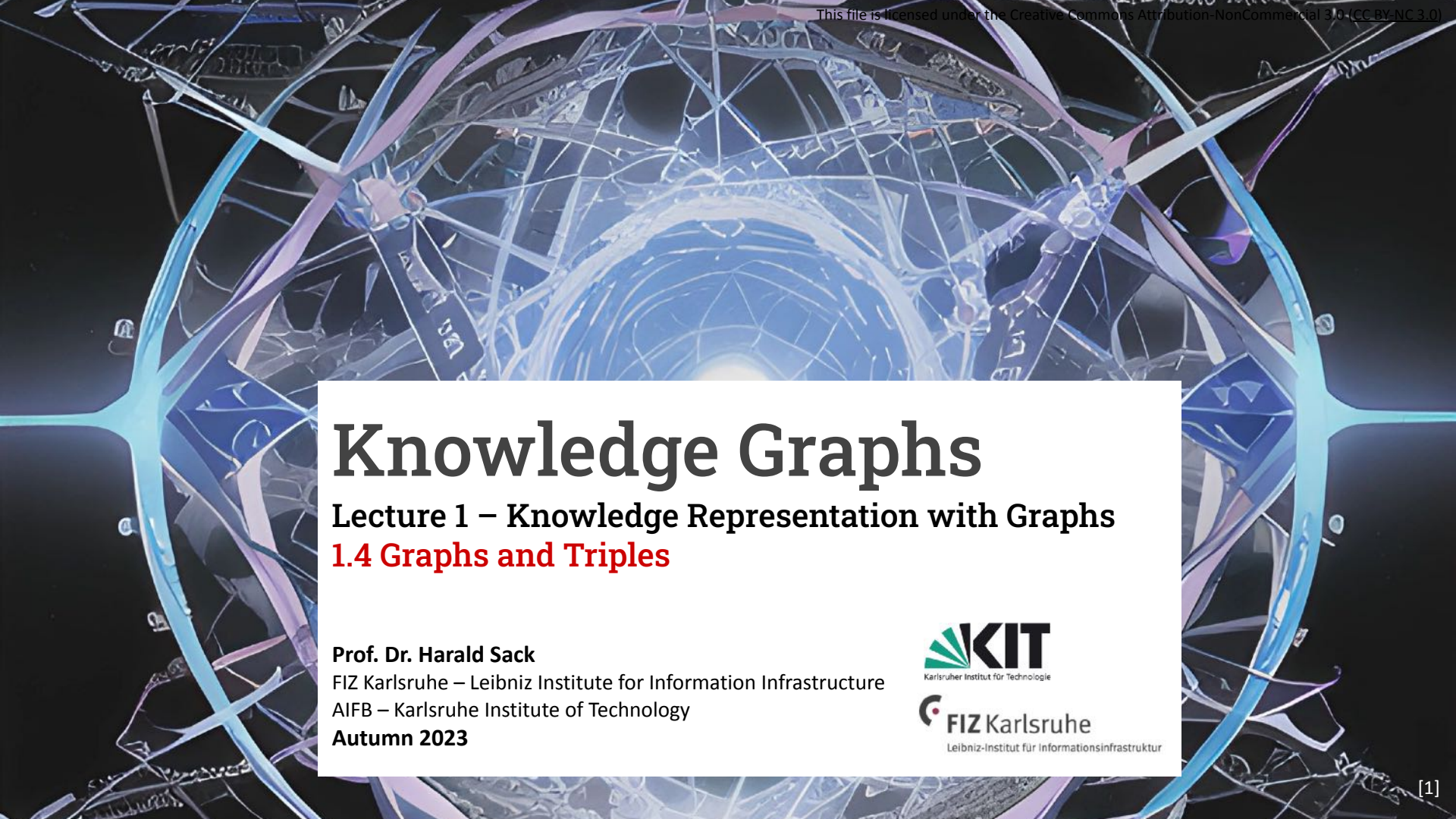

Knowledge Graphs

Lecture 1 – Knowledge Representation with Graphs

1.4 Graphs and Triples

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FIZ Karlsruhe – Leibniz Institute for Information Infrastructure
AIFB – Karlsruhe Institute of Technology
Autumn 2023

Knowledge Graphs

Lecture 1: Knowledge Representation with Graphs

1.1 From Data to Knowledge

1.2 Knowledge and how to represent it

1.3 The Art of Understanding

1.4 Graphs and Triples

1.5 Knowledge Graphs

1.6 The Semantic Web

1.7 Linked Data and the Web of Data

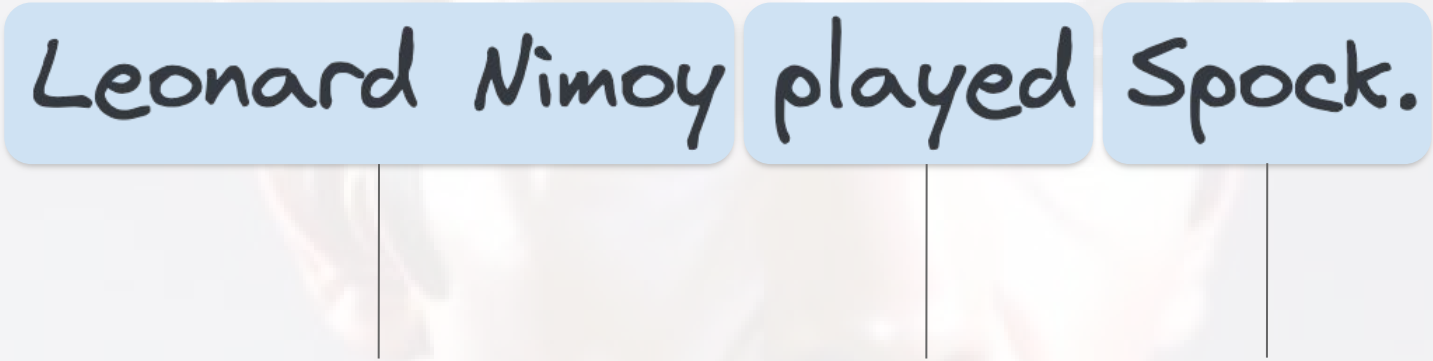

I am not Spock
Leonard Nimoy played Spock.
Spock is a character in Star Trek.
Leonard Nimoy starred in Star Trek.

[2]

[2]

An Intuitive Way to Represent Knowledge

Karlsruher Institut für Technologie
FIZ Karlsruhe
Leibniz Institute for Information Infrastructure



Leonard Nimoy played Spock.
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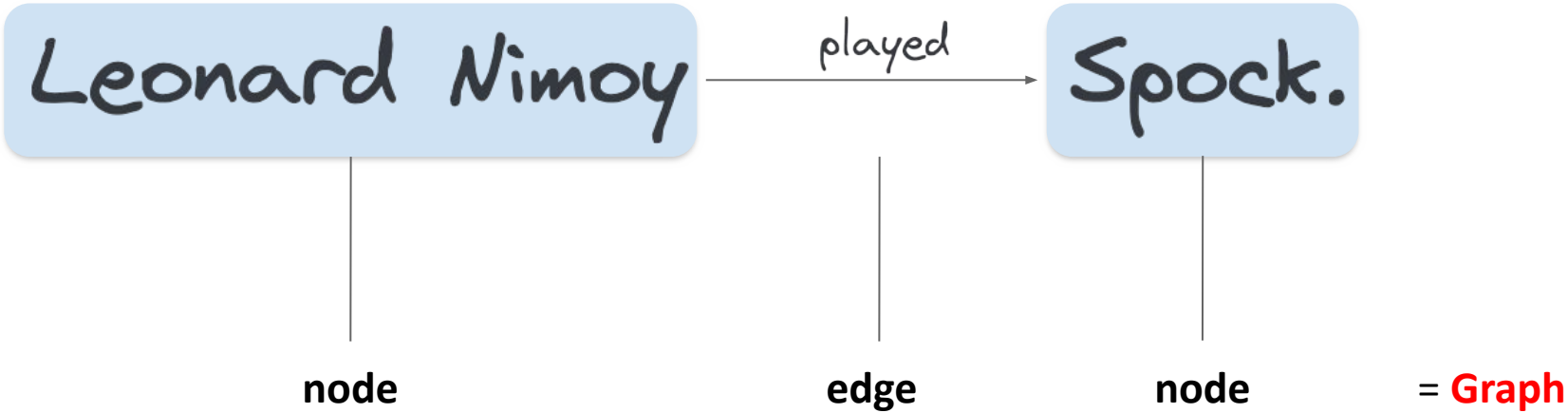
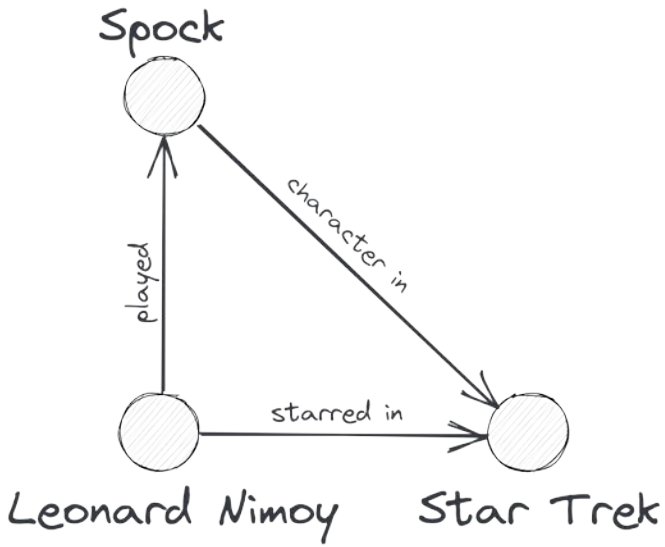
[2]

An Intuitive Way to Represent Knowledge



An Intuitive Way to Represent Knowledge

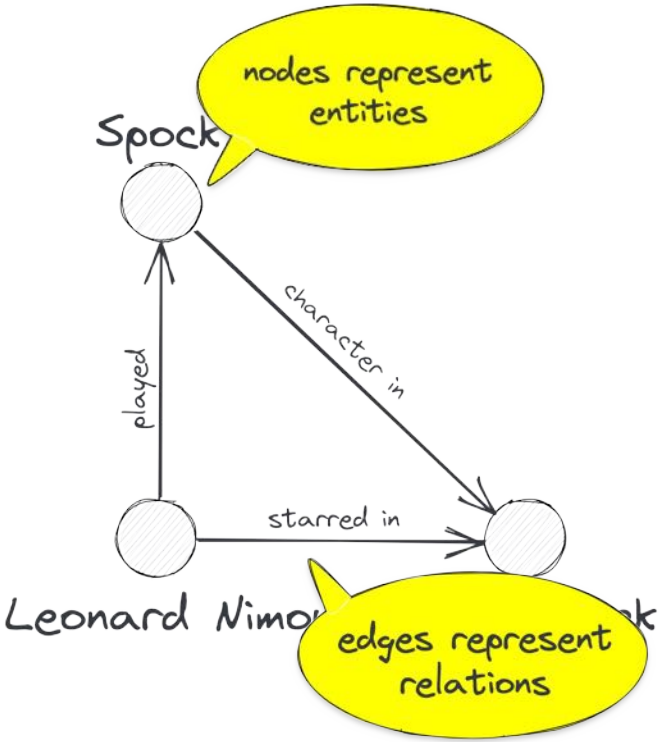


Definition 1.1:
A **directed edge-labeled graph G=(V,E,L)** consists of

- a set **V** of **nodes (vertices)**, |V|=n,
- a set **L** of **edge labels**,
- and a set **E** of **directed edges**, $E \subseteq V \times L \times V$, where each edge $e_i=(v_k, l_j, v_l)$, $e_i \in E$ is an ordered triple of two vertices $v_k, v_l \in V$ and an edge label $l_j \in L$.

V={Spock, Leonard Nimoy, Star Trek}
L={played, starred in, character in}
E={(Leonard Nimoy, played, Spock), (Leonard Nimoy, starred in, Star Trek),
(Spock, character in, Star Trek)}

An Intuitive Way to Represent Knowledge



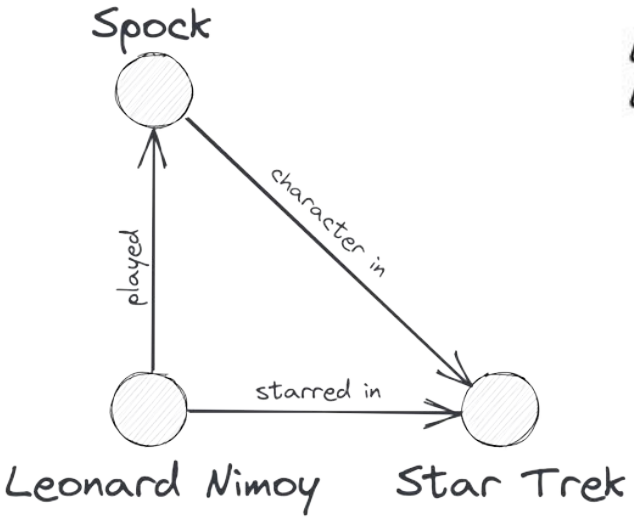
Definition 1.2:

- **Entity**: a thing of distinct and independent existence.
- **Relation**: describes how entities are related to one another.

Let **N** be a set of entities, then a relation **R** is defined as:

$$R \subseteq N \times N$$

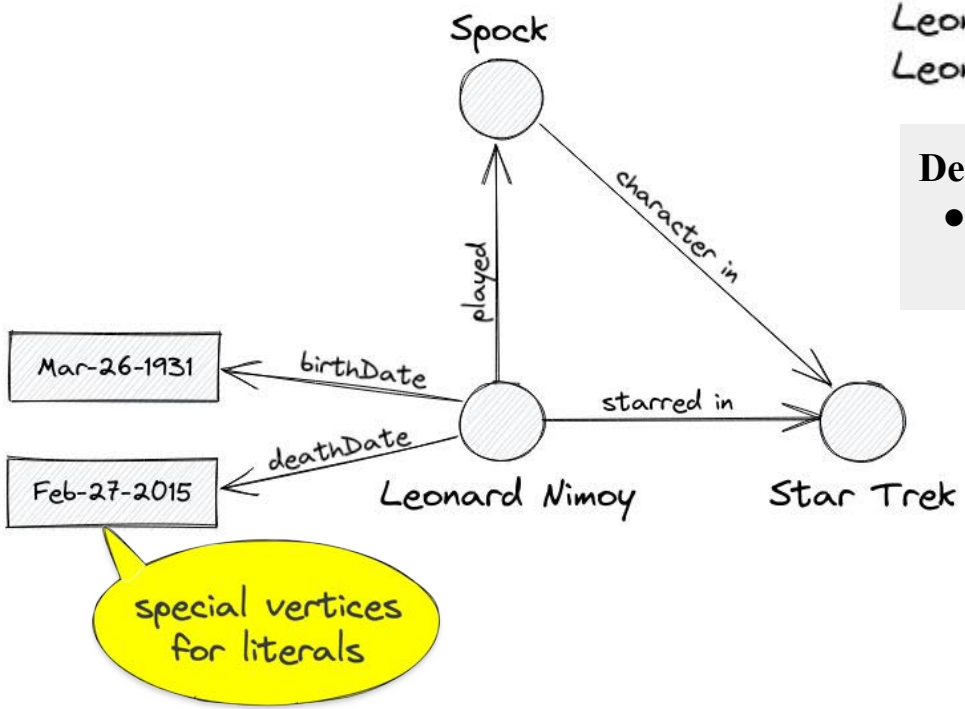
Further Refinements



Leonard Nimoy was born on Mar-26-1931.
Leonard Nimoy passed away on Feb-27-2015.

Is a date an entity?

Further Refinements

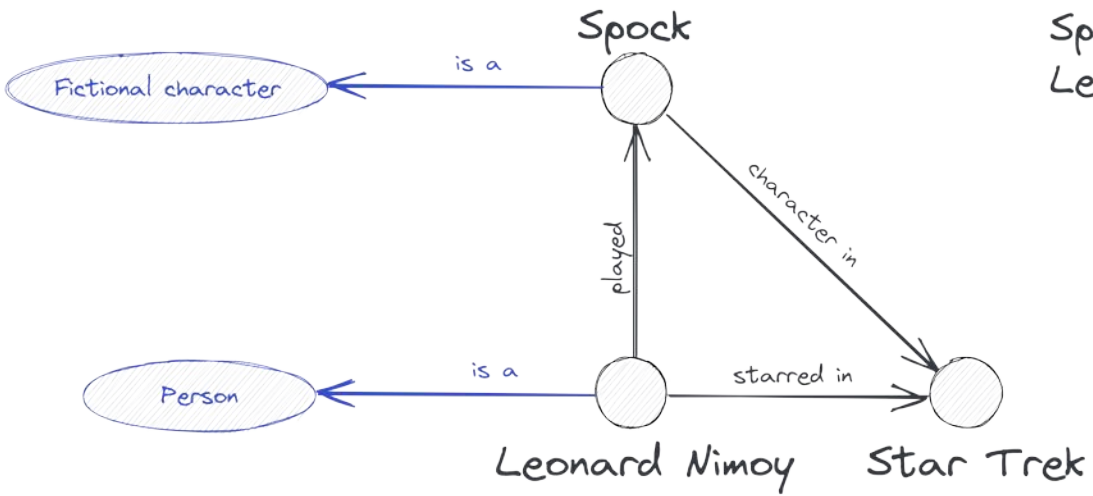


Leonard Nimoy was born on Mar-26-1931.
Leonard Nimoy passed away on Feb-27-2015.

Definition 1.3:

- **Literals**: describe data values that do not have a separate existence.

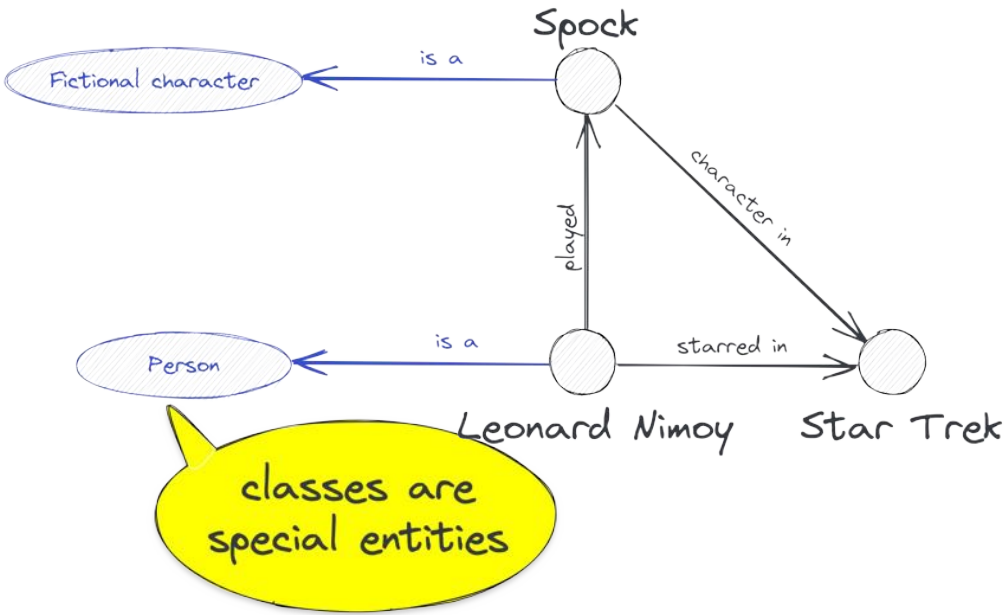
Further Refinements



Spock is a fictional character.
Leonard Nimoy is a person.

individual vs aggregation

Further Refinements

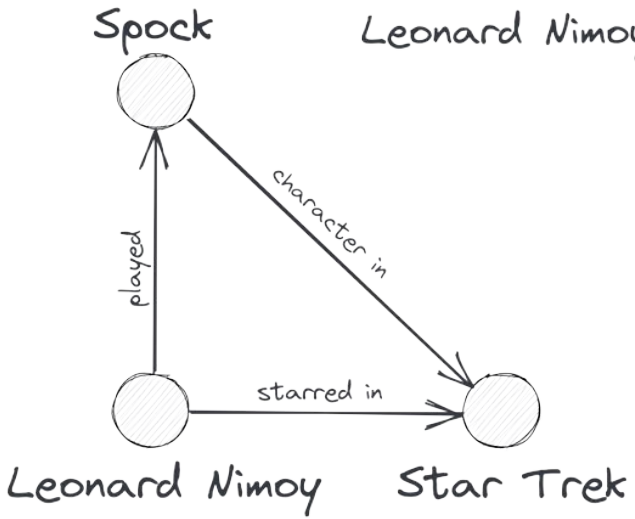


Spock is a fictional character.
Leonard Nimoy is a person.

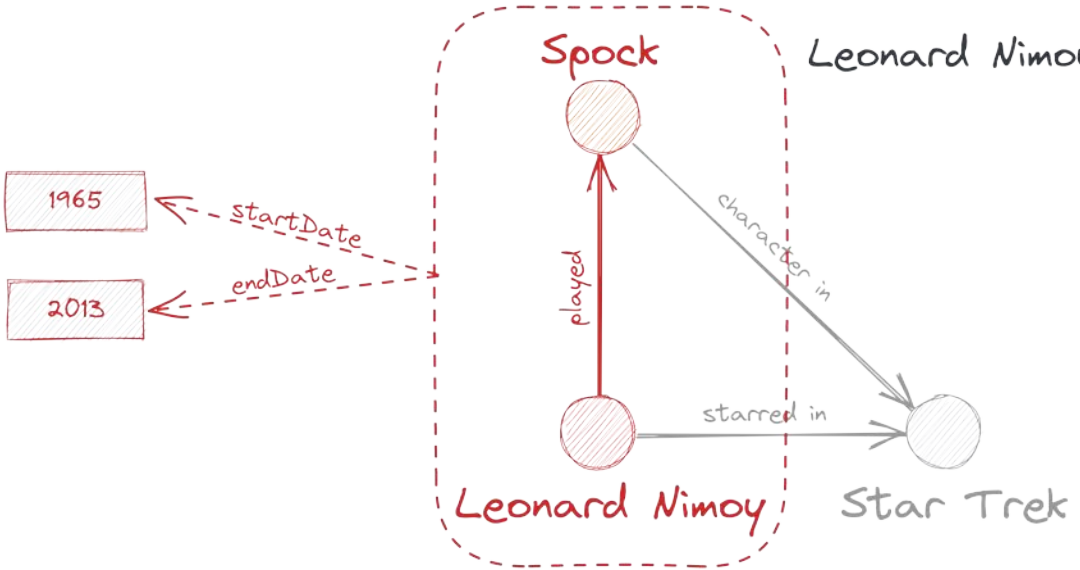
Definition 1.3:

- **Classes**: collections of individuals or objects, defined as
  - **Extension**: specifying all class members or
  - **Intension**: specifying class constraints

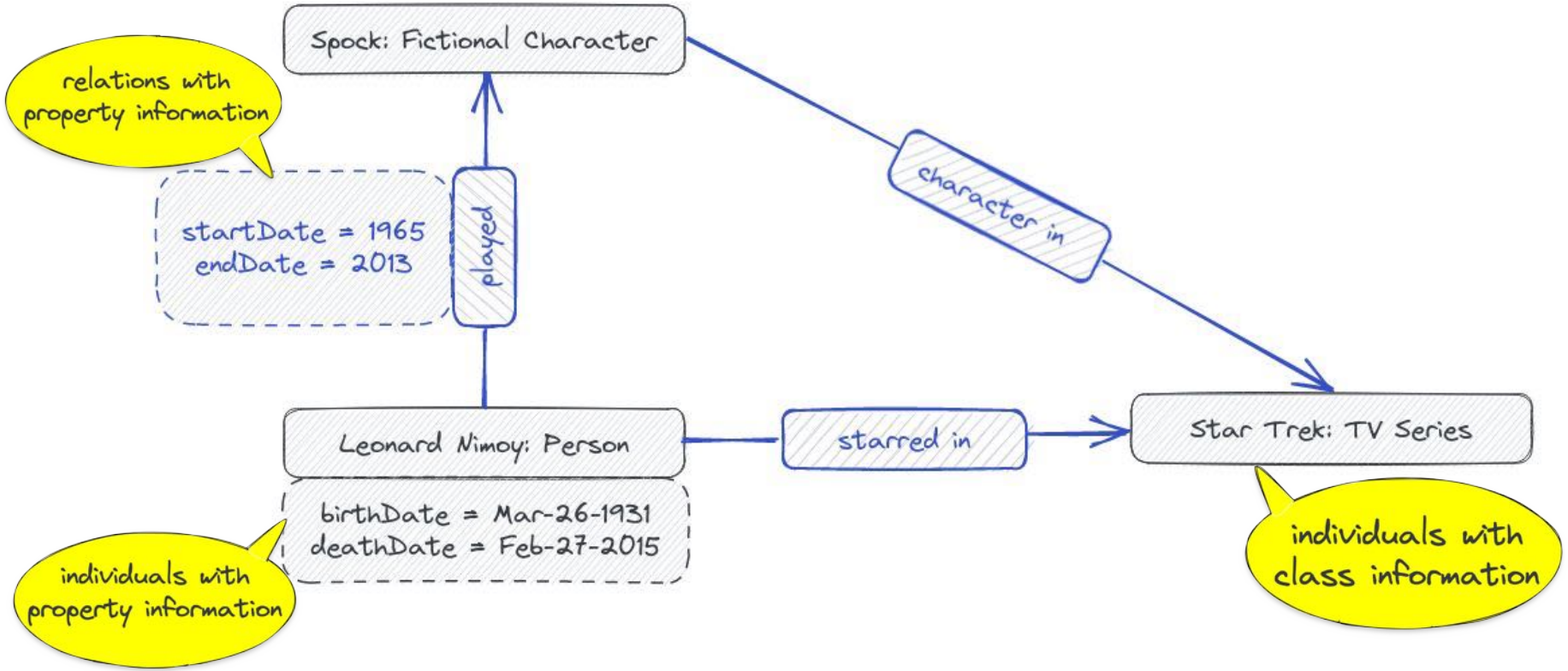
Further Refinements

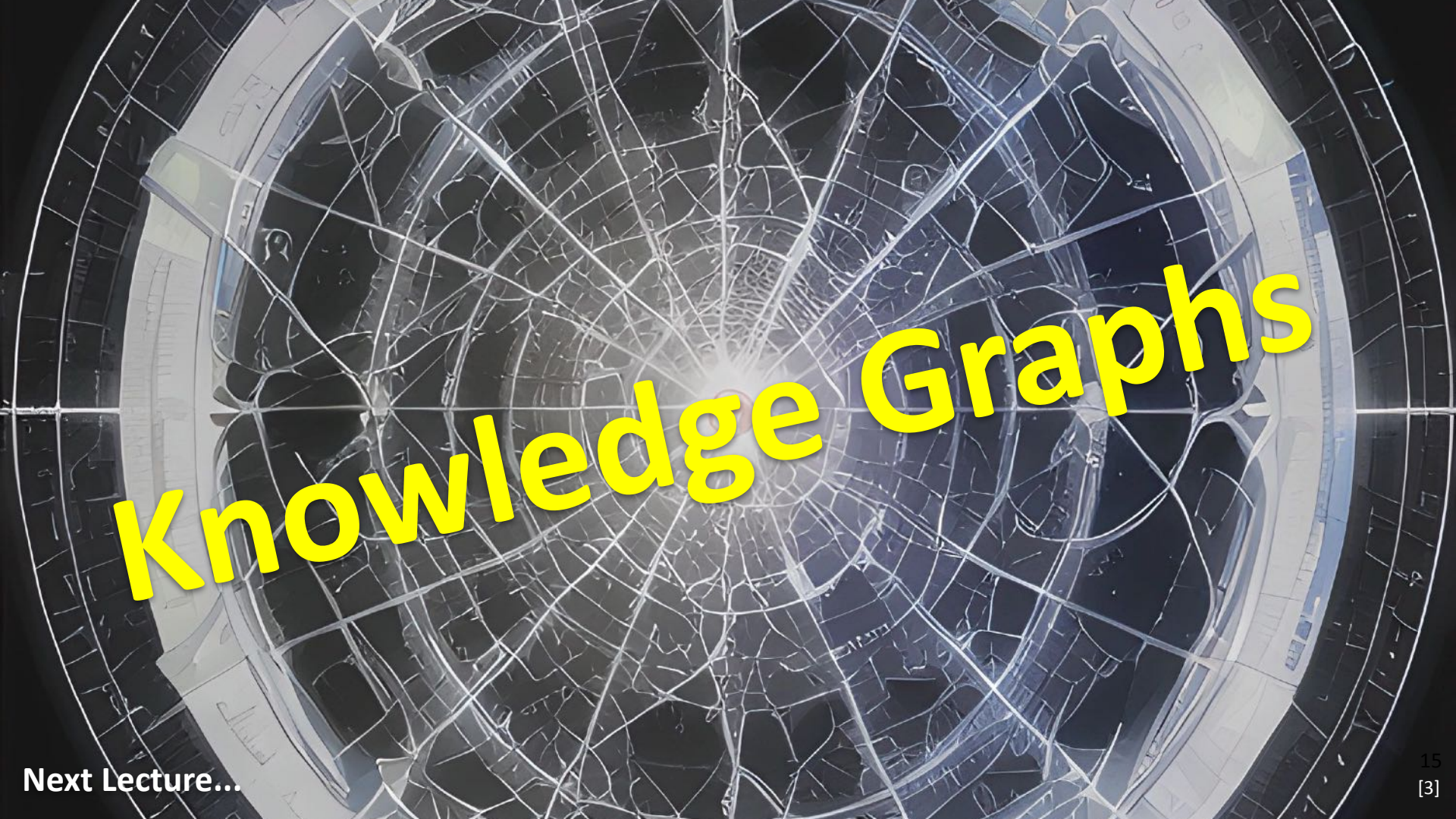


Further Refinements



Property Graphs





Next Lecture...

[3]

Bibliographic References:

- Aidan Hogan, Eva Blomqvist, Michael Cochez, Claudia d'Amato, Gerard de Melo, Claudio Gutierrez, Sabrina Kirrane, José Emilio Labra Gayo, Roberto Navigli, Sebastian Neumaier, Axel-Cyrille Ngonga Ngomo, Axel Polleres, Sabbir M. Rashid, Anisa Rula, Lukas Schmelzeisen, Juan Sequeda, Steffen Staab, Antoine Zimmermann: *Knowledge Graphs*. Synthesis Lectures on Data, Semantics, and Knowledge, Morgan & Claypool Publishers 2021.
  Chapter 2: Data Graphs, p. 5-11.

Picture References:

[1] "An image of the Semantic Web which is an extension of the World Wide Web…" , created via ArtBot, Dreamlike Diffusion, 2023, [CC-BY-4.0], https://tinybots.net/artbot

[2] Spock, created via ArtBot, Dreamlike Diffusion, 2023, CC-BY-4.0, https://tinybots.net/artbot

[3] "An image of the Semantic Web which is an extension of the World Wide Web…" , created via ArtBot, Dreamlike Diffusion, 2023, [CC-BY-4.0], https://tinybots.net/artbot