

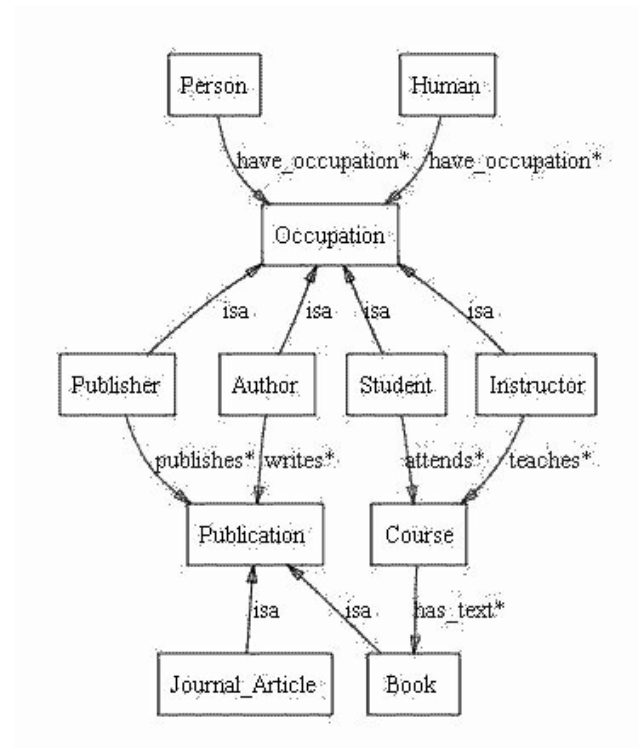
In this case study, we will go deeper into ontologies and the Web Ontology Language (OWL) and how we can represent domains in a rigorous fashion using OWL and ontologies.

### Opening prompt / problem statement

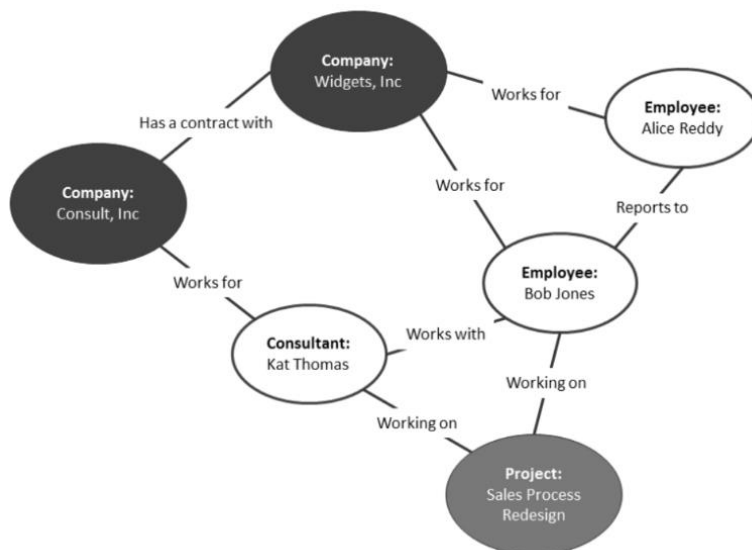
Ontologies are used to capture knowledge about some domain of interest. An ontology describes the concepts in the domain and also the relationships that hold between those concepts. Different ontology languages provide different facilities. The most recent development in standard ontology languages is OWL from the World Wide Web Consortium (W3C). OWL makes it possible to describe concepts but it also provides new facilities. It has a rich set of operators - e.g. intersection, union and negation. It is based on a different logical model which makes it possible for concepts to be defined as well as described. Complex concepts can therefore be built up in definitions out of simpler concepts. Furthermore, the logical model allows the use of a reasoner which can check whether or not all of the statements and definitions in the ontology are mutually consistent and can also recognize which concepts fit under which definitions. The reasoner can therefore help to maintain the hierarchy correctly. This is particularly useful when dealing with cases where classes can have more than one parent.

Below, we provide some examples of ontologies, which may or may not be represented as OWL (although the examples below can be easily represented as OWL). Subsequently, you will do the famous pizza ontology example which is publicly available on the Web and is a good way to get started with OWL and Protégé.

## Publications:



## Personnel:



### Context and opportunity

Traditionally, ontologies have been difficult to represent using easy-to-use software. However, at the beginning of the 2000s, the Protégé tool was released to provide support for ontology design, modeling and representation, along with a range of many other capabilities that have been added over the years.

Protégé is supported by a strong community of academic, government, and corporate users, who use Protégé to build knowledge-based solutions in areas as diverse as biomedicine, e-commerce, and organizational modeling. Protégé's plug-in architecture can be adapted to build both simple and complex ontology-based applications. Developers can integrate the output of Protégé with rule systems or other problem solvers to construct a wide range of intelligent systems.

### Example: Pizza Ontology

Many of the case questions will be relying on the tutorial here:

<https://protegewiki.stanford.edu/wiki/Protege4Pizzas10Minutes> According to this website, you already have a pizza ontology defined at least on paper. Try to come up with such an ontology as a graph. Make it sufficiently rich i.e., make sure you can customize crusts, toppings, proteins etc.

### Case Questions

- i) Follow the tutorial to make a pizza ontology as OWL. Make sure to understand the various steps involved, as we will soon be moving to a new domain.
- ii) Imagine you are a party planner and you need to decide the menu and cuisine. Choose a cuisine and start constructing an ontology for it. As a hint, try to think about how a restaurant that serves in that cuisine tries to organize its menu.

- iii) As a bonus step, try to build this ontology in Protégé to make sure you understand it correctly.
- iv) Now suppose you have been given a total budget amount, and there is a database somewhere with prices for the different items in your ontology. Discuss in detail how you would use your ontology, in conjunction with other software, methods, constraints or paradigms (e.g., optimization), to design a good and affordable menu for your client.
- v) Is a structured ontology the only way to represent a domain? What other modalities can you think of? What are their pros and cons compared to an ontology as the representation?