What's the Difference Between an Ontology and a Knowledge Graph?

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As semantic applications become increasingly hot topics in the industry, clients often come to EK asking about ontologies and knowledge graphs. Specifically, they want to know the differences between the two. Are ontologies and knowledge graphs the same thing? If not, how are they different? What is the relationship between the two?

In this blog, I'll walk you through both ontologies and knowledge graphs, describing how they're different and how they work together to organize large amounts of data and information.

What is an ontology?

Ontologies are semantic data models that define the **types** of things that exist in our domain and the **properties** that can be used to describe them. Ontologies are *generalized* data models, meaning that they only model *general* types of things that share certain properties, but don't include information about *specific* individuals in our domain. For example, instead of describing your dog, Spot, and all of his individual characteristics, an ontology should focus on the general concept of *dogs*, trying to capture characteristics that most/many dogs might have. Doing this allows us to reuse the ontology to describe additional dogs in the future.

There are three main components to an ontology, which are usually described as follows:

- **Classes:** the distinct types of things exist in our data (e.g. ….)
- **Relationships:** properties that connect two classes
- **Attributes:** properties that describe an individual class

For example, imagine we have the following information on books, authors, and publishers:

Books

Title	Author	Publisher	Year Published	Followed By
To Kill a Mockingbird	Harper Lee	J. B. Lippincott Company	1960	Go Set a Watchman
Go Set a Watchman	Harper Lee	HarperCol-lins, LLC; Heinemann	2015	
The Picture of Dorian Gray	Oscar Wilde	J. B. Lippincott & Co.	1890	
2001: A Space Odyssey	Arthur C. Clarke	New American Library, Hutchinson	1968	

Publishers

Name	City	Country
J. B. Lippincott & Company	Philadelphia	United States
HarperCollins, LLC	New York City	United States
Heinemann	Portsmouth	United States
New American Library	New York City	United States
Hutchinson	London	United Kingdom

Authors

Name	Country of Birth
Harper Lee	United States
Oscar Wilde	Ireland
Arthur C. Clarke	United Kingdom

First, we want to identify our classes (the unique types of things that are in the data). This sample data appears to capture information about **books**, so that's a good candidate for a class. Specifically, the sample data captures certain types of things about books, such as **authors** and **publishers.** Digging a little deeper, we can see our data also captures information about **publishers** and **authors**, such as their **locations**. This leaves us with four classes for this example:

- Books
- Authors
- Publishers
- Locations

Next, we need to identify relationships and attributes (for simplicity, we can consider both relationships and attributes as properties). Using the classes that we identified above, we can look at the data and start to list all of the properties we see for each class. For example, looking at the **book** class, some properties might be:

- Books have authors
- Books have publishers
- Books are published on a date
- Books are followed by sequels (other books)

Some of these properties are *relationships* that connect two of our classes. For example, the property "**books** have **authors**" is a relationship that connects our **book** class and our **author** class. Other properties, such as "**books** are published on a date," are attributes, describing only one class, instead of connecting two classes together.

It's important to note that these properties *might* apply to any given book, but they don't necessarily *have* to apply to every book. For example, many books don't have sequels. That's fine in our ontology because we just want to make sure we capture possible properties that could apply to many, but not necessarily all, books.

While the above list of properties is easy to read, it can be helpful to rewrite these properties to more clearly identify our classes and properties. For example, "**books** have **authors**" can be written as:

Book → has author → Author

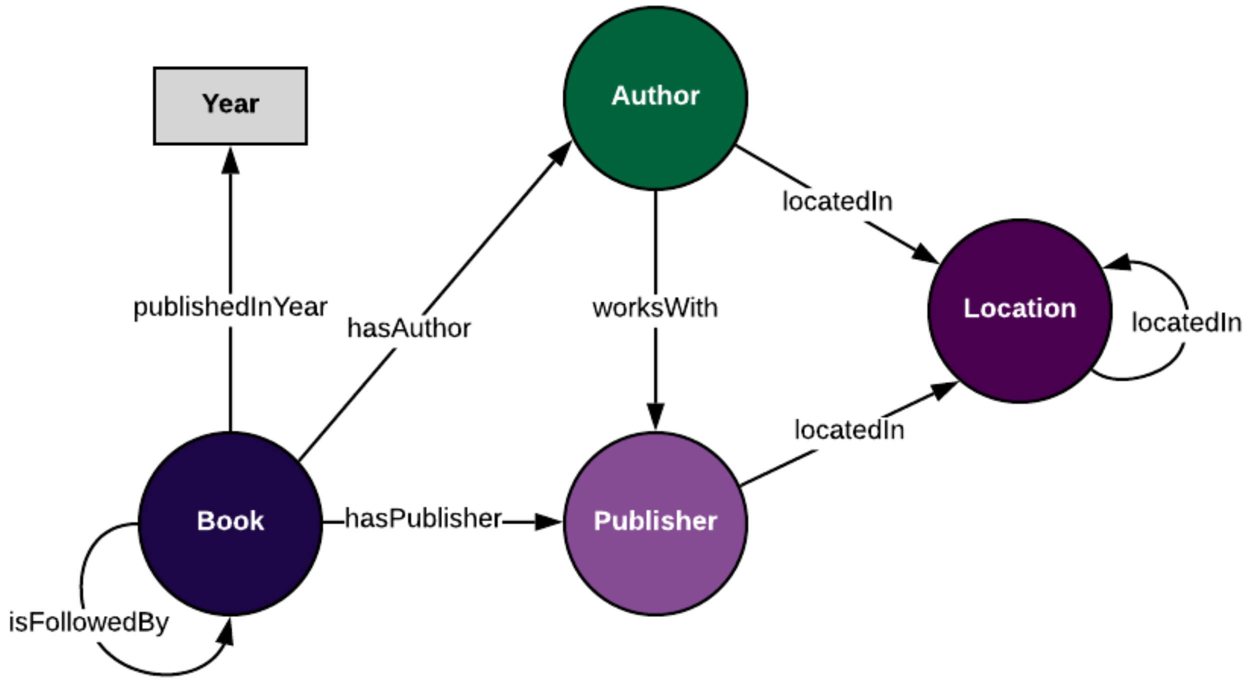
Although there are many more properties that you could include, depending on your use case, for this blog, I've identified the following properties:

- Book → has author → Author

- Book → has publisher→ Publisher
- Book → published on → Publication date
- Book → is followed by → Book
- Author → works with → Publisher
- Publisher → located in → Location
- Location → located in → Location

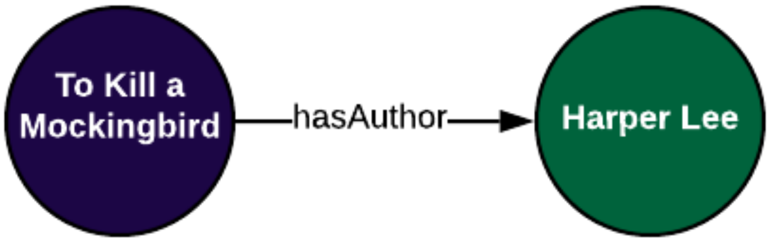
Remember that our ontology is a general data model, meaning that we don't want to include information about *specific* books in our ontology. Instead, we want to create a reusable framework we could use to describe additional books in the future.

When we combine our classes and relationships, we can view our ontology in a graph format:

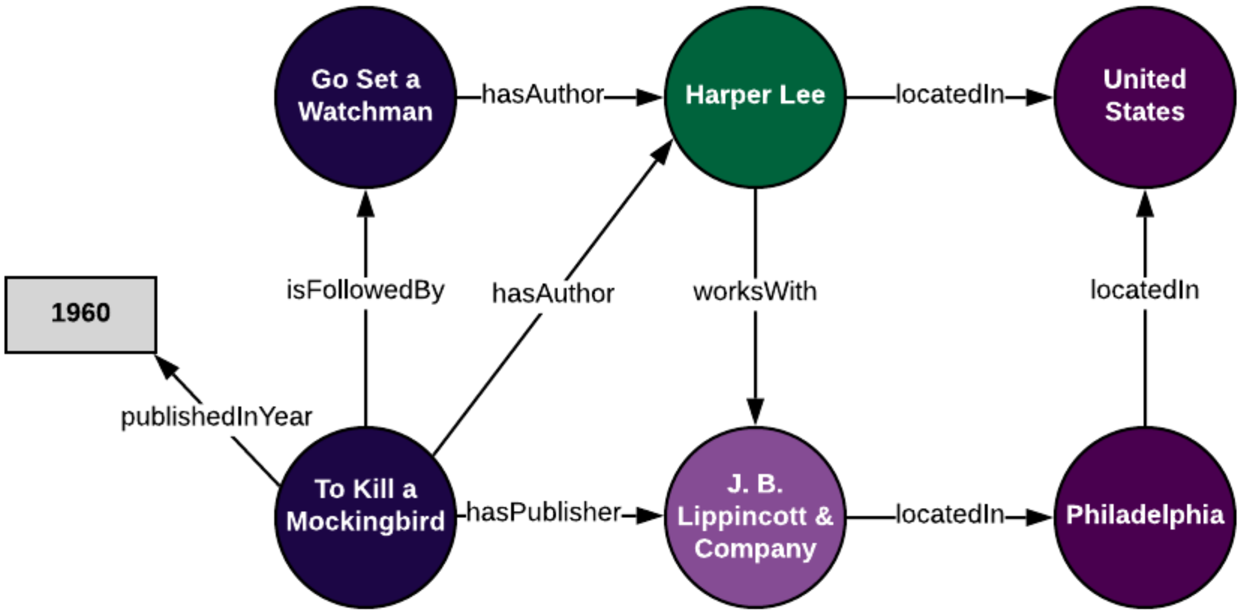


What is a knowledge graph?

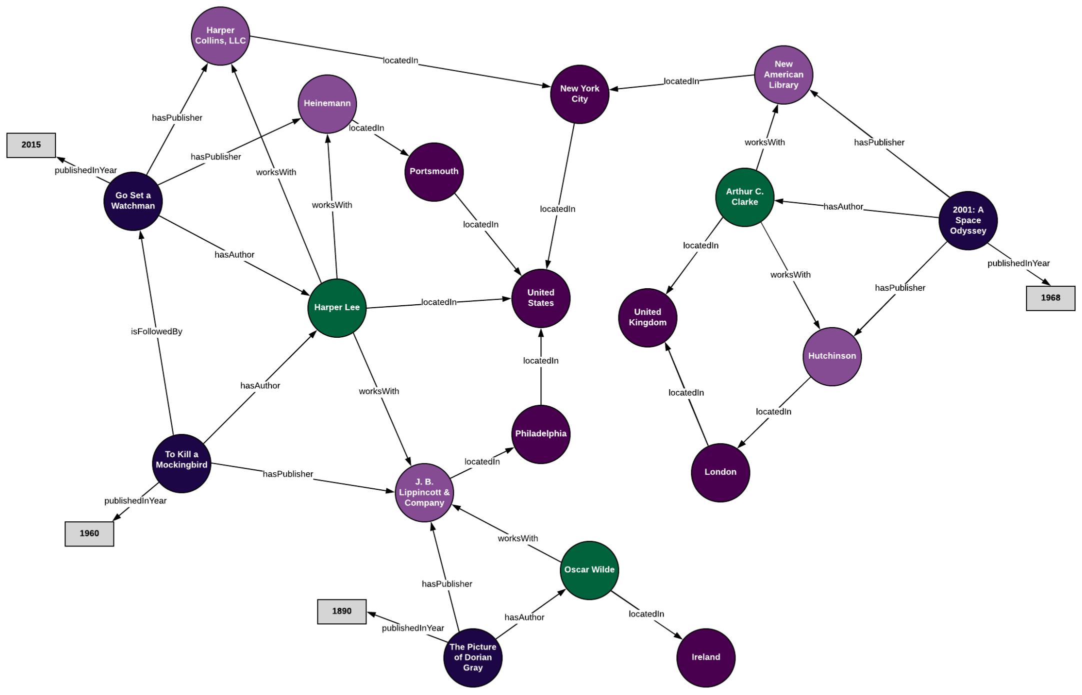
Using our ontology as a framework, we can add in real data about individual books, authors, publishers, and locations to create a knowledge graph. With the information in our tables above, as well as our ontology, we can create specific instances of each of our ontological relationships. For example, if we have the relationship *Book → has author → Author* in our ontology, an individual instance of this relationship looks like:



If we add in all of the individual information that we have about one of our books, To Kill a Mockingbird, we can start to see the beginnings of our knowledge graph:



If we do this with all of our data, we will eventually wind up with a graph that has our data encoded using our ontology. Using this knowledge graph, we can view our data as a web of relationships, instead of as separate tables, drawing new connections between data points that we would otherwise be unable to understand. Specifically, using SPARQL, we can query this data, using inferencing, letting our knowledge graph make connections for us that weren't previously defined.



So how are ontologies and knowledge graphs different?

As you can see from the example above, a knowledge graph is created when you apply an ontology (our data model) to a dataset of individual data points (our book, author, and publisher data). In other words:

ontology + data = knowledge graph

Ready to get started? Check our ontology design and knowledge graph design best practices, and contact us if you need help beginning your journey with advanced semantic data models.