

МИНОБРНАУКИ РОССИИ  
Федеральное государственное автономное образовательное учреждение  
высшего образования  
«ЮЖНЫЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ»  
ИНСТИТУТ КОМПЬЮТЕРНЫХ ТЕХНОЛОГИЙ И ИНФОРМАЦИОННОЙ  
БЕЗОПАСНОСТИ

# Knowledge Graph

**Выполнила:**

ст. гр. КТмо1-4

Гоманченко Наталья

**Проверил:**

Целых Алексей Александрович

# Contents



Glossary



Technology in Brief



Methodology



State of the Art and Open Issue



Industry Leaders, Startup



Bibliography



# Glossary



Types of entities and relations are defined in some machine-understandable dictionaries called **ontologies**.

The standard ontology language is called OWL (**Web Ontology Language**).

**Knowledge Graphs** are large networks of entities, their semantic types, properties, and relationships between those entities.

In a knowledge graph, the objects are called “**nodes**”, while relationships are called “**edges**”.

# Technology in Brief

A **knowledge graph** consists of a set of interconnected typed entities and their attributes.

**Knowledge Graphs** are large networks of *entities*, their *semantic types*, *properties*, and *relationships* between those entities.

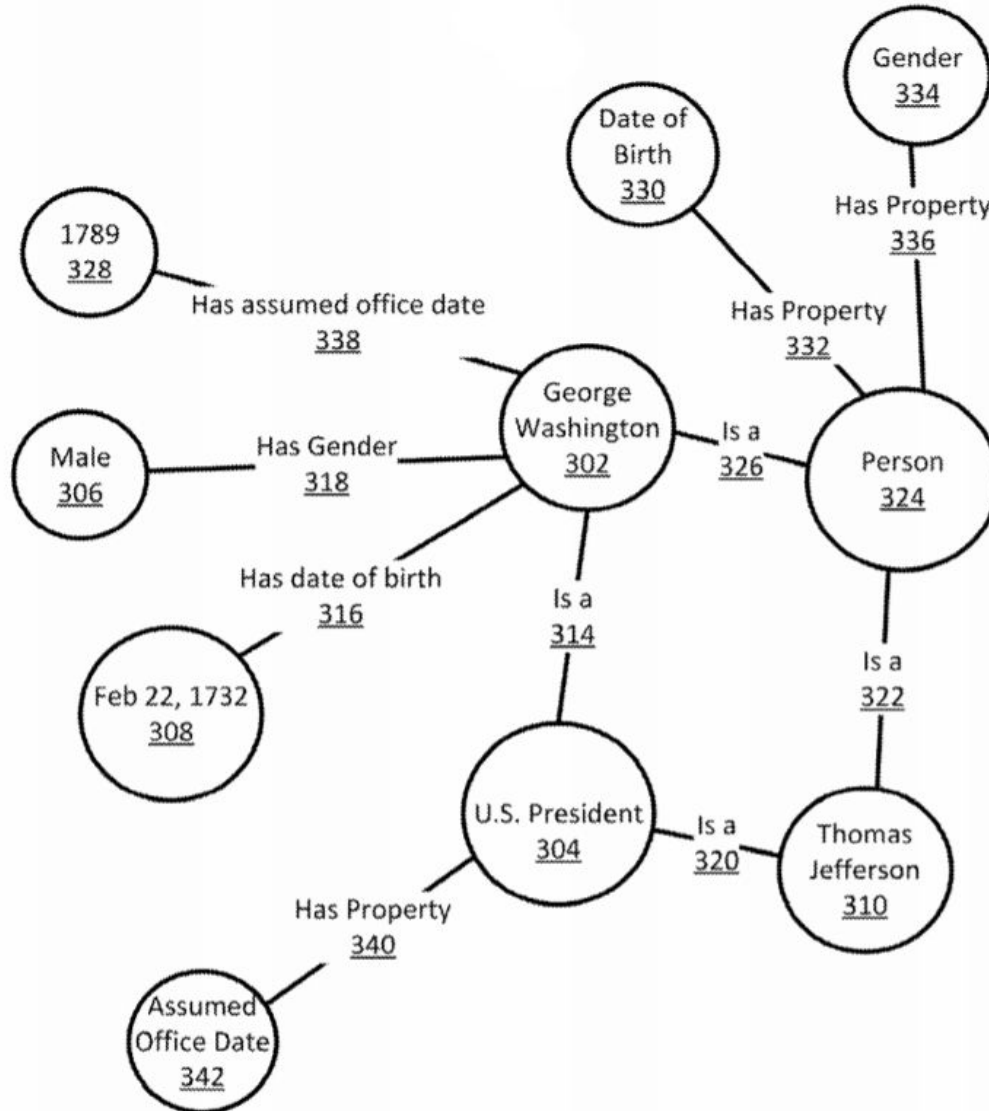
Those *entities* can be grouped into *classes* according to their *semantics*, and should ideally cover every aspect that is important for a certain domain

## The Knowledge Graph



A visualization of the Knowledge Graph

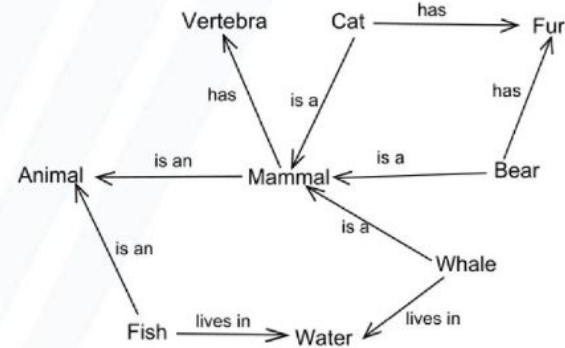
# Technology in Brief



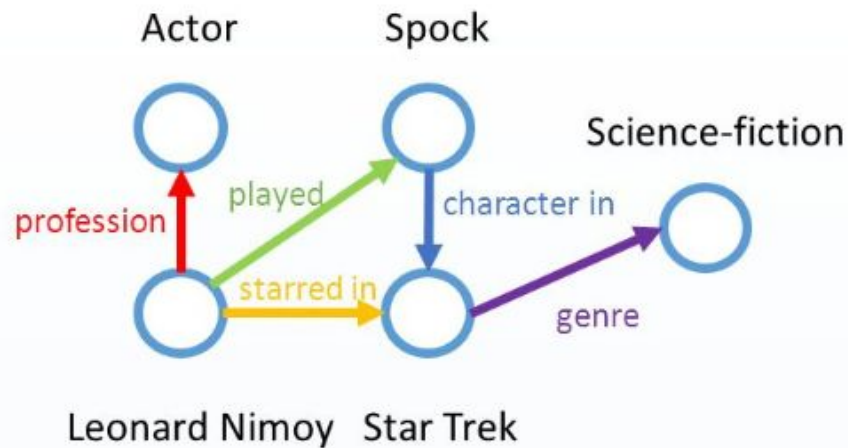
# Technology in Brief

- a.k.a. Semantic network (1960s)
- a.k.a. Knowledge base (1970s)
- a.k.a. Semantic web (2000s)
- a.k.a. Big data (2010s)
- a.k.a. Knowledge graph (2012)
- a.k.a. Artificial Intelligence

## Semantic Network

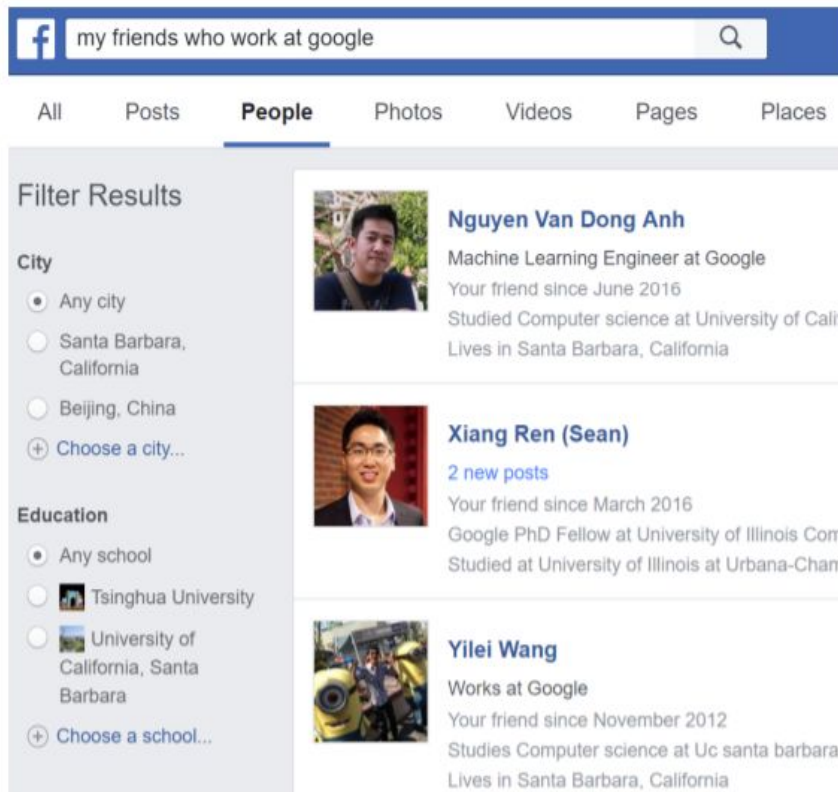


Node: Concept    Edge: Relationship



# Technology in Brief

## Application: Facebook Entity Graph



The screenshot shows a Facebook search interface. The search bar contains the text "my friends who work at google". Below the search bar, there are tabs for "All", "Posts", "People", "Photos", "Videos", "Pages", and "Places". The "People" tab is selected. On the left, there are filter options for "City" and "Education". The "City" filter has options for "Any city", "Santa Barbara, California", "Beijing, China", and "Choose a city...". The "Education" filter has options for "Any school", "Tsinghua University", "University of California, Santa Barbara", and "Choose a school...". The main content area displays three search results for people:

- Nguyen Van Dong Anh**: Machine Learning Engineer at Google. Your friend since June 2016. Studied Computer science at University of Calif. Lives in Santa Barbara, California.
- Xiang Ren (Sean)**: 2 new posts. Your friend since March 2016. Google PhD Fellow at University of Illinois Comp. Studied at University of Illinois at Urbana-Champ.
- Yilei Wang**: Works at Google. Your friend since November 2012. Studies Computer science at Uc santa barbara. Lives in Santa Barbara, California.



### People, Places, and Things

Facebook's knowledge graph (entity graph) stores as entities the users, places, pages and other objects within the Facebook.



### Connecting

The connections between the entities indicate the type of relationship between them, such as friend, following, photo, check-in, etc.



# Methodology



## A **knowledge graph**

1. mainly describes real world entities and their interrelations, organized in a graph.
2. defines possible classes and relations of entities in a schema.
3. allows for potentially interrelating arbitrary entities with each other.
4. covers various topical domains.



# Methodology

There are various ways of building such knowledge graphs. They can be curated like **Cyc**, edited by the crowd like **Freebase** and **Wikidata**, or extracted from large-scale, semi-structured web knowledge bases such as **Wikipedia**, like **DBpedia** and **YAGO**. Furthermore, information extraction methods for unstructured or semi-structured information are proposed, which lead to knowledge graphs like **NELL**, **PROSPERA**, or **KnowledgeVault**.



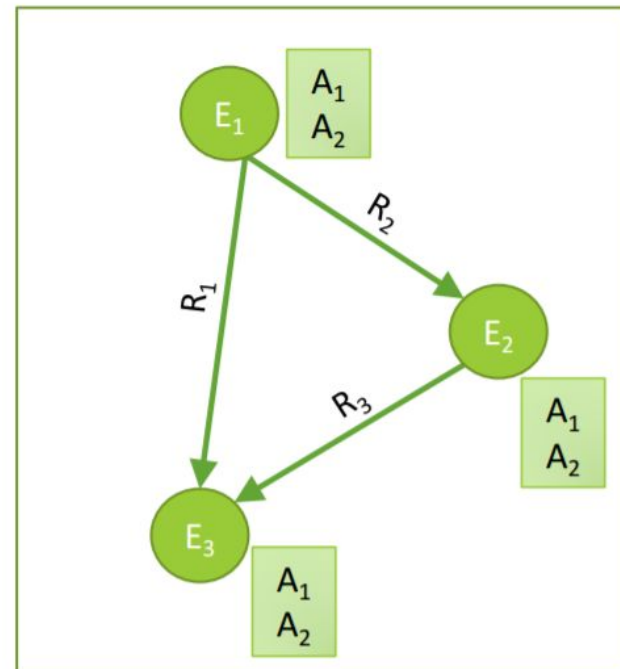
# State of the Art and Open Issues

Whichever approach is taken for constructing a knowledge graph, the result will never be perfect.

## Basic problems

---

- **Who** are the entities (nodes) in the graph?
- **What** are their attributes and types (labels)?
- **How** are they related (edges)?

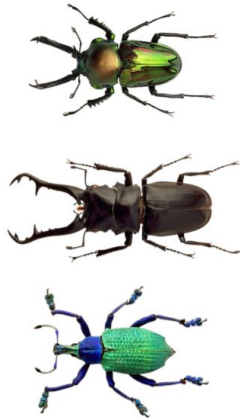


# State of the Art and Open Issues

Extracted knowledge is:

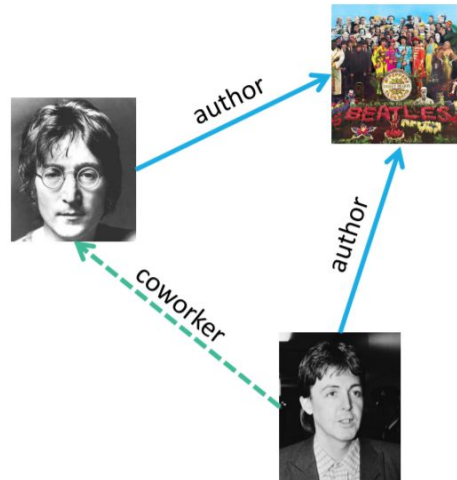
- ambiguous:

- Ex: Beetles, beetles, Beatle
- Ex: citizenOf, livedIn, bornI



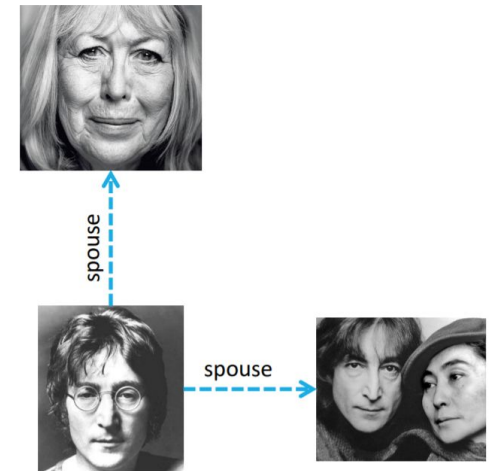
- incomplete

- Ex: missing relationship
- Ex: missing labels
- Ex: missing entities



- inconsistent

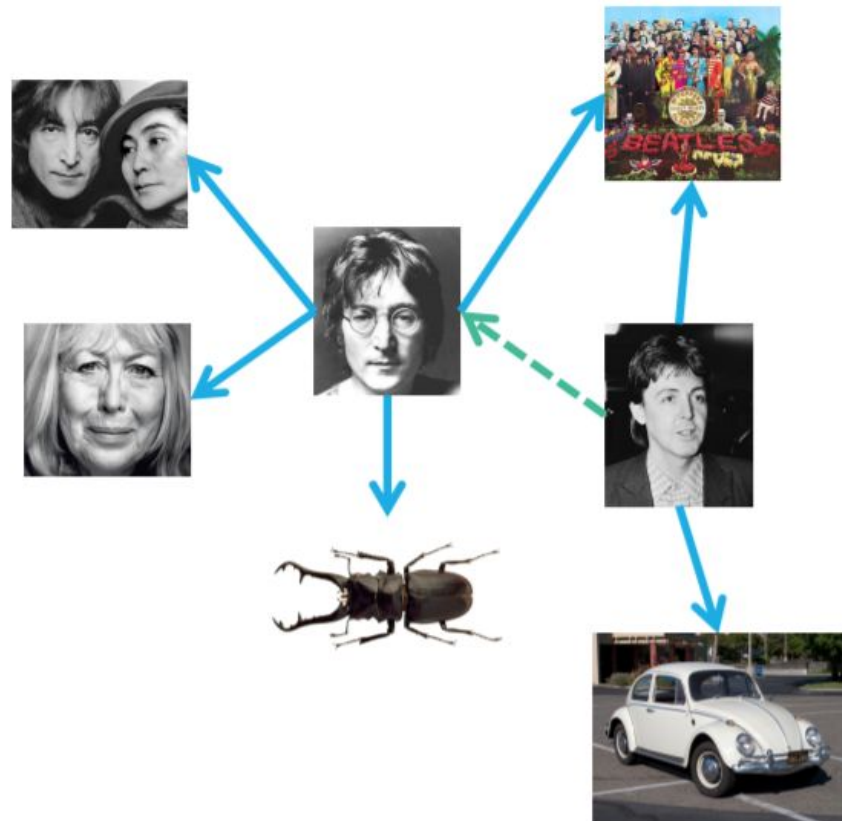
- Ex: Cynthia Lennon, Yoko Ono
- Ex: exclusive labels (alive, dead)
- Ex: domain-range constraints



# State of the Art and Open Issues

Extracted knowledge is:

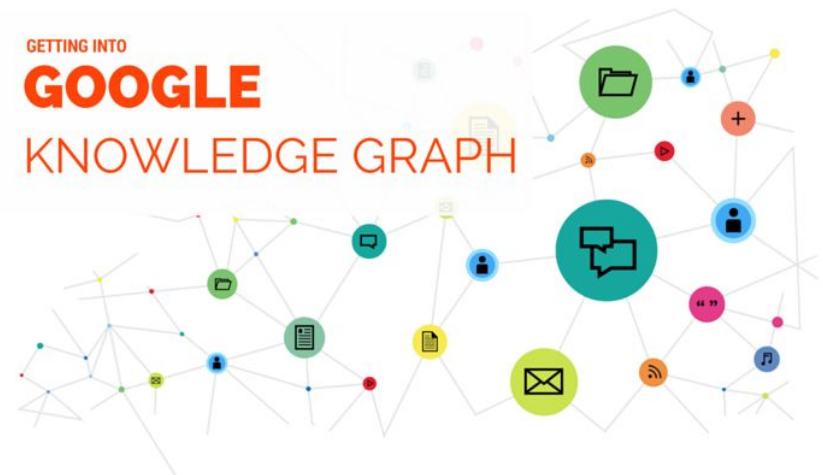
- ambiguous
- incomplete
- inconsistent



# Industry Leaders, Startup

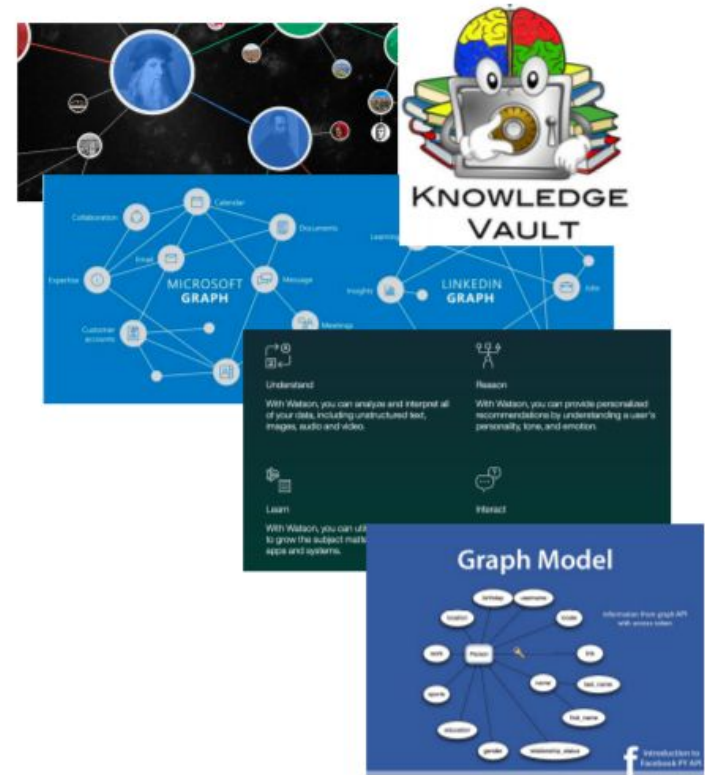
The term '**Knowledge Graph**' became well known in 2012 when **Google** started to use knowledge graph in their search engine, allowing users to search for things, people or places, rather than just matching strings in the search queries with those in Web documents.

Inspired by the success story of **Google**, knowledge graphs are gaining momentum in the world's leading information companies.



# Industry Leaders, Startup

- Google Knowledge Graph
  - Google Knowledge Vault
- Amazon Product Graph
- Facebook Graph API
- IBM Watson
- Microsoft Satori
  - Project Hanover/Literome
- LinkedIn Knowledge Graph
- Yandex Object Answer
- Diffbot, GraphIQ, Maana, ParseHub, Reactor Labs, SpazioDati





# Bibliography



- Ehrlinger, Lisa; Wöß, Wolfram (2016). "Towards a Definition of Knowledge Graphs"
- Wang, Z.; Zhang, J.; Feng, J.; and Chen, Z. 2014a. Knowledge graph and text jointly embedding. In Proceedings of EMNLP, 1591–1601.
- Singhal, Amit (May 16, 2012). "Introducing the Knowledge Graph: Things, Not Strings". Google Official Blog. Retrieved September 6, 2014.
- Wang, Z.; Zhang, J.; Feng, J.; and Chen, Z. 2014b. Knowledge graph embedding by translating on hyperplanes. In Proceedings of AAAI, 1112–1119.
- A. Blumauer. From Taxonomies over Ontologies to Knowledge Graphs, July 2014. <https://blog.semanticweb.at/2014/07/15/from-taxonomies-over-ontologiesto-knowledge-graphs> [December, 2018].
- How Google's Knowledge Graph Updates Itself by Answering Questions URL:([www.seobythesea.com/2018/10/how-googles-knowledge-graph-updates-itself-by-answering-questions/](http://www.seobythesea.com/2018/10/how-googles-knowledge-graph-updates-itself-by-answering-questions/)) [December, 2018].
- Bakker, R.R., Knowledge Graphs : Representation and Structuring of Scientific Knowledge, PhD Thesis, University of Twente, Enschede, The Netherlands, ISBN 9001963-4 (1987).
- Mining Knowledge Graphs from Text URL:(<https://kgtutorial.github.io/>) [December, 2018].
- Knowledge Graph URL:([https://en.wikipedia.org/wiki/Knowledge\\_Graph](https://en.wikipedia.org/wiki/Knowledge_Graph)) [December, 2018].