Automatic Extraction of Descriptive Metadata to Promote the Usage of RDM Tools

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Introduction

- There is an ongoing task to transform research data to FAIR Digital Objects (FDOs)

- These FAIR Digital Objects contain
  - The Digital Object (research data)
  - Metadata about the Digital Object
  - Some Service Interfaces
  - A Persistent Identifier

- The big point we focus on here today is metadata

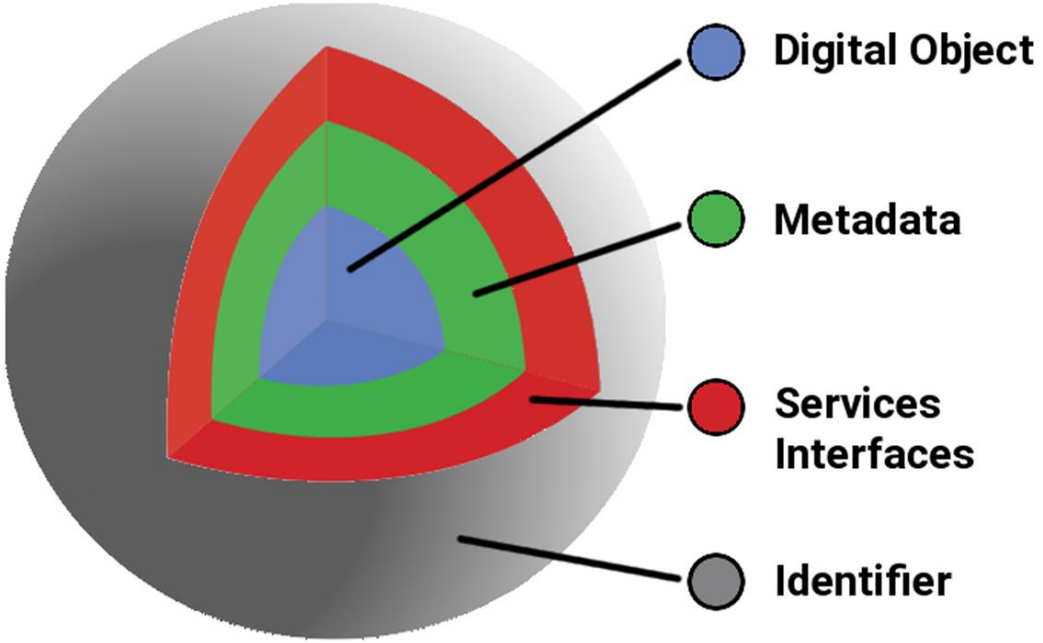
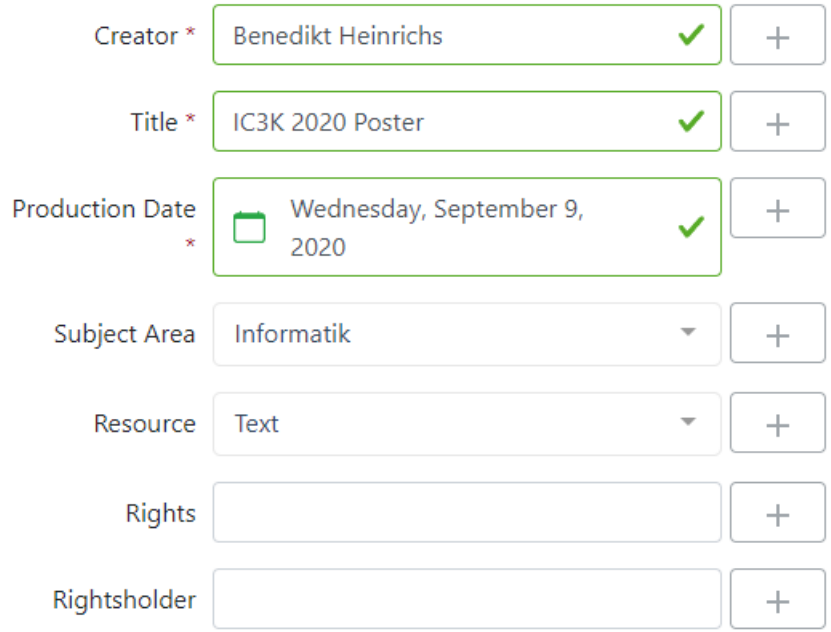


Image from "Digital Objects – FAIR Digital Objects: Which Services Are Required?", located at: https://datascience.codata.org/articles/10.5334/dsj-2020-015/

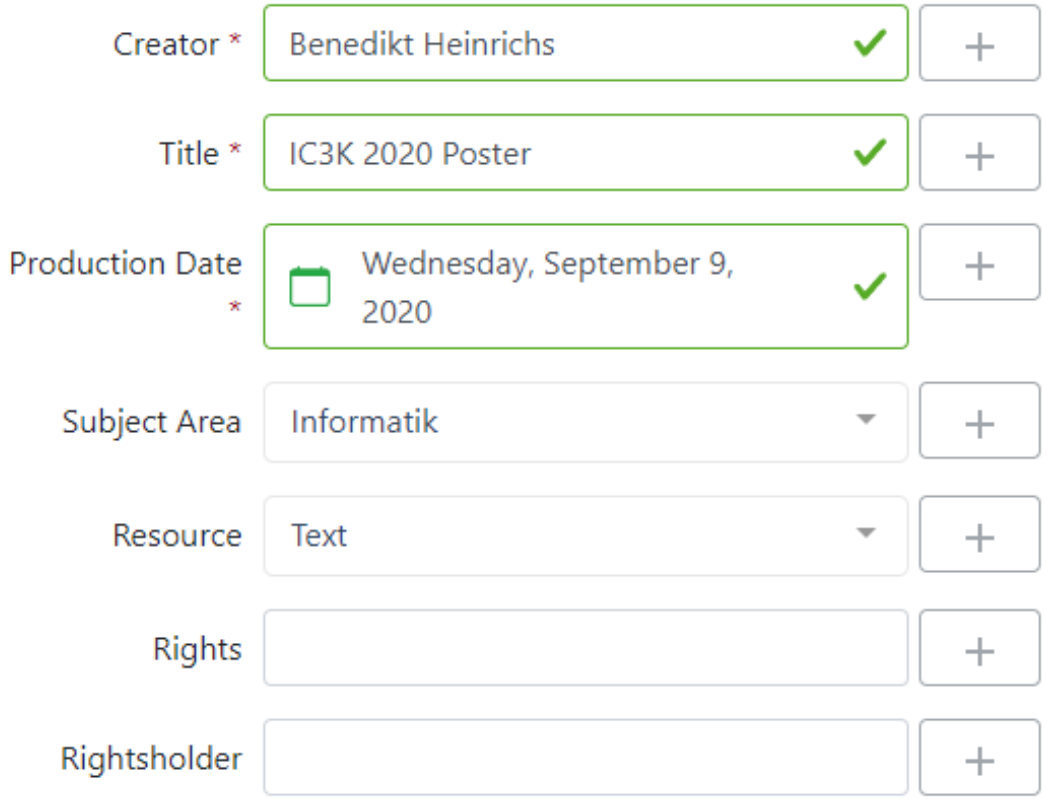
Metadata

- Why Metadata?
  - Describing the information surrounding the generation of a research item
  - Example: Describing a research experiment, the time it took place, etc.
- What Metadata?
  - Administrative: e.g. location or rights
  - Structural: provenance information
  - Descriptive: who, when or what
  - Formulated in RDF using ontologies and validated by SHACL
- How Metadata?
  - Manually input
  - Automatically generated during an experiment



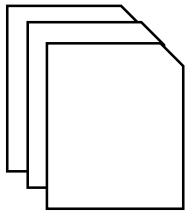
Manual Metadata Input

- Administrative and Structural are usually fairly simple to automatically determine
  - e.g. a platform which manages metadata should be able to be aware of these types of metadata
- Descriptive metadata, however, currently mostly needs to be entered manually
  - This is usually a tedious and time-consuming task
  - A goal of RDM is to make the research process easier and not to create additional hurdles
    - Thankfully, the research data itself a lot of the time brings a subset of the necessary descriptive metadata with itself



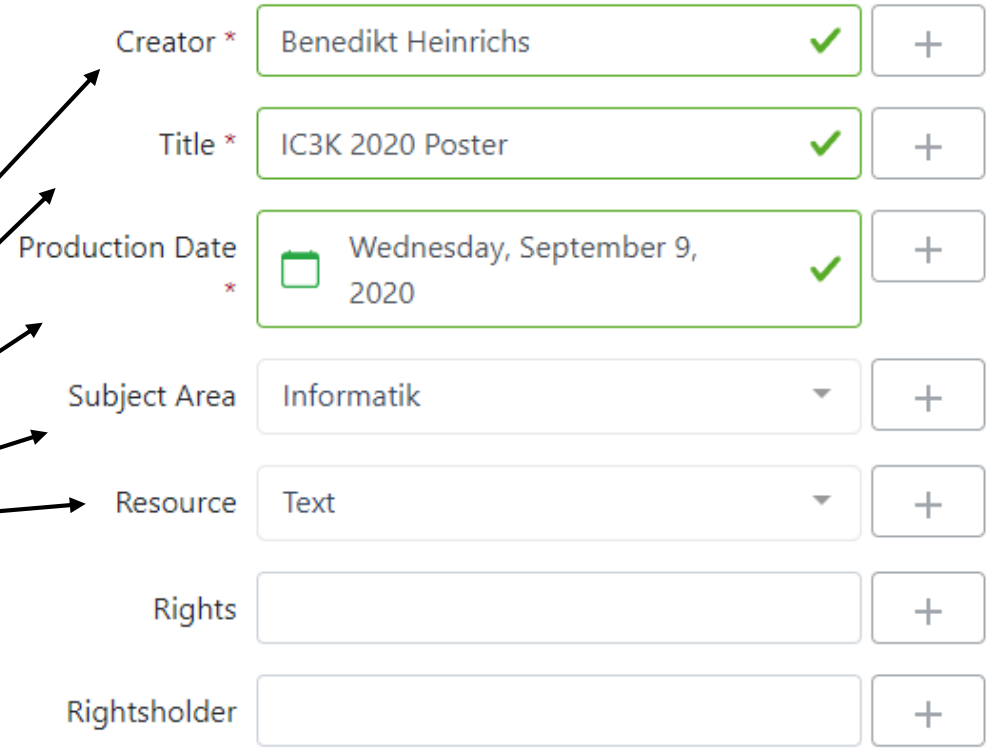
Motivation for Automatic Metadata Extraction

- We want to know what our research data is about
- We want to provide the most detailed information about the content of our research data
- We want to spend only as much time as is necessary to input values into forms
- Proposition:



Research Data

Metadata Extraction



Filled out Metadata

Result Motivation for Automatic Metadata Extraction

```
47        image:mode "RGB" ;
48        ebucore:hasFormat "JPEG" ;
49        ebucore:height "425" ;
50        ebucore:width "640" .
51
52    imageobject:apple rdfs:label "apple" ;
53        imageobject:count "6" .
54
55    imageobject:orange rdfs:label "orange" ;
56        imageobject:count "7" .
```

TestText.txt - Editor

Datei Bearbeiten Ansicht

```
Benedikt and Amin work in the same office.
David is eavesdropping their conversation.
David can also speak chinese and knows the characters '性格'.
```

```
68  <http://pikes.fbk.eu/#Amin> a <http://www.newsreader-project.eu/ontologies/PERSON> .
69
70  <http://pikes.fbk.eu/#Benedikt> a <http://www.newsreader-project.eu/ontologies/PERSON> .
71
72  <http://pikes.fbk.eu/#eavesdropping> rdfs:seeAlso <http://dbpedia.org/resource/Eavesdropping> .
```

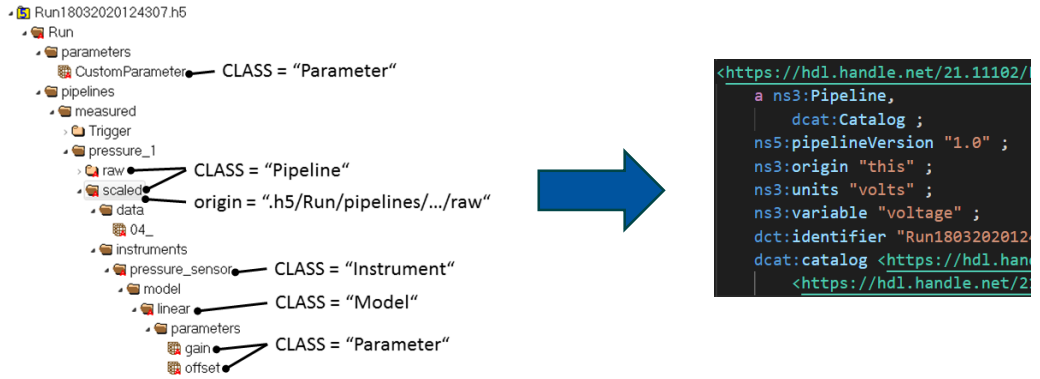
Prepare the deployment for production server

Refer to the product ticket for the description of the ticket.

- [ ] Update AutoSPInstaller.xml for installation
  - [ ] Check if there need to be seperate SP Installer xmls for the Farm join since there is only one farm.
  - [x] Check if we need a separate file. Set the secret keys and replace it with Consul values into the deployment script.
- [x] Detect why the error during installation "Previously installed Office 2019" (PreReqCheck) occurred
- [x] Parameter for the Installation => For Produktiv vs Dev
  - Create a parameter to filter (blacklist) steps
  - Add a json file with default values for config params, also secrets, check if this solves #322
- [ ] Make sure the production deployment is working
- [x] Put CoSciIE DB creation into its own step and otherwise throw 3.02 out

Topic/600-productionDeployment

```
87
88  <http://pikes.fbk.eu/#installation> a <http://dbpedia.org/class/yago/Initiation107453195> ;
89      rdfs:seeAlso <http://dbpedia.org/resource/Installation_(computer_programs)> .
90
91  <http://pikes.fbk.eu/#json> rdfs:seeAlso <http://dbpedia.org/resource/JSON> .
92
```

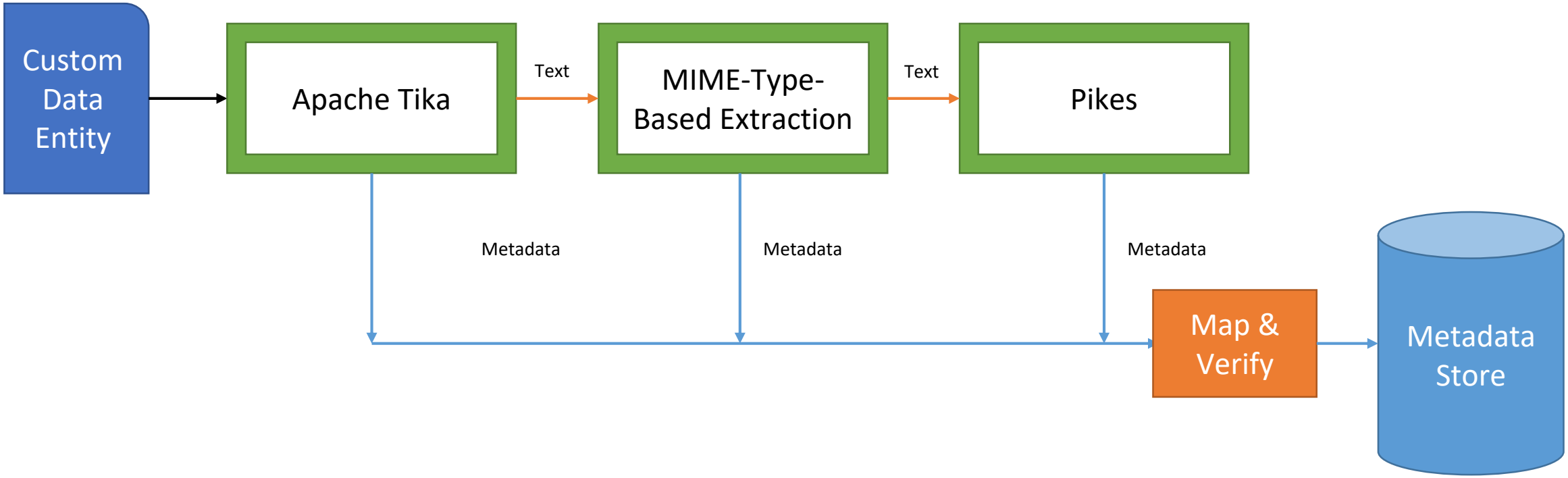



```
<https://hdl.handle.net/21.11102/
    a ns3:Pipeline,
        dcat:Catalog ;
    ns5:pipelineVersion "1.0" ;
    ns3:origin "this" ;
    ns3:units "volts" ;
    ns3:variable "voltage" ;
    dct:identifier "Run1803202012
    dcat:catalog <https://hdl.han
        <https://hdl.handle.net/2
```

HDF5 File Structure

Metadata Extraction Pipeline

Metadata Extraction

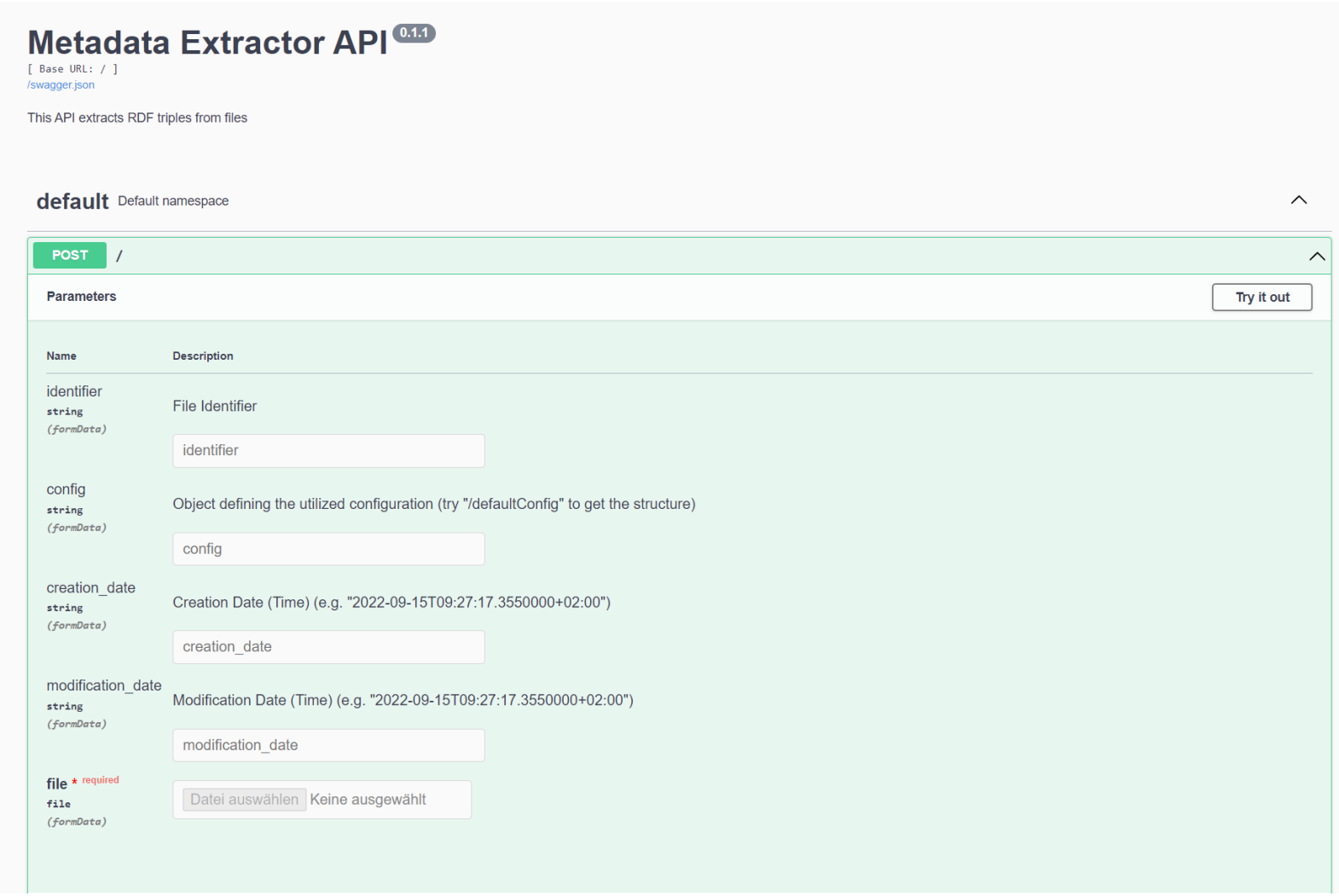


Heinrichs, B. ; Politze, M.
Moving Towards a General Metadata Extraction Solution for Research Data with State-of-the-Art Methods
12th International Conference on Knowledge Discovery and Information Retrieval, KDIR 2020, online, 2 Nov 2020 - 4 Nov 2020

Metadata Extraction Application

- Dynamic Configuration
  - You can configure every extractor which shall be called and specify certain environment variables
- Registration of custom extractors
  - Once implemented, an extractor will listen to its registration method which can e.g. listen to certain MIME-Types like “image/png”
  - Custom extractors can be excluded from the default configuration, so that specific use cases can be proposed without impacting everything else
- Highly extendable
  - By being open source, this application is easily extendable to different use cases

Metadata Extraction Service



Example Results – Object Detection

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51
52      imageobject:apple rdfs:label "apple" ;
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Example Results – Text

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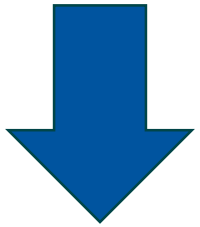

```
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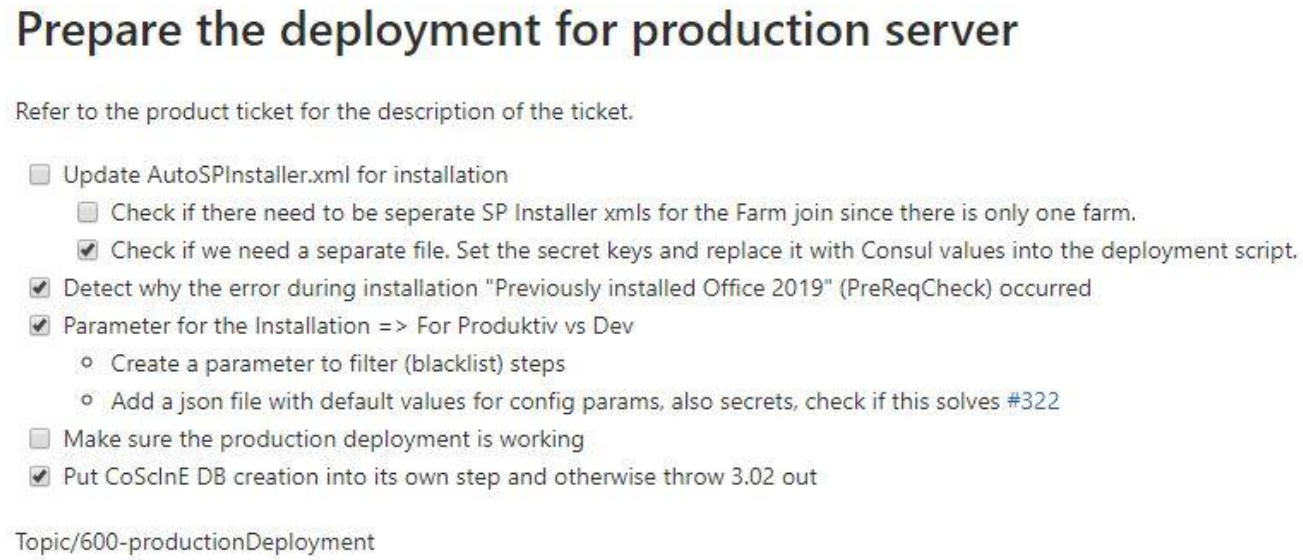
69
70    <http://pikes.fbk.eu/#Benedikt> a <http://www.newsreader-project.eu/ontologies/PERSON> .
71
72    <http://pikes.fbk.eu/#eavesdropping> rdfs:seeAlso <http://dbpedia.org/resource/Eavesdropping> .
```

Example Results – Image to Text



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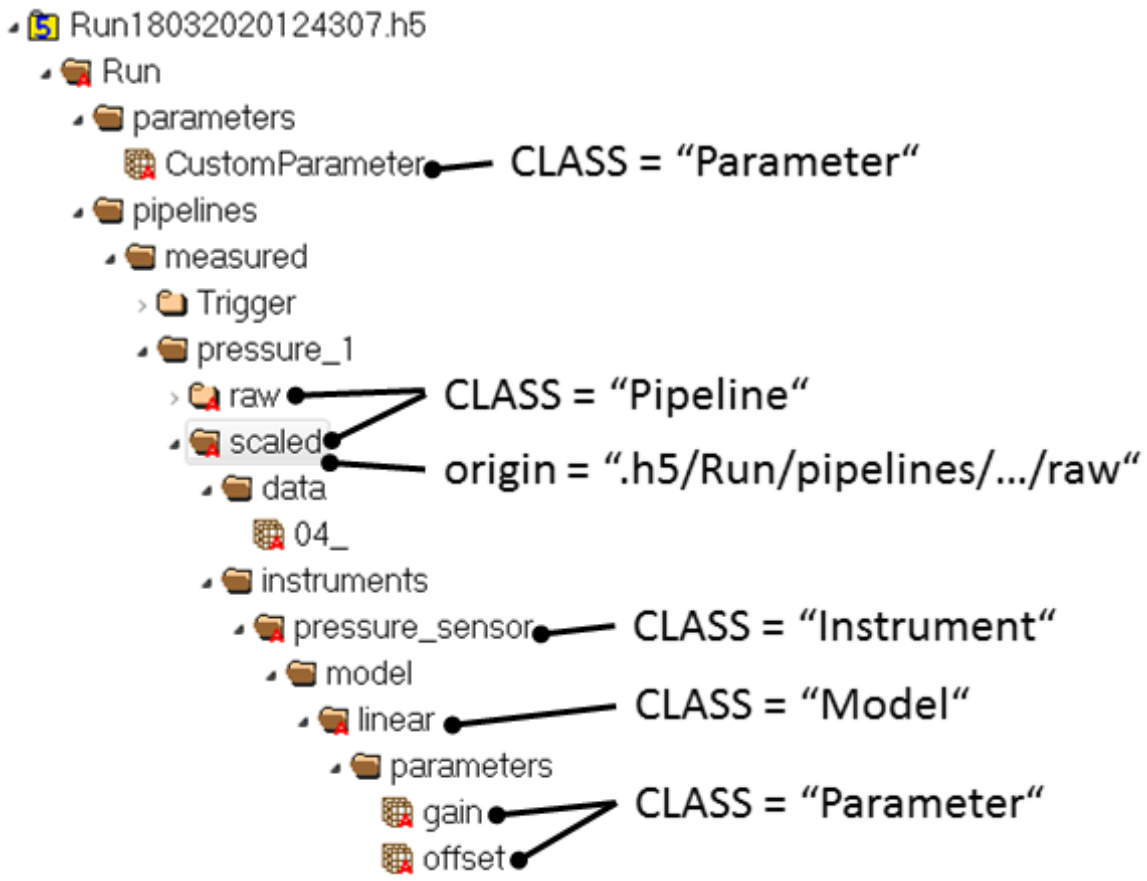
89        rdfs:seeAlso <http://dbpedia.org/resource/Installation_(computer_programs)> .
90
91    <http://pikes.fbk.eu/#json> rdfs:seeAlso <http://dbpedia.org/resource/JSON> .
92
```

Example Results – Real Research Data Example with HDF5



HDF5 File Structure

```
<https://hdl.handle.net/21.11102/
    a ns3:Pipeline,
        dcat:Catalog ;
    ns5:pipelineVersion "1.0" ;
    ns3:origin "this" ;
    ns3:units "volts" ;
    ns3:variable "voltage" ;
    dct:identifier "Run1803202012
    dcat:catalog <https://hdl.han
        <https://hdl.handle.net/2
```

Metadata Extraction Service – Usage

Open Source

- Git Repo (Python Code):
  https://git.rwth-aachen.de/coscine/research/metadataextractor

- Docker Image:
  registry.git.rwth-aachen.de/coscine/research/metadataextractor:latest

- Demo:
  https://metadataextractor.otc.coscine.dev/

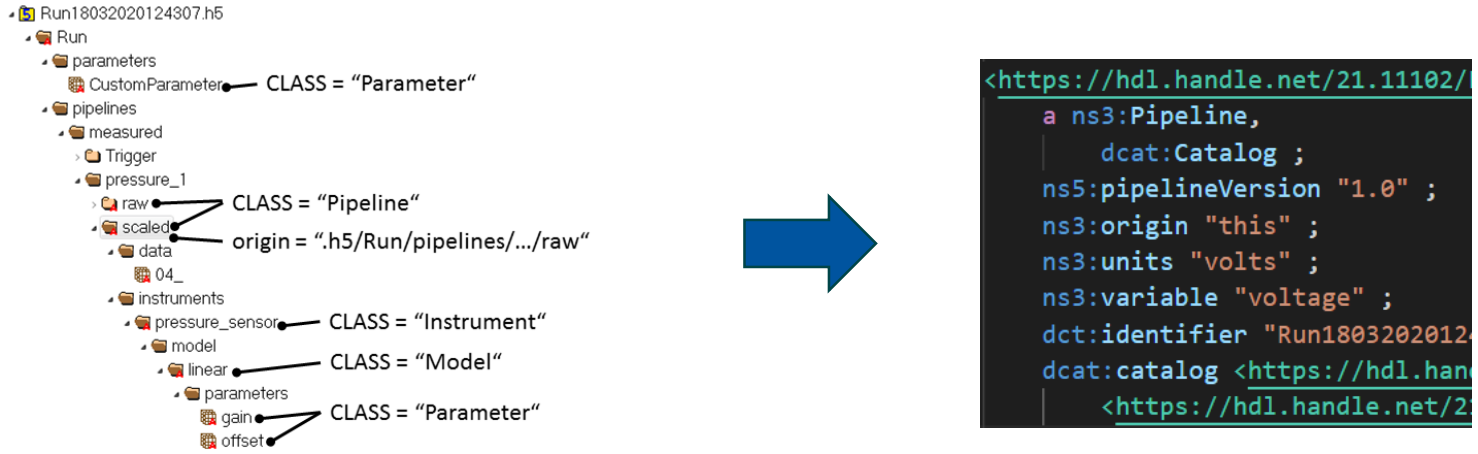
- Start adding your own extractor now by using Gitpod:
  https://gitpod.io/#https://git.rwth-aachen.de/coscine/research/metadataextractor

Metadata Extraction Service – Use Cases (Future Work)

- Inclusion in research data management systems like Coscine
  - Automatically extract the metadata for research data based on a given configuration
  - Fill the metadata form automatically based on a templating engine
  - Make use of the extracted metadata in applications like “search”
- Utilize the extracted metadata to determine the similarity between research data when the MIME-Type is different (e.g. image with text vs. text file)
  - Making use of https://git.rwth-aachen.de/coscine/research/semanticsimilarity
- Improve the performance and make it better scale against big research data

Conclusion

- Today, I showed a look into my proposed solution of metadata extraction
- It is a pipeline which takes research data and tries to describe the content as metadata
- The usage has been demonstrated on different examples with a real-life use case as well



HDF5 File Structure

- Future work is being done to utilize this in real life applications

Thank you
for your attention!