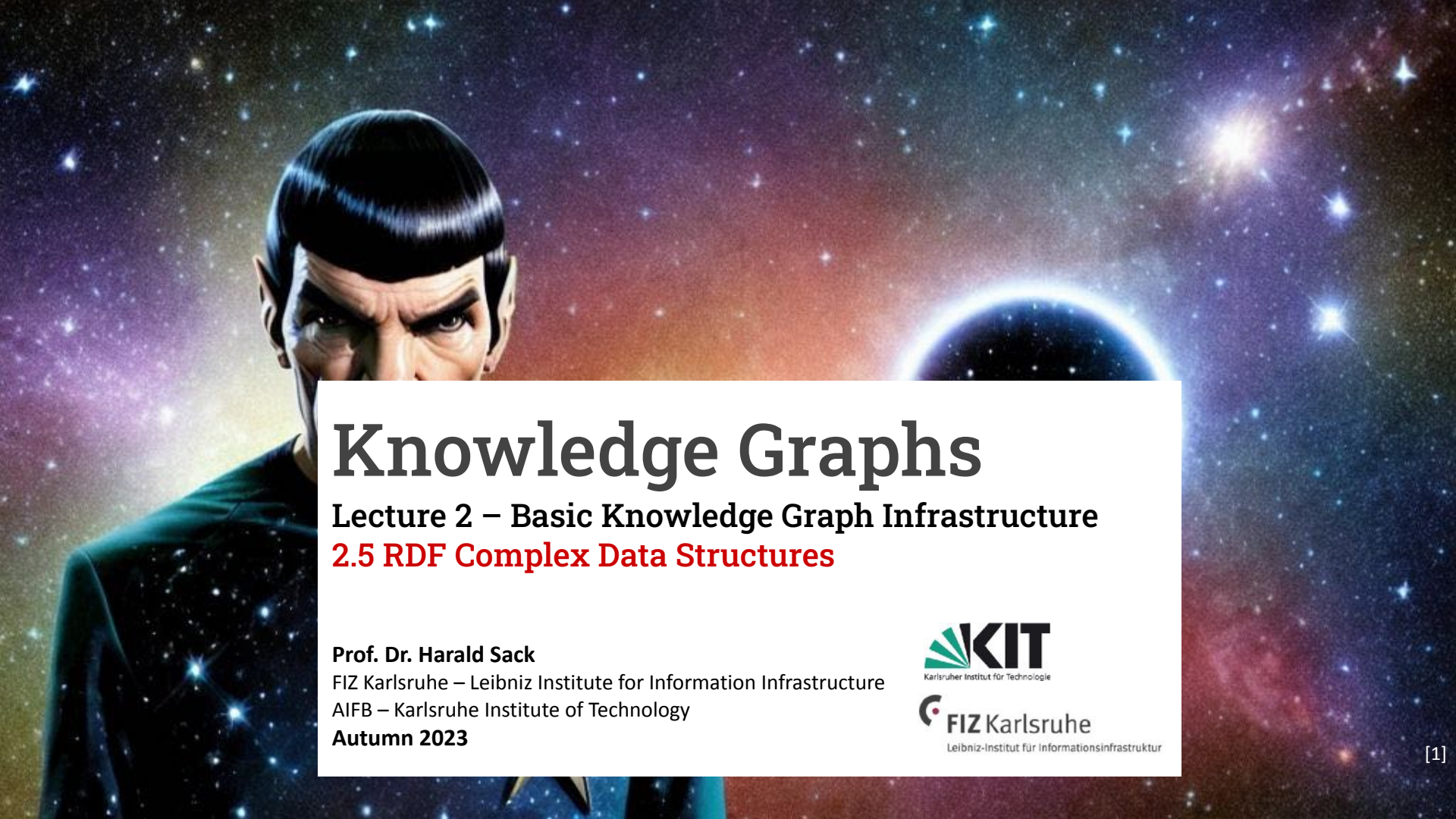


Knowledge Graphs

Lecture 2 – Basic Knowledge Graph Infrastructure

2.5 RDF Complex Data Structures

Prof. Dr. Harald Sack
FIZ Karlsruhe – Leibniz Institute for Information Infrastructure
AIFB – Karlsruhe Institute of Technology
Autumn 2023

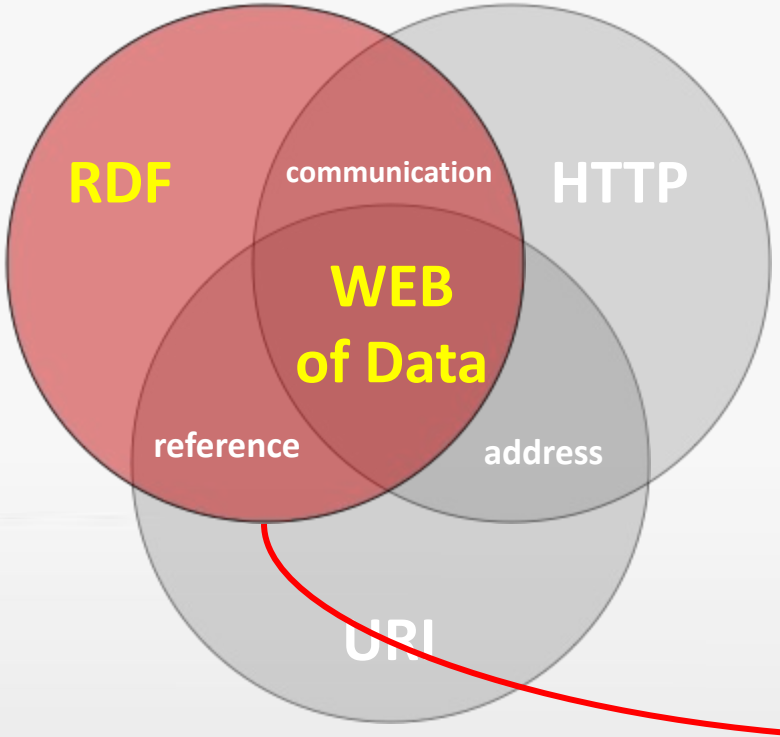
[1]

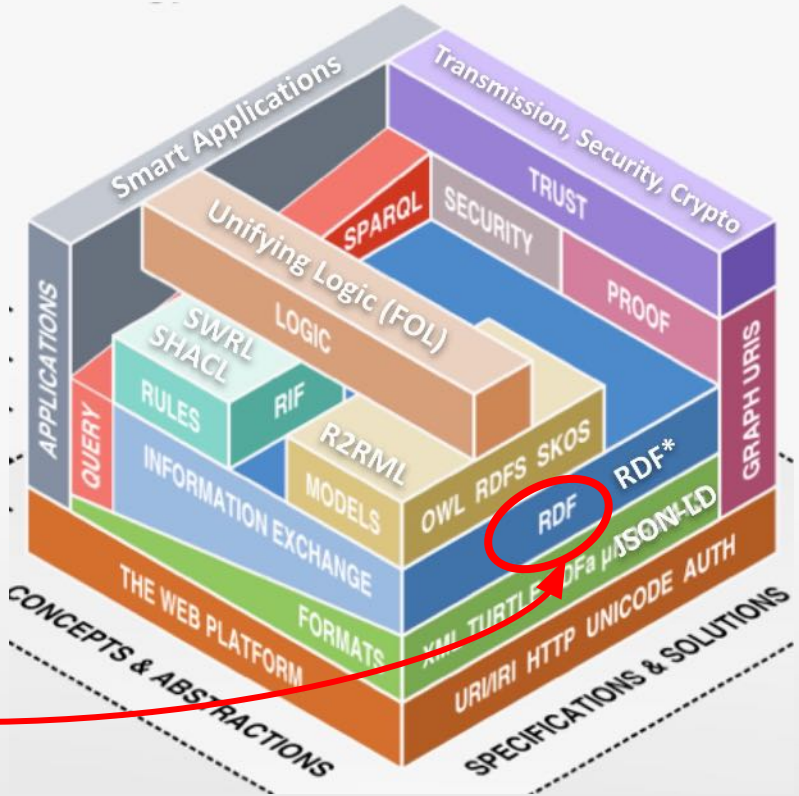
Knowledge Graphs

Lecture 2: Basic Knowledge Graph Infrastructure

[1]

Basic Architecture of the Web of Data





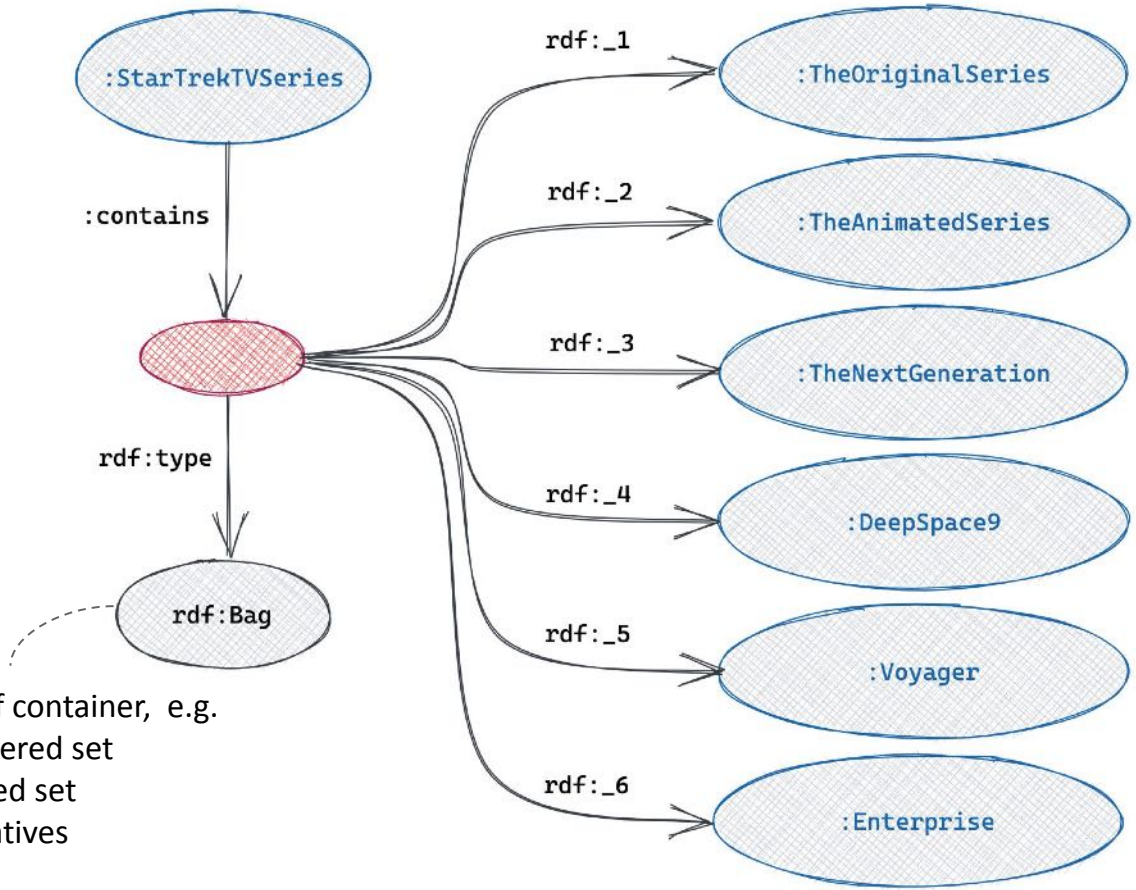
[2]

RDF Complex Data Structures

- An RDF graph is an unordered set of RDF triples.
- **RDF Lists**
  - General data structures to enumerate any resources or literals and to introduce an ordering.
  - No new semantics, just “syntactic sugar”.
- Distinguish between:
  - **Container**
    open list, i.e. extension (new entries) possible
  - **Collection**
    closed list, i.e. no extension possible

RDF Container

Open Lists



defines the type of container, e.g.

- **Bag** - unordered set
- **Seq** - ordered set
- **Alt** - alternatives

`rdf:_1 ... rdf:_n` relates a container to one of its elements.

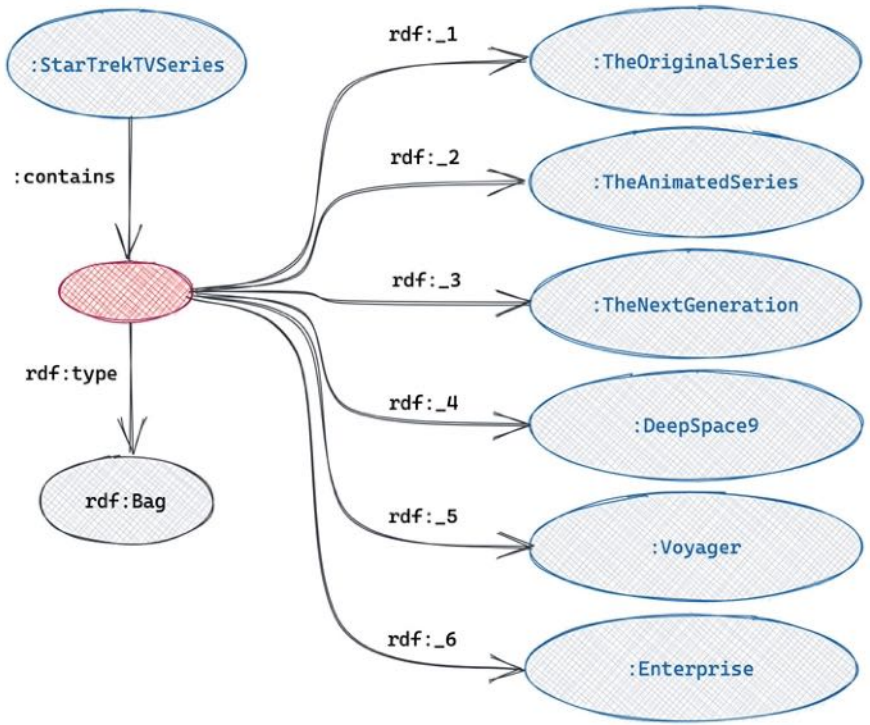
RDF Container

Open Lists

= **rdf:type** rdf:Bag

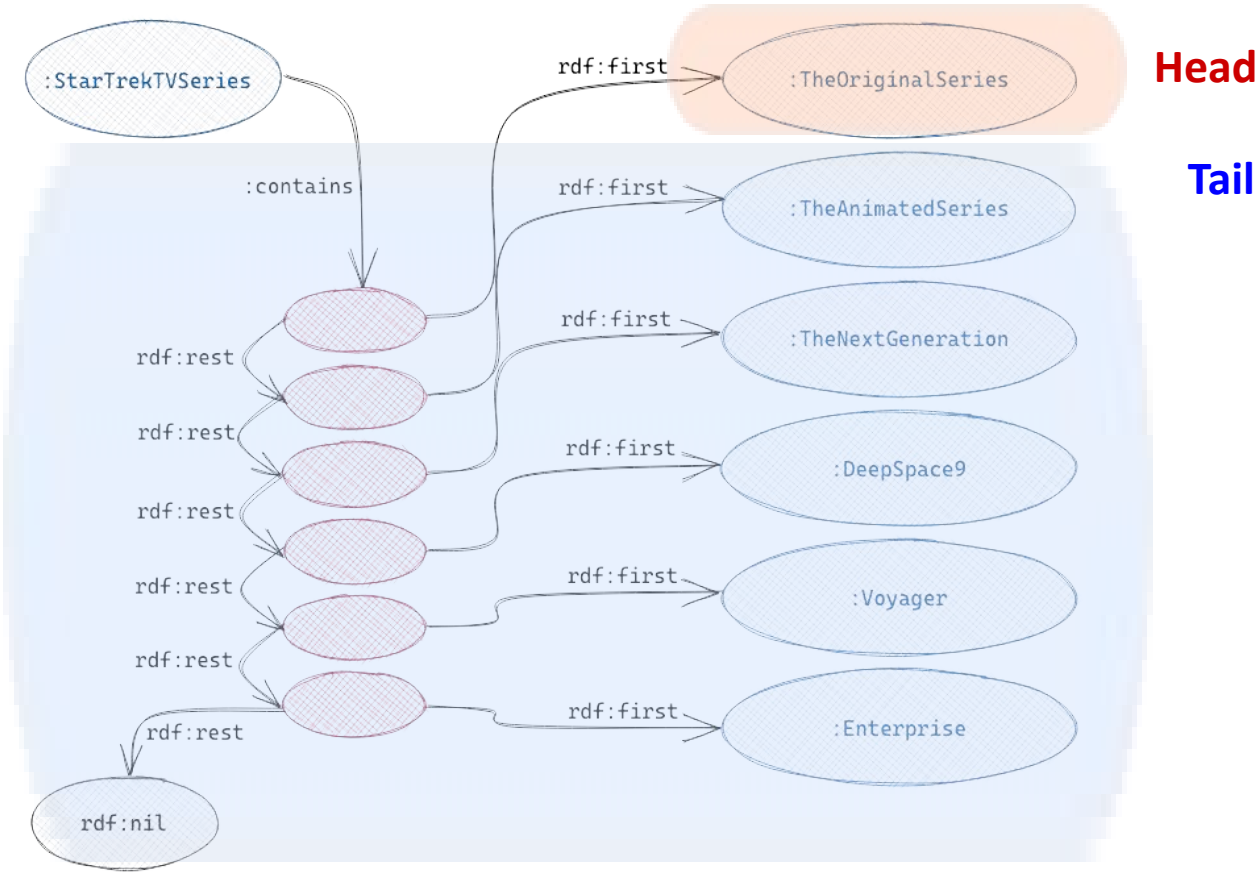
```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix : <http://example.org/KG2023#> .

:StarTrekTVSeries :contains [
  a rdf:Bag ;
  rdf:_1 :TheOriginalSeries ;
  rdf:_2 :TheAnimatedSeries ;
  rdf:_3 :TheNextGeneration ;
  rdf:_4 :DeepSpace9 ;
  rdf:_5 :Voyager ;
  rdf:_6 :Enterprise
] .
```



RDF Collection

Closed Lists



RDF Collection

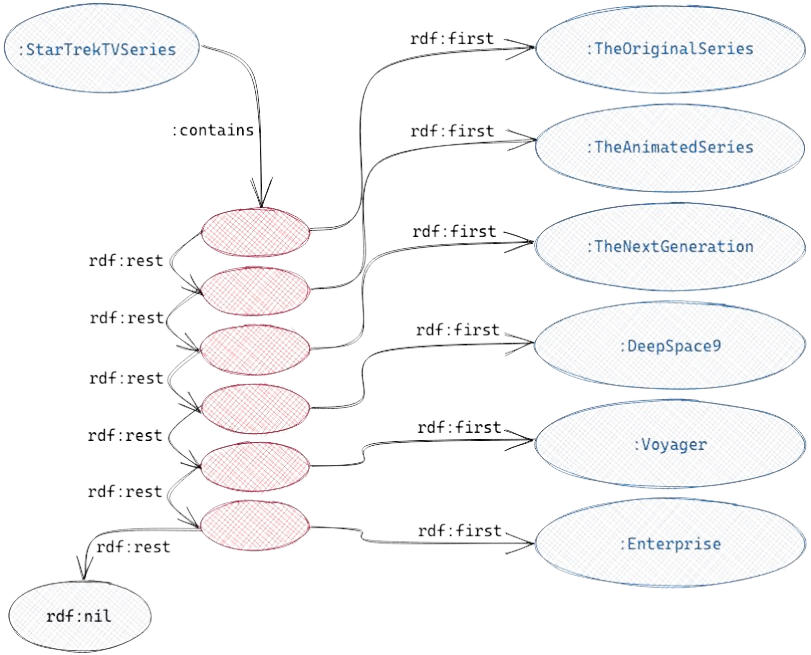
Closed Lists

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix : <http://example.org/KG2023#> .

:StarTrekTVSeries :contains [
  rdf:first :TheOriginalSeries ; rdf:rest [
   rdf:first :TheAnimatedSeries ; rdf:rest [
    rdf:first :TheNextGeneration ; rdf:rest [
     rdf:first :DeepSpace9 ; rdf:rest [
      rdf:first :Voyager ; rdf:rest [
       rdf:first :Enterprise ;
       rdf:rest rdf:nil
     ]
    ]
   ]
  ]
 ]
] .
```

in short

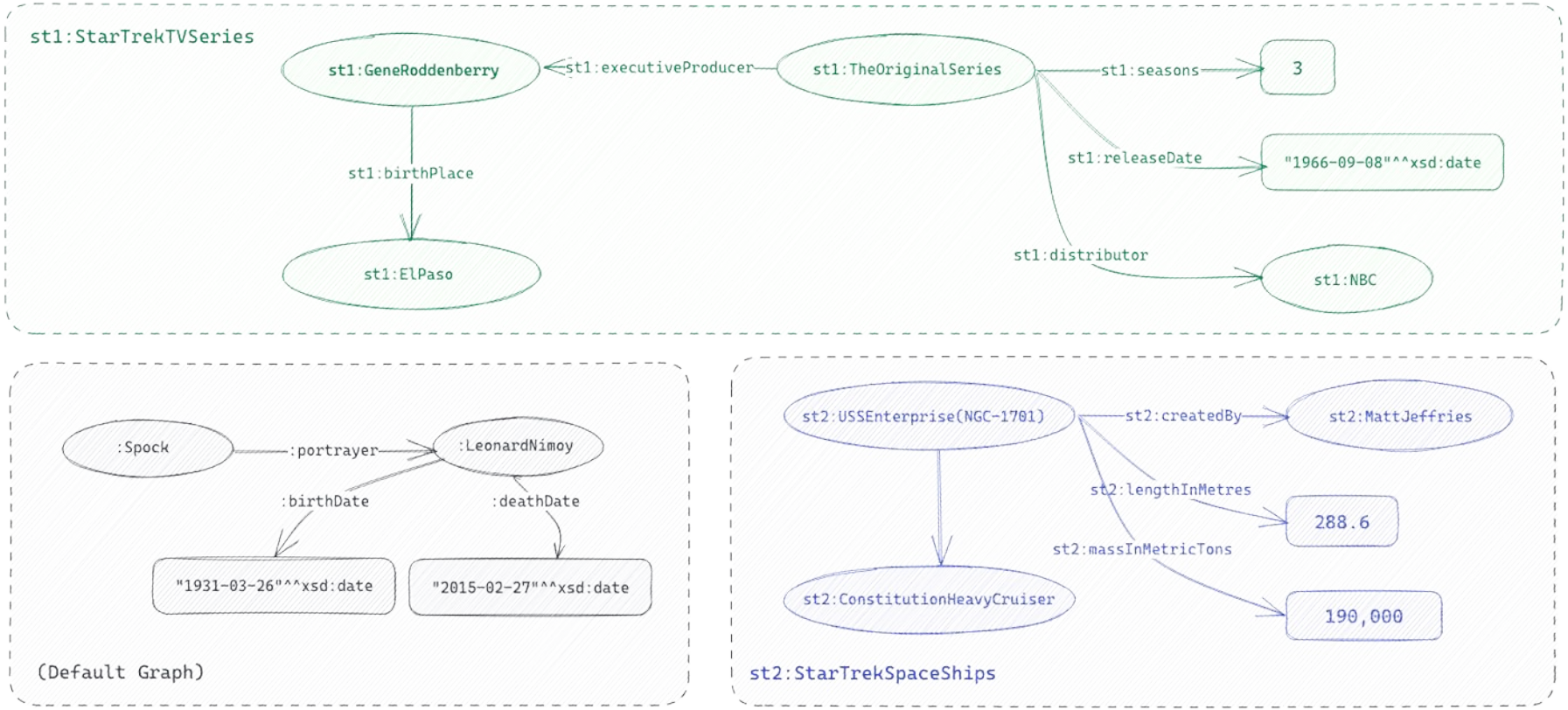
```
:StarTrekTVSeries :contains (
:TheOriginalSeries :TheAnimatedSeries
:TheNextGeneration :DeepSpace9 :Voyager
:Enterprise ) .
```



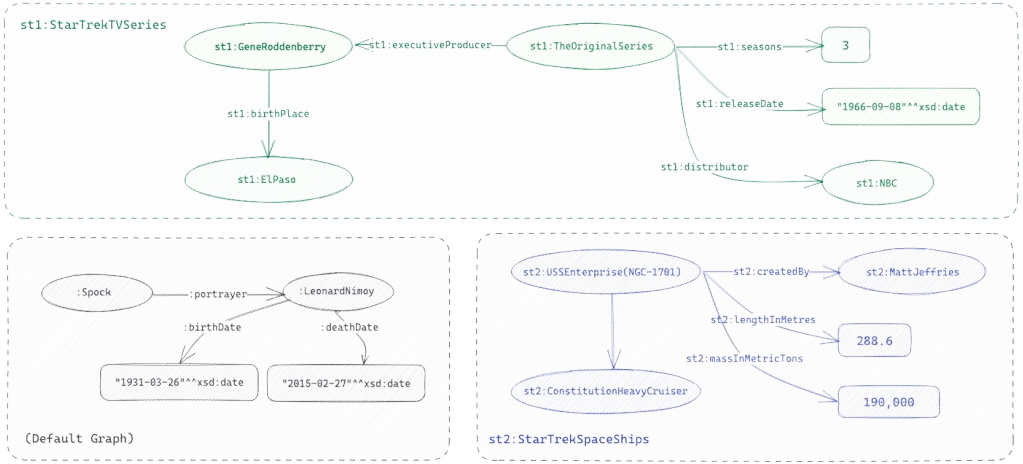
RDF Datasets

- Sometimes it is beneficial to keep data in **separate RDF graphs**, e.g.,
  - data from different sources (of different trustworthiness or accuracy),
  - the same data, but from different points in time,
  - etc.
- An **RDF dataset** is a dictionary of RDF graphs, consisting of:
  - one **default graph**: an RDF graph (that may be empty),
  - zero or more **named graphs**: pairs consisting of
    i. a **name** that can be a URI/IRI or a blank node, and
    ii. an **RDF graph** (that may be empty).

RDF Datasets – Example



RDF Datasets – Example



- In practical scenarios quadruples (quads)
  (s,p,o,g)
  are used to serialize RDF datasets.
- E.g.,
  `st2:GeneRoddenberry st2:birthPlace st2:ElPaso .`
  from the graph `st1:StarTrekTVSeries` can be represented with
  `st2:GeneRoddenberry st2:birthPlace st2:ElPaso st1:StarTrekTVSeries .`


Excursion 1: Reification and RDF*
Next Lecture...

Bibliographic References:

- Guus Schreiber, Yves Raimond (2014), *RDF 1.1 Primer*, W3C Working Group Note 24 June 2014.
- Aidan Hogan (2020), *The Web of Data*, Springer.
  - Chap. 3.5.4 Containers and Collections, pp. 83–84.
  - Chap. 4.2.4 Containers, pp. 126–128.
- Antoine Zimmerman (2014), *RDF 1.1: On Semantics of RDF Datasets*, W3C Working Group Note 25 February 2014.

Picture References:

[1] "In this Star Trek-inspired image, Mr. Spock is depicted in deep space. Among the stars in the background deep space is fully covered with interlinked the RDF code fragments.", created via ArtBot, ProtoGen Diffusion, 2023, [CC-BY-4.0], https://tinybots.net/artbot

[2] Benjamin Nowack, *The Semantic Web - Not a Piece of cake…*, at bnode.org, 2009-07-08 , [CC BY 3.0], https://web.archive.org/web/20220628120341/http://bnode.org/blog/2009/07/08/the-semantic-web-not-a-piece-of-cake

[3] "In this image in the style of Dürer's Renaissance woodcuts, Mr. Spock, science officer of the USS Enterprise, is depicted in deep space fully covered with interlinked the RDF source code fragments.", created via ArtBot, ProtoGen Diffusion, 2023, [CC-BY-4.0], https://tinybots.net/artbot