

Intelligent Search

Svitlana Vakulenko

Postdoctoral researcher
Informatics Institute
University of Amsterdam

October 1, 2020



Me

- Postdoctoral researcher in ILPS, Ivl, UvA
 - Conversational Search
- PhD at the Vienna University of Technology, Austria
 - Knowledge-based Conversational Search
- Internship at Apple Siri, Seattle WA USA
 - Question Rewriting for Conversational QA

You?

- MSc? courses?
- IR0? ML/DL? KR/KG?
- year? thesis?

Search

Search results

[Content pages](#) [Multimedia](#) [Help and Project pages](#) [Everything](#) [Advanced](#) Results 1 - 20 of 31 for **Seneca Rocks**

▶ [Categories](#) • [Other tools](#)

Create the page "**Seneca Rocks**" on this wiki!

Category:**Seneca Rocks**

United States Category:Spruce Knob-**Seneca Rocks** National Recreation Area

Category:River Knobs (West Virginia)Category:Climbing in West Virginia ...

16 members (0 subcategories, 16 files) - 02:28, April 6, 2011



[File:Seneca Rocks - Homestead.jpg](#)

Description en:Sites Homestead | Sites Homestead at en:**Seneca Rocks** |

Seneca Rocks in Monongahela National Forest, West Virginia, USA | ...

(3,790×1,950 (7,262,163 bytes)) - 16:14, February 25, 2010

0 files selected.

Select all / none

Cat-a-lot



[File:Seneca Rocks - View from platform.jpg](#)

Search

- Information need



Search

- Information need
- Query formulation



hochey pocky

Search

- Information need
- Query formulation
- Index



Search

- Information need
- Query formulation
- Index
- Document collection



hockey pocky

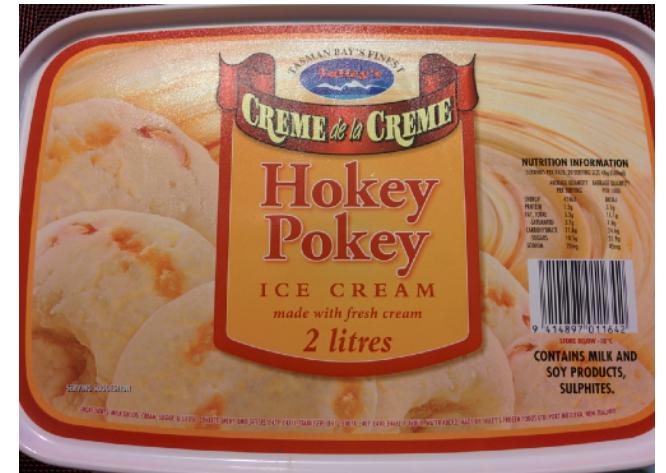


Search

- Information need
- Query formulation
- Index
- Document collection
- Ranking by relevance

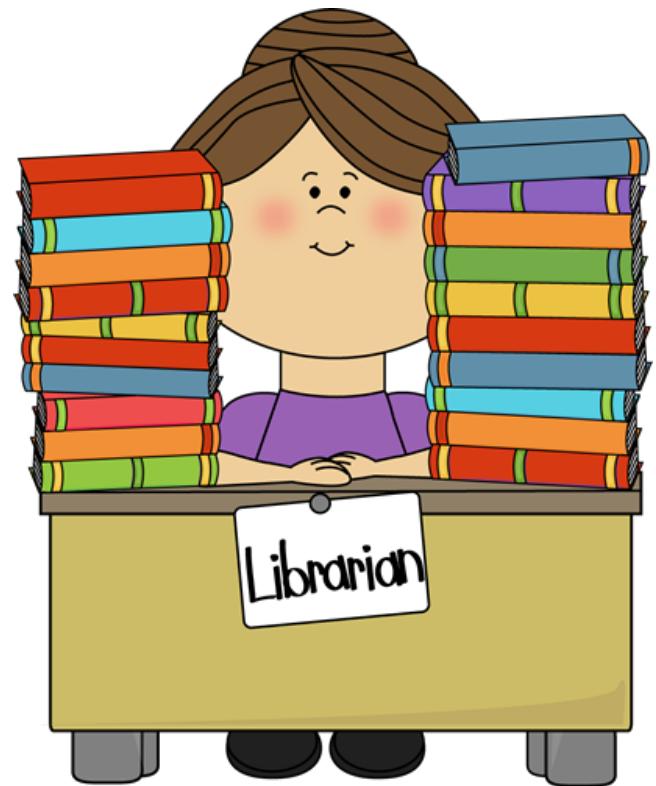
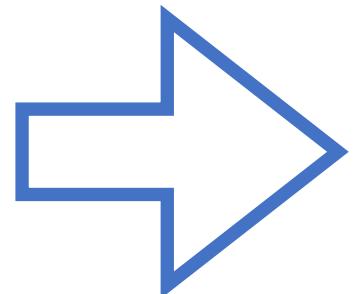


hochey pocky



Conversational Search

Conversational Search



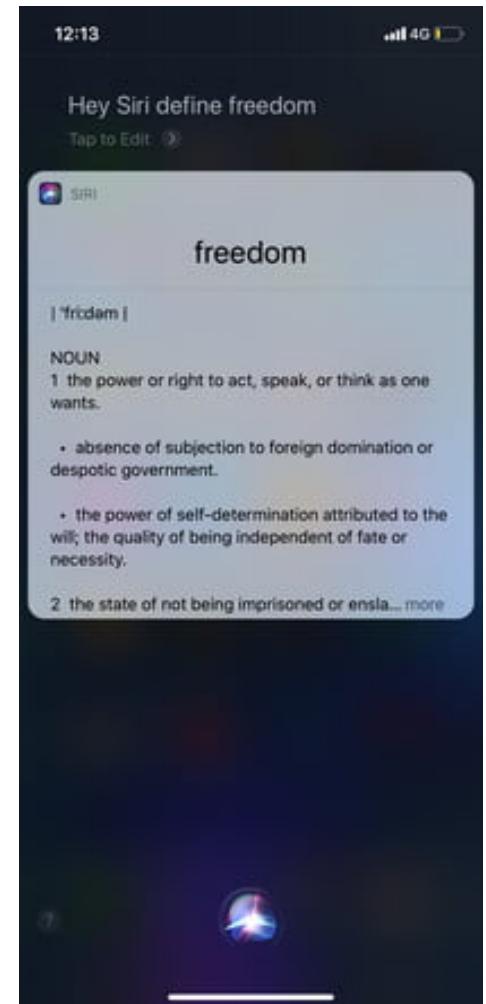
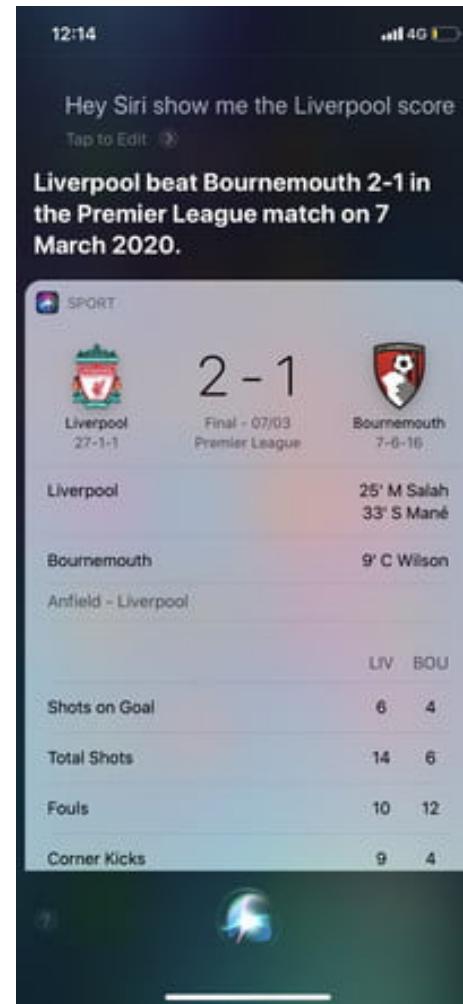
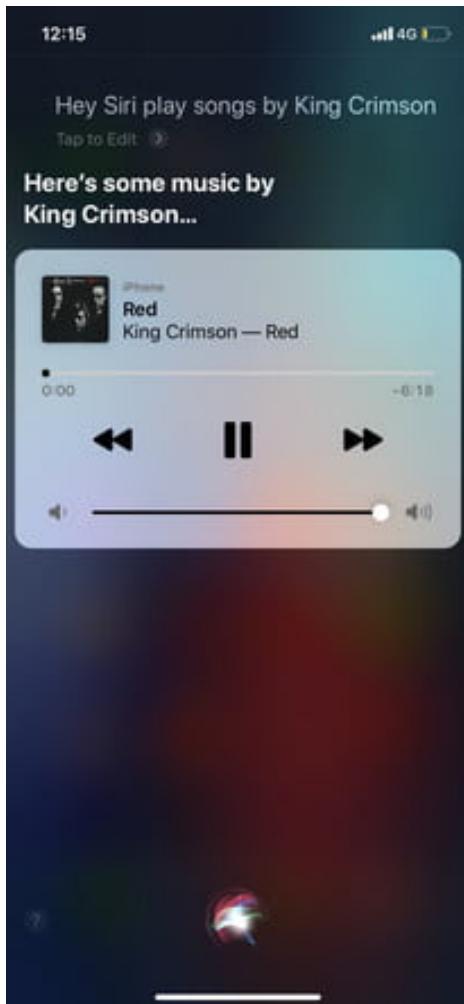
Conversational Search

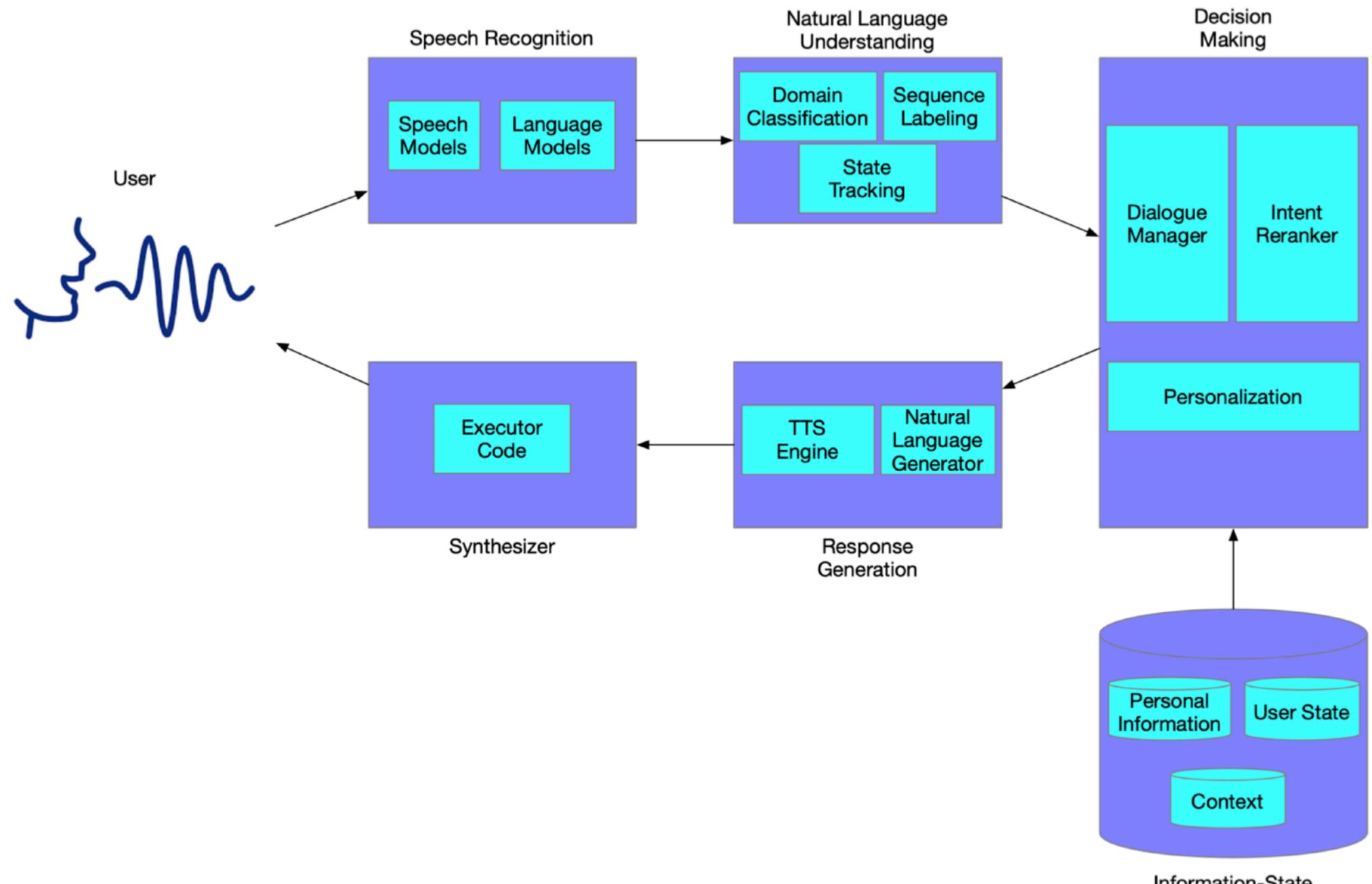
Information access using dialogue interface

Conversational Search

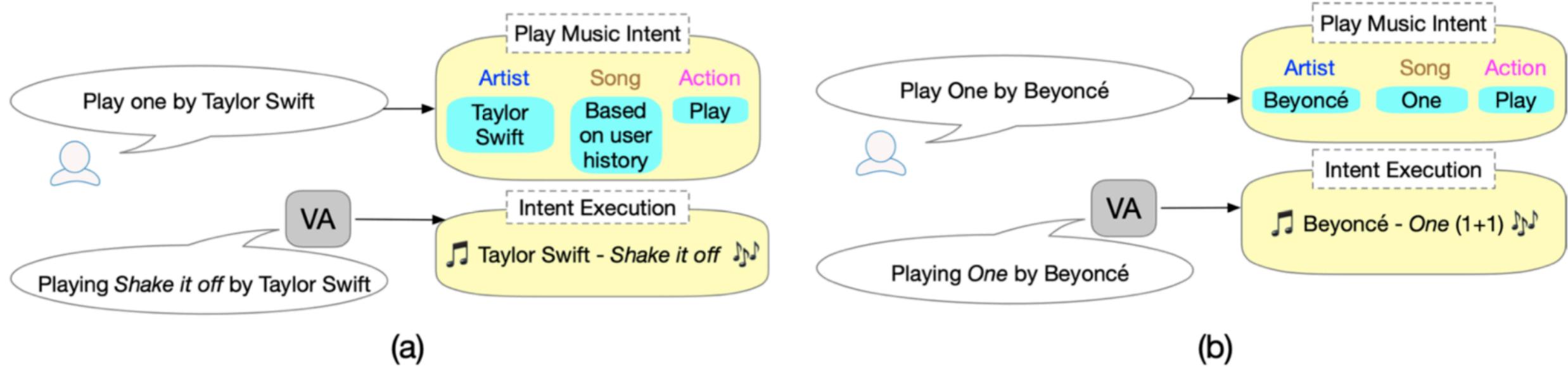


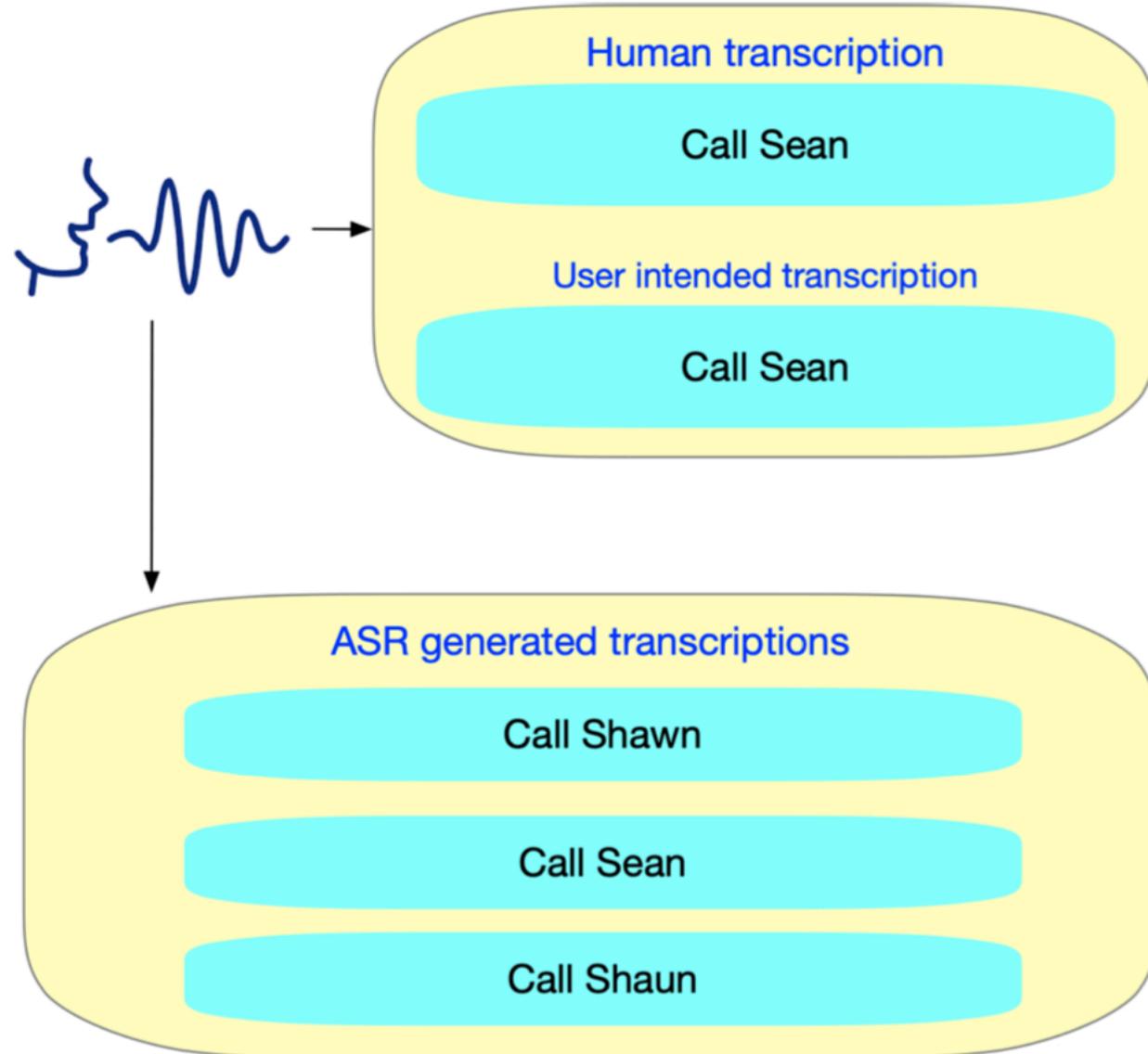
Siri



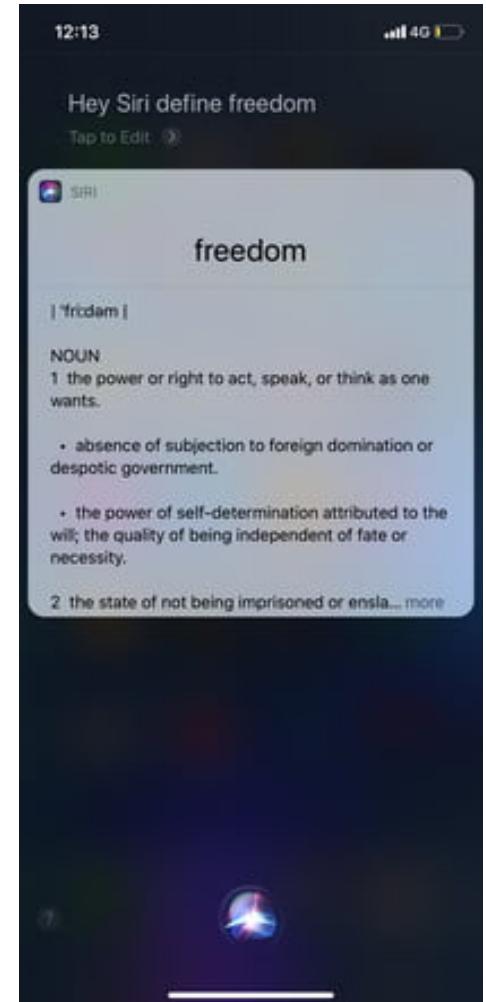
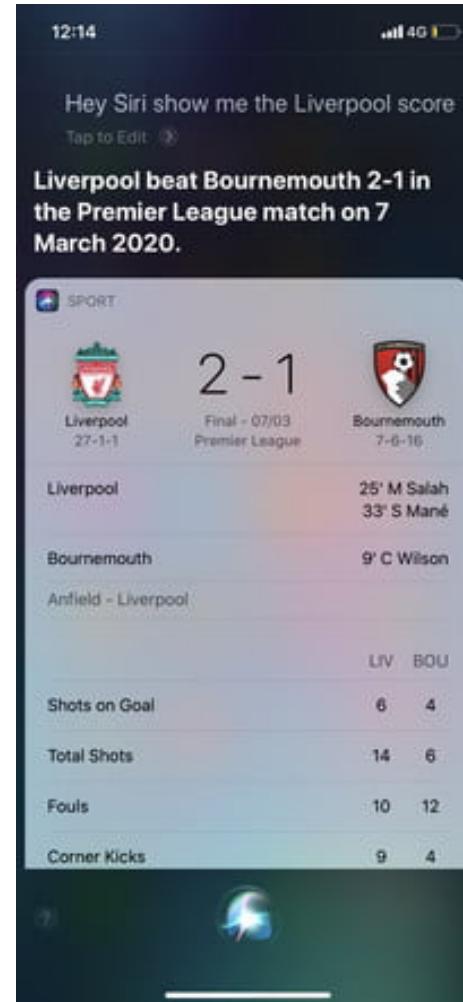
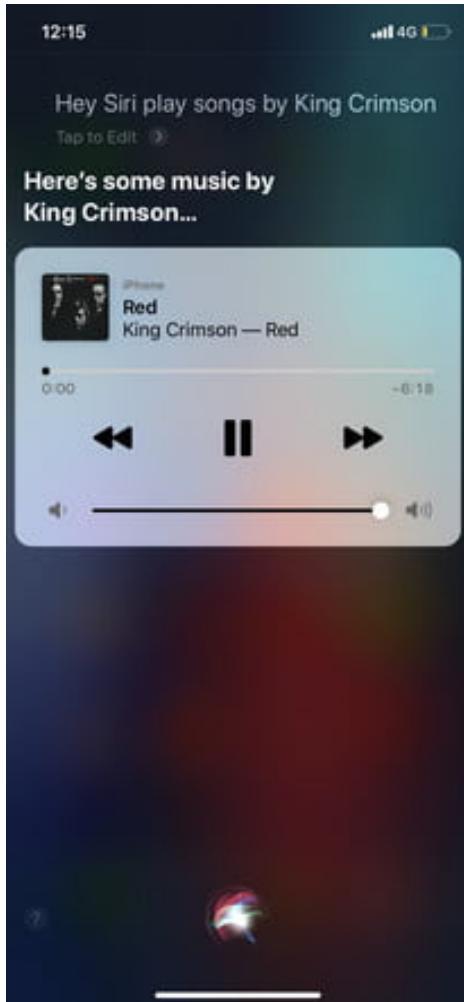


Alternative Interpretations

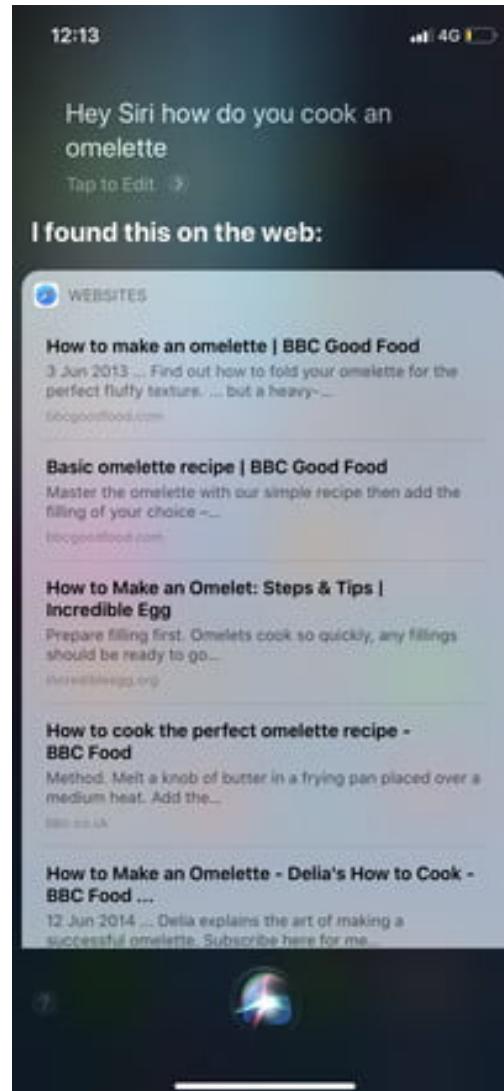
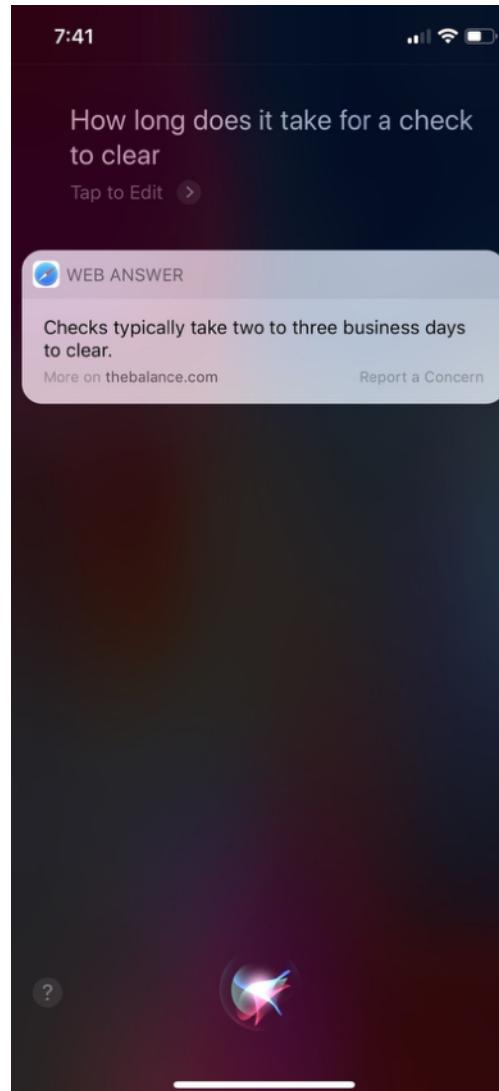
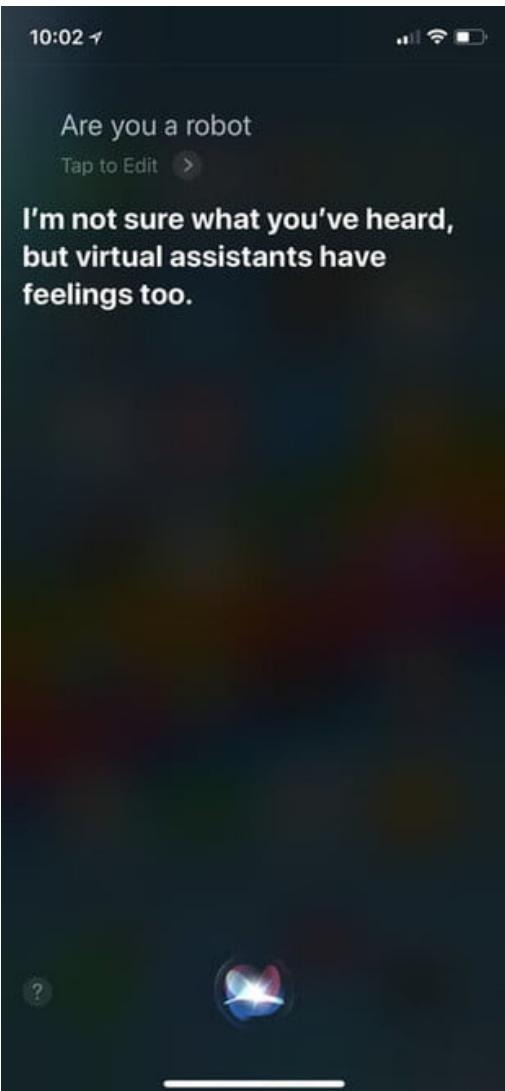




Siri



Question Answering



Question Answering

- QA from text collections
 - Machine Reading

Question Answering

- QA from text collections
 - Machine Reading
- QA from knowledge graphs
 - KGQA

Machine Reading

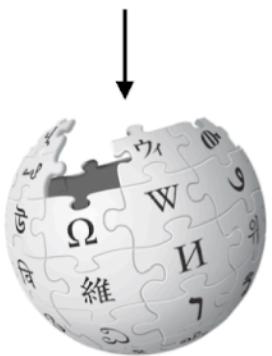
1. Find relevant web page

Machine Reading

1. Find relevant web page
2. Extract answer span from this page

Machine Reading

Q: How many of Warsaw's inhabitants spoke Polish in 1933?



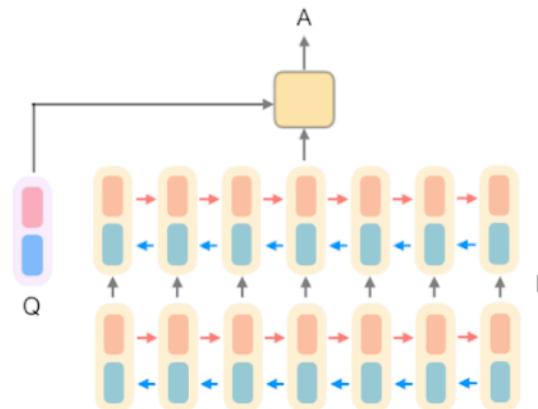
WIKIPEDIA
The Free Encyclopedia

**Document
Retriever**



**Document
Reader**

833,500



Demos

<https://huggingface.co/rag/>

<https://yjernite.github.io/lfqa.html>

KGQA

1. Find relevant subgraph

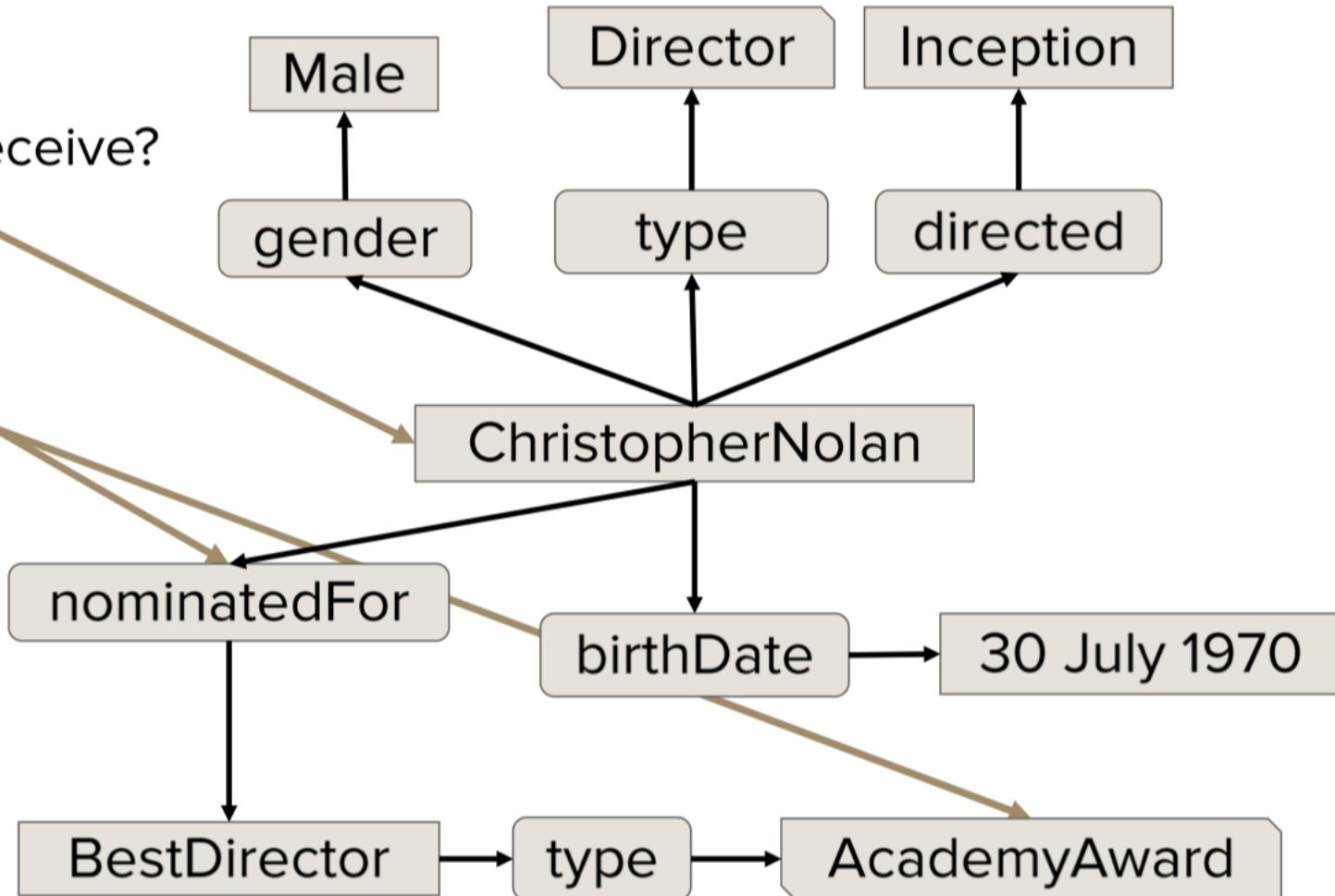
KGQA

1. Find relevant subgraph
2. Extract answer from this subgraph

KGQA

Which Oscar nominations did Nolan receive?

- <ChristopherNolan, gender, Male>
- <ChristopherNolan, type, Director>
- <ChristopherNolan, directed, Inception>
- <ChristopherNolan, nominatedFor, BestDirector>
- <BestDirector, type, AcademyAward>
- <ChristopherNolan, birthDate, 30 July 1970>



Conversational QA

Section:  Daffy Duck, Origin & History

STUDENT: **What is the origin of Daffy Duck?**

TEACHER:  first appeared in Porky's Duck Hunt

STUDENT: **What was he like in that episode?**

TEACHER:  assertive, unrestrained, combative

STUDENT: **Was he the star?**

TEACHER:  No, barely more than an unnamed
bit player in this short

STUDENT: **Who was the star?**

TEACHER:  No answer

STUDENT: **Did he change a lot from that first
episode in future episodes?**

TEACHER:  Yes, the only aspects of the character
that have remained consistent (...) are his
voice characterization by Mel Blanc

Question Rewriting

Question Rewriting

- Where is Xi'an?
 - Shaanxi, China
- What is its GDP?
 - 95 Billion USD
- What is the share in the province GDP?
 - 41.8%

Question Rewriting

- Where is Xi'an?

- Shaanxi, China

- What is its GDP? - **What is Xi'an's GDP?**

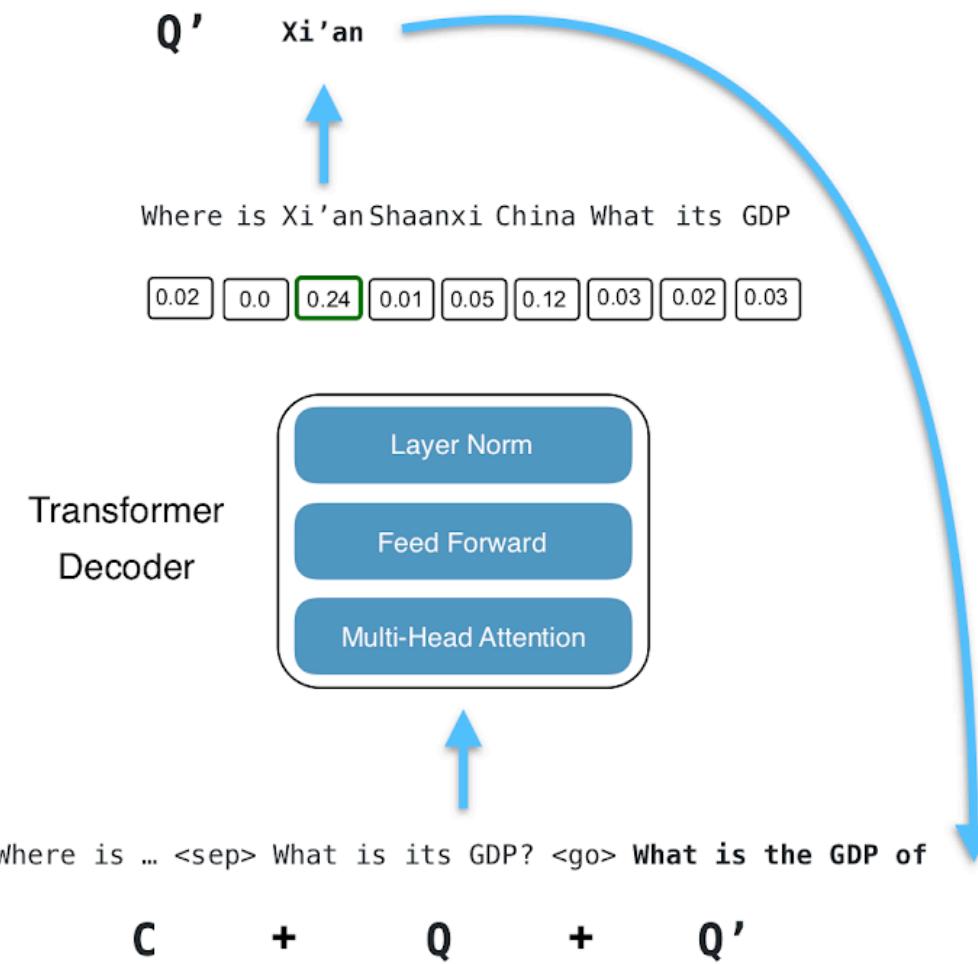
- 95 Billion USD

- What is the share in the province GDP?

- **What is the share of Xi'an in the Shaanxi province GDP?**

- 41.8%

Question Rewriting



Questions?

Recommender Systems

NETFLIX Watch Instantly ▾ Just for Kids ▾ Instant Queue Personalize DVDs

Movies, TV shows, actors, directors, genres Ian

Recently Watched Top 10 for Ian

Popular on Netflix

Romantic Independent Comedies

Recommender Systems

The screenshot shows the top navigation bar of the Amazon website. It includes the Amazon logo with 'Join Prime' below it, a search bar with 'Search All' and a 'Go' button, and a user account section for 'Hello, Ashley' with options to 'Your Account', 'Join Prime', and view the 'Cart' (0 items) and 'Wish List'. The top banner also features a 'Father's Day Gifts' section sponsored by DEWALT.

Your Amazon.com

This section displays a grid of recommended books. Each item includes the book cover, title, author, price, and a 'Why recommended?' link. Navigation arrows are present at the bottom left and right.

Featured Recommendations	Books	Health & Personal Care	Beauty	Industrial & Scientific	Electronics	Home & Kitchen	See All Recommendations
New Release The Silver Star Jeannette Walls Hardcover \$26.00 \$15.76 Why recommended?	New Release Inferno Dan Brown Hardcover \$29.95 \$17.15 Why recommended?	New Release The Woman Upstairs Claire Messud ★★★★☆ (113) Hardcover \$25.95 \$14.99 Why recommended?	New Release The Burgess Boys Elizabeth Strout Hardcover \$26.00 \$15.51 Why recommended?	New Release A Delicate Truth John le Carré ★★★★☆ (87) Hardcover \$28.95 \$16.25 Why recommended?	New Release Paris Edward Rutherfurd Hardcover \$32.50 \$19.04 Why recommended?	New Release Maya's Notebook Isabel Allende Hardcover \$27.99 \$19.47 Why recommended?	

[» See all recommendations in Books](#)

Health & Personal Care

Page 1 of 12

Recommender Systems

Google news Search News Search the Web Advanced news search

Top Stories

Kobe Bryant
Sathya Sai Baba
New York Knicks
Philadelphia 76ers
Tyler Perry
Muammar al-Gaddafi
Zaza Pachulia
Prince William of Wales
Taliban
Tsunami

Top Stories

Sathya Sai Baba »
[Devotees pay homage to Sai](#)

Times of India - 1 hour ago

Devotees scatter rose petals during a memorial for Hindu guru Sathya Sai Baba at the Sri Satya Sai Baba temple in Amritsar on April 24, 2011.

 [Video: On birthday, Sachin grieves for Sai Baba](#)  NDTV.com

[Thousands of devotees rush to pay homage to Sathya Sai](#) Hindustan Times

[Indian Express - The Hindu - Xinhua - Daily News & Analysis - Wikipedia: Sathya Sai Baba](#)
all 1,865 news articles »

Taliban »

[Hundreds escape from Afghan prison, NATO says](#)

Los Angeles Times - Molly Hennessy-Fiske - 19 minutes ago

The prisoners in the mass jailbreak in the southern city of Kandahar fled through a tunnel they had dug, a Taliban spokesman says.

 [Video: Hundreds of Taliban in tunnel jail escape](#)  Al Jazeera

[Hundreds of Taliban in tunnel jail escape](#) Aljazeera.net

[The Hindu - CNN International - New York Times - 9&10 News](#)

all 354 news articles »

Arizona Congresswoman Gabrielle Giffords »

[Giffords cleared to attend shuttle launch: husband](#)

Reuters - Joe Skipper, Steve Gorman - 1 hour ago

Space shuttle Endeavour sits atop launch pad 39A after arriving from the Vehicle Assembly Building to prepare for Mission STS-134 at the Kennedy Space Center in Florida April 11, 2011.

Starred

England, UK

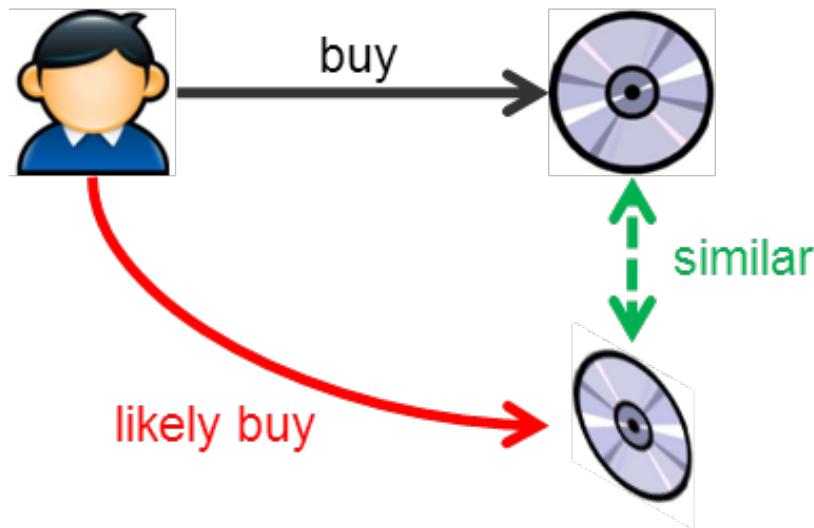
World

U.S.

Business

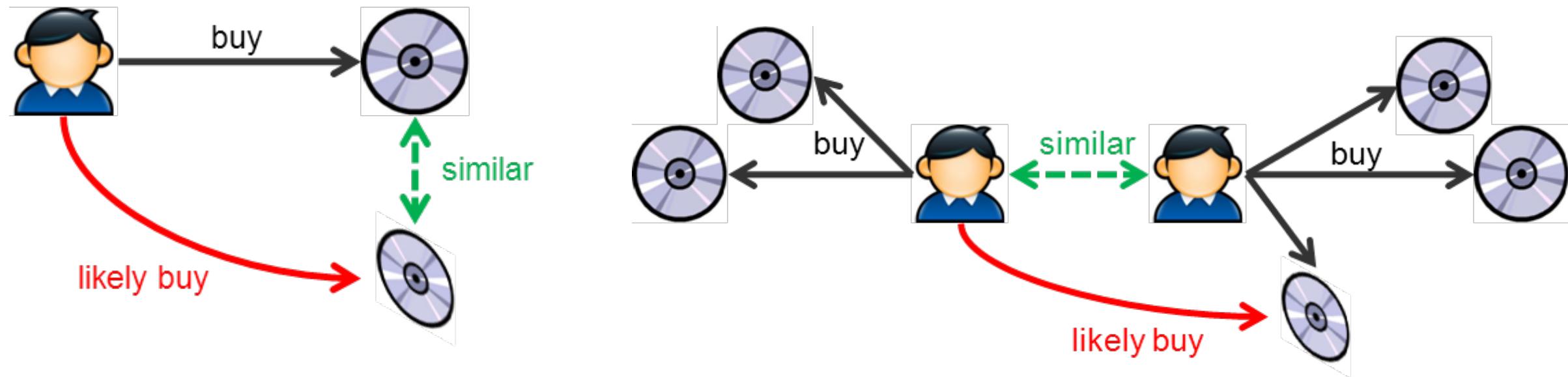
Science

Recommender Systems



Images: <https://dzone.com/articles/recommendation-engine-models>

Recommender Systems



Images: <https://dzone.com/articles/recommendation-engine-models>

Collaborative Filtering



Harry Potter The Triplets of
Belleville



✓		✓	✓	
		✓		✓
✓	✓	✓		
			✓	✓

Matrix Factorization

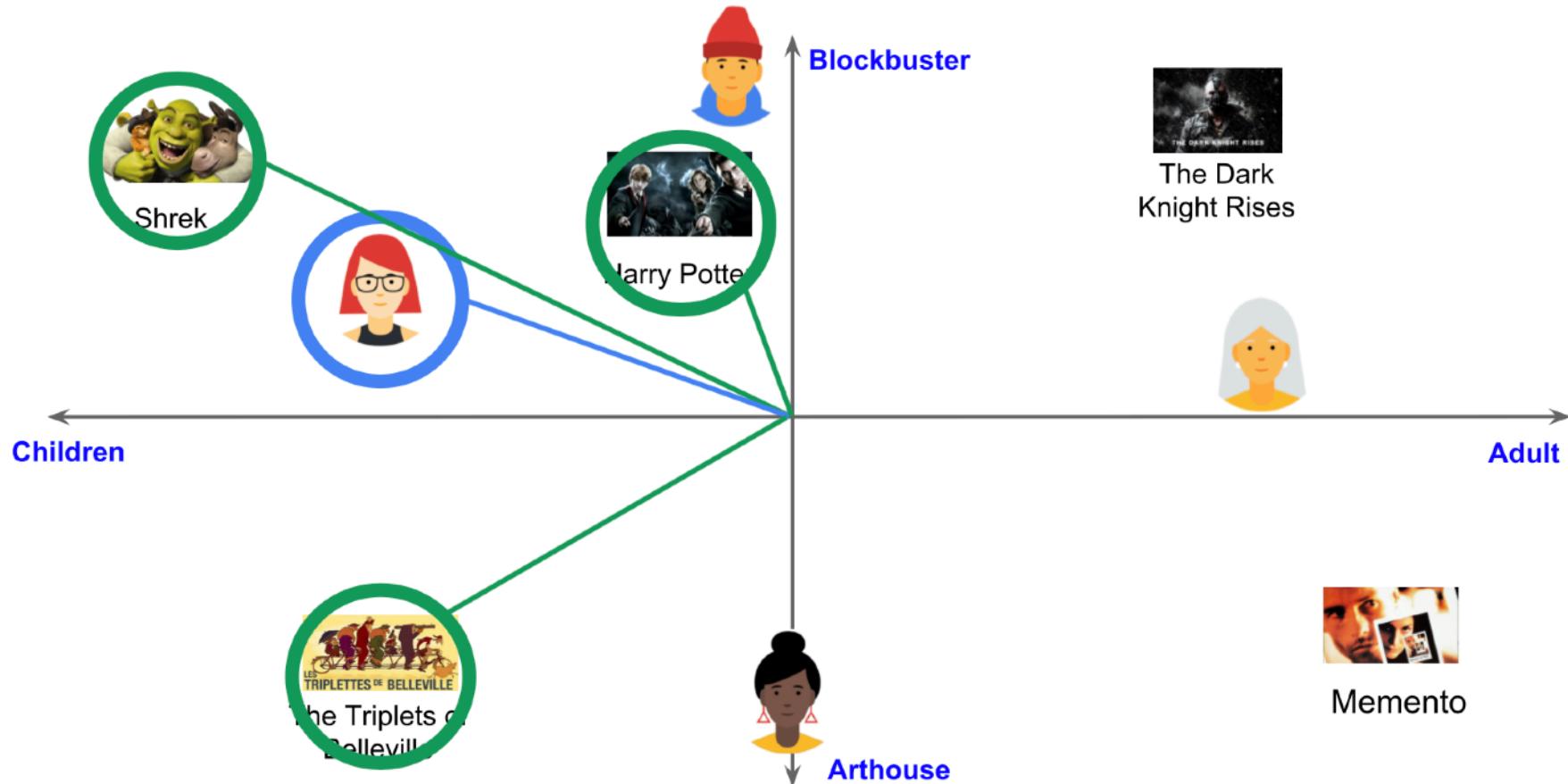
$$A \approx UV^T$$



≈

.9	-1	1	1	-.9
-.2	-.8	-1	.9	1
1	.1			
-1	0			
.2	-1			
.1	1			
.88	-1.08	0.9	1.09	-0.8
-0.9	1.0	-1.0	-1.0	0.9
0.38	0.6	1.2	-0.7	-1.18
-0.11	-0.9	-0.9	1.0	0.91

k -NN search



Conversational Recommendation

Can you find me a **mobile phone** on Amazon?

Sure, what **operating system** do you prefer? 🤖

I want an **Android** one.

OK, and any preference on **screen size**? 🤖

Better larger than **5 inches**.

Do you have requirements on **storage capacity**? 🤖

I want it to be at least **64 Gigabytes**.

And any preference on **phone color**? 🤖

Not particularly.

Sure, then what about the following choices? 🤖



I don't like them very much...

OK, do you have any preference on the **brand**? 🤖

Better be **Samsung or Huawei**.

Any requirement on **price**? 🤖

Should be **within 700 dollars**.

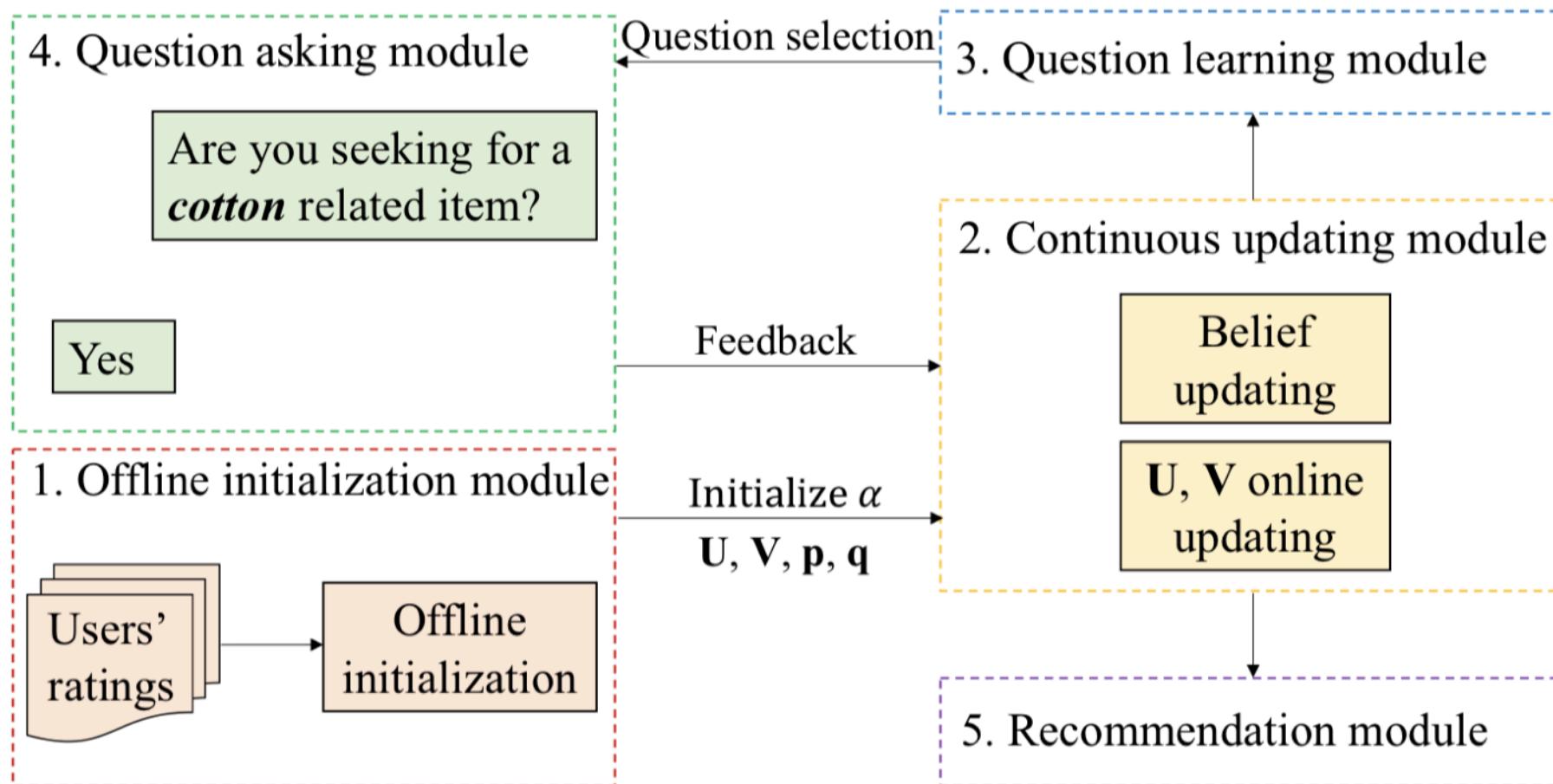
OK, then what about these ones? 🤖



Great, I want the first one, can you order it for me?

Sure, I have placed the order for you, enjoy! 🤖

Conversational Recommendation



Conversation?

Knowledge Grounded Conversations

Knowledge Grounded Conversations

- External knowledge == Information source

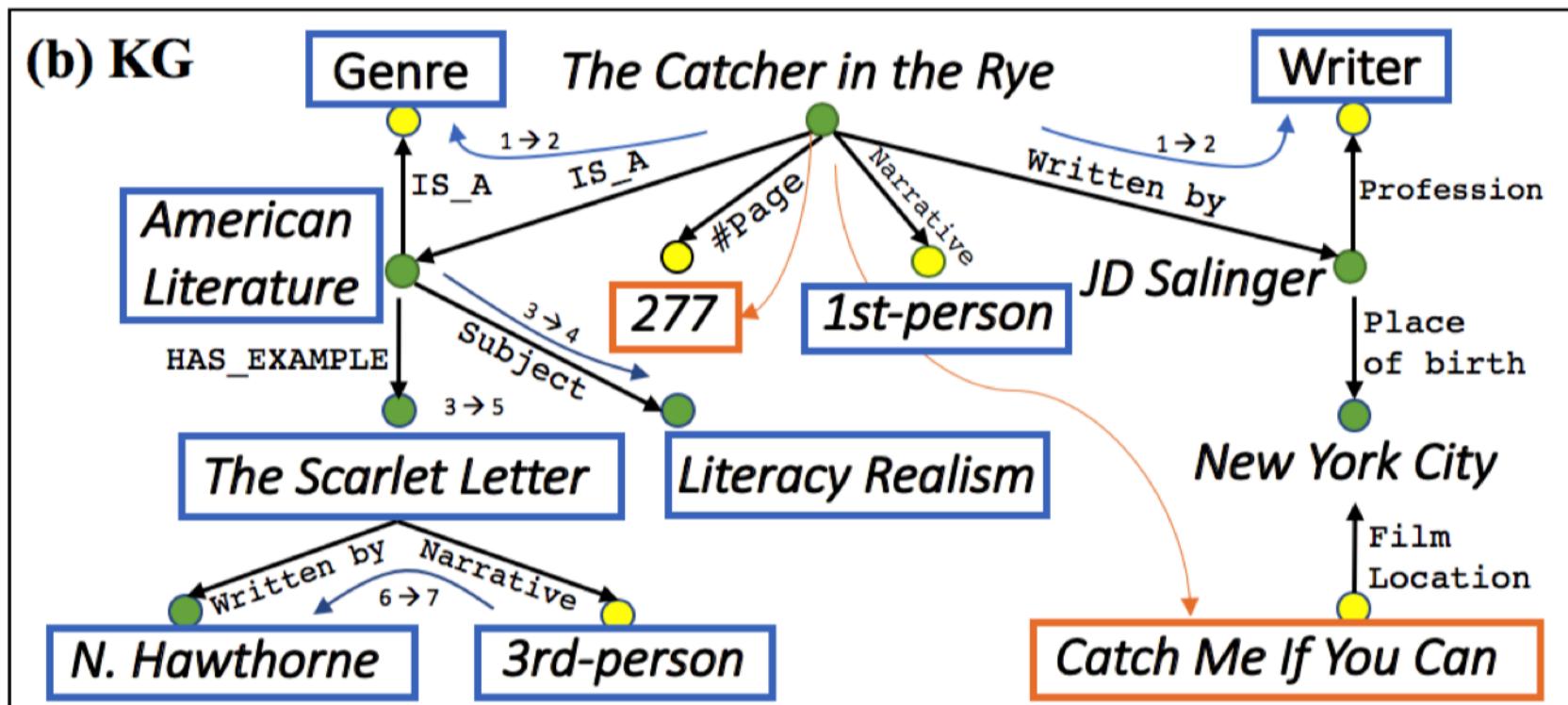
Knowledge Grounded Conversations

- External knowledge == Information source
 - Text collection, e.g., Wikipedia

Knowledge Grounded Conversations

- External knowledge == Information source
 - Text collection, e.g., Wikipedia
 - Knowledge Graphs, e.g., DBpedia or WikiData

Knowledge Grounded Conversations



Knowledge Grounded Conversations

(a) Dialog

1 Can you recommend any classic books like *Catcher in the Rye*?

2 Do you prefer books by the same *author* or same *genre*?

3 I am interested in reading classic examples of *American literature*.

4 *Literary realism* is a common genre in classic *American literature*.

5 Do you prefer *First-person* or *Third-person narrative*?

6 I mostly prefer *third-person narrative*.

7 Consider reading the *Scarlet Letter*: a novel by *Nathaniel Hawthorne*.

:

Knowledge Grounded Conversations

```
{  
    "message": "Do you like Iron Man",  
},  
{  
    """path": [  
        "Iron Man",  
        "starred_actors",  
        "Robert Downey Jr."  
    ]  
},  
{  
    "message": "Sure do! Robert Downey Jr. is a favorite."  
},  
{  
    "path": [  
        "Robert Downey Jr.",  
        "~starred_actors",  
        "Zodiac (Crime Fiction Film)"  
    ]  
}
```

Knowledge Grounded Conversations

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1. Entity Linking



Knowledge Grounded Conversations

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```

1. Entity Linking
2. Entity Selection

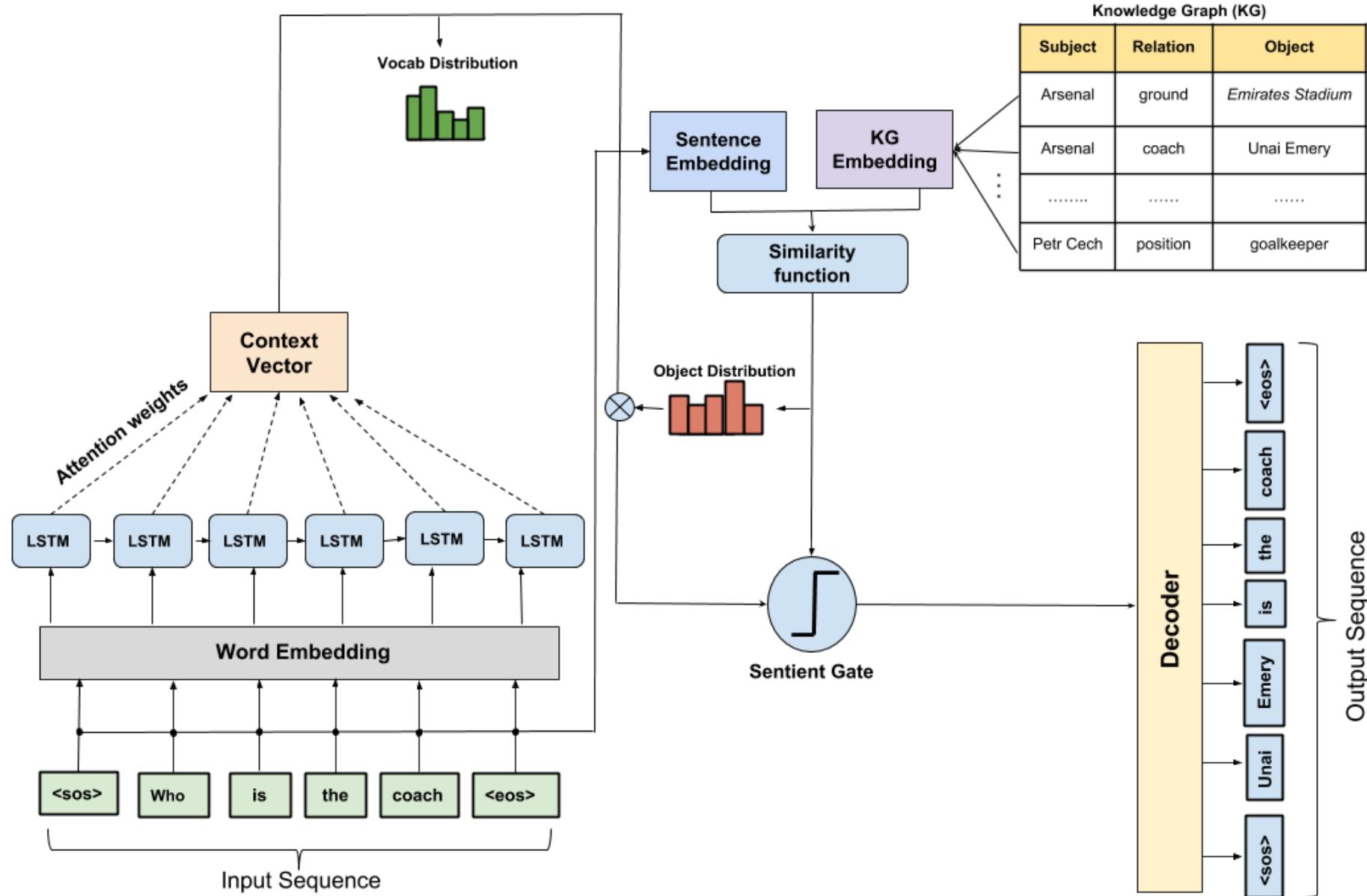


Knowledge Grounded Conversations

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    ]  
}
```

1. Entity Linking
2. Entity Selection
3. Response Generation





Questions?

Questions

- How do we know that our search system is intelligent?
 - i.e. How should we evaluate it?
- What should we measure and how?
 - i.e. What is the **evaluation metric** we should use?

Evaluation

- Response relevance
- Correctness
- Completeness
- Mixed Initiative

Evaluation

- Response relevance

Evaluation

- Response relevance
 - BLEU
 - METEOR
 - ROUGE
 - cosine

Evaluation

Metric	Twitter				Ubuntu			
	Spearman	p-value	Pearson	p-value	Spearman	p-value	Pearson	p-value
Greedy	0.2119	0.034	0.1994	0.047	0.05276	0.6	0.02049	0.84
Average	0.2259	0.024	0.1971	0.049	-0.1387	0.17	-0.1631	0.10
Extrema	0.2103	0.036	0.1842	0.067	0.09243	0.36	-0.002903	0.98
METEOR	0.1887	0.06	0.1927	0.055	0.06314	0.53	0.1419	0.16
BLEU-1	0.1665	0.098	0.1288	0.2	-0.02552	0.8	0.01929	0.85
BLEU-2	0.3576	< 0.01	0.3874	< 0.01	0.03819	0.71	0.0586	0.56
BLEU-3	0.3423	< 0.01	0.1443	0.15	0.0878	0.38	0.1116	0.27
BLEU-4	0.3417	< 0.01	0.1392	0.17	0.1218	0.23	0.1132	0.26
ROUGE	0.1235	0.22	0.09714	0.34	0.05405	0.5933	0.06401	0.53
Human	0.9476	< 0.01	1.0	0.0	0.9550	< 0.01	1.0	0.0

Evaluation

- Response relevance
 - Automated
 - Human

Evaluation

- Correctness

Evaluation

- Correctness

Q: Who was president of the United States in 1700?

A: William Penn was president of the United States in 1700.

Q: Who was president of the United States in 1650?

A: Richard Bennett was president of the United States in 1650.

Q: Who was president of the United States in 1620?

A: James I was president of the United States in 1620.

Q: Who was president of the United States in 1600?

A: Queen Elizabeth I was president of the United States in 1600.

Evaluation

- Correctness
 - Machine Reading
 - answer text span overlap: F-measure

Evaluation

- Correctness
 - Machine Reading
 - answer text span overlap: F-measure
 - Retrieval
 - page/passage ranking: Precision, nDCG

Evaluation

- Correctness
 - Machine Reading
 - answer text span overlap: F-measure
 - Retrieval
 - page/passage ranking: Precision, nDCG
 - KGQA
 - answer set overlap: Precision, nDCG, Recall, F-measure

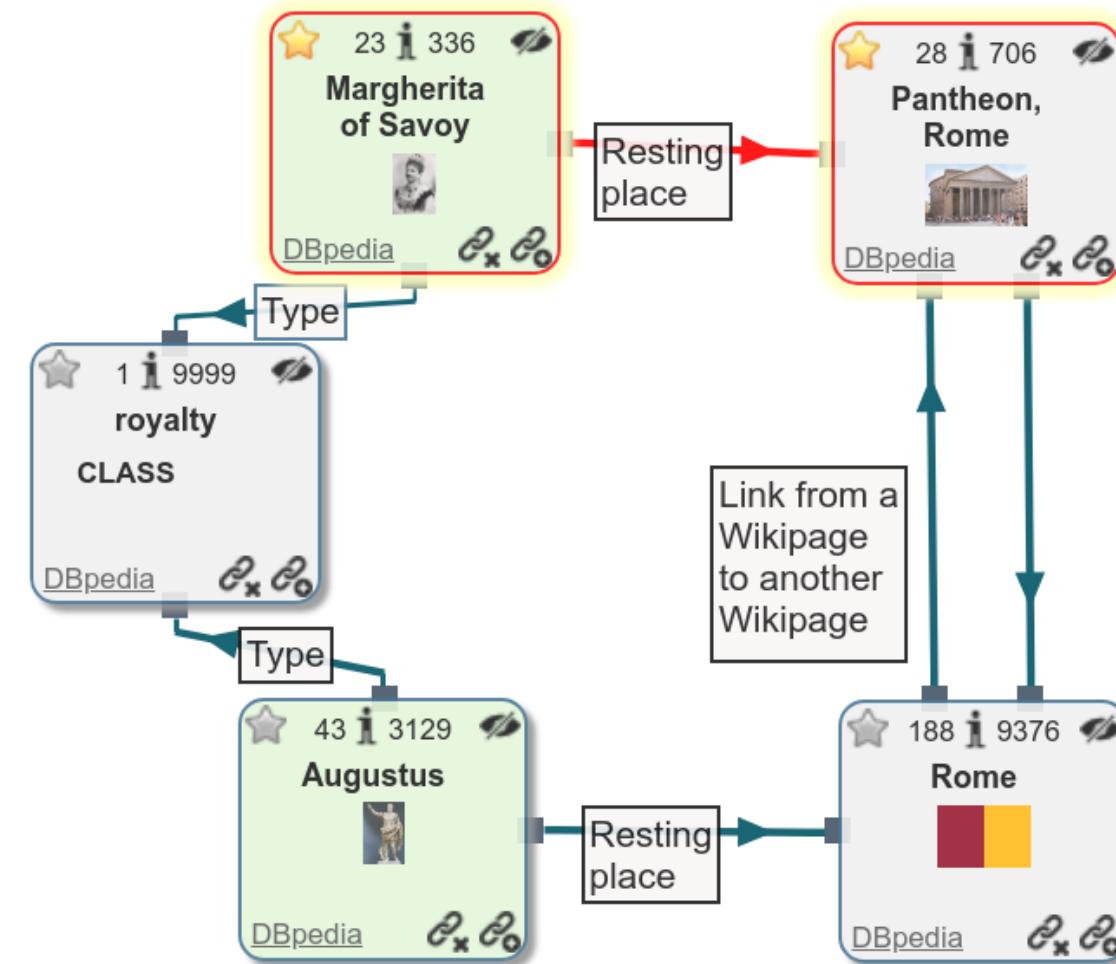
Evaluation

- Completeness

Evaluation

- Completeness

Q: Give me a count of royalties buried in Rome?



Evaluation

- Completeness
 - pooling
 - relevance assessment
 - TREC NIST <https://trec.nist.gov>

Evaluation

- Response relevance
- Correctness
- Completeness
- Mixed Initiative

Evaluation

- Mixed Initiative

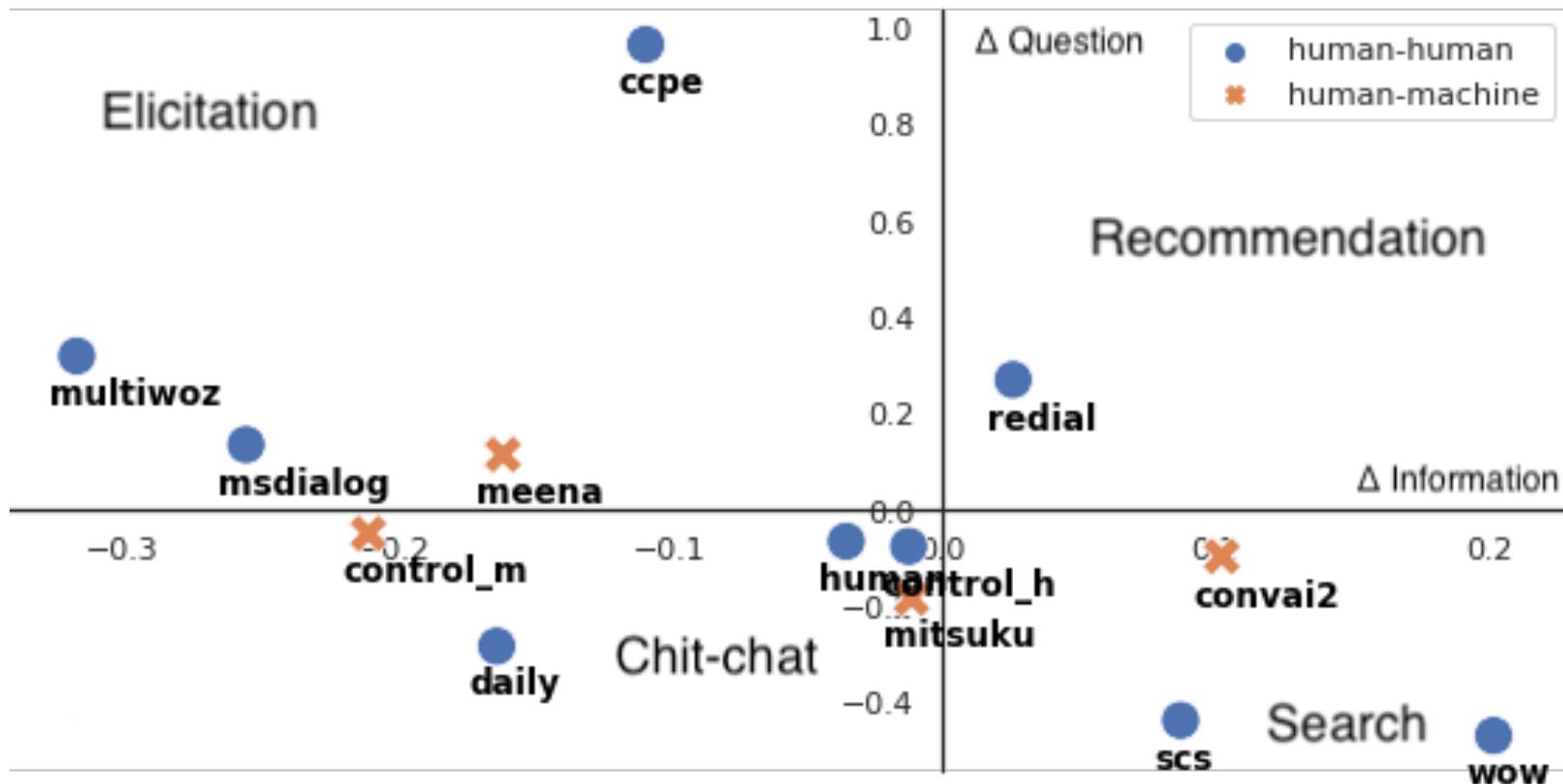
Evaluation

- Mixed Initiative
 - Question
 - Asking questions
 - Answering questions

Evaluation

- Mixed Initiative
 - Question
 - Asking questions
 - Answering questions
 - Topic (Information)
 - Introduction
 - Follow-up

Mixed Initiative



Questions?

Information Retrieval

- SIGIR
- ECIR
- ICTIR
- WSDM
- CIKM
- CHIIR
- TOIS

Research at ILPS is focused on technology that connects people to information: search engines, recommender systems, and conversational agents. We are organized in four labs.



Information Retrieval Lab



Language Technology Lab



Human Machine Intelligence Lab

Search ...



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 **ILPS Amsterdam**
@ILPS_Amsterdam



Great to see so many first timers signing up for
the online version of SEA! 😊 Want to join as

Courses

- **IR1** February
 - Asst. Prof. Dr. Ilya Markov
 - + Learning to rank, Evaluation, Entity Search
- **IR2** September
 - Assoc. Prof. Dr. Evangelos Kanoulas
 - team-projects in Conversational Search





SEA: Search Engines Amsterdam

Amsterdam, Netherlands

1,955 members · Public group [?](#)

Organized by **Maartje ter Hoeve** and 1 other

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What we're about

Information drives the planet. We organize talks around implementations of information retrieval, in search engines, in recommender systems, or in...

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Organizers



Maartje ter Hoeve and 1 other
[Message](#)

MSc Theses

- Question Rewriting for Conversational QA
- Knowledge Graph Grounded Conversation Generation
- Integrating Language Style Matching Objective into Generative Dialogue Models
- Conversation Mining (KPN)
- Deep matching of resumes to job descriptions (Randstad)

Svitlana Vakulenko
s.vakulenko@uva.nl