

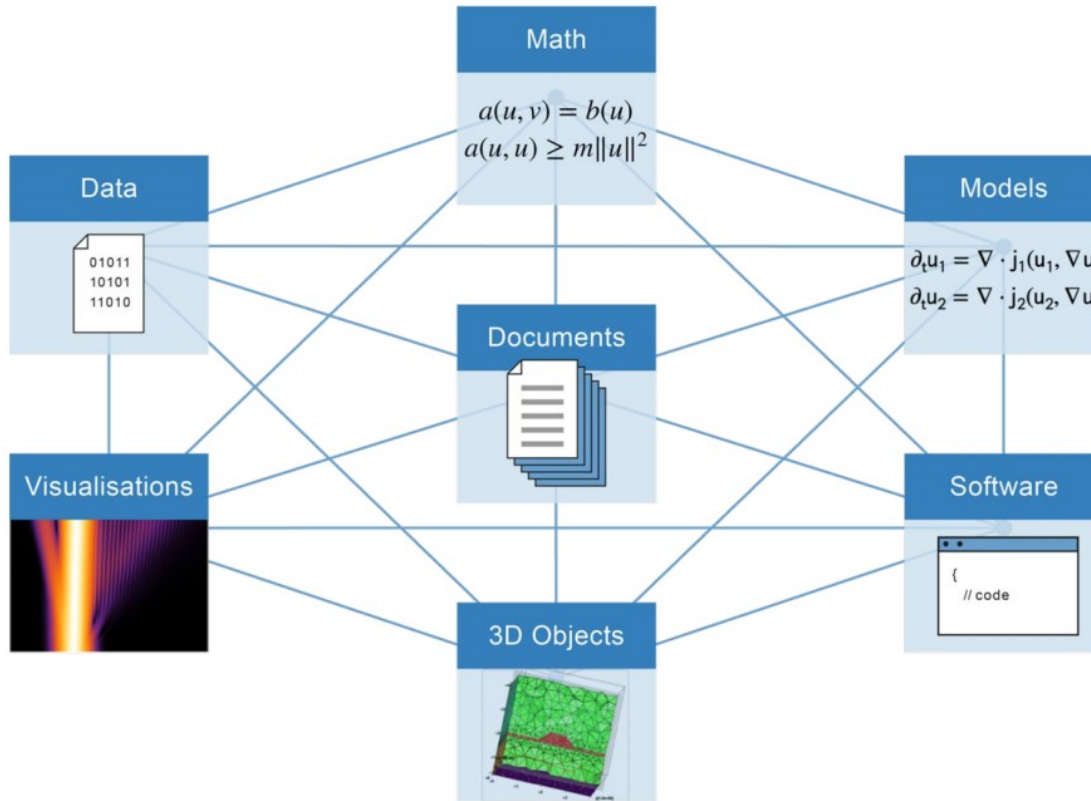
MaRD^{MO}

Document and Retrieve Interdisciplinary Workflows Using the MaRDI Portal.

MaRDI Mini-Symposium @ DMV Meeting 2023
Ilmenau, 25.09.2023

Marco Reidelbach, Eloi Ferrer & Marcus Weber

Research Data in Mathematics



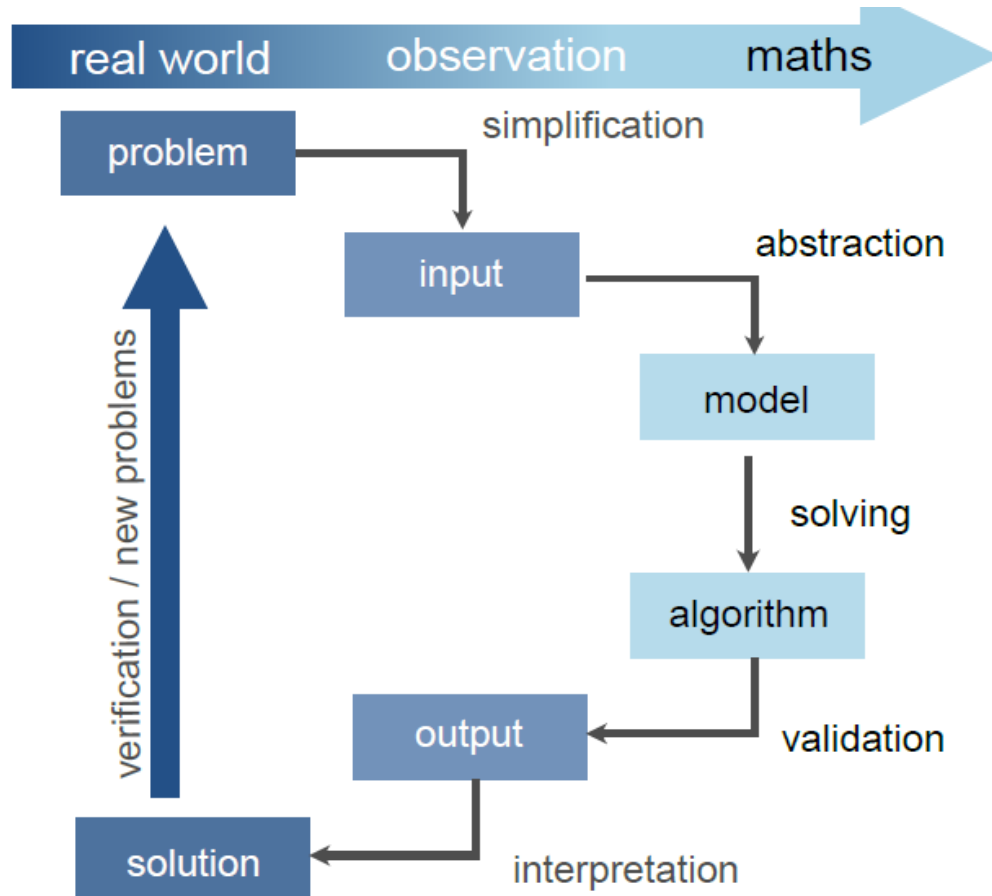
MaRDI: Mathematical Research Data Initiative Proposal

Key Aims of the NFDI:

systematically catalogize research data resulting from publicly funded research, to secure these for the future and make them findable and accessible

to develop and establish standards in research-data management and guarantee the (inter-)national linkage of research data

Interdisciplinary Workflows



Which research question was addressed?

Which mathematical model was used?

What algorithms were applied? Parameters?

Implemented in which software?

Input/Output Data Properties? Location?

Workflow reproducible? Under which conditions?

...

Workflow Documentation

MaRDI Workflow Template

PID (if applicable):

Problem Statement

Object of Research and Research Objective

Procedure

Involved Disciplines

Data Streams

Model

Discretization (Time/Space)

Variables & Parameter (Name/Unit/Symbol)

Process Information

Process Steps (Name/Description/Input/Output/Method/Parameter/Environment/Mathematical Area)

Applied Methods (ID/Name/Process Step/Parameter/implemented by)

Software used (ID/Name/Description/Version/P. Language/Dependencies/versioned/published/documentated)

Hardware & Experimental Devices (ID/Name/Processor/Compiler/Nodes/Cores)

Input Data (ID/Name/Size/Data Structure & Format/File Type/proprietary/to publish/to document)

Output Data (ID/Name/Size/Data Structure & Format/File Type/proprietary/to publish/to document)

Reproducibility

Mathematical Reproducibility

Runtime Reproducibility

Reproducibility of Results

Reproducibility on original Hardware

Reproducibility on other Hardware

Transferability to

Legend

Not ,core math‘, but workflows must be **FAIR**

Crucial for interdisciplinary exchange

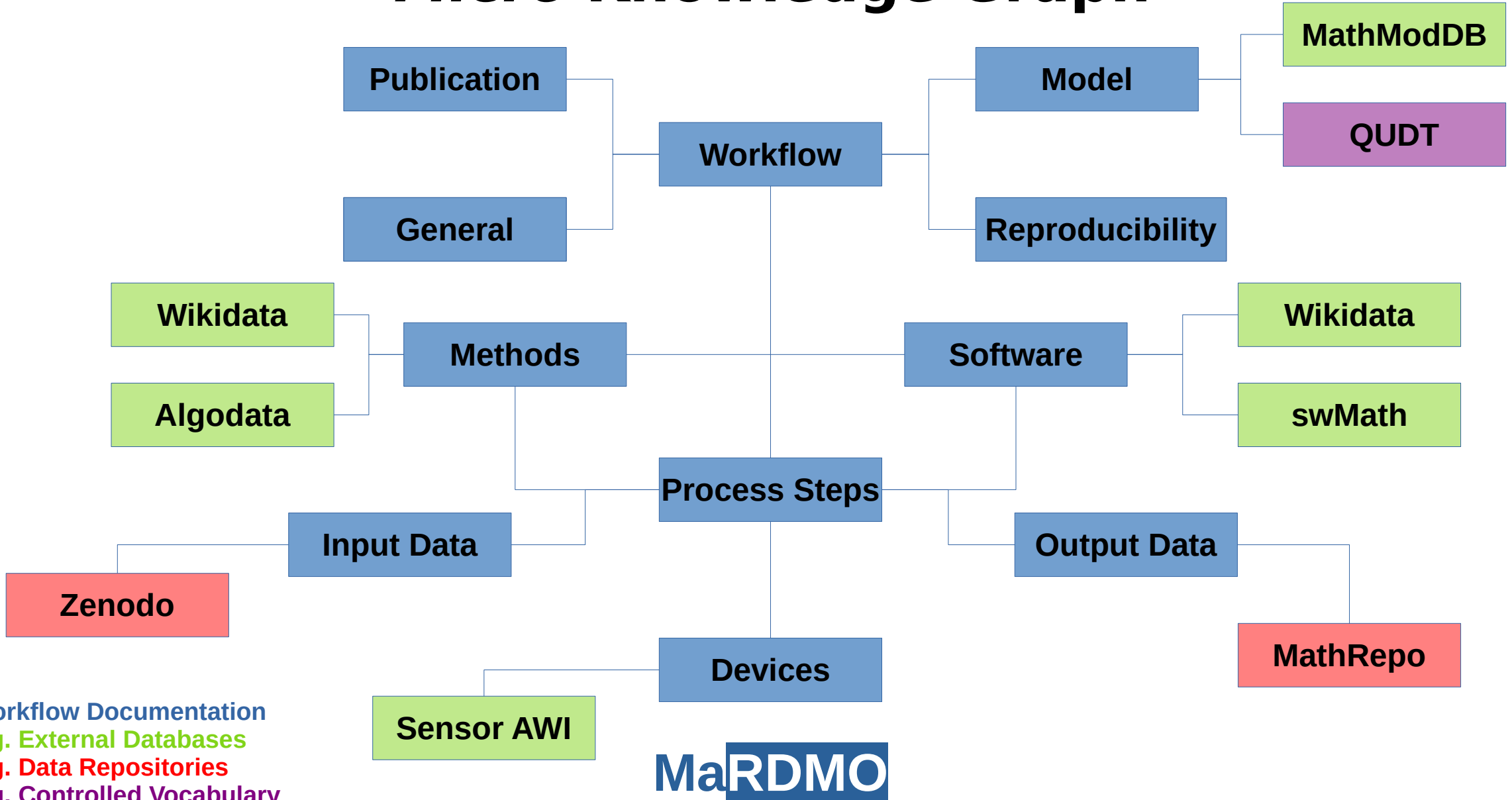
Workflow documentations need to be...

readable, writeable and interpretable

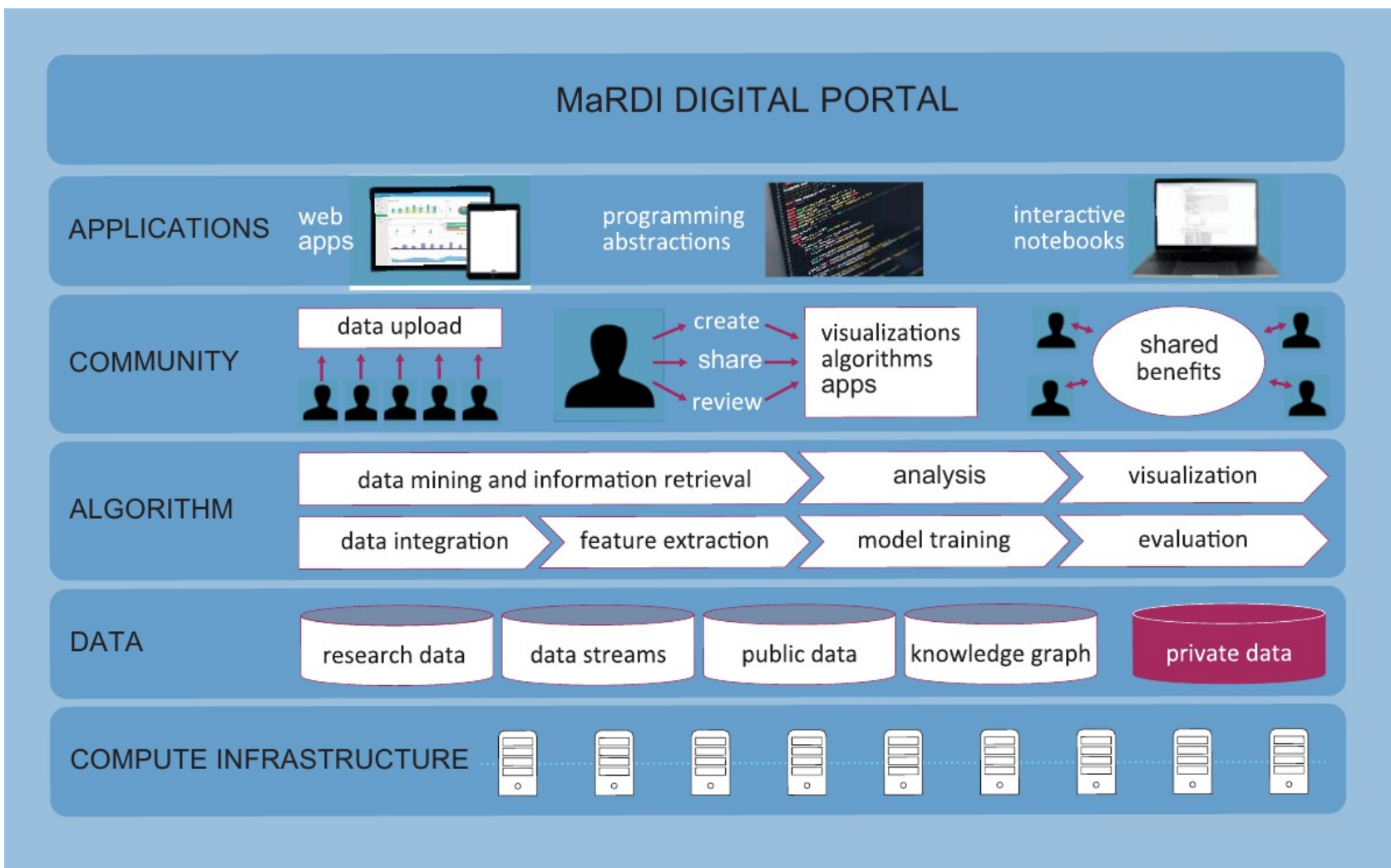
...by humans and machines.

Low-Barrier Documentation Template

Micro Knowledge Graph



MaRDI Portal



Low-Barrier

Workflow Documentation



- 1) Retrieve Documentation Template
- 2) Fill in Template:
 - Enter Workflow Information
 - Find Ids in appropriate Databases
- 3) Visit MaRDI Portal
- 4) Create Wikipage for Workflow
- 5) Create Graph Entry for Workflow

- 1) Answer Questions in familiar Environment
- 2) Automatic Integration of Ids
- 3) Automatic Wikipage Creation
- 4) Automatic Knowledge Graph Entry

Low-Barrier Workflow Search



- 1) Visit MaRDI Portal
- 2) Learn SPARQL to query Graph
- 3) Search Workflow Graph Entry
- 4) Retrieve corresponding Wikipage

- 1) Search in familiar Environment
- 2) Query Graph using natural Language
- 3) Automatic Wikipage retrieval

Research Data Management Organiser

Developed in DFG Project from 2015 - 2020

Since 2020 RDMO Working Group

Most widely used Research Data Management Software in Germany

RDMO is used (or planned to be used) by 2/3 of NFDI consortia



Research Data Management Organiser

Individual RDMO Instances

e.g. for research institutes (rdmo.zib.de)
for research associations (rdmo.mathplus.de)
for NFDI consortia (rdmo.nfdi4ing.de)
...

➔ **Instances customizable using additional Plugins**

Based on structured Interviews

e.g. for Horizon Europe,
for DFG,
...

➔ **Questionnaires fully customizable**



Research Data Management Organiser

Individual RDMO Instances

- e.g. for research in (biology)
- for research in (chemistry)
- for NFDI c...
- ...



Instances

Plugins

Based on structure

- e.g. for Horizon
- for DFG,
- ...



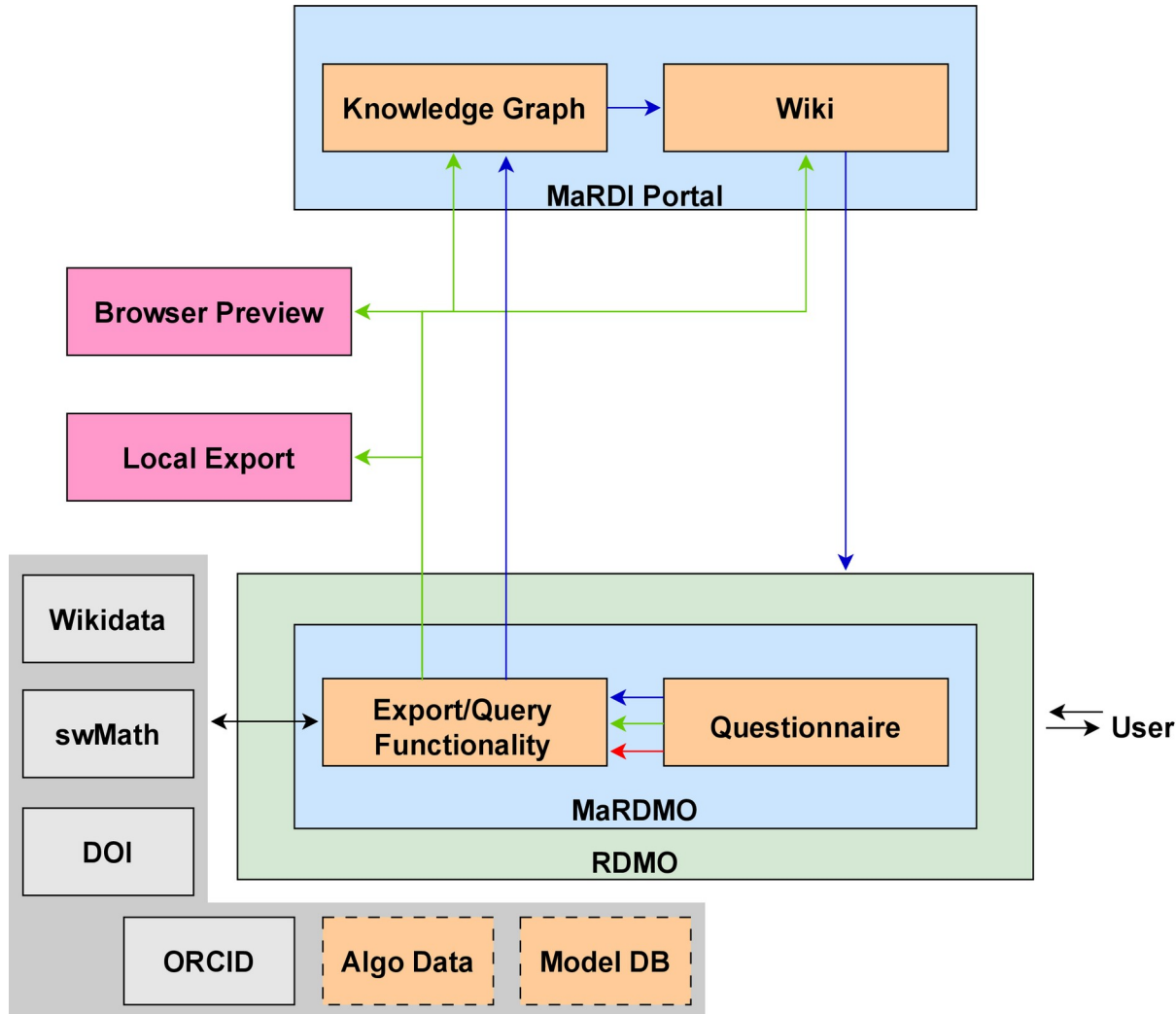
Questionnaires fully customizable

Idea:

- 1 Workflow Questionnaire
- 2 Dynamic Option Sets
- 3 Functionality to...
- ...write to MaRDI Portal
- ...query MaRDI Portal



MaRDMO Concept



RDMO Questionnaire for...

- Operation Modus
- Workflow Documentation
- Workflow Search

Dynamic Option Sets to choose from...

- MaRDI Portal
- Wikidata

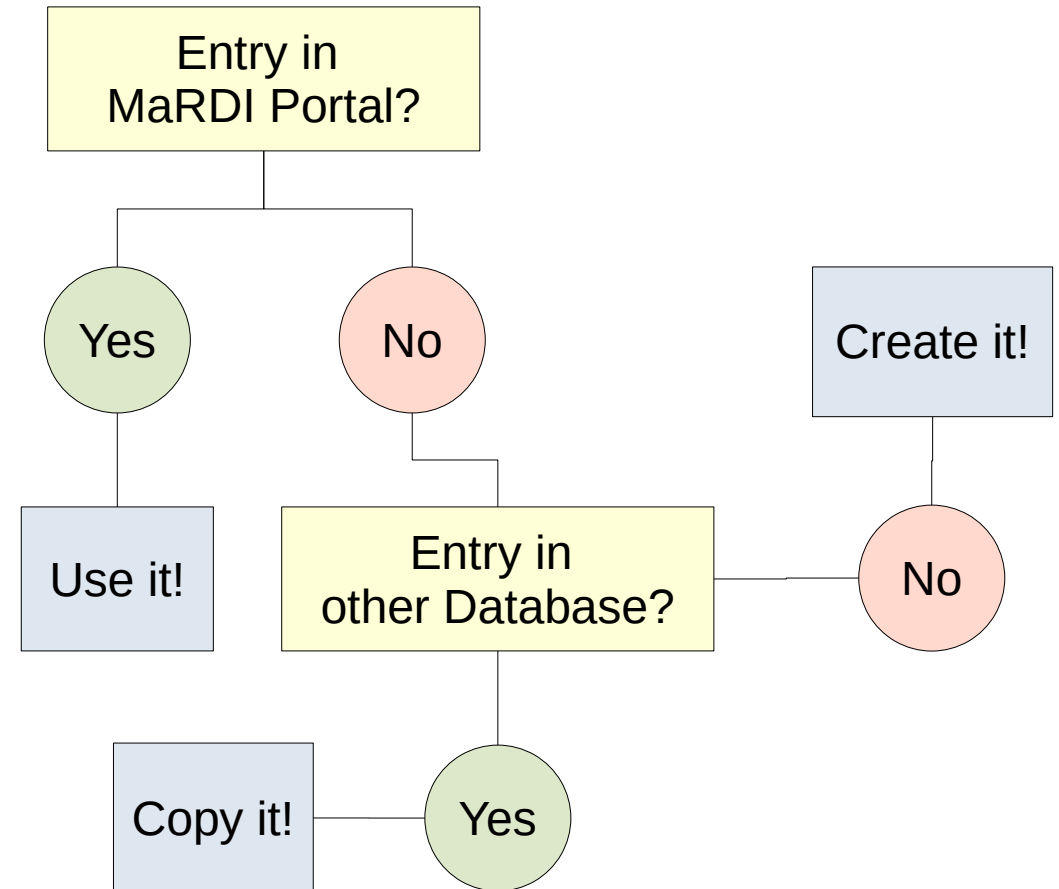
Export/Query Functionality to...

- download Documentation as .md file
- to preview Documentation in Browser
- to create Wiki Documentation Page
- to create Documentation Graph Entry
- to query MaRDI Knowledge Graph
- controlled by single button

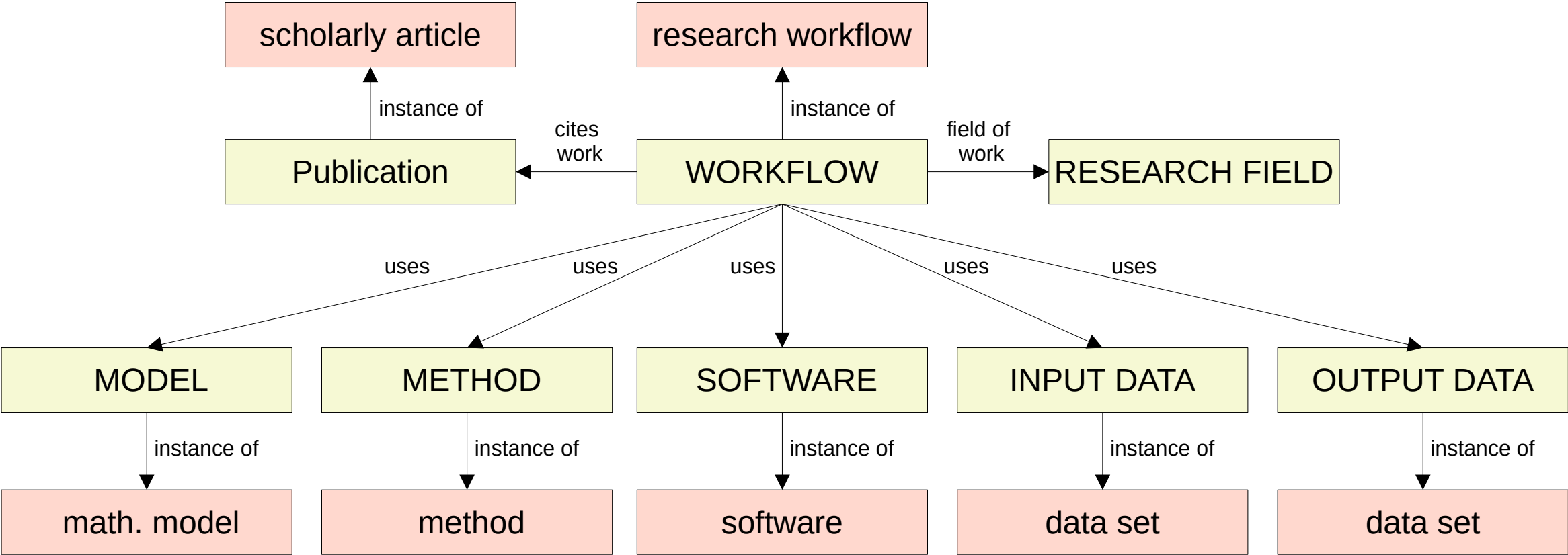
MaRDMO Questionnaire

Sections:

- 1) MaRDI Plugin Operation Modus
- 2) Workflow Search
- 3) Workflow Documentation**
 - 3.1) General Description
 - 3.2) Model, Variables and Parameter
 - 3.2) Process Information
 - 3.3) Reproducibility



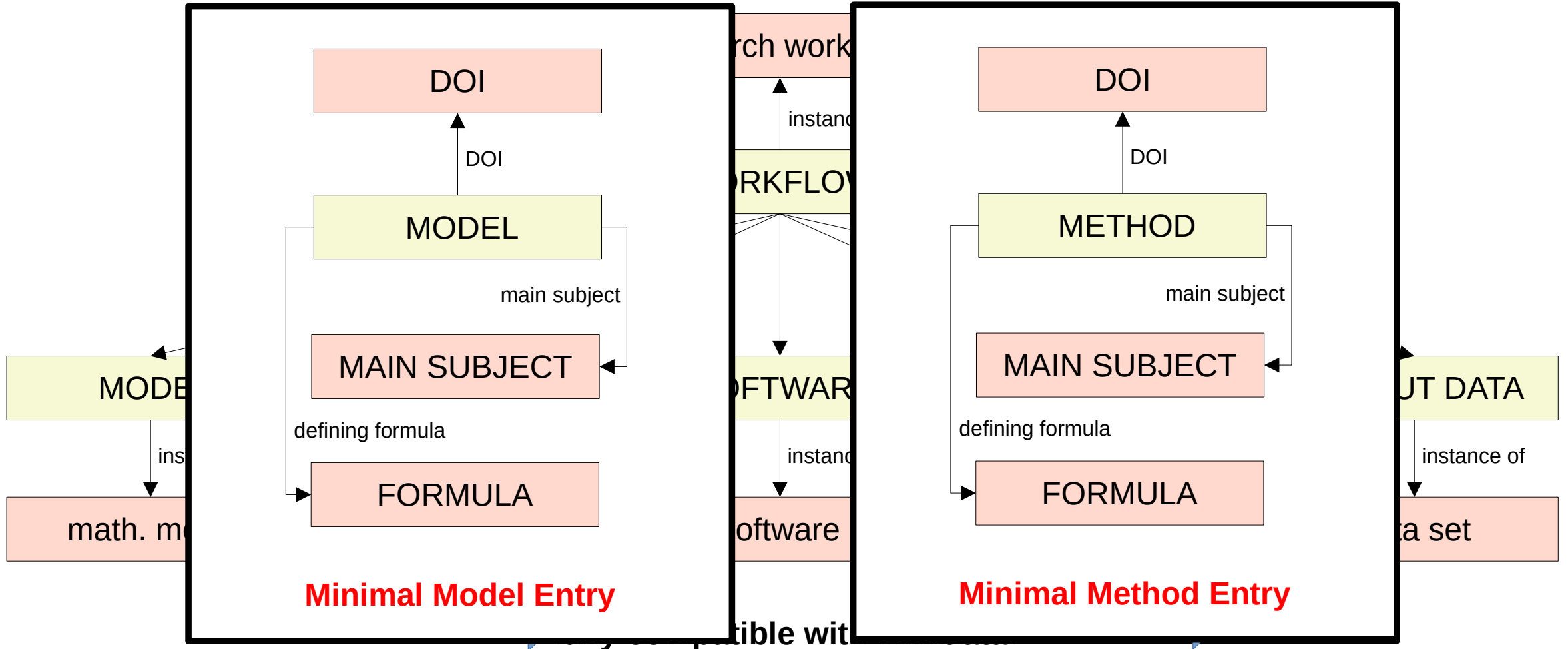
MaRDMO Vocabulary



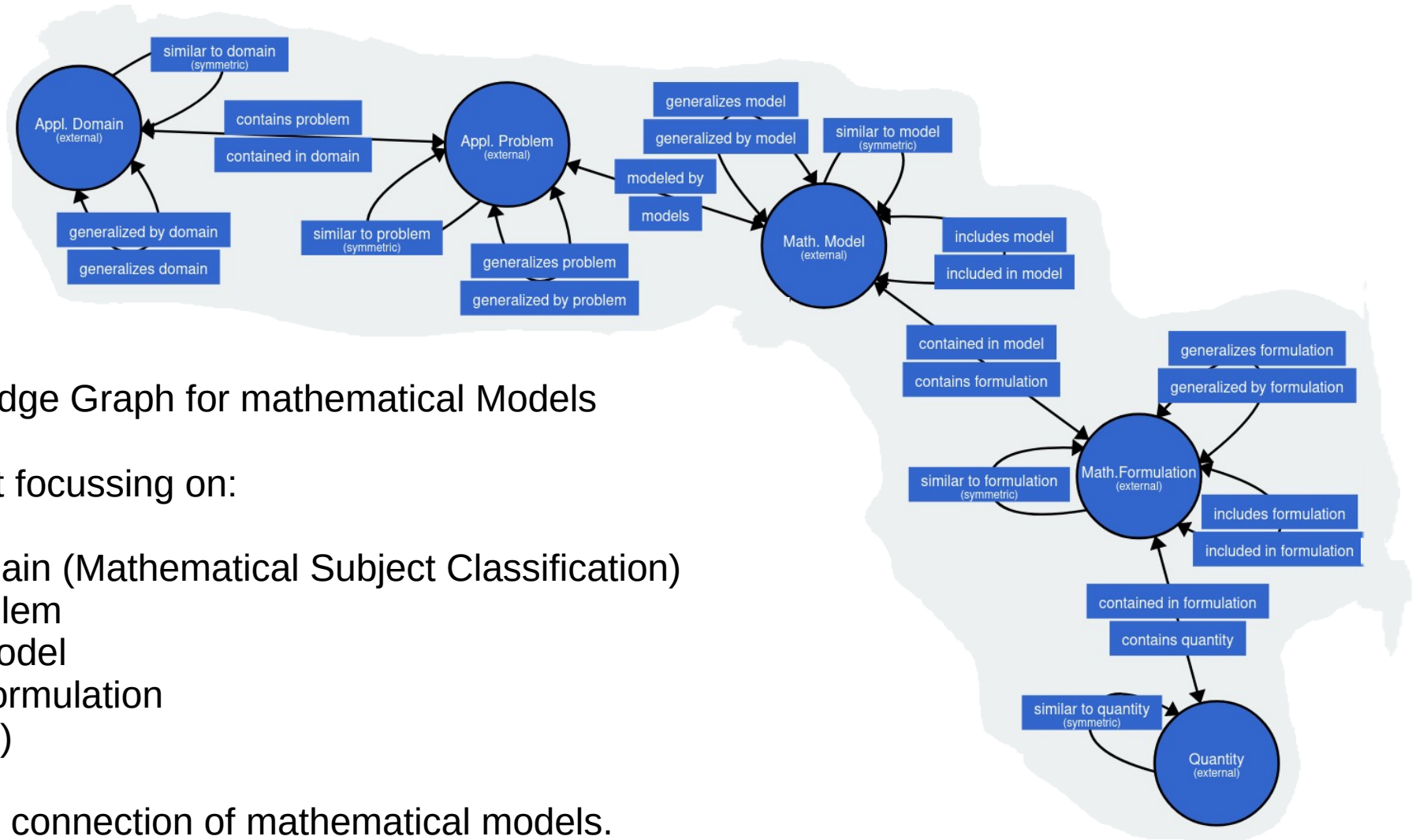
➡ fully compatible with Wikidata!



MaRDMO Vocabulary



Connection to other MaRDI Services



MathModDB – Knowledge Graph for mathematical Models

Additional Question Set focussing on:

- 1) Application Domain (Mathematical Subject Classification)
- 2) Application Problem
- 3) Mathematical Model
- 4) Mathematical Formulation
- 5) Quantity (QUDT)

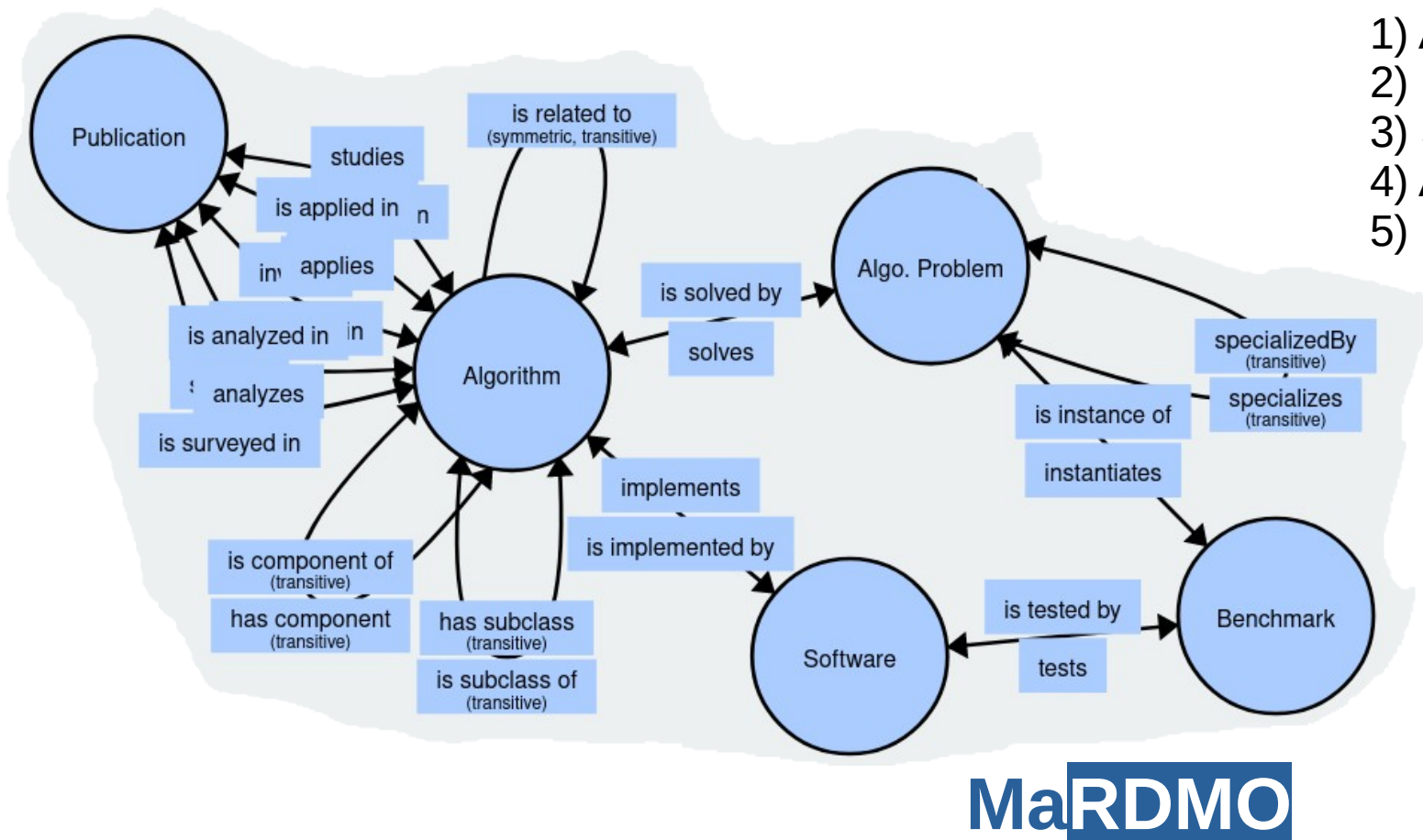
Allows the creation and connection of mathematical models.

Connection to other MaRDI Services

AlgoData – Knowledge Graph for Algorithms

Additional Question Set focussing on:

- 1) Algorithmic Problem
- 2) Benchmark
- 3) Software
- 4) Algorithm
- 5) Publication



Connection to other NFDI Services



Electronic
Lab Books

Device
Platforms

Discipline-
specific
Services

We would be happy to embed your service in MaRDMO!

Workflow Search

Search workflows...

... applying specific mathematical model...

... applying specific method /algorithm...

... involving specific input/output data...

... involving specific research disciplines...

...using natural language.



Workflow in MaRDI KG, why?

FAIR Workflow Description

Math Query?

“I have this cool new method, where can I find test data?”

App Query?

“I have some problem, how can I model it?”

Generation of new Workflows?

“I have some data, what has been done in other disciplines with data sets with similar properties?”

**Thank you,
for your attention!**

MaRDMO