

Ontology Marketplace: Enabling Scalable Ontology Sharing for Semantic Interoperability

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Abstract

The increasing adoption of semantic web technologies and the rapid proliferation of knowledge graph-driven tools underscore the urgent need for a robust, scalable infrastructure to manage ontology change requests, foster community feedback, and support both developers and users with advanced tooling. There is a growing demand for a platform that not only facilitates these processes but also accelerates community engagement and practical use of ontologies and knowledge graphs through AI-ready technologies such as Neo4j. To address this gap, we present the Ontology Marketplace, a community-driven, event-aware platform designed to streamline the submission, tracking, moderation, and implementation of ontology-related requests. By establishing seamless communication channels among users, tools, and curators, this platform aims to reduce the turnaround time for ontology updates from months to minutes.

Keywords

Ontology, Knowledge Graph, Application, Neo4j

1. Introduction

Semantic web technologies and knowledge graphs have become a core substrate for modern data integration and analytics, increasing the reliance of researchers and practitioners on ontologies as shared conceptual backbones. There are many workflows and methodologies available that capture the stages of ontology building [1, 2, 3]. However, while ontology usage has scaled, ontology maintenance often remains slow and fragmented. Ontologies define how information is organized and related, but current practices for proposing, validating, and implementing updates are frequently distributed across issue trackers, email threads, or informal conversations. When users encounter missing or outdated terms, they often lack a direct mechanism to submit requests, follow their progress, understand decisions, or visualize the affected portions of the ontology graph. This friction is especially problematic in domains where terminology evolves rapidly and downstream pipelines depend on timely updates. For example, in drug surveillance on social platforms, informal, misspelled, or newly coined terms are common and can contribute to delays between emerging trends and formal recognition [4]. The Ontology Marketplace¹ project addresses this problem by providing a single, connected platform in which users, curators, and tools can jointly manage ontology updates and requests. From a knowledge-capture perspective, the key goal is to make change activity, requests, feedback, and curator actions observable and tractable through a unified workflow rather than scattered across disconnected systems. The Marketplace combines authentication, API-based access, and graph visualization in Neo4j [5] to support the ontology lifecycle from submission to discovery, curation, and feedback, enabling stakeholders to move from “reporting problems” to “capturing, tracking, and resolving changes” in a structured way. To realize this vision, Ontology Marketplace provides standard APIs and data formats for ontology submissions, updates, and searches, ensuring consistency and interoperability across systems. A central mediation service

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¹<https://www.ontologymarketplace.com/>

connects ontology users, tools, and databases through a shared communication layer, enabling requests and ontology records to be handled uniformly regardless of source. Modules extend the platform to interact with external semantic repositories for both retrieval and submission of ontology resources. Finally, a curation and visualization layer, initially leveraging Neo4j, supports interactive exploration of ontology structure and provides ontology managers with interfaces to review, comment on, and refine content. Taken together, these capabilities position Ontology Marketplace as a community-driven infrastructure that improves how ontologies are managed, shared, and iteratively refined in settings where knowledge capture and reuse are central requirements.

2. Current Version Implementation

2.1. Ontology Lifecycle Management

The Ontology Marketplace supports the full lifecycle of an ontology record, from creation through modification and eventual deletion, via a REST API that enables both individual and batch submission workflows. Ontology Marketplace provides REST-based lifecycle management supporting creation, update, deletion, and access-controlled discovery of ontology records with structured metadata for integration and search.

In addition to managing ontology metadata, the Marketplace includes built-in support for parsing OWL and Turtle ontology files and uploading their structural representations into Neo4j. When a user provides a link to an ontology file, the system downloads it, converts it into a supported format if needed, and extracts the class hierarchy by traversing subclass relationships. Classes are represented as nodes in Neo4j, and subclass axioms are materialized as directed edges, enabling immediate graph-based exploration and downstream tooling that benefits from AI-ready graph storage. To make this feasible for large ontologies and task-specific workflows, users may optionally specify a root class and upload only the relevant subtree, reducing load and focusing attention on a region of interest. Before initiating an upload, users can test Neo4j credentials to validate connectivity and prevent runtime failures, supporting a more robust end-to-end ingestion experience. This template based approach allows user-flexibility for use cases that may involve further personalization. Ontologies are further organized using a graph-based tag system that supports easy filtering and discovery, with tags stored as connected nodes for future extensions.

2.2. Permission and Visibility Model

Access control is enforced through a combination of visibility status and explicit permission relationships, reflecting the practical needs of both open community sharing and restricted collaboration. Each ontology is labeled public or private, controlling whether it appears in public search results. Private ontologies are visible only to users who have been granted permission, enabling controlled sharing while maintaining a unified discovery interface. The system defines three permission types: *created*, which indicates original authorship and full control; *can edit*, which allows modification of ontology metadata; and *can delete*, which permits removal of the ontology. Before any update or deletion, the backend checks that the requesting user holds the required permission relationship to the ontology, ensuring that management operations remain consistent with curator intent and ownership constraints.

2.3. External Repository Integration

The biomedical research community maintains numerous ontology repositories, with BioPortal being one of the largest, hosting over 1,000 ontologies covering domains from anatomy to disease classification. Manually adding these ontologies to the Marketplace would be time-consuming and would quickly become outdated as repositories are continuously updated. To address this challenge, we have developed an automated synchronization system that periodically fetches ontology metadata from BioPortal and various GitHub repositories. This automated workflow then updates the Marketplace database which

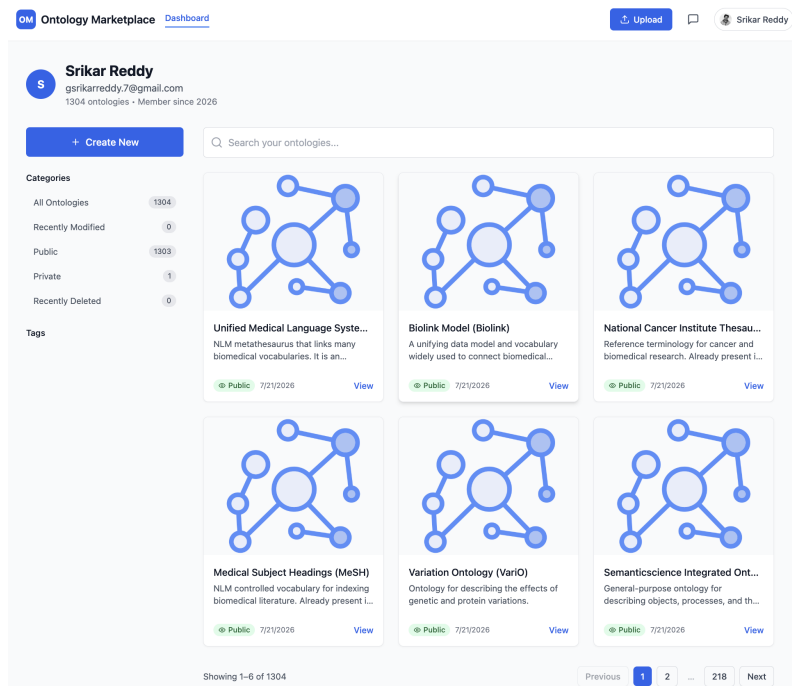


Figure 1: The main dashboard of the Ontology Marketplace, displaying a user’s ontology library with category filters (Public, Private, Recently Modified, Recently Deleted) and a searchable, paginated grid of ontology cards showing title, description, and visibility status.

allows the users a up-to-date experience without overwhelming the system. For the initial integration, we focus on ontologies that are submitted to Bioportal [6].

The synchronization design follows three principles: completeness, consistency, and efficiency. In this context and for this project, *completeness* ensures that all publicly available BioPortal ontologies are represented within the Marketplace. *Consistency* ensures that metadata such as class counts and descriptions reflect current repository state. *Efficiency* minimizes requests and database operations by detecting and processing only changes since the previous run, which is essential for sustainability at scale. Operationally, synchronization executes in three phases: fetch, compare, and update. The fetch phase retrieves the full BioPortal ontology list and maps relevant fields into the Marketplace schema. The compare phase identifies additions and metadata changes by checking existing BioPortal-sourced entries against the newly fetched snapshot. The update phase applies those changes by creating nodes for newly observed ontologies and updating properties for modified entries. Automation is implemented via GitHub Actions on a weekly schedule, with logs capturing counts of fetched/added/updated ontologies and surfacing errors for maintainers.

2.4. User Interface Design

The Ontology Marketplace frontend 1 is designed to support efficient ontology discovery and management through a clean, responsive interface. The dashboard serves as the primary entry point and presents ontologies in a grid of cards that surface key summary signals, thumbnail images, titles, descriptions, tags, and visibility status, supporting rapid triage and browsing. A search bar provides real-time filtering over textual metadata, while category tabs enable quick switching among views such as all ontologies, recently modified entries, public ontologies, and private ontologies. To support faceted navigation, the tag sidebar lists available tags alongside ontology counts, enabling users to iteratively narrow results using domain-relevant labels. For deeper management, an ontology details view provides comprehensive record information, and authorized users are given inline edit controls for direct modification. The UI also includes an upload dialog that guides users through uploading class hierarchies to an external Neo4j instance, including connection testing and progress feedback to make

ingestion transparent and less error-prone.

3. Future Directions

The next phase of the Ontology Marketplace addresses a critical gap: transitioning ontology maintenance from an informal, loosely coordinated process to a structured, end-to-end lifecycle. Building on our existing foundation of standardized APIs and graph visualization, future development will establish an event-aware infrastructure where change activities are captured as structured, searchable, and reusable data.

We will introduce a unified request-to-resolution workflow encompassing feedback submission, update proposals, and formal approval decisions. Each request will be represented as a lifecycle artifact with typed metadata, moving the platform beyond simple "ticketing" toward captured knowledge regarding why an ontology changed. This structure enables downstream automation, such as linking requests to impacted entities and surfacing precedent decisions. To reduce fragmentation, we will integrate a deliberation pipeline directly into the ontology graph. Our Neo4j-based visualization will evolve into an actionable curation substrate, allowing curators to navigate from a request to the affected region and record structured rationale at the point of change. This ensures that decisions remain contextually attached to the specific entities and axioms they concern.

A second priority is supporting implementation pathways that connect approved changes to practical deployment. The Marketplace will support staged execution, including the generation of candidate patches, tracking of semantic diffs, and coordination of updates via programmatic hooks (e.g., CI-style validation). This transforms ontology evolution into a repeatable operational process with explicit governance. By treating requests, discussions, and decisions as queryable graph artifacts, we will shorten the path from community feedback to implemented change. Together, these enhancements ensure the Ontology Marketplace is not merely a repository, but a collaborative platform that operationalizes the full lifecycle of ontology change, aligning stewardship with the needs of fast-moving knowledge graph ecosystems.

4. Conclusion

Ontology maintenance today is slow and fragmented, with change requests scattered across issue trackers, email threads, and informal conversations. The Ontology Marketplace addresses this gap by bringing ontology sharing, discovery, and management into a single, connected platform. The current version provides REST-based lifecycle management for ontology records, a permission and visibility model that supports both open sharing and controlled collaboration, automated synchronization with BioPortal, and built-in parsing of OWL and Turtle files into Neo4j for graph-based exploration, all surfaced through a responsive interface for discovery and curation. Together, these components lower the barrier to finding, sharing, and working with ontologies, and give curators a unified view of the resources they manage. Our next steps make change activity itself a first-class part of the platform by capturing feedback, update proposals, and approval decisions as structured, queryable graph artifacts, and by connecting approved changes to staged, validated deployment. This shift from static hosting to an event aware, community driven lifecycle is what will keep ontologies aligned with fast-moving domains, and the Ontology Marketplace lays the groundwork to make it practical.

Declaration on Generative AI

During the preparation of this work, the authors used Claude (Anthropic) in order to assist with: Grammar and spelling check, and improve writing style. After using this tool/service, the authors reviewed and edited the content, and they take full responsibility for the publication's content.

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