

Seminar: Knowledge Graphs

Alsayed Algergawy

Module: 5369S

Welcome!!

- ◆ Prof. Dr. Ing. Alsayed Algergawy
 - Data and knowledge engineering
- ◆ Senior researcher and data manager at Heinz-Nixdorf Endowed Chair for Distributed Information Systems
 - Friedrich-Schiller-University Jena
 - Prof. Dr. Birgitta König-Ries



Welcome!!

- ◆ Research Interests:
 - Schema/data integration
 - Schema/ontology matching
 - Semantic data integration
 - Data and knowledge engineering
- ◆ Room: HK30 209
- ◆ alsayed.algergawy@uni-passau.de



Welcome!!

Name: Vishvapalsinhji Parmar

Education: M.Sc. Computer Science

Occupation: Research Assistant at the Chair of Data and Knowledge Engineering

Office: HK30 – 211

E-Mail: Vishvapalsinhji.Parmar@uni-passau.de



Research interests:

- **Big Data Management**
- **Natural Language Processing**
- **Information Retrieval**
- **Deep Learning**

Welcome!!

Asha Mannarapotta Venugopal (M.Sc.)

asha.mannarapottavenugopal@uni-passau.de

Research Areas:

- Synthetic Data Generation
- Generative Adversarial Network (GAN)
- Synthetic Minority Oversampling Technique (SMOTE)
- Locality Sensitive Hashing (LSH)
- Data Anonymization: Masking & Generalization

And you....??



Agenda

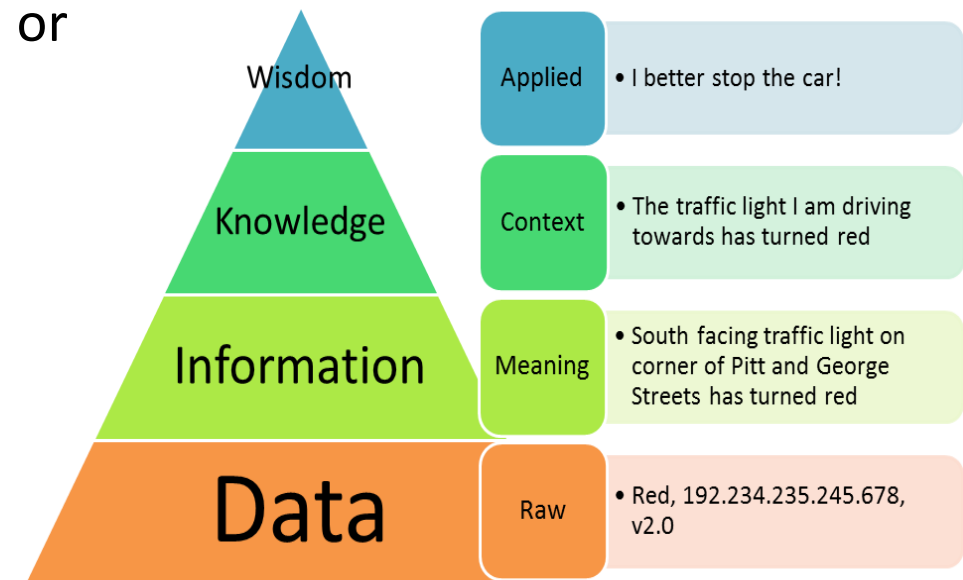
- ◆ Introduction
- ◆ Seminar rules and requirements
- ◆ Topics
- ◆ Topic Registration

Agenda

- ◆ Introduction
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Knowledge

- ◆ What is knowledge?
 - “**Knowledge** is a familiarity, awareness or understanding of someone or something, such as facts, information, descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning” ([Wikipedia](#))
- ◆ **The Breadth Hypothesis**: “To behave intelligently in unexpected situations, an agent must be capable of falling back on increasingly general knowledge.”¹
- ◆ Data, information, knowledge

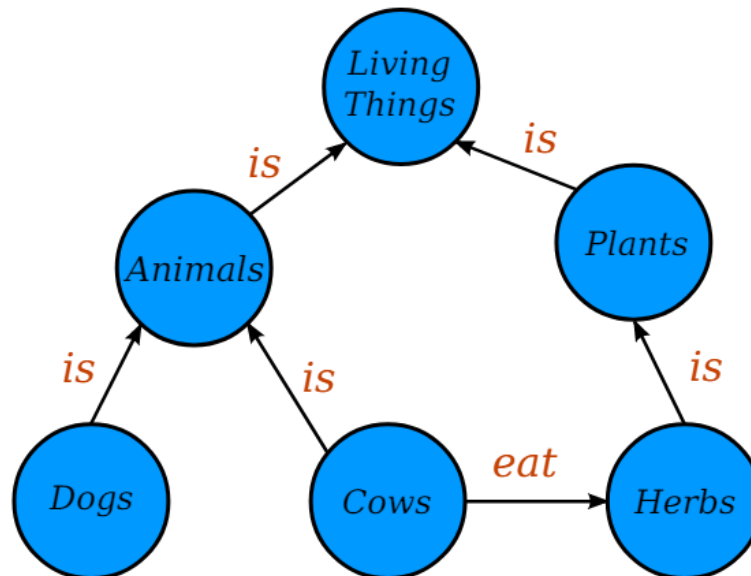


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¹Taken from: Lenat & Feigenbaum, Artificial Intelligence 47 (1991), "On the Threshold of Knowledge"

Graphs

- ◆ Data is increasingly connected (graph data)
- ◆ Relationships within data are often themselves an integral part of the data
- ◆ The world is structured: we are surrounded by **entities** connected by **relations**
- ◆ Graphs are a natural abstraction that captures the **relationships** between **entities**

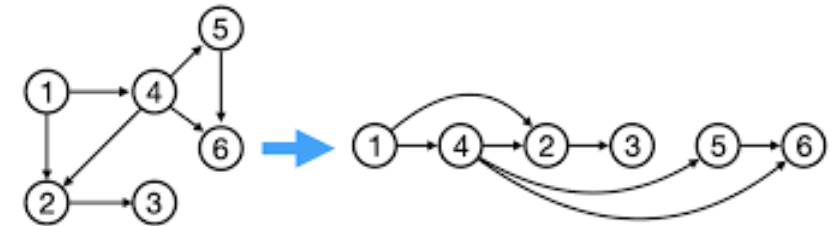
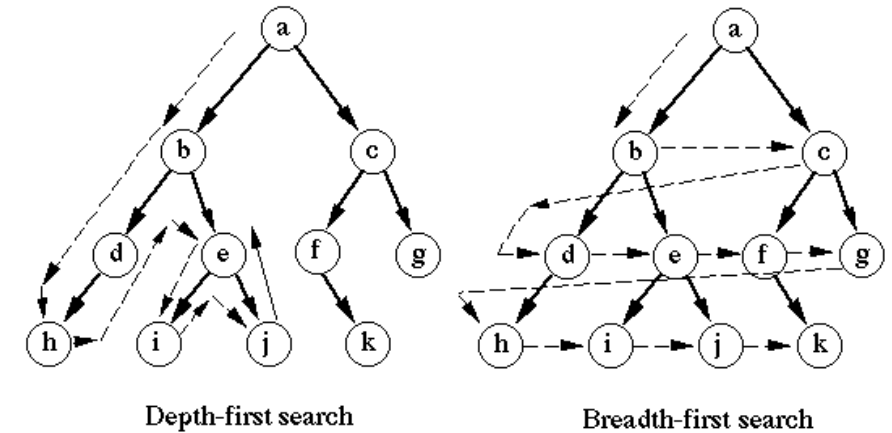


Graphs

- ◆ Data is increasingly connected (graph data)
- ◆ Relationships within data are often themselves an integral part of the data
- ◆ The world is structured: we are surrounded by **entities** connected by **relations**
- ◆ Graphs are a natural abstraction that captures the **relationships** between **entities**
- ◆ **Web Graphs**: trillions of nodes and edges
 - 4.7 billion web pages and 8 billion links
- ◆ **Social Graphs**
 - **Facebook**: 2.963 billion monthly active users with hundreds of billions of relationships (as of January 2023)
 - **Twitter**: 450 million monthly active users

Graph Algorithms

- ◆ Traversal
 - Depth first search
 - Breadth first search
- ◆ Topological sort
- ◆ Minimum spanning trees
- ◆ Shortest paths
- ◆ Connected components (strong/weak)
- ◆ Graph matching



http://faculty.simpson.edu/lydia.sinapova/www/cmsc250/LN250_Weiss/L27-GraphSummary.htm

<https://web.stanford.edu/class/cs97si/06-basic-graph-algorithms.pdf>

https://www-users.cs.umn.edu/~karypis/parbook/Lectures/AG/chap10_slides.pdf

Knowledge Graphs (KG)

◆ Set of entities



seit 1558

Knowledge Graphs (KG)

- ◆ Set of entities, labeled with attributes/properties



Type: city
Area : 114.30 km²
Pop: 109.527
Name: Jena

ID4

Type: Person
Name: B.
König-Ries
Title: Prof



ID2



Type: Person
Name: A.
Algergawy
Title: Dr. Ing

ID1



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ID3

Type: University
Founded : Feb.
2, 1558
Students: 18.916

Type: research
group
Name: fusion
Spec:
distributed IS



ID5

Knowledge Graphs (KG)

- ◆ Set of entities, labeled with attributes



Type: city
Area : 114.30 km²
Pop: 109.527
Name: Jena

ID4:
(Q3150)

Type: Person
Name: B.
König-Ries
Title: Prof



ID2:
(Q56476045)



Type: Person
Name: A.
Algergawy
Title: Dr. Ing

ID1:
(Q107504296)

Type: research
group
Name: fusion
Spec:
distributed IS



ID5

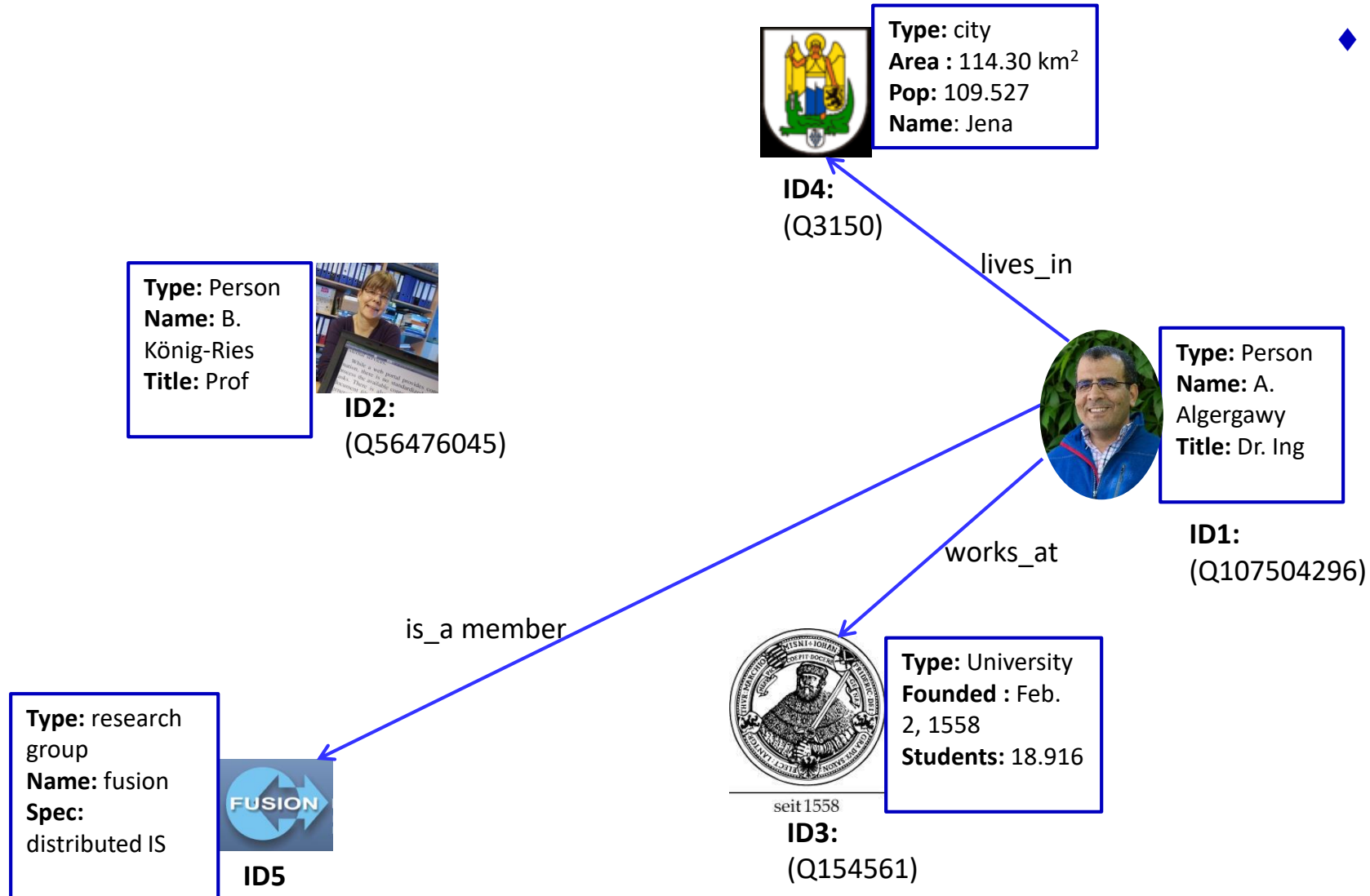


seit 1558

Type: University
Founded : Feb.
2, 1558
Students: 18.916

ID3:
(Q154561)

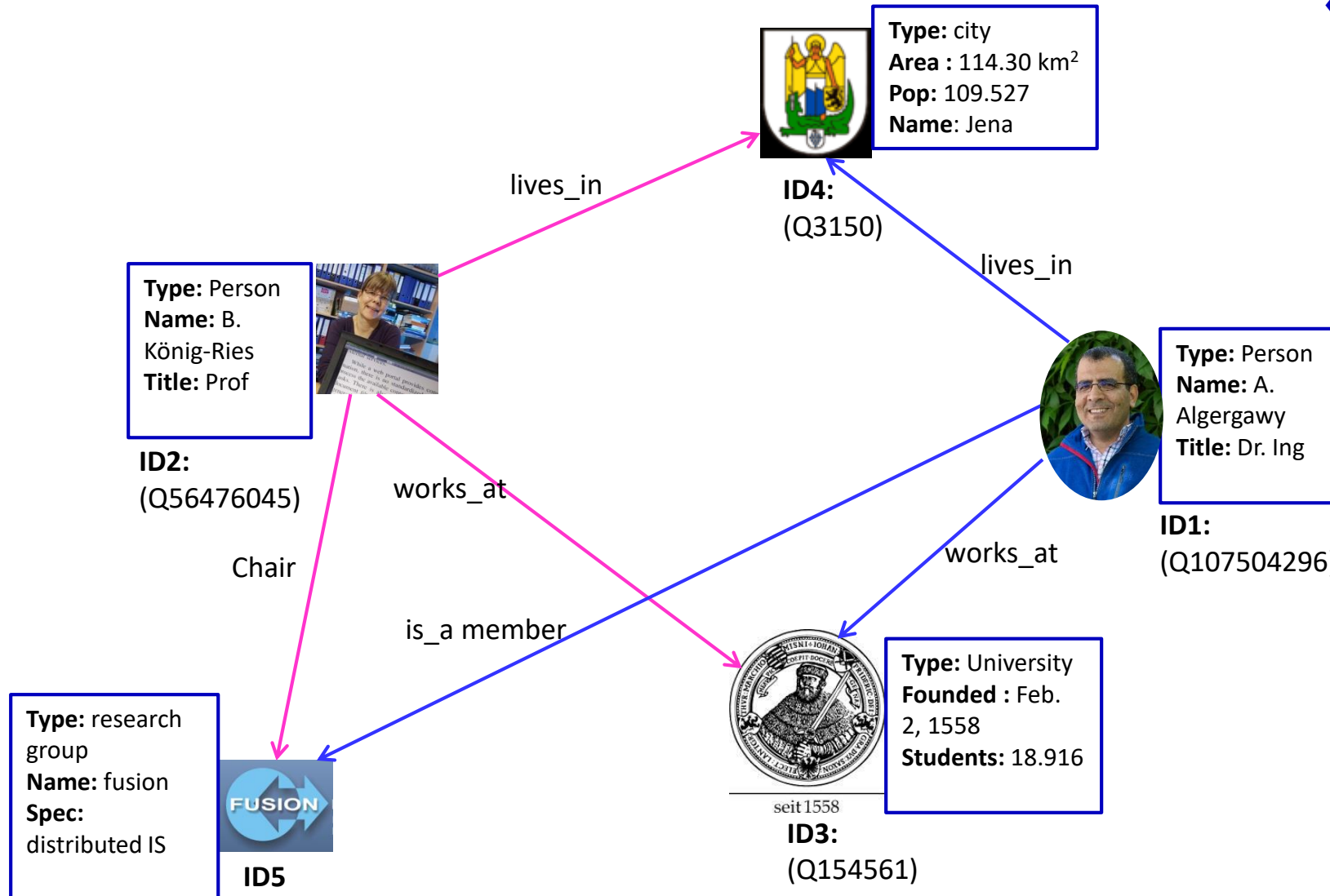
Knowledge Graphs (KG)



- ◆ Set of entities + relationships

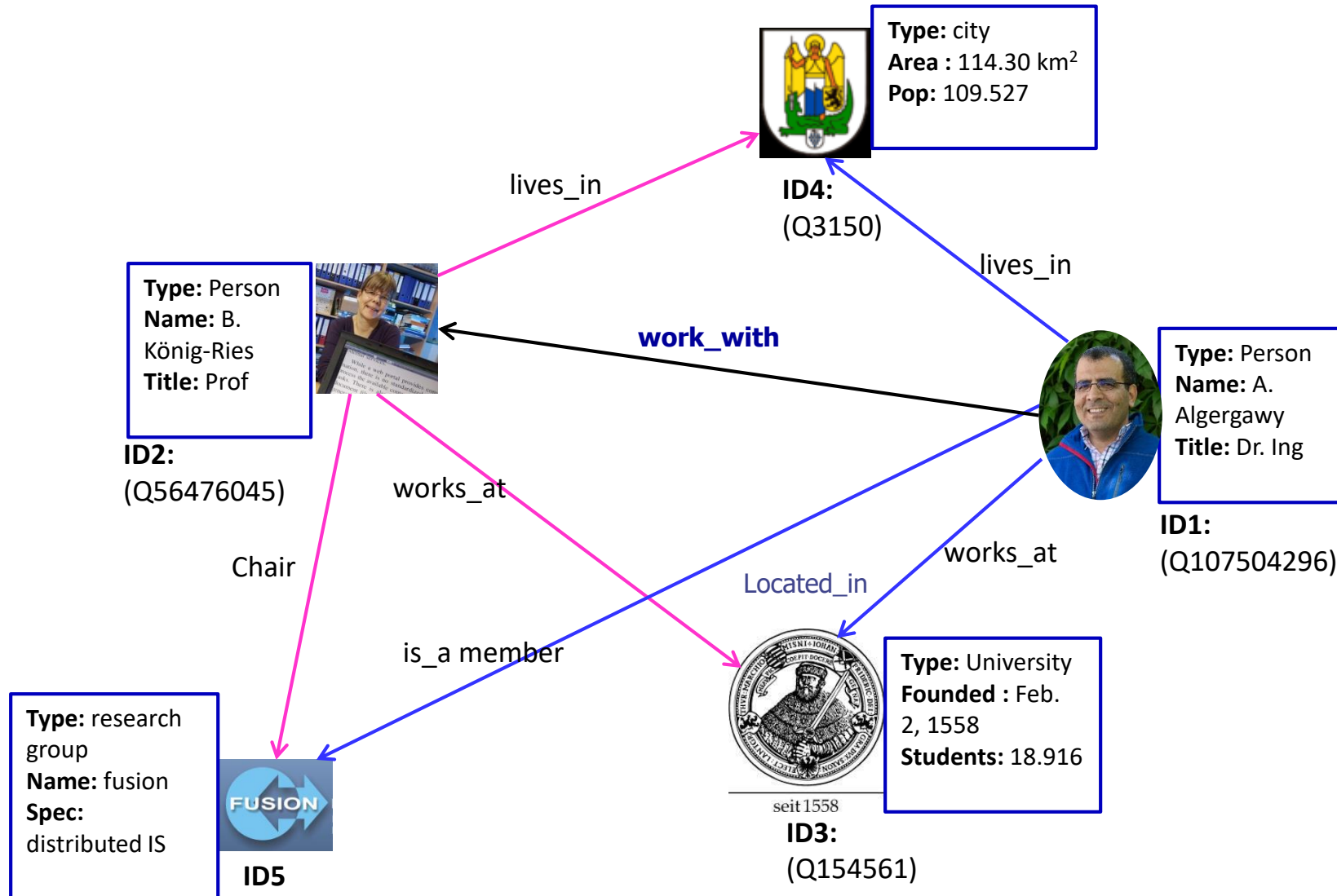
Knowledge Graphs (KG)

- ◆ Set of entities + relationships

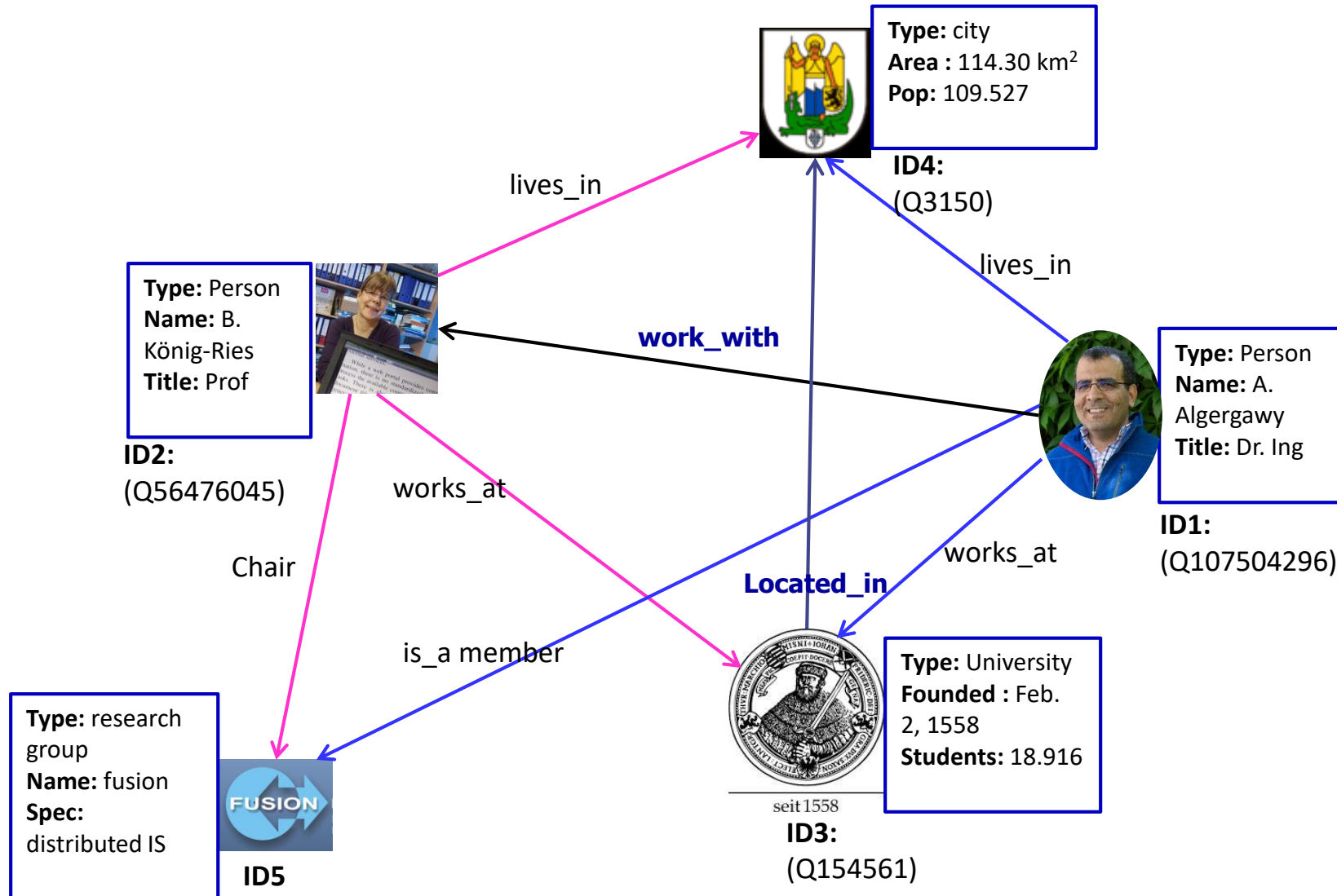


Knowledge Graphs (KG)

- ◆ Set of entities + relationships

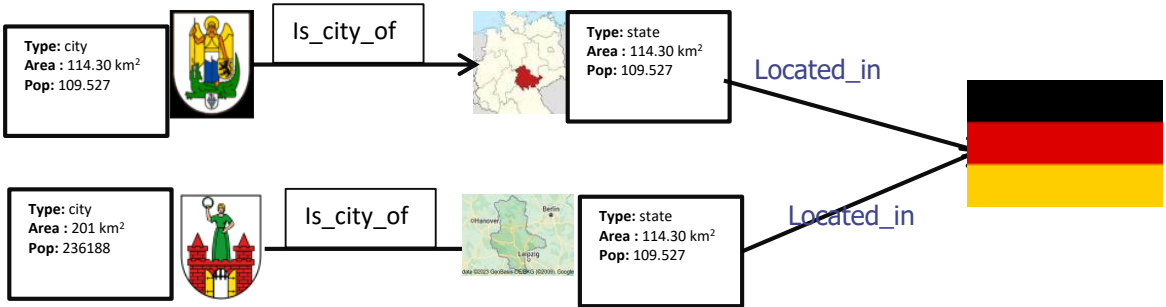
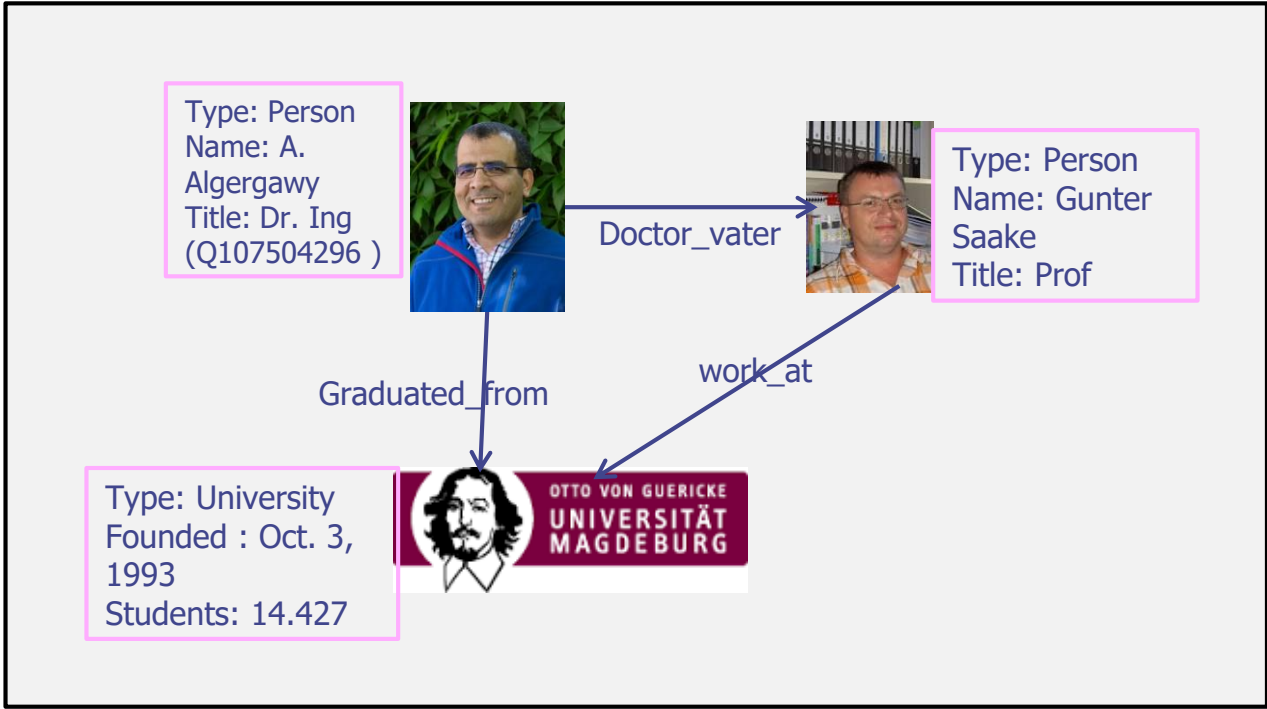
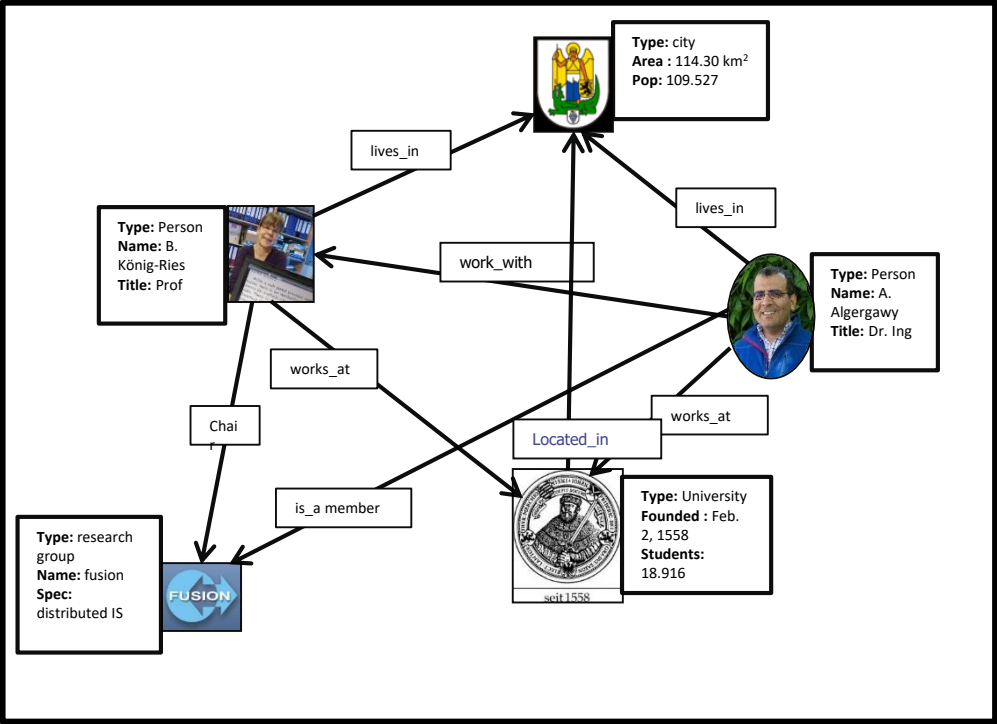


Knowledge Graphs (KG)



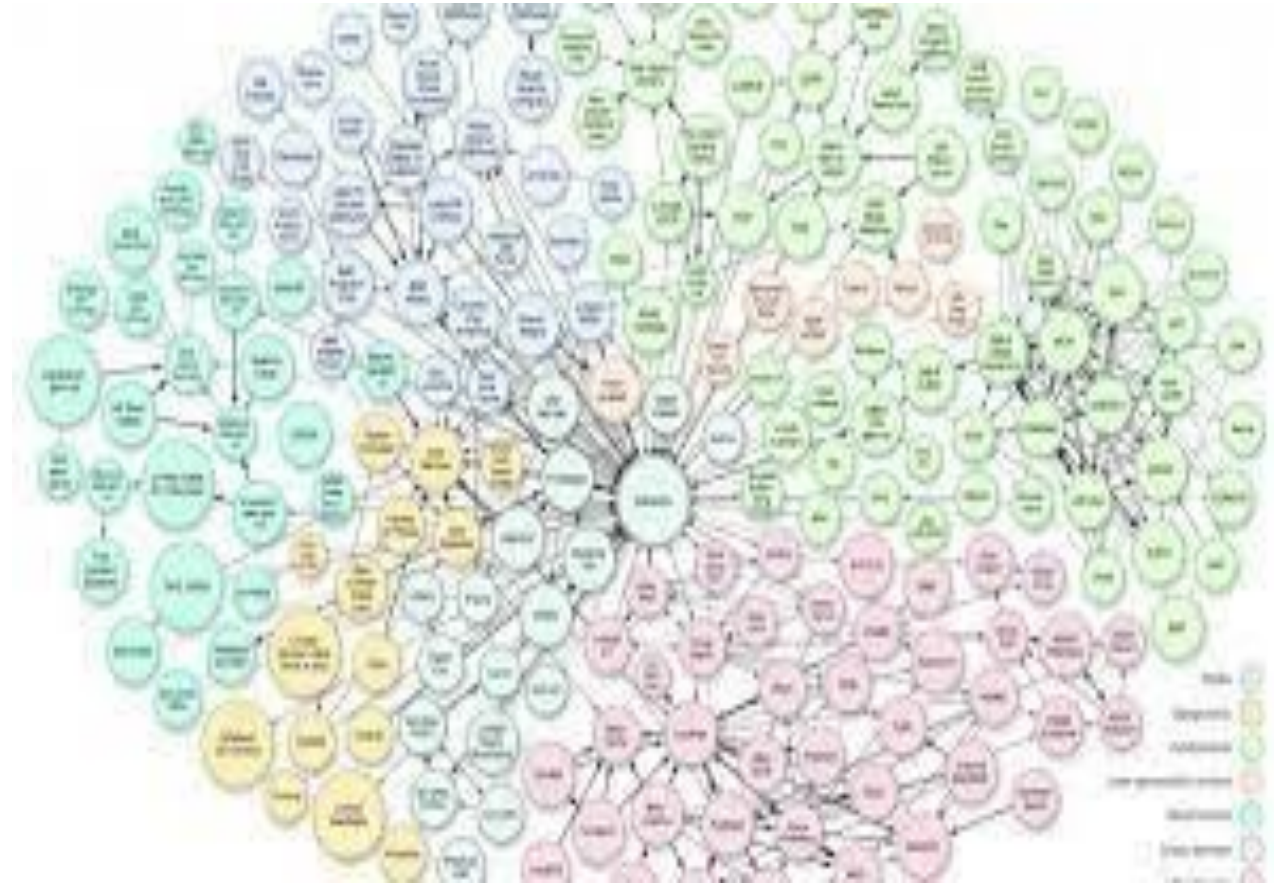
◆ Set of entities + relationships

Knowledge Graphs (KG)



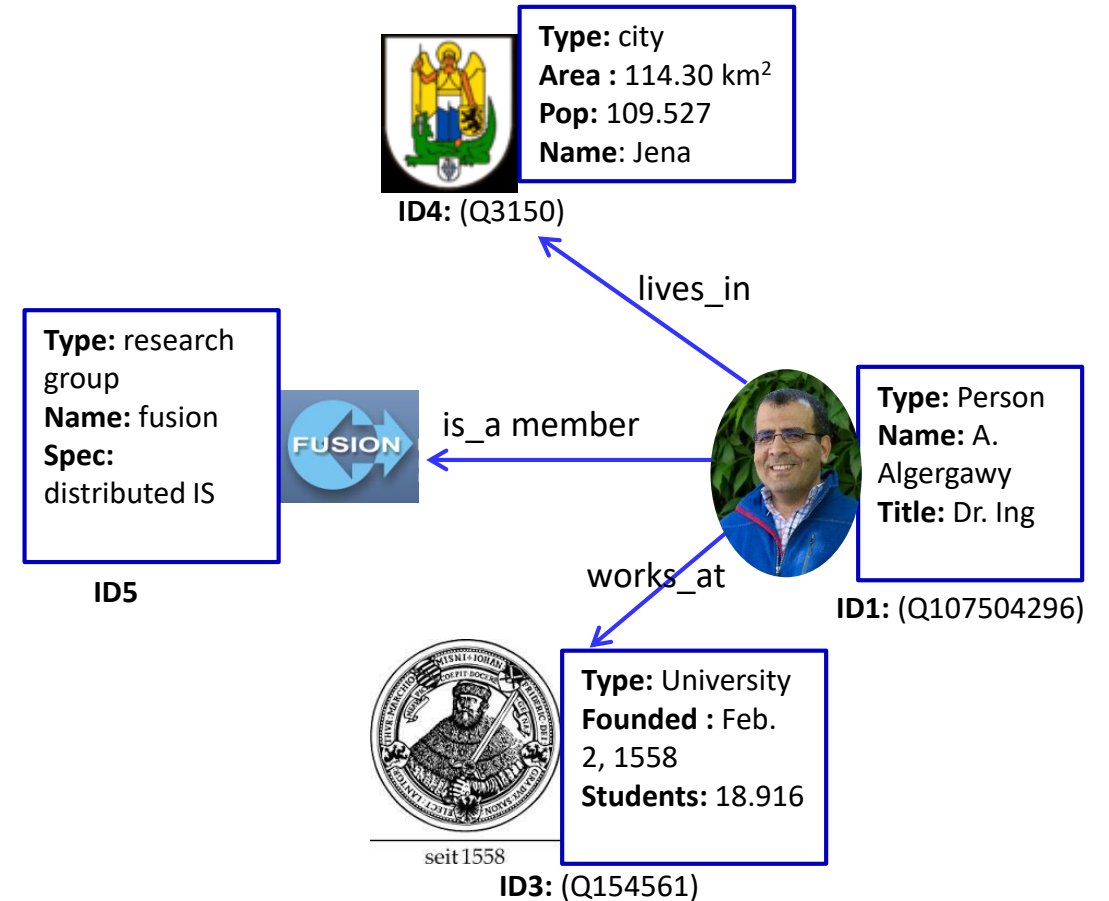
What is a Knowledge Graph?

- ◆ No clear (or generic) definition...
- ◆ Structured representation of knowledge
- ◆ Collection of *facts* about real-world concepts
- ◆ Represented as $\langle s; p; o \rangle$ triples
 - $\langle \text{FSU}, \text{located_in}, \text{Jena} \rangle$
 - s and o : **entities**, represented as nodes in the graph
 - p : **relation** between entities, represented as an edge in the graph



What is a Knowledge Graph?

<ID1, has_name, "A. Algergawy">
<ID1, is-a, Person>
<ID4, is-a, City>
<ID4, has_name, "Jena">
<ID1, lives_in, ID4>
<ID1, work_at, ID3>
<ID3, locate_in, ID4>

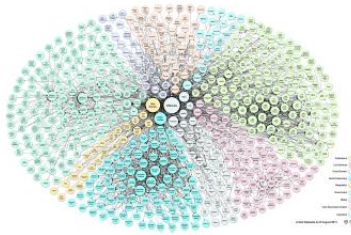


What is a Knowledge Graph?

LinkedIn
Knowledge Graph

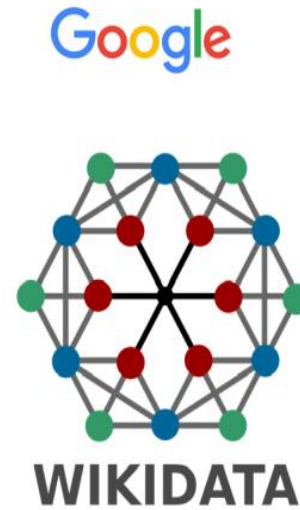


Amazon
Product Graph

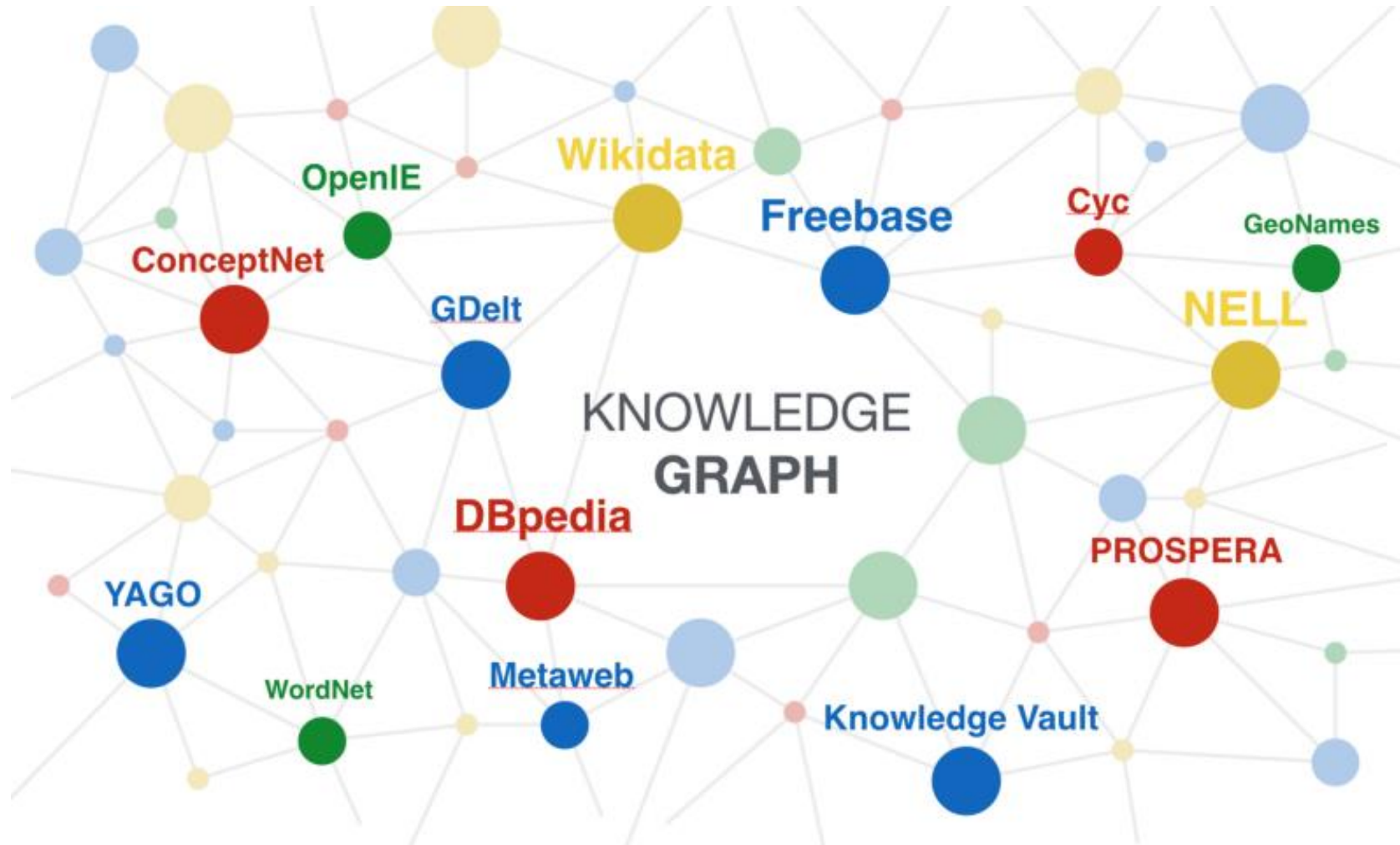


Facebook
Entity Graph

Microsoft
Satori

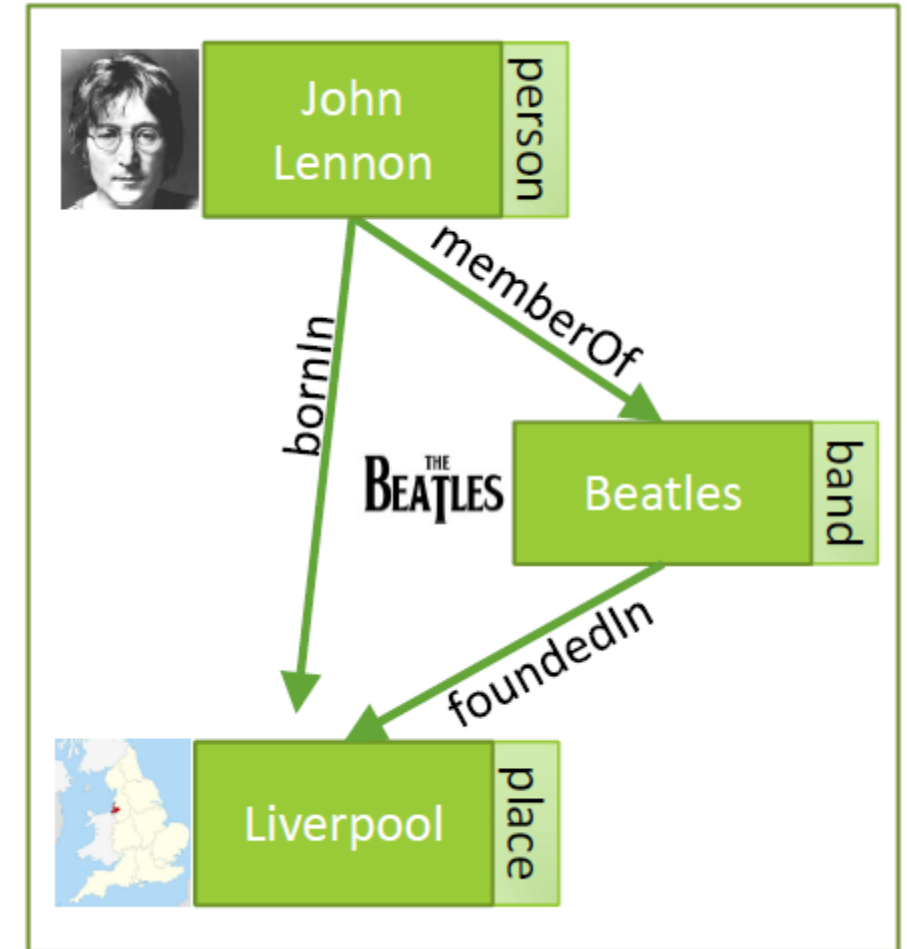


What is a Knowledge Graph?

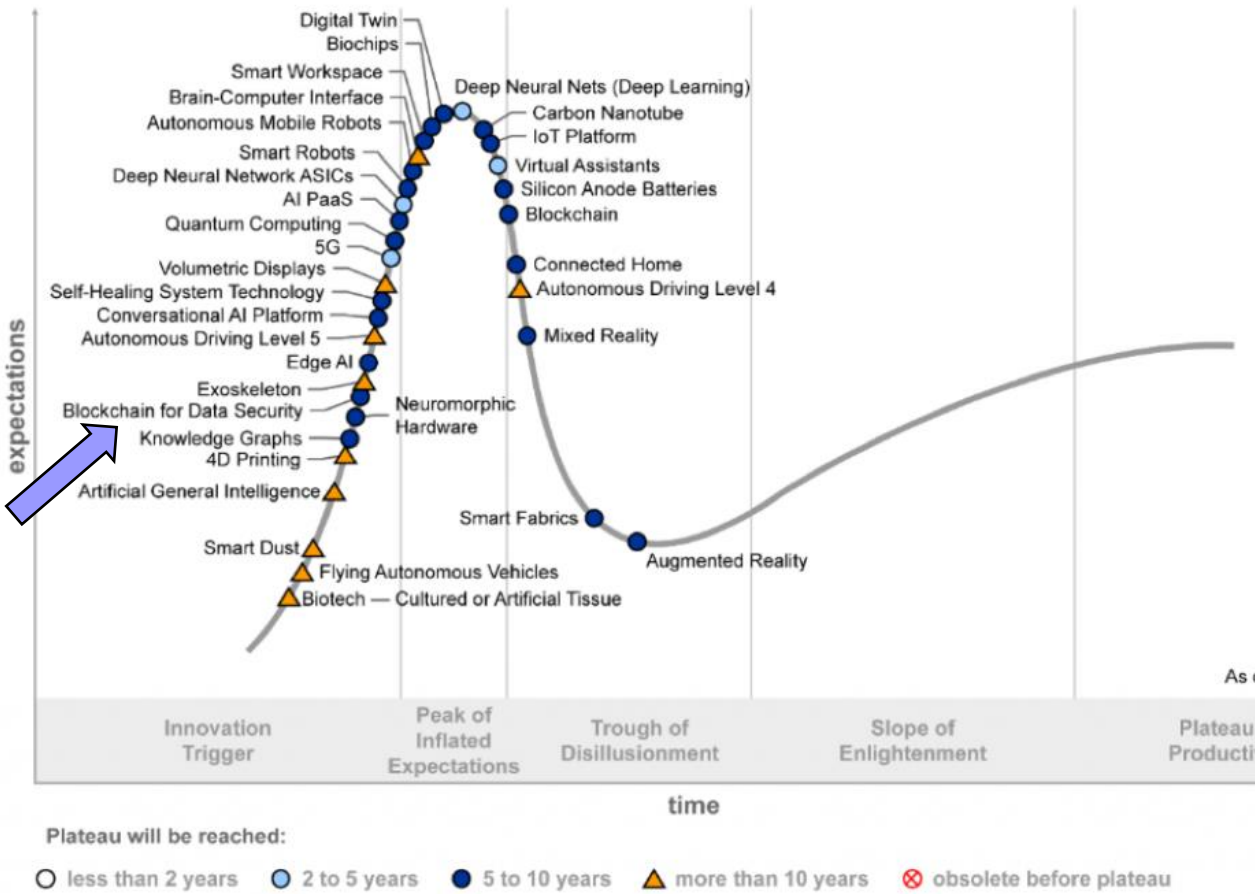


So, what is a Knowledge Graph?

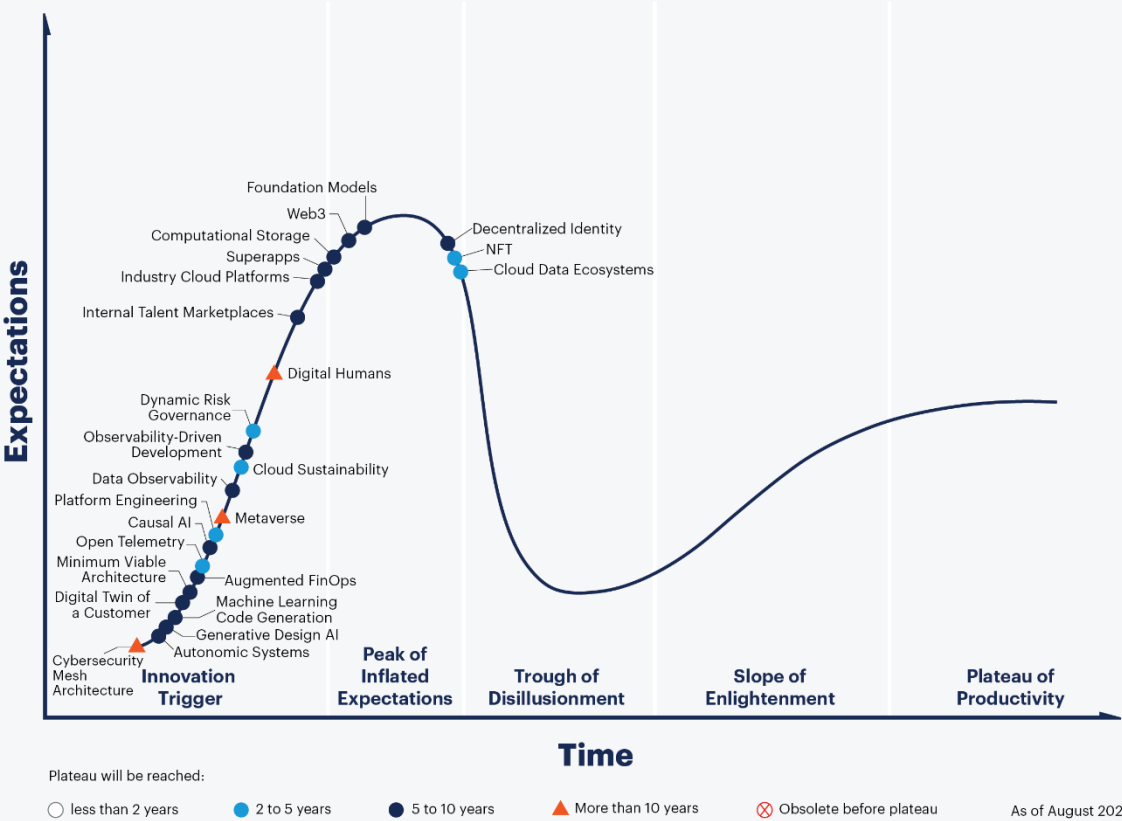
- ◆ Knowledge in graph form!
- ◆ Captures entities, attributes, and relationships
- ◆ Nodes are entities
- ◆ Nodes are labeled with attributes (e.g., types)
- ◆ Typed edges between two nodes capture a relationship between entities



Why KGs?



Hype Cycle for Emerging Tech, 2022



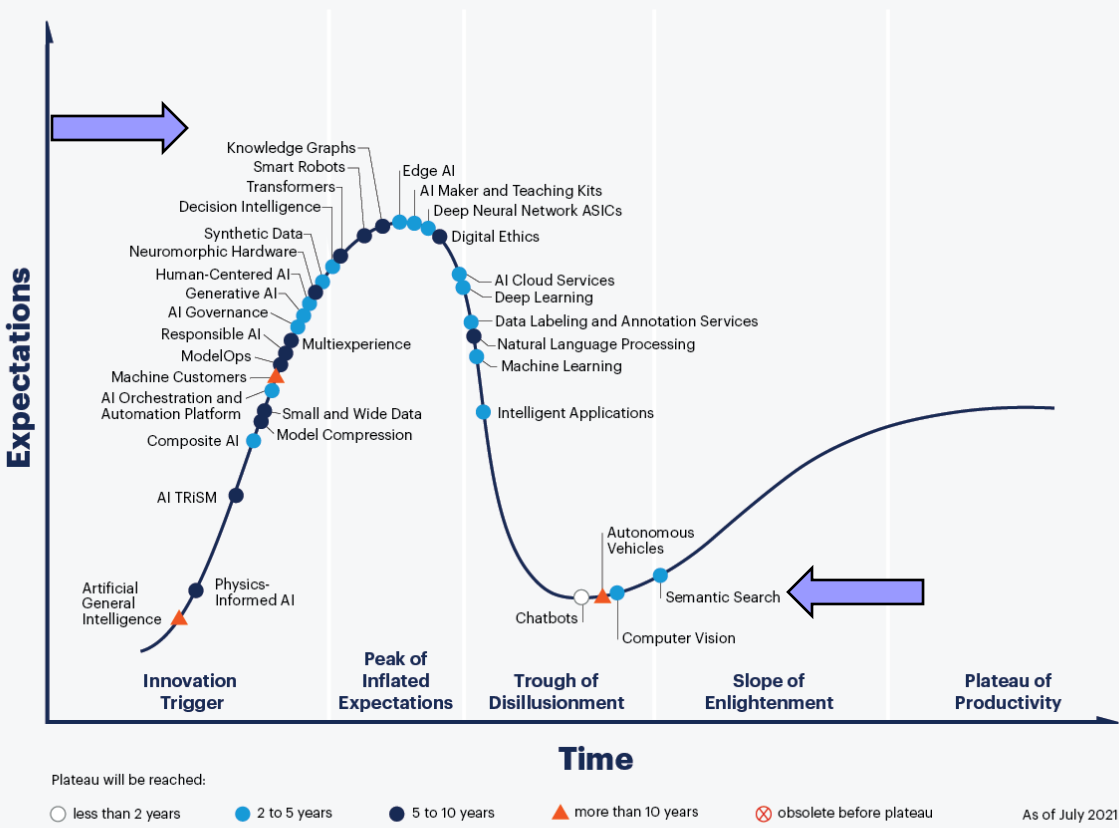
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Gartner

Why KGs?

Hype Cycle for Artificial Intelligence, 2021

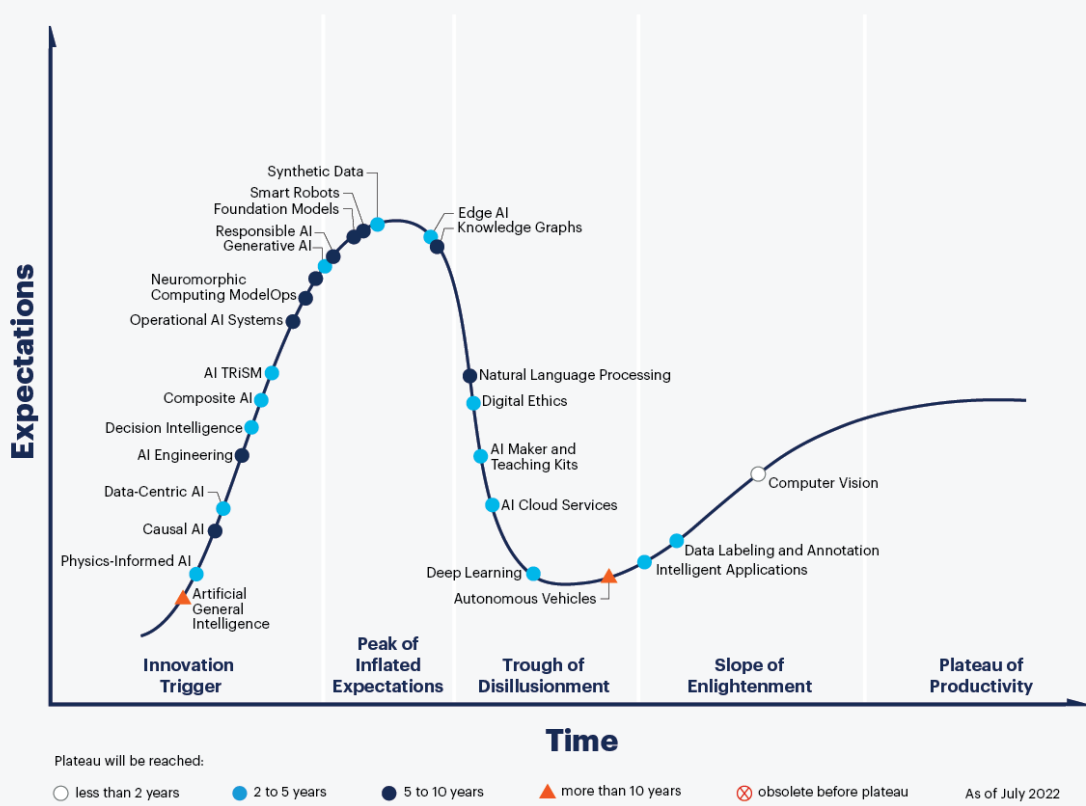


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Gartner

Hype Cycle for Artificial Intelligence, 2022



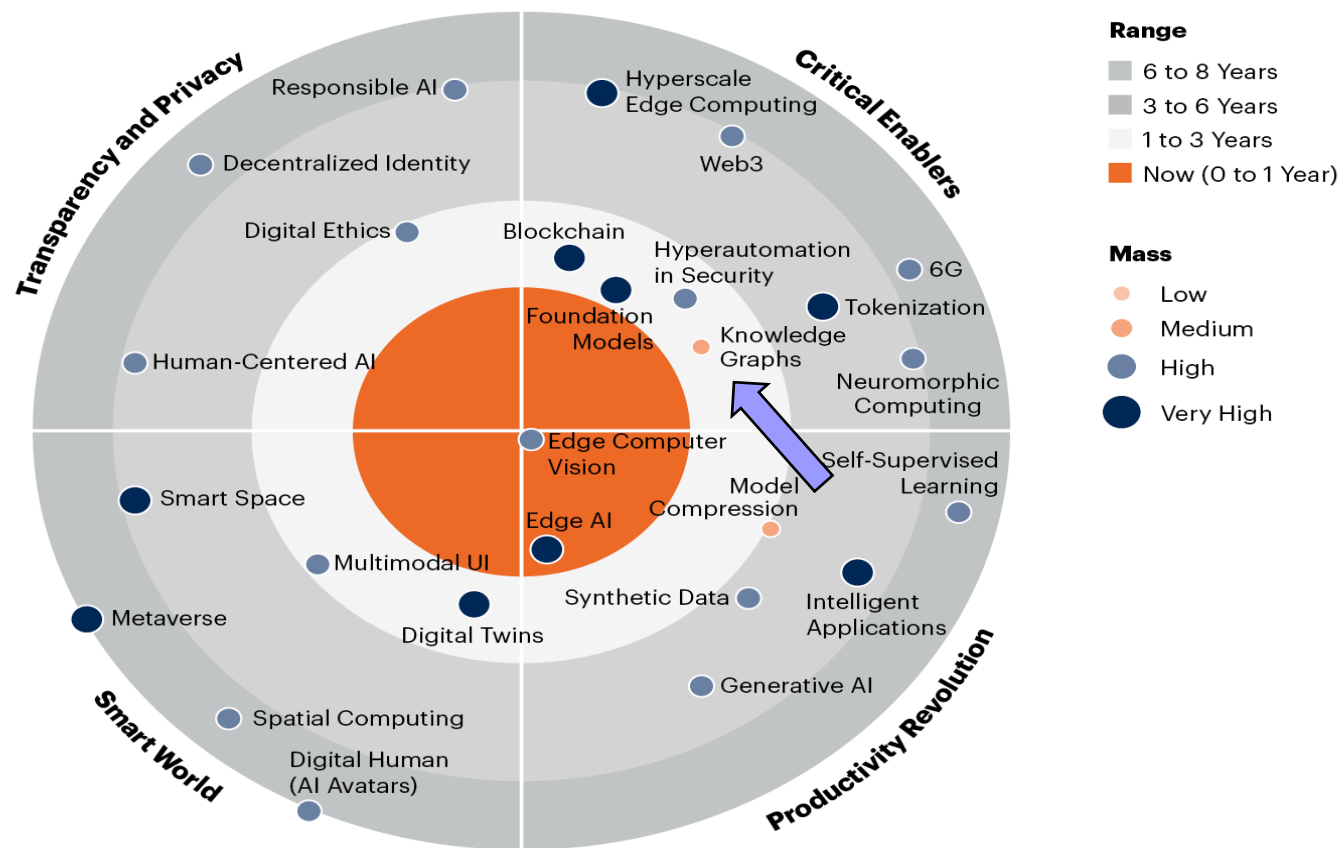
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Gartner

Why KGs?

2023 Gartner Emerging Technologies and Trends Impact Radar



gartner.com

Note: Range measures number of years it will take the technology/trend to cross over from early adopter to early majority adoption. Mass indicates how substantial the impact of the technology or trend will be on existing products and markets.

Source: Gartner
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Have you used KGs?



who is the best german football player?



Google Search

I'm Feeling Lucky

Google offered in: [Deutsch](#)

who is the best german football player?



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About 104.000.000 results (0,56 seconds)

According to [thetoptens.com](#)

[View 40+ more](#)



Franz Beckenba...



Gerd Müller



Manuel Neuer



Mesut Özil



Karl-Heinz Rummeni...



Oliver Kahn



Marco Reus

Best German Football Players

- 1 Franz Beckenbauer Franz Anton Beckenbauer is a **German** former professional **footballer** and manager. ...
- 2 Gerd Müller. ...
- 3 Manuel Neuer Manuel Peter Neuer is a **German** professional **footballer** who plays as a goalkeeper for Bayern Munich and the **Germany** national team.

What are KGs used for?


◆ Query Answering

who is the best german football player?


All Images News Videos Maps More Settings Tools

About 104.000.000 results (0,56 seconds)


According to thetoppens.com [View 40+ more](#)




Franz Beckenba...




Gerd Müller




Manuel Neuer




Mesut Özil



Karl-Heinz Rummeni...



Oliver Kahn



Marco Reus

Best German Football Players

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- 3 Manuel Neuer Manuel Peter Neuer is a **German** professional **footballer** who plays as a goalkeeper for Bayern Munich and the **Germany** national team.

What are KGs used for?

◆ what is the periodic symbol for silicon?

Q what is the periodic symbol for silicon

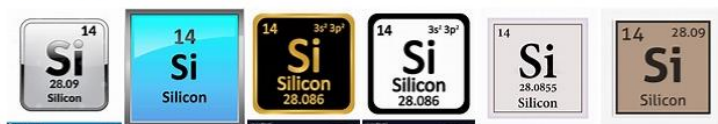
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Etwa 687.000 Suchergebnisse

Suchergebnisse:

Bilder



Alle anzeigen

www.periodic-table.org › silicon-periodic-table

Silicon - Periodic Table

21.11.2020 · **Silicon** is a chemical element with atomic number 14 which means there are 14 protons and 14 electrons in the atomic structure. The chemical **symbol** for **Silicon** is Si. **Silicon** is ...

Electron Affinity: 133.6 kJ/mol Electron Conf.: [Ne] 3s² 3p²

Electronegativity: 1.9 Oxidation States: 4; ... +4

dbpedia.org/fct/facet.vsp?cmd=text&sid=6329



Displaying Ranked Entity Names and Text summaries where:

?s1 has any Attribute with Value "what is the periodic symbol for silicon?" Drop.

View query as SPARQL Facet permalink

No Result

This query did not produce any results.
Try dropping some of the conditions, to make the query less specific.

Complete result - 0 processed in 7 msec.
Resource utilization: 93 rnd 1.452K seq 0 same seg 0 same pg 0 same par 0 disk 0 spec disk 0B / 0 messages 0 fork

Google

what is the periodic symbol for silicon



All Images News Shopping Videos More

Tools

About 7.270.000 results (0,86 seconds)

Silicon / Symbol

Si



People also search for



Boron
B



Carbon
C



Germanium
Ge

Feedback

https://en.wikipedia.org › wiki › Silicon

Silicon - Wikipedia

Silicon is a chemical element with the symbol Si and atomic number 14. It is a hard, brittle crystalline solid with a blue-grey metallic luster, ...

Black silicon · Silicon tombac · Silicon Wadi · Polycrystalline silicon

Microsoft Bing

what is the periodic symbol for silicon



ALL IMAGES VIDEOS MAPS NEWS SHOPPING

684.000 Results Date Open links in new tab

Images of What Is The Periodic Symbol For Silicon
bing.com/images



See all images



Silicon - Symbol
Si

Silicon

Chemical Element

Silicon is a chemical element with the symbol Si and atomic number 14. It is a hard, brittle crystalline solid with a blue-grey metallic luster, and is a tetravalent metalloid and semiconductor. It is ...

W



Discoverer Jöns Jacob Berzelius

Discovered 1823

Symbol Si

Electron configuration Ne 3s² 3p²

See more

Data: Wikipedia
Wikipedia text under CC-BY-SA license

Feedback

Explore more



Silicon dioxide

Aluminium

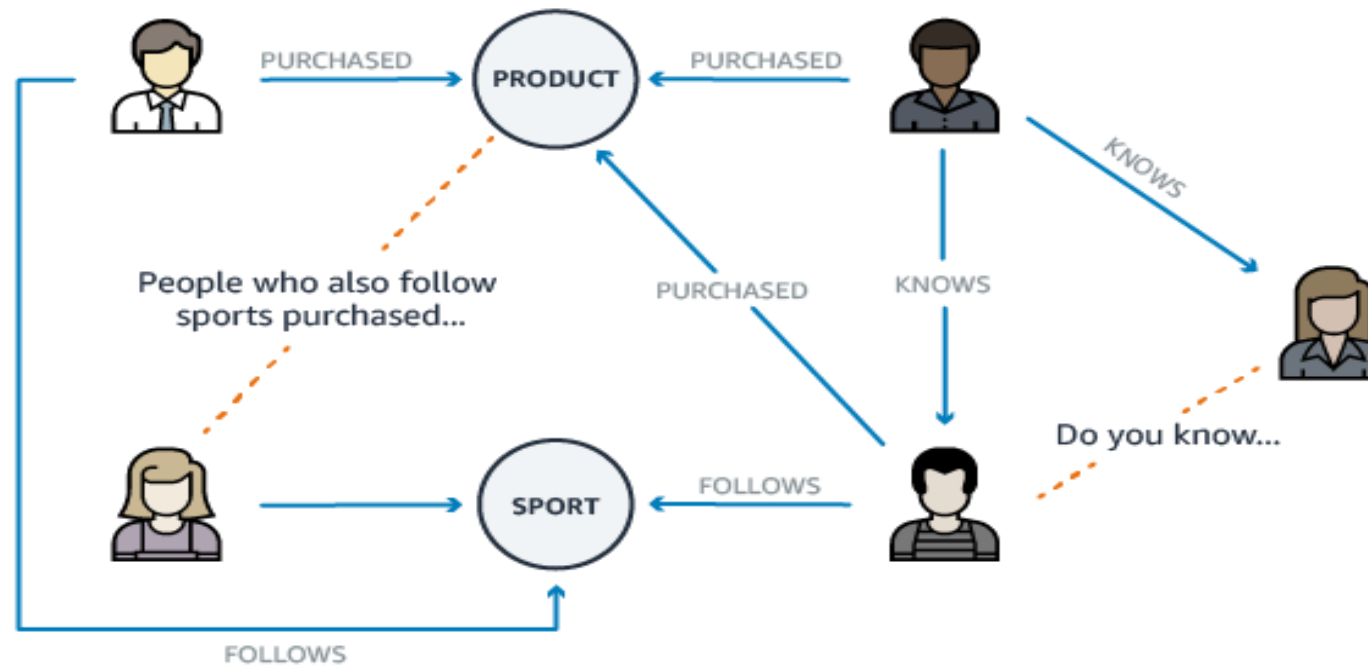
Germanium

Carbon

Phosphorus

What are KGs used for?

◆ Recommendation



Agenda

- ◆ Introduction
- ◆ Seminar organization and rules
- ◆ Topics
- ◆ Topic Registration

Seminar organization

- ◆ Module number: 5369S/ SoSe23
- ◆ 2 SWS/ 5 ECTS points
- ◆ When/where: Wed., 19.04.2023 08:00 - 10:00 Uhr,
 - Room: (HK 28) SR 101

Seminar organization: schedule

Week	Topic
Wed. 19.04.2023	Introduction
Wed. 26.04.2023	Topic selection/Monitoring
Wed. 03.05.- 31.05.2023	Monitoring/presentation/report preparing
Wed. 07.06.2023	Student presentations (3 talks)
Wed. 14.06.2023	Student presentations (3 talks)
Wed. 21.06.2023	Student presentations (3 talks)
Wed. 28.06.2023	Student presentations (3 talks)
Wed. 05.07.2023	Student presentations (3 talks)
Wed. 12.07.2023	Student presentations (3 talks)
Wed. 19.07.2023	Student presentations (3 talks)
Wed. 26.07.2023	Final report submission

Seminar rules

- ◆ Please pick One topic (for example):
 - What are Knowledge graphs (KGs)?
 - How to construct KGs (text, semi-structure, table, csv,...)
 - How to evaluate KGs? KG quality?
 - KGs in different applications, e.g. agriculture, medicine, education, generic
 - Examples of KGs
 - KGs embedding
 - KGs alignment

Seminar rules

- ◆ For the selected topic, use 2/3 papers (published in highly ranked conference, such as ISWC, ESWC, VLDB, WWW, CIKM or journals)
- ◆ The selected topic as well as the selected set of papers should be registered and sent through the email to your monitor
- ◆ In a case having questions, simply send an email or ask for a meeting

Seminar rules

- ◆ The seminar contains two main parts: **presentation** and **technical report** (implementation/deployment one of the related system is plus)
- ◆ Presentation
 - 20 minutes talk in English
 - Around 10 minutes of Q&A
 - Talk regularly to your instructor/tutor, especially before your talk
 - **Prepare your own slides** (power point or latex code must be sent to your tutor)

Guidelines for presentation

- ◆ It is important to **clearly introduce** the problem and the idea presented in the papers
- ◆ In the papers look for:
 - **Contributions** of the paper
 - Improvements to the **state-of-the-art**
 - Main **results**
 - **Conclusions** and **future work**
- ◆ Discuss the **insights** that are provided in the papers
- ◆ Identify **strengths** and **weaknesses**, question the **assumptions**, criticize the bad **decisions** in the papers

Report

- ◆ Up to **3-5 pages** using your own template
- ◆ Maximum of **one week** after the end of presentations
- ◆ Contents of the report:
 - include the **basic idea** presented in the papers
 - **summarize** the papers
 - include the points raised in the seminar by the moderator (collaborate with the opponents if necessary)
 - Identify **strengths** and **weaknesses**, question the **assumptions**, criticize the bad **decisions** in the papers
 - include the **important results** and **conclusions**
 - **bonus points** if you include the content from the papers outside of your assigned papers (such as any follow up works, new results etc)

Moderators

- ◆ One **moderator** per talk
 - **introduces** the speaker and topic
 - **moderates** the Q&A session
 - must **read the papers thoroughly**
 - prepare **questions**
 - **challenge** the ideas and results in the papers (if there are any weaknesses)

Grading

- ◆ Presentation 40%
- ◆ Report 30%
- ◆ Your performance as a moderator 15%
- ◆ Active participation in the seminars 15%

Agenda

- ◆ Introduction
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- ◆ Topics
- ◆ Topic Registration

Topics

- ◆ What is a KG? -- 1
- ◆ KG construction from
 - Text --2
 - Table --3
 - Mixed --4
- ◆ KG search
 - Keyword over KG --5
 - Question answering over KG--6
 - ChatGPT for KG --7
- ◆ KG schema
 - Ontology design for KG --8
- ◆ KG alignment---9
- ◆ KG embedding ---10
- ◆ KG for ML ---11
- ◆ KG applications:
 - KG for health --- 12
 - KG for agriculture --- 13
 - KG for energy ---14
 - KG for biodiversity ---15
- ◆ KG frameworks:
 - Google KG --- 16
 - Amazon PKG --- 17
 - Dbpedia ---- 18
 - Wikidata --- 19

Agenda

- ◆ Introduction
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Topic registration

- ◆ Select your topic from the poll
- ◆ Next week will revise selection and monitoring

Reference

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- ◆ Ji, Shaoxiong, et al. "A survey on knowledge graphs: Representation, acquisition, and applications." IEEE transactions on neural networks and learning systems 33.2 (2021): 494-514.
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Reference

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- ◆ Completeness and consistency analysis for evolving knowledge bases. Web Semantics: Science, Services and Agents on the World Wide Web 54 (2019) 48–71
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