

Introduction to Knowledge Graphs and Semantic Web Technologies

Motivation and Usage Examples

Olaf Hartig

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About 8 540 000 results (0,55 seconds)

Results for **Linköping University, Linköping** · Choose area

https://liu.se · Translate this page

Linköpings universitet - Linköpings universitet

Linköpings universitet (LiU) är känt för innovativa utbildningar, gränsöverskridande forskning och nära samarbete med näringsliv och samhälle.

Results from liu.se [Search]

Hitta din utbildning här!

Om du letar efter en utbildning som lönar sig för både dig och ...

Courses

Exchange students are selected by their home universities. For ...

Exchange studies

Studying abroad is not just new knowledge, but a life-changing ...

Biblioteket

Linköpings universitetsbibliotek. Här kan du söka artiklar, böcker ...

People also ask

- Är Linköping ett bra universitet?
 - Vad kan man plugga till i Linköping?
 - Vad krävs för att komma in på Linköpings universitet?
 - Har Linköping bra studentliv?
- Feedback

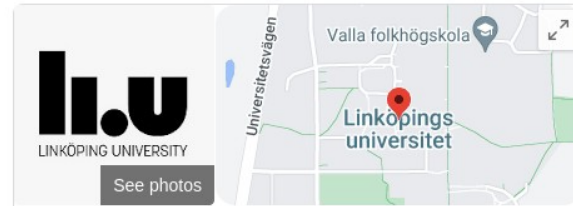
https://twitter.com/liu_universitet

Linköpings universitet (@liu_universitet) · Twitter

Researchers at @LOE_at_LIU @Lundsuni @goteborgsuni have successfully grown electrodes in living tissue using the body's molecules as triggers. The result paves way for fully integrated electronic circuits in living organisms. #bioelectronics #research liu.se/en/news-item/e...

Twitter · 4 days ago

Images for Linköping University



Linköping University (Linköpings universitet)

Website Directions Save

Public university in Linköping

Linköping University is a public research university based in Linköping, Sweden. Originally established in 1969, it was granted full university status in 1975 and is one of Sweden's largest academic institutions. [Wikipedia](#)

Address: 581 83 Linköping

Phone: 013-28 10 00

Total enrollment: 32,000 (2019)

Undergraduate tuition and fees: International tuition 13,750 SEK (2011 – 12)

Rector: Jan-Ingvar Jönsson

Founded: 1975

Colors: Green, Blue, Turquoise

Ranking

History

Refund

[Suggest an edit](#)

Disclaimer

Events

Sun, 11 Jun Nordic Design Research Society conference

Thu, 27 Jul NärCon Summer 2023

Fri, 28 Jul 14:00 [Ryu Ga Gotoku & Judgment Meetup - När...](#)

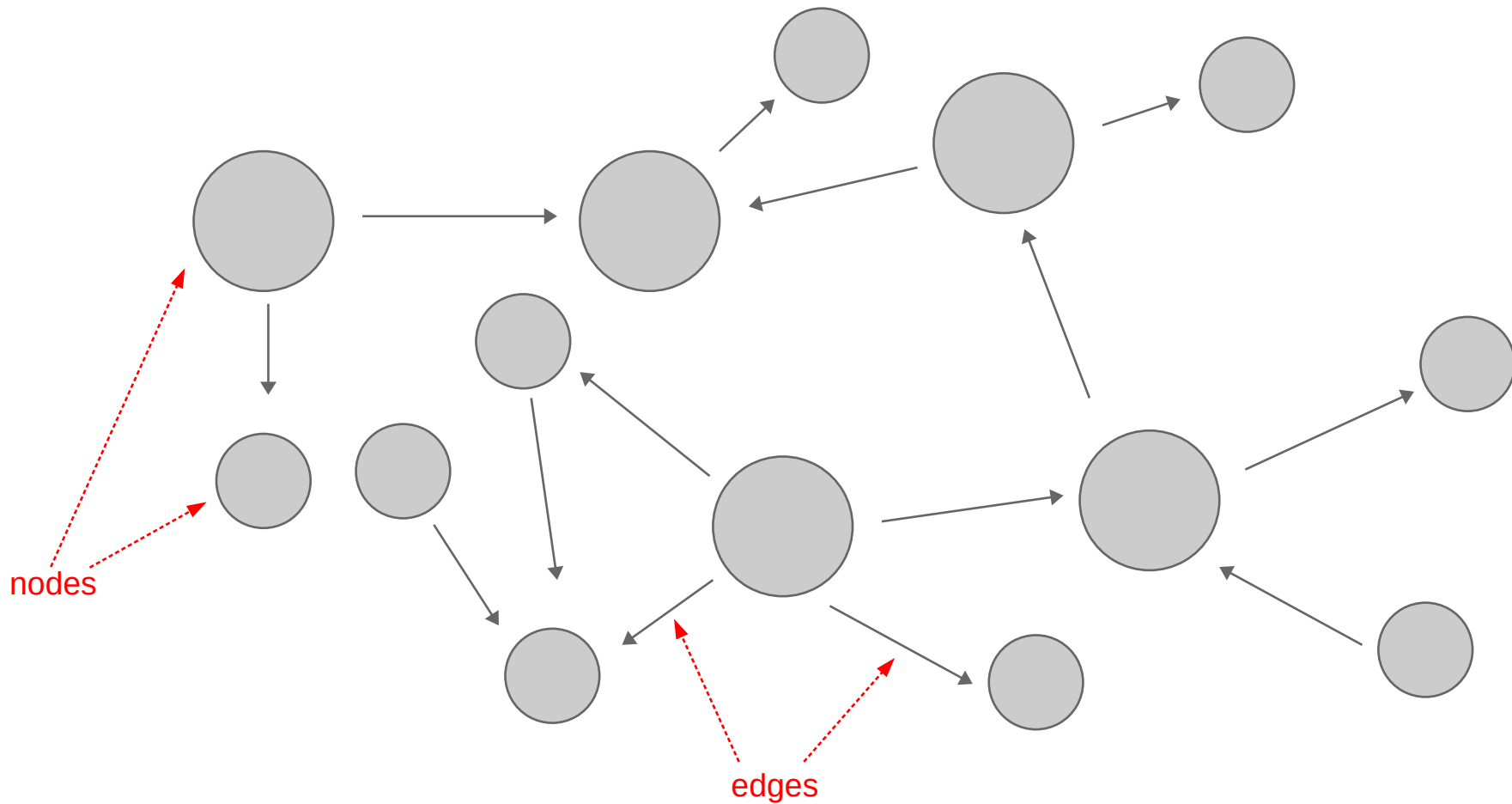
type and location

typical type-specific (!) attributes

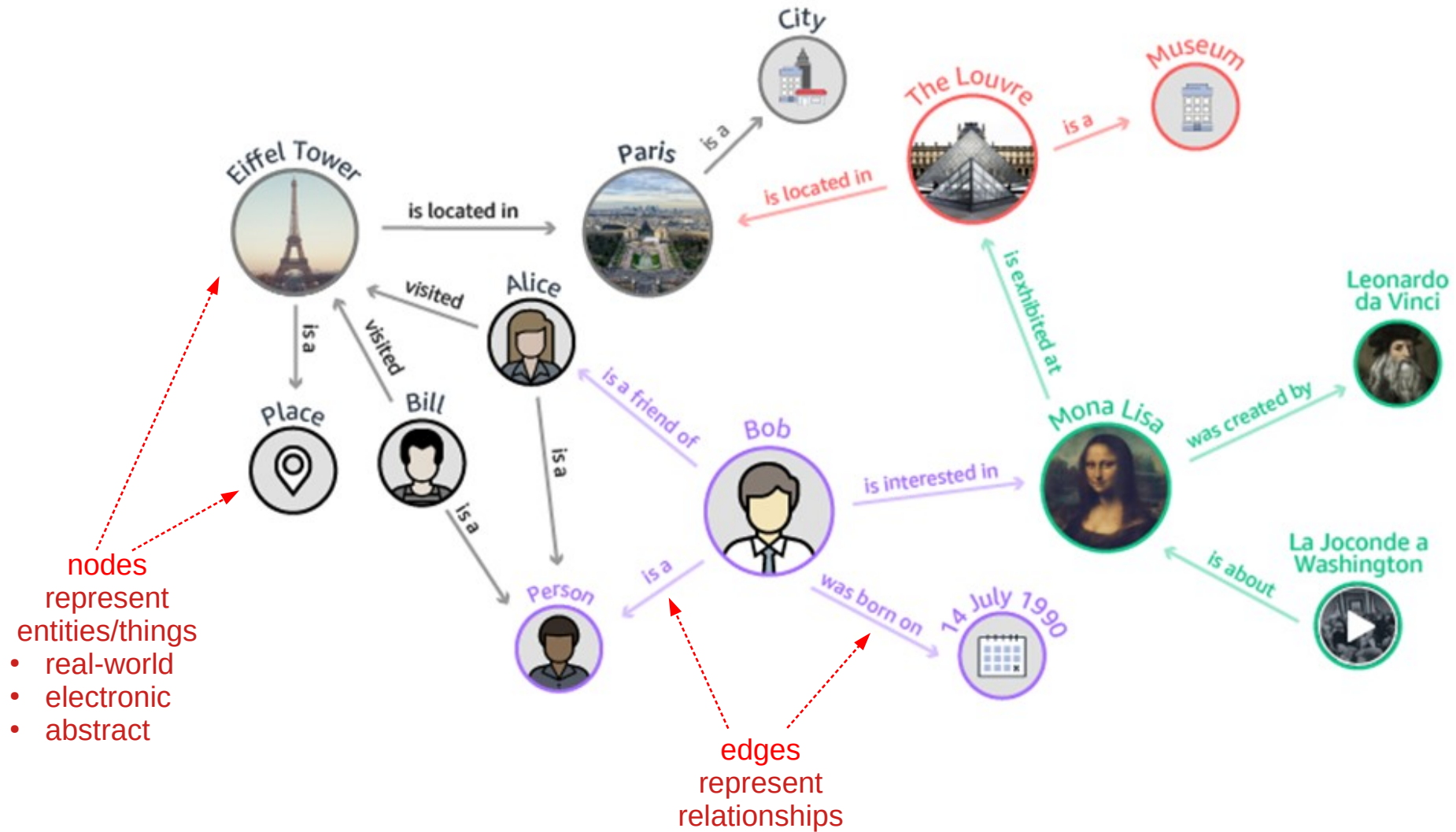
type-specific articles and data

links to search pages about related events

What is a Graph?

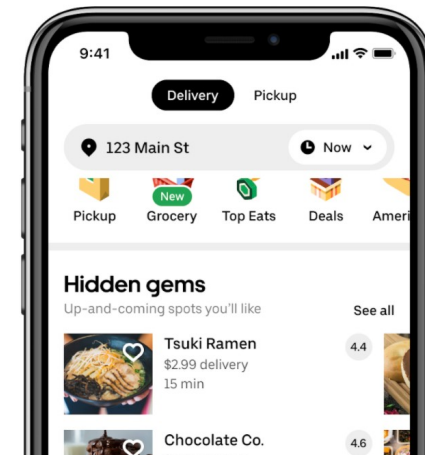


What is a Knowledge Graph?



Source: <https://aws.amazon.com/neptune/knowledge-graphs-on-aws/>

Example: Uber Eats



- Online food ordering and delivery platform, mediates between customers and participating restaurants
- KG of restaurants, cuisines, menu items, etc.

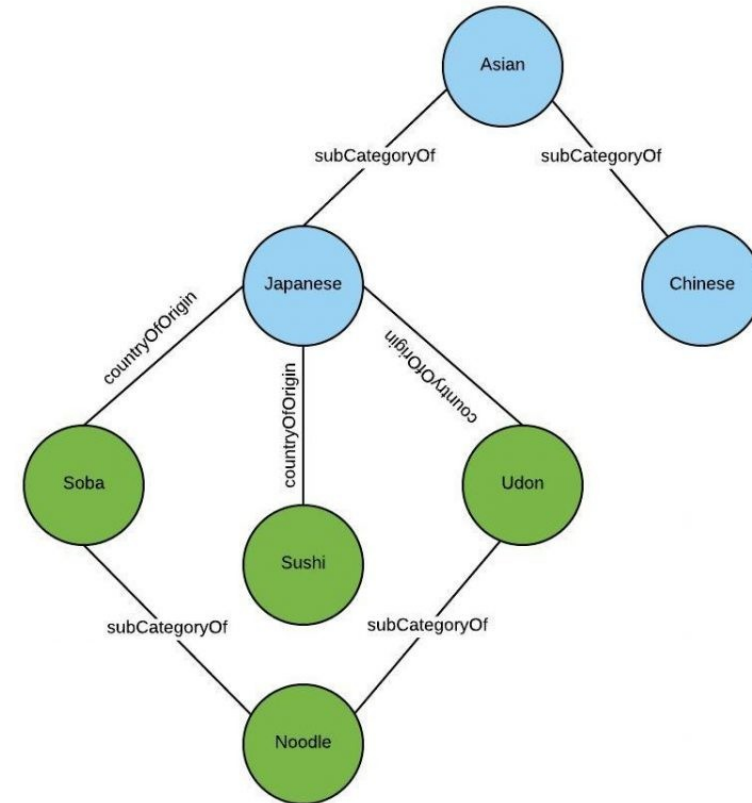
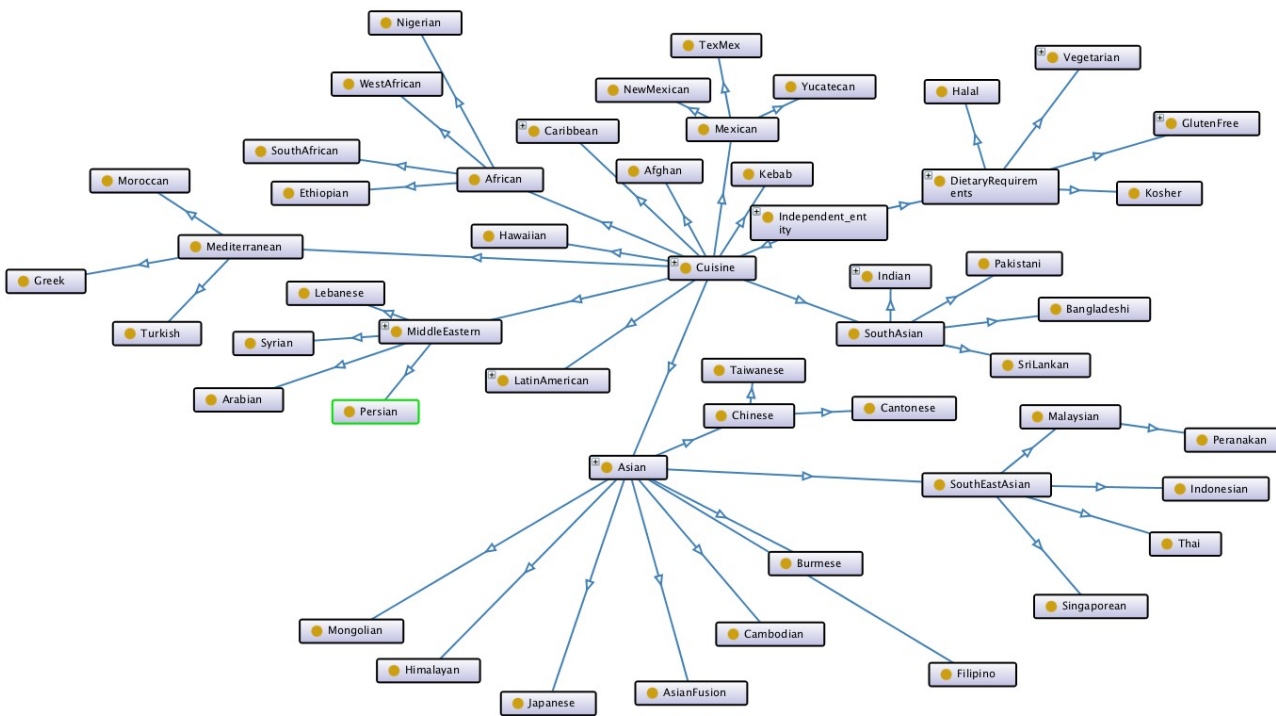


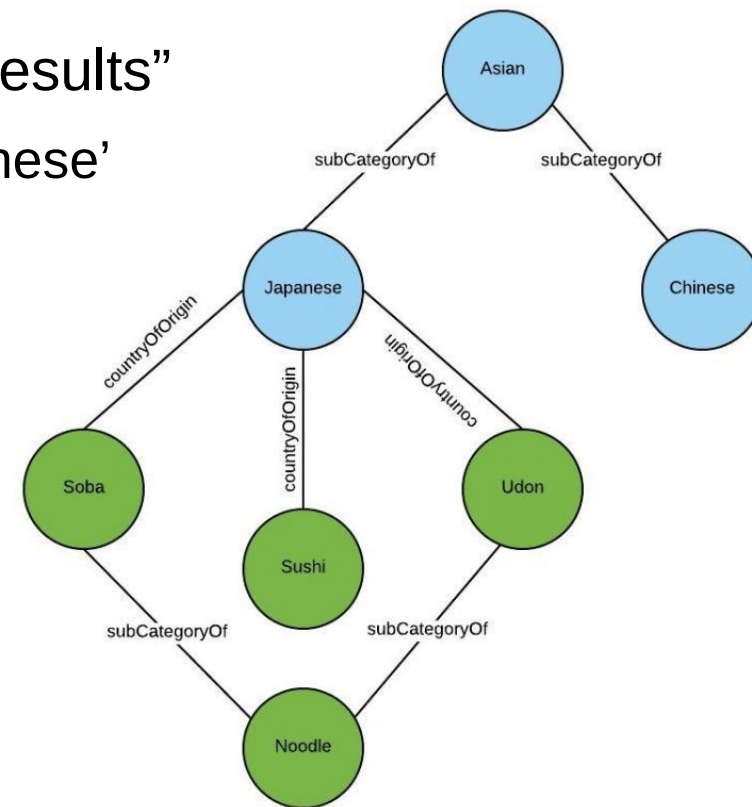
Image source: <https://thespoon.tech/uber-eats-revamped-app-aims-to-make-restaurant-discoverability-easier/>

Examples from <https://eng.uber.com/uber-eats-query-understanding/>

Example: Uber Eats (cont'd)



- Online food ordering and delivery platform, mediates between customers and participating restaurants
- KG of restaurants, cuisines, menu items, etc.
- Application: “optimize an eater’s search results”
 - restaurants tagged as ‘Chinese’ or ‘Japanese’ surfaced when searching for ‘Asian’ (semantic search!)
 - query for ‘Udon’ would be expanded to also include related terms such as ‘Soba’ and ‘Ramen’
 - only show restaurants in the city of the user (such location-aware search results are possible because restaurants are linked to areas in the KG)








Examples from <https://eng.uber.com/uber-eats-query-understanding/>

Applications of the Amazon Product KG



- Improving search

All ▾ k-cups dunkin donuts dark 🔍

 Dunkin' Donuts Original Blend Medium Roast Coffee, 48 K Cups for Keurig Coffee Makers ★★★★★ 3,395 \$38 ⁵⁰ (\$0.44/Count) Save 5% more with Subscribe & Save ✓prime FREE Delivery Sun, May 10 88 Count	 Dunkin' Donuts K-cups Dark Roast - 48 K-cups ★★★★★ 112 \$38 ⁶⁹ (\$38.69/Count) ✓prime FREE Delivery Fri, May 8 More Buying Choices \$28.00 (7 new offers)	 Dunkin' Donuts Dark K Cup Pods, Dark Roast Coffee, for Keurig Brewers, 60Count ★★★★★ 55 \$35 ⁹⁹ (\$0.60/Count) Save 5% more with Subscribe & Save ✓prime FREE Delivery Sun, May 10 60 Count (Pack of 1)	 Dunkin' Donuts Dunkin Dark Coffee K-Cups For Keurig K Cup Brewers (96 Count) - Packaging May Vary ★★★★★ 79 \$70 ⁵⁷ (\$0.74/Count) ✓prime FREE Delivery Sat, May 9 More Buying Choices \$66.95 (8 new offers)	 The Original Donut Shop Keurig Single-Serve K-Cup Pods, Regular Medium Roast Coffee, 72 Count ★★★★★ 9,914 \$29 ⁹⁹ (\$0.42/Count) Save 5% more with Subscribe & Save ✓prime FREE One-Day Get It Tomorrow, May 5 72 Count
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Source: https://naixlee.github.io/Product_Knowledge_Graph_Tutorial_KDD2021/

Applications of the Amazon Product KG



- Improving search
- Providing structured product information



Roll over image to zoom in

Brand	Cetaphil
Ingredients	Water, Cetyl Alcohol, Propylene Glycol, Iodopropynyl Butylcarbamate, 2-Bromo-2-Nitropropane-1, 3-Diol, Sodium Lauryl Sulfate, Stearyl Alcohol, Methylparaben, Propylparaben, Sodium Citrate, Butylparaben, Allantoin, Zinc Gluconate.
Scent	Fragrance free
Additional Information	Non-Comedogenic, Fragrance-free, Natural
Skin Type	Sensitive

About this item

- Gentle for everyday use; Cetaphil gentle skin cleansing cloths will leave your skin feeling clean, refreshed and balanced after every use
- Removes makeup & dirt: Thoroughly remove makeup and dirt, leaving skin clean
- Mild & non irritating: Soap free formulation won't strip skin of its natural protective oils and emollients

Source: https://naixlee.github.io/Product_Knowledge_Graph_Tutorial_KDD2021/

Applications of the Amazon Product KG



- Improving search
- Providing structured product information
- Facilitating structured product comparisons

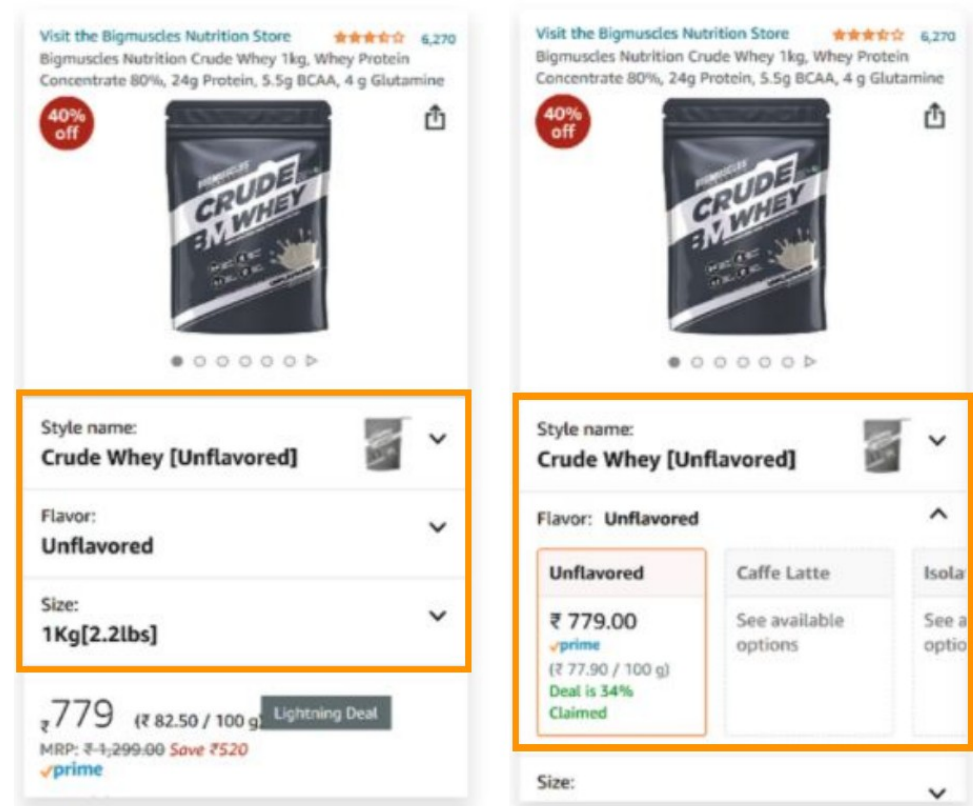
				
	Pro Air Fryer 5.8QT	Pro II Air Fryer 5.8QT	WIFI Air Fryer Oven 7QT	Stainless Air Fryer 5.8QT
Included	100 Recipes	100 Recipes	30 Recipes&More Online Recipes	100 Recipes & Rack & 5 Skewers
Control	Digital	Digital	Digital/WIFI	Digital
Capacity	5.8QT	5.8QT	7QT	5.8QT
Color	Black/Red/White	Black	Black	Silver
Cooking Functions	13	12 (Customizable)	14	10
Shake Remind	✓	Customizable Shake Remind	✓	Customizable Shake Remind
Keep Warm	✓	✓	✓	-
Preheat	✓	✓	✓	✓
Power	1700W	1700W	1800W	1700W
Voltage	AC 120V	AC 120V	AC 120V	AC 120V

Source: https://naixlee.github.io/Product_Knowledge_Graph_Tutorial_KDD2021/

Applications of the Amazon Product KG



- Improving search
- Providing structured product information
- Facilitating structured product comparisons
- Providing choices



Source: https://naixlee.github.io/Product_Knowledge_Graph_Tutorial_KDD2021/

Applications of the Amazon Product KG



- Improving search
- Providing structured product information
- Facilitating structured product comparisons
- Providing choices
- Improving recommendations



KitchenAid KSM150PSEB Artisan Tilt-Head Stand Mixer with Pouring Shield, 5-Quart, Empire Red
by KitchenAid
★★★★★ 6,331 customer reviews | 972 answered questions

List Price: \$429.99
Price: **\$249.99 & FREE Shipping**
You Save: **\$180.00 (42%)**

i Item is eligible for **6 Month Special Financing** with your Amazon.com Store Card. [Learn more](#)


Note: Not eligible for Amazon Prime. Available with free Prime shipping from other sellers on Amazon.

Only 14 left in stock.
Estimated Delivery Date: July 28 - Aug. 2 when you choose Standard at checkout.
Ships from and sold by GE Premier in easy-to-open packaging.

Color: **Empire Red**



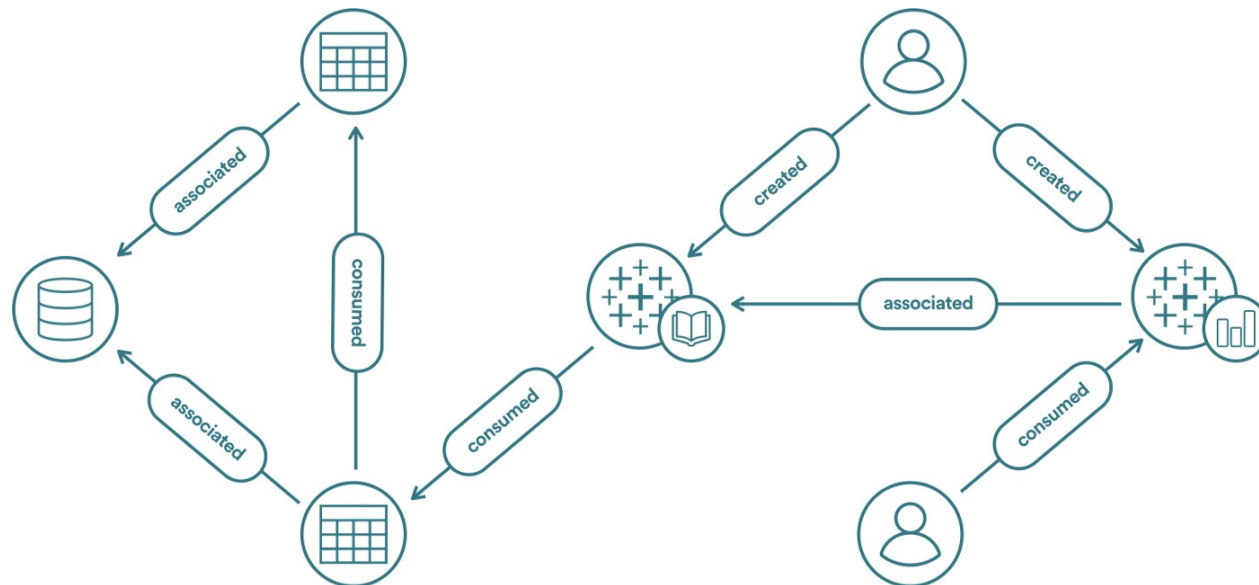
Similar But Different

More Capacity	More Attachments	Different Brand
		
See more choices	See Color Options	See Color Options

Source: https://naixlee.github.io/Product_Knowledge_Graph_Tutorial_KDD2021/

Example: Airbnb Dataportal

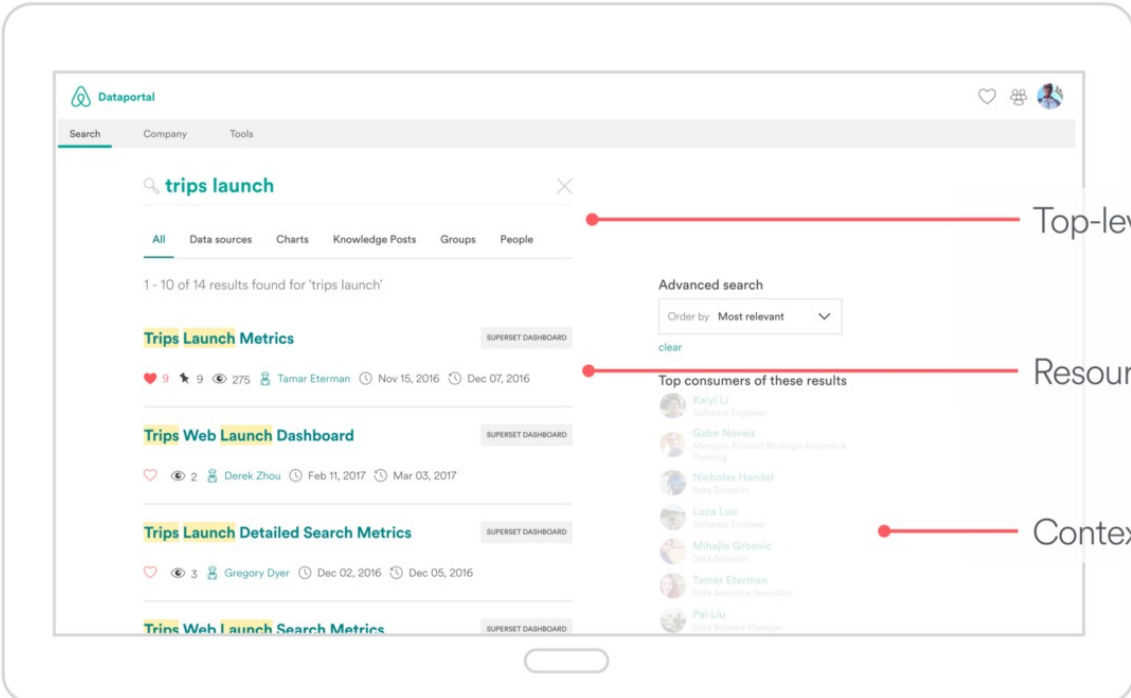
- Challenges for data-informed decision making at Airbnb:
 - amount of data and number of internal data sources exploded (data tables, dashboards, reports, metrics definitions)
 - data resources isolated by tool or team
- Aim: application for employees to search for, discover, and learn about internal data resources



Source: <https://medium.com/airbnb-engineering/democratizing-data-at-airbnb-852d76c51770>

Example: Airbnb Dataportal (cont'd)

- Features:
 - search (graph topology used to boost search relevance)

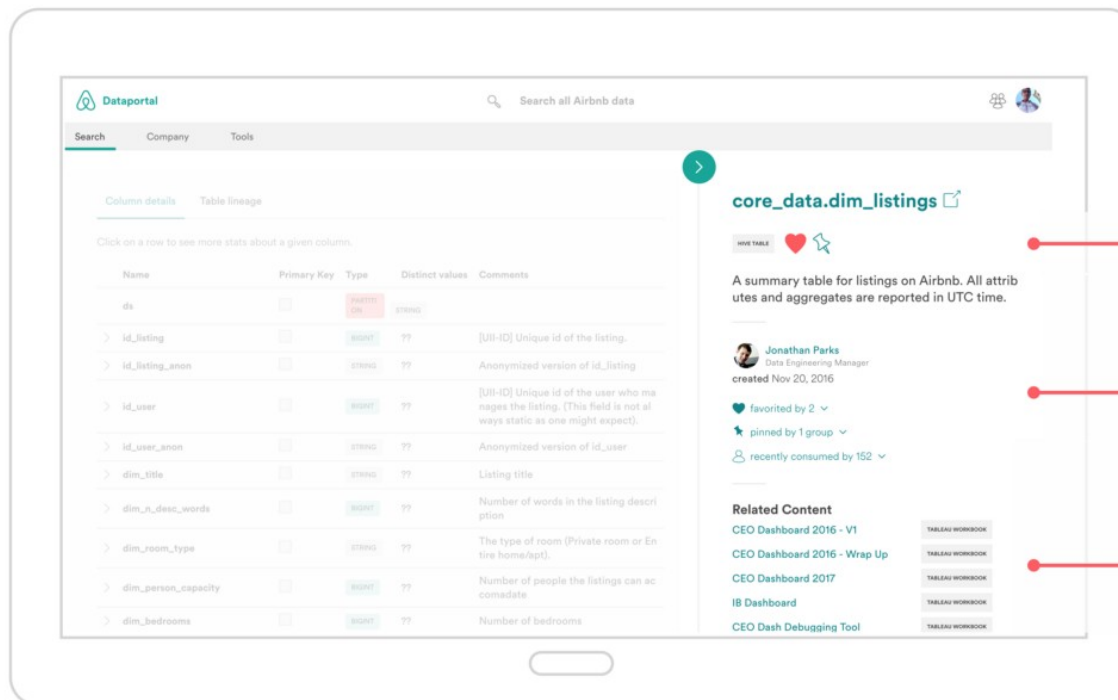


The screenshot displays the Airbnb Dataportal interface. At the top, there is a search bar with the text 'trips launch'. Below the search bar, there are tabs for 'All', 'Data sources', 'Charts', 'Knowledge Posts', 'Groups', and 'People'. The main content area shows search results for 'trips launch', including 'Trips Launch Metrics', 'Trips Web Launch Dashboard', and 'Trips Launch Detailed Search Metrics'. On the right side, there is an 'Advanced search' section with a dropdown menu set to 'Most relevant' and a 'clear' button. Below this, there is a 'Top consumers of these results' section listing several users with their roles and dates. Red lines with dots at the end point from text labels on the right to specific elements in the interface: 'Top-level search filters' points to the search bar and tabs; 'Resource details & metadata' points to the search results; and 'Context, context, & context' points to the 'Top consumers of these results' section.

Source: <https://medium.com/airbnb-engineering/democratizing-data-at-airbnb-852d76c51770>

Example: Airbnb Dataportal (cont'd)

- Features:
 - search (graph topology used to boost search relevance)
 - context and metadata



Description, external link, social

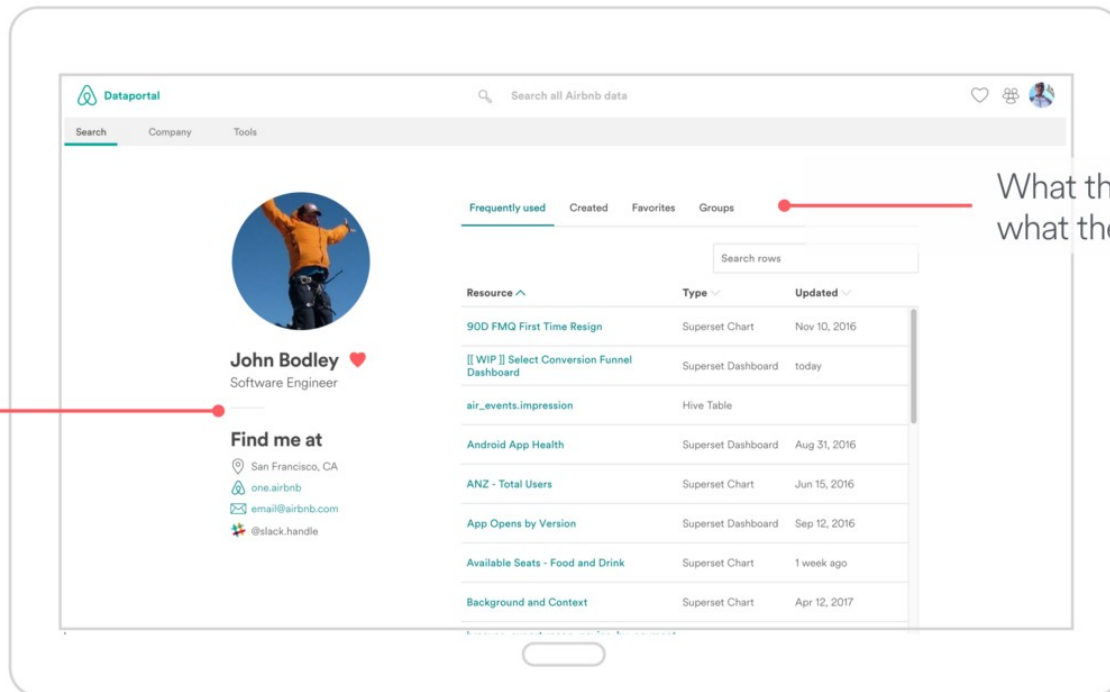
Metadata & consumption

Surface relationships, everything's a link to promote exploration

Source: <https://medium.com/airbnb-engineering/democratizing-data-at-airbnb-852d76c51770>

Example: Airbnb Dataportal (cont'd)

- Features:
 - search (graph topology used to boost search relevance)
 - context and metadata
 - employee-centric data



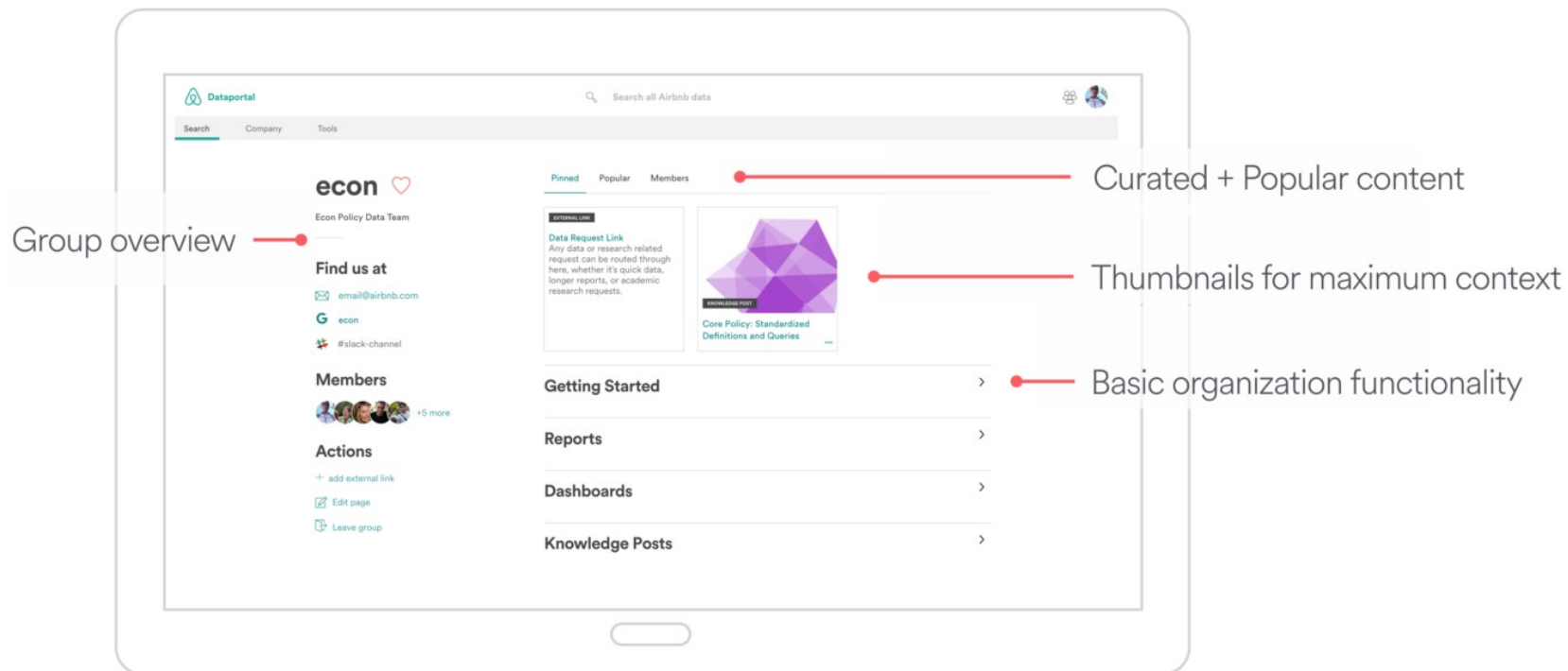
User details & metadata

What they make, what they consume

Source: <https://medium.com/airbnb-engineering/democratizing-data-at-airbnb-852d76c51770>

Example: Airbnb Dataportal (cont'd)

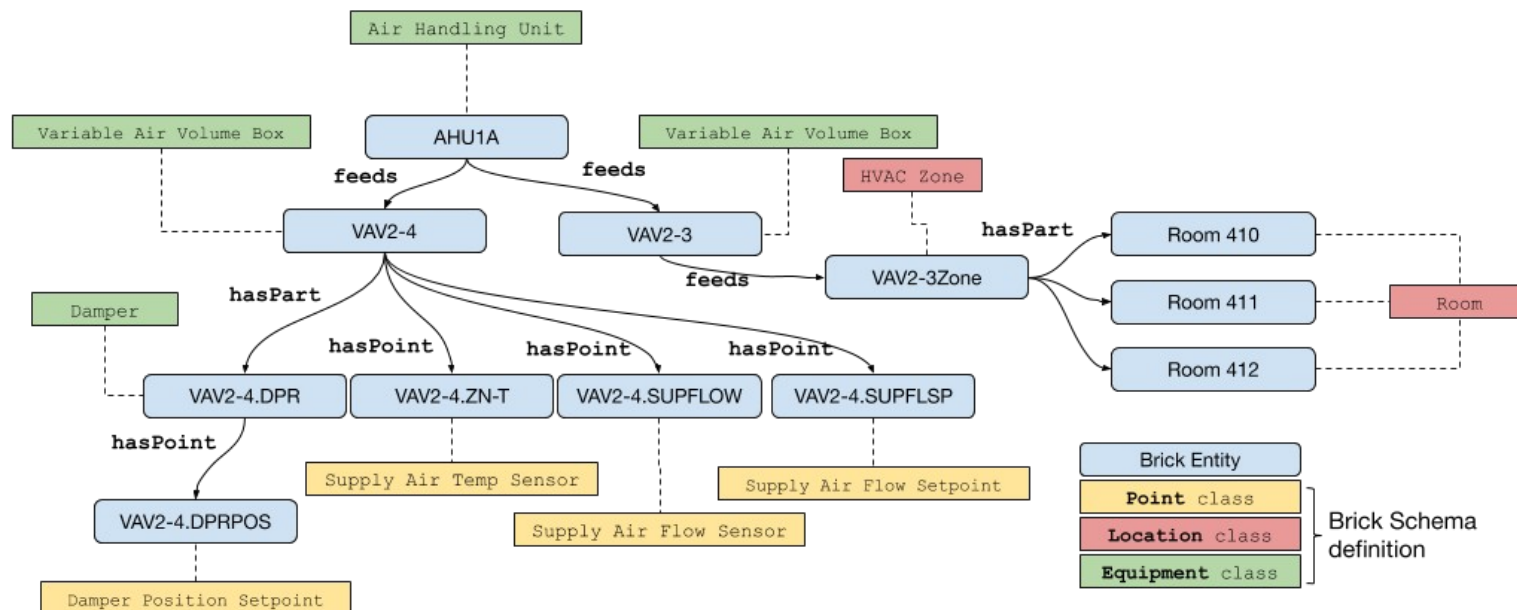
- Features:
 - search (graph topology used to boost search relevance)
 - context and metadata
 - employee-centric data
 - team-centric data



Source: <https://medium.com/airbnb-engineering/democratizing-data-at-airbnb-852d76c51770>

Example: Schneider Electric

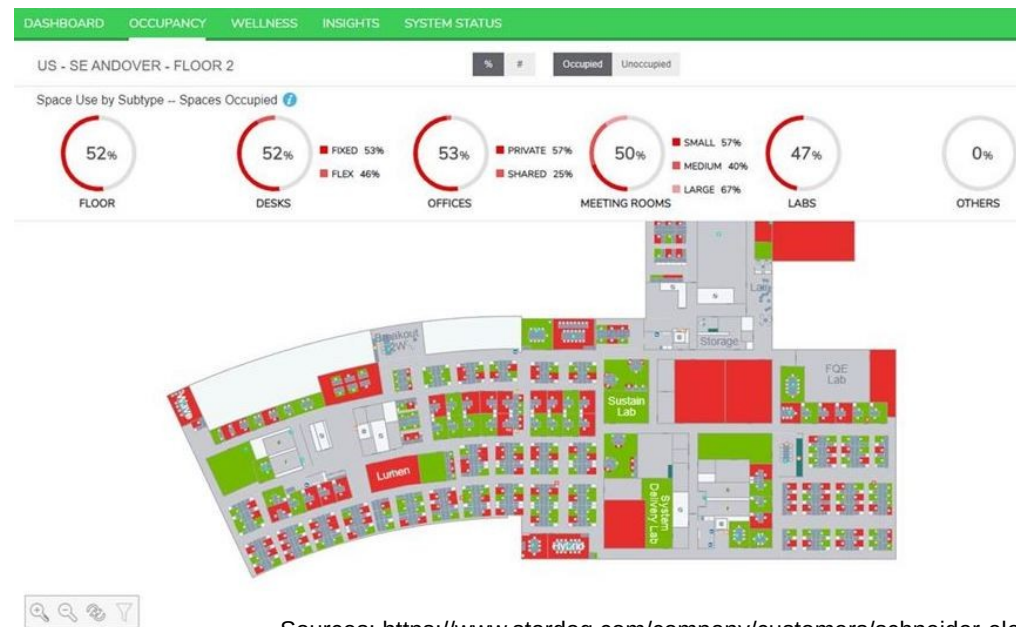
- Use case: management of buildings
 - Building management systems consist of hundreds of thousands of devices, controllers, and sensors that need to be tracked
 - IoT sensors, elevators, access control, digitized floor plans, etc.
- “Building Graph” is a KG that links many sources of building data
 - i.e., the KG contains the relationships between the data sources



Sources: <https://www.stardog.com/company/customers/schneider-electric/> and <https://brickschema.org/>

Applications of the Building KG

- Enable building owners and facility managers to derive actionable insights to optimize building occupancy and occupant comfort
- Apps for employees to connect to their smart offices
 - Example: when arriving at their office building, employees can select working spaces (based on properties such as lighting, proximity to a printer, etc); when they leave, janitors are notified immediately



Example: Siemens Energy

- Use case: maintenance of spare parts of large gas turbines
 - multiple, heterogeneous data sources including catalogs of spare parts, turbine configurations, maintenance schedules and history

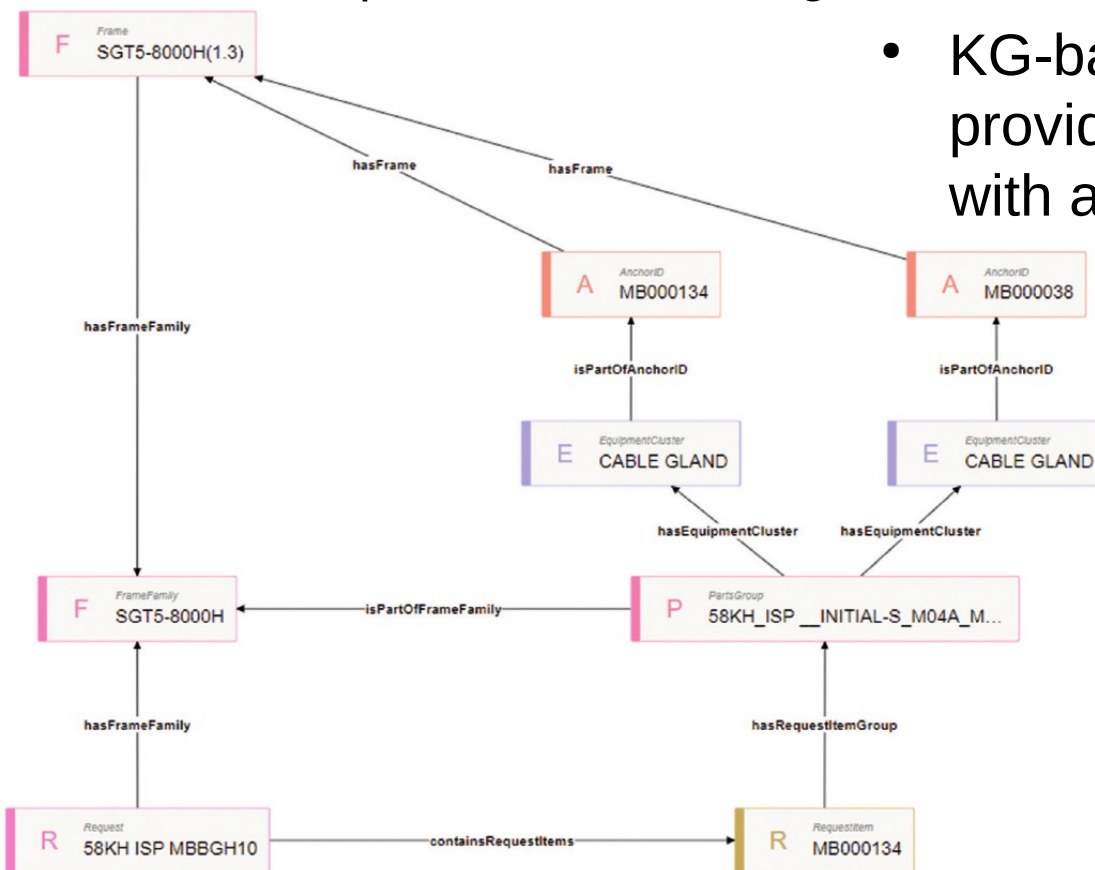


Source: <https://metaphacts.com/images/PDFs/case-studies/metaphacts-Case-Study-Turbine-Spare-Parts-Management-at-Siemens-Energy.pdf>

Example: Siemens Energy

- Use case: maintenance of spare parts of large gas turbines
 - multiple, heterogeneous data sources including catalogs of spare parts, turbine configurations, maintenance schedules and history

- KG-based software application that provides turbine service engineers with a unified overview of this data



Source: <https://metaphacts.com/images/PDFs/case-studies/metaphacts-Case-Study-Turbine-Spare-Parts-Management-at-Siemens-Energy.pdf>

Siemens Energy KG Application

- Compare existing configurations
- Find spare parts
- Analyze where these parts are in use
- Identify identical parts
- Give recommendations on the quantities for required spare parts
- Interactive visualization to gain insights into relationships between spare parts, turbines, customer-specific configurations, maintenance schedules, and maintenance history



Source: <https://metaphacts.com/images/PDFs/case-studies/metaphacts-Case-Study-Turbine-Spare-Parts-Management-at-Siemens-Energy.pdf>

The Semantic Web

Vision and Challenges

Semantic Web Vision

- An evolution of the WWW in which Web content is represented in a form that is more easily processable by computer programs
- Software agents may then take advantage of these representations



THE SEMANTIC WEB

A new form of Web content
that is meaningful to computers
will unleash a revolution of new abilities

by
TIM BERNERS-LEE,
JAMES HENDLER and
ORA LASSILA



Source: <https://www.scientificamerican.com/magazine/sa/2001/05-01/>

Example Scenario

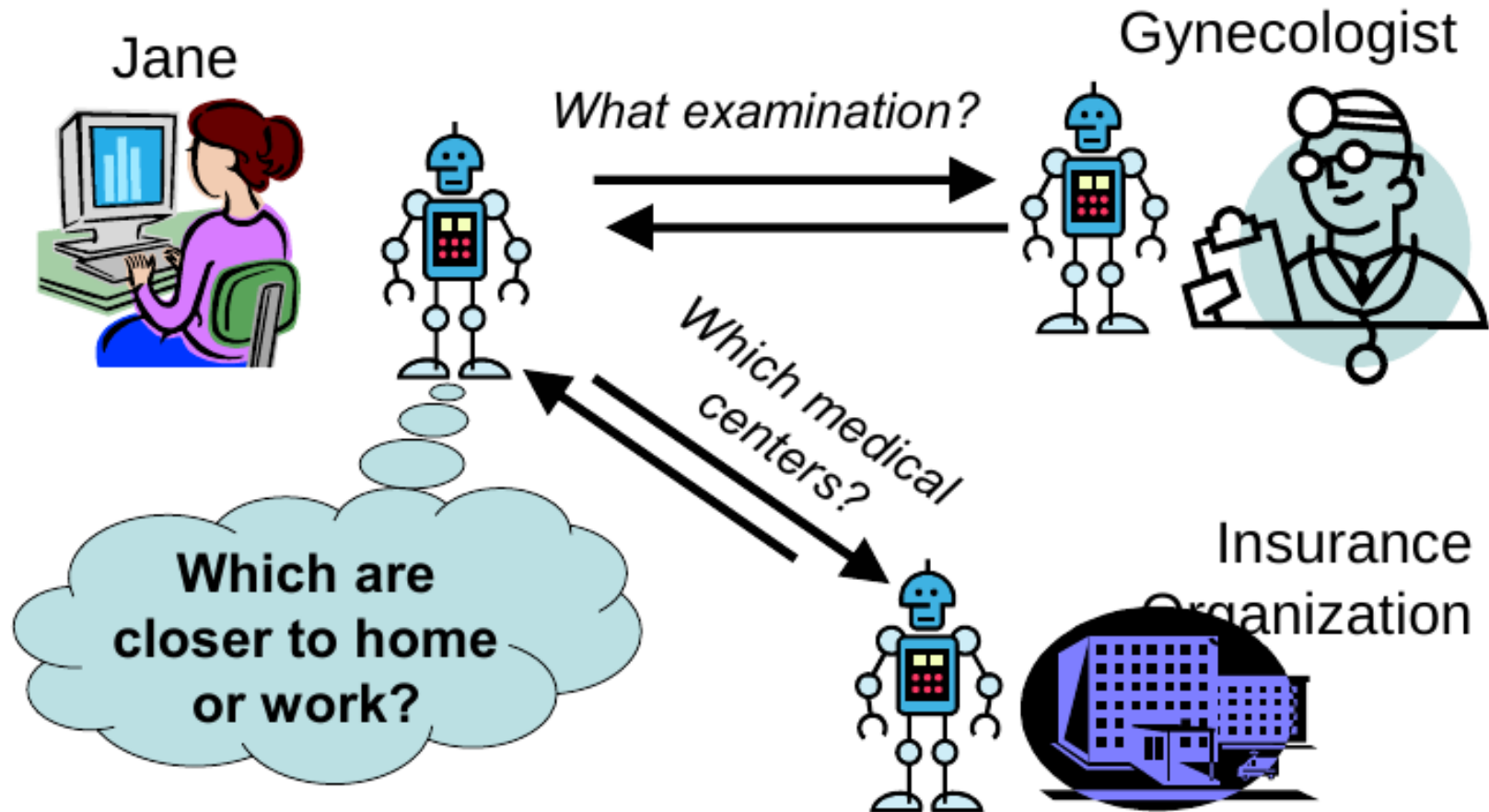


Image source: "Semantic Web: Vision and Technologies" by Nick Bassiliades (2005), <http://ipis.csd.auth.gr/publications/conf-cs-halkidiki-bassiliades.pdf>

Example Scenario

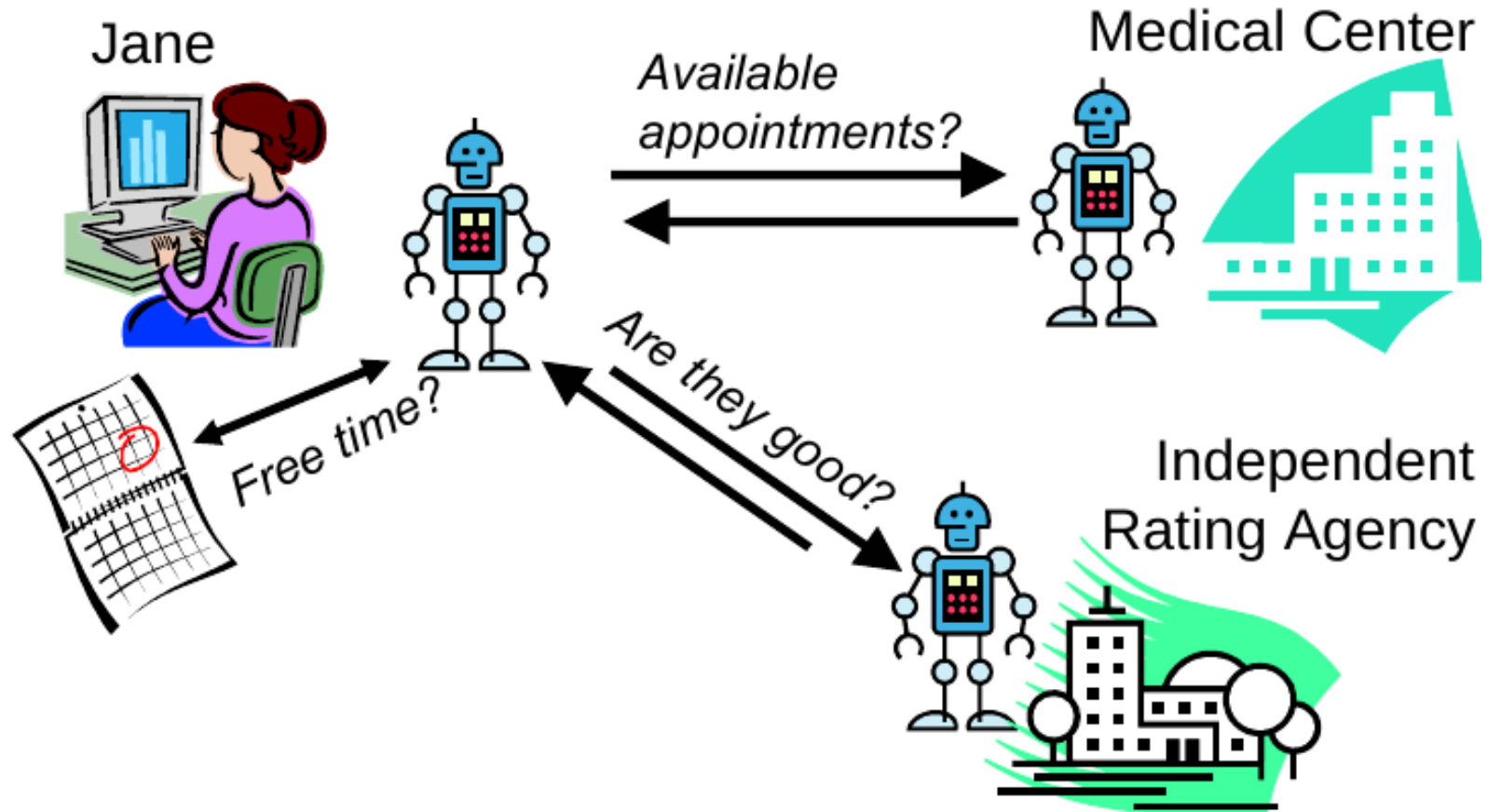


Image source: "Semantic Web: Vision and Technologies" by Nick Bassiliades (2005), <http://ipis.csd.auth.gr/publications/conf-cs-halkidiki-bassiliades.pdf>

Example Scenario

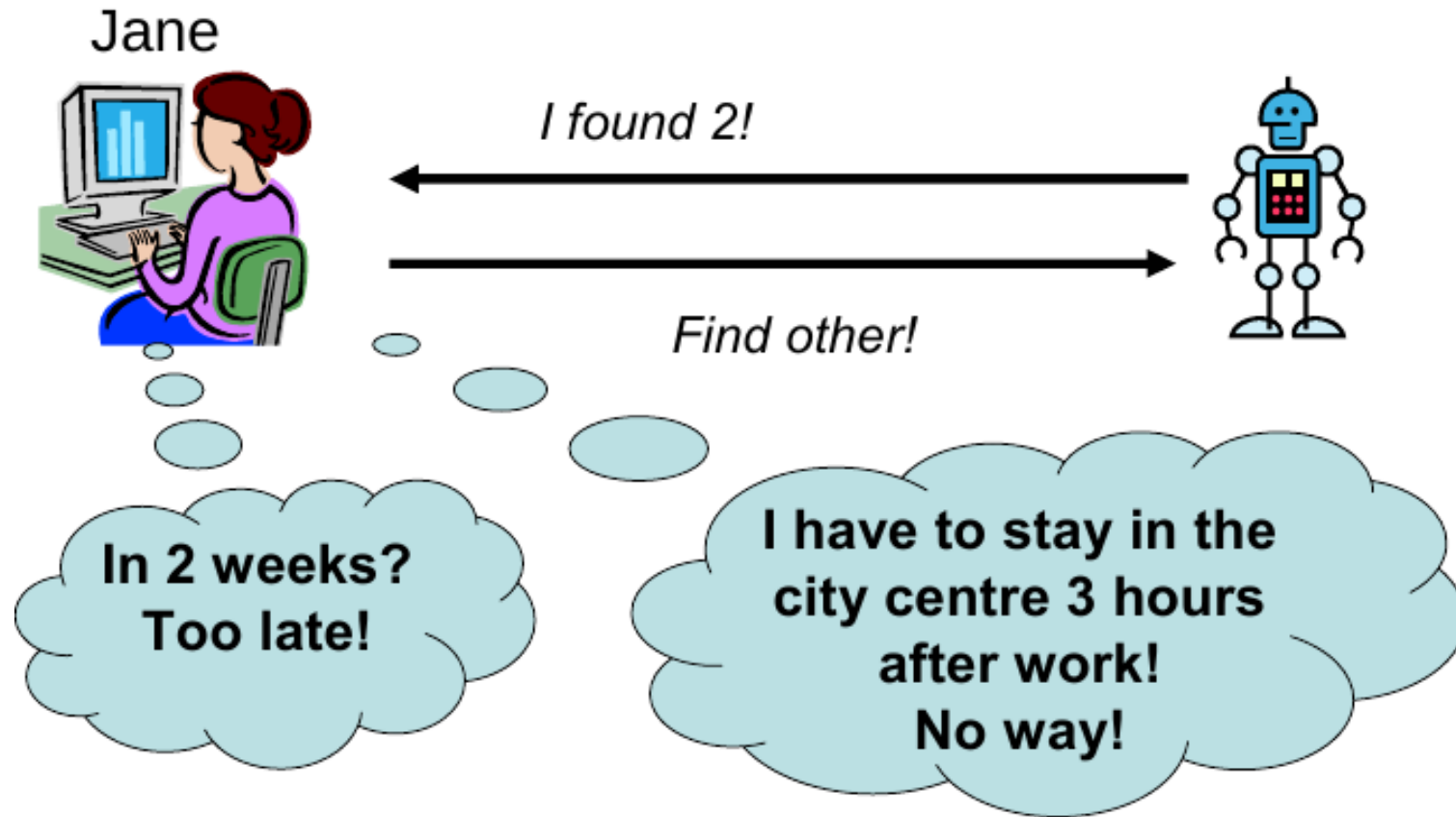


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Example Scenario

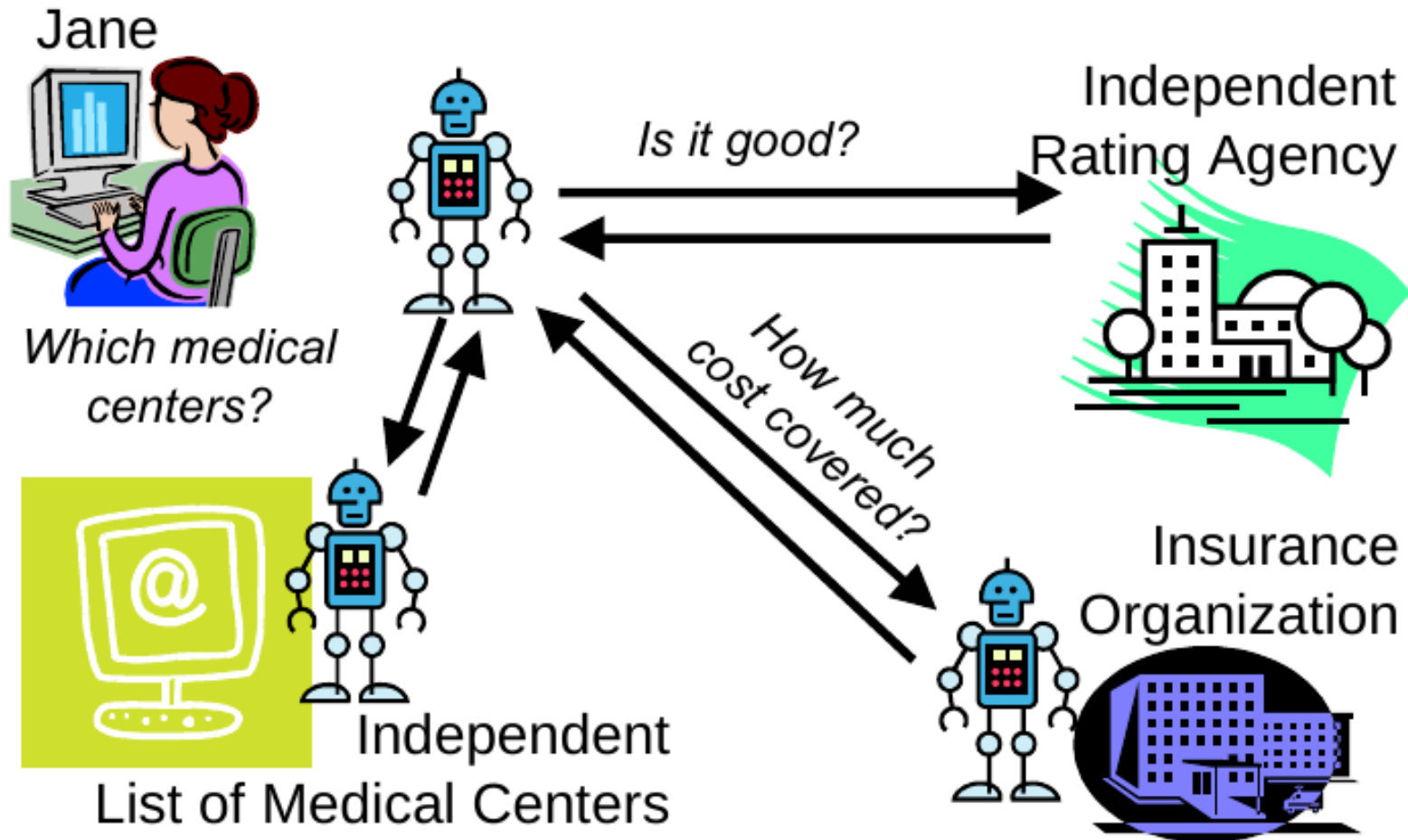


Image source: "Semantic Web: Vision and Technologies" by Nick Bassiliades (2005), <http://lpis.csd.auth.gr/publications/conf-cs-halkidiki-bassiliades.pdf>

Example Scenario

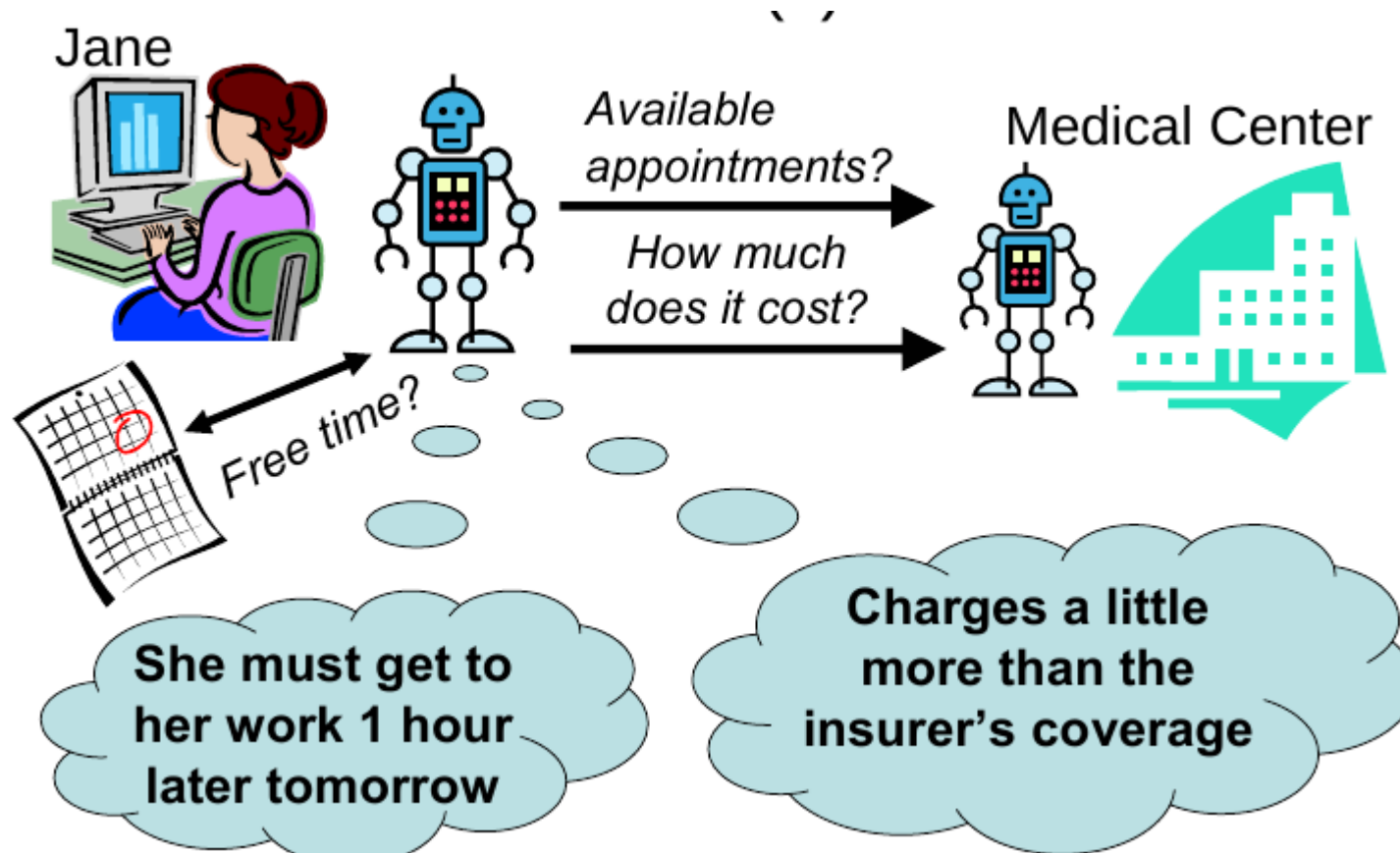


Image source: "Semantic Web: Vision and Technologies" by Nick Bassiliades (2005), <http://ipis.csd.auth.gr/publications/conf-cs-halkidiki-bassiliades.pdf>

Example Scenario

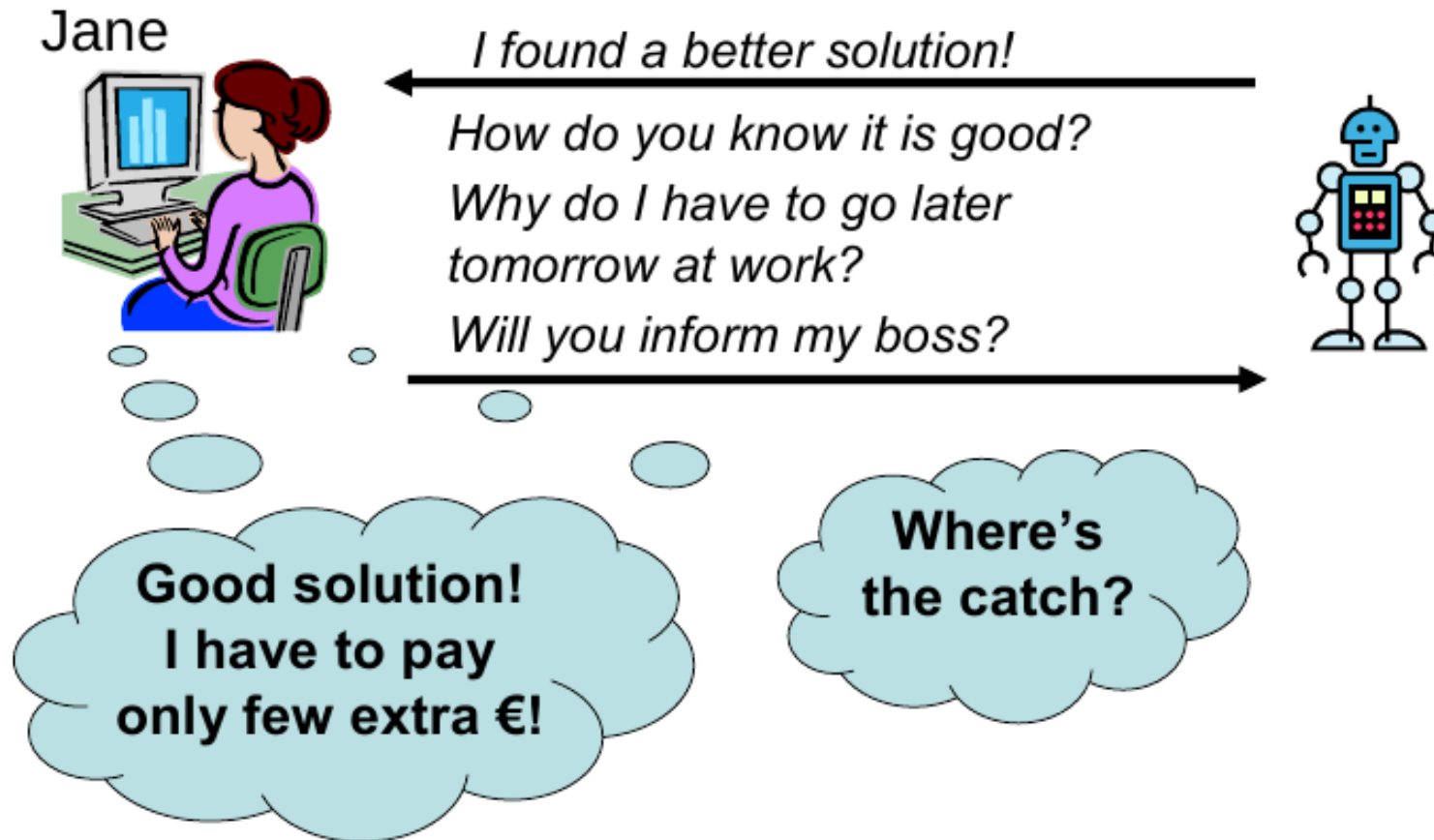


Image source: "Semantic Web: Vision and Technologies" by Nick Bassiliades (2005), <http://ipis.csd.auth.gr/publications/conf-cs-halkidiki-bassiliades.pdf>

Example Scenario

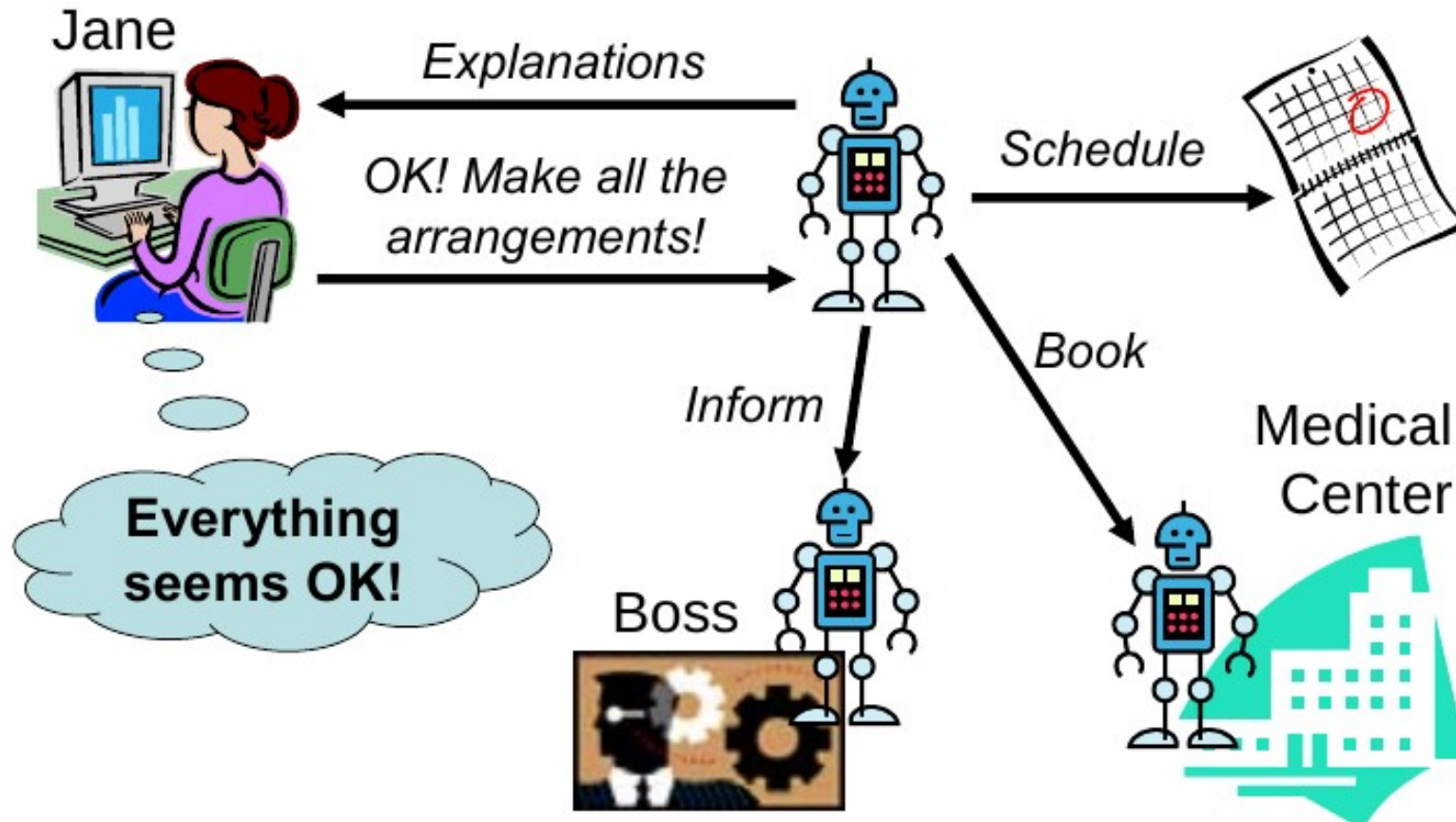


Image source: "Semantic Web: Vision and Technologies" by Nick Bassiliades (2005), <http://ipis.csd.auth.gr/publications/conf-cs-halkidiki-bassiliades.pdf>

Challenges

Why did the Web have to evolve?

Why was a new form of representing
Web content necessary?

Data on the Web

- Traditionally published in HTML documents that are designed for human consumption

Go to CIA.gov

THE WORLD FACTBOOK Countries Maps References About

services: 40.3% (2017 est.)

Unemployment rate

5.83% (2019 est.)
6.32% (2018 est.)

note: these official rates may not include those working at near-subsistence farming

[country comparison to the world: 96](#)

Unemployment, youth ages 15-24

total: 27%
male: 27.8%
female: 25.9% (2019 est.)

[country comparison to the world: 42](#)

Population below poverty line

14.3% (2012 est.)

CIA World Factbook Database

IMDb All Search IMDb Sign In EN

War Child

TV Movie · 1999 · 25m

YOUR RATING ☆ Rate

Cast & crew · IMDbPro All topics

Documentary War + Add to Watchlist

Director Michael Davie

Storyline

kosovo albania

Add full plot · Add synopsis

Taglines Young people affected by the war in Kosovo

Genres Documentary · War

Details

Release date July 12, 1999 (United States)

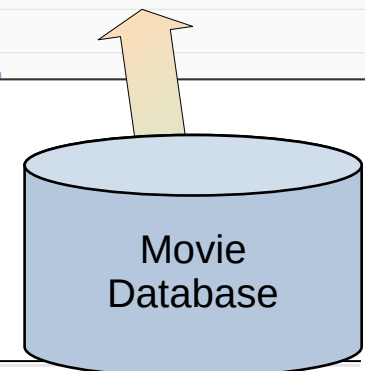
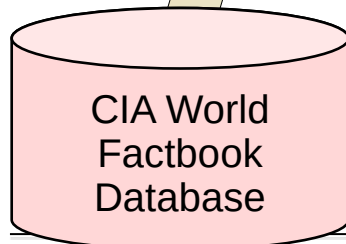
Country of origin United States

Language English

Filming locations Albania

Production company National Geographic Television

Movie Database



What do you see?

Semantik gör webben smartare

Publicerad av CIO Sweden

Morgondagens internet är inte bara anpassat för människor. Nya lösningar gör att maskiner kan göra smartare sökningar.

Den semantiska webben är tänkt som en förlängning av den befintliga webben snarare än som en helt ny webb. Internet är en underbar uppfinning. Inte minst den del som kallas World Wide Web, eller webben, och som gör det möjligt att söka sig fram i en grafisk miljö via hyperlänkar. Det funkar på många sätt utmärkt – för oss människor.

Vi kan presentera dokument som visas på skärmar runt om hela jordklotet och andra människor kan, förutsatt att det språk som används är begripligt för båda parter, ta del av informationen.

Men för maskinen är det värre. Webben av idag är läsbar för maskiner. Men den är inte förståbar.

...

Av: Robert Brännström
cioreporter@idg.se

What about XML and Tags?

<title> Semantik gör webben smartare </title>

Publicerad av **<publisher> CIO Sweden </publisher>**

<intro> Morgondagens internet är inte bara anpassat för människor. Nya lösningar gör att maskiner kan göra smartare sökningar. </intro>

<section> Den semantiska webben är tänkt som en förlängning av den befintliga webben snarare än som en helt ny webb. Internet är en underbar uppfinning. Inte minst den del som kallas World Wide Web, eller webben, och som gör det möjligt att söka sig fram i en grafisk miljö via hyperlänkar. Det funkar på många sätt utmärkt – för oss människor.

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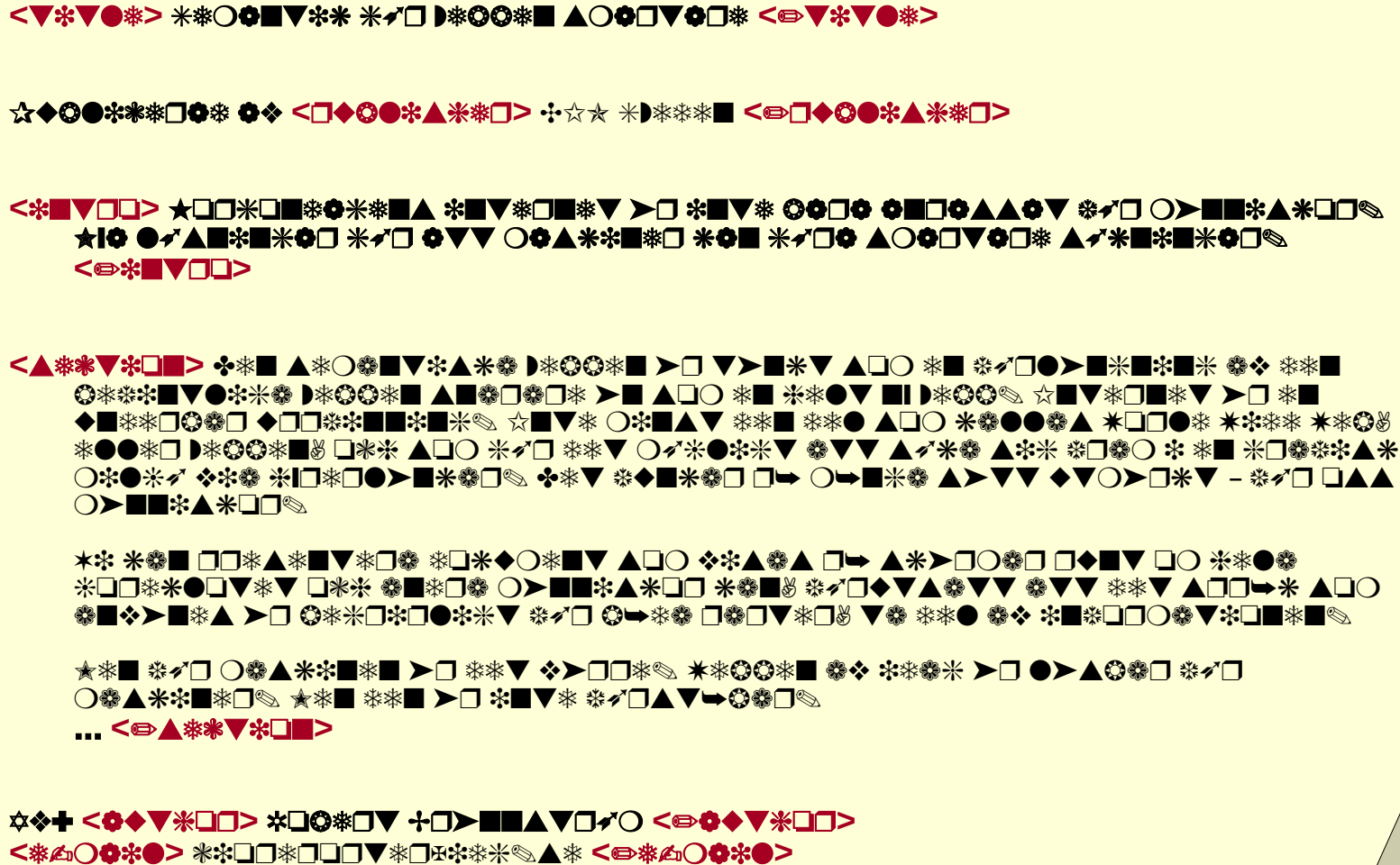
Men för maskinen är det värre. Webben av idag är läsbar för maskiner. Men den är inte förståbar.

... **</section>**

Av: <author> Robert Brännström </author>

<e-mail> cioreporter@idg.se </e-mail>

But still ...





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<https://creativecommons.org/licenses/by-sa/4.0/>

www.liu.se