Final Project Writeup: Enhancing Information Retrieval Through Ontology and Semantic Networks

Introduction

This project explores the intersection of ontology, information foraging, and semantic networks to create a structured and intuitive food knowledge platform. By leveraging these concepts, the project enhances how users navigate and interact with complex datasets. The platform showcases recipe recommendations, crop preferences, and semantic networks, allowing users to uncover hidden connections and make informed decisions. This writeup details the process undertaken, technical specifications, and the integration of class concepts into the platform.

Conceptual Foundation

1. Ontology and Semantic Networks

Ontology provides a systematic framework for organizing data, making it comprehensible and accessible. For this project, ontologies structured food-related data, categorizing recipes, crop details, cuisines, and preferences. Semantic networks visualized these relationships, offering users clear cues on the connections between various elements.

2. Web Ontology Language (OWL)

The project also explored the Web Ontology Language (OWL) to understand its potential for representing complex relationships. While OWL was not directly implemented due to project scope and tools, its principles informed the development of semantic relationships and data hierarchies.

3. Information Foraging Theory

Information foraging theory was applied to ensure strong information scent across the platform. By embedding semantic relationships into the network, users were guided to relevant data points through meaningful connections, strengthening their decision-making process.

4. Semantic metadata

Semantic metadata further enriched the user experience, presenting well-defined relationships (e.g., “is a,” “suitable for,” “similar to”) to clarify navigation paths and improve information retrieval.

Design and Implementation Process

Research and Ideation

The project began by researching popular platforms that employ ontology and semantic networks, such as Netflix’s recommendation system and Google’s knowledge graph. These

platforms inspired the focus on categorization, user-centric navigation, and meaningful data connections.

Prototype Development

The platform was built using HTML, CSS, and JavaScript due to its small-scale nature and focus on visualization. While React was initially considered, the simplicity of HTML, CSS, and JavaScript ensured quicker implementation and straightforward interaction with the DOM.

Key features of the prototype included:

- Recipe Recommendations: Based on user-selected dietary preferences, cuisine types, and locations.

- Food Explorer: Highlighting crop details, categories, and uses, emphasizing sustainability and cultural relevance.

- Semantic Networks: A visual representation of relationships between recipes, crops, and preferences.

Data Sourcing

Images were sourced from Pexels and Pixabay, providing high-quality visuals to enhance user engagement. Dataset attributes included color, category, nutritional value, usage, and health benefits, curated for relevance and comprehensiveness.

Technical Specifications

Tools and Frameworks

- HTML/CSS: For structuring and styling the website.

- JavaScript: To manage dynamic content, user interactions, and semantic network visualization.

- Vis.js: For rendering semantic networks, enabling clear visualization of relationships.

Google APIs

The project integrated several Google APIs to enhance functionality and provide location-based insights, connecting users with real-world data:

- **Maps JavaScript API:** Displays interactive maps showing locations where crops are grown or where recipes are available in nearby restaurants.

- **Places API:** Retrieves information about nearby restaurants or markets that serve specific recipes or sell relevant crops.

- **Geolocation API:** Determines the user's current location to offer personalized recommendations for crops or restaurants nearby.

- **Geocoding API:** Converts user-input addresses into geographic coordinates, seamlessly integrating them into the map view.

These APIs collectively strengthened the connection between digital information and physical locations, allowing users to find where their preferred crops are grown or recipes are served. This enhanced the practicality of the platform, making it a useful tool for both decision-making and exploration.

User Interface Design

The platform features a clean layout, responsive design, and animations for interactivity. Semantic networks were styled to enhance readability, with nodes and edges clearly labeled and interactive elements guiding user exploration.

Challenges Encountered

One challenge was balancing the complexity of relationships with usability. Simplifying the semantic network required careful pruning of unnecessary links while preserving meaningful connections.

Incorporation of Class Concepts

This project integrates key concepts from the class:

- Ontology: Defined categories and relationships in food data (e.g., recipes, crops, and preferences), creating a structured framework for dynamic navigation.

- Semantic Networks: Represented the relationships visually, allowing users to intuitively explore connections like "similar to" and "used for."

- Information Foraging: Optimized information scent through semantic metadata, guiding users efficiently toward relevant information.

The design prioritized clear affordances, strong visual cues, and logical categorization to align with class readings on usability and data-driven interfaces.

User Testing and Feedback

User testing was conducted primarily with classmates, who explored the platform's features and provided valuable feedback. Their input highlighted the platform's potential as a practical tool for finding relevant food-related information.

Key Observations:

1. **Strengths:**
    - Some of my classmates expressed appreciation for the platform's ability to recommend crops with similar nutrients. They noted how this feature could be particularly helpful for individuals looking to explore alternative food options with comparable health benefits.

    - The recipe recommendation feature and its integration with dining locations were praised as practical tools for discovering new dishes and identifying where to find them.

    - The visual representation of data through semantic networks was noted as a strong feature, helping users understand the connections between various categories such as preferences, cuisines, and crop details

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2. **Areas for Improvement:**

    - Suggestions included expanding the dataset to include more diverse crops, recipes, and dietary attributes to enhance the platform's utility.

    - Classmates recommended refining the semantic network layout for even better clarity and interactivity, especially as the data set grows.

Future Enhancements

- **Data Expansion:** Include more data attributes and refine categories to increase relevance.

- **Advanced Features:** Introduce personalized user profiles to save preferences and browsing history.

- **Integration with External APIs:** Connect with food databases to dynamically pull recipes, crop data, and usage patterns.

Conclusion

The project demonstrates how ontology, semantic networks, and information foraging principles can create a robust knowledge platform for food-related exploration. By combining theoretical concepts with practical implementation, the platform delivers an intuitive and engaging experience that simplifies complex data navigation. Future iterations could focus on scalability, user personalization, and deeper integration of semantic metadata to further enrich the platform’s value.