Welcome to the course Semantic Web

as part of the Web & Data Science curriculum at Uni Koblenz

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Semantic Web — **What's this?**

- Source: https://www.w3.org/standards/semanticweb/
  - "The term 'Semantic Web' refers to W3C's vision of the Web of linked data. Semantic Web technologies enable people to create data stores on the Web, build vocabularies, and write rules for handling data. Linked data are empowered by technologies such as RDF, SPARQL, OWL, [...]."
- Even simpler "definition" by Ralf:
  - Data models for the modern WWW/Web.
  - Metadata/schemas/ontologies for semantic data.
  - Query languages and technologies for semantic data.
  - …

Semantic Web — **Some scenarios**

Based on recent papers with SoftLang involvement published at the “International Semantic Web Conference”

ISWC 2019

Type Checking Program Code using SHACL

Martin Leinberger[1], Philipp Seifer[2], Claudia Schon[1], Ralf Lämmel[2], Steffen Staab[1,3]

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[2] The Software Languages Team, University of Koblenz-Landau, Germany
[3] Web and Internet Science Research Group, University of Southampton, England

```
ex:StudentShape a sh:NodeShape;
  sh:targetClass ex:Student;
  sh:property [
    sh:path ex:studiesAt;
    sh:minCount 1;
    sh:node ex:UniversityShape ];
  sh:class ex:Person.

ex:PersonShape a sh:NodeShape;
    sh:targetClass ex:Person;
    sh:property [
      sh:path ex:name;
      sh:minCount 1;
      sh:maxCount 1 ].
```

```
ex:UniversityShape a
    sh:NodeShape;
   sh:property [
    sh:path [
      sh:inversePath;
      ex:studiesAt ];
    sh:minCount 1;
    sh:node
        ex:StudentShape ].
```

Fig. SHACL constraints for RDF data graph G_1.

Context:
Use semantic data constraints for type checking in programs

Listing Program that may produce a run-time error.

```
map (fun x -> x.?X.age) (query {
    SELECT ?X WHERE { ?X rdf:type ex:Student.} })
```

ISWC 2021

ProGS: Property Graph Shapes Language (Extended Version)

Philipp Seifer[1], Ralf Lämmel[1], and Steffen Staab[2,3]

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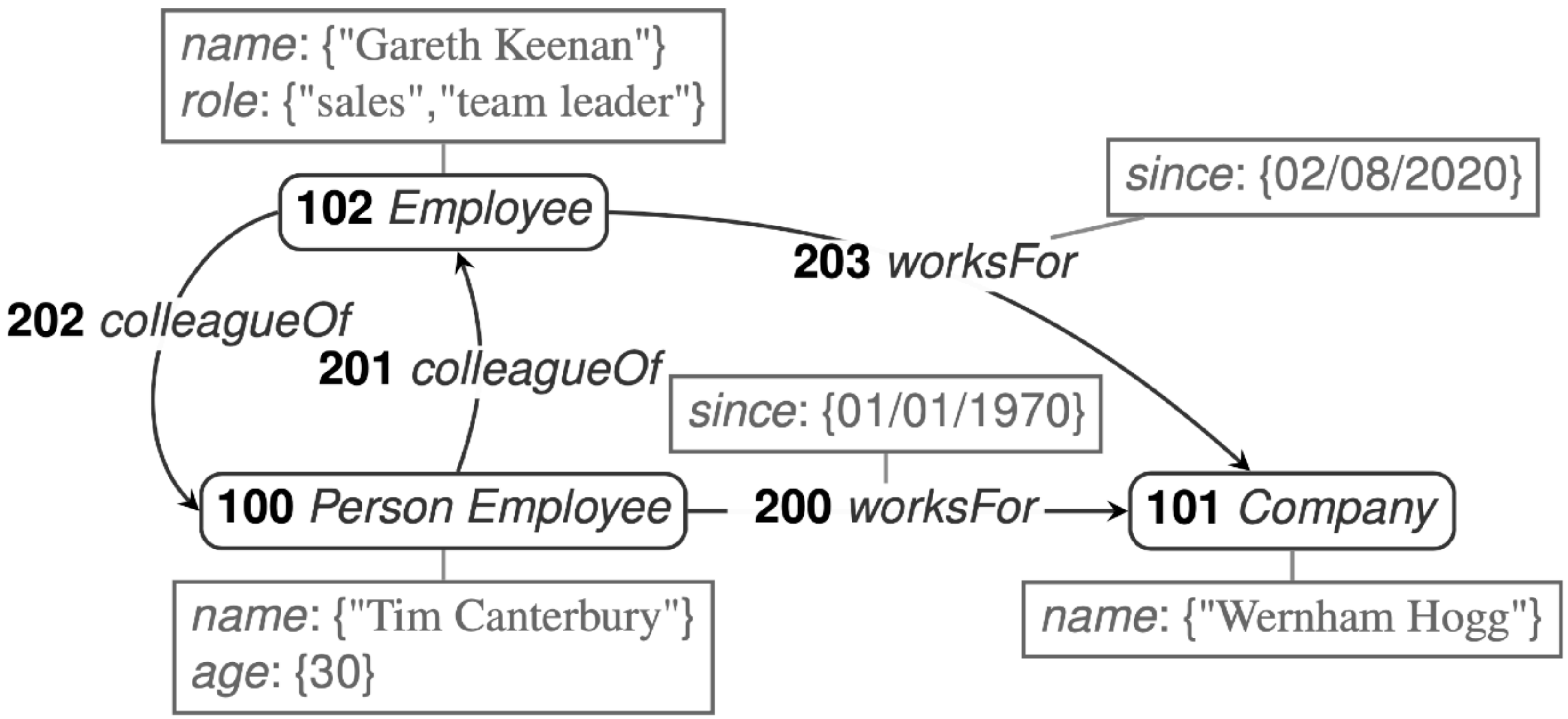

Fig. Example property graph G_{office} showing employment relationships in G-CORE style: Nodes are depicted as rounded boxes. Each node has exactly one identifier, e.g., 100 or 101, and it has zero or more labels, e.g., $\{$*Person*, *Employee*$\}$ or $\{$*Company*$\}$. Each edge has an identifier, e.g., 200, as well as zero or more labels, e.g., $\{$*worksFor*$\}$. Both nodes and edges may have a set of affiliated properties (key-value pairs shown in rectangular boxes), e.g., $\{age : \{30\}\}$ or $\{since : \{01/01/1970\}\}$.

Context: Advanced data models for knowledge graphs with validation

ISWC 2020

Deciding SHACL Shape Containment through Description Logics Reasoning

Martin Leinberger[1], Philipp Seifer[2], Tjitze Rienstra[1], Ralf Lämmel[2], and Steffen Staab[3,4]

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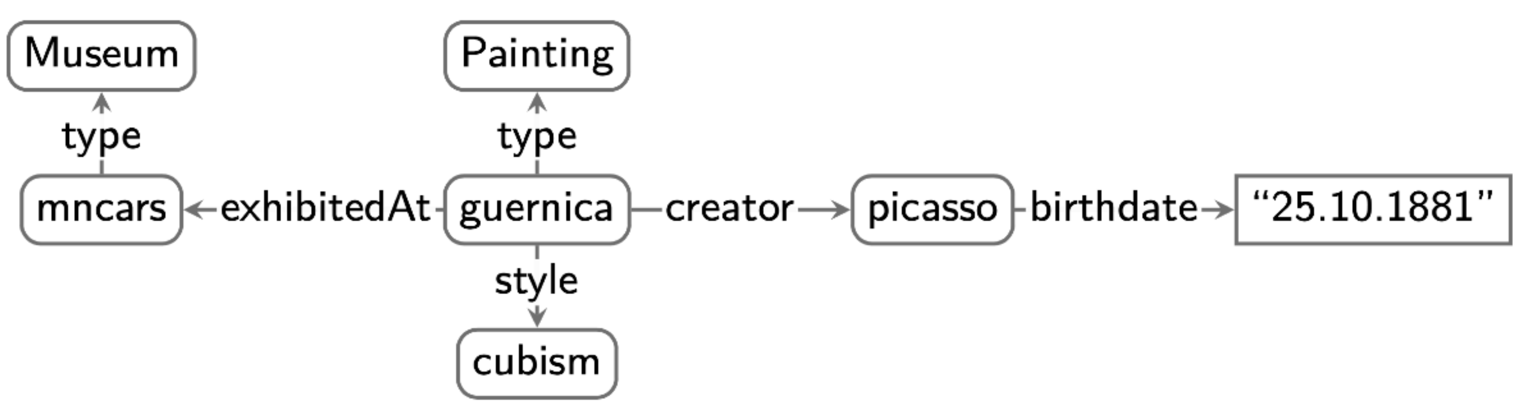
```
:PaintingShape a sh:NodeShape;
    sh:targetClass :Painting;
    sh:property [ sh:path :exhibitedAt; sh:minCount 1; ];
    sh:property [ sh:path :creator; sh:node :PainterShape; ].

:PainterShape a sh:NodeShape;
    sh:property [ sh:inversePath :creator; sh:node :PaintingShape; ];
    sh:property [ sh:path :birthdate; sh:minCount 1; sh:maxCount 1; ];

:CubistShape a sh:NodeShape
    sh:property [ sh:path ( [sh:inversePath :creator] :style );
        sh:minCount 1; sh:value :cubism; ].
```

(a) Example for a SHACL shape graph.



(b) Example for a data graph that conforms to the shape graph.

Fig. Example of a shape graph (a) and a data graph (b).

Context: Logic-based optimization of queries

Semantic Web — Course topics

- Intro
- Description Logic
- XML
- RDF
- RDF-S and OWL
- Ontology Engineering
- Ontology Matching
- SPARQL
- Ontology-based Data Access

See OLAT for lectures, tutorials, assignments, exams, etc.

Semantic Web — **Course staff** at SoftLang Team

- Formally responsible faculty member:
  - Prof. Dr. Ralf Lämmel
- Recorded lectures:
  - Dr. Jandson S. Ribeiro
  - PD Dr. Matthias Thimm
- Execution (tutorials, homework, etc.):
  - **MSc. Iryna Dubrovska**
- Support of execution:
  - MSc. Johannes Härtel
- Student tutors

Semantic Web — Course logistics

- Please, see OLAT page for all details on homework, exam, etc.
- Please, discuss all such issues in the lab with I.D.
- You are welcome to use the OLAT forum as well.

Thank you for attention.
Wishing you a great
course experience!