

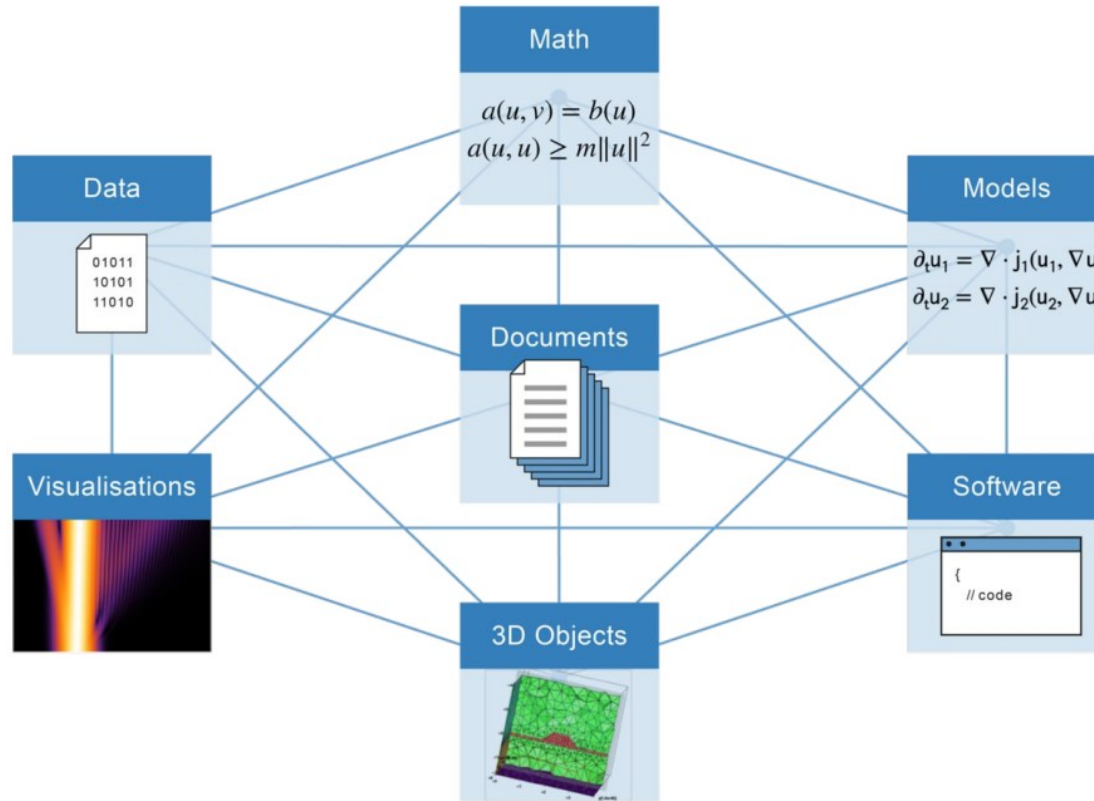
# MaRDMO

**Document and Retrieve Interdisciplinary  
Workflows Using the MaRDI Portal.**

**NFDI4Ing Conference 2023  
27.09.2023**

**Marco Reidelbach, Eloi Ferrer & Marcus Weber**

# Research Data in Mathematics



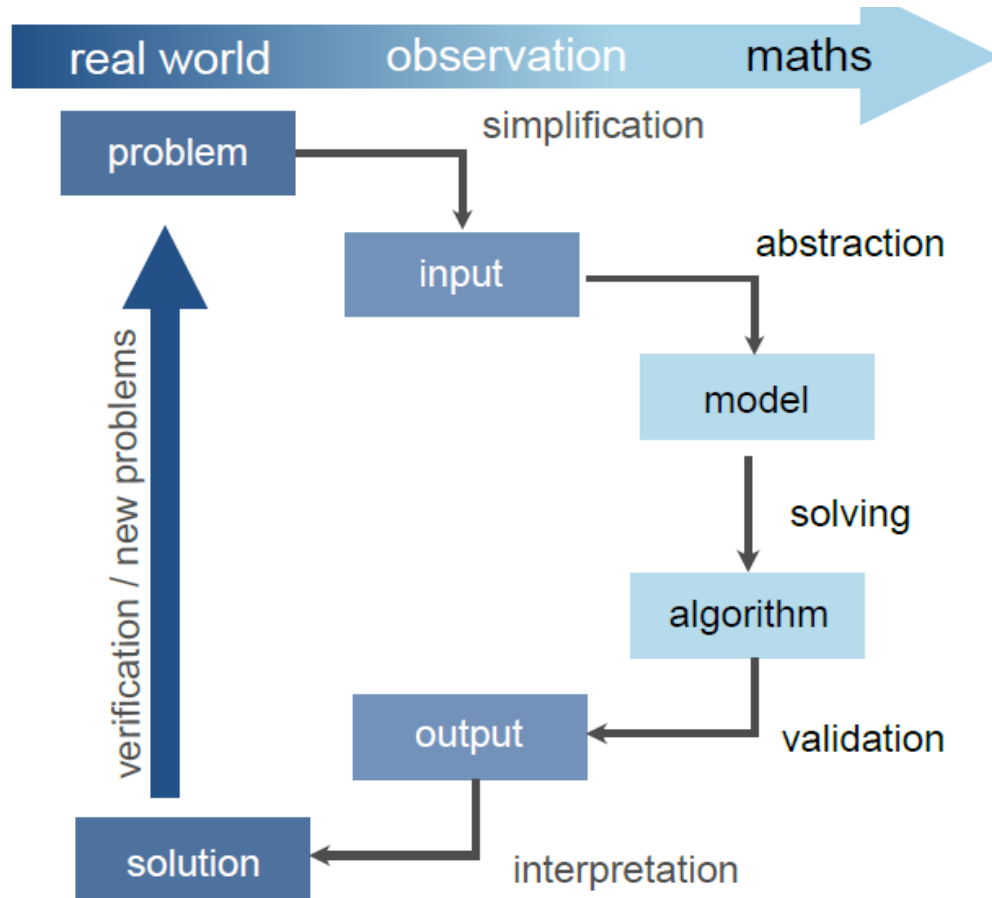
MaRDI: Mathematical Research Data Initiative Proposal

## 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

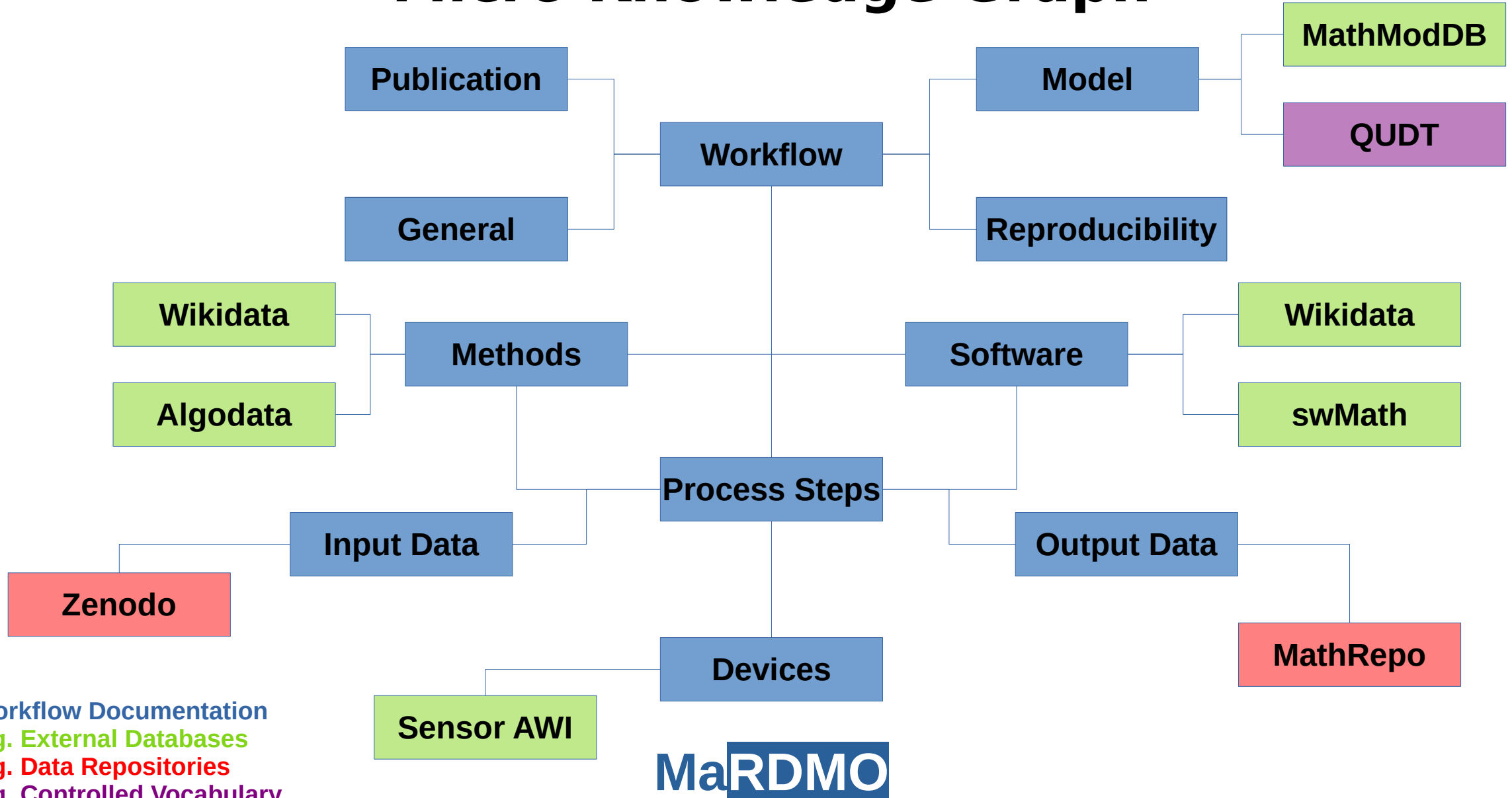
Workflow documentations need to be...

**readable, writeable and interpretable**

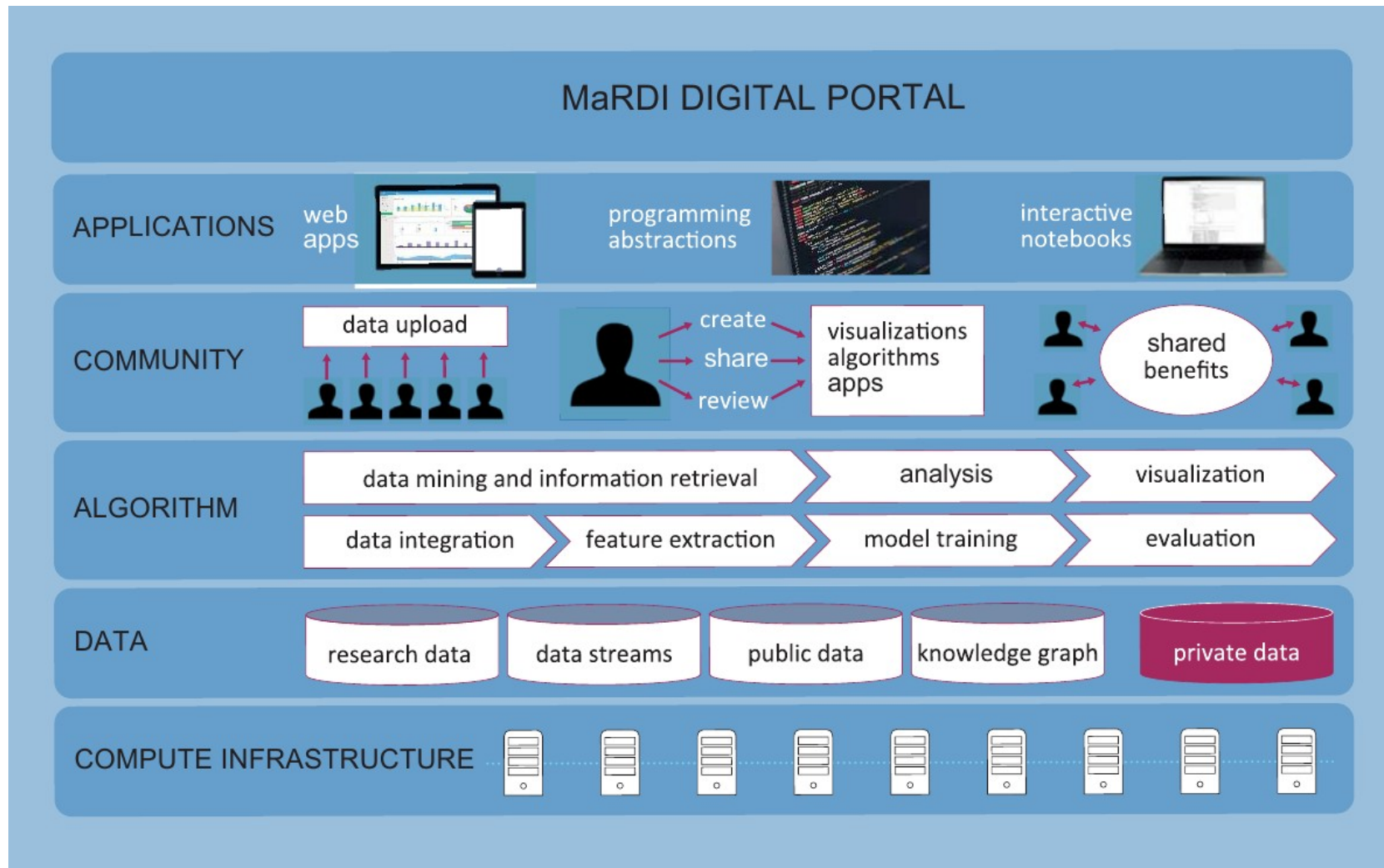
**...by humans and machines.**

**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

Standard DMP-Tool 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  
for research  
for NFDI c  
...

→ Instance Plugins

Based on structure

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

→ Questionnaires fully available

Idea:

1 Workflow Questionnaire

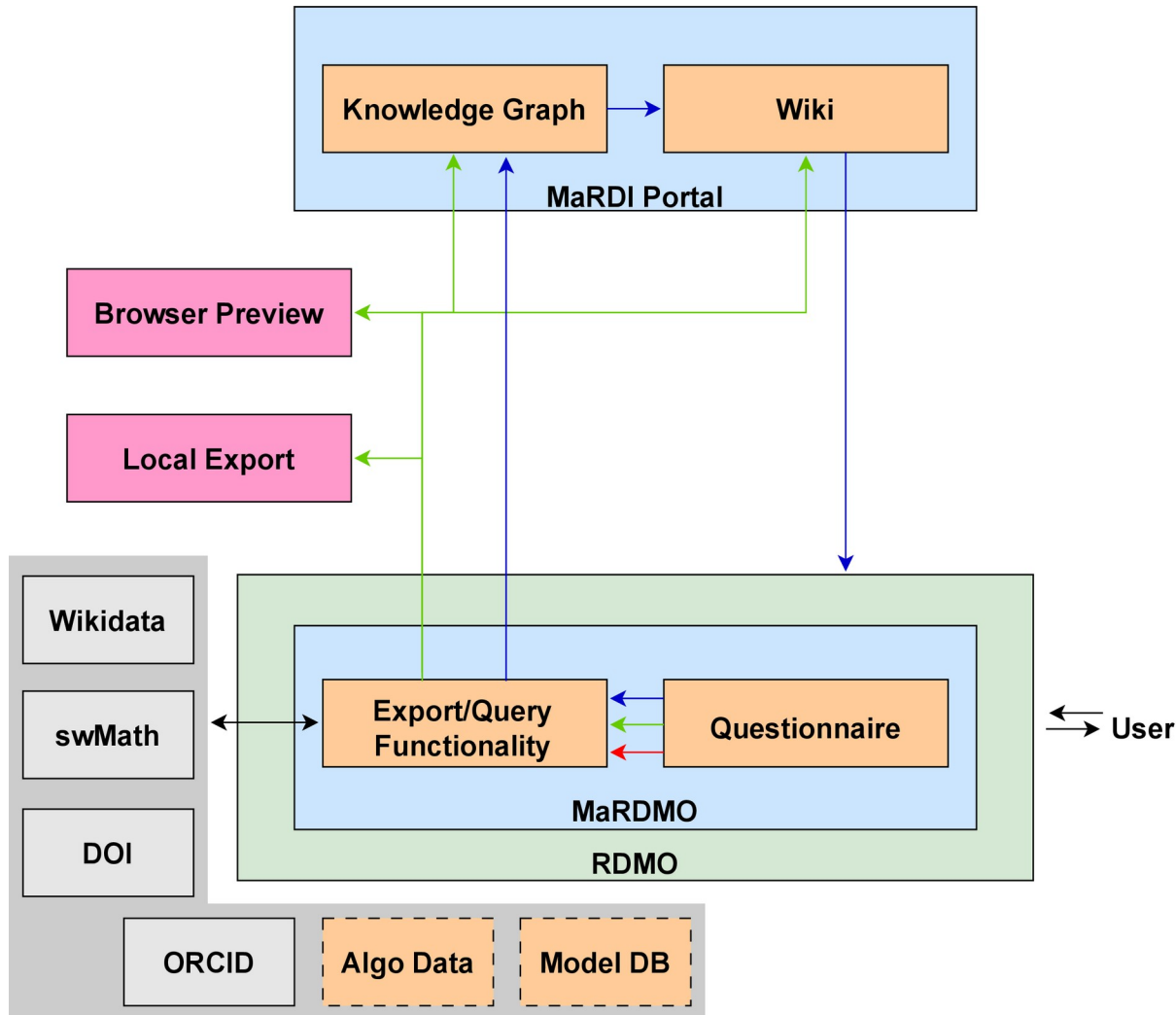
2 Dynamic Option Sets

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

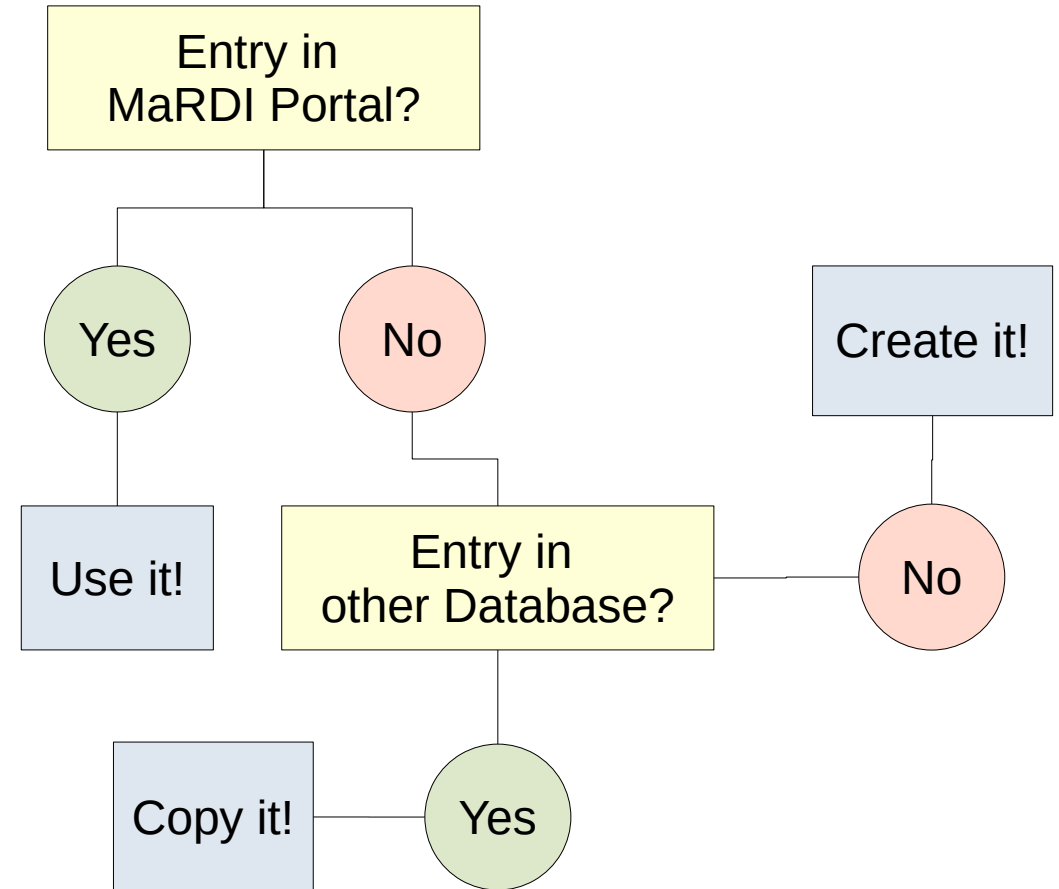
## Export/Query Functionality to...

- 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

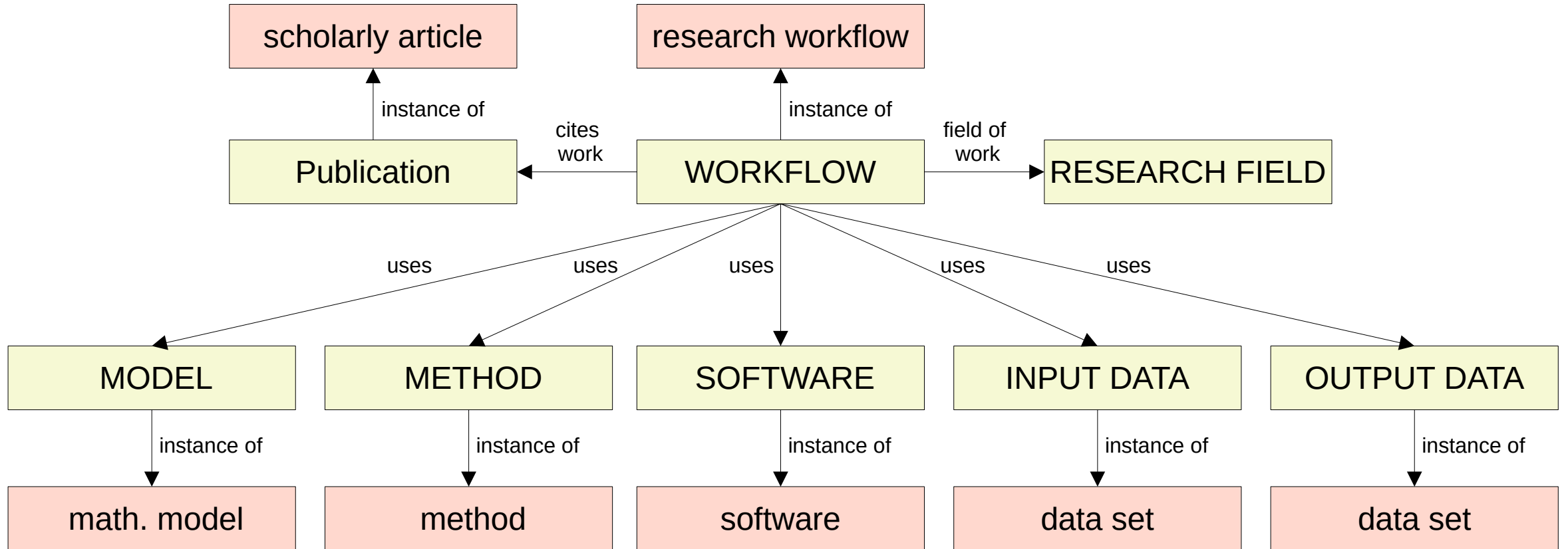
# MaRDMO Questionnaire

## 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

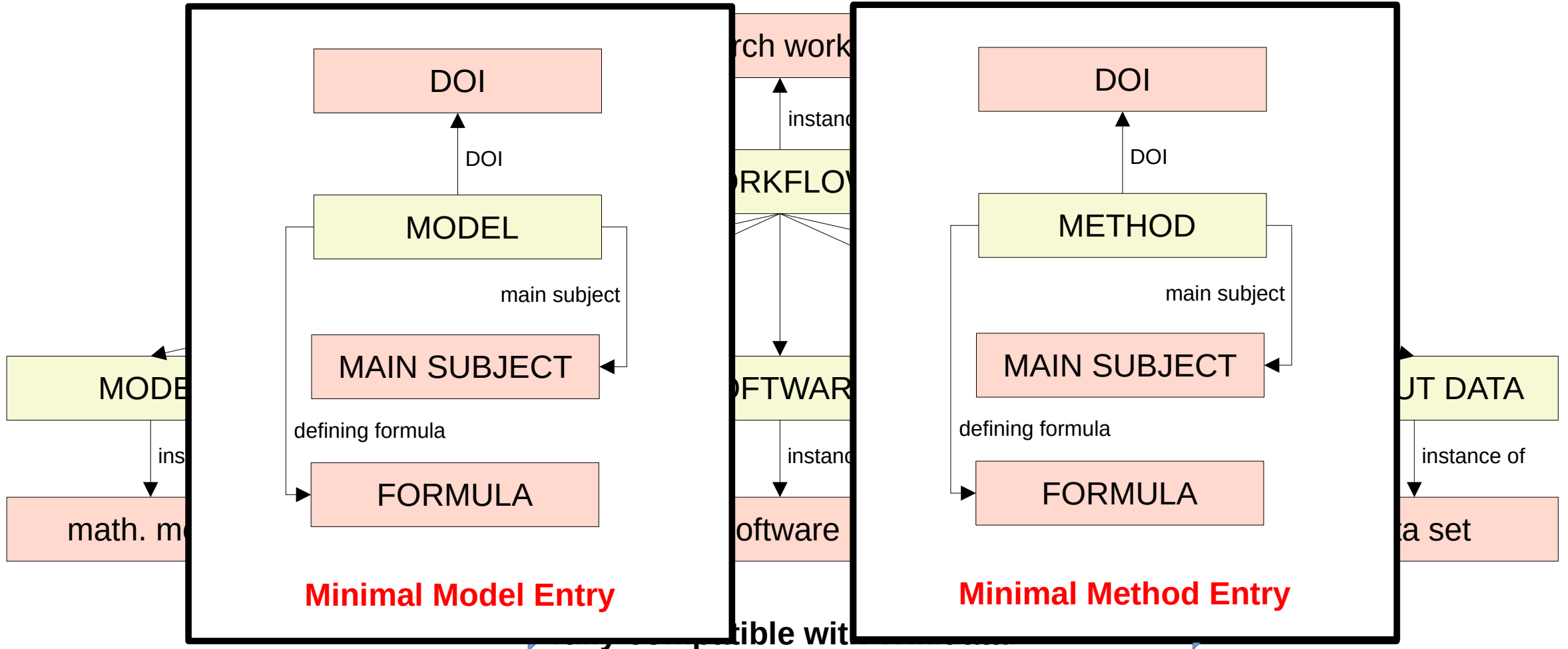


# MaRDMO Vocabulary

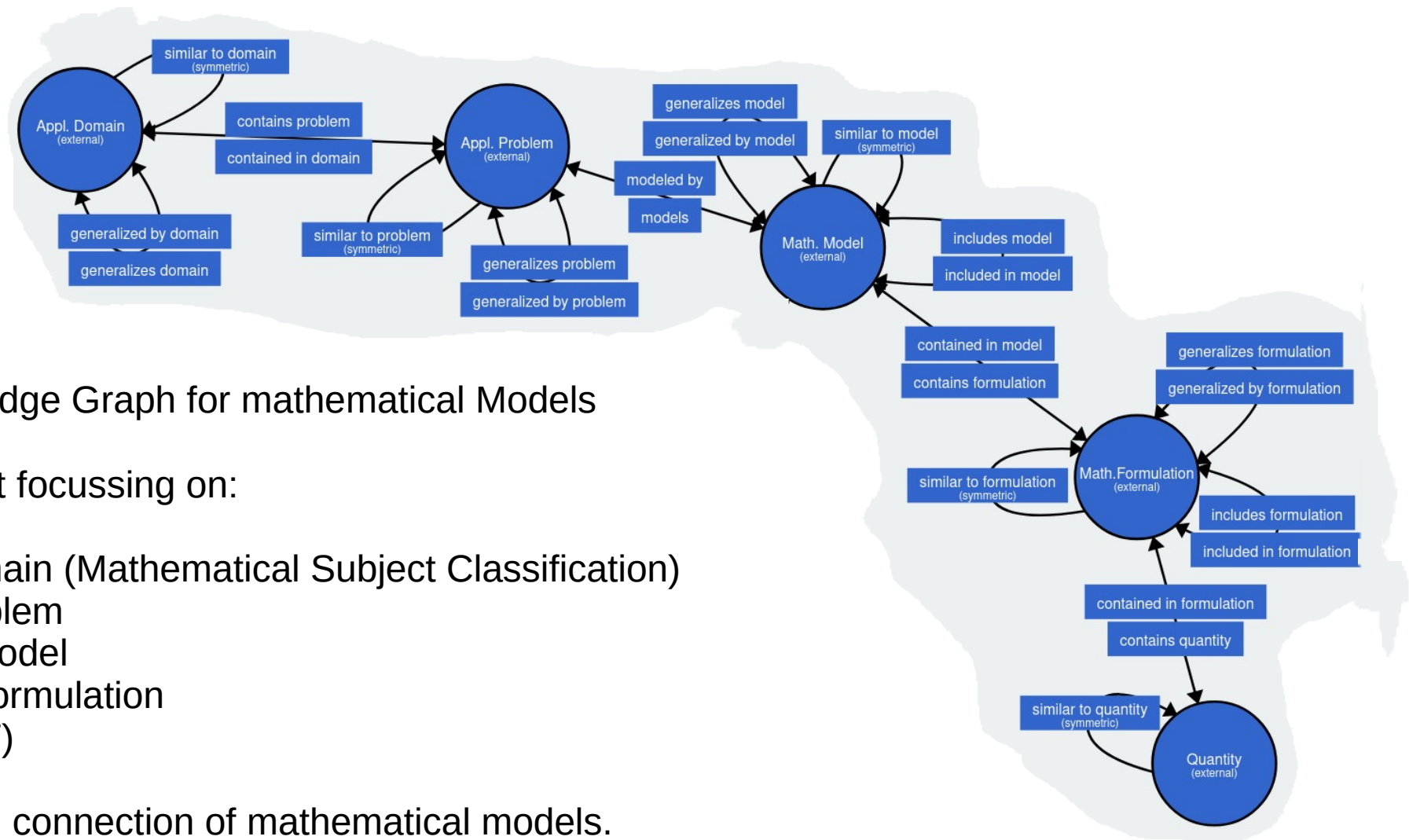


➡ fully compatible with Wikidata!

# 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.

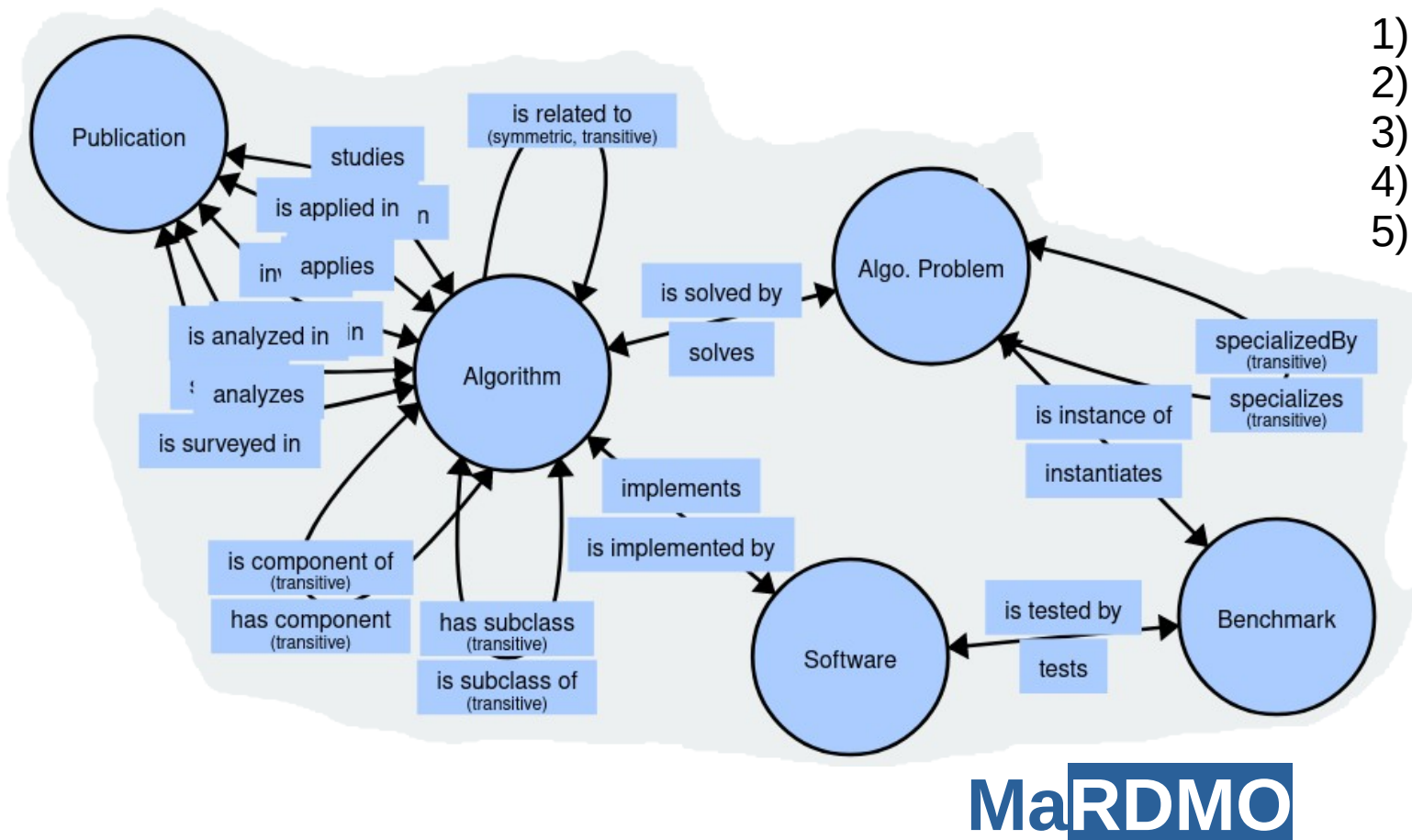


# Connection to other MaRDI Services

**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**