



U.S. Public Sector Forum Meeting

February 2025

Welcome! We will get started in just a few moments.

- This meeting will be recorded, and the recording will be made available.
- Please mute your microphone when not speaking.

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U.S. Public Sector Forum February 2025 Meeting

Knowledge Series Presentation:
Combating & Measuring Fraud: GAO's Use of Ontology

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U.S. Public Sector Forum Meeting February 2025



Agenda:

- Welcome and Agenda
 - **Peter Holden**, Senior Advocate, Government, EDM Council
- Forum Updates
 - EDM Council
 - **Alex Izotic**, Member Services Manager, EDM Council
 - Data Innovation Lab
 - **Elisa Kendall**, Lead Ontologist, EDM Council
- Knowledge Series Presentation: *Combating & Measuring Fraud: GAO's Use of Ontology*
 - U.S. Government Accountability Office (GAO)
 - **Leia Dickerson** Taxonomy + Research Lead
 - **Nicholas Weeks**, Senior Analyst, Forensic Audits and Investigative Service Team
- Question & Answer / Forum Discussion
- .Next Meeting & Survey



EDM Council Update

February 2025

edmcouncil.org

EDM Council Introduction



Mission:

Global advocates for elevating data management and analytics through best practices, standards, training, education and research.

Principles:

We believe in a **responsible data-driven** organization and establishing data literacy for all.

We are the **neutral, non-profit** industry forum.

We advocate **industry collaboration** to advance data management and analytics capabilities for all organizations.



Established
2005



Worldwide
Americas, Europe,
Africa, Asia,
Australia



350+
Member Firms
Cross-industry,
including Regulators



25,000+
Professionals

EDM Council Members – Industry Leaders



EDM Council Members – Global Public Sector



EDM Council's Areas of Advocacy



Best Practices

- **DCAM** – Data Mgmt. Framework
- **CDMC** – Cloud Data Management
- **Forums** – Communities
 - DCAM v3
 - Data Risk
 - Artificial Intelligence
 - US Public Sector

Driving Standards

- Data Innovation Lab
- Knowledge Graph
- Open Industry Ontologies

Training & Certification

- Open & Dedicated Virtual Courses
- 7 eLearning Training & Certification Tracks with 50+ Courses
- Educational EDMWebinars

Research & Benchmarking

- Global & Regional Industry Studies
- Data Management, Cloud Data Management, Data Sharing, etc.
- Vertical Industry Benchmarks, e.g. Life Sciences

Regulatory Engagement

- Regulators are members and use EDM Council Frameworks
- Regulators participate in the agenda

Networking

- EDMConnect Community
- Forums including Global Data Leaders & Women Data Professionals
- DataVision Regional events
- Conferences & Summits

U.S. Public
Sector
Forum
Meeting
February
2025



January 2025 U.S. PSF Meeting Knowledge Series Presentation

*From Data to Impact: Driving Collaboration,
Governance, and Performance in State
Government*

Presenters: Josh Wagner, CDAO, AZ State Data & Analytics Office



Brandon McIver, CDAO, AZ Dept. of Environmental
Quality (ADEQ)

Susan Robinson, Chief Strategy & Innovation Officer,
AZ Dept. of Health Service

January 2025 U.S. Public Sector Forum

Register to view the Meeting Recording:





EDM Council

Data Innovation Lab Introduction

Elisa Kendall

Partner, Thematix Partners LLC

Lead Ontologist, EDM Council

ekendall@thematix.com

Data Innovation LAB (DIL) Introduction

Purpose:

Developing **open-source, publicly available industry ontologies** using our **Collaborative Ontology Development** model – thus driving data interoperability, industry adoption and addressing ambiguity across multiple, competing regulations and standards

Focus:

Industry standard ontology development using the DIL Platform and methodology, resulting in **pre-competitive, vendor-agnostic open-source models**

Projects:

Finance (FIBO), **pharmaceutical industry** (IDMP-O), **automotive** (AUTO), **government** (NIST / OAGI-IOF), **ESG** (Smart Dictionary for GHG reporting standards)

Benefits & Value:

Reducing costs AND implementation effort, dramatically improving industry adoption and reducing development time through effective project management, reuse, customized methods, automation, continuous deployment / integration

Supporting knowledge graph development is critical to help members drive innovation across emerging technology ecosystems

Emerging Tech

Illustrative Knowledge Graph Innovation Benefits

Machine Intelligence *(AI / ML)*

- Provides structured knowledge for vastly improved LLM performance and accuracy
- Improves the ability to learn and adapt more rapidly and accurately
- More robust and generalizable models
- Enables Explainable AI

Asset Digitization *(DA, RWA, Tokenization)*

- Significant enrichment of context and metadata to support real world asset digitization more rapidly
- Automation of asset creation and issuance
- Accelerate adoption by removing ambiguity across token formats

Quantum Computing

- Quantum algorithm optimization for analysis, optimization of performance and hardware optimization
- Facilitate automation of the generation of code, reducing development time and complexity
- Analysis and visualization of complex data and output
- Promotes standardization and interoperability

Sustainability *(ESG)*





- Mass acceleration for integration of data from financial, sustainability, social and environmental monitoring systems
- Improved reliability of data analysis and insights
- Enhance transparency, accountability and provenance of data
- Facilitates collaboration and innovation across diverse set of regulators, industry participants and emerging environmental solutions

Projects – Data Innovation Lab (DIL)



Data models by and for the global data management community

- The EDM Council promotes the adoption of data content standards to promote innovation across industries.
- Identifying the precise meaning of data to ensure business understanding is critical to enable progress, as well as to support the next developments in advanced analytics, artificial intelligence (AI) and machine learning (ML).

 FIBO	 AUTO	 IDMP	 NIST / Industrial Ontology Foundry (IOF)
FIBO FIBO® is the Financial Industry Business Ontology. It is a business conceptual ontology of how financial instruments, business entities and financial processes work across the global financial industry.	AUTO This Autonomous Vehicles Ontology defines the shared conceptual structures for the automotive industry, including the digital activities related to automobiles.	IDMP The ISO standards for Identification of Medicinal Products (IDMP) provide the framework to uniquely identify and describe medicinal products. The ontology will enable deep, semantic interoperability.	NIST / Industrial Ontology Foundry (IOF) This ontology for the manufacturing industry is being developed in partnership with the U.S. National Institute of Standards and Technology to drive data interoperability and analytics.
FIBO – Finance Industry	AUTO – Automotive	IDMP – Pharmaceuticals	NIST – Digital Manufacturing



Knowledge Series Presentation

Combating & Measuring Fraud: GAO's Use of Ontology

Presenters:

U.S. Government Accountability Office (GAO)

Leia Dickerson, Taxonomy + Research Lead

Nicholas Weeks, Senior Analyst, Forensic Audits and Investigative Service Team



THE GAO

FRAUD ONTOLOGY AND ANTIFRAUD RESOURCE

Presented by:

Nick Weeks

Senior Analyst, Forensic Audits
and Investigative Service

Leia Dickerson

Taxonomy & Research Lead,
Applied Research and Methods

Background



Longstanding interest by Congress about the extent of fraud affecting the federal government



Initial engagement scope was to determine the nature and extent of federal fraud

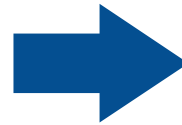


Previous experiences and initial engagement work showed that the federal government lacked common terms for fraud

Background



Team identified need for structured method to define key fraud terms affecting the federal government

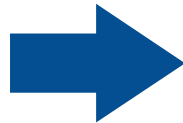


Ontology identified as the best conceptual framework

Development Process



Work started in April 2019 and issuance in January 2022



Two key deliverables:

Ontology

+

Website

Both deliverables required significant capacity building within GAO

(Expertise building and specialized developer expertise as well as hardware and software procurement)

Development Process - Ontology

Limited GAO
experience
with
ontologies at
start of work

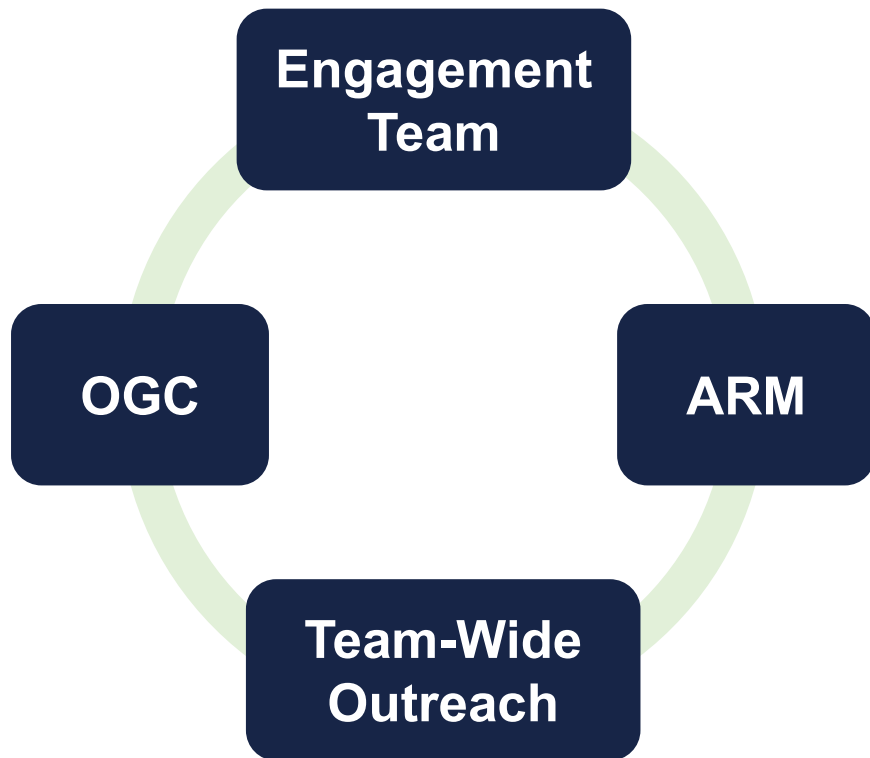


Ontology
developed
and refined
through an
iterative
process



- 1. Collect and analyze information**
(academic and public federal agency information)
- 2. Develop/refine model**
(develop initial framework using MS office then used WebProtégé)
- 3. Collect additional information**
(interviews with OIGs, ontology experts, other SMEs, additional academic and agency documentation)
- 4. Refine model**
(incorporate information learned into the structure of the ontology through regular working meetings using WebProtégé)
- 5. Validation internally and externally**
- 6. Repeat steps 3 and 4**

Development Process - Ontology



- ✓ Immediate engagement team and ARM performed work with significant support from OGC and additional team-wide outreach (e.g. those with criminology degrees)
- ✓ GAO also received specific ontology training from Enterprise Data Management Council

Development Process - Website



Website developed
at the same time as
the ontology



Content and site
layout created by
engagement team



GAO's Innovation Lab
provided developer and
contractor support

**(Innovation lab was
newly created when our
engagement began)**

Development Process - Website



Website development included extensive user testing

- ✓ Facilitated discussions with agency officials involved in fraud risk management
- ✓ Internal user testing of draft website (GAO analysts)
- ✓ External testing of draft website (agency officials)

Full scope and methodology available on the antifraud resource

Ontology Updates



- Several smaller updates made since issuance to fix broken hyperlinks, typos, and other small issues
- Larger changes planned for end of this month (September)
- Updates will include additional schemes taken from recent GAO work (around 40) and additional resources (around 40) identified online
 - Some outdated and non-accessible content removed
 - Scheme additions still require manual work
- Plan to make substantive updates every 2 years

Your feedback on what to include in future updates is very welcome!

Tracking Our Impact – External Measures



Google analytics
used to track
Antifraud
Resource
website visitors



We track our
different
presentations
including number
of visitors (over
7,000 attendees
since launch)



Ontology users
are more likely
power users



Total website
users likely
provides limited
insights into our
impact

Tracking Our Impact – Internal Successes

Ontology

```
graph TD; A[Ontology] --> B[Helps develop a basic understanding of how fraud works]; A --> C[Useful for understanding various types of frauds that can impact federal programs]; A --> D[Provides useful terms and definitions that can be reused]; A --> E[Used to help record and analyze fraud cases on engagement work];
```

Helps develop a basic understanding of how fraud works

Useful for understanding various types of frauds that can impact federal programs

Provides useful terms and definitions that can be reused

Used to help record and analyze fraud cases on engagement work

Ontology Key Concepts

Classes

- Concepts; types of objects or kinds of things

Individuals

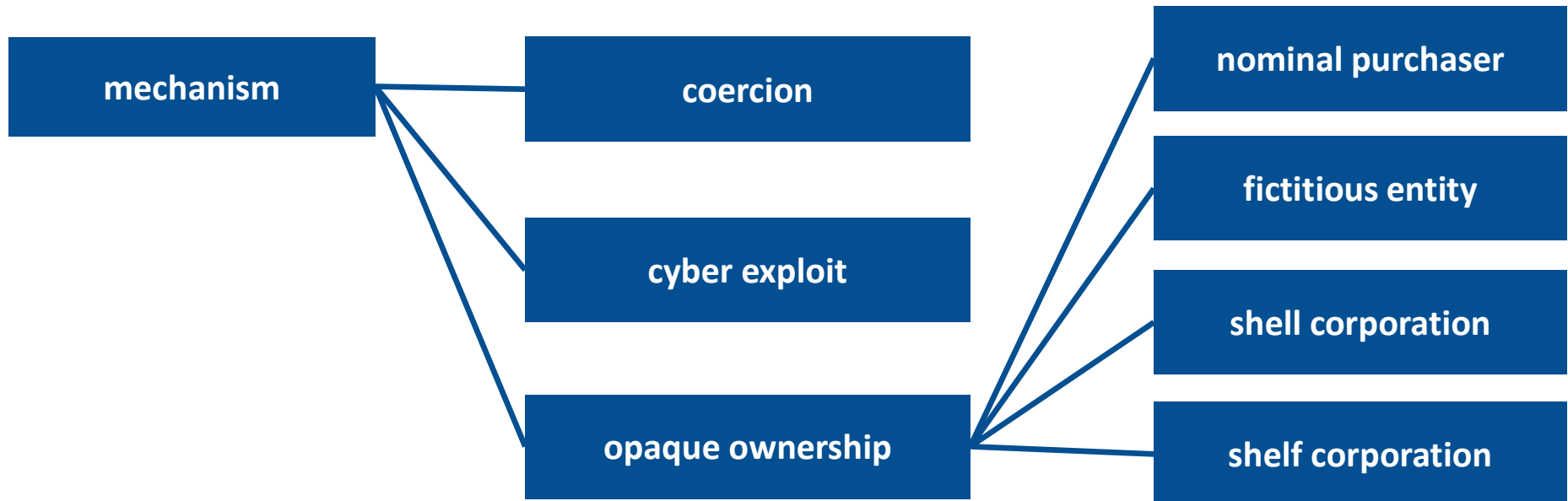
- Instances of a class

Properties

- Ways in which classes and individuals can be related to one another; also describes attributes of a particular entity

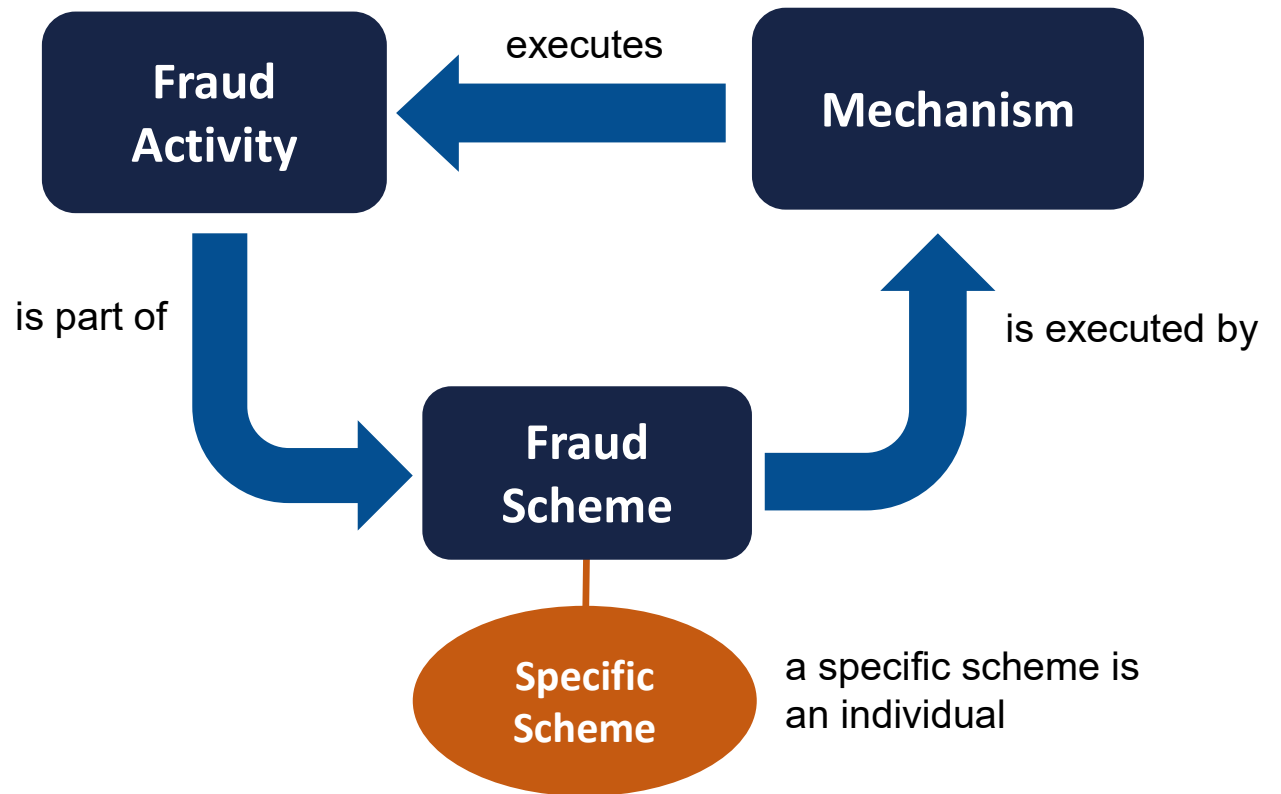
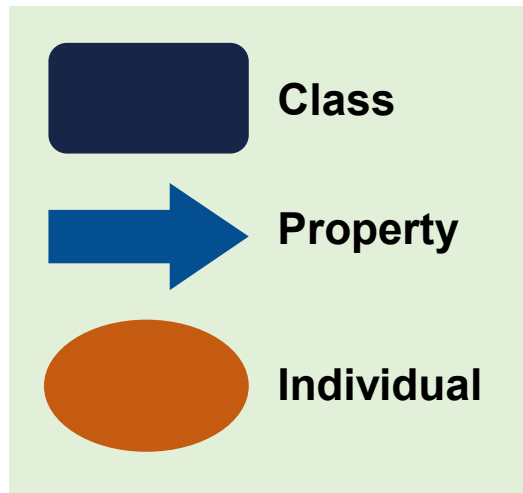
Ontology Key Concepts

Ontologies have a generally hierarchical structure with classes and subclasses.



Ontology Key Concepts

Properties show ways in which classes and individuals relate to each other.



Lessons Learned

- **Define your problem to determine if an ontology is the right solution**
- **Include the right staff expertise including both domain and technical knowledge**
- **Continuously refine your problem such as through using competency questions**
- **Bring in outside technical assistance**
- **Seek input and feedback from many different sources**
- **Determine realistic benchmarks**
- **Plan to support and update your ontology**

WebProtégé: Filtering Results with Basic Search

The screenshot displays the WebProtégé interface. On the left, the 'Class Hierarchy' panel shows a tree of classes under 'owl:Thing'. A search icon (magnifying glass) is highlighted with a red circle. The main area shows a 'Class' view. A 'Search for Class' dialog box is open, showing a search input field with the text 'shelf'. Below the input field, there is a list of search results. The first result, 'shelf corporation abuse rdfs:label @en', is selected and highlighted in blue. Other results include 'shelf company abuse rdfs:label @en', 'abusive tax shelter rdfs:label @en', 'shelf corporation abuse https://gaoinnovations.gov/antifraud_resource/howfraudworks/gfo/ShellCo', 'shelf company abuse https://gaoinnovations.gov/antifraud_resource/howfraudworks/gfo/ShellCo', and 'abusive tax shelter https://gaoinnovations.gov/antifraud_resource/howfraudworks/gfo/AbusiveT'. The dialog box also shows 'Displaying 6 of 6 results', a pagination bar indicating 'Page 1 of 1', and 'Cancel' and 'Select' buttons.

Search for Class

shelf

Separate search words by spaces to perform multi-word search. Search for tagged entities by entering the name of the tag.

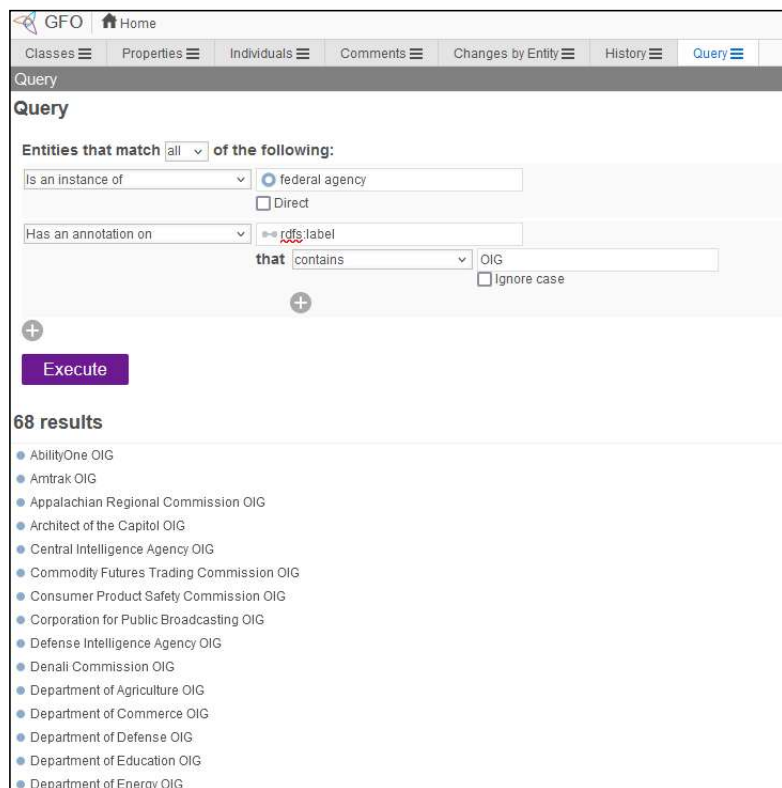
Displaying 6 of 6 results

- shelf corporation abuse rdfs:label @en
- shelf company abuse rdfs:label @en
- abusive tax shelter rdfs:label @en
- shelf corporation abuse https://gaoinnovations.gov/antifraud_resource/howfraudworks/gfo/ShellCo
- shelf company abuse https://gaoinnovations.gov/antifraud_resource/howfraudworks/gfo/ShellCo
- abusive tax shelter https://gaoinnovations.gov/antifraud_resource/howfraudworks/gfo/AbusiveT

Page 1 of 1 Prev Next

Cancel Select

WebProtégé: Filtering Results with the Query Tab

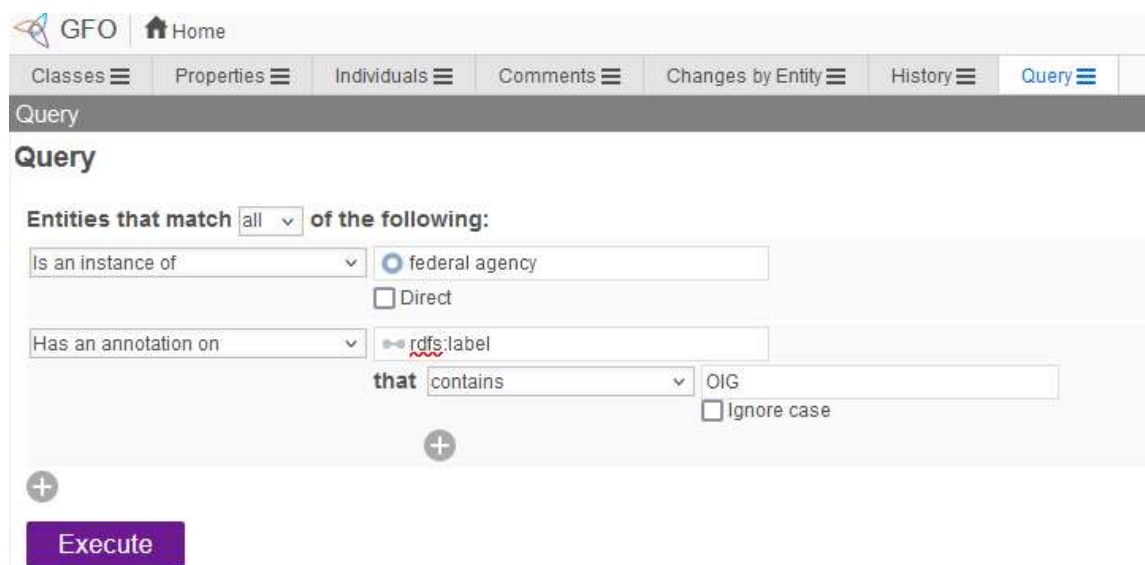


The screenshot shows the WebProtégé interface with the Query tab selected. The query is defined as follows:

- Entities that match **all** of the following:
- Is an instance of federal agency
- Direct
- Has an annotation on that contains Ignore case

The results list shows 68 results, including:

- AbilityOne OIG
- Amtrak OIG
- Appalachian Regional Commission OIG
- Architect of the Capitol OIG
- Central Intelligence Agency OIG
- Commodity Futures Trading Commission OIG
- Consumer Product Safety Commission OIG
- Corporation for Public Broadcasting OIG
- Defense Intelligence Agency OIG
- Denali Commission OIG
- Department of Agriculture OIG
- Department of Commerce OIG
- Department of Defense OIG
- Department of Education OIG
- Department of Energy OIG

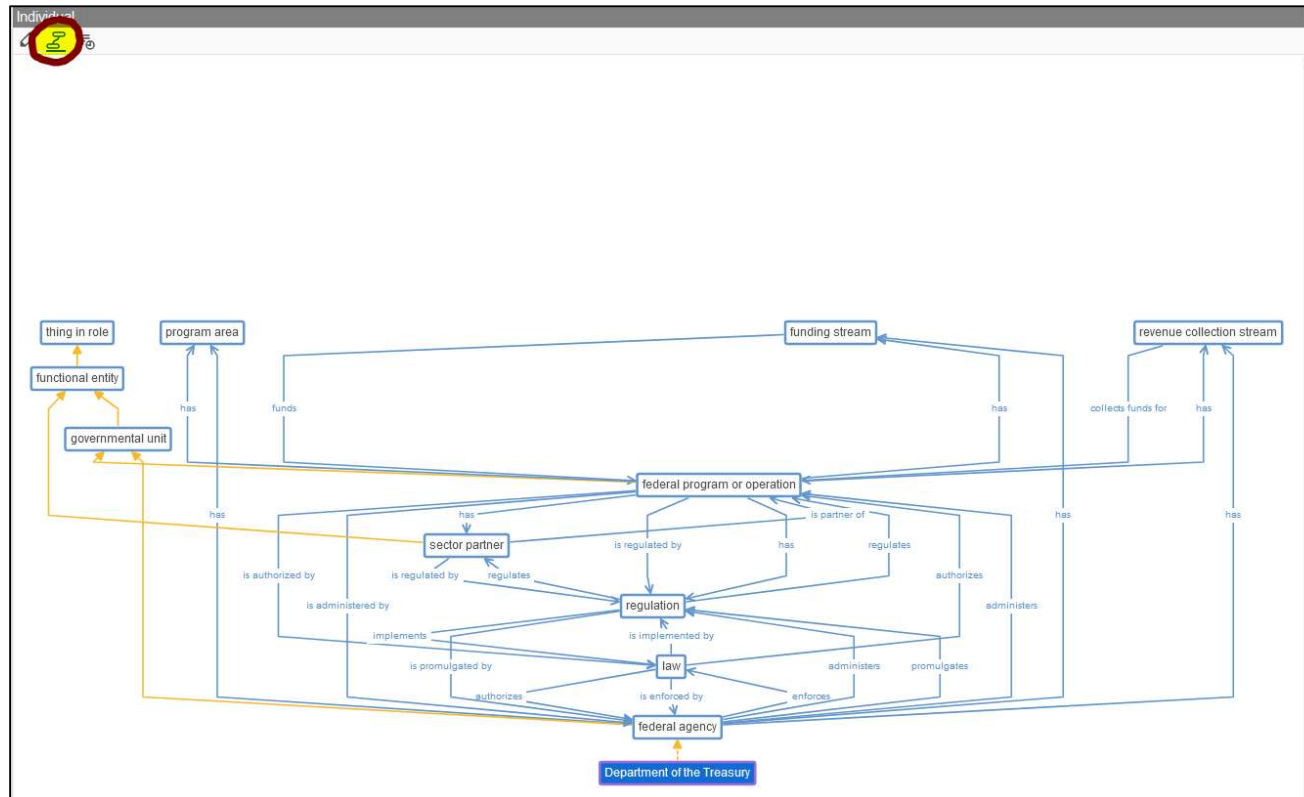


The screenshot shows the WebProtégé interface with the Query tab selected. The query is defined as follows:

- Entities that match **all** of the following:
- Is an instance of federal agency
- Direct
- Has an annotation on that contains Ignore case

The results list is currently empty.

Entity Graphs in WebProtégé



- Entity graph available through the second icon at the top of each class and individual record
- Possible to customize display through filters
- SVG image only downloadable in Safari browser (known issue)

SPARQL – A Power User’s Friend

- SPARQL, pronounced ‘sparkle’ is RDF’s query language
- Has some similarities to SQL
- Excellent way to display and download custom results
- Can be accessed in different ways (RDFLib, Apache Jena, SPARQL endpoints, etc.)

```
current_query = """
SELECT DISTINCT ?entityname ?pname
WHERE
{
    ?entity rdf:type ?restriction .
    ?restriction owl:onProperty ?p .
    ?restriction owl:someValuesFrom gfo:DepartmentofDefense.
    ?entity rdfs:label ?entityname .
    ?p rdfs:label ?pname .
}
ORDER BY ?entityname"""
```

Ontology Resources

- DeBellis, Michael. “New Protégé Pizza Tutorial.”, (2023). <https://www.michaeldebellis.com/post/new-protege-pizza-tutorial>
- Demelo, Jonathan, and Kamran Sedig. "Forming Cognitive Maps of Ontologies Using Interactive Visualizations" (2021). Multimodal Technologies and Interaction 5, no. 1: 2. [2](#)
- Enterprise Data Management Council. “FIBO.” The Financial Industry Business Ontology, 2024. <https://spec.edmcouncil.org/fibo/>.
- Noy, Natalya F., and Deborah L. McGuinness. "Ontology development 101: A guide to creating your first ontology."(2001). https://protege.stanford.edu/publications/ontology_development/ontology101-noy-mcguinness.html.
- Stanford Center for Biomedical Informatics Research. “Protégé.” (2020). <https://protege.stanford.edu/>.
- Wikibooks. “SPARQL.” (2022). <https://en.wikibooks.org/wiki/SPARQL>.

Website and Contact Information

Web resource link: https://gaoinnovations.gov/antifraud_resource/

Provide comments and suggestions on the website or the underlying ontology via email: antifraud@gao.gov



Image sources: Icons-Studio/stock.adobe.com, fandy/stock.adobe.com, and tuu_stock/stock.adobe.com.

Questions Sent to GAO

What is the history of creating the GAO Fraud Ontology? How long did the project take to be published?

What is an ontology? What are the fundamentals to creating a conceptual model? What should you consider? What are the best practices?

How often are the GAO Fraud Ontology schemes updated? When is the next scheduled update?

Does GAO track the usage of the GAO Fraud Ontology tool? Has GAO observed a high usage of the tool?

Can the GAO Fraud Ontology be analyzed for trends and patterns using data analytics tools?

Questions Sent to GAO

What is the difference between Classes, Properties, and Individuals?

Can I download my results? Can I share my results with others? If yes, how?

How can I filter the information I am interested in?

Can you demo use of the Entity Graph?

Do you have to be an expert to use the GAO Fraud Ontology WebProtégé?



Forum Discussion

Q&A

Have any questions or comments? Let's engage in discussion!

- Activate your camera and raise your hand if you would like to ask a question.
- Utilize the 'Q&A' feature on Zoom to submit your inquiries.

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Next Forum Meeting

Date: Thursday, April 17, 2025

Time: 11:00 AM – 12:30 PM EST | 8:00 AM – 9:30 AM PST

Knowledge Series Presentation:

The Future of Data Transparency: Updates from the Data Foundation

April 2025

Meeting Registration



Join the U.S. Public Sector Forum

on EDMConnect



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Survey

Tell us what you think! We appreciate your feedback.

Please complete the meeting survey:

<https://s.zoom.us/m/b9kHN4lo6>

