ONTOTRANS

EMMO

European Materials & Modelling Ontology

TOWARDS A COMMON LANGUAGE FOR MATERIALS SCIENCE

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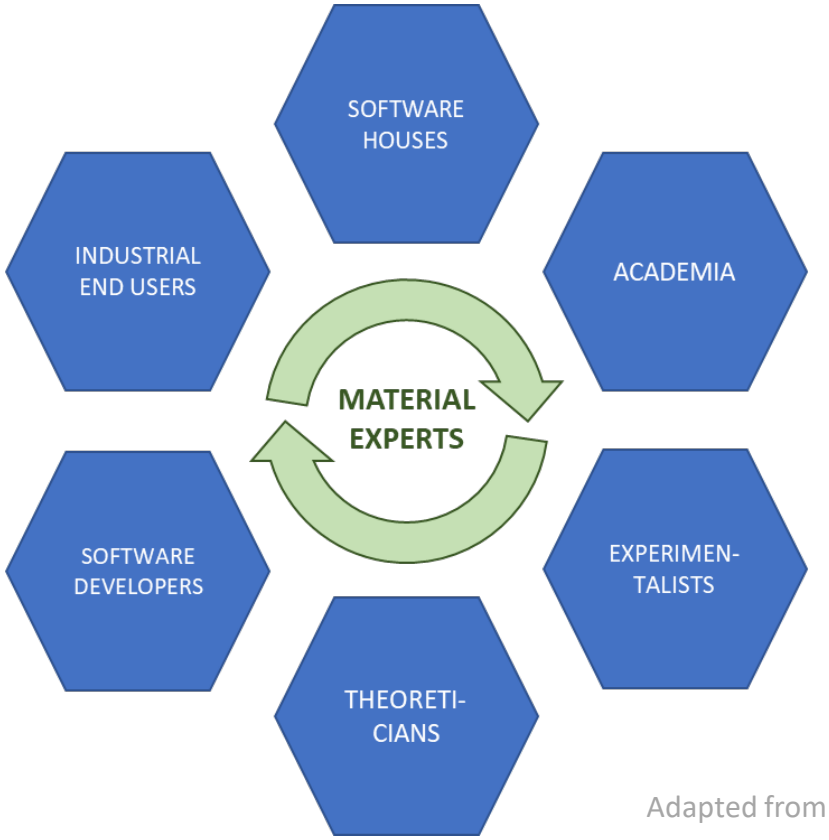
Motivation

EMMO - a tool facilitating materials experts in connecting stakeholders

Stakeholders



Adapted from E. Ghedini

Common language to facilitate

- Collaboration
- Connecting domains
- Digital representation of data
- Knowledge systems
- Interoperability

EMMO Top Level

Person

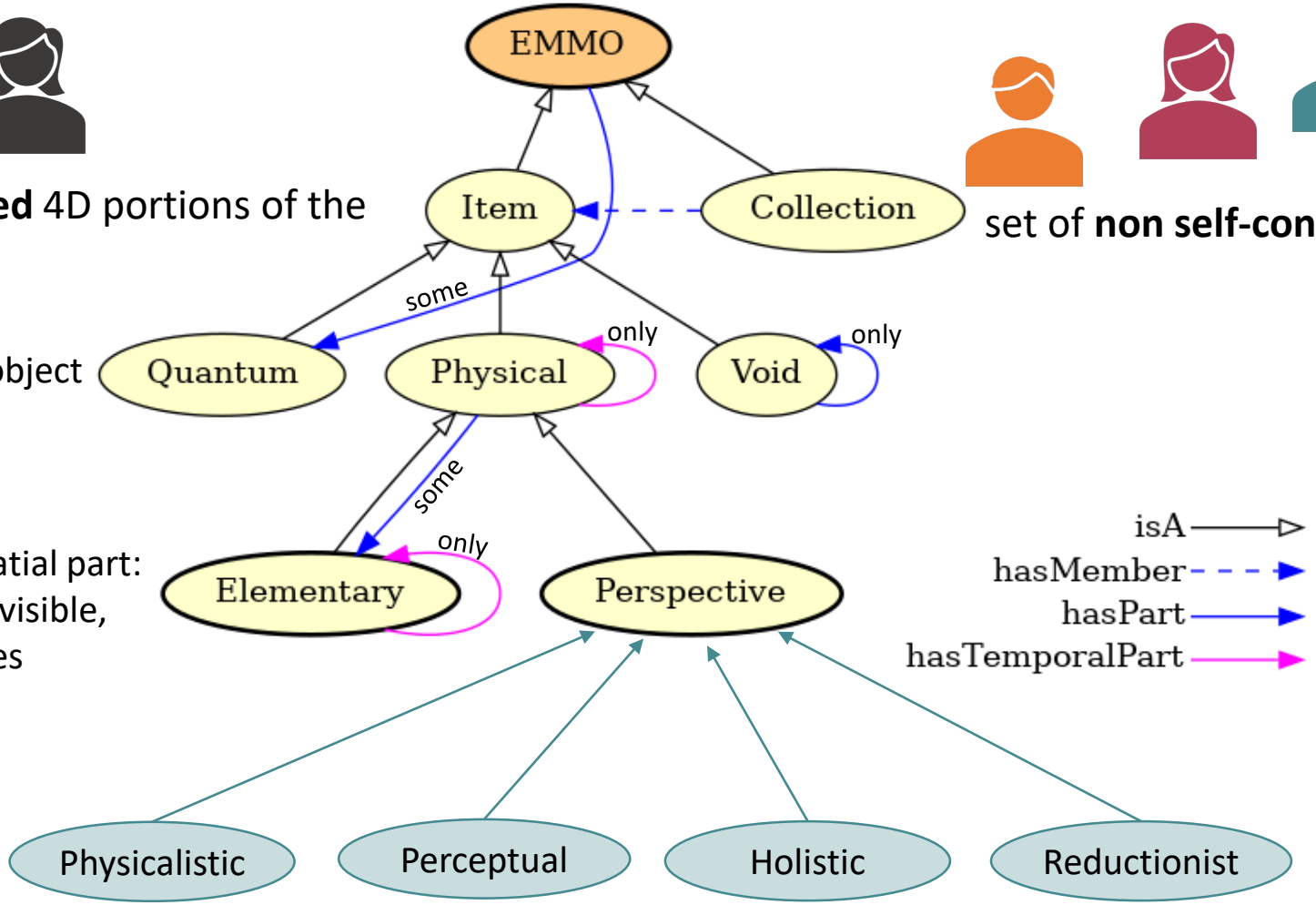
Several people

causal self-connected 4D portions of the universe

set of **non self-connected** items

Smallest possible 4D object

Smallest possible spatial part: fundamental, non-divisible, constituent of entities



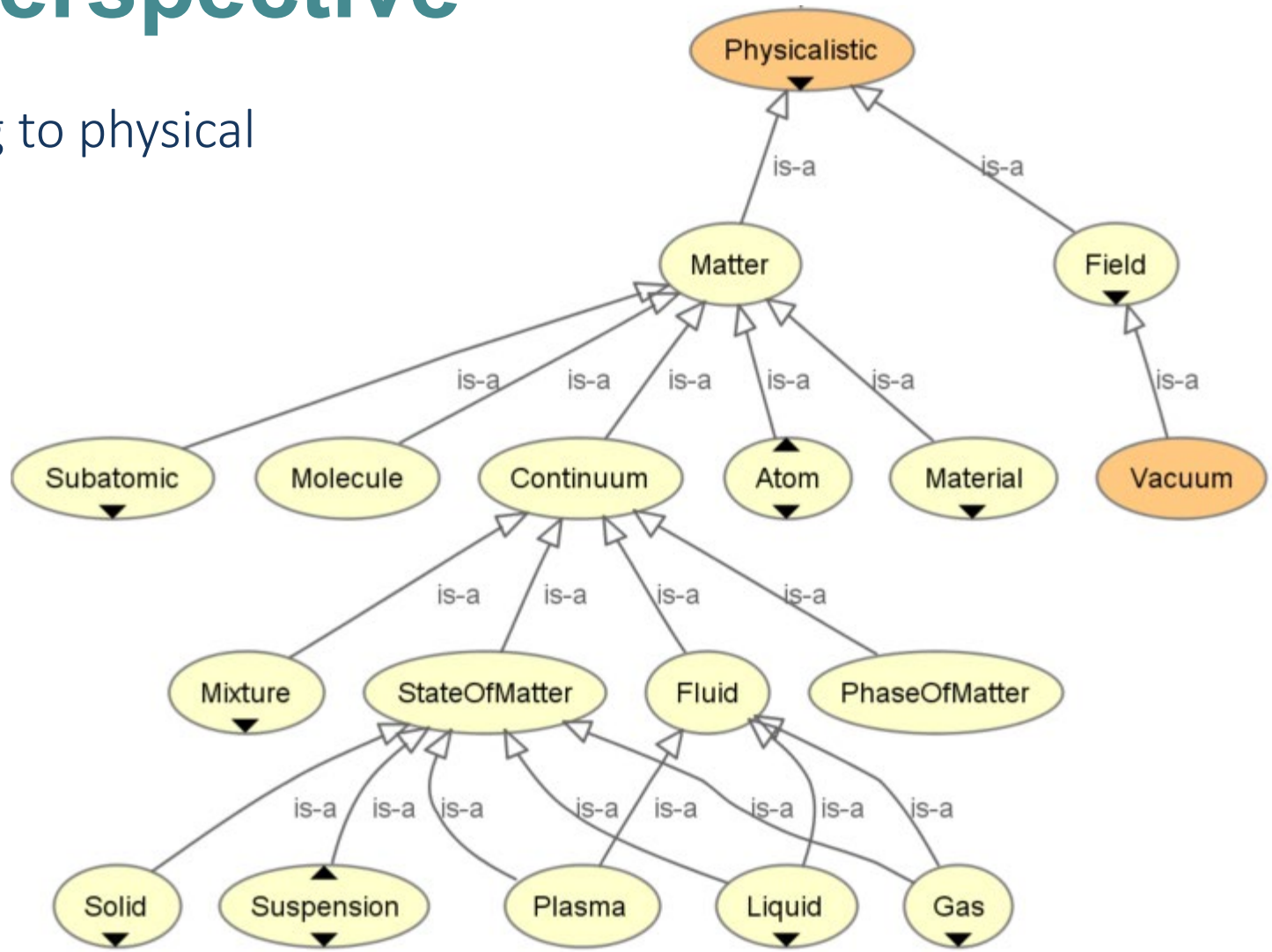
'Perspective' subclasses: several subjective ways to represent Physicals (pluralism)

Adapted from G. Goldbeck

Physicalistic perspective

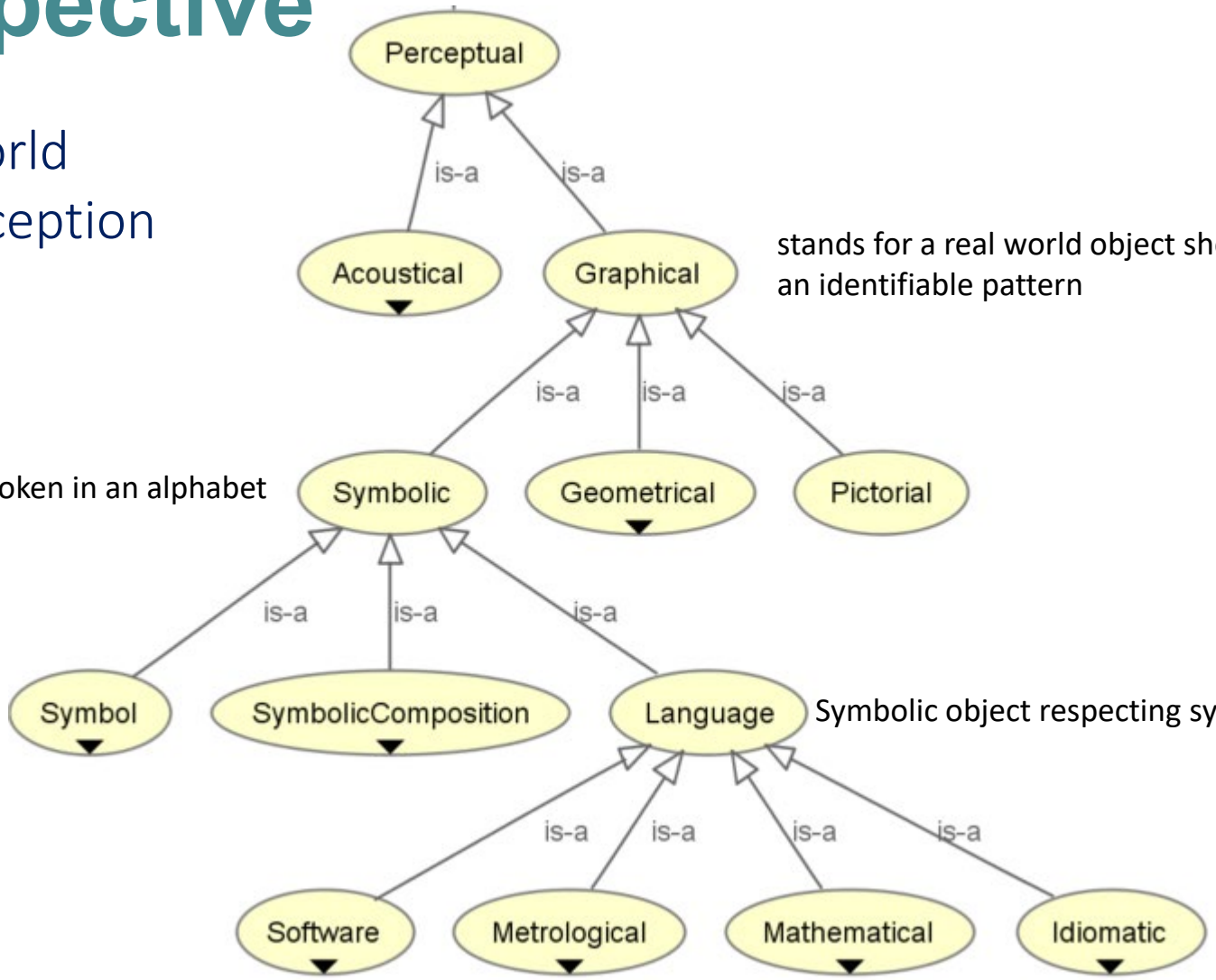
Physical categorised according to physical sciences

Essentially field and matter



Perceptual perspective

Physicals that stand for a real world objects that can stimulate a perception



stands for a real world object showing an identifiable pattern

Graphical that stands for a token in an alphabet

stands for an elementary mark in an alphabet

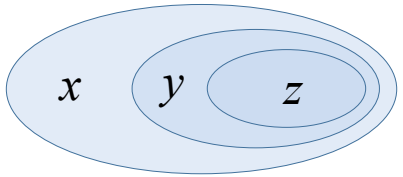
Symbolic object respecting syntactic rules

physical quantities, units, …

Reductionistic perspective: direct parthood

Material Entities **can** be represented in EMMO by a Hierarchy of parthood relations.
Including the NEW concept of **direct parthood**

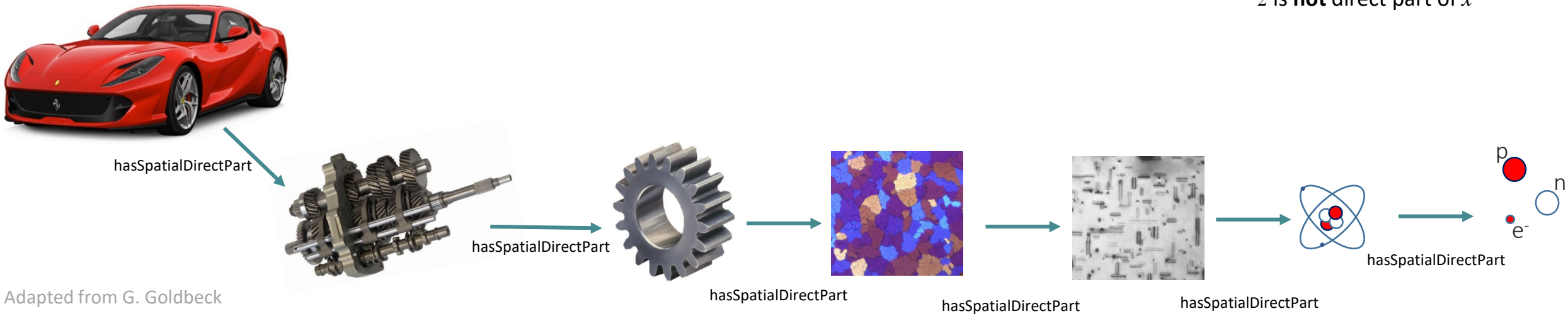
Direct parthood is non-transitive



y is direct part of x
z is direct part of y
z is **not** direct part of x

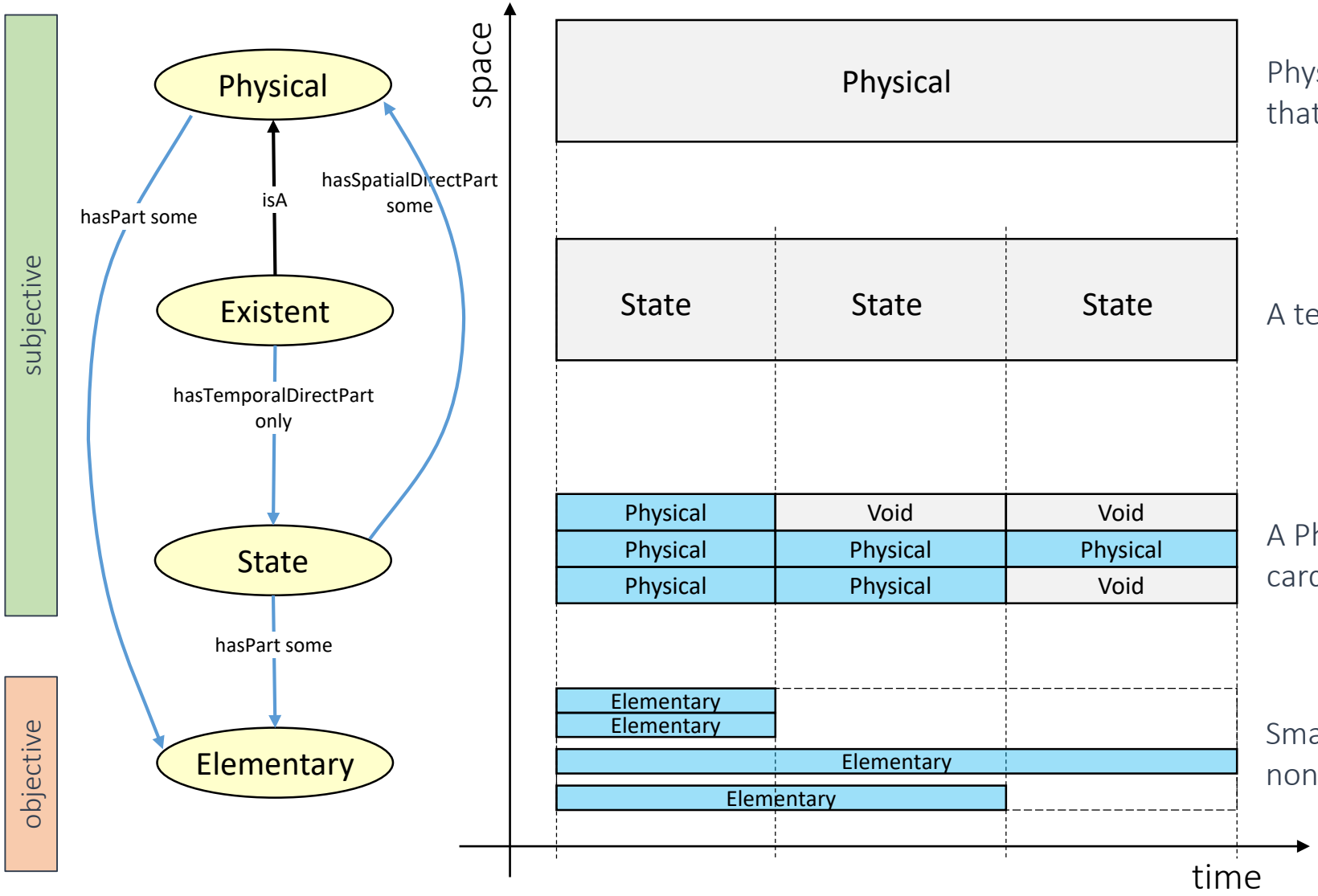
One material - different levels of granularity.

Hierarchy of structure can be univocally defined.



Adapted from G. Goldbeck

Reductionistic perspective and mereotopology



Physical objects – stands for real world objects that interact physically with the ontologist

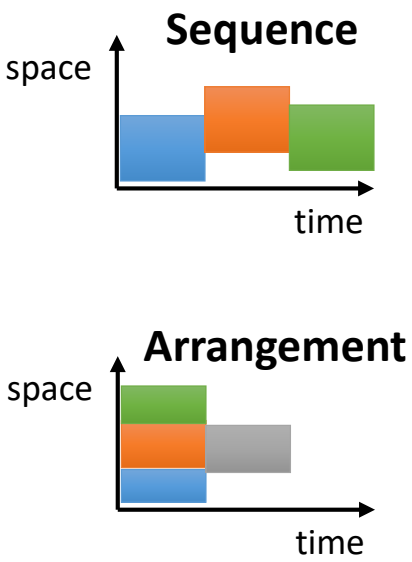
A temporal succession of **states**

A Physical whose parts have a constant cardinality during its life time

Smallest possible spatial part: fundamental, non-divisible, constituent of entities

Adapted from E. Ghedini

Direct Parthood: counting & ordering

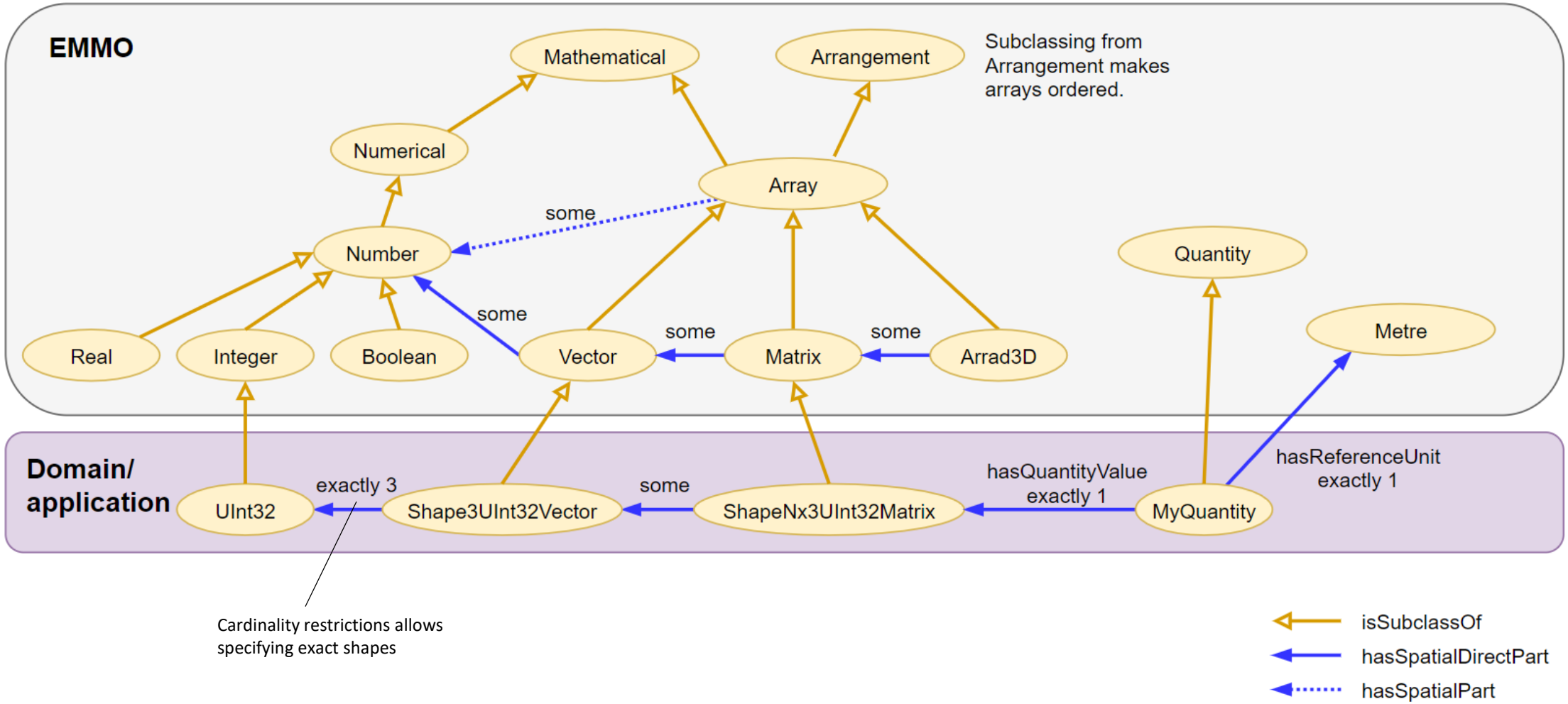


Quantity
Reductionistic
only
NumberOfElements
OrderedElement
Existent
some
State
Ordered
Sequence
Arrangement
some
some
TemporalOrderedElement
SpatialOrderedElement
a
a
a
a
elem3
elem2
elem1
myContainer

isSubclassOf
hasSpatialDirectPart
isPropertyOf
hasFirstElement
hasNext

Combining perceptual and reductionistic

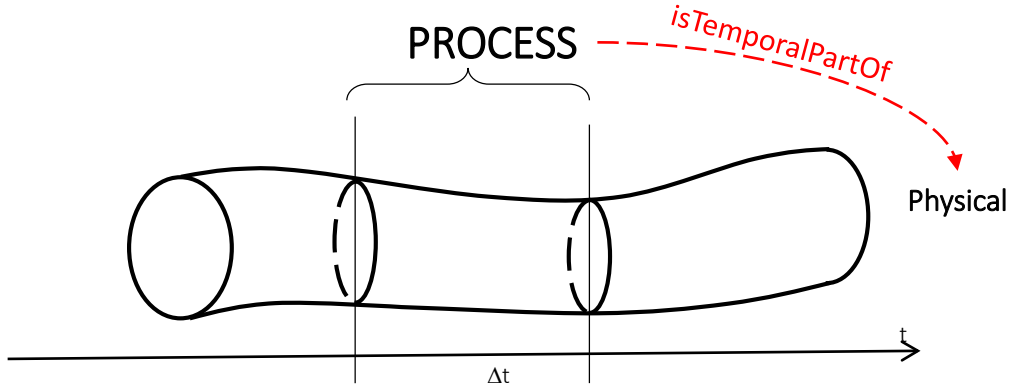
Provides a very powerful way to describe scientific data (type, shape, unit)



Holistic Perspective

Describes whole 4D object (process) and the **role** of its participants

Assigned by
the Ontologist



Example: Measurement process
May be divided into sub-processes

Sample preparation | Experimental setup | Measure | Postprocess raw output

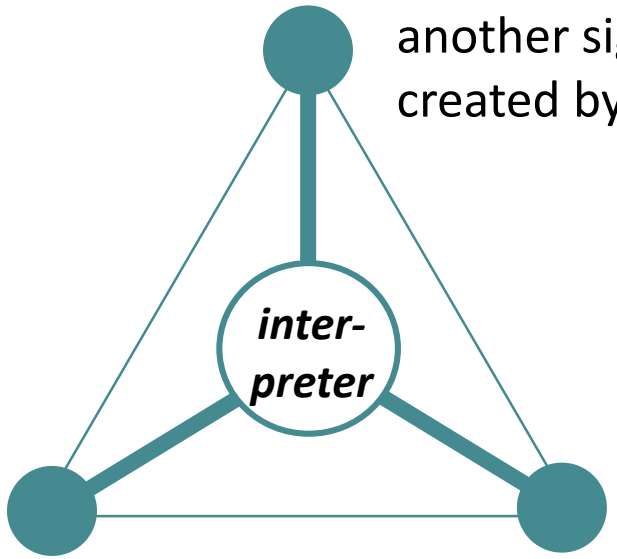
Adapted from G. Goldbeck

Semiotic process

Charles S. Peirce
semiotic theory

interpretant

another sign determined or created by the first one



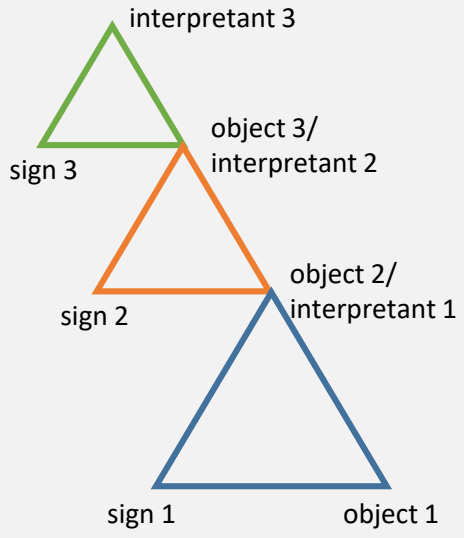
stands for (represents) the object

sign

real world object represented by the sign

object

The cascade of semiosis



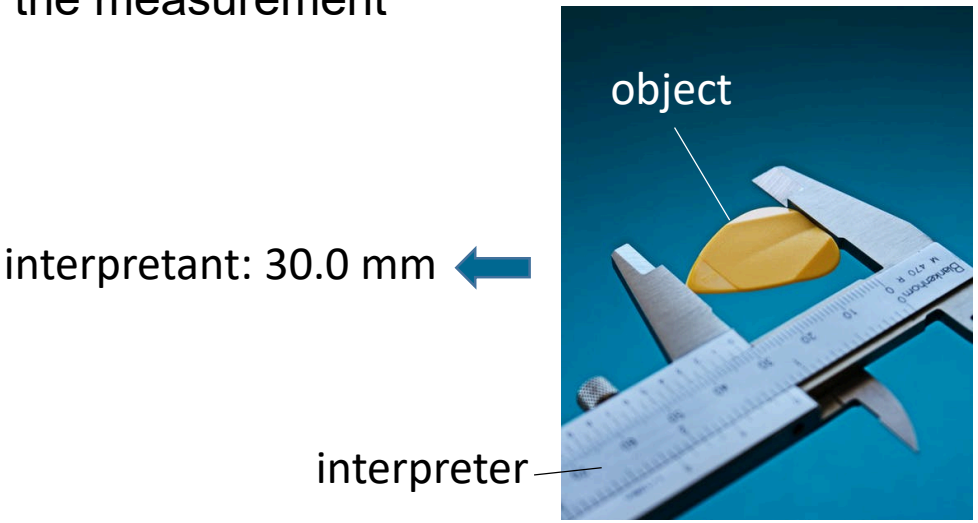
Provides a formal way to describe a process to needed level of granularity

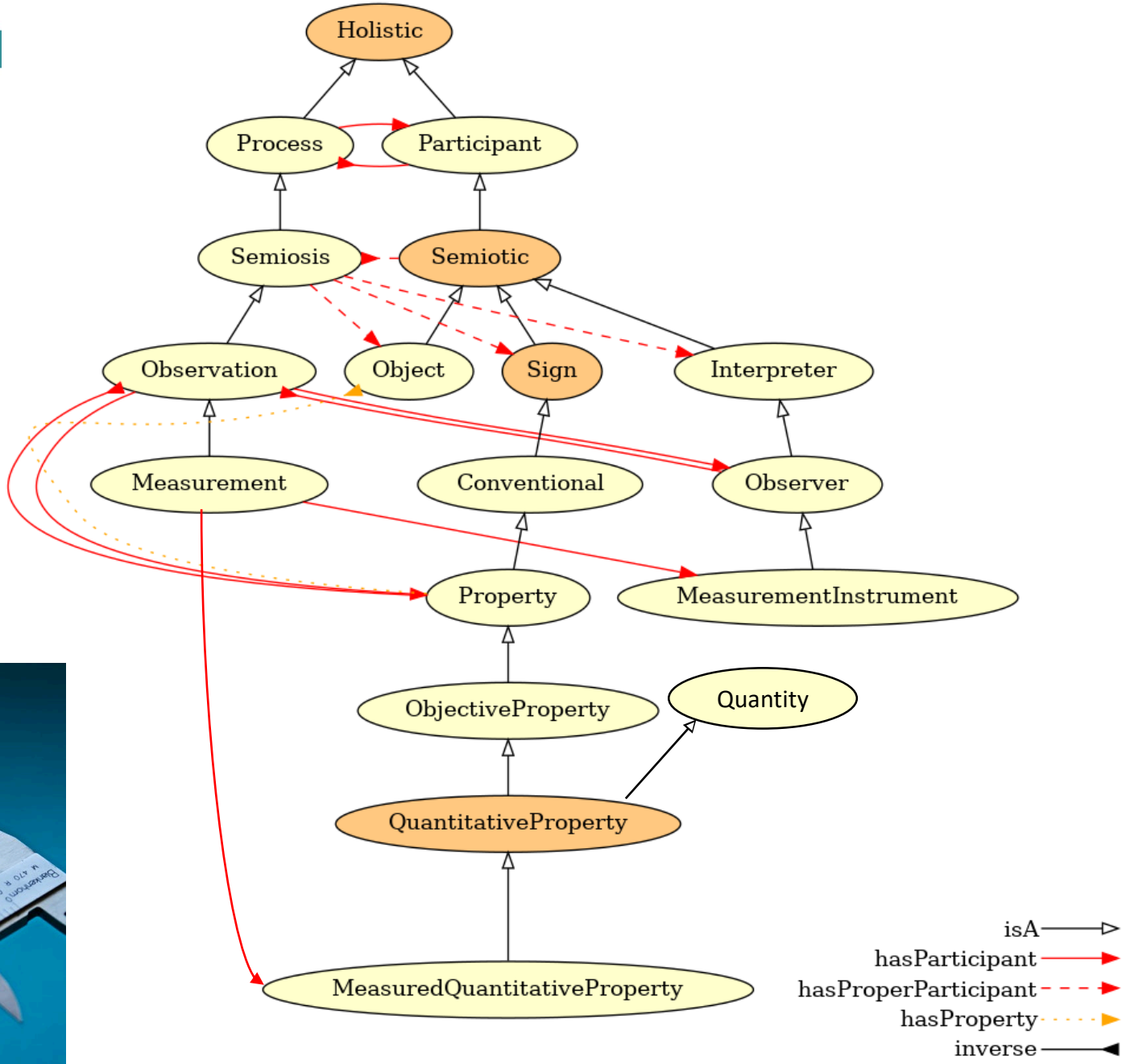
The **interpreter** providing the connections between the three elements

Measurement

Quantitative properties are determined by a well-defined semiotic process, with participants:

- **Object**: real world object with a property that we want to measure
- **Sign**: stands for the object (in this triadic process)
- **Interpretant**: the measured quantitative property
- **Interpreter**: the measurement instrument used to perform the measurement

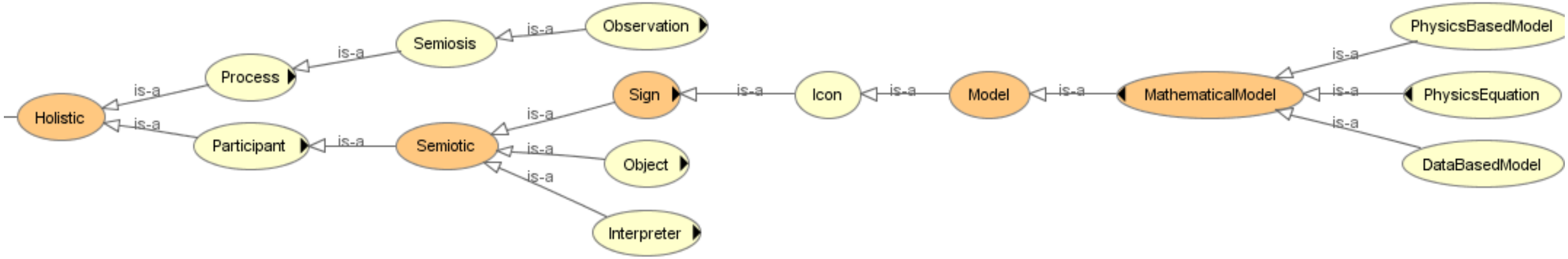




EMMO Models

A **Model** is also **Sign**

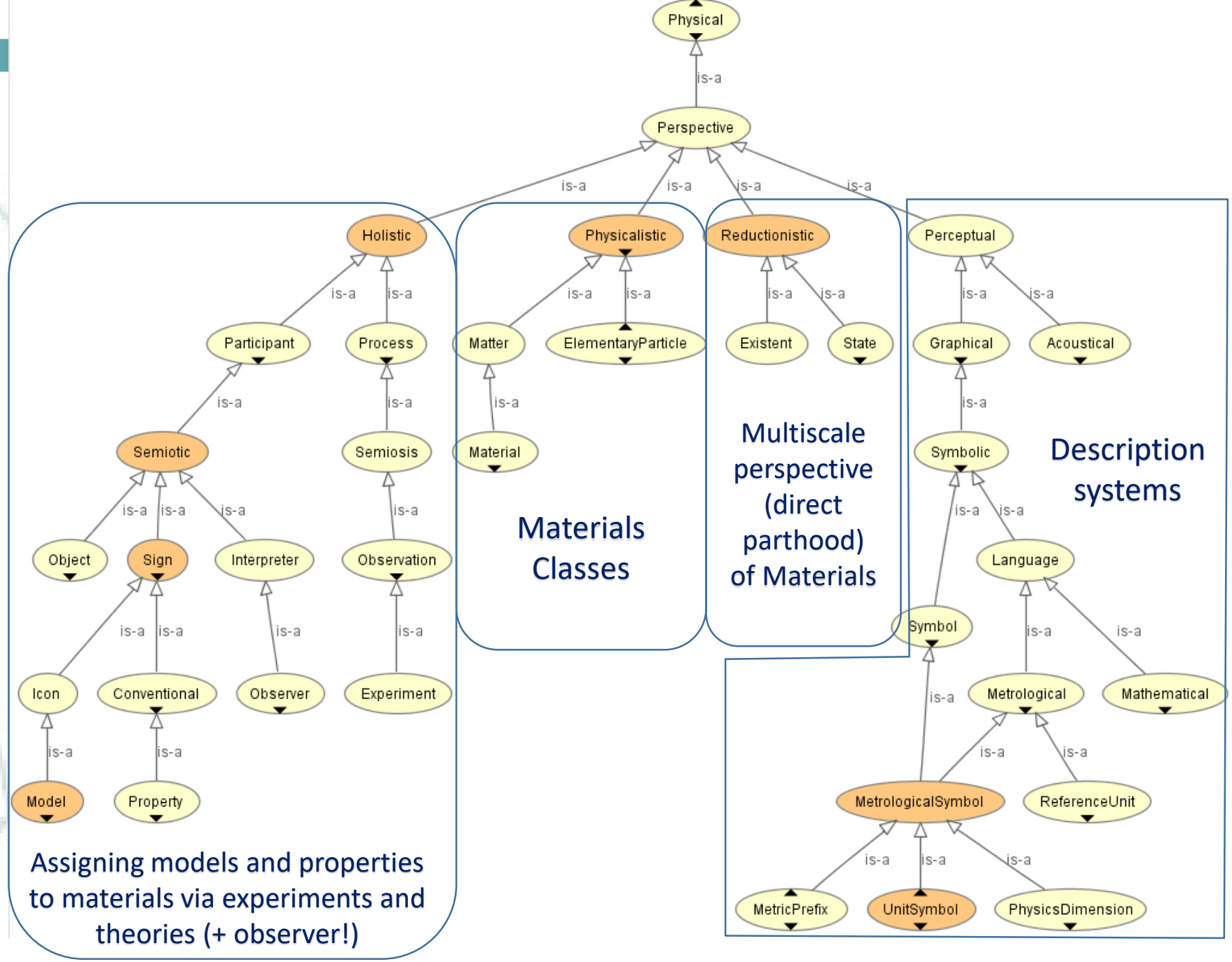
A simplified representation of a physical or process, aimed to assist calculations for describing or predicting its behaviour.



https://emmo.tech

EMMO

Overview



https://github.com/emmo-repo/

Development and application of EMMO in EU Projects

2016

European Materials Modelling Council, EMMC-CSA, EMMC ASBL

EMMO foundations laid within EU project
EMMO governance managed by EMMC ASBL

Digital Ontology-based Modelling Environment for Simulation of materials

EMMO applications cases
Team of philosophers, ICT experts and applied scientists.

Materials Modelling Marketplace for Increased Industrial Innovation

EMMO applied to larger materials modelling communities and marketplaces infrastructures.

Virtual Materials Market Place

Ontology Driven Open Translation Environment

EMMO Domain ontologies and industrial application cases

Ontology-driven data documentation for Industry Commons

Ontologies and tools foundation for data documentation in materials and manufacturing industry

2024

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