JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

National Security Ontology Foundry

May 28, 2026

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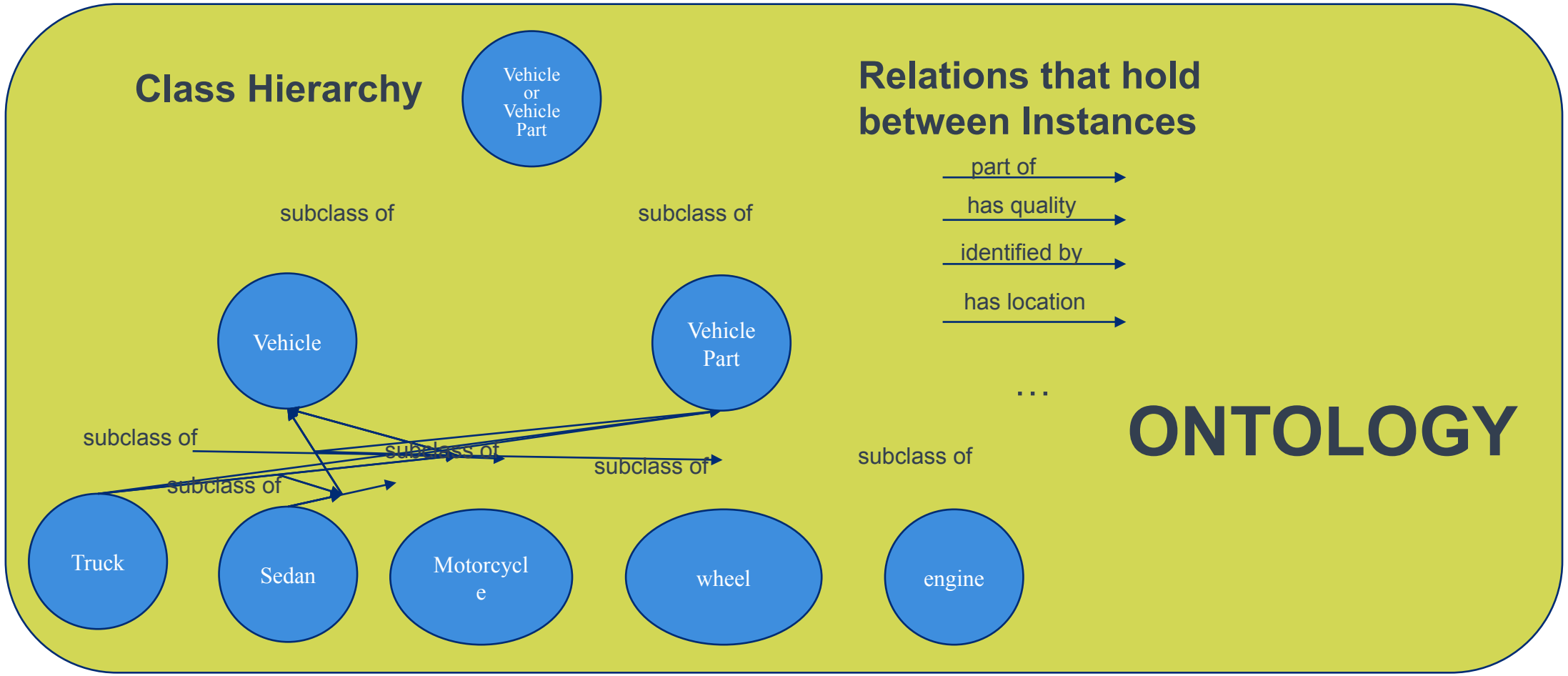
- neil.otte@jhuapl.edu

Agenda

- Little 101
- The NSOF
- History
- Present Day


Class Hierarchy
Vehicle or Vehicle Part
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subclass of
Vehicle
Vehicle Part
subclass of
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Truck
Sedan
Motorcycl e
wheel
engine
Relations that hold between Instances
part of
has quality
identified by
has location
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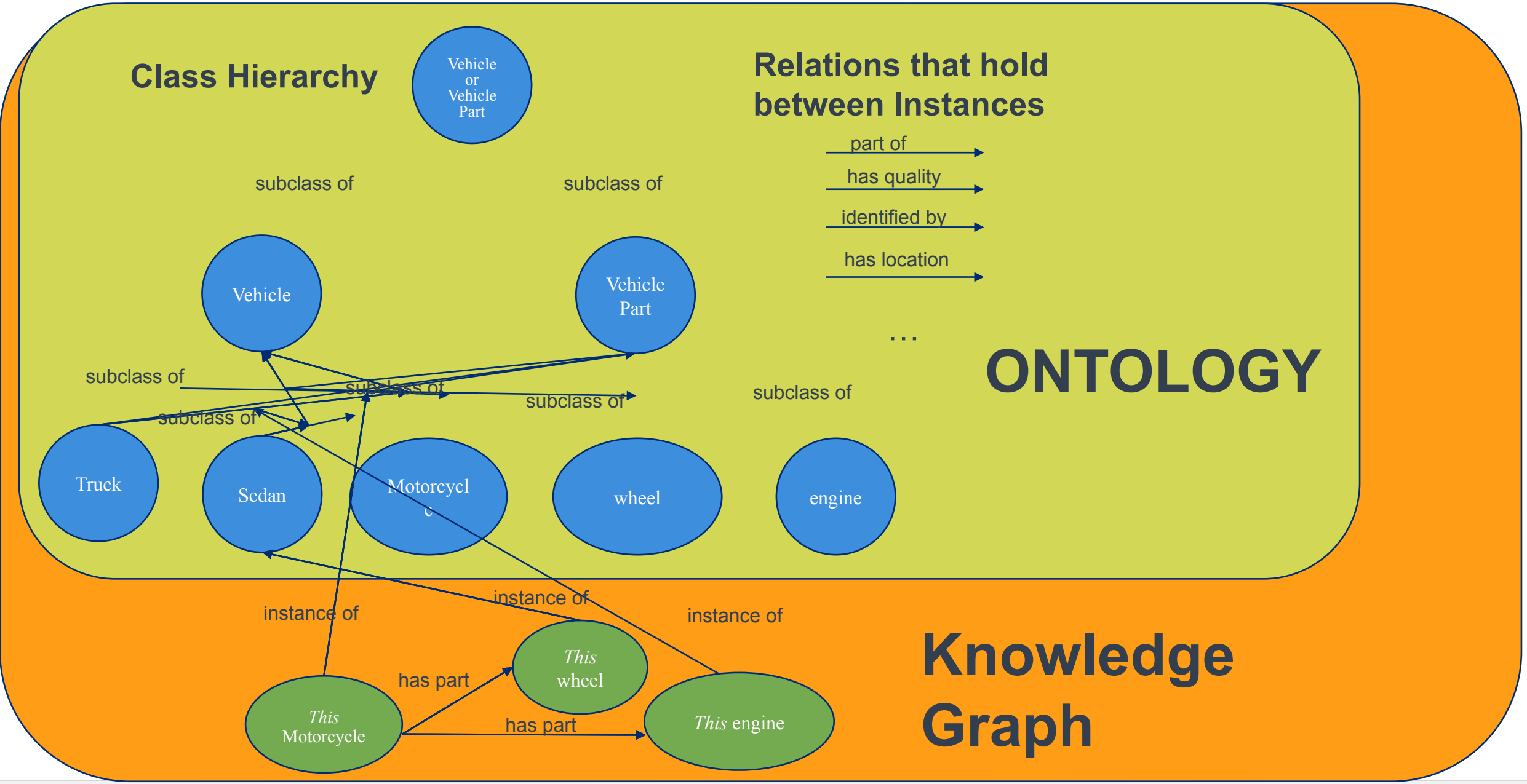
ONTOLOGY


Class Hierarchy
Vehicle or Vehicle Part
Relations that hold between Instances
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ONTOLOGY
Truck
Sedan
Motorcycle
wheel
engine
instance of
instance of
instance of
This wheel
has part
has part
This Motorcycle
This engine
Knowledge Graph

Class Axioms

OWL Constructor	DL Syntax	Manchester OWL	Example
intersection of	C ⊓ D	C and D	Every instance of this class is male **and** human.
union of	C ⊔ D	C or D	Every instance of this class is a man **or** a woman.
complement of	¬ C	not C	**No** instance of this class is male.
one of	{a} ⊔ {b}..	{a b …}	Every instance of this class is either **Britain, Canada, or France**
some values from	∃RC	R some C	Every instance of this class has **one or more** Tracked Wheels
all values from	∀RC	R only C	Every instance of this class can have **only** person as members.
min cardinality	≥NR	R min 3	Every instance of this class has at least four wheels.
max cardinality	≤NR	R max 3	Every instance of this class has at most four wheels.
cardinality	= N R	R exactly 3	Every instance of this class is supervised by exactly 1 national government.
has value	∃ R {a}	R value a	Every instance of this class is a friend of Kevin Bacon.

Two Kinds of Ontologies

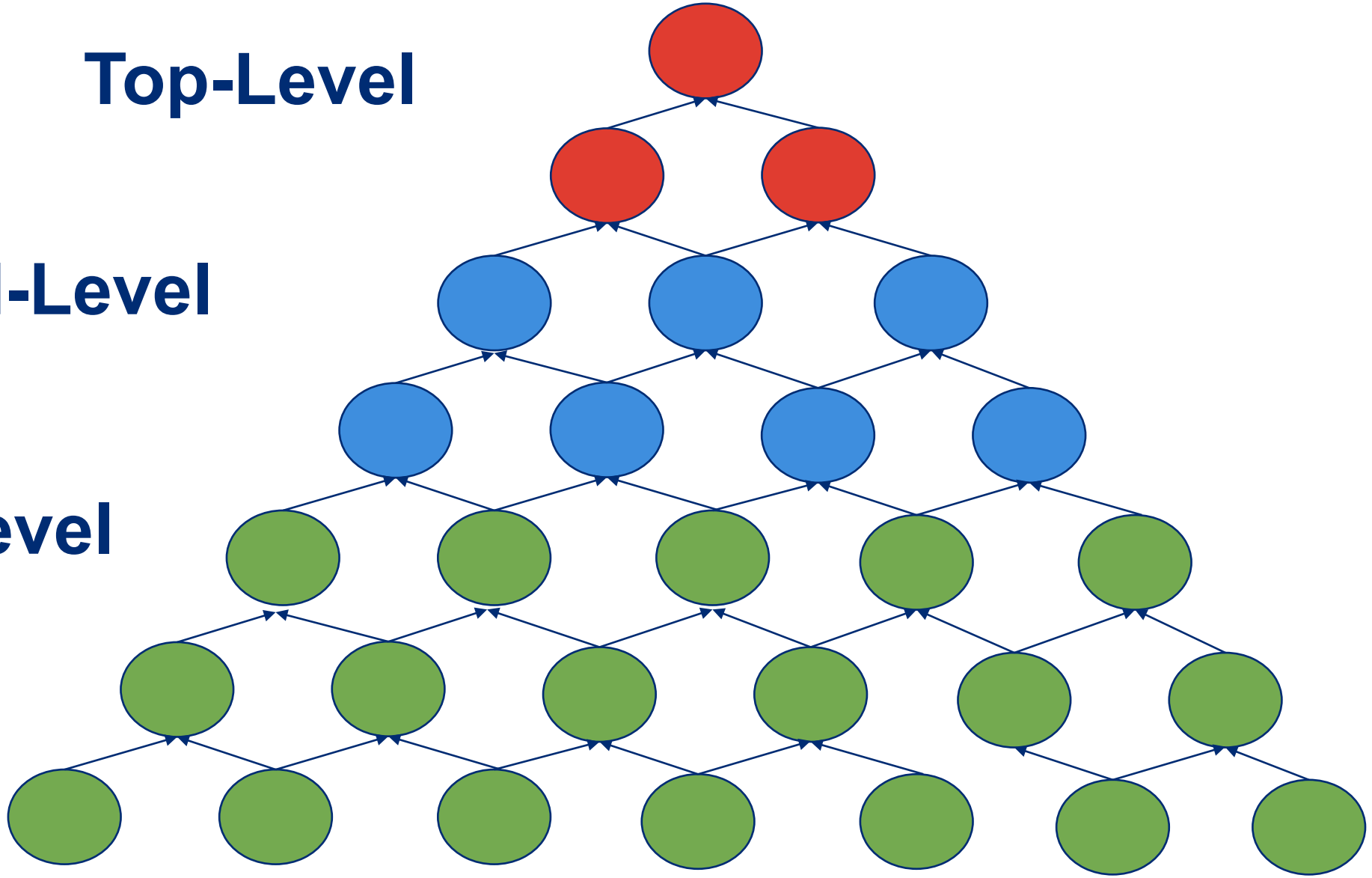
- **Reference/Domain Ontology:** an ontology created according to best practices that is designed to provide an authoritative representation of a domain of interest.
- **Application Ontology:** an ontology engineered for a specific use or application focus and whose scope is specified through testable use cases.

Three (More) Kinds of Ontologies

Top-Level

Mid-Level

Domain Level



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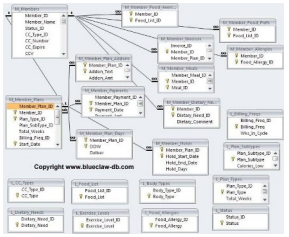

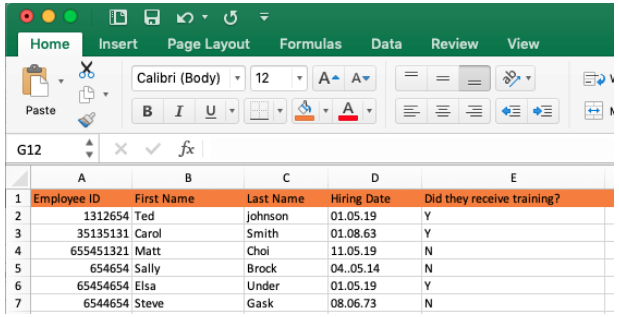

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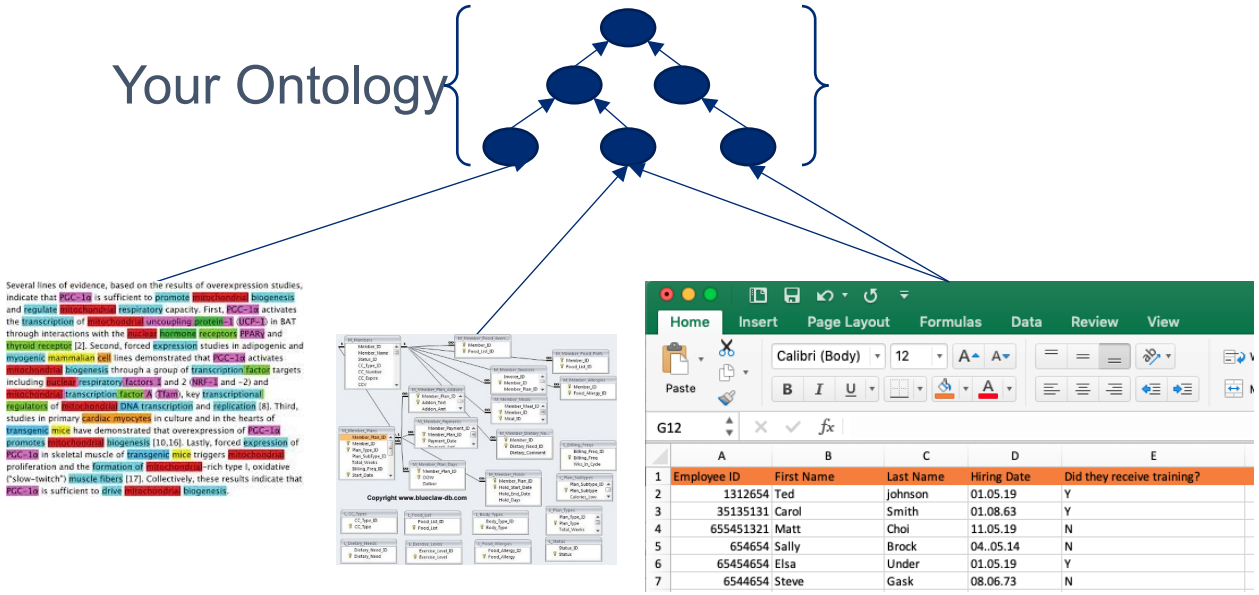
Your Ontology



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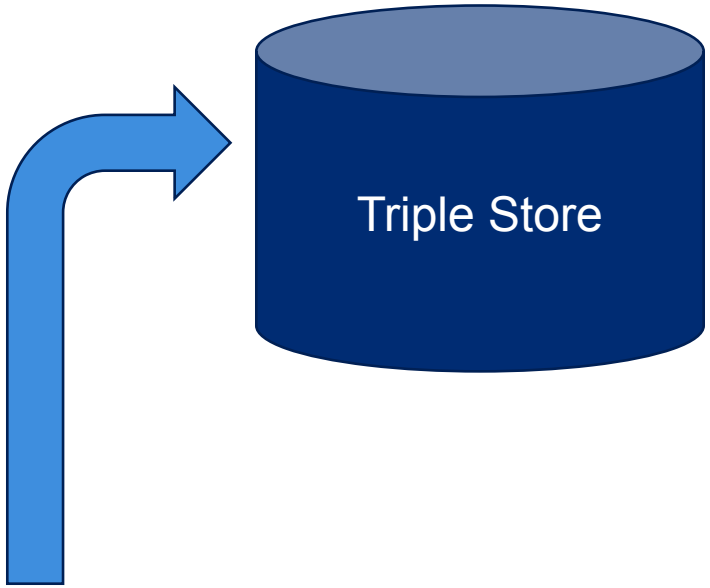

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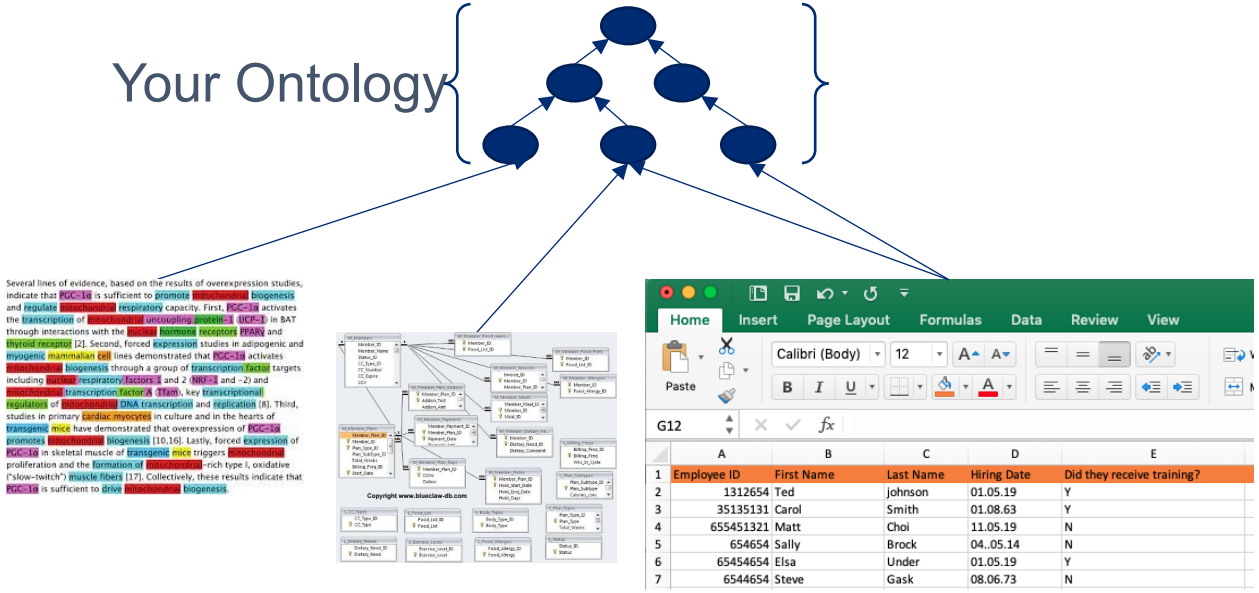

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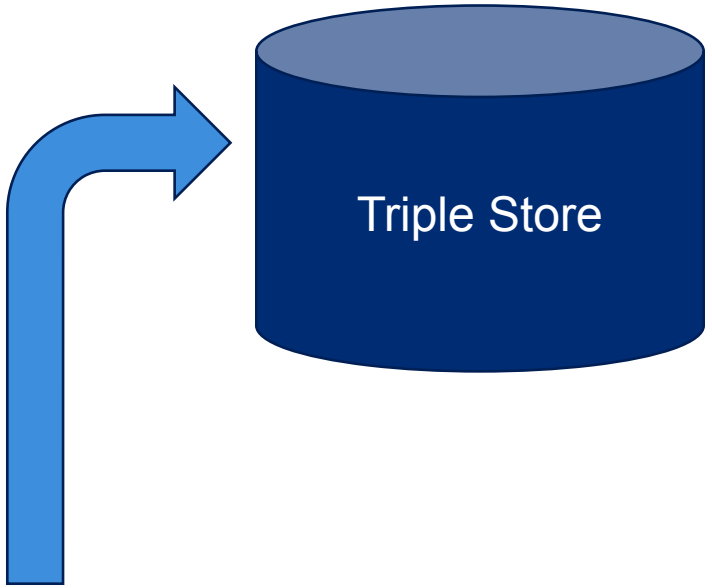

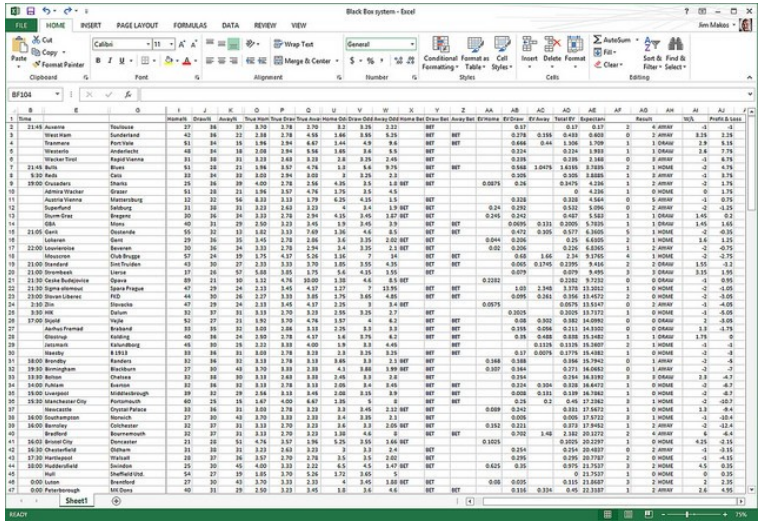

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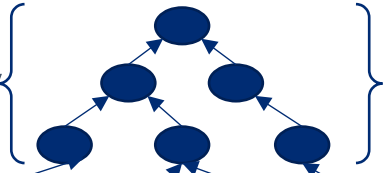

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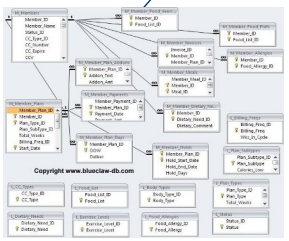

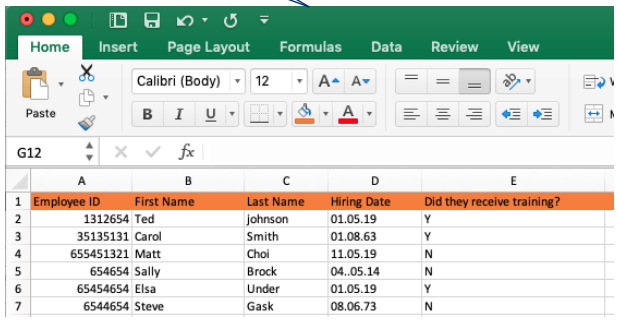

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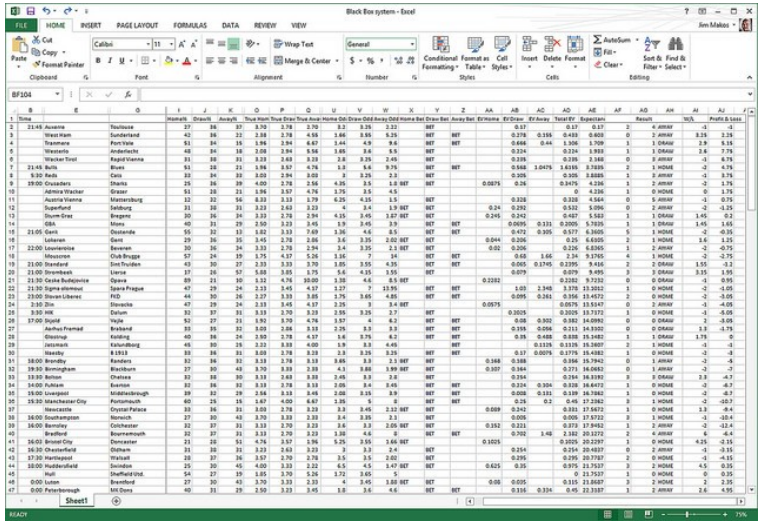
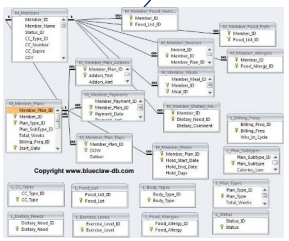
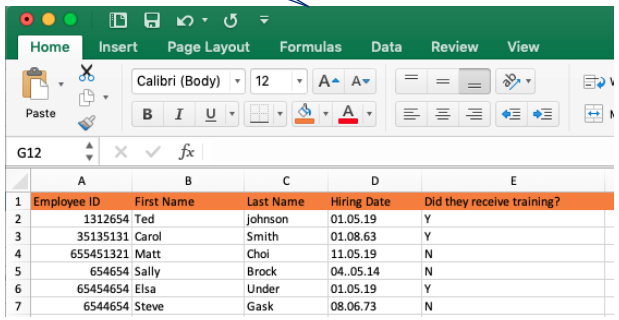


Triple Store

Your Ontology





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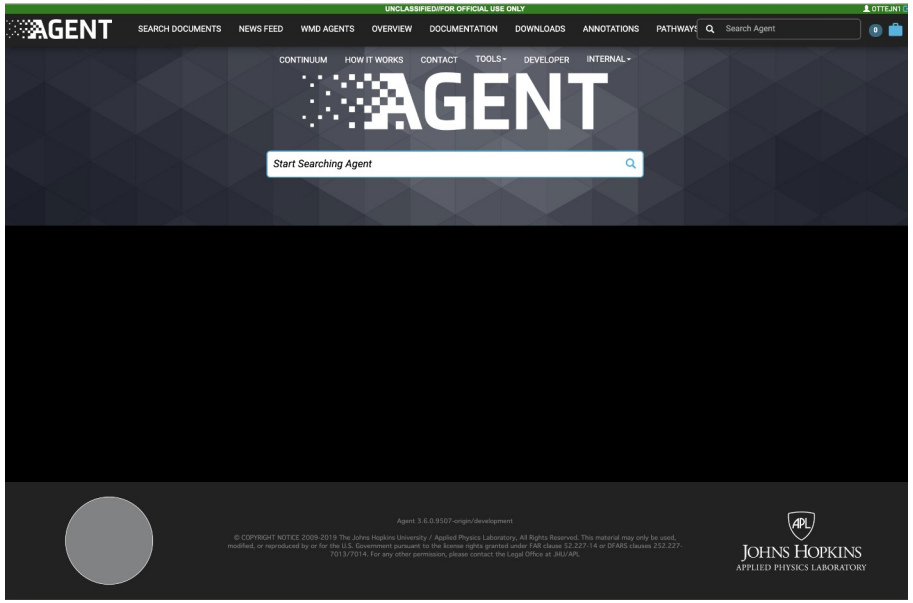
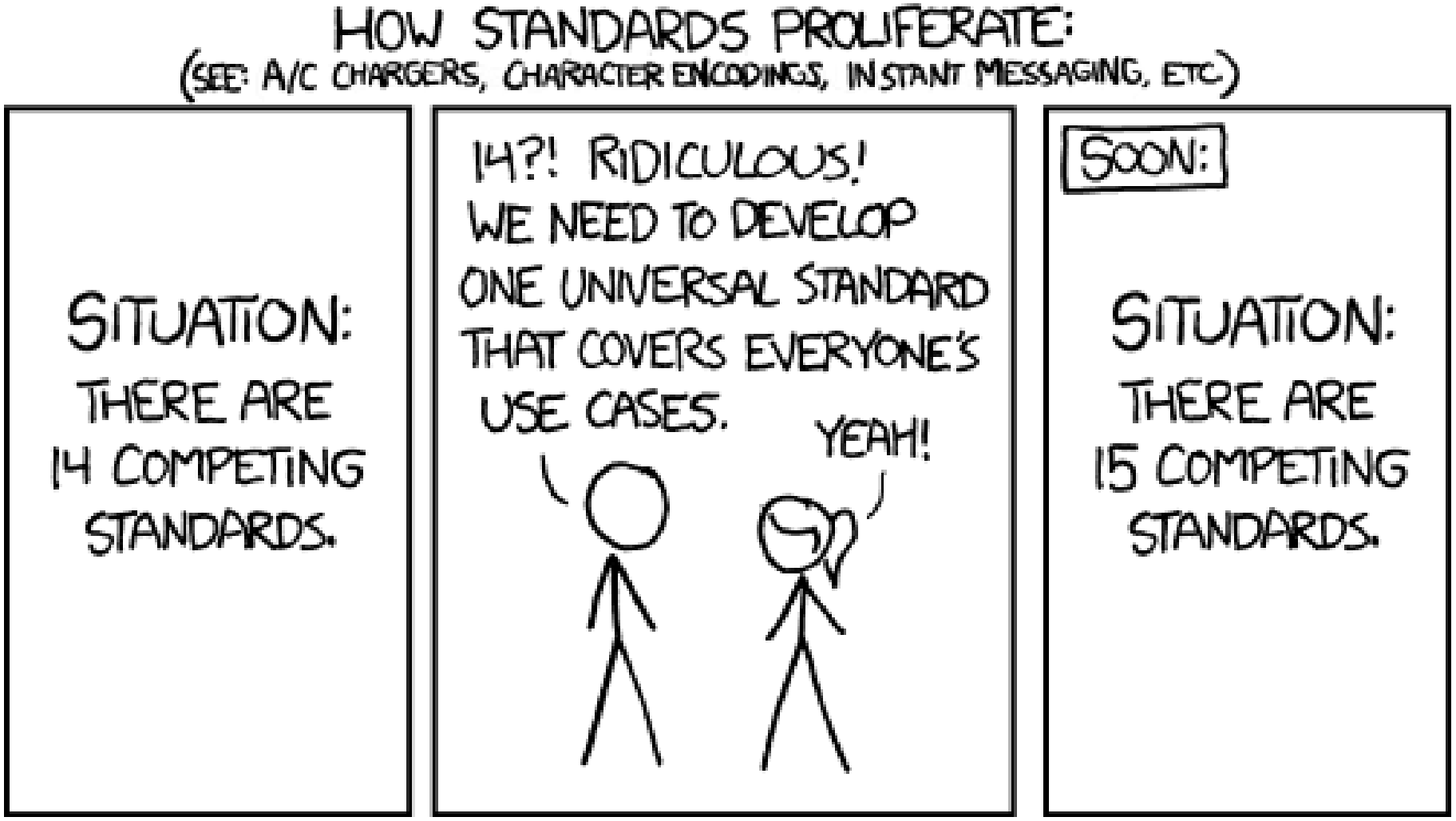
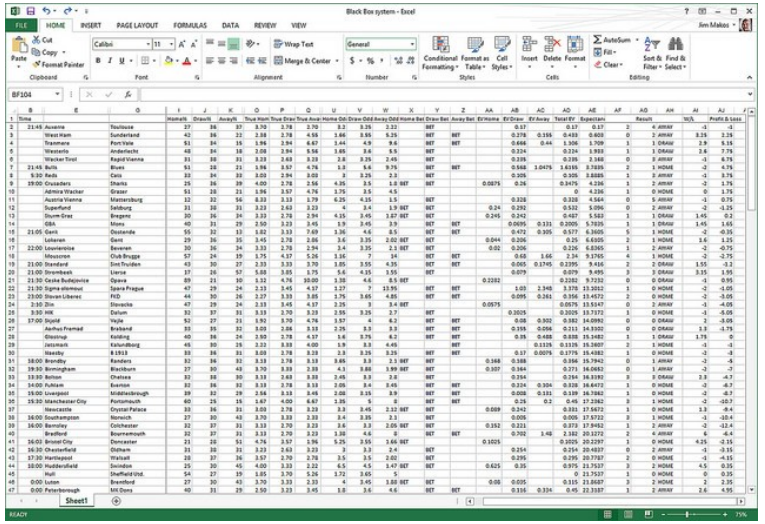


What do we do about competing ontologies?





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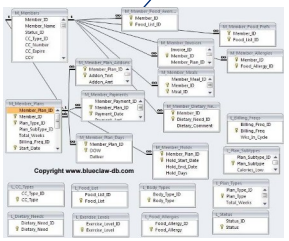

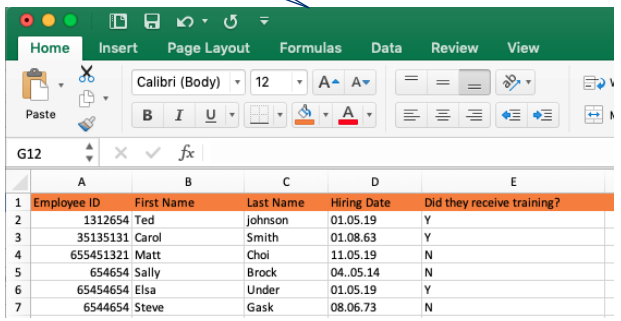

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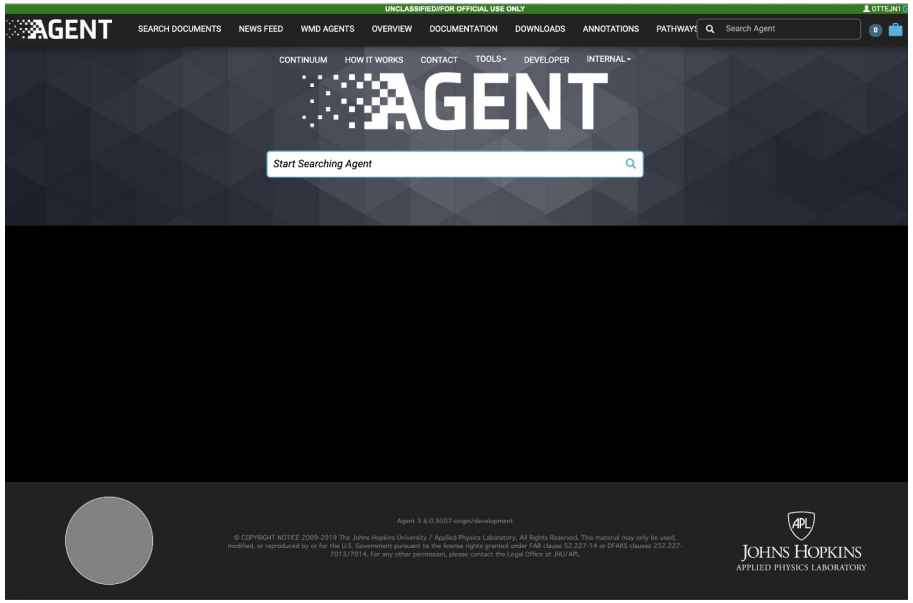


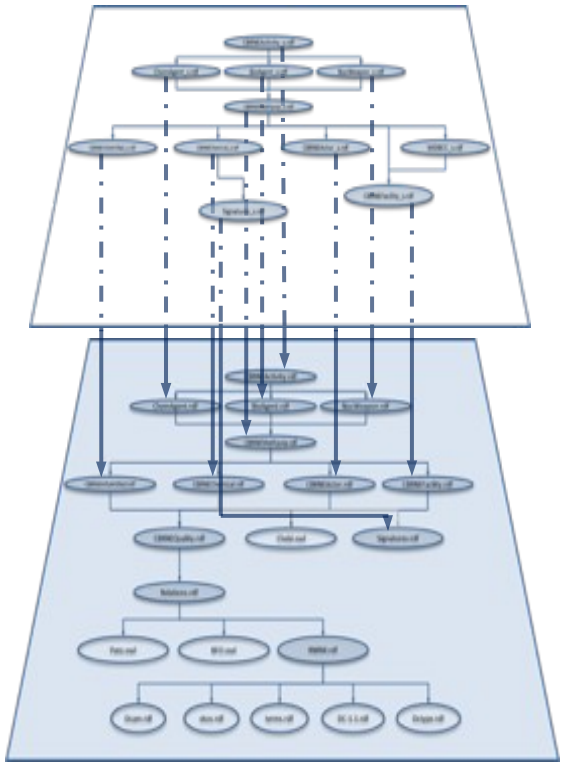
Joint Intelligence Knowledge Graph and Ontologies

JIKO

- A modular suite of ontologies for DoD IC applications
- Aligned to Basic Formal Ontology (BFO) and Common Core Ontology (CCO)
- Strict Semi-Automated QC process

Broad DoD/IC Domain Coverage

- CBRNE & WMD
- Sensors & Signatures
- Air, Ground, & Maritime Orders Of Battle
- Missile Supply Chain & Fuel Production
- Improvised Explosive Devices
- Weapons
- Cyber & Electronic Warfare
- Space Ops
- Facilities
- Countries & Governments
- People & Organizations
- Events
- Multi-Modal Data Labeling

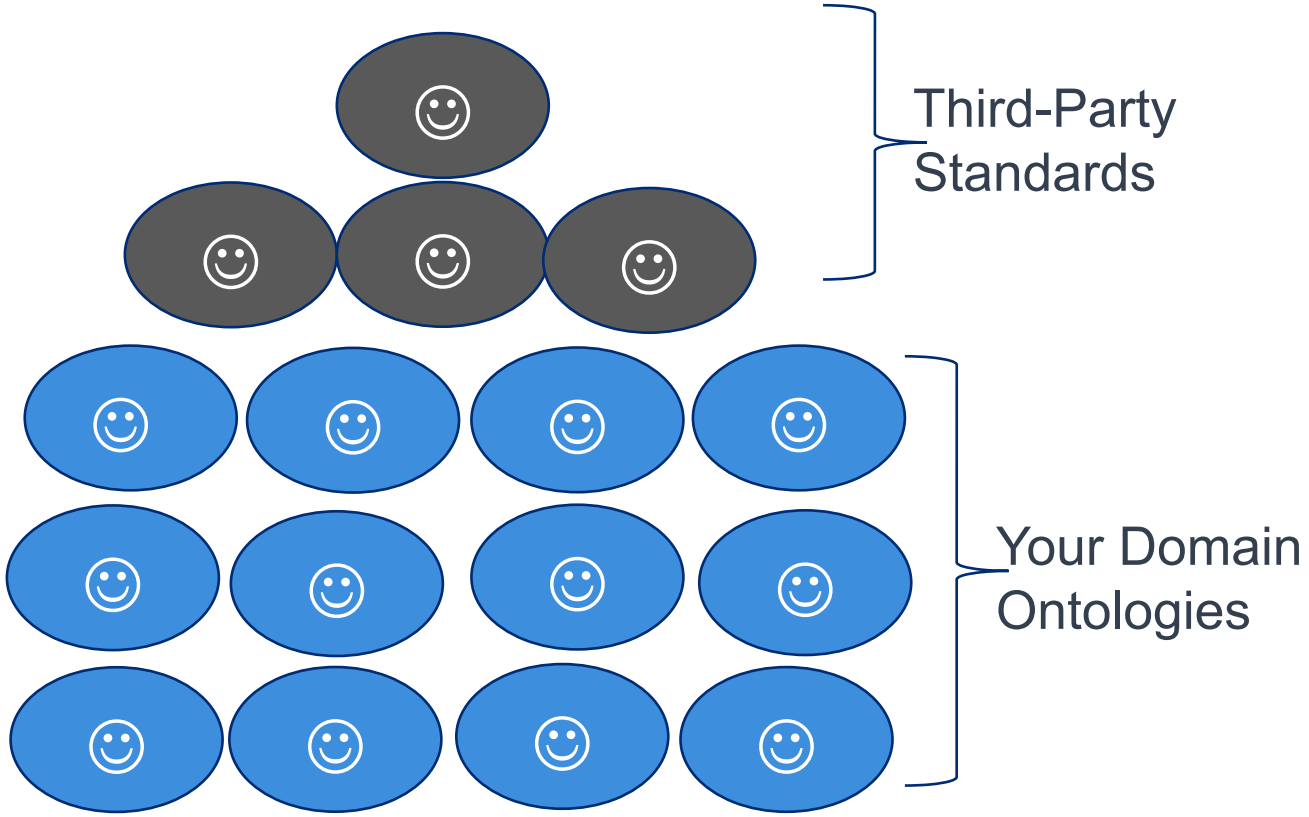


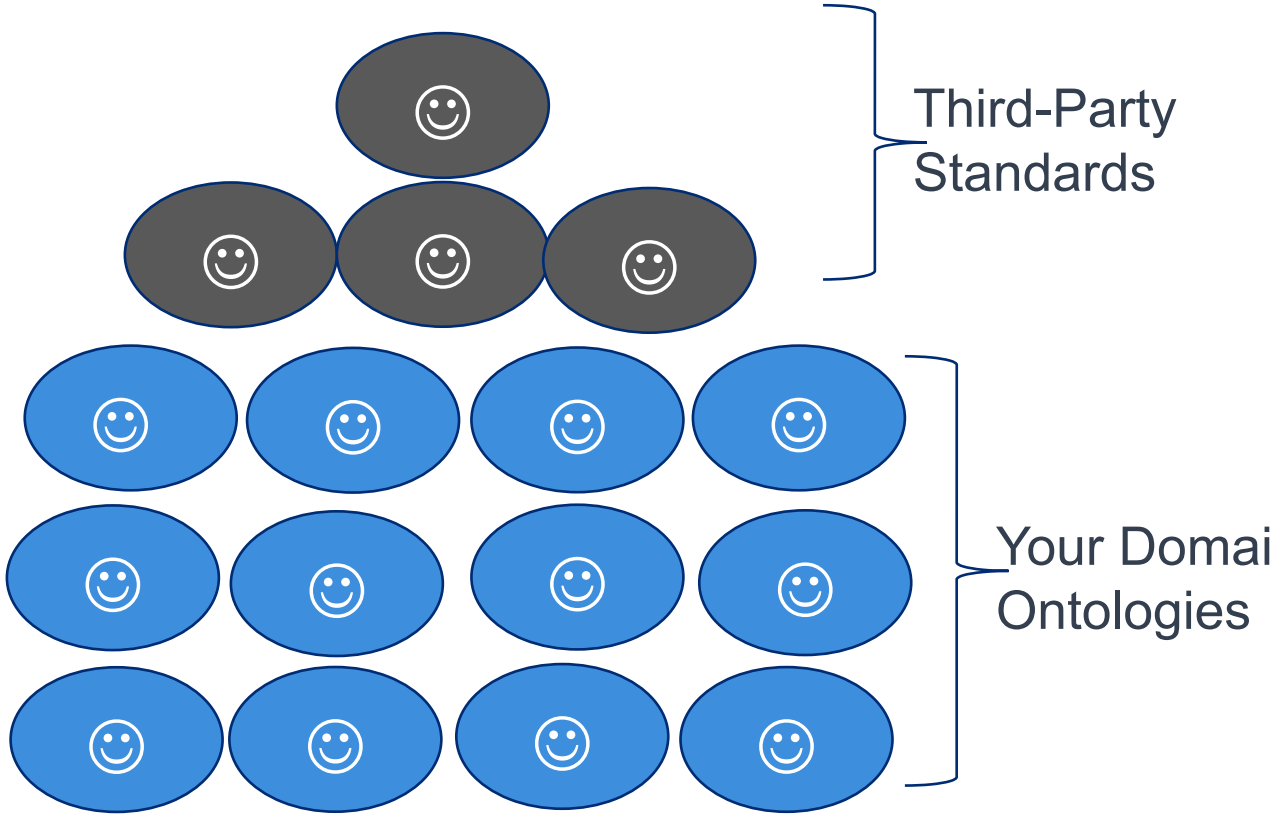
Partitioned into layers that enable compatibility across classification levels

Reuses and links to existing, authoritative resources

- *National System for Geospatial Intelligence (NSG) Application Scheme*
- MIL STDs 2525 & 6016
- GeoSPARQL
- Quantities, Units, Dimensions, and Data Types (QUDT)
- DoD Equipment Codes
- US Customs Class B Export Code
- PubChem
- Hazardous Substance Databank

	APL Proprietary	Total
Ontologies	~160	~300
Classes	~16,000	~163,000
Properties	~116	~330
Axiomatized Classes	~51,000	~52,000


Third-Party
Standards
Your Domain
Ontologies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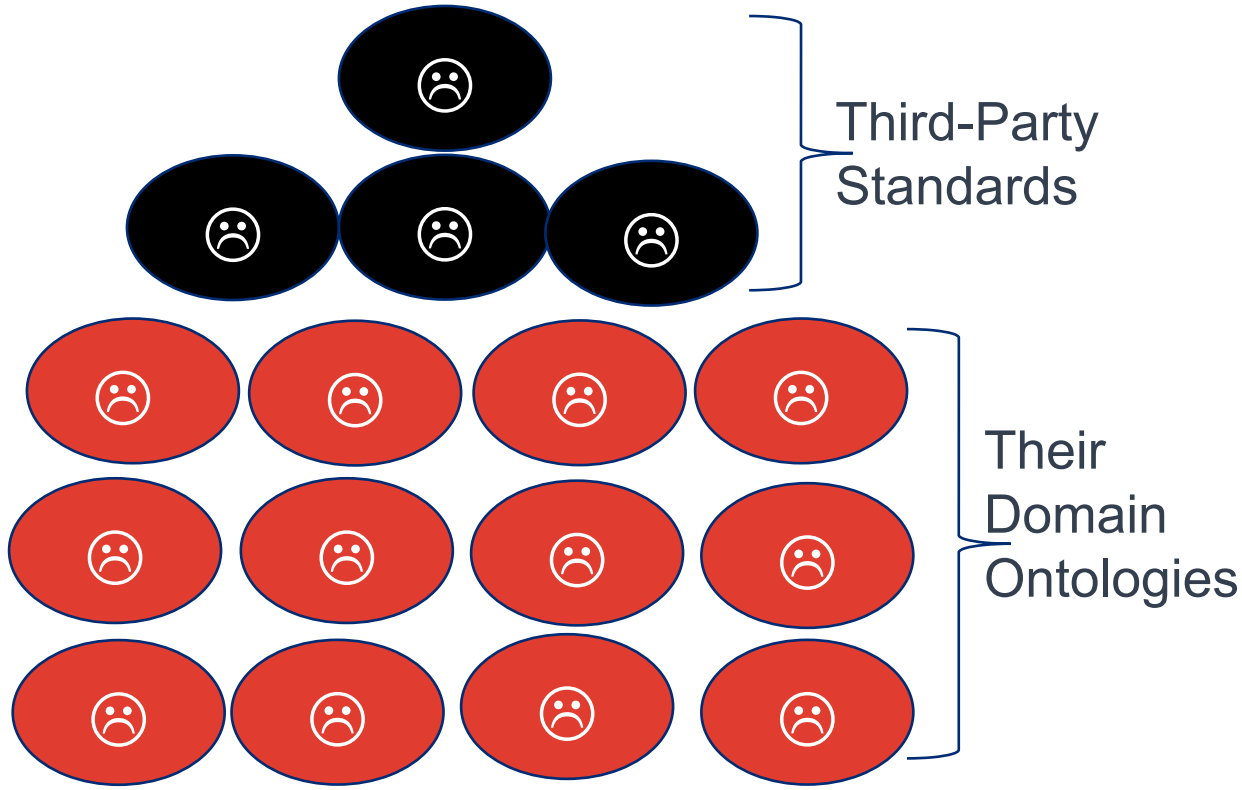
Third-Party
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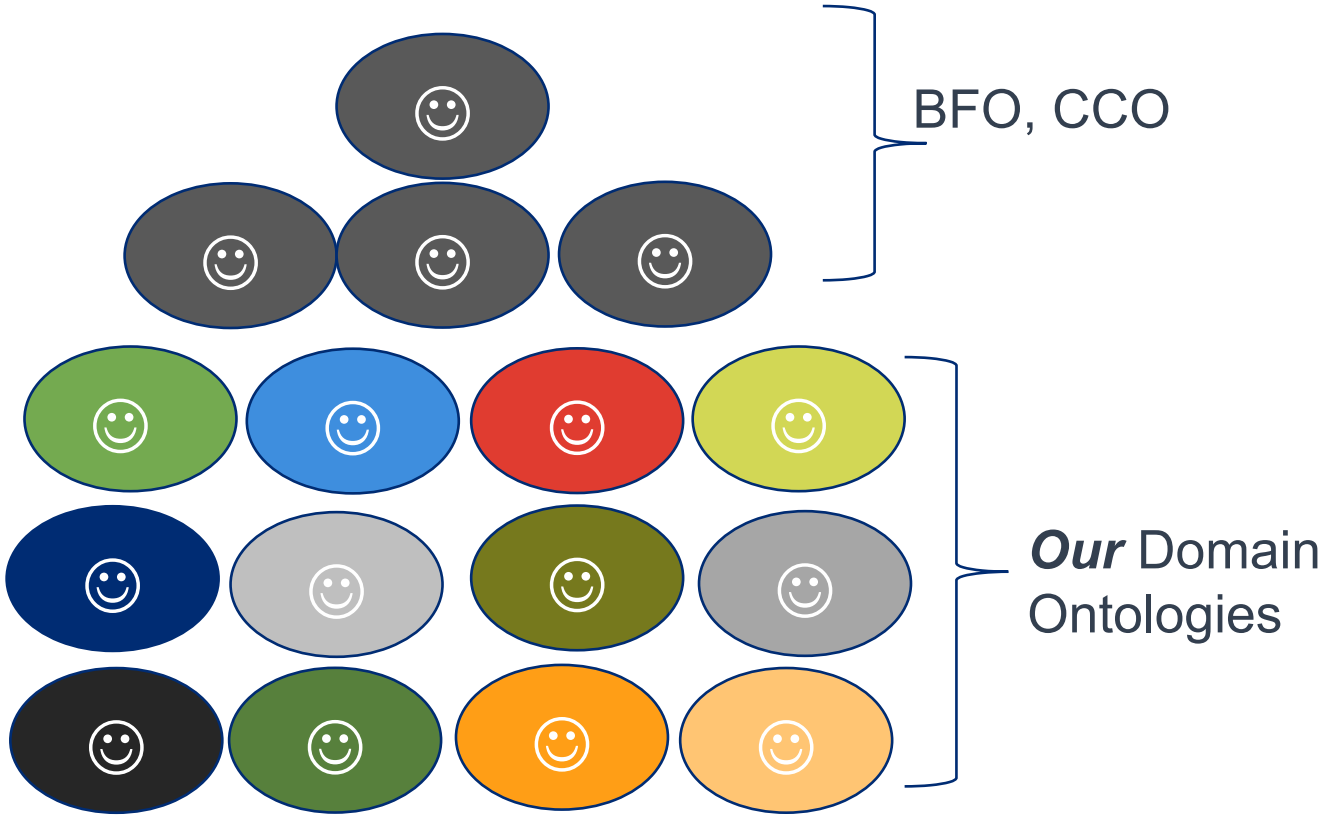
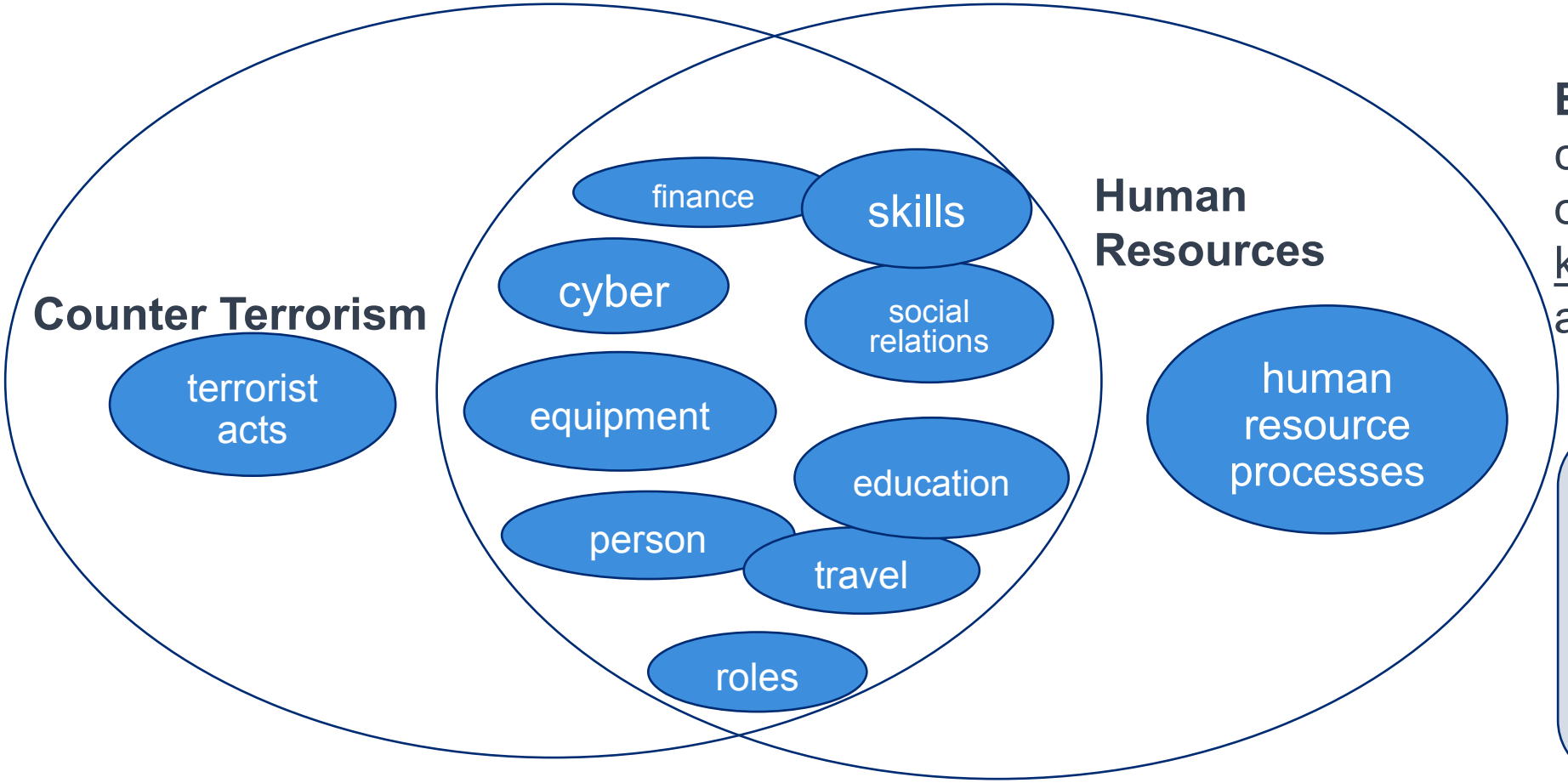

BFO, CCO
Our Domain Ontologies

Mission Areas correspond to **Sets** of Domain Ontologies.

A mission area describes what one wants to **do**.

A domain ontology describes a domain of expertise or science.

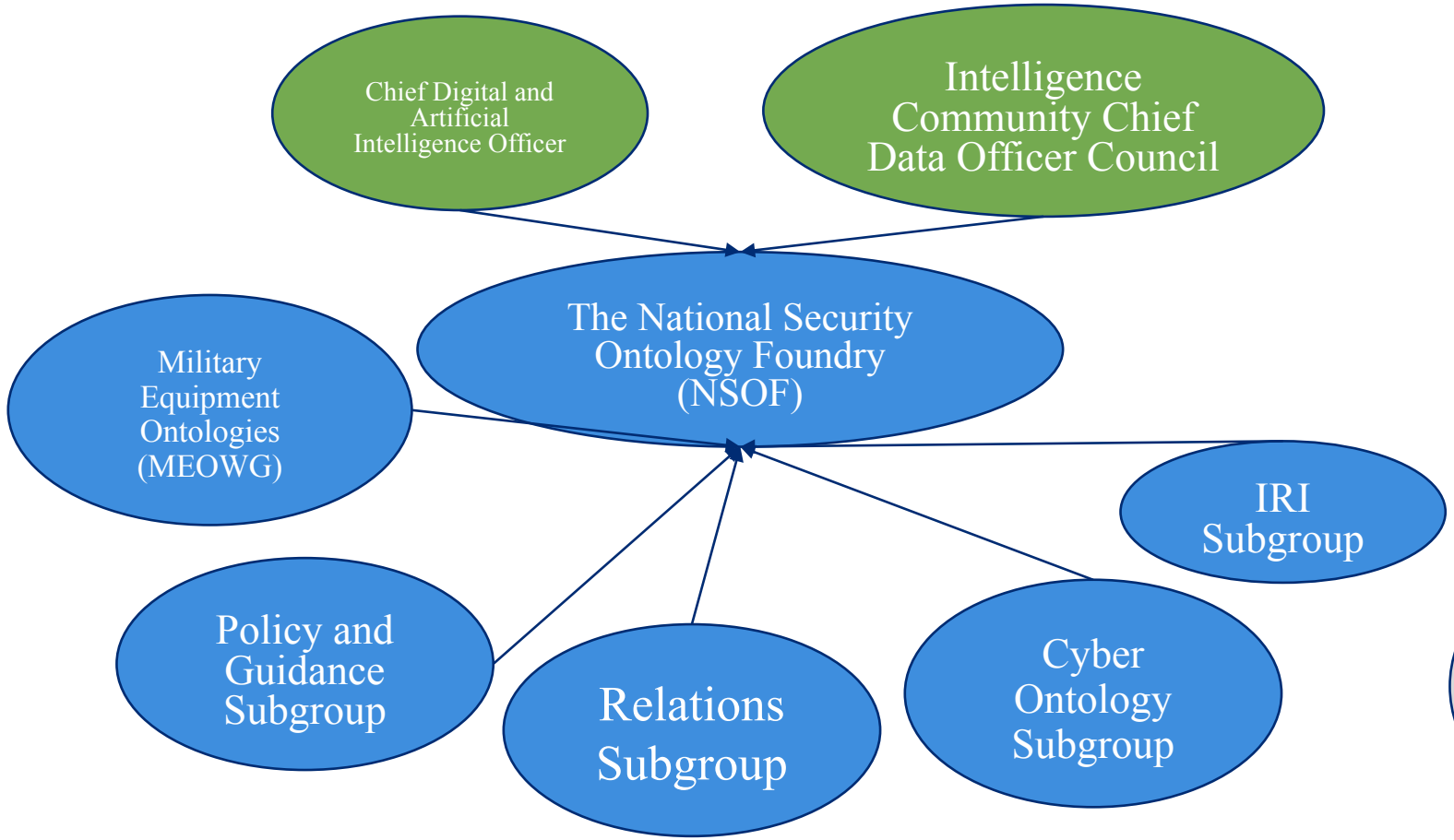


Example: Whether one cares about counter terrorism or human resources, the kinds of things one cares about are the same.

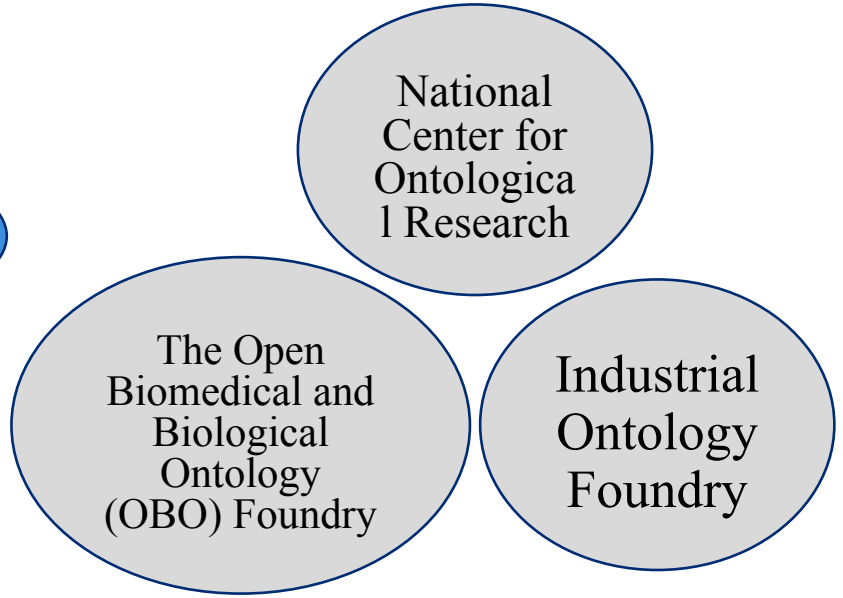
Lesson: We have to work together to avoid duplication.

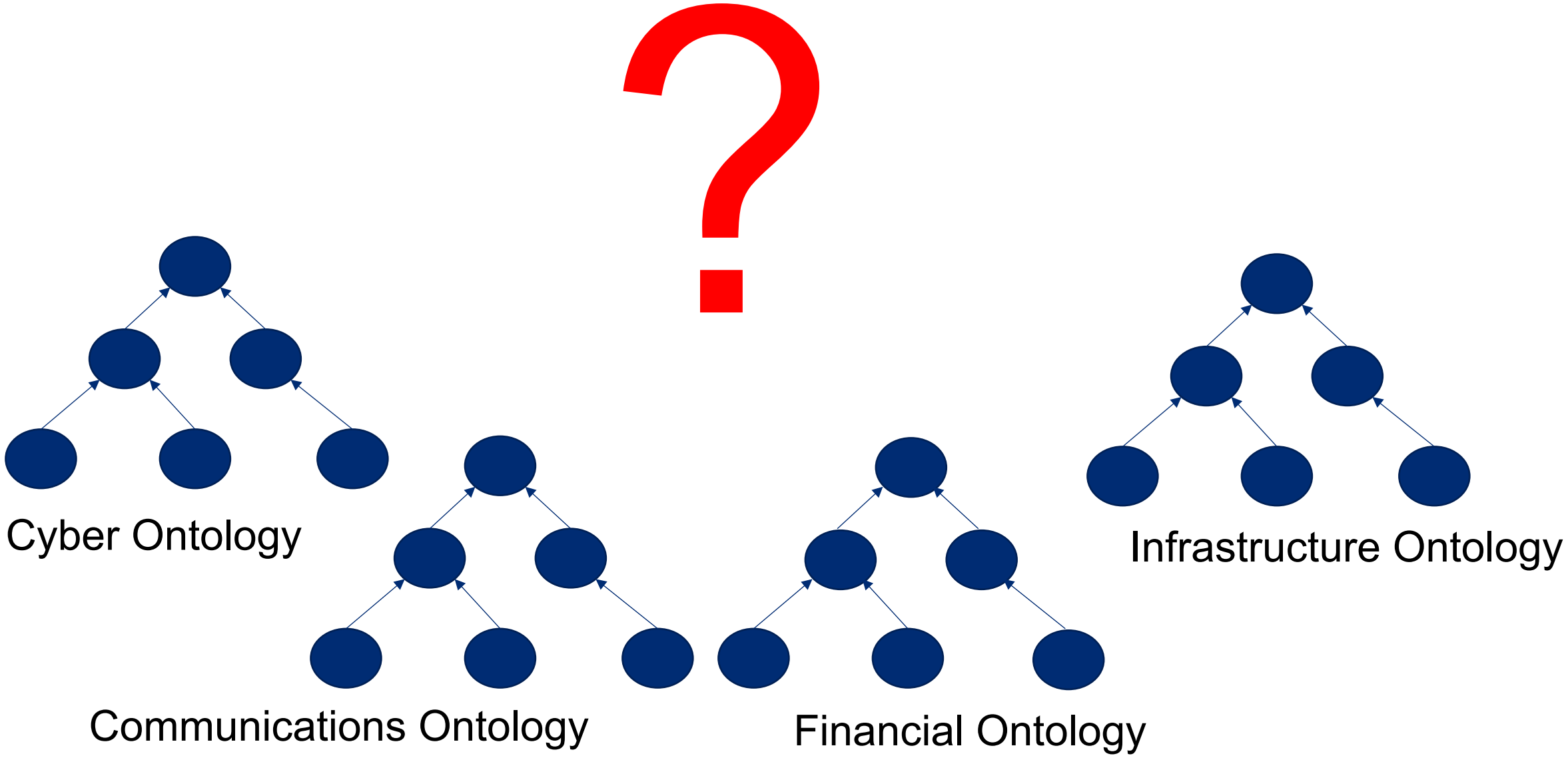
History of the National Security Ontology Working Group

- 2016 – IC OWG Charter signed, effective for 5 years.
- 2019 – DoD/IC OWG -- started as a five-person group in May 2019. Distribution now exceeds 250.
- 2021 – JAIC funded initial feature enrichment for National Security Ontology Foundry.
- 2022 – NGA supports National Security Ontology Foundry.
- 2024 – IC CDO C and CDAO sign memo directing use of top-level and mid-level for the Foundry.
- **2025 – National Security Ontology Foundry achieves initial operating capability at NGA.**
- **2026 – FY26 National Defense Authorization Act directs the SECDEF to establish an ontology working group for the DoW.**



Related Organizations

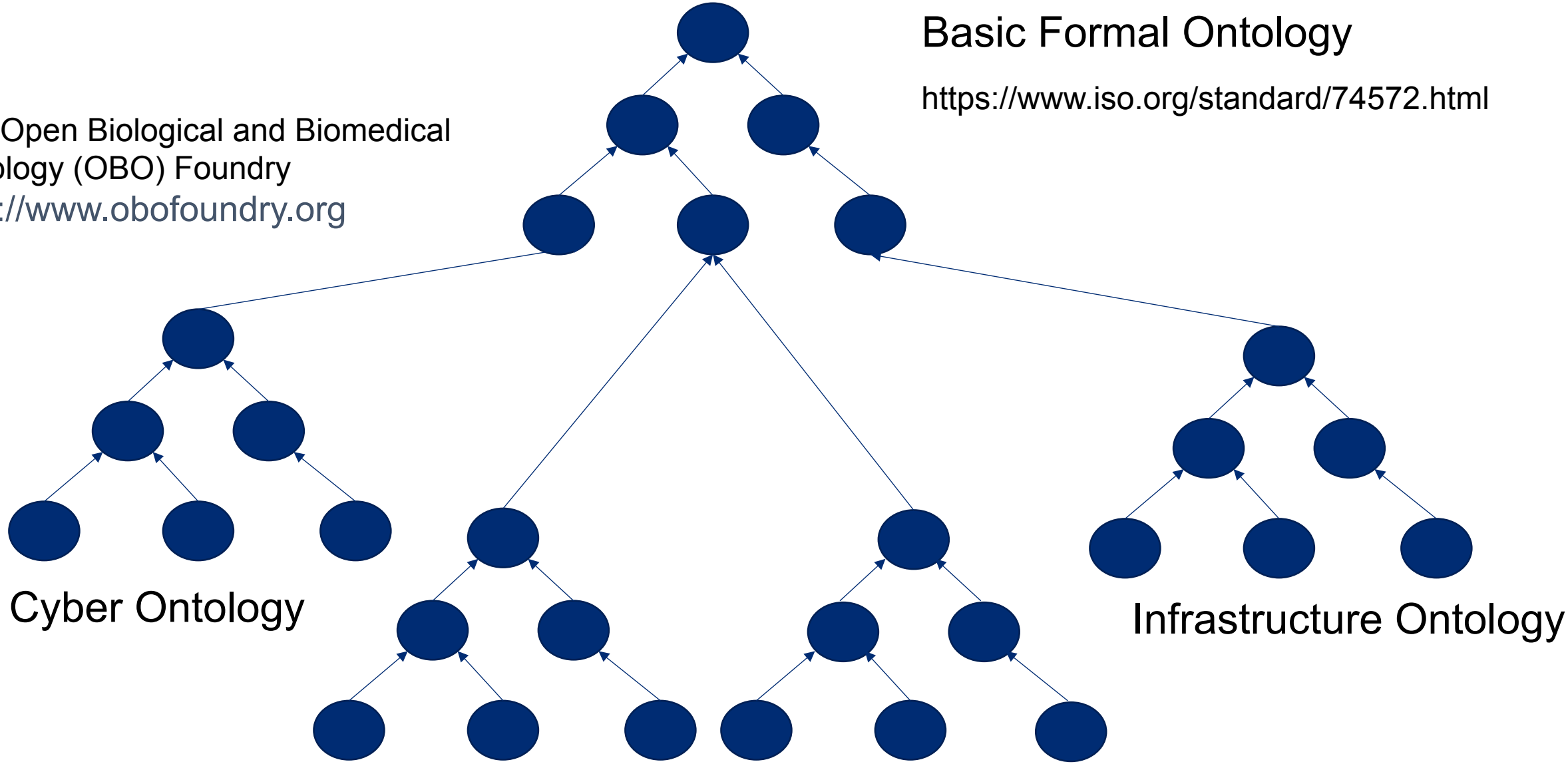



Cyber Ontology
Communications Ontology
Financial Ontology
Infrastructure Ontology

The Open Biological and Biomedical Ontology (OBO) Foundry
http://www.obofoundry.org

Basic Formal Ontology

https://www.iso.org/standard/74572.html



MEMORANDUM FOR CHIEF DIGITAL AND ARTIFICIAL INTELLIGENCE OFFICER COUNCIL MEMBERS
INTELLIGENCE COMMUNITY CHIEF DATA OFFICER COUNCIL MEMBERS

SUBJECT: Baseline Standards for Formal Ontology within the Department of Defense and the Intelligence Community

In April 2023, the Chief Digital and Artificial Intelligence Officer Council and the Intelligence Community Chief Data Officer Council chartered the joint Department of Defense (DoD) and Intelligence Community (IC) Ontology Working Group (DIOWG). It was tasked with developing coordinated ontologies to set the agreed definitions and standard necessary to make data machine understandable. Based on the DIOWG's recommendations, both Councils direct the use of three baselines: Top-Level Ontology, Basic Formal Ontology, and Common Core Ontology. These will set the baseline standards for formal DoD and IC ontology.

By aligning the DoD and IC ontologies to a common set of top and mid-level standards, the combined enterprise will realize significant gains in data interoperability, federated search and discovery, decreased analytic timelines, and better cost efficiency. This common approach to data ontology is key to deriving value from shared data assets at speed and scale. The DIOWG has provided additional background information on these international ontological standards in Attachment A.

The nation's warfighters and intelligence professionals will need to have a decisional advantage in the immediate future and that can only be unlocked through the sharing of interoperable data. The next steps for the DIOWG are to codify recommended principles and governance processes to manage the DoD-IC Ontology Foundry. The DIOWG collaboration site can be accessed by visiting https://www.trmc.osd.mil/wiki/display/DIOWG/.

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Lori Wade
Intelligence Community Chief Data Officer
Office of the Director of National Intelligence

Dr. Craig H. Martell
Chief Digital and Artificial Intelligence Officer
Department of Defense

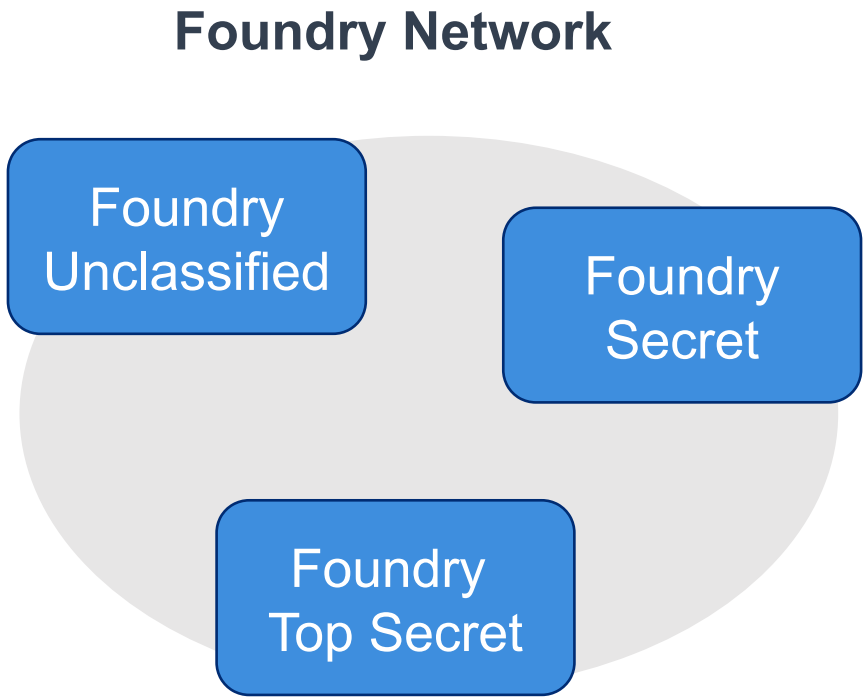
"Both councils direct the use of… Basic Formal Ontology and Common Core Ontology."

"The next steps.. are to codify recommended principles and governance processes to manage the DoD-IC Ontology Foundry"

-IC CDO and CDAO, 2023

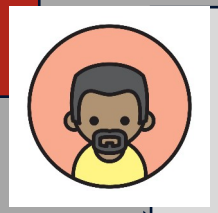
The National Security Ontology Foundry (NSOF)

- **Foundry Organization**: A collective of individuals dedicated to building ontologies that adhere to a common set of principles that are designed to facilitate interoperability.
- **A NSOF Environment**: A development environment at a specific security level that facilitates the development and release of ontologies under shared governance.
- **The NSOF Network**: The interconnected set of NSOF Environments, distinguished by security constraints, which jointly facilitate the coordinated evolution of domain ontologies.



AGENT
DOCUMENTATION
ONTOLOGY DASHBOARD
REPORT CARD
TOOLS
DEVELOPER
Search Foundry Ontology Terms
The National Security Ontology Foundry
Coordinating Ontologies for National Security
Start Searching Foundry Ontology Terms
Name
Description
Version
Agent Ontology
This ontology is designed to represent agents, especially persons and organizations, and their roles.
Version 2.0
All Core Ontology
An import of all the Common Core mid-level ontologies into a single file so that content is easy to view. The All Core Ontology is not an ontology in the sense it contains no unique content. As such it should not be added to, but can be extended from.
Version 2.0
Artifact Ontology
This ontology is designed to represent artifacts that are common to multiple domains along with their models, specifications, and functions.
Version 2.0
BFO 2020
Basic Formal Ontology implemented in the Web Ontology Language (OWL 2) with direct semantics.
CCO NSOF-Foundry Overlay Ontology
This is an overlay intended to house all and only annotation statements using Foundry approved properties to support display in Agent.
1.0.0.1788025
Currency Unit Ontology
This ontology is designed to represent currencies that are issued and used by countries.
Version 2.0
Event Ontology
This ontology is designed to represent processual entities, especially those performed by agents, that occur within multiple domains.
Version 2.0
Extended Relation Ontology
No description found.
Version 2.0
This ontology is designed to represent buildings and campuses that are designed to

Some ontology developers will use tools in the Foundry environments to do all of their development.



Foundry Node
Security level 4

Foundry Node
Security level 3

Foundry Node
Security level 2

Foundry Node
Security level 1

The Foundry network consists of a set of development environments. Each environment contains a git platform, an ontology browser, a continuous integration/continuous development pipeline, and artifact storage that stores previous versions. Ontologies published at one level of security are pushed out as read only copies to environments at higher security levels.

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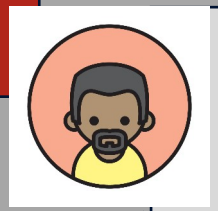
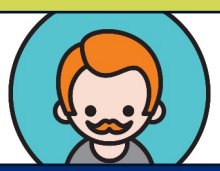


Other ontology developers already have their own environments, and will just publish to Foundry repositories and use them for accessing new ontology releases.



A local development environment

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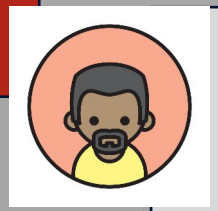

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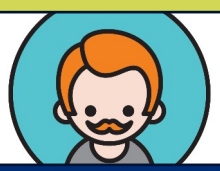

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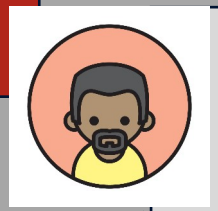

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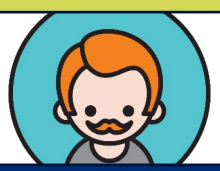

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A Production-Ready, Mission-Specific Ontology Environment

Domain ontologies in the Foundry are always created according to shared principles, but mission use cases will need the freedom to pursue their own requirements. For this reason, mission owners will need subsets of Foundry domain ontologies or other artifacts derived from the ontologies. Mission owners can create these custom artifacts in the Foundry environments, or take domain ontologies from the Foundry into their own compartmentalized development environments. When mission owners are done, they can publish content back to the Foundry that can be re-used by the community.

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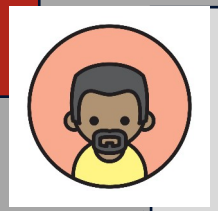

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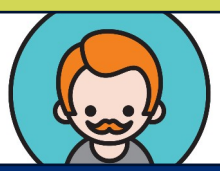

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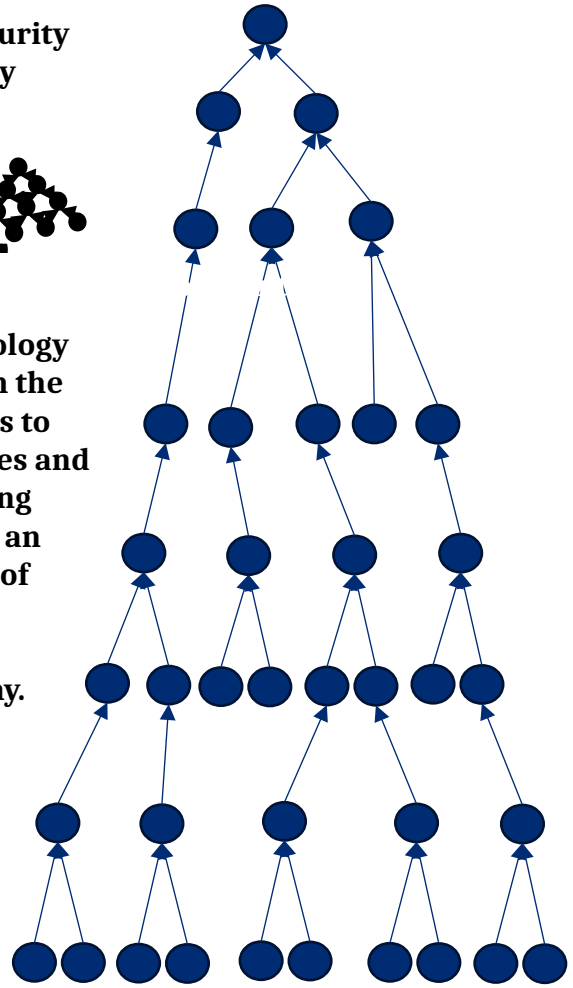
Ontology consumers (e.g. data labelers, developers) need ontologies for their work. They can find the content they need directly by going to a Foundry Environment, or work with an ontologist to create custom releases for their efforts. Whereas the Foundry-approved ontologies will continuously evolve in the Foundry Environments, mission uses of ontologies will often require taking ontologies into a separate production-ready environment for testing and deployment. Tools from the Foundry can be used to facilitate these as well.

From Development To Production

The National Security Ontology Foundry

Each domain ontology (e.g. watercraft)in the Foundry conforms to common principles and standards, allowing each to form part an ever-evolving set of ontologies that together form a common hierarchy.



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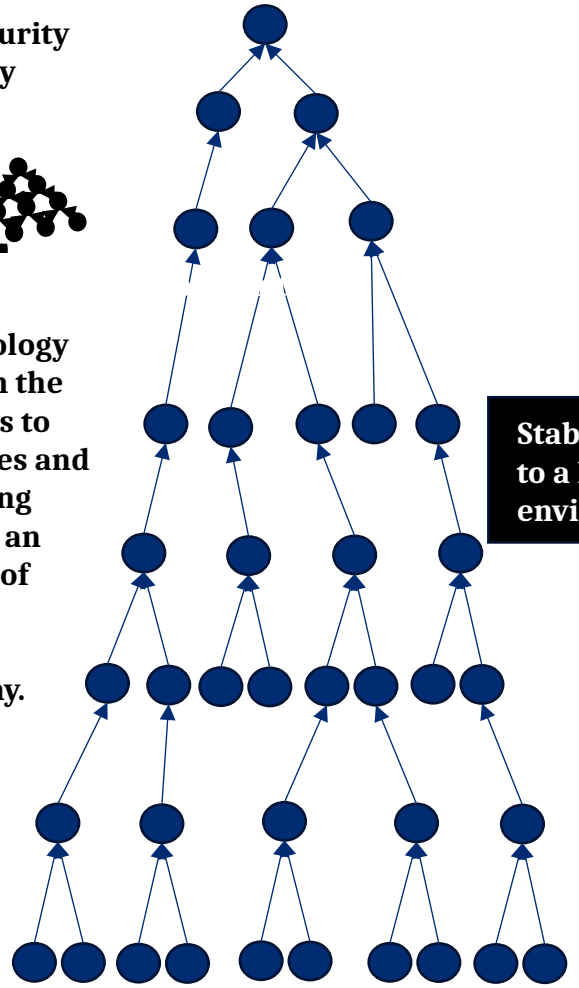
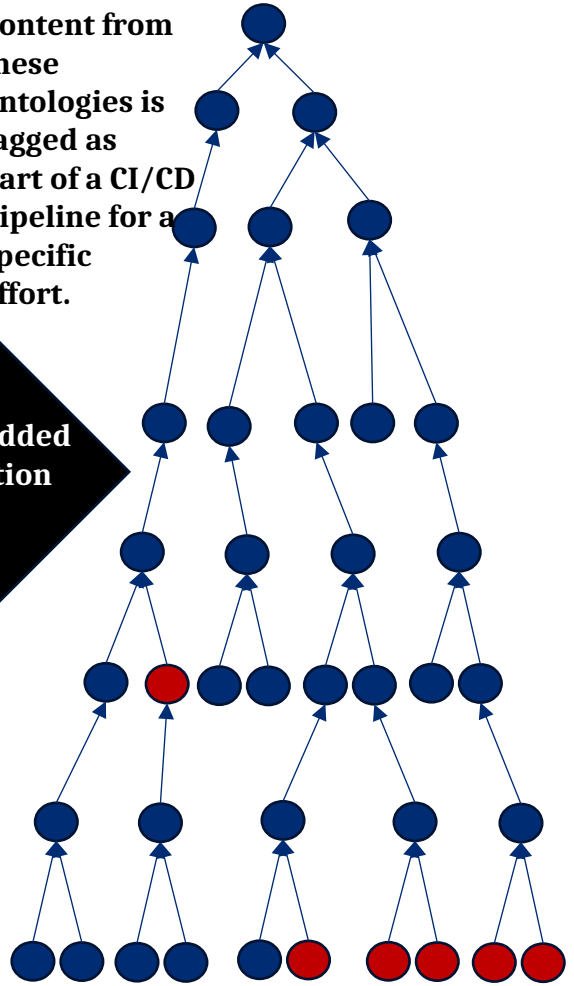


Stable versions added to a local production environment.

Content from these ontologies is tagged as part of a CI/CD pipeline for a specific effort.



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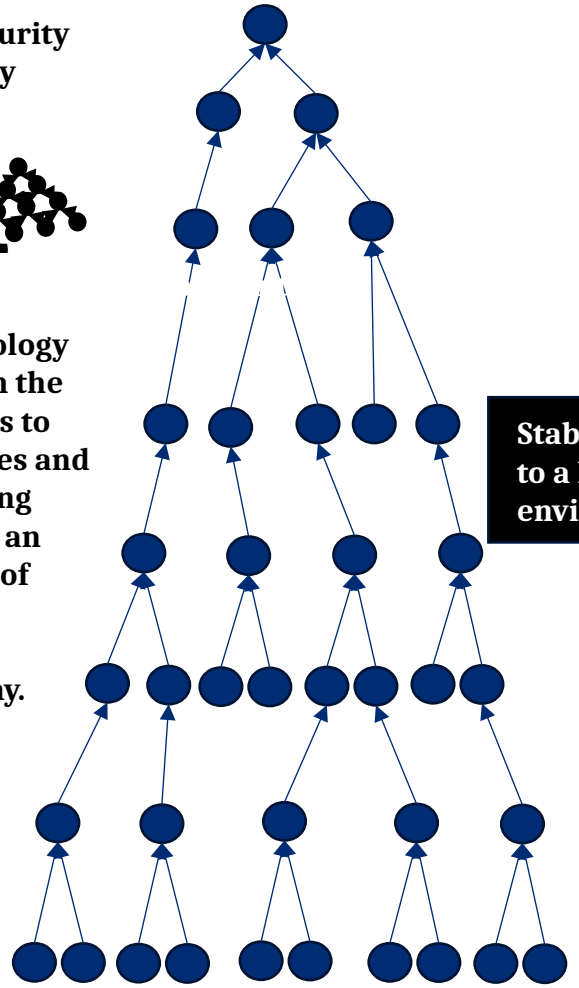

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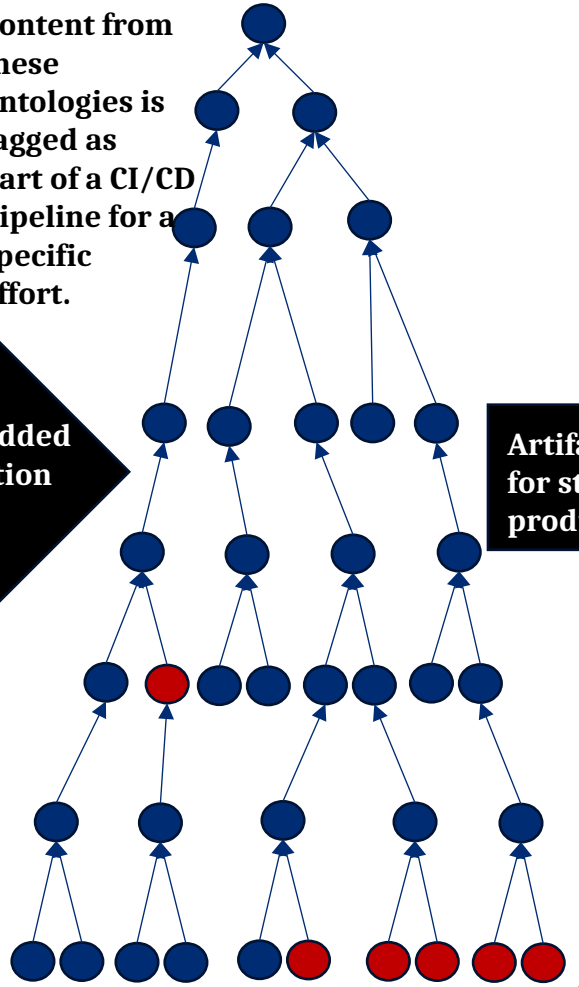
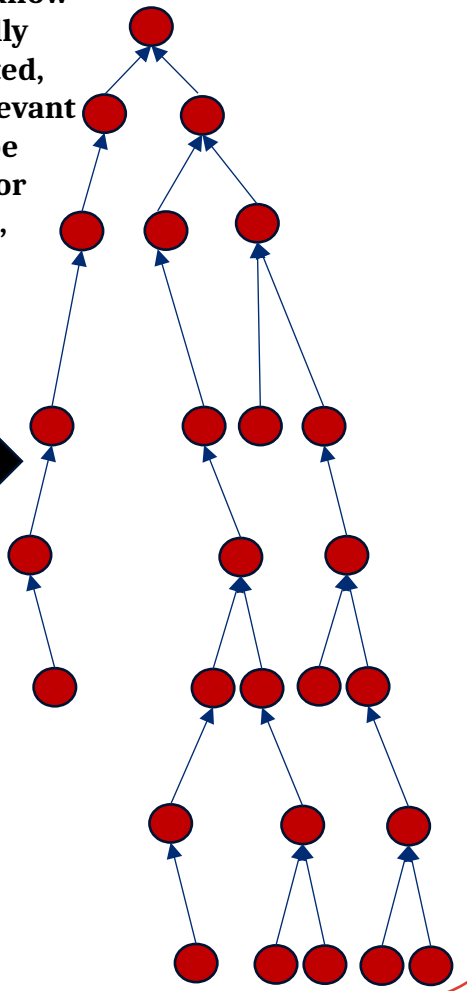


Artifacts are generated for staging and production.

These tags allow automatically down selected, mission-relevant content to be generated for enrichment, testing, and release



NSOF 2026

New congressional direction

New infrastructure availability

New tools forthcoming

FY26 National Defense Authorization Act

SEC. 1504. DEPARTMENT OF DEFENSE DATA ONTOLOGY GOVERNANCE WORKING GROUP.

(a) ESTABLISHMENT.—

(1) IN GENERAL.—The Secretary of Defense shall establish a working group to develop and implement a common data ontology and governance structure across the Department of Defense.

(2) DESIGNATION.—The working group established under to paragraph (1) shall be known as the "Department of Defense Data Ontology Governance Working Group" (in this section the "Working Group").

(3) USE OF EXISTING STRUCTURES.—

(A) IN GENERAL.—Notwithstanding paragraph (1), the Secretary of Defense may designate an existing forum, council, or organizational body to serve as the Working Group if such entity satisfies the requirements of subsections (b) and (c).

(B) RULE OF CONSTRUCTION.—For the purposes of this section, a forum, council, or organizational body designated under subparagraph (A) is deemed to be a working group established by the Secretary of Defense under paragraph (1).

(b) PURPOSE.—The purpose of the Working Group is to inform and to progress the Department of Defense's foundational data ontology work by developing and implementing domain-specific data ontologies and governance structures across the Department of Defense to expand data interoperability, enhance information

Coming Soon: Foundry Tooling Lab

The Foundry Tooling Lab is a platform to support ontology development through AI-enabled tools. A current prototype is in its earliest stages and focused on demonstrating the art of the possible.

Three tools:

1. **A hierarchy comparison capability** that allows users to quickly review the ancestors of inter-ontology matches.

In-development capabilities include:

2. **A candidate class matching pipeline** – automatically identifying equivalent classes across ontologies.
3. **A class definition generation feature** – generating draft definitions for undefined classes.

Three FAQs

How can I help create policy and best practices for NSOF?

How can I get my ontologies into NSOF?

How can I access the NSOF?

How can I help create policy and best practices for NSOF?

Join the **National Security Ontology Working Group (NSOWG)**

For accessing the “DIOWG space” on the TRMC, log into https://www.trmc.osd.mil/ and contact diowg-coord@lists.aerospace.org for access.

How can I get my ontologies in the NSOF?

Write to the OntologyTeamMailbox@nga.mil

How can I access the NSOF?

NSOF on SBU / NIPR

-Agent: https://agent.nga.mil/

-GitLab: https://my.gs.mil/login

JOHNS HOPKINS
APPLIED PHYSICS LABORATORY