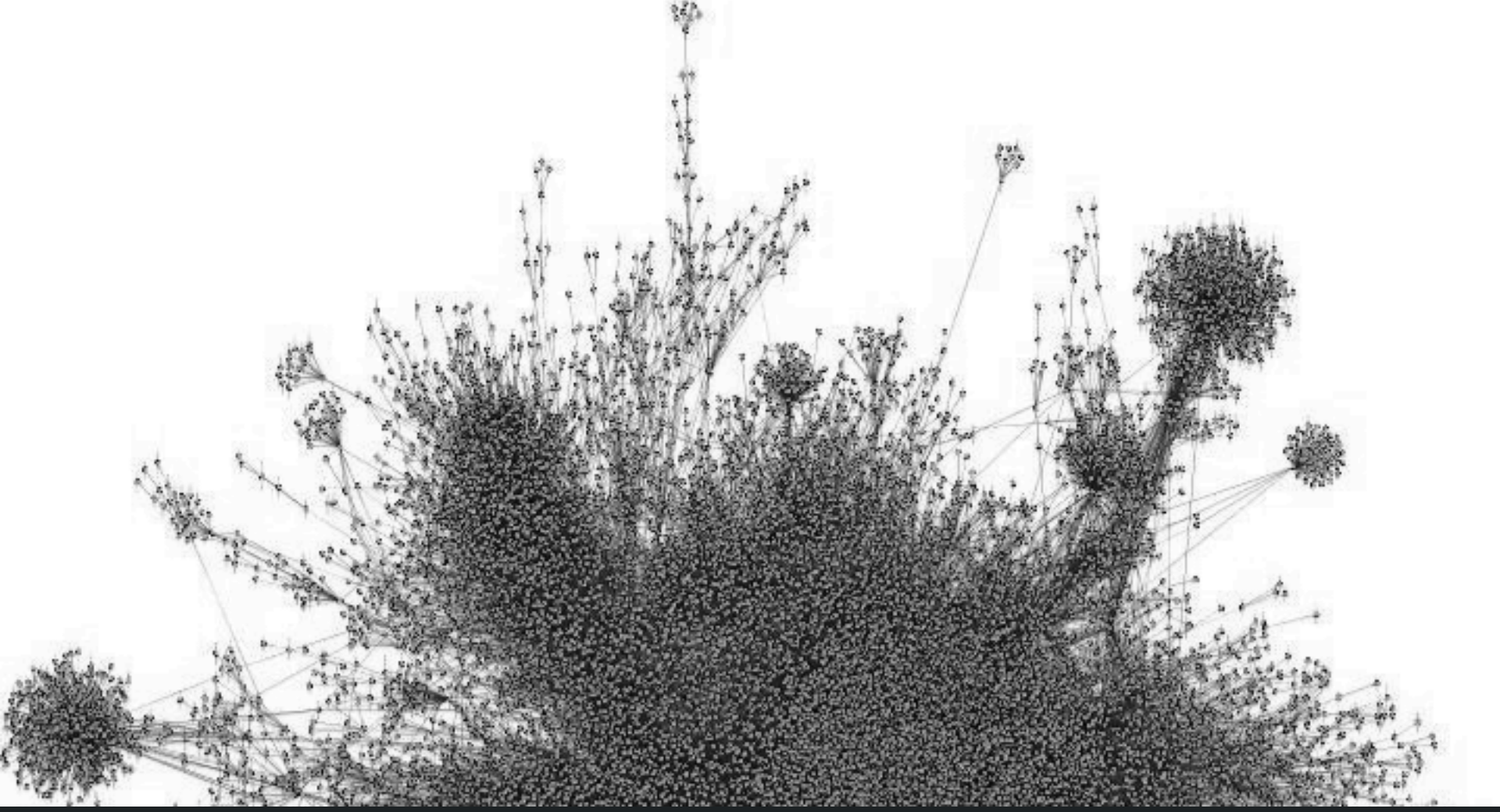


Ontology Design and Development

representing the world in 1s and 0s

CS 4100/5100

Foundations of AI

Announcements

- Assignment 2 clarifications
- Final projects: what's next?
  - Feedback
  - Project Proposal
- Midterm Exam: October 18th

ASP CLARIFICATIONS

Assignment 2

- Running clingo
- Python script
- Interpreting python output
- What to add to python script

FINAL PROJECTS

Feedback on Pitches

- Scope
- Suitability of project
- Suggestions for how to get started

Project Proposal

- 2-3 pages
- Description of project, based on scope feedback
- Description of related projects (3-4) and how your planned project is similar
- Algorithms you plan to use, example output
- Priorities and work breakdown

Final Project Grading

- Pitch & status reports: 10%
- Proposal: 20%
- Presentation: 20%
- Final report: 20%
- Code/deliverable: 30%

- Anonymous peer evaluations

MIDTERM EXAM

Midterm Exam: October 18th

- In class, October 18th
  - Full three hours
- Open note, open book
  - Internet acceptable **only** for course resources
- Material:
  - Lectures through October 11
  - Readings (textbook and additional reading)
  - Prolog: derivation trees, FOL, unification
  - ASP: choice rules, integrity constraints

ONTOLOGY DESIGN

What is an Ontology?

- The study of the nature of being

- Formally representing **real world** concepts

General vs. Domain-Specific Ontologies

- **General knowledge ontology**: frameworks for understanding…
  - Physical attributes
  - Time
  - Places and positions; space
  - Qualities, quantities, measurements
  - Motion, change, causality
  - Human activities, motivations, beliefs
- Requires millions of concepts and associations

Domain-Specific Ontologies

- These are everywhere!
  - Database schema
  - Designing an OO program with classes
  - Website organization

What is an Ontology?

- Adventure Game

- Maps

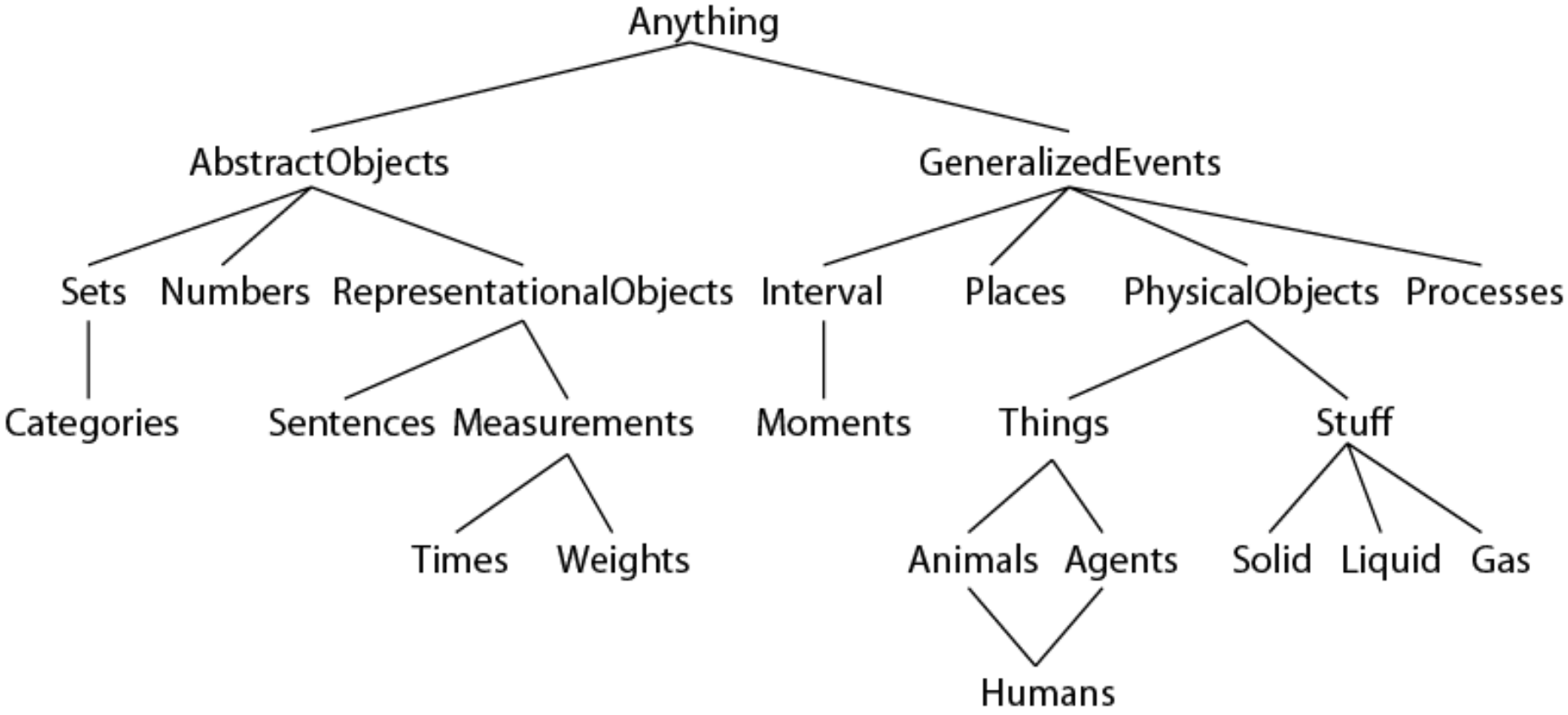
Why Ontologies?

- Organization of knowledge
- Shared information
  - Between agents
  - Between domains
- Separate *knowledge* from *operation*
- What was the ontology in our taxi driver example?

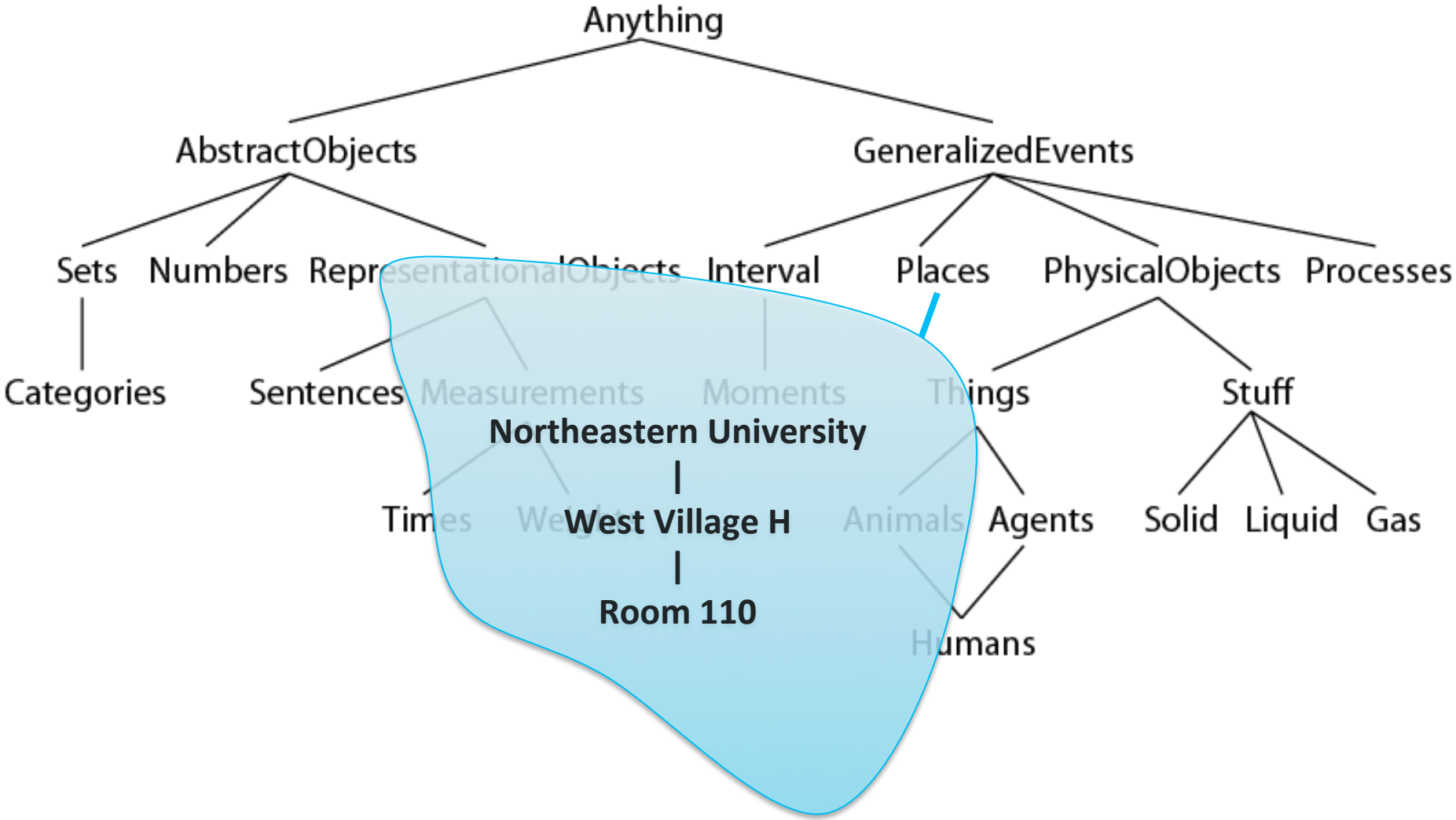
What is an Ontology?

Anything

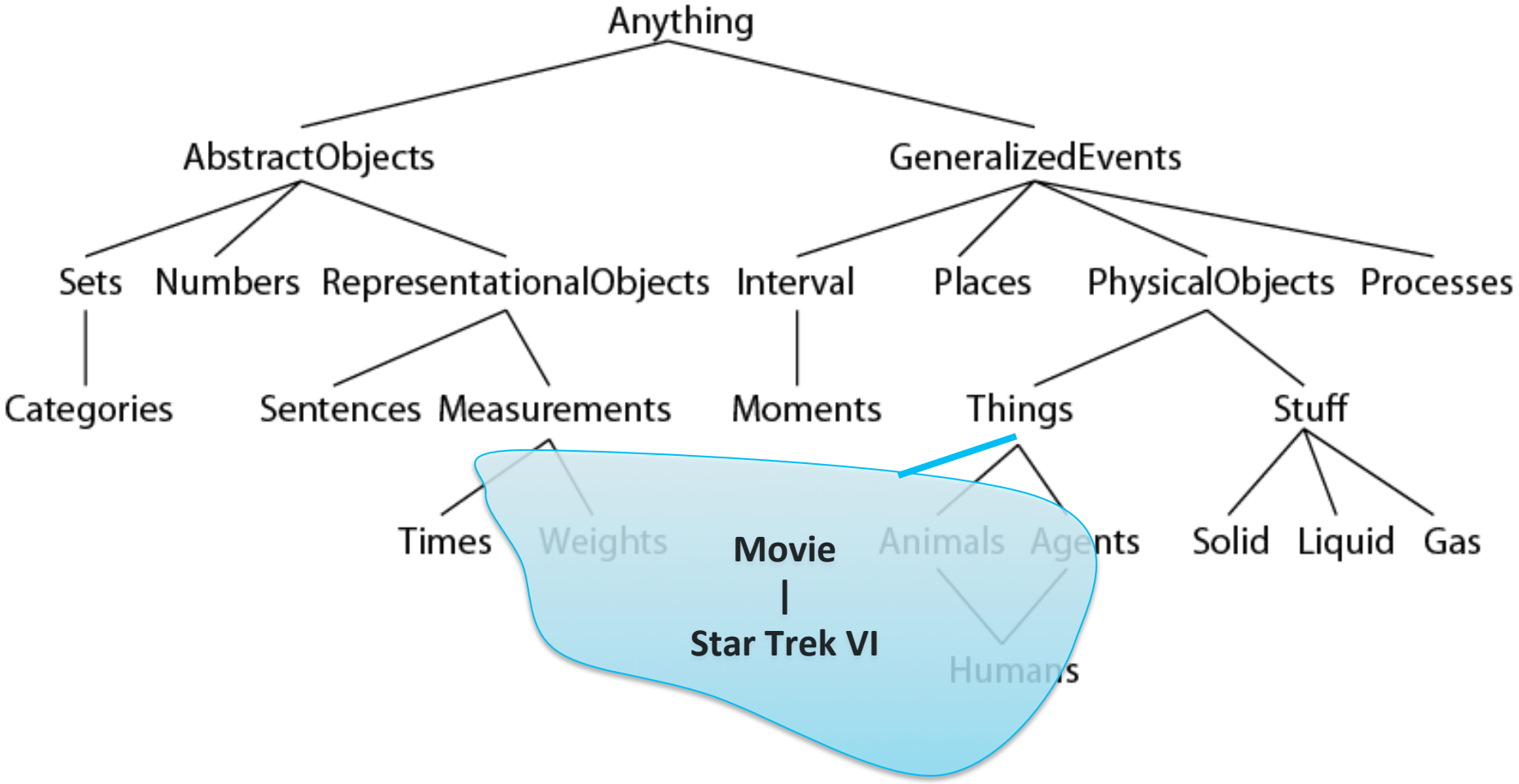
General Purpose Ontology



General Purpose Ontology



General Purpose Ontology



Major Elements of Ontologies

- Taxonomy: “is-a” hierarchy

- Relationships
  - part-of
  - has-a
  - used-for
  - prerequisite-of
  - location-of
  - …

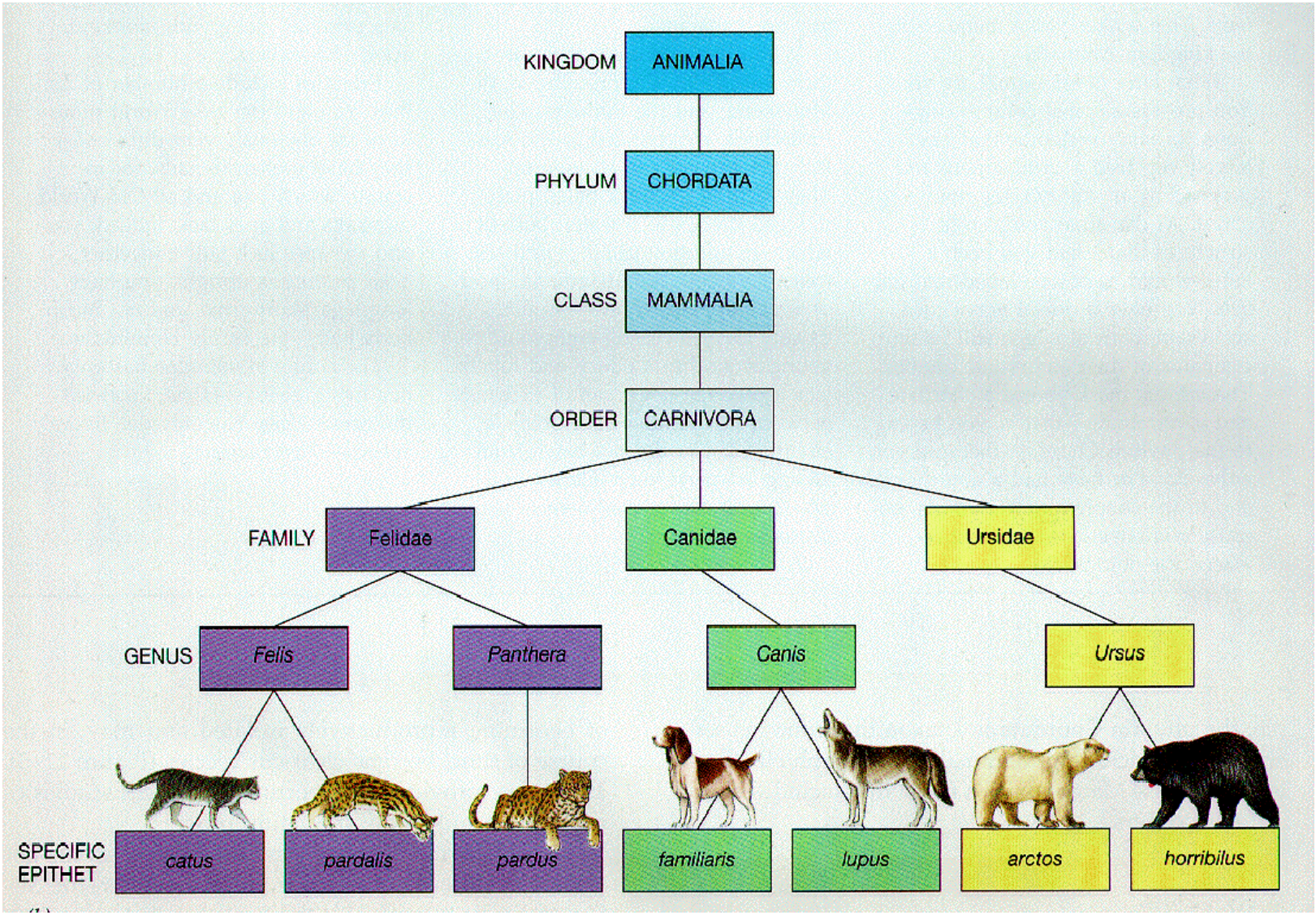
Reasoning on Ontologies

- is-a and part-of relationship is **transitive**
  - if X is a Y and Y is a Z then X is a Z
- properties and relationships may be **inherited**
  - if Z has a Y and X is a Z then X has a Y

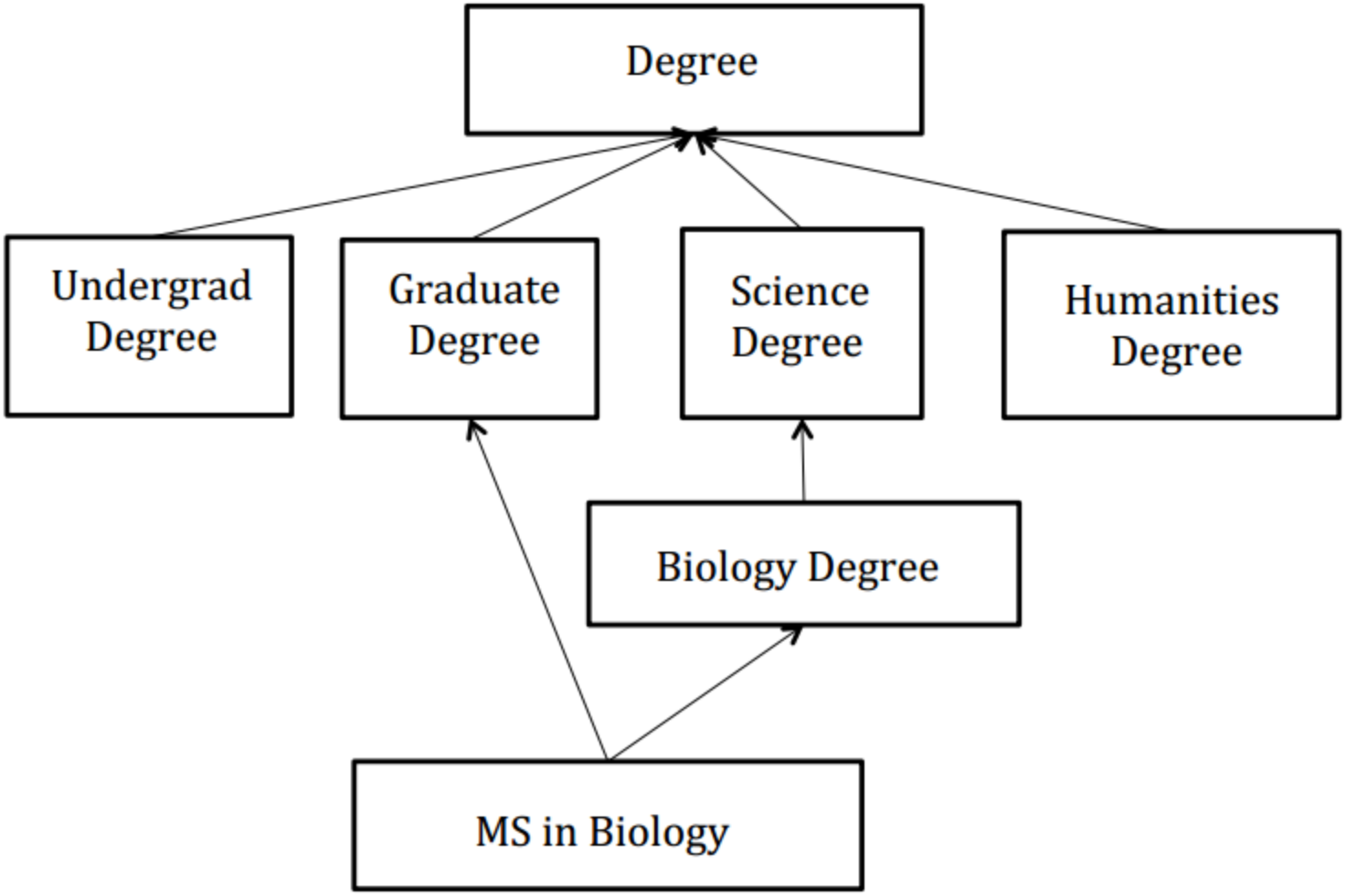
Reasoning on Ontologies

- is-a and part-of relationship is **transitive**
  - if X is a Y and Y is a Z then X is a Z
- properties and relationships may be **inherited**
  - if Z has a Y and X is a Z then X has a Y
- Real world examples:
  - Human is-a primate; primate is-a mammal
  - Arm part-of primate; hand part-of arm
  - Crime has-a victim; murder is-a crime

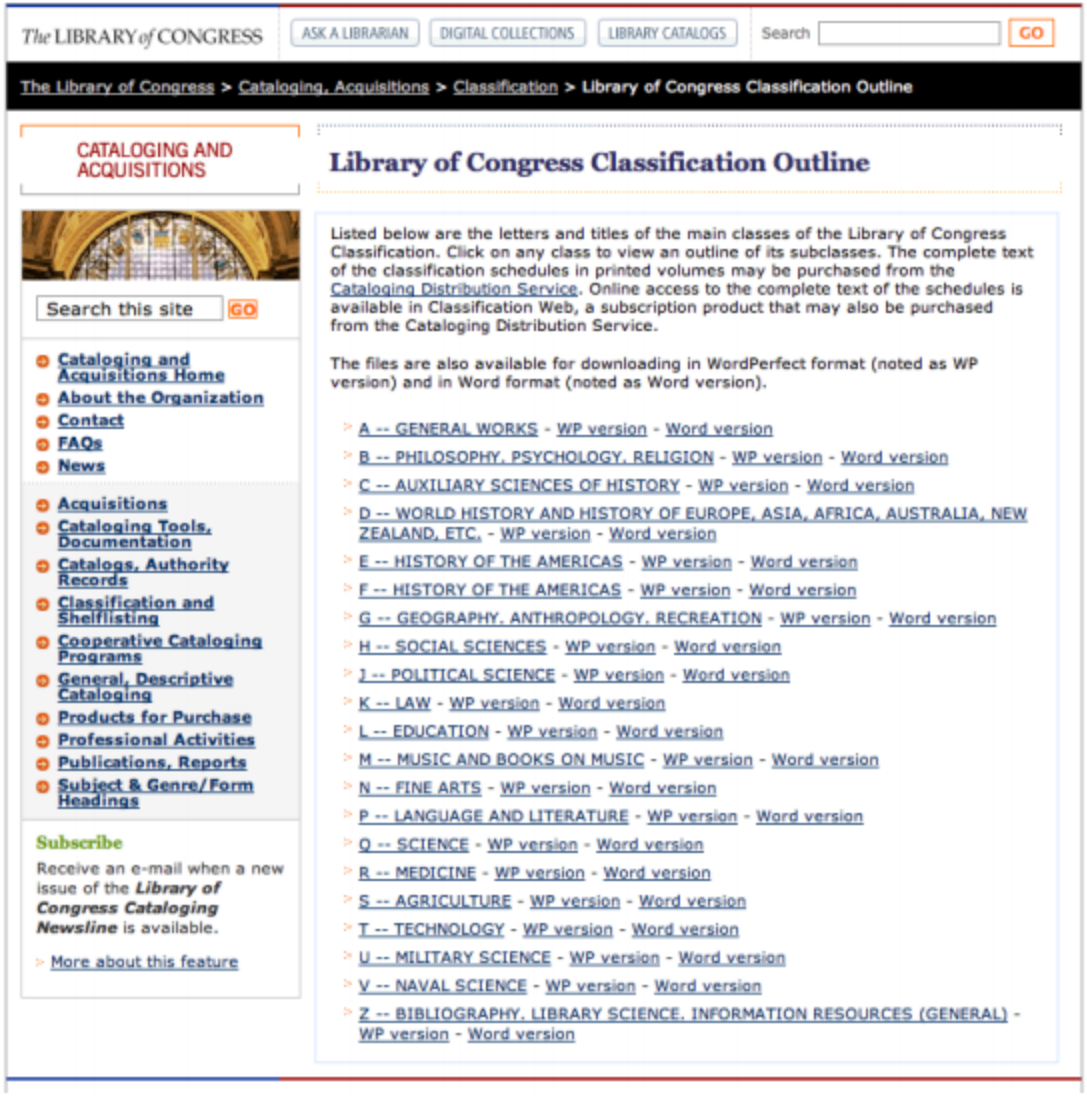
Taxonomies: Animal Kingdom



Taxonomies: University Degrees



Taxonomies: Library of Congress



The LIBRARY of CONGRESS | ASK A LIBRARIAN | DIGITAL COLLECTIONS | LIBRARY CATALOGS | Search | GO

The Library of Congress > Cataloging, Acquisitions > Classification > Library of Congress Classification Outline

CATALOGING AND ACQUISITIONS

Search this site GO

- Cataloging and Acquisitions Home
- About the Organization
- Contact
- FAQs
- News
- Acquisitions
- Cataloging Tools, Documentation
- Catalogs, Authority Records
- Classification and Shelflisting
- Cooperative Cataloging Programs
- General, Descriptive Cataloging
- Products for Purchase
- Professional Activities
- Publications, Reports
- Subject & Genre/Form Headings

Subscribe

Receive an e-mail when a new issue of the ***Library of Congress Cataloging Newsline*** is available.

» More about this feature

Library of Congress Classification Outline

Listed below are the letters and titles of the main classes of the Library of Congress Classification. Click on any class to view an outline of its subclasses. The complete text of the classification schedules in printed volumes may be purchased from the Cataloging Distribution Service. Online access to the complete text of the schedules is available in Classification Web, a subscription product that may also be purchased from the Cataloging Distribution Service.

The files are also available for downloading in WordPerfect format (noted as WP version) and in Word format (noted as Word version).

- A -- GENERAL WORKS - WP version - Word version
- B -- PHILOSOPHY, PSYCHOLOGY, RELIGION - WP version - Word version
- C -- AUXILIARY SCIENCES OF HISTORY - WP version - Word version
- D -- WORLD HISTORY AND HISTORY OF EUROPE, ASIA, AFRICA, AUSTRALIA, NEW ZEALAND, ETC. - WP version - Word version
- E -- HISTORY OF THE AMERICAS - WP version - Word version
- F -- HISTORY OF THE AMERICAS - WP version - Word version
- G -- GEOGRAPHY, ANTHROPOLOGY, RECREATION - WP version - Word version
- H -- SOCIAL SCIENCES - WP version - Word version
- J -- POLITICAL SCIENCE - WP version - Word version
- K -- LAW - WP version - Word version
- L -- EDUCATION - WP version - Word version
- M -- MUSIC AND BOOKS ON MUSIC - WP version - Word version
- N -- FINE ARTS - WP version - Word version
- P -- LANGUAGE AND LITERATURE - WP version - Word version
- Q -- SCIENCE - WP version - Word version
- R -- MEDICINE - WP version - Word version
- S -- AGRICULTURE - WP version - Word version
- T -- TECHNOLOGY - WP version - Word version
- U -- MILITARY SCIENCE - WP version - Word version
- V -- NAVAL SCIENCE - WP version - Word version
- Z -- BIBLIOGRAPHY, LIBRARY SCIENCE, INFORMATION RESOURCES (GENERAL) - WP version - Word version

Taxonomies: Library of Congress

LIBRARY OF CONGRESS CLASSIFICATION OUTLINE

CLASS H - SOCIAL SCIENCES

(Click each subclass for details)

Subclass H	Social sciences (General)
Subclass HA	Statistics
Subclass HB	Economic theory. Demography
Subclass HC	Economic history and conditions
Subclass HD	Industries. Land use. Labor
Subclass HE	Transportation and communications
Subclass HF	Commerce
Subclass HG	Finance
Subclass HJ	Public finance
Subclass HM	Sociology (General)
Subclass HN	Social history and conditions. Social problems. Social reform
Subclass HQ	The family. Marriage. Women
Subclass HS	Societies: secret, benevolent, etc.
Subclass HT	Communities. Classes. Races
Subclass HV	Social pathology. Social and public welfare. Criminology
Subclass HX	Socialism. Communism. Anarchism

Taxonomies: Library of Congress

Subclass HB

HB1-3840	Economic theory. Demography
HB71-74	Economics as a science. Relation to other subjects
HB75-130	History of economics. History of economic theory
	Including special economic schools
HB131-147	Methodology
HB135-147	Mathematical economics. Quantitative methods
	Including econometrics, input-output analysis, game theory
HB201-206	Value. Utility
HB221-236	Price
HB238-251	Competition. Production. Wealth
HB501	Capital. Capitalism
HB522-715	Income. Factor shares
HB535-551	Interest
HB601	Profit
HB615-715	Entrepreneurship. Risk and uncertainty. Property
HB801-843	Consumption. Demand
HB846-846.8	Welfare theory
HB848-3697	Demography. Population. Vital events
HB3711-3840	Business cycles. Economic fluctuations

Ontology Design Methodology

1. Determine **domain** and **scope**
2. Consider **reusing** existing ontologies
3. **Enumerate** important concepts
4. Define the classes and class **hierarchy**
5. Define the **properties**, parts, and roles

Domain & Scope

- What is the domain we will cover?
- What will we use the ontology for?
- What types of questions should we be able to answer?
  - Competency questions
  - Litmus test for later evaluation of ontology

Example: Board Games

- Domain: ontology for board games
- Applications: recommendation systems for families and/or friends, game design research
- Competency questions?

Ontology Design Methodology

1. Determine **domain** and **scope**
2. Consider **reusing** existing ontologies
3. **Enumerate** important concepts
4. Define the classes and class **hierarchy**
5. Define the **properties**, parts, and roles

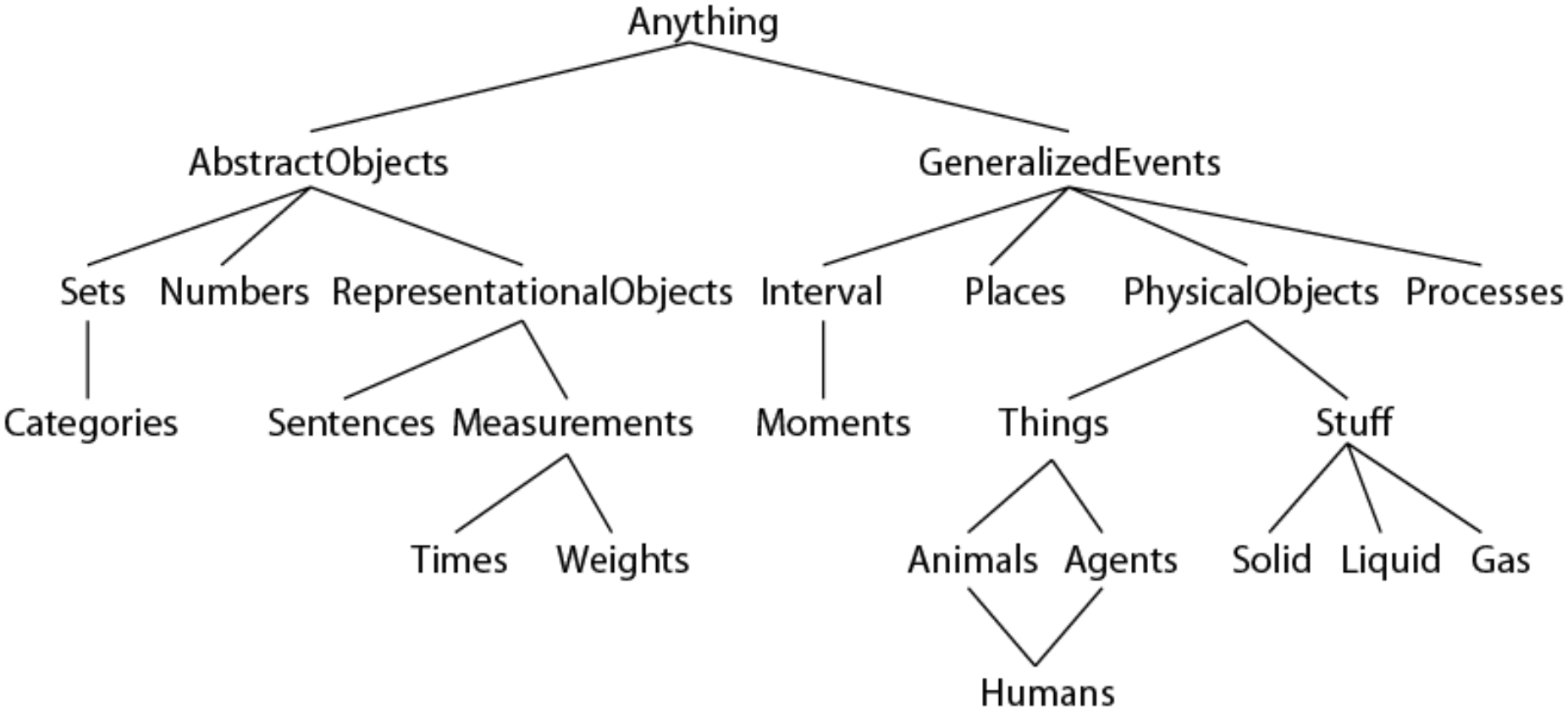
Ontology Design Methodology

1. Determine **domain** and **scope**
2. Consider **reusing** existing ontologies
3. **Enumerate** important concepts
4. Define the classes and class **hierarchy**
5. Define the **properties**, parts, and roles

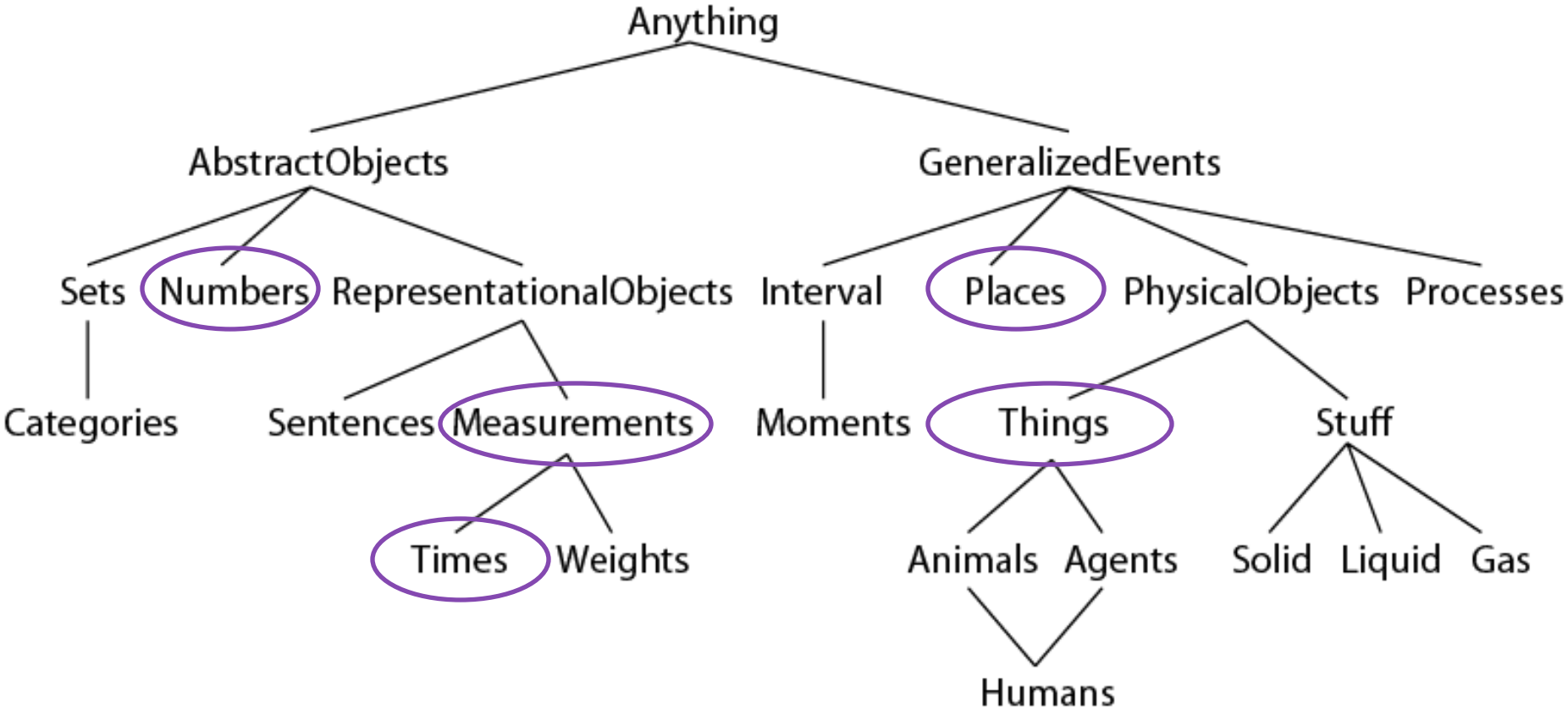
Identifying Concepts

- What are the concepts we need to talk about?
- What do we want to say about them?

Identifying Concepts: Board Games



Identifying Concepts: Board Games



Identifying Concepts: Board Games

- Monopoly, Chess, Settlers of Catan, Poker, Dominion, Taboo, Tales of the Arabian Nights…
- Tokens, cards
- Game length, number of players
- Strategy, luck, word play
- Capitalism, history, fantasy, storytelling

Ontology Design Methodology

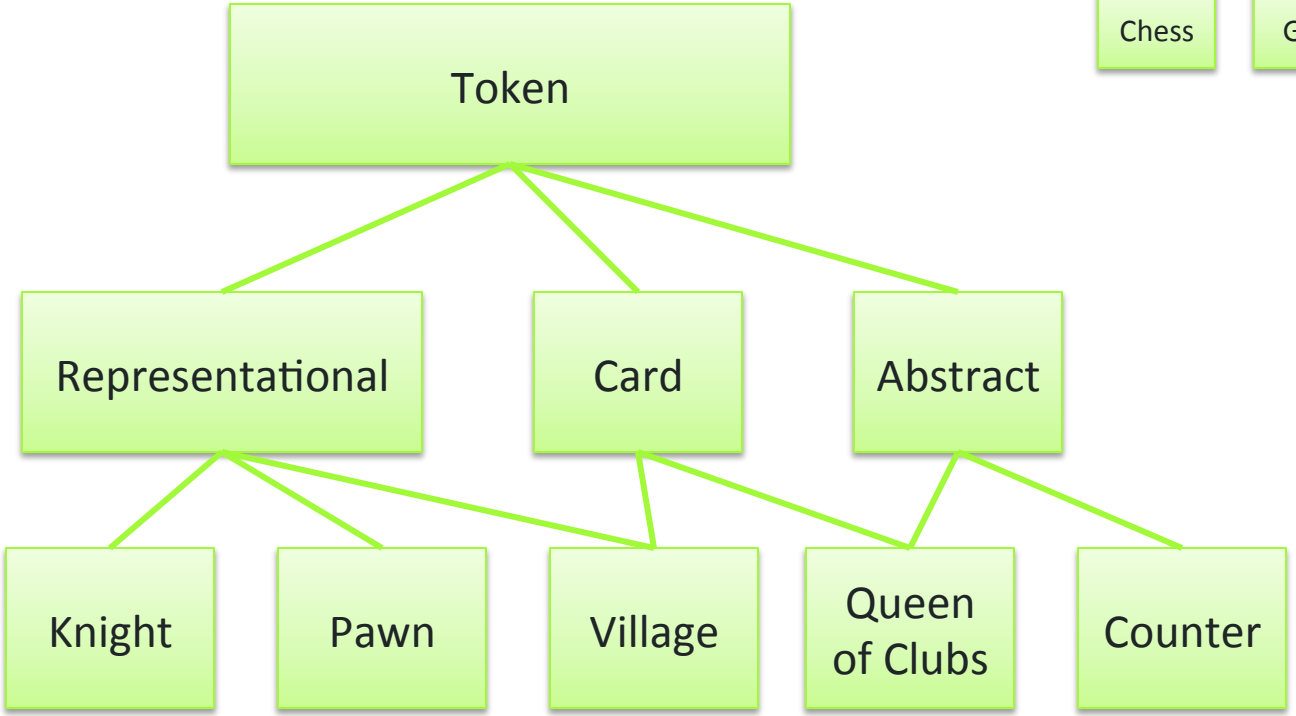
1. Determine **domain** and **scope**
2. Consider **reusing** existing ontologies
3. **Enumerate** important concepts
4. Define the classes and class **hierarchy**
5. Define the **properties**, parts, and roles

Taxonomy: is-a hierarchy

- Class: concept in the domain
  - Subclasses
- Class is collection of elements with similar properties
- Approaches:
  - Top-down
  - Bottom-up
  - Combination

Taxonomy: Board Games

Taxonomy: Board Games



Ontology Design Methodology

1. Determine **domain** and **scope**
2. Consider **reusing** existing ontologies
3. **Enumerate** important concepts
4. Define the classes and class **hierarchy**
5. Define the **properties**, parts, and roles

Properties

- Types
  - Simple
  - Complex
- Inherit properties of its superclass
  - Multiple inheritance

ConceptNet

- Natural language
- Crowd-sourced
  - Asking for input
  - Mining Wikipedia
  - WordNet