

Agenda • Day 1

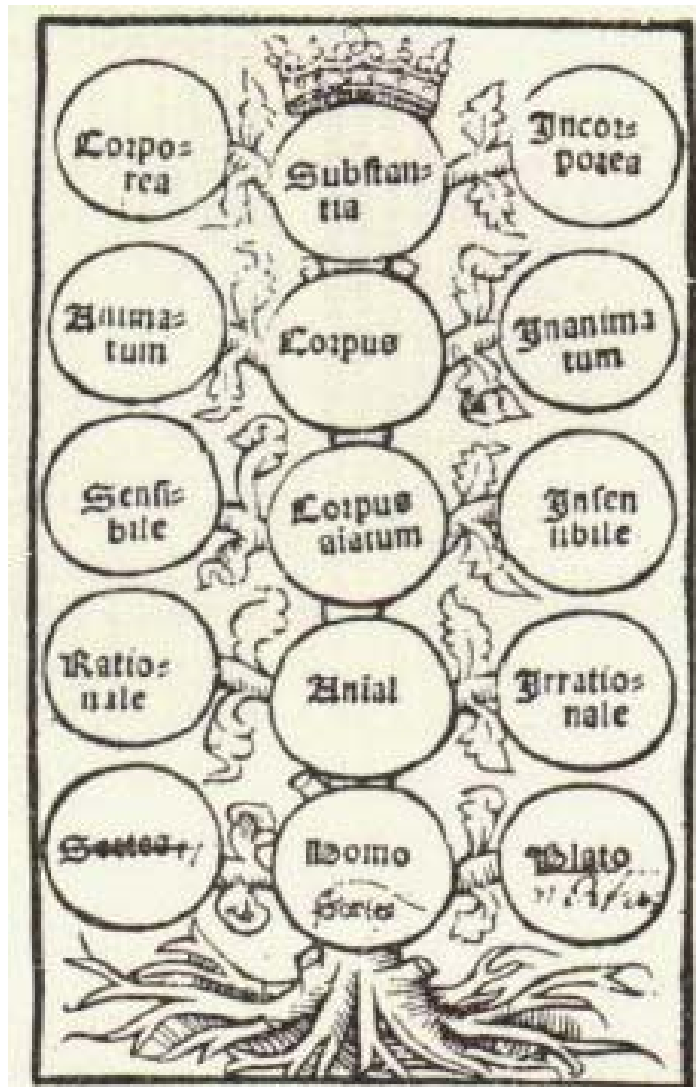
- Introduction: What is an ontology and what is it useful for?
- **Basic Formal Ontology: An upper-level ontology to support scientific research**
- Open Biomedical Ontologies (OBO) and the Web Ontology Language (OWL)
- The OBO Relation Ontology

Ontology

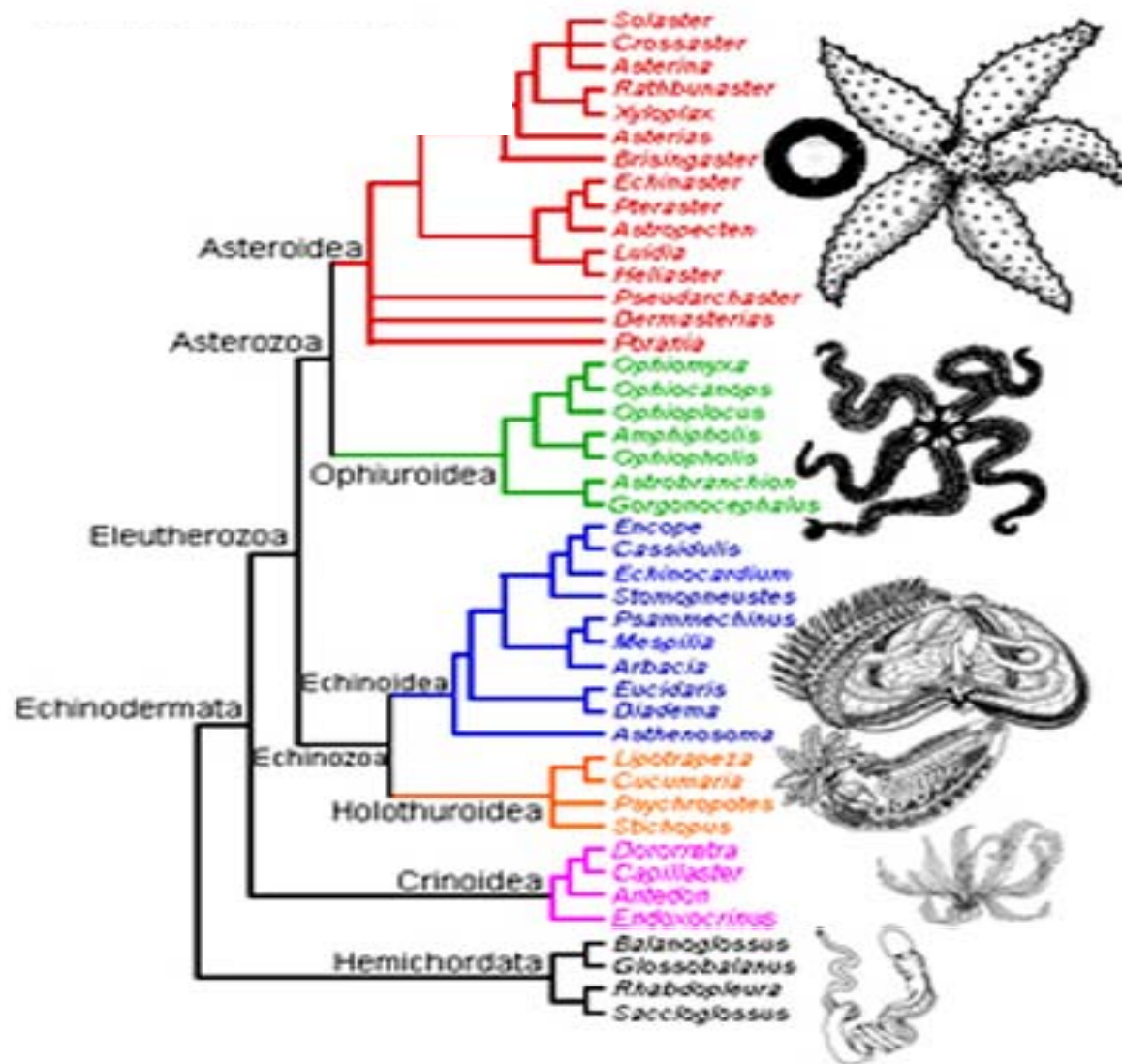
the science of the kinds and structures of objects, properties, events, processes and relations in every domain of reality

World's first ontology

(from Porphyry's *Commentary on Aristotle's Categories*)



Linnaean Ontology



Contemporary top-level ontologies

DOLCE = Domain Ontology for Linguistic and Cognitive Engineering

SUMO = Suggested Upper Merged Ontology

BFO = Basic Formal Ontology

Each of these ontologies

is not just a system of categories

but a *formal theory*

with definitions, axioms, theorems

designed to provide the resources for

reference ontologies built to represent the
entities in specific domains

of sufficient richness that terminological

incompatibilities can be resolved

intelligently rather than by brute force

BFO is a very small ontology to support integration of scientific research data

SUMO contains many portions which are more properly conceived of as domain ontologies (airports, bacteria, ...)

DOLCE is tilted towards objects of general thought and communication (fiction, mythology, ...)

Basic Formal Ontology

- a true upper level ontology
- no interference with domain ontologies
- no interference with issues of cognition
- no negative entities
- no putative fictions
- a small subset of DOLCE but with more adequate treatment of instances, universals, relations and qualities

<http://www.ifomis.org/bfo/>

Groups and Organizations using BFO

AstraZeneca - Clinical Information Science

BioPAX-OBO

BIRN Ontology Task Force (BIRN OTF)

Computer Task Group Inc.

Duke University Laboratory of Computational Immunology

Dumontier Lab

INRIA Lorraine Research Unit

Kobe University Graduate School of Medicine

Language and Computing

National Center for Multi-Source Information Fusion

Ontology Works

Science Commons - Neurocommons

University of Texas Southwestern Medical Center

Ontologies using BFO

BioTop: A Biomedical Top-Domain Ontology
Common Anatomy Reference Ontology (CARO)
Foundational Model of Anatomy (FMA)
Gene Ontology (GO)
Infectious Disease Ontology
Ontology for Biomedical Investigations (OBI)
Ontology for Clinical Investigations (OCI)
Phenotypic Quality Ontology (PaTO)
Protein Ontology (PRO)
RNA Ontology (RnaO)
Senselab Ontology
Sequence Ontology (SO)
Subcellular Anatomy Ontology (SAO)
Vaccine Ontology (VO)

Realist Perspectivalism: The philosophical basis of BFO

There is a multiplicity of ontological perspectives on reality, all equally veridical i.e. transparent to reality

Ontologies are windows on reality

The Time Problem

The tumor developed in John's lung over
25 years

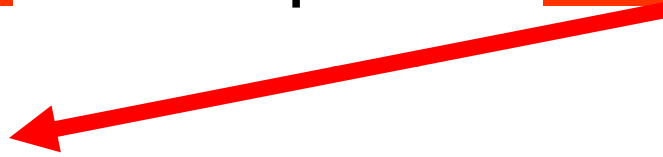
The Problem

_____ developed in _____ over 25 years



The Problem

The tumor developed in the lung over 25 years



substances

things

objects

continuants

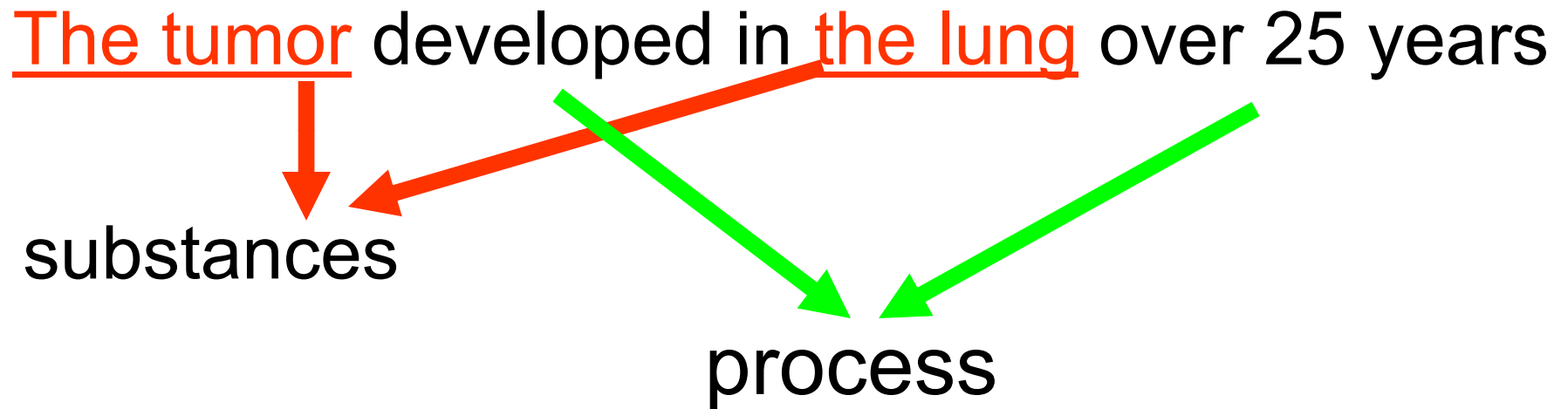
The Problem

The tumor developed in the lung over 25 years

what is it that participates in this process of
tumor development?

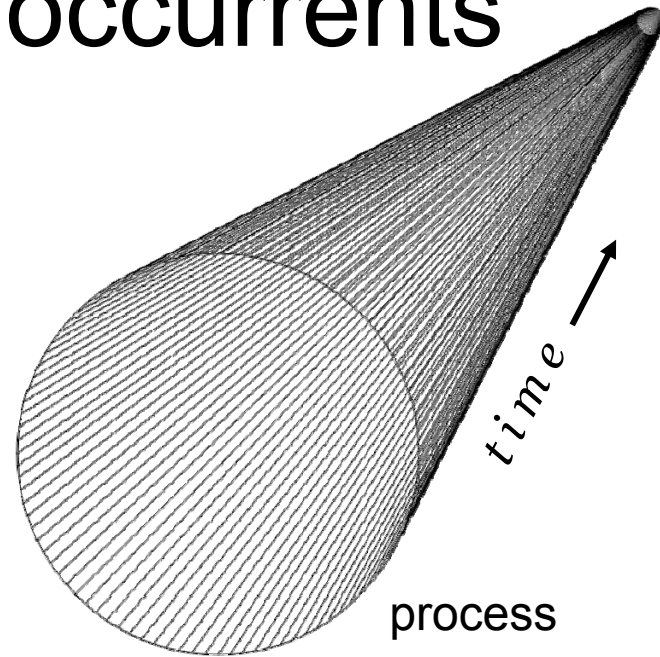
parthood here not determinate

The Problem



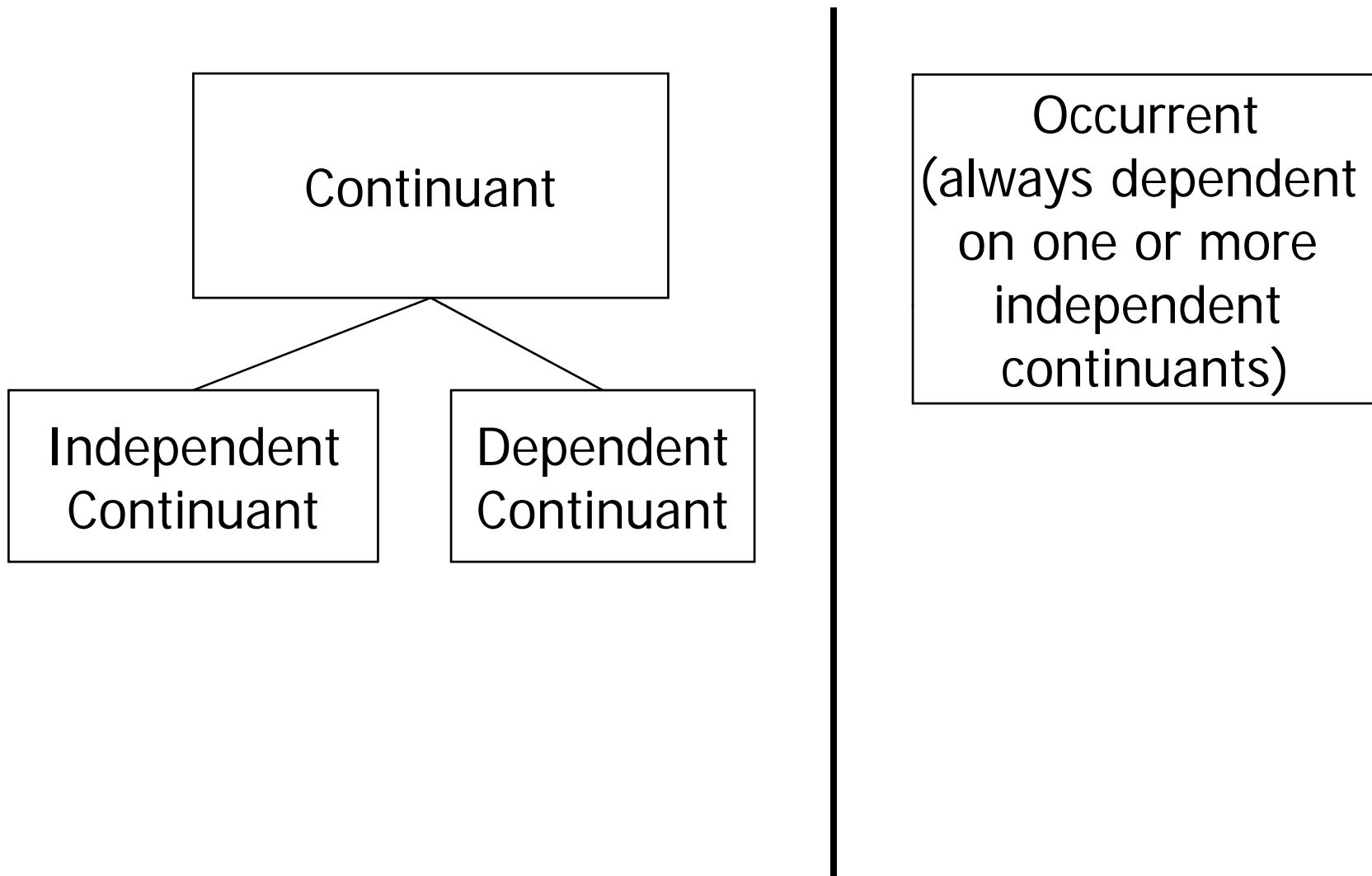
gluing these two types of entities together yields
ontological monsters

Continuants vs occurrents



In preparing an inventory of reality we keep track of these two different kinds of entities in two different ways

BFO: the very top



An alternative approach: Fourdimensionalism

- only processes (occurrences) exist
- time is just another dimension, analogous to the three spatial dimensions
- substances are analyzed away as worms/fibers within the four-dimensional plenum
- fourdimensionalism brings benefits especially for computational purposes

There are no substances

Bill Clinton does not exist

Rather: there exists within the four-dimensional plenum a continuous succession of processes which are similar in a Billclintonizing way

Fourdimensionalism
("everything is flow") is right in
everything it says

But it is incomplete

Realist Perspectivalism

There is a multiplicity of ontological perspectives on reality, all equally veridical = transparent to reality

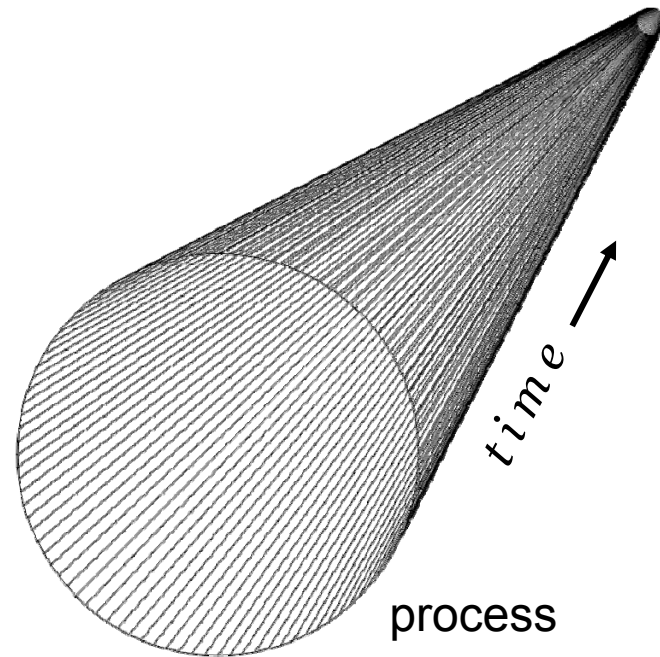
Fourdimensionalism is one veridical perspective among others

Cf. particle vs. wave ontologies used in quantum mechanics

Snapshot
ontology



Video
ontology



Continuants and Occurrents

Two Orthogonal, Complementary Perspectives

stocks and flows

commodities and services

product and process

anatomy and physiology

Continuant entities

- have continuous existence in time
- preserve their identity through change
- exist *in toto* if they exist at all

Occurrent entities

- have temporal parts
- unfold themselves phase by phase
- exist only in their phases/stages

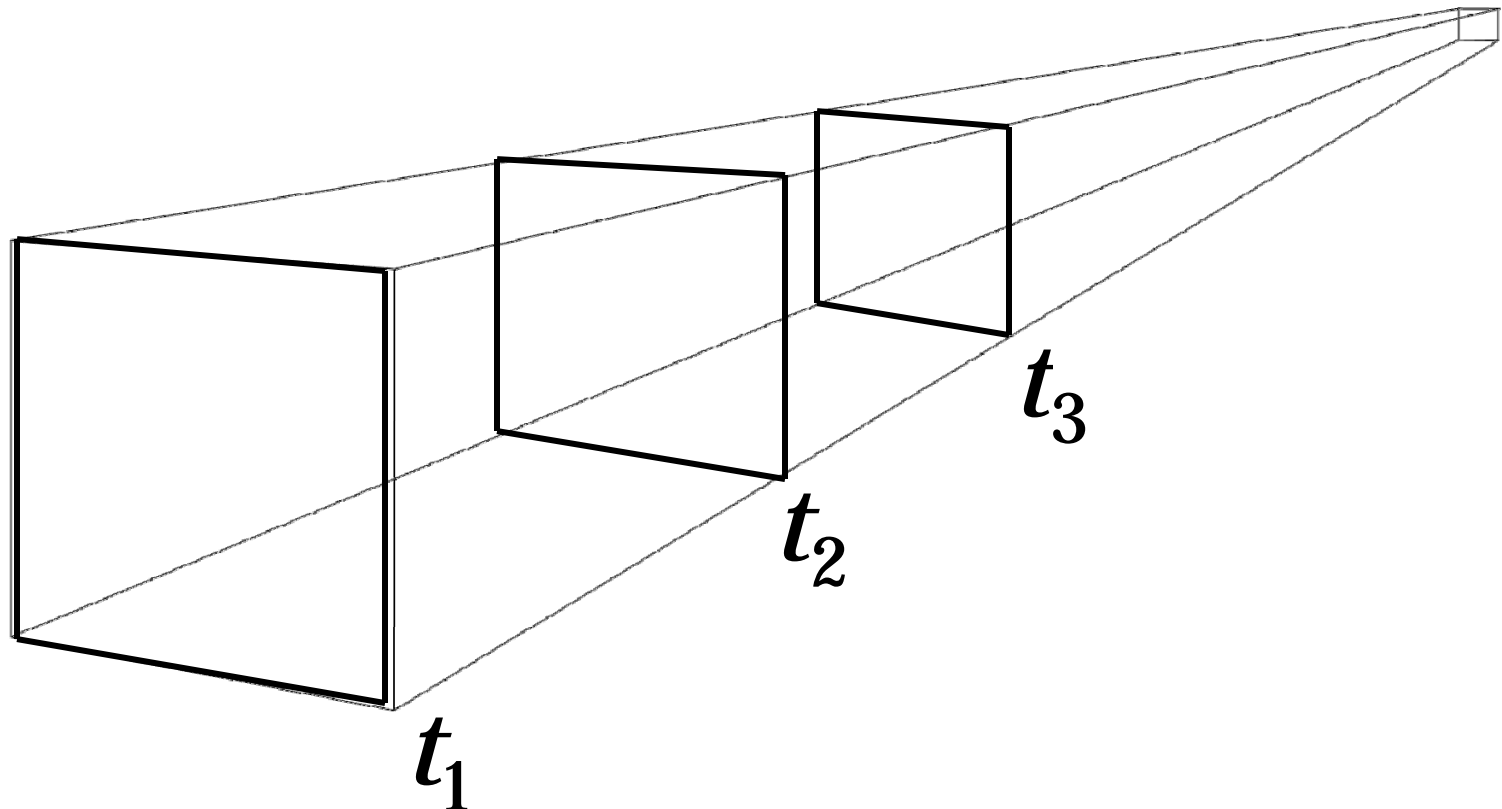
You are a substance

Your *life* is a process

***You* are 3-dimensional**

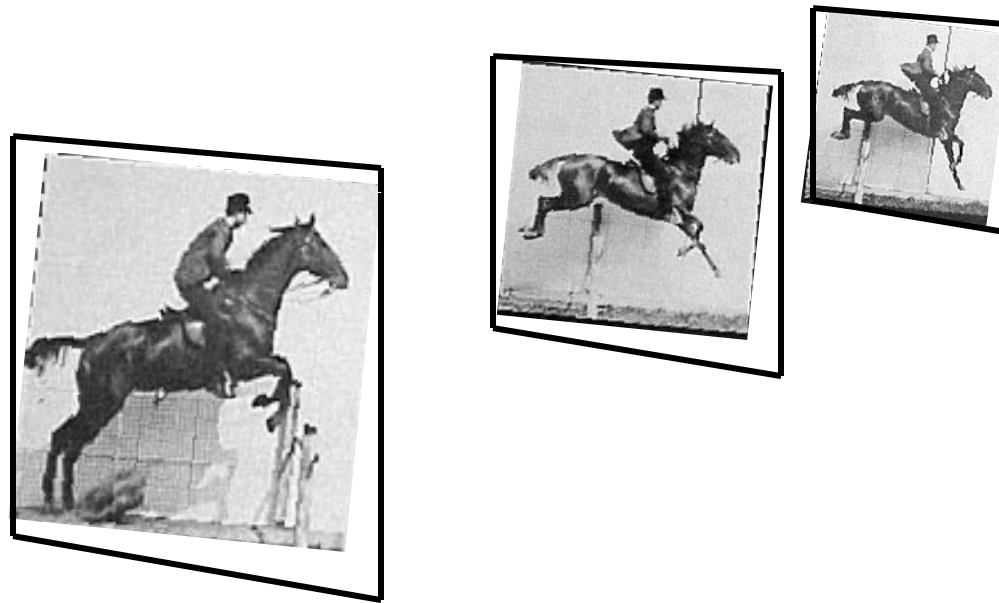
Your *life* is 4-dimensional

Many SNAPshot Ontologies



here time exists **outside** the ontology,
as an *index* or *time-stamp*

mereology works without restriction
(parthood is everywhere determinate) in
every SNAP ontology



**Note that, while, the *views* are
instantaneous, the *objects viewed* endure**

Three kinds of continuant entities

1. Substances (Independent)
2. SNAP Dependent Entities
3. Spatial regions, contexts, niches, environments, settings

Dependent continuants:

one-place:

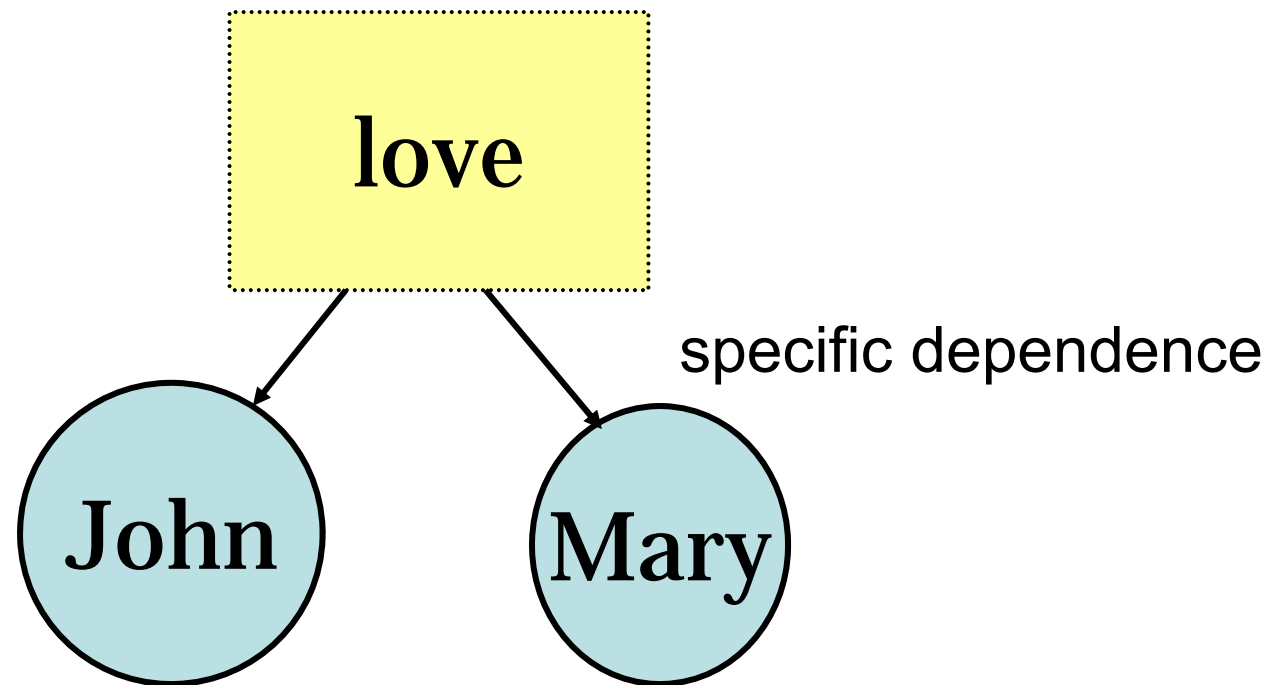
your temperature, color, height

my knowledge of French

the whiteness of this cheese

relational dependent continuants

stand in relations of one-sided dependence to a plurality of substances simultaneously

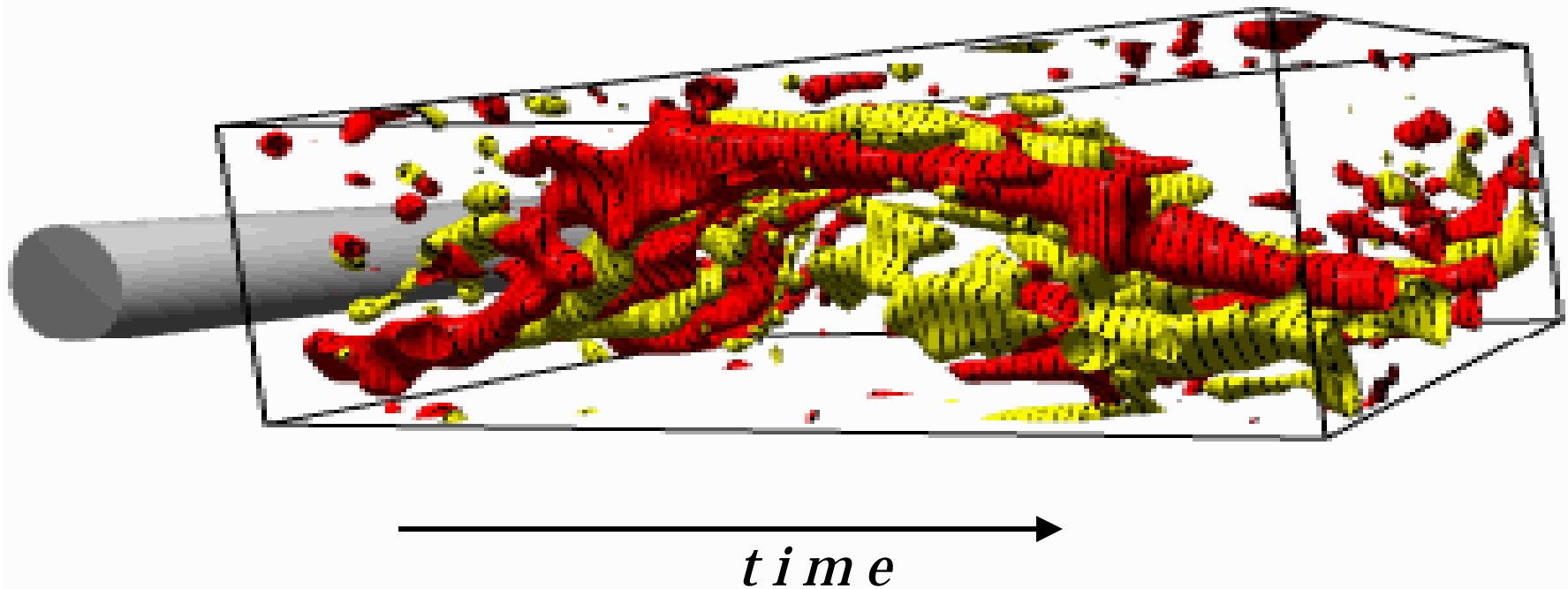


Dependent continuants

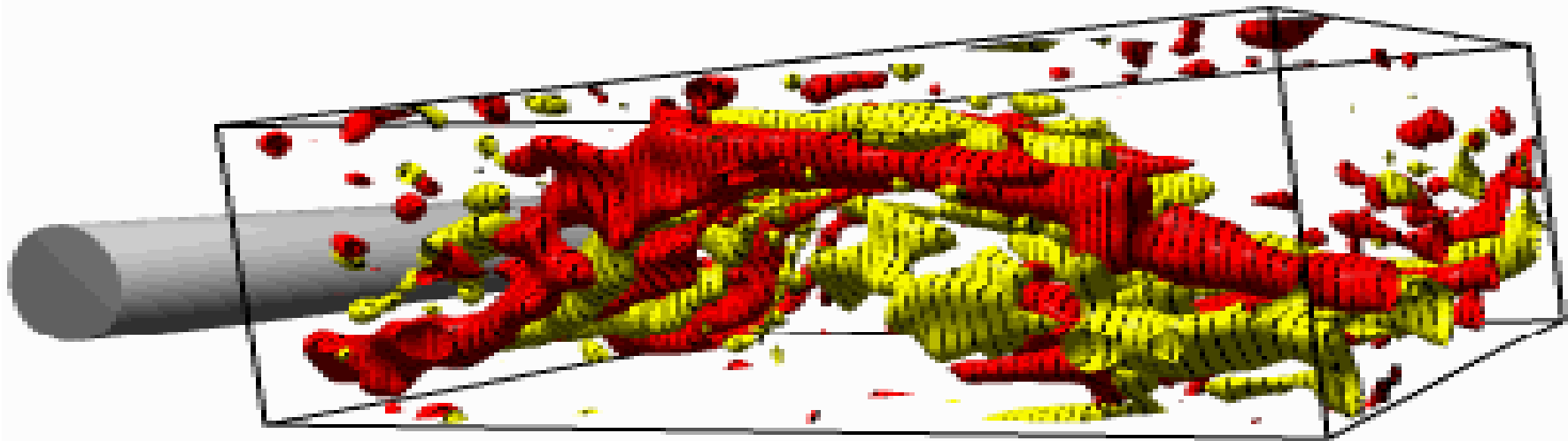
Functions, qualities, roles ...

dispositions, plans, shapes, diseases ...

The world of processes

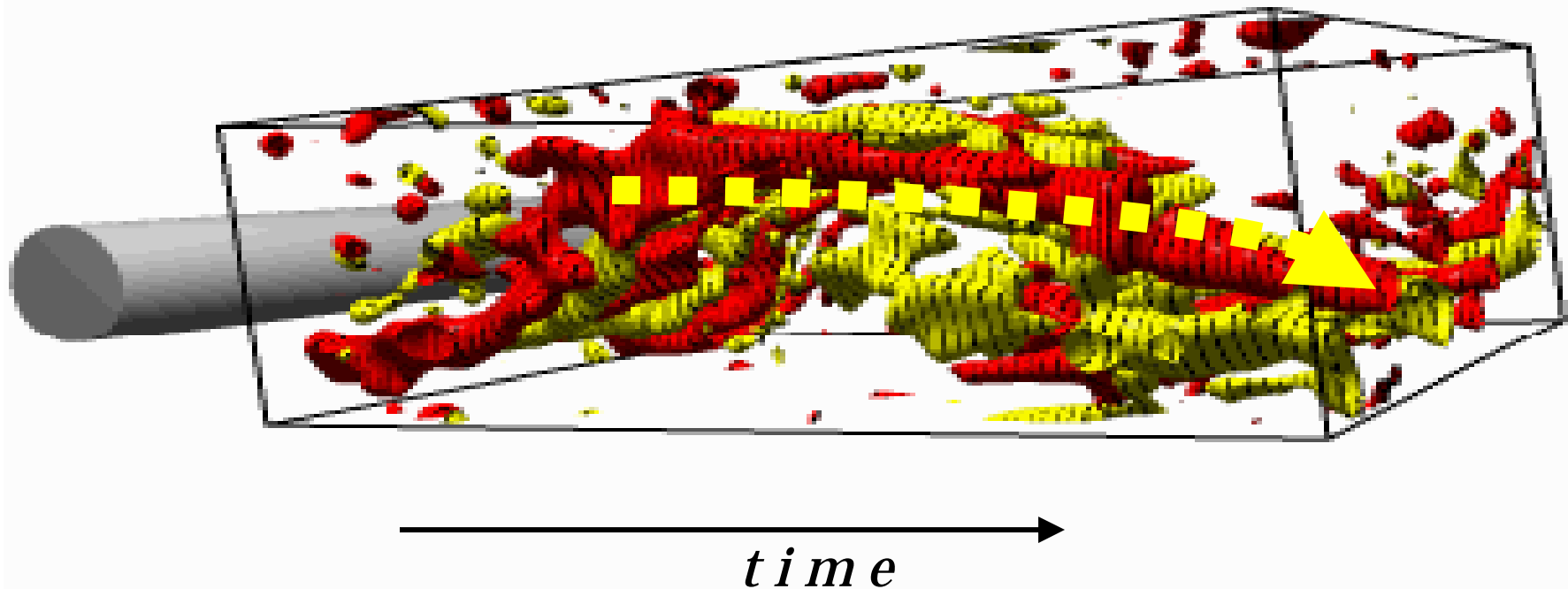


Occurrences



here time exists as part of the domain of the ontology

mereology works without restriction
everywhere here
and boundaries are mostly fiat



Processes, too, are dependent on substances

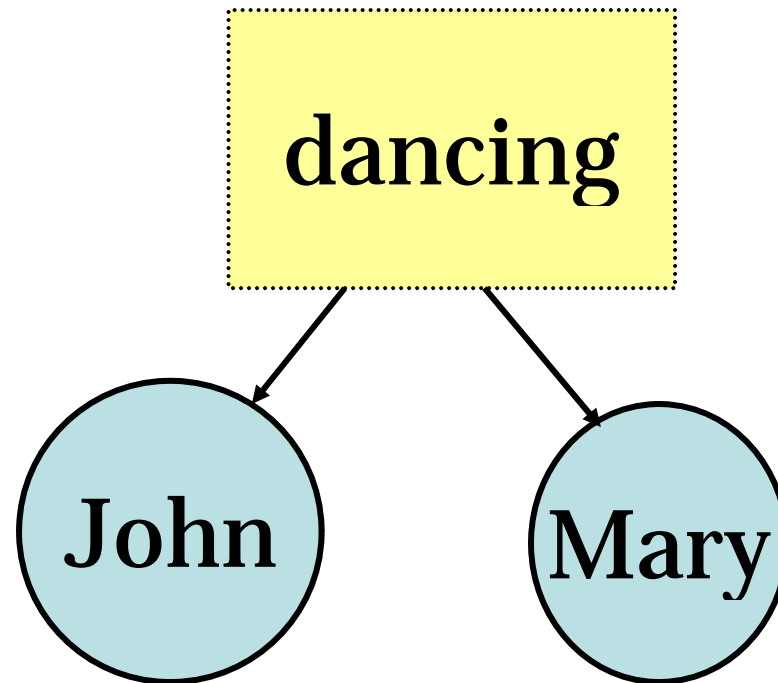
One-place vs. relational processes

One-place processes:
your getting warmer
your getting hungrier

Examples of relational processes

kissings, thumpings, conversings, dancings, ...

join their carriers together into *collectives* of greater or lesser duration



Two kinds of occurrent entities

1. Processes (including events, beginnings, endings = process-boundaries)
2. Spatio-temporal regions

How do you know whether an entity is a
continuant or an occurrent?



problem cases

forest fire

the Olympic flame

epidemic

hurricane

traffic jam

ocean wave

forest fire

a process

a pack of monkeys jumping from tree to tree
and eating up the trees as they go

(anthrax spores are little monkeys)

The Epidemic (Continuant)

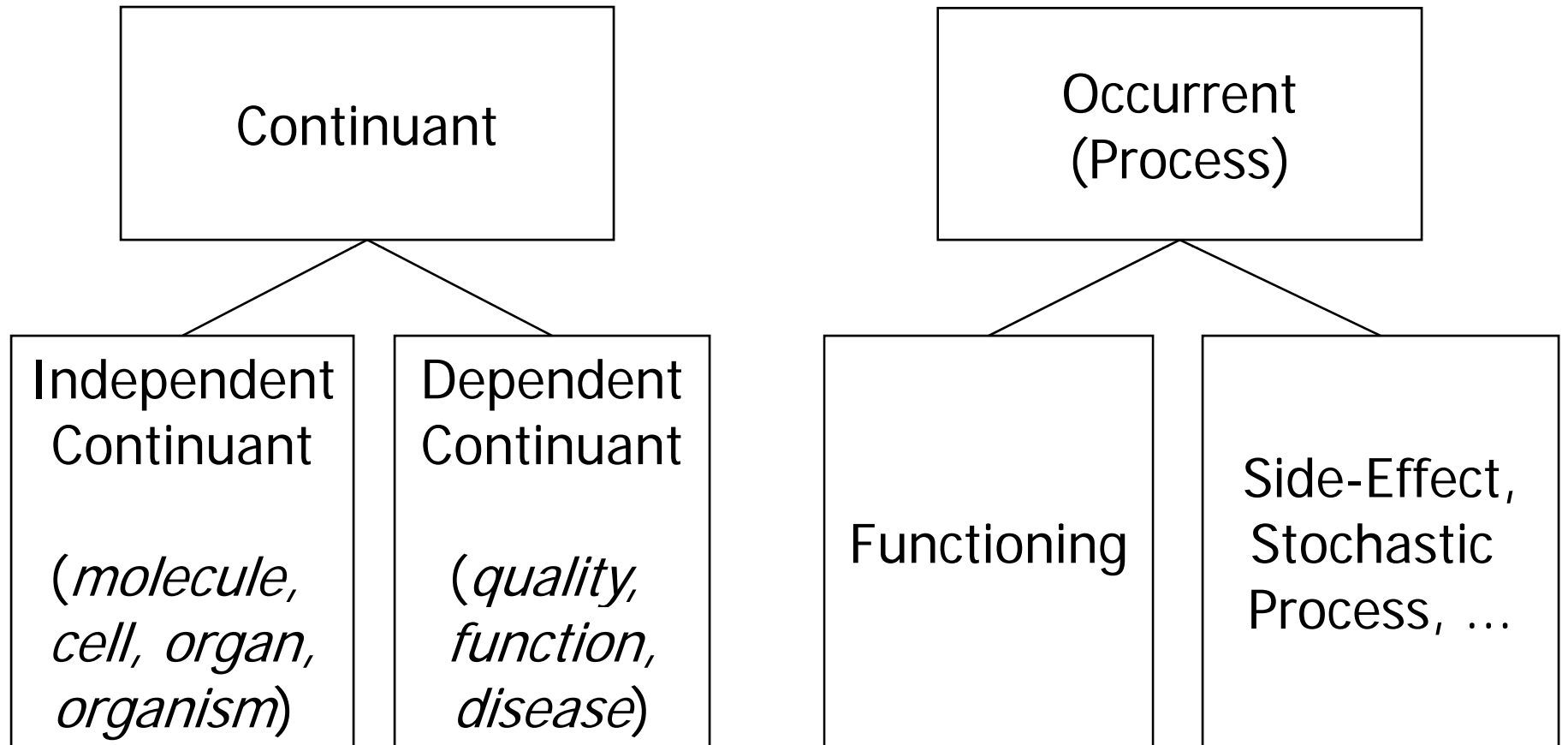
The Spread of an Epidemic (Occurrent)

Three dichotomies

- instance vs. universal
- continuant vs. occurrent
- dependent vs. independent

- universals exist in reality *through their instances*

BFO



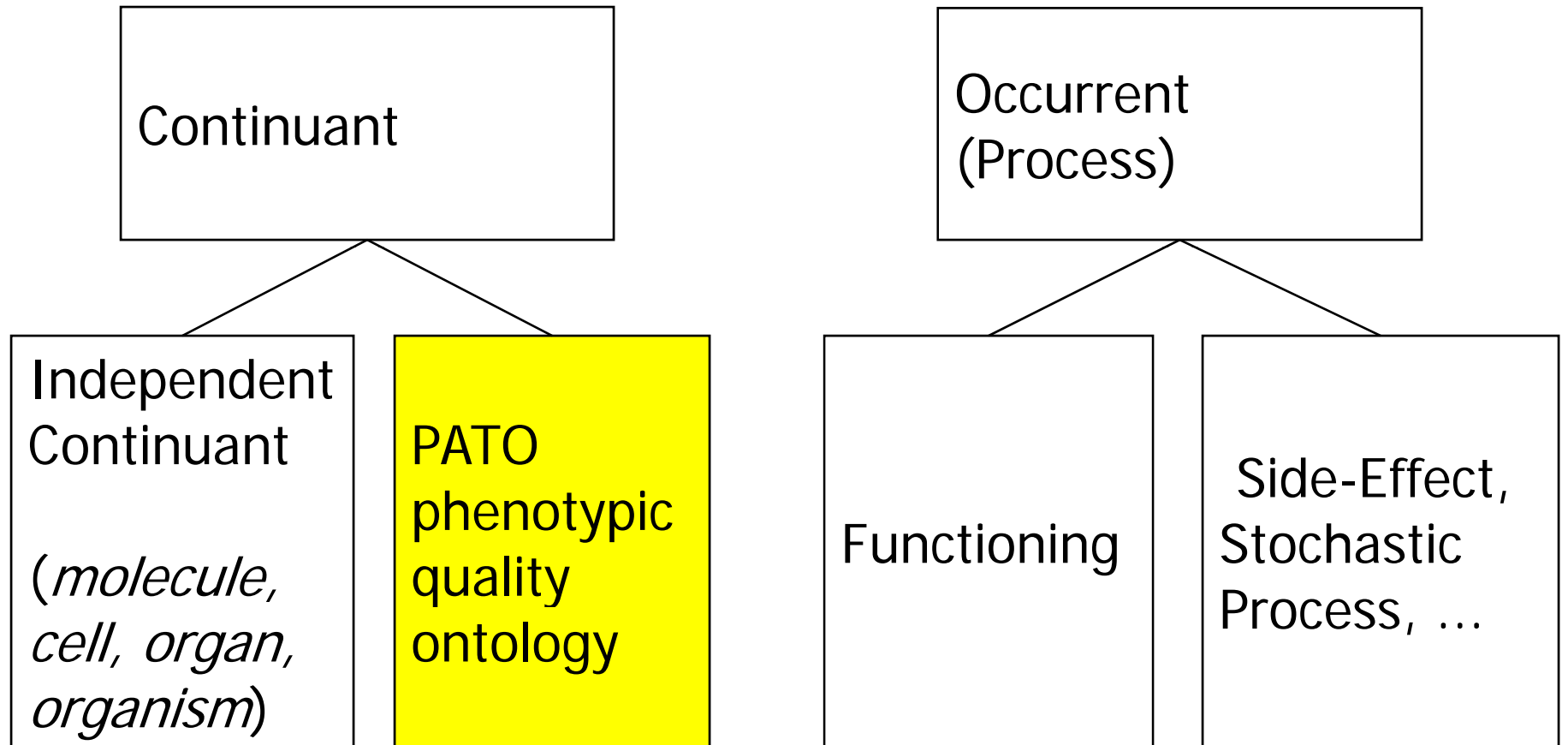
BFO

all terms included in the ontology are intended to designate universals in reality

in conformity with the basic principle of science-based ontology

science-based ontologies are windows on reality

Phenotype Ontology



An example of a quality

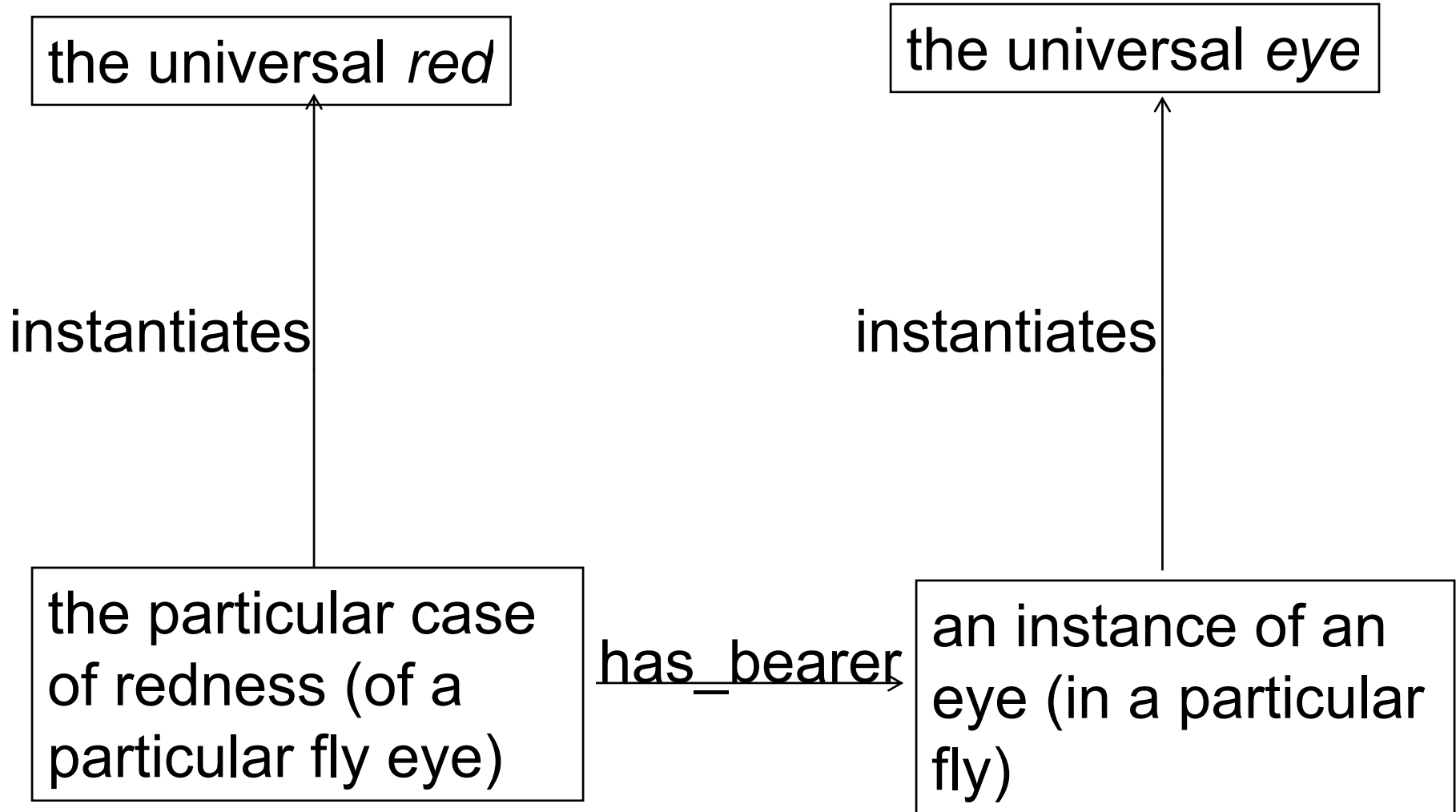
- The particular redness of the left eye of a single individual fly
 - An *instance* of a quality universal
- The color ‘red’
 - A quality universal
- Note: the eye does not instantiate ‘red’
- PATO represents **quality universals**: color, temperature, texture, shape ...

Qualities are *dependent* entities

- Qualities require (depend on) *bearers*, which are independent continuants

Example:

- A shape requires a physical object as its bearer
- If the physical object ceases to exist (e.g. it decomposes), then the shape ceases to exist



What a quality is NOT

- Qualities are not measurements
 - Instances of qualities exist independently of their measurements
 - Qualities can have zero or more measurements
- These are not the names of qualities:
 - percentage
 - process
 - abnormal
 - high
- Open problem: how relate qualities such as length to measurement values?

