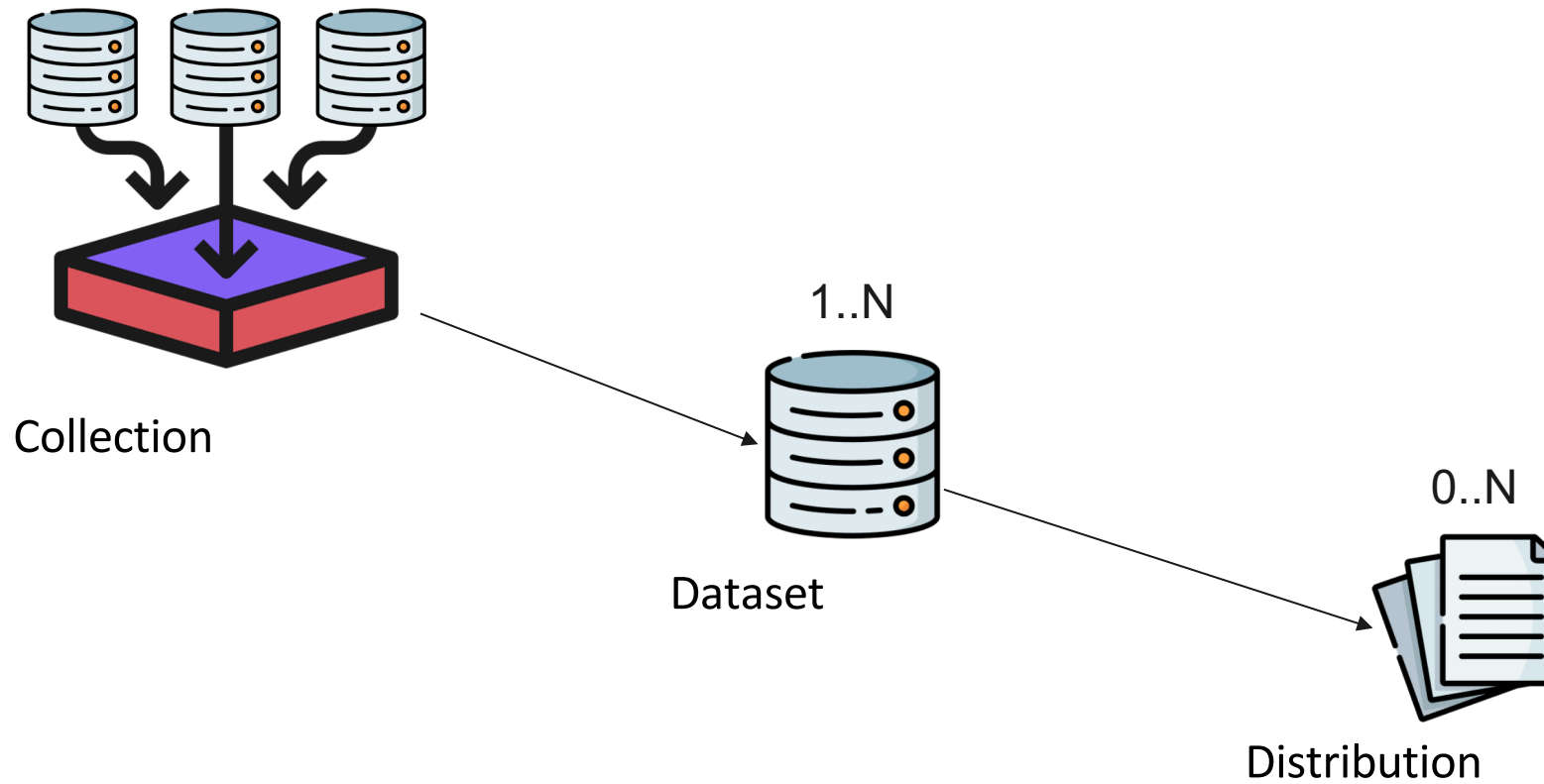
-  Vocabulary
-  Template field
-  Template element

Generic Dataset Metadata Template (GDMT)

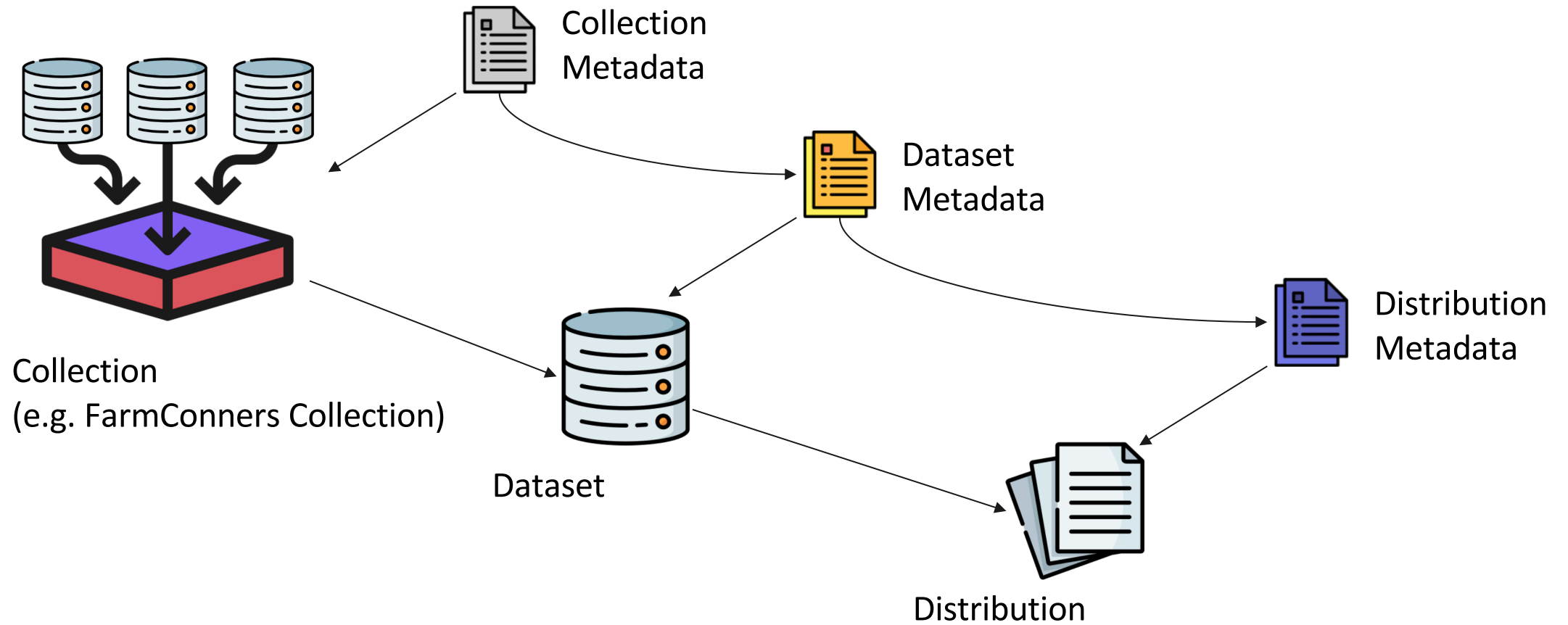
- Developed by FAIR Data Collective (FDC)
- Made by fusing and improving **DataCite** and **DCAT** scheme
- GDMT contains 100 fields ('only' 13 mandatory) grouped in ~20 elements
- Unlike the DataCite template, GDMT is **MACHINE-ACTIONABLE**, details at:
 - [CEDAR](#)
 - [GitHub](#)
- GDMT contains a ['back-end' ontology](#) that enables machine-actionability and has:
 - ~**120** RDF properties (i.e., defined fields and elements with resolvable PIDs)
 - ~**1000** controlled terms (with resolvable PIDs)

*PID = Persistent Identifier, URL = resolvable PID (e.g., your ORCID ID)

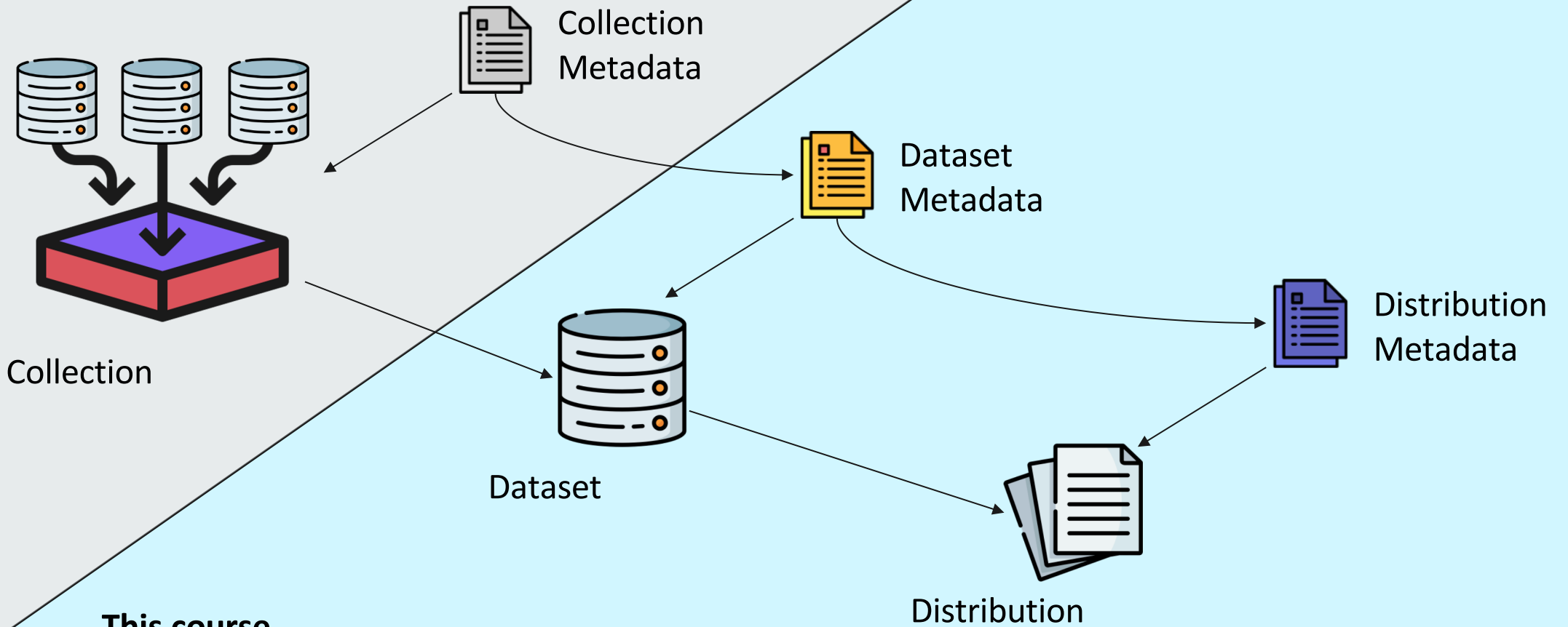
DCAT (Data Catalog Vocabulary) organizations



DCAT organizations

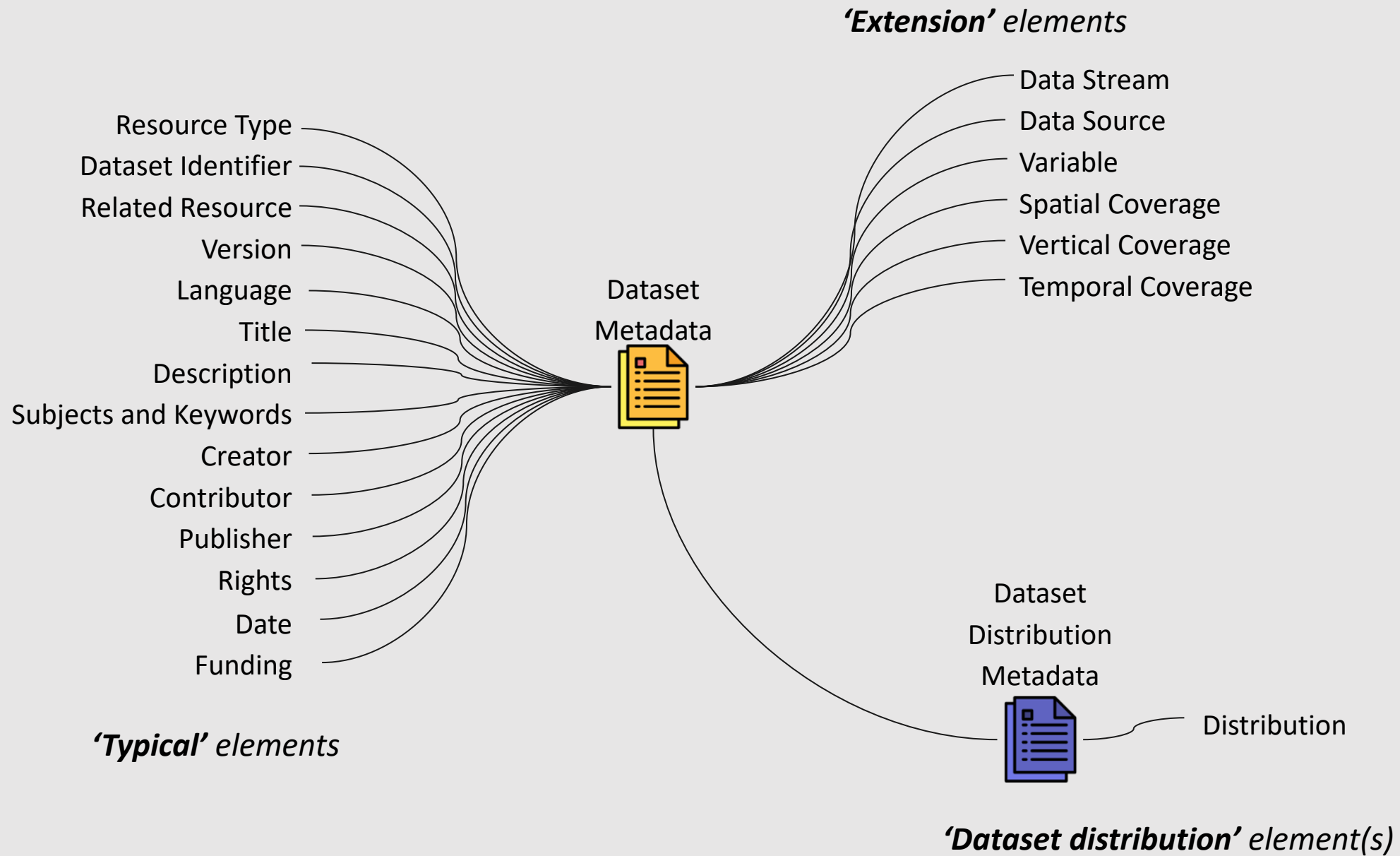


DCAT organizations



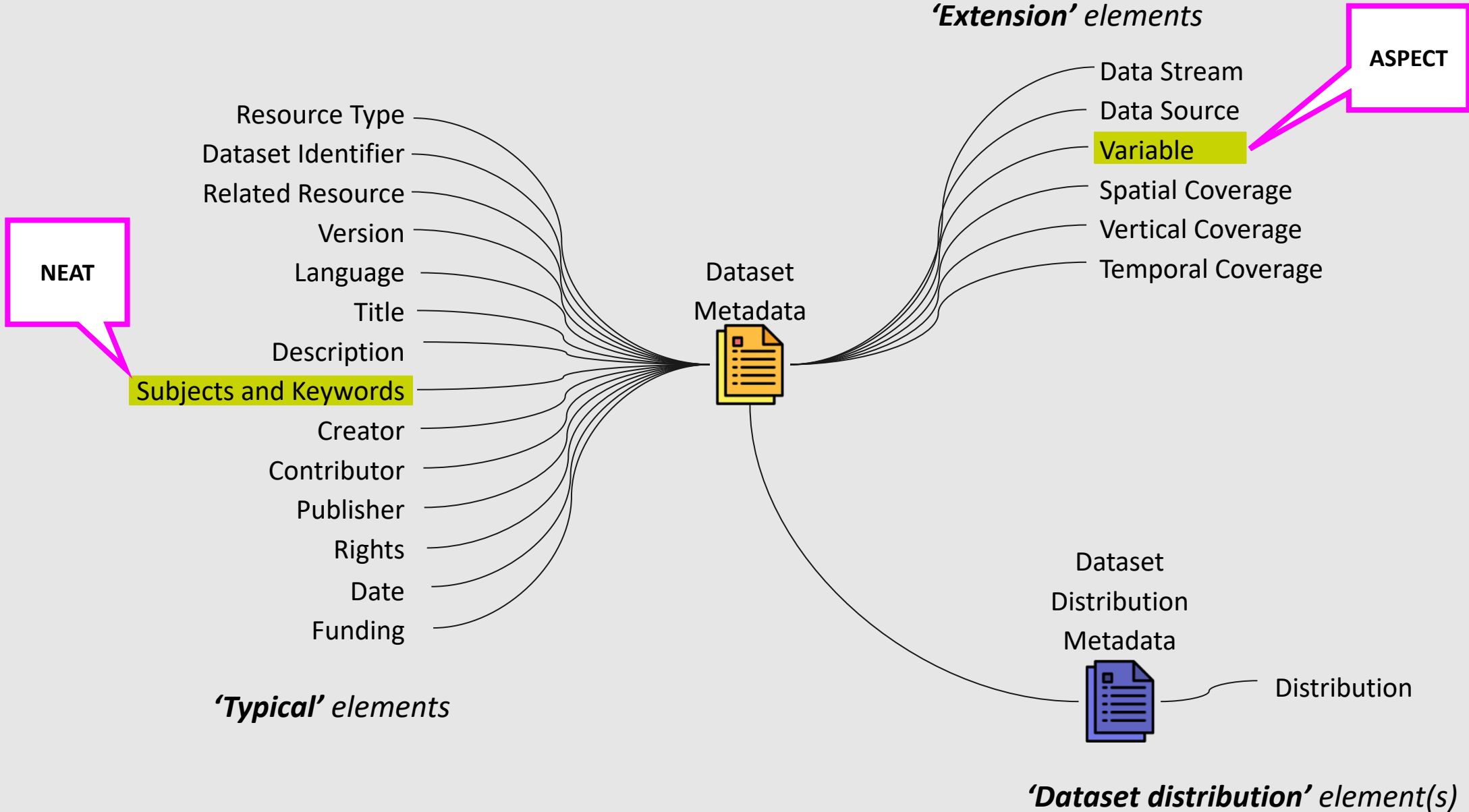
Repository
concern

**This course
concern**

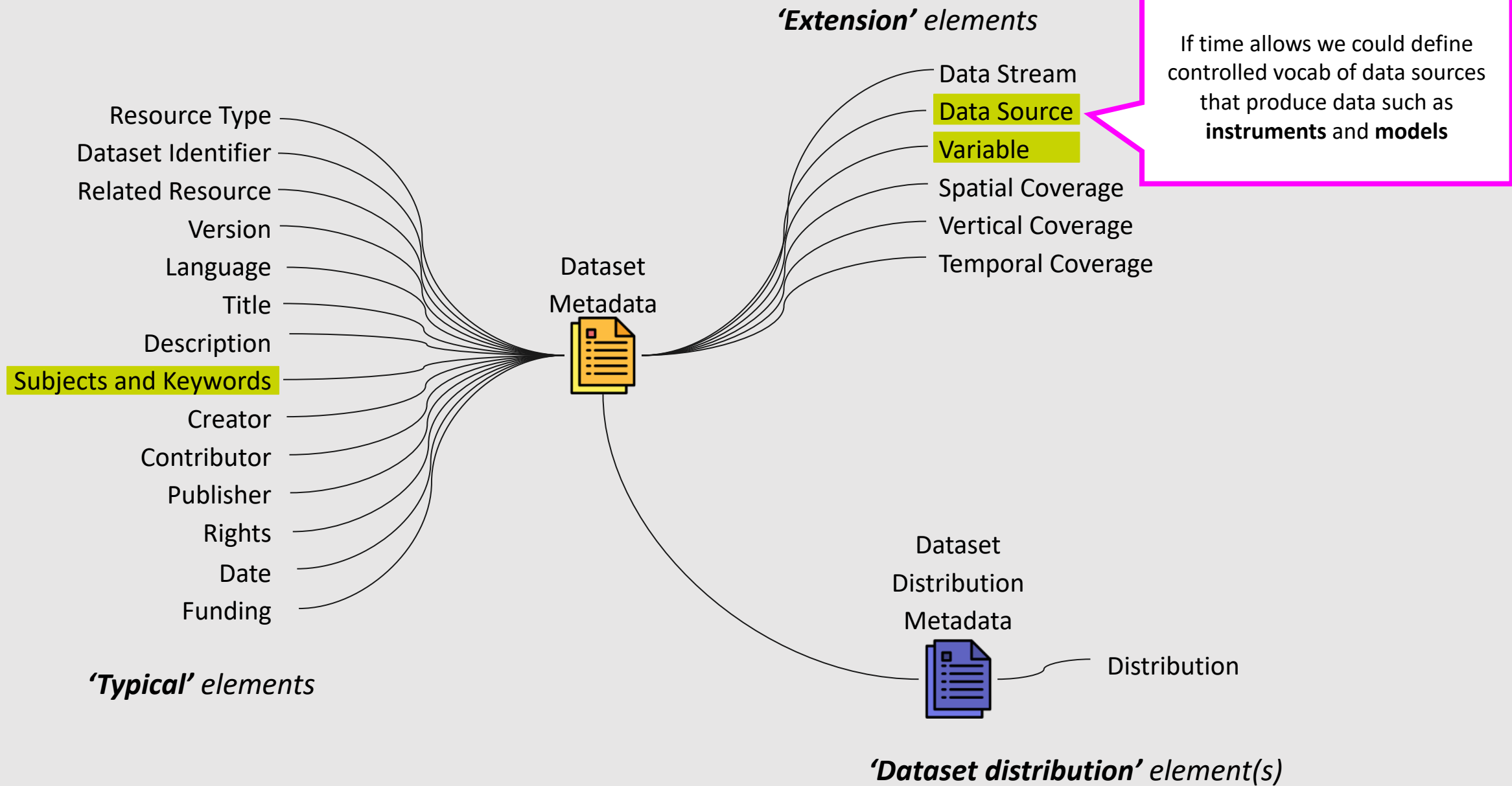


You can find definitions of elements and fields on [CEDAR](#) and [GitHub](#).

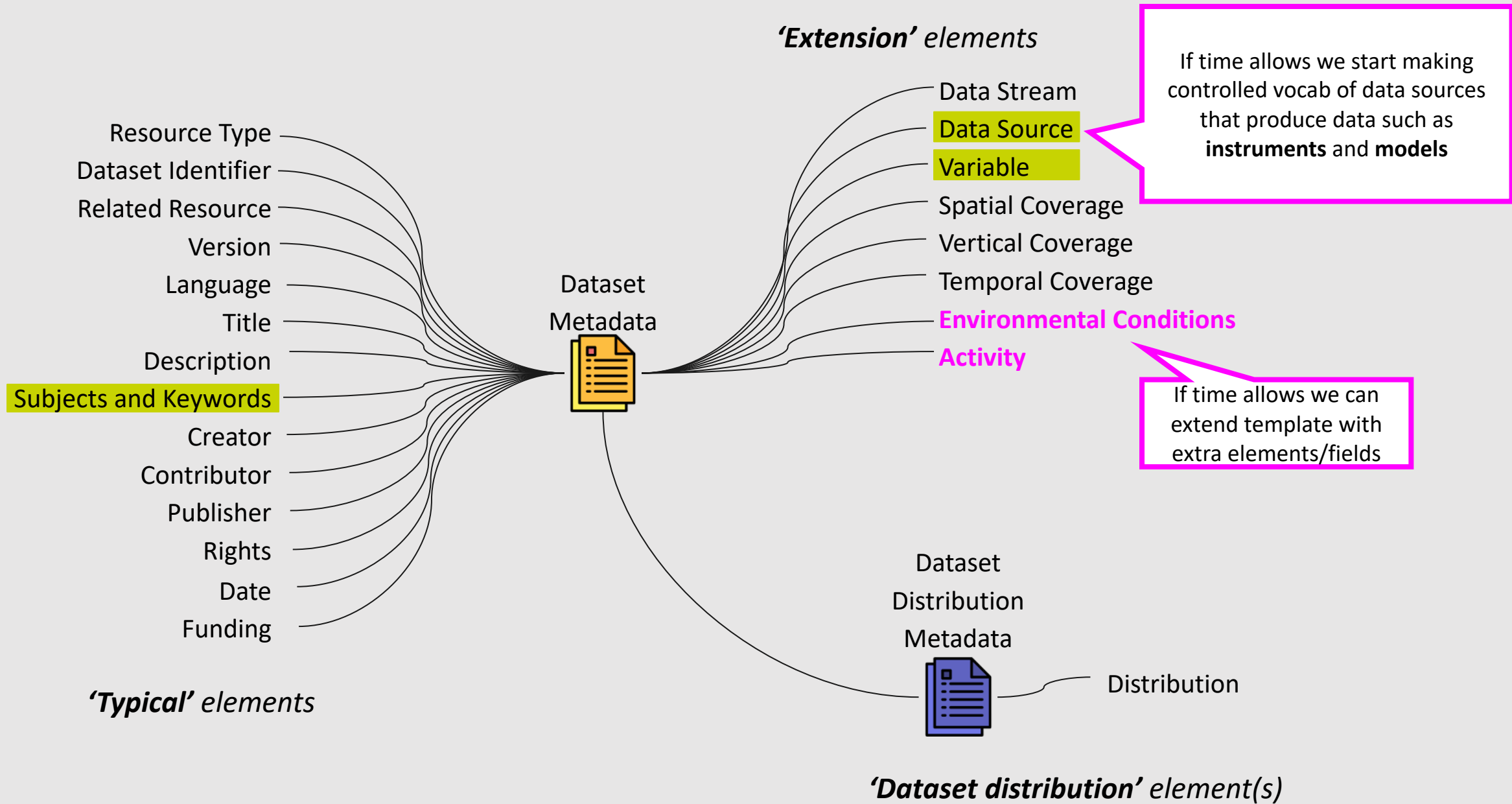
[OntoStack](#) serves the GDMT ontology, which contains a number of controlled terms and RDF properties that enable machine-actionability.



By creating domain specific controlled vocabularies and updating **GDMT** to use them, we turn GDMT to Specific Dataset Metadata Template (**SDMT**)



By creating domain specific controlled vocabularies and updating **GDMT** to use them, we turn GDMT to Specific Dataset Metadata Template (**SDMT**)



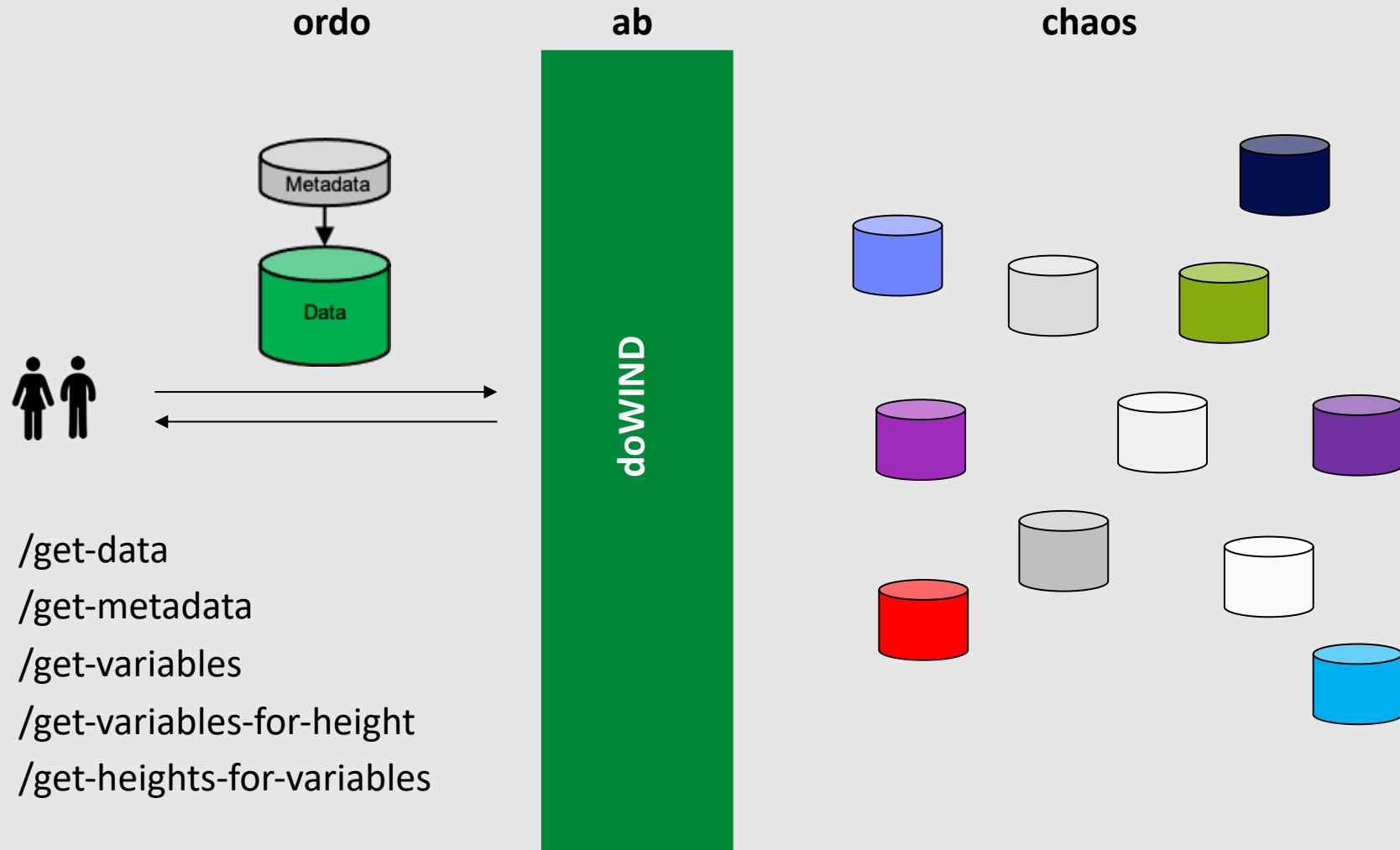
By creating domain specific controlled vocabularies and updating **GDMT** to use them, we turn GDMT to Specific Dataset Metadata Template (**SDMT**)

Questions/Comments?

Why should I do this? What is the point of wasting time on this? Research cannot be standardized, that is for industry! This is only for academia and not for industry! Why do you think 'your way' is better than 'my way'? I am busy! We have our own standard! There is a header in a CSV file and it is readable by my computer! Our data are not open! This is difficult and I don't want to spend time learning it! Scientific papers is what matters! This is a utopian idea!

Implementation of semantics

doWIND: data aggregation and subsetting API



/get-data
/get-metadata
/get-variables
/get-variables-for-height
/get-heights-for-variables

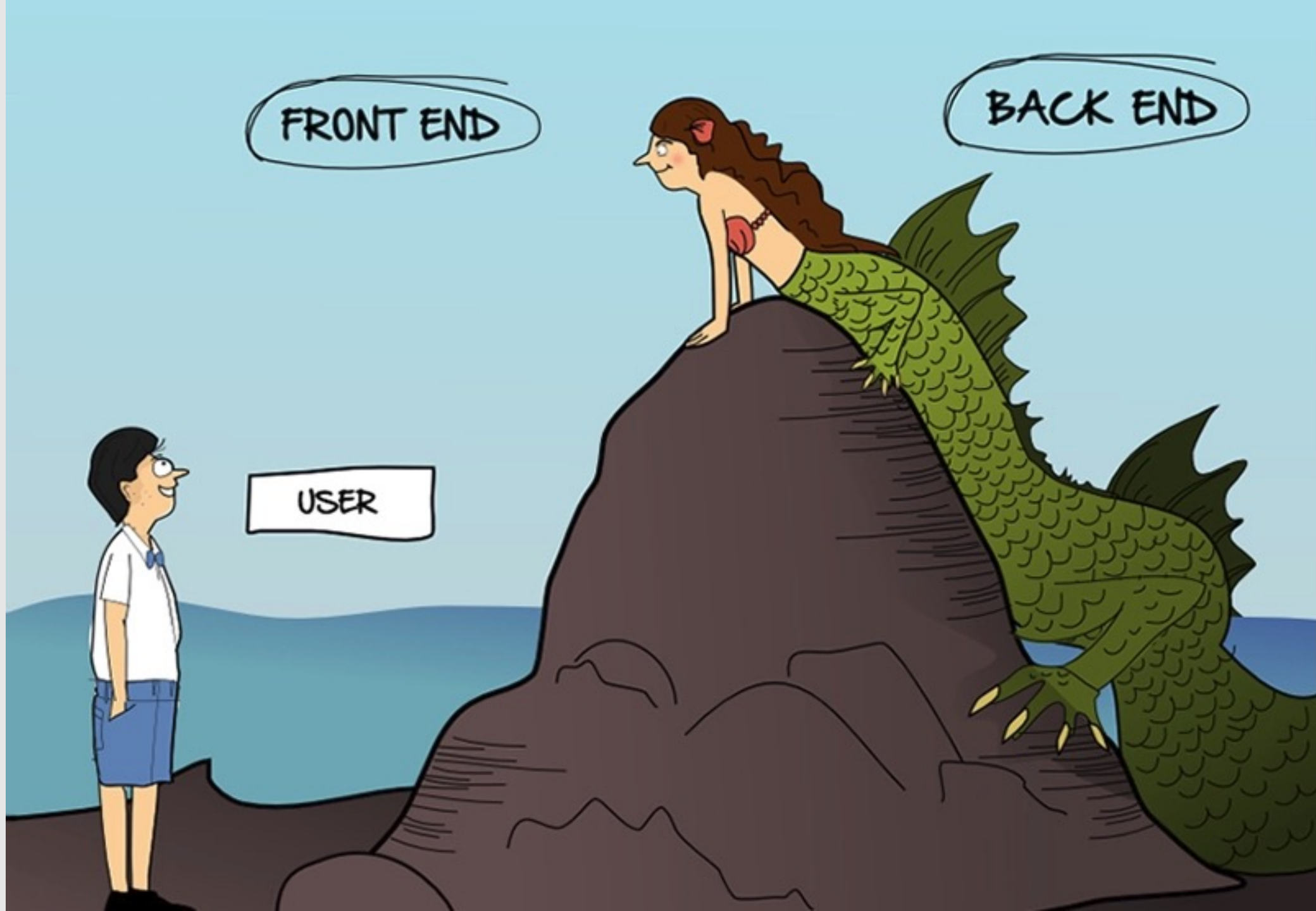
Standard data format
Rich metadata
Single approach to access (meta)data

Unorganized data in all kind of formats
Limited or no metadata
Located evrywhere and nowhere

FRONT END

BACK END

USER



doWIND: key features

Data owners

- API provided as a docker container / python package
- Configuration of the API through a simple YAML file
- Ability to control maximum file size served to user
- Ability to control data access using *auth* package
- Back-end data can be in various formats:
GeoTiff, NetCDF, Zarr, ...
- **Metadata make use of controlled vocabularies**

Data users

- Ability to aggregate and subset data based on (currently):
 - Variables
 - Geospatial coverage (Bounding box, Height)
- Access to data through HTTP calls (basically links)
- **Receive NetCDF file with rich metadata**
- **NetCDF conforms to metadata schema**
- **NetCDF variable attributes linked to controlled vocabularies**

doWIND instances



- New European Wind Atlas (NEWA):
 - [NEWA microscale atlas](#)
 - [NEWA mesoscale atlas](#)

Implementation of semantics in doWIND

doWIND API: NEWA Mesoscale Atlas 0.1.0 OAS3
</api/mesoscale-atlas/v1/openapi.json>

Servers

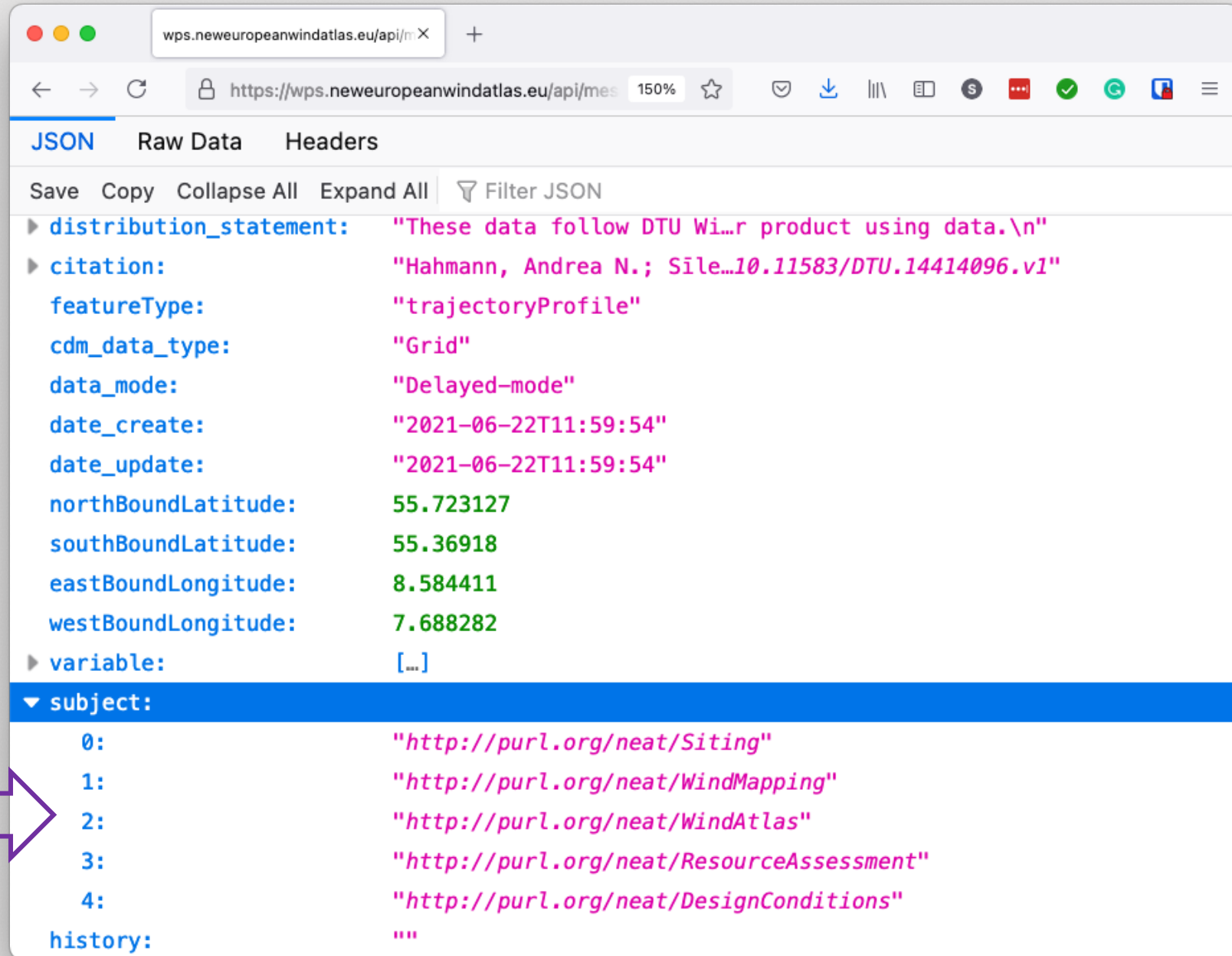
default

- GET** `/get-data` Get Data Bbox
- GET** `/get-metadata` Get Metadata
- GET** `/get-heights-for-variable` Get Heights For Variable
- GET** `/get-variables-for-height` Get Variables For Height
- GET** `/get-variables` Get Variables

<https://wps.neweuropeanwindatlas.eu/api/mesoscale-atlas/v1/docs>

<https://.../get-metadata>

Subject resolvable PIDs



```
JSON Raw Data Headers
Save Copy Collapse All Expand All Filter JSON
distribution_statement: "These data follow DTU Wi...r product using data.\n"
citation: "Hahmann, Andrea N.; Sile...10.11583/DTU.14414096.v1"
featureType: "trajectoryProfile"
cdm_data_type: "Grid"
data_mode: "Delayed-mode"
date_create: "2021-06-22T11:59:54"
date_update: "2021-06-22T11:59:54"
northBoundLatitude: 55.723127
southBoundLatitude: 55.36918
eastBoundLongitude: 8.584411
westBoundLongitude: 7.688282
variable: [...]
subject:
  0: "http://purl.org/neat/Siting"
  1: "http://purl.org/neat/WindMapping"
  2: "http://purl.org/neat/WindAtlas"
  3: "http://purl.org/neat/ResourceAssessment"
  4: "http://purl.org/neat/DesignConditions"
history: ""
```

Subject PIDs

Resolvable PIDs

The screenshot shows a web browser window with the URL `data.windenergy.dtu.dk/ontologies/view/neat/`. The page title is "NEAT: wind Energy taxonomy of Topics". The browser's address bar shows the URL and a search icon. The page has a dark teal header with the title and a search bar. Below the header, there are three tabs: "Alphabetical", "Hierarchy", and "Groups". The "Alphabetical" tab is selected, showing a list of concepts: Economics, Operation & Maintenance, Siting (selected), Design Conditions, Infrastructures, Long-Term Extrapolation, Resource Assessment, Spatial Planning, Wind Atlas, Wind Mapping, Wind Power Plant, and Wind Turbine. The "Siting" concept is expanded, showing its details. The details include: Preferred Term: Siting; Definition: A process of evaluating a number of factor before deciding to pursue development of a new wind farm project. These factors include: wind resource and compatibility of land/area, environmental impacts and community input (i.e., social acceptance); Narrower Concepts: Design Conditions, Infrastructures, Long-Term Extrapolation, Resource Assessment, Spatial Planning, Wind Atlas, Wind Mapping; Contributor: <https://orcid.org/0000-0002-9381-9693>; Creator: <http://orcid.org/0000-0003-4124-9040>; URI: <http://data.windenergy.dtu.dk/controlled-terminology/neat/Siting>; Download this concept: RDF/XML TURTLE JSON-LD.

Ontology viewer: neat: Siting

data.windenergy.dtu.dk/ontologies/view/neat/

NEAT: wind Energy taxonomy of Topics

Content language English

Search

Alphabetical Hierarchy Groups

- Economics
- Operation & Maintenance
- Siting**
 - Design Conditions
 - Infrastructures
 - Long-Term Extrapolation
 - Resource Assessment
 - Spatial Planning
 - Wind Atlas
 - Wind Mapping
 - Wind Power Plant
 - Wind Turbine

PREFERRED TERM Siting

DEFINITION A process of evaluating a number of factor before deciding to pursue development of a new wind farm project. These factors include: wind resource and compatibility of land/area, environmental impacts and community input (i.e., social acceptance)

NARROWER CONCEPTS Design Conditions, Infrastructures, Long-Term Extrapolation, Resource Assessment, Spatial Planning, Wind Atlas, Wind Mapping

CONTRIBUTOR <https://orcid.org/0000-0002-9381-9693>

CREATOR <http://orcid.org/0000-0003-4124-9040>

URI <http://data.windenergy.dtu.dk/controlled-terminology/neat/Siting>

Download this concept: [RDF/XML](#) [TURTLE](#) [JSON-LD](#)

Variables metadata

The screenshot shows the doWIND API: NEWA Mesoscale Atlas interface. The browser address bar displays the URL `https://wps.neweuropeanwindatlas.eu/api/mesoscale`. The page title is **doWIND API: NEWA Mesoscale Atlas** with version **0.1.0** and **OAS3** specification. A dropdown menu for **Servers** is set to `/api/mesoscale-atlas/v1`. Under the **default** section, a list of endpoints is shown:

- GET** `/get-data` Get Data Bbox
- GET** `/get-metadata` Get Metadata
- GET** `/get-heights-for-variable` Get Heights For Variable
- GET** `/get-variables-for-height` Get Variables For Height
- GET** `/get-variables` Get Variables

A purple arrow points from the text `https://.../get-variables` to the `/get-variables` endpoint in the list.

`https://.../get-variables`

Variables resolvable PIDs

Variable PID

The screenshot shows a web browser window with the URL `wps.neweuropeanwindatlas.eu/api/mes`. The browser's developer tools are open, displaying a JSON response. The JSON is structured as follows:

```
{
  "wind_speed_min": {...},
  "wind_speed_max": {...},
  "wind_speed_mean": {
    "long_name": "Horizontal Wind Speed",
    "standard_name": "wind_speed",
    "units": "m s-1",
    "concept_pid": "http://purl.org/aspect/wind_speed",
    "heights": {
      "0": 10,
      "1": 50,
      "2": 75,
      "3": 100,
      "4": 150,
      "5": 200,
      "6": 250,
      "7": 500
    }
  },
  "wind_speed_std": {...},
  "air_temperature_min": {...},
  "air_temperature_max": {...}
}
```

A purple arrow points to the `concept_pid` field within the `wind_speed_mean` object, which is highlighted as the 'Variable PID'.

Variables resolvable PIDs

The screenshot shows a web browser window with the URL `data.windenergy.dtu.dk/ontologies/view/aspect`. The page title is "Ontology viewer" and the main heading is "ASPECT: wind energy vARiableS ParametErs and ConstAnts". The content language is set to "English".

The left sidebar shows a tree view of the ontology with the following categories and terms:

- Alphabetical
- Hierarchy
- Groups
- Environmental Condition Terms
 - air_pressure
 - air_temperature
 - crosswind
 - flow_inclination_angle
 - headwind
 - number_of_particles_classified
 - particle_diameter
 - particle_fall_speed
 - radar_reflectivity
 - radial_velocity_of_scatterers_toward_inst
 - rain_status
 - rainfall_amount
 - rainfall_kinetic_energy
 - rainfall_rate
 - relative_humidity
 - tailwind
 - wind_direction
 - wind_speed**
- Generic Terms
- Wind Power Plant Terms

The main content area displays the details for the concept "wind_speed":

- Environmental Condition Terms** > wind_speed
- PREFERRED TERM**: wind_speed
- DEFINITION**: Speed is the magnitude of velocity. Wind is defined as a two-dimensional (horizontal) air velocity vector, with no vertical component. (Vertical motion in the atmosphere has the standard name upward_air_velocity.) The wind speed is the magnitude of the wind velocity.
- BROADER CONCEPT**: Environmental Condition Terms
- ENTRY TERMS**: horizontal_wind_speed, Vh
- ABBREVIATION**: WS
- PREFERRED UNIT**: m s-1
- CREATOR**: <https://orcid.org/0000-0002-9381-9693>
- URI**: http://data.windenergy.dtu.dk/controlled-terminology/aspect/wind_speed
- Download this concept:** [RDF/XML](#) [TURTLE](#) [JSON-LD](#)

Embedded metadata in data

<https://.../data>

doWIND API: NEWA Mesoscale Atlas 0.1.0 OAS3

</api/mesoscale-atlas/v1/openapi.json>

Servers

default

- GET** `/get-data` Get Data Bbox
- GET** `/get-metadata` Get Metadata
- GET** `/get-heights-for-variable` Get Heights For Variable
- GET** `/get-variables-for-height` Get Variables For Height
- GET** `/get-variables` Get Variables

<https://wps.neweuropeanwindatlas.eu/api/mesoscale-atlas/v1/docs>

NetCDF global and variable attributes

Resulting NetCDF

Metadata embedded as attributes

subject attribute

```
Untitled - Jupyter Notebook
localhost:8888/notebooks/Untitled.ipynb
jupyter Untitled Last Checkpoint: Last Friday at 7:54 PM (unsaved changes)
Python 3

In [1]: 1 import xarray as xr
In [2]: 1 ds = xr.open_dataset("./newa_mesoscale_data.nc")
In [3]: 1 print(ds)

<xarray.Dataset>
Dimensions:          (height: 1, south_north: 14, west_east: 20)
Coordinates:
  * west_east        (west_east) float64 4.174e+06 4.177e+06 ... 4.231e+06
  * south_north      (south_north) float64 3.626e+06 3.623e+06 ... 3.587e+06
  * height           (height) int32 100
  crs                int8 ...
Data variables:
  wind_speed_mean    (height, south_north, west_east) float32 ...
Attributes: (12/23)
  title:              New European Wind Atlas: Mesoscale Atlas
  authors:            Andrea N. Hahmann, Tija Sile, Björn Witha, Neil ...
  summary:            The mesoscale part of the New European Wind Atla...
  dataset_pid:        https://doi.org/10.11583/DTU.14414096
  subset_pid:         https://wps.neweuropeanwindatlas.eu/api/mesoscal...
  institution:        DTU Wind Energy
  ...
  southBoundLatitude: 55.36918
  eastBoundLongitude: 8.584411
  westBoundLongitude: 7.688282
  variable:           wind_speed_mean
  subject:             http://purl.org/neat/Siting, http://purl.org/nea...
  history:            2021-06-24T04:00:36\tdaTap v0.1.1\thttps://wps.n...
```

Embedded and stand-off metadata linking

```
JSON Raw Data Headers
Save Copy Collapse All Expand All Filter JSON
distribution_statement: "These data follow DTU Wi...r product using data.\n"
citation: "Hahmann, Andrea N.; Sile...10.11583/DTU.14414096.v1"
featureType: "trajectoryProfile"
cdm_data_type: "Grid"
data_mode: "Delayed-mode"
date_create: "2021-06-22T11:59:54"
date_update: "2021-06-22T11:59:54"
northBoundLatitude: 55.723127
southBoundLatitude: 55.36918
eastBoundLongitude: 8.584411
westBoundLongitude: 7.688282
variable: [...]
subject:
  0: "http://purl.org/neat/Siting"
  1: "http://purl.org/neat/WindMapping"
  2: "http://purl.org/neat/WindAtlas"
  3: "http://purl.org/neat/ResourceAssessment"
  4: "http://purl.org/neat/DesignConditions"
history: ""
```

JSON

```
Untitled - Jupyter Notebook
localhost:8888/notebooks/Untitled.ip
jupyter Untitled (unsaved changes)
File Edit View Insert Cell Kernel Widgets Help
In [1]: 1 import xarray as xr
In [2]: 1 ds = xr.open_dataset("./newa_mesoscale_data.nc")
In [13]: 1 # print(ds)
In [11]: 1 print(ds.subject.replace(", ", "\n"))
http://purl.org/neat/Siting
http://purl.org/neat/WindMapping
http://purl.org/neat/WindAtlas
http://purl.org/neat/ResourceAssessment
http://purl.org/neat/DesignConditions
In [ ]: 1
```

NetCDF (variable attribute)

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Thank you!

