

A light gray, irregular, cloud-like shape with soft, wavy edges, centered on the page. It serves as a background for the main title text.

SEMANTIC WEB & KNOWLEDGE GRAPH

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OUTLINE

- Semantic Web
- Three phases of Semantic Web
- Knowledge Graphs

SEMANTIC WEB

TODAY'S WEB

The image displays three overlapping screenshots of the British Computer Society (BCS) website, illustrating web navigation and content. Red arrows point from the main page to specific content areas.

- Top Screenshot:** Shows the BCS homepage with a navigation menu (HOME, TEXT, CONTACT, SITE MAP, SEARCH, FORUMS, MEMBERS AREA) and a sidebar with links like 'Join BCS', 'About', 'News', 'Awards & Events', 'Groups', 'Products & Services', 'Information & Advice', and 'Careers'. The main content area features a 'Welcome to The British Computer Society' message and sections for 'SITE FEATURES' (For Members... Browse SFI Awards) and 'REGULAR FEATURES' (Online Services, Join the BCS).
- Middle Screenshot:** Focuses on the 'Individual Continuing Professional Development' section, highlighting the 'Browse SFI Awards' feature. It includes a sub-section for 'Browse SFI Awards' and a 'Professional Development' sidebar.
- Bottom Screenshot:** Focuses on the 'BCS Review' section, featuring 'The British Computer Society Annual Review 2005'. It includes a 'BCS Review' sidebar and a 'BCS Student Membership' section.

- Distributed hypertext/hypermedia
- Information accessed via (keyword based) search and browse
- Browser tools render information for **human consumption**

SYNTACTIC VS SEMANTIC

- Syntactic
 - how we communicate things
- Semantic
 - how we understand things

WHAT IS SEMANTIC WEB?

- enhancement of the current World Wide Web with machine-understand-able information
- together with services utilizing this information
- Provision of machine understandable information in this case is done by endowing data with expressive metadata for the data.
- in the Semantic Web, this metadata is generally in the form of ontologies
- establishing efficient methods and tools for data sharing, discovery, integration, and reuse

METADATA

- The origins of the Semantic Web lie in metadata
- Metadata is data about data
 - A webpage is data
 - A description of the webpage is metadata
 - Metadata for a webpage could include
 - author
 - date of publication
 - file size
 - ...
- Library cataloguing = metadata

SEMANTIC WEB VS WORLD WIDE WEB

- The World Wide Web is the Web for people
 - Information is predominantly textual
 - Technologies include URI, HTTP, XML, HTML
- The Semantic Web is the Web for machines
 - Information needs to be structured
 - Technologies include RDF, RDFS, OWL
(in addition to those for the Web)

THREE PHASES IN SEMANTIC WEB

THREE PHASES OF SEMANTIC WEB

Ontologies

Linked
Data

Knowledge
Graphs

PHASE 1: ONTOLOGIES

- Ontology is a knowledge base of concepts and their relationships specified in a knowledge representation language based on a formal logic
- In Semantic Web, ontologies are the main vehicle for data integration, sharing, and discovery
- Standard to build ontologies:
 - OWL
 - RDF
 - SPARQL

WEB ONTOLOGY LANGUAGE (OWL)

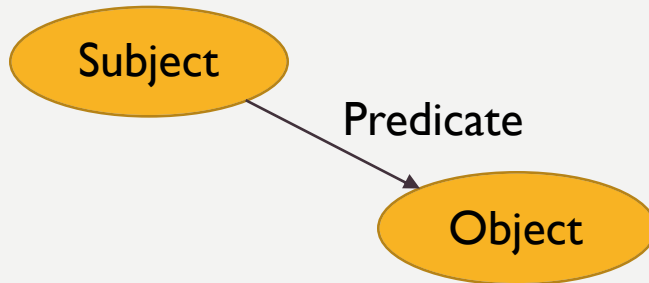
- OWL is a computational logic-based language
- Knowledge expressed in OWL can be exploited by computer programs
- Based on description logic

RESOURCE DESCRIPTI ON FRAMEWO RK (RDF)

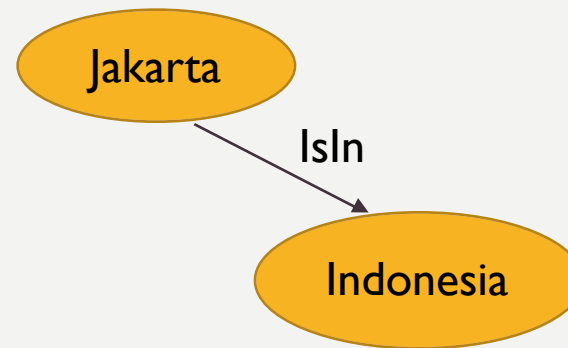
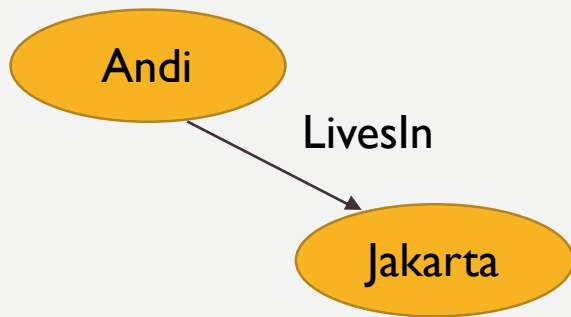
- RDF is a syntax for expressing directed, labeled, and typed graphs
- OWL ontology can serve as a schema for RDF typed graphs
 - Use OWL to specify an ontology of types and their relationships
 - Use the types as types in RDF graphs
 - Represent relationships as edges

COMPONENTS OF RDF

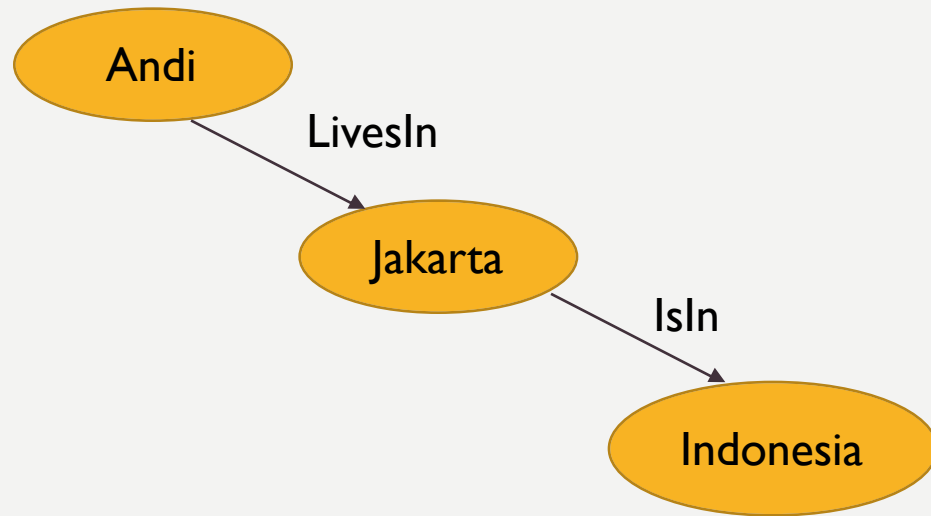
- In RDF graphs, all data are declared in the form of
 - Subject \rightarrow Predicate \rightarrow Object



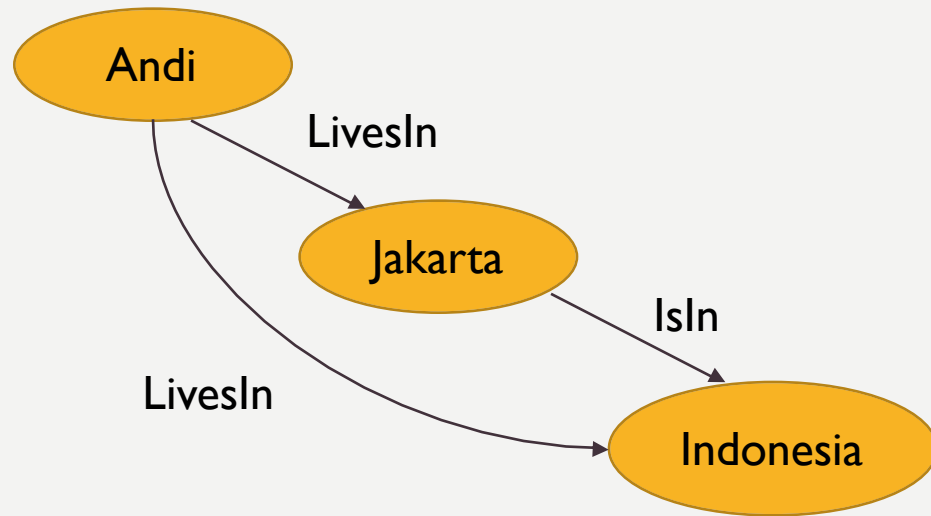
CONTOH RDF



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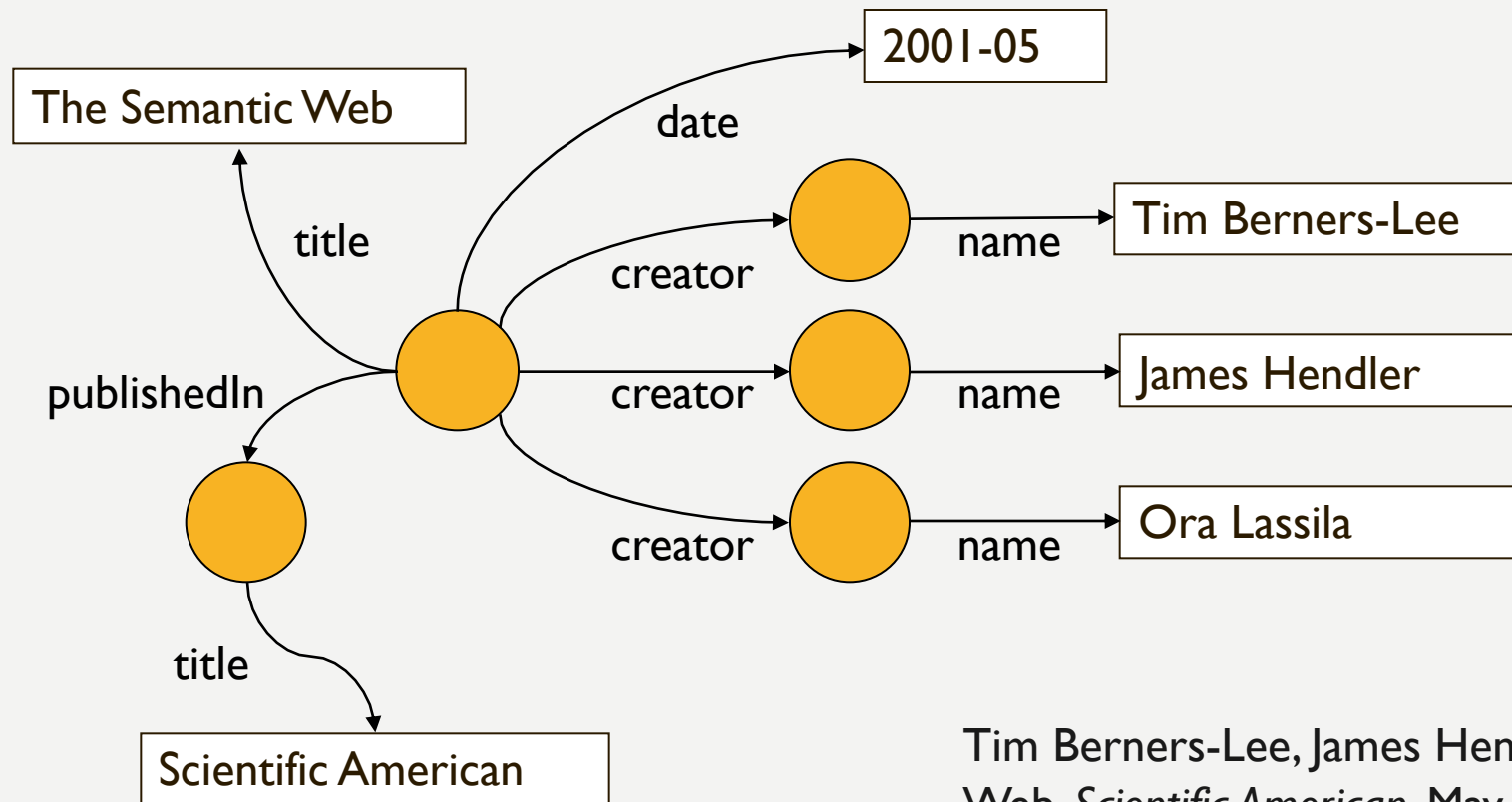


MORE EXAMPLE

- Take a citation:

Tim Berners-Lee, James Hendler and Ora Lassila. *The Semantic Web*. *Scientific American*, May 2001
- We can identify a number of distinct statements in this citation:
 - There is an article titled “The Semantic Web”
 - One of its authors is a person named “Tim Berners-Lee” (etc)
 - It appeared in a publication titled “Scientific American”
 - It was published in May 2001

- We can represent these statements graphically



Tim Berners-Lee, James Hendler and Ora Lassila. The Semantic Web. *Scientific American*, May 2001

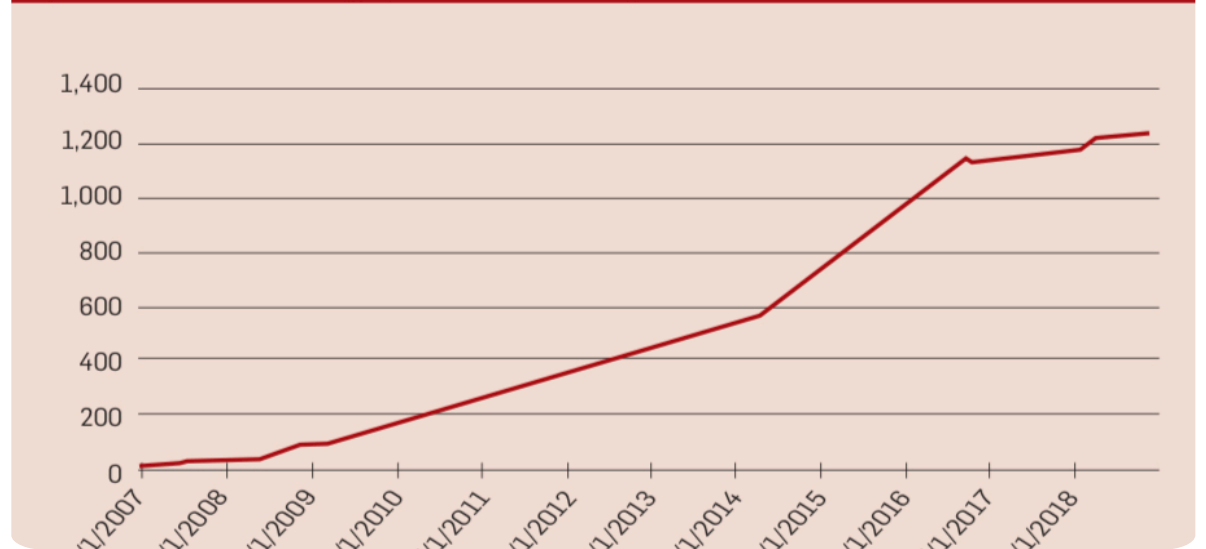
SPARQL

- SPARQL is an RDF query language
- Semantic query language for database that is able to retrieve and manipulate data stored in RDF format

PHASE 2: LINKED DATA (1)

- Consists of set of RDF graphs that are linked
- The collection of all linked RDF graphs can be understood as one very big RDF graph
- The number of publicly available linked RDF graphs has been showing significant growth

Figure 1. Number of RDF graphs in the Linked Open Data Cloud over time.



PHASE 2: LINKED DATA (2)

- In this phase, ontologies played a much less prominent role
- The information in RDF graphs was shallow
- It turned out that we need much effort in integrating data

PHASE 3: KNOWLEDGE GRAPHS

- Knowledge graph is a knowledge base that uses a graph-structured data model to integrate data
- Often used to store interlinked descriptions of entities while also encoding the semantics underlying the used terminologies
- Focus on connection between concepts and entities to represent semantics



(MORE ABOUT) KNOWLEDGE GRAPHS

KNOWLEDGE MODEL

- Knowledge model is a collection of interlinked descriptions of concepts, entities, relationships and events where:
 - Descriptions have formal semantics that allow both people and computers to process them in an efficient and unambiguous manner;
 - Descriptions contribute to one another, forming a network, where each entity represents part of the description of the entities related to it;
 - Diverse data is connected and described by semantic metadata according to the knowledge model.

COMPONENTS OF KNOWLEDGE GRAPHS

- **Database**
 - the data can be explored via structured queries
- **Graph**
 - they can be analyzed as any other network data structure
- **Knowledge base**
 - they bear formal semantics, which can be used to interpret the data and infer new facts.

THANK YOU