Innovation Center for Artificial Intelligence

SERP-Based Conversations

Maarten de Rijke

University of Amsterdam

derijke@uva.nl

Work in progress

Joint work in progress with

Pengjie Ren
U. Amsterdam

Maarten de Rijke
U. Amsterdam

Svitlana Vakulenko
TU Wien

Nikos Voskarides
U. Amsterdam

Yangjun Zhang
U. Amsterdam

Information retrieval

- **Connecting people to information**
  - Search
  - Recommendation
  - Conversations

Conversational search

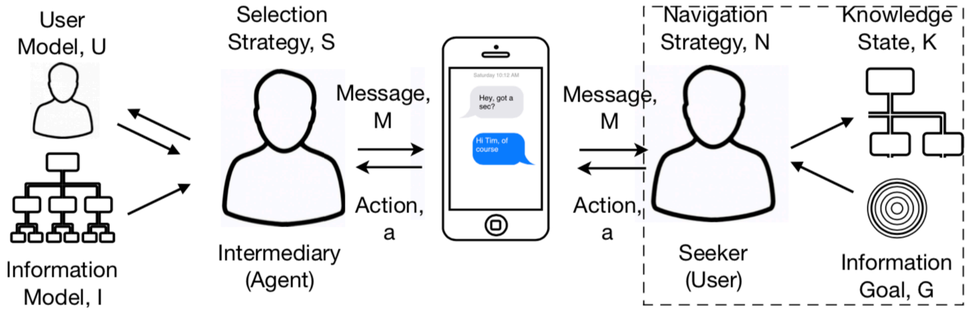
- Idea of **search as conversation** has been around since early 1980s (Belkin, CJIS 1980)
- Making information retrieval interfaces feel more natural and convenient for their users (Radlinski & Craswell, CHIIR 2017)
- Ongoing research and development efforts heavily skewed towards **question answering tasks**

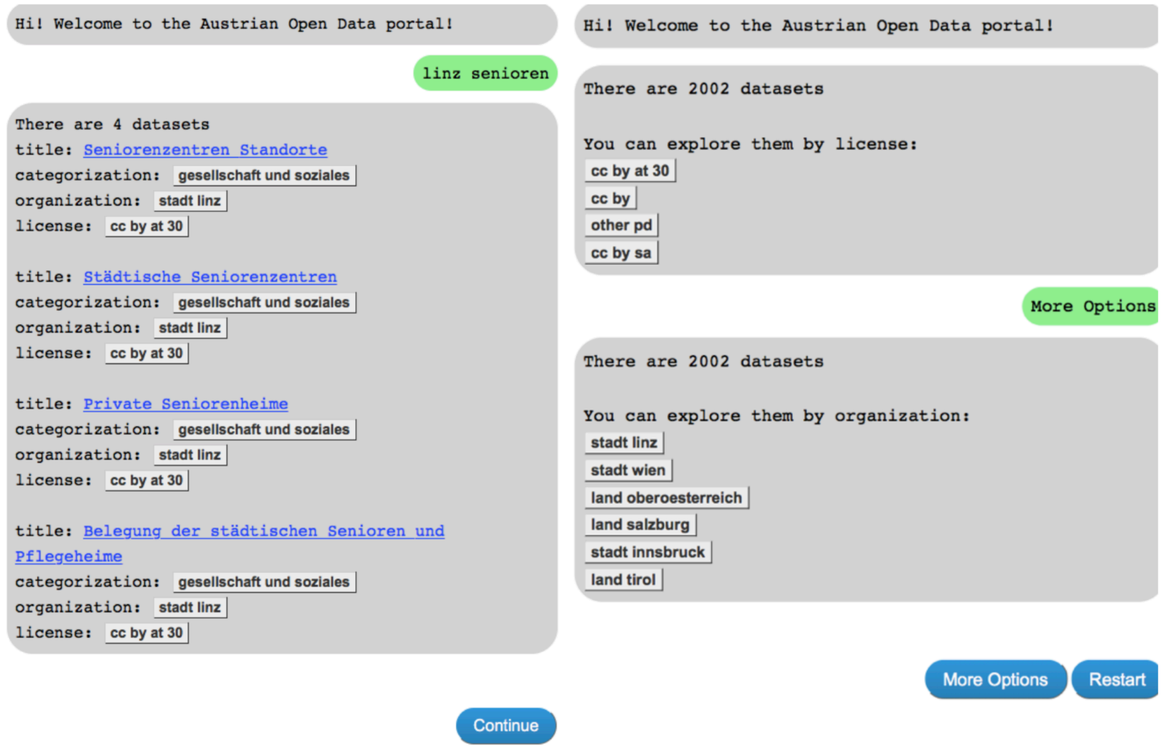
But there’s more …

Conversational browsing

- Using conversations to **browse** large collections of information objects (Vakulenko et al, ISWC 2018)

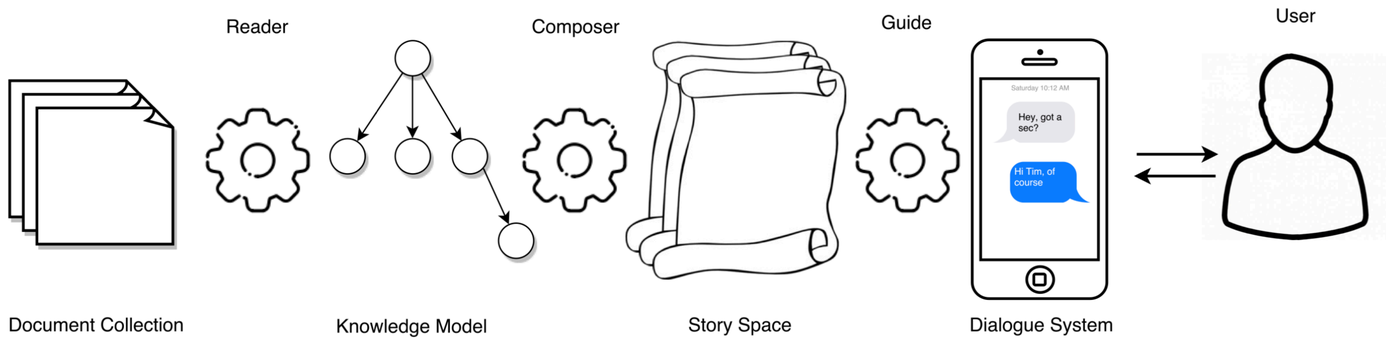
- User model maintains knowledge state, information goal, navigation strategy





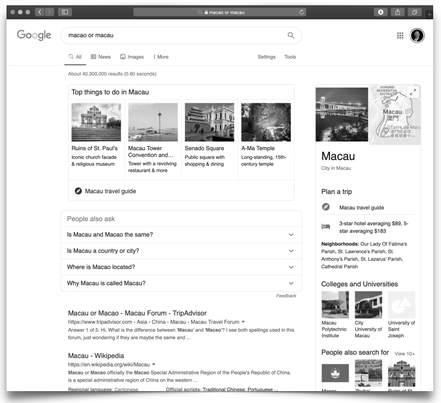
Conversations for exploratory search

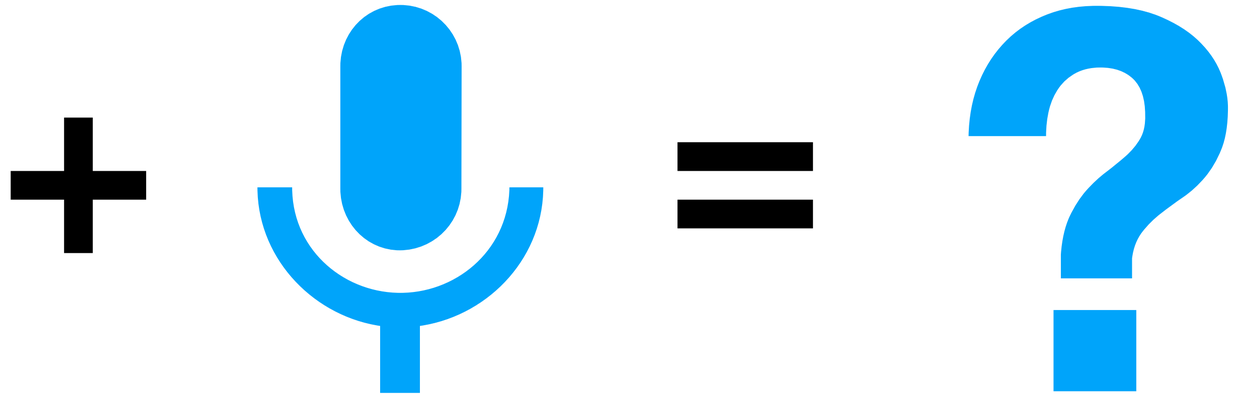
- **Exploratory** search important
  - Educational purposes
  - Serendipitous discoveries of cultural artifacts – users often look for inspiration, surprises, novel ideas
  - E-commerce
- (Vakulenko et al., SCAI 2017)



Conversational SERPs

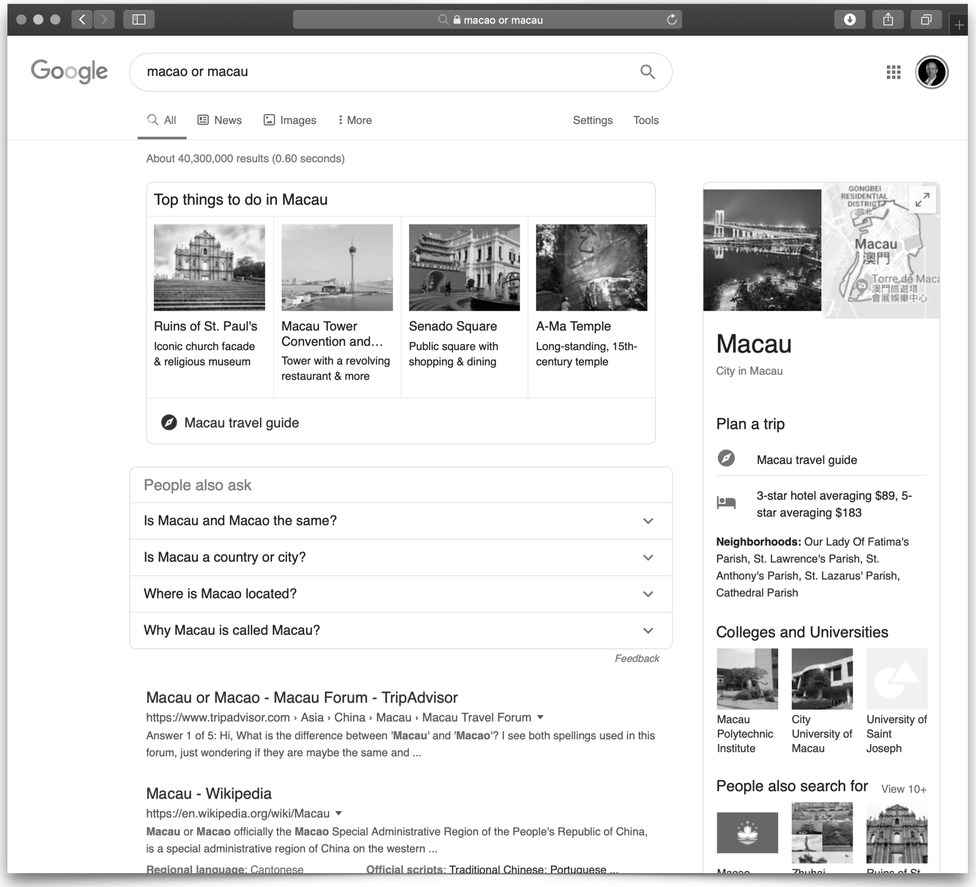
- Conversational **search engine result pages**

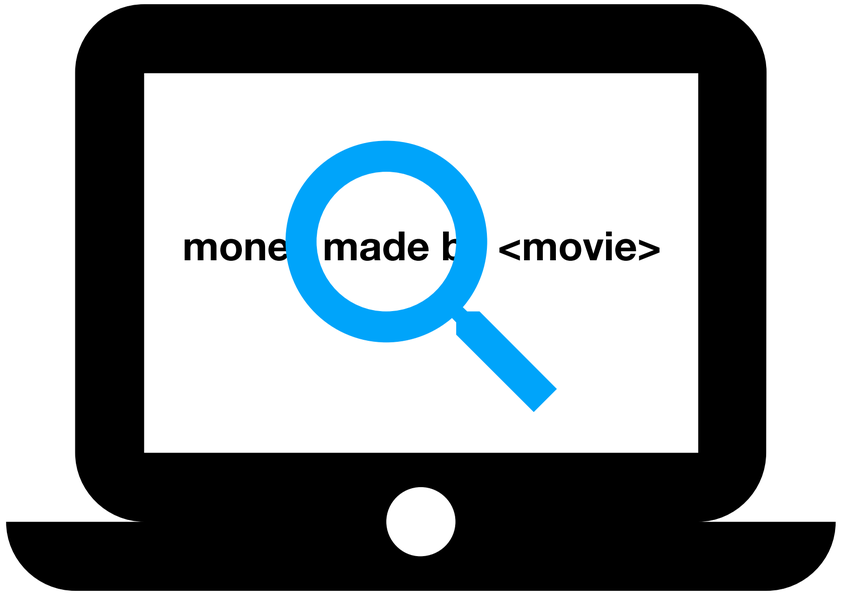




Conversational SERPs

- **Heterogeneous SERPs**
  - Dealing with multiple intents
  - Multiple answers
  - Text vs. image/video vs. knowledge cards vs. …
  - Structured vs. unstructured information
  - Static blogs/articles vs. live news/ reports
  - Closed world vs. open world
  - …
- **But let's start a bit simpler …**





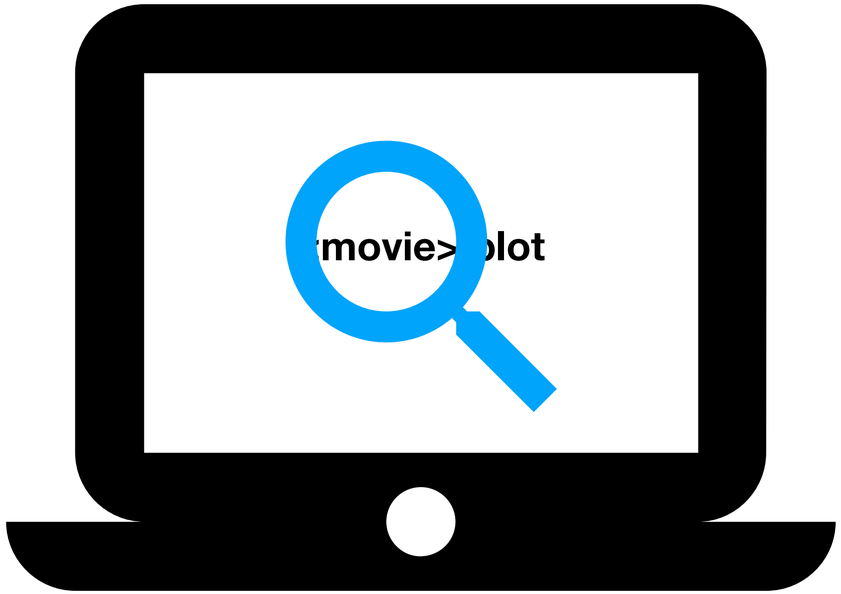
... that 's redundant because it is a ben stiller movie . clearly my expectations for this movie were not high and , maybe because of that , i found " meet the fockers " quite funny . do you remember when big box office $ 279,167,575 awards ascap film and television music awards 2005 top box office ...

what did you think of the title ?

the title pretty much describes the level of the humor in this ben stiller movie .

haha , i agree ! do you know if it made any money ?

yeah , it made $ 279,167,575 . pretty good .



...being captured by boris and onatopp . bond arrives in st . petersburg and meets his cia contact , jack wade (joe don baker) . wade agrees to take bond to the hideout of a russian gangster , valentin zukovsky (robbie coltrane) , whom bond had shot in the leg and given a permanent limp years before ...

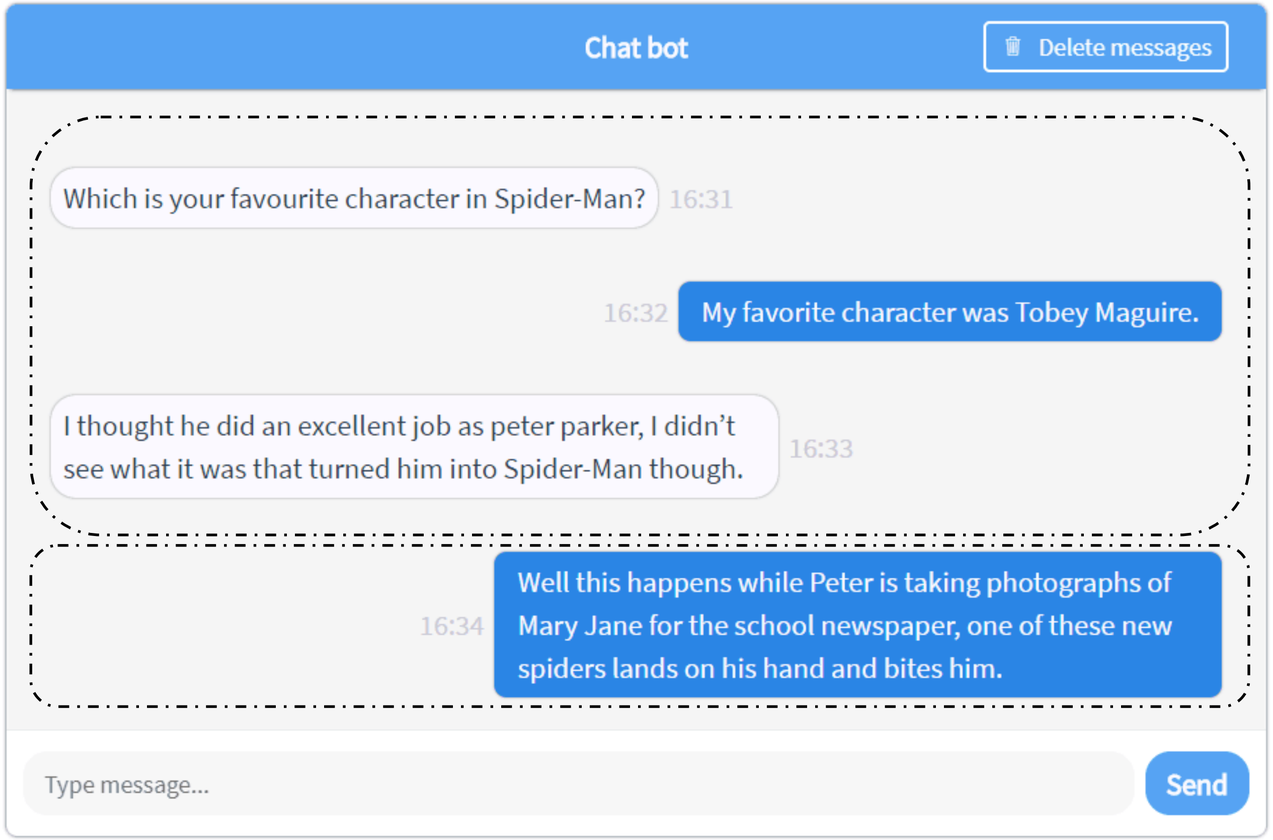
that was a good scene

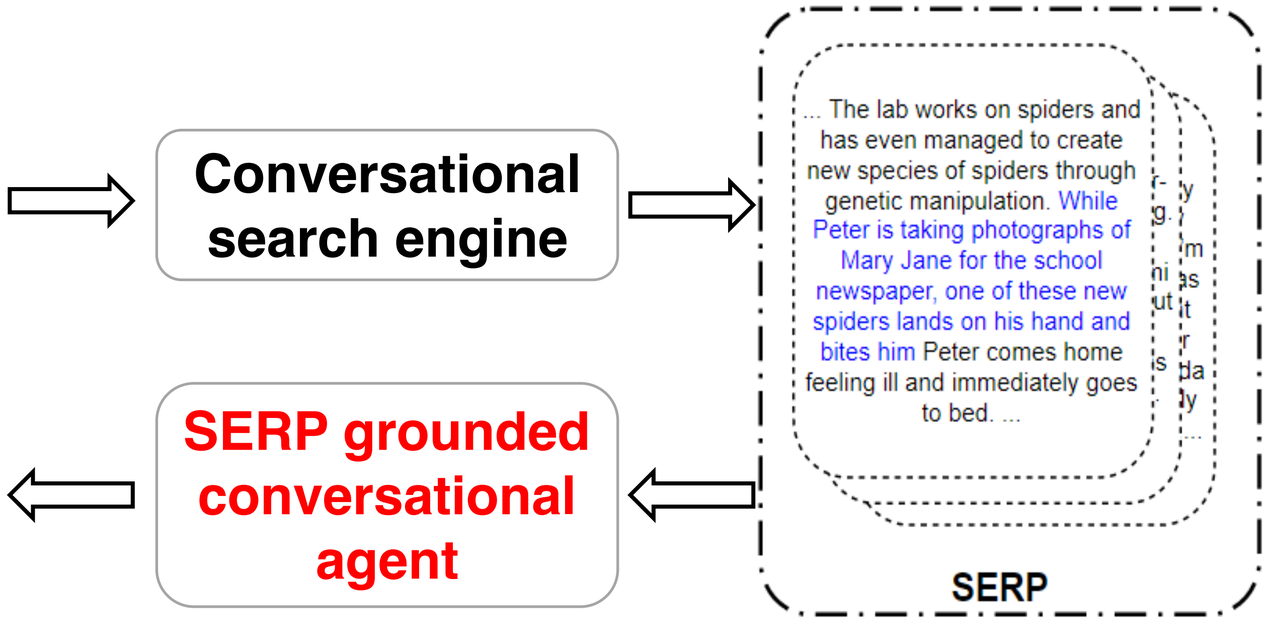
what did you like about the movie ?

i liked his friend , jack wade .

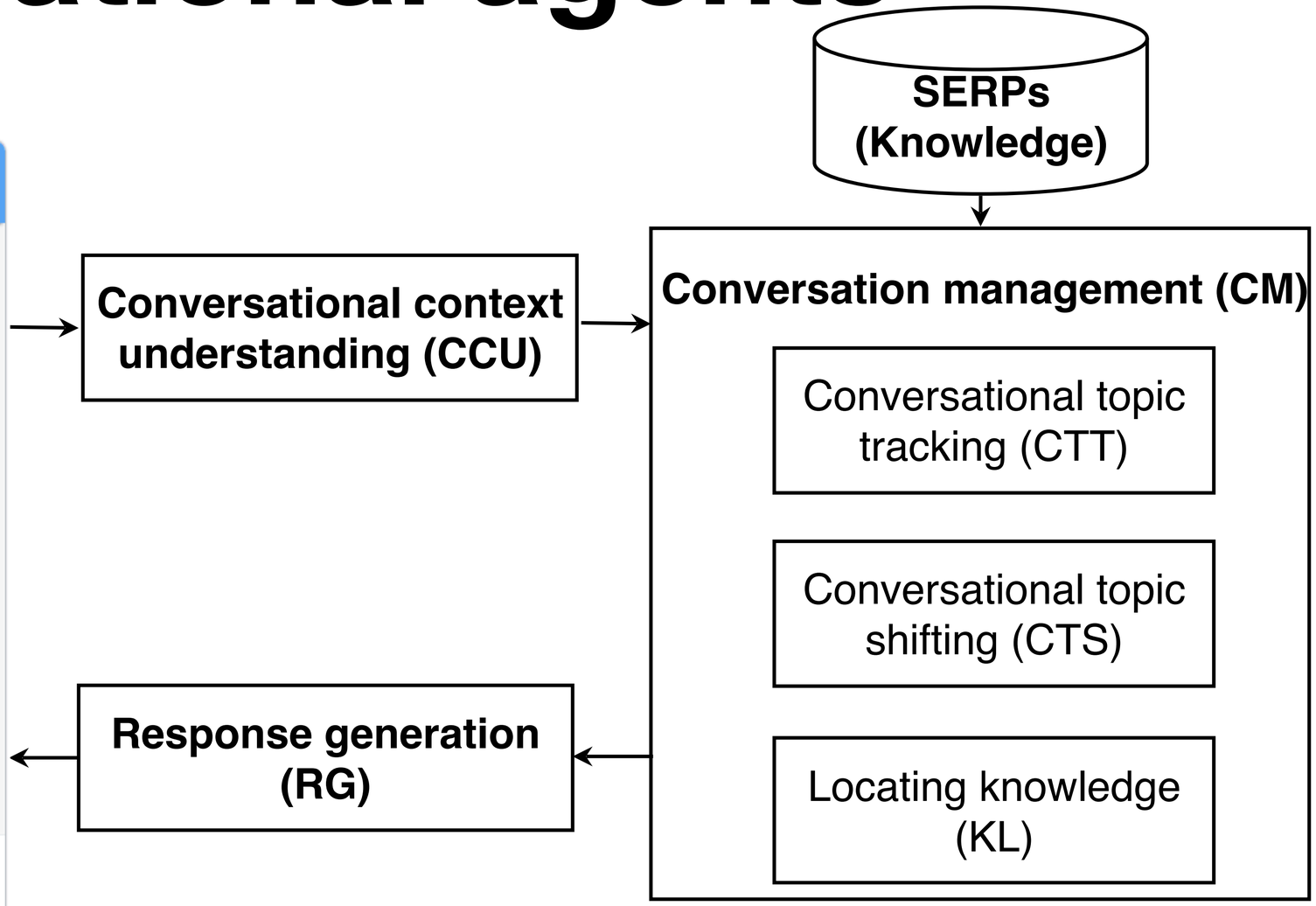
i loved the part where bond arrives in st . petersburg and meets his cia contact , jack wade (joe don baker) .

Search as conversation



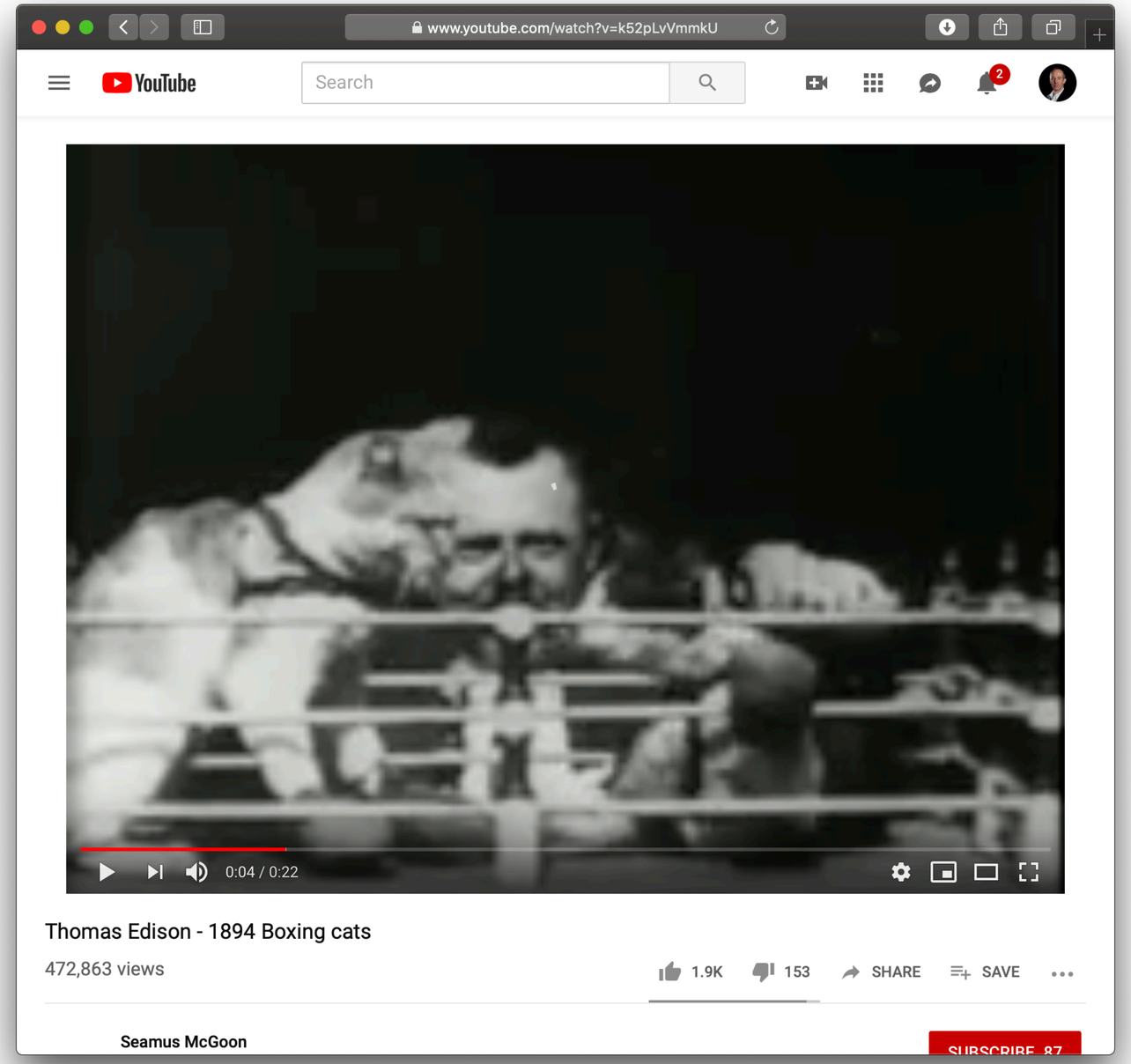


SERP grounded conversational agents



Make it more interactive.

Who shot the first cat video?


www.youtube.com/watch?v=k52pLvVmmkU
YouTube
Search
2
0:04 / 0:22
Thomas Edison - 1894 Boxing cats
472,863 views
1.9K
153
SHARE
SAVE
Seamus McGoon
SUBSCRIBE 87

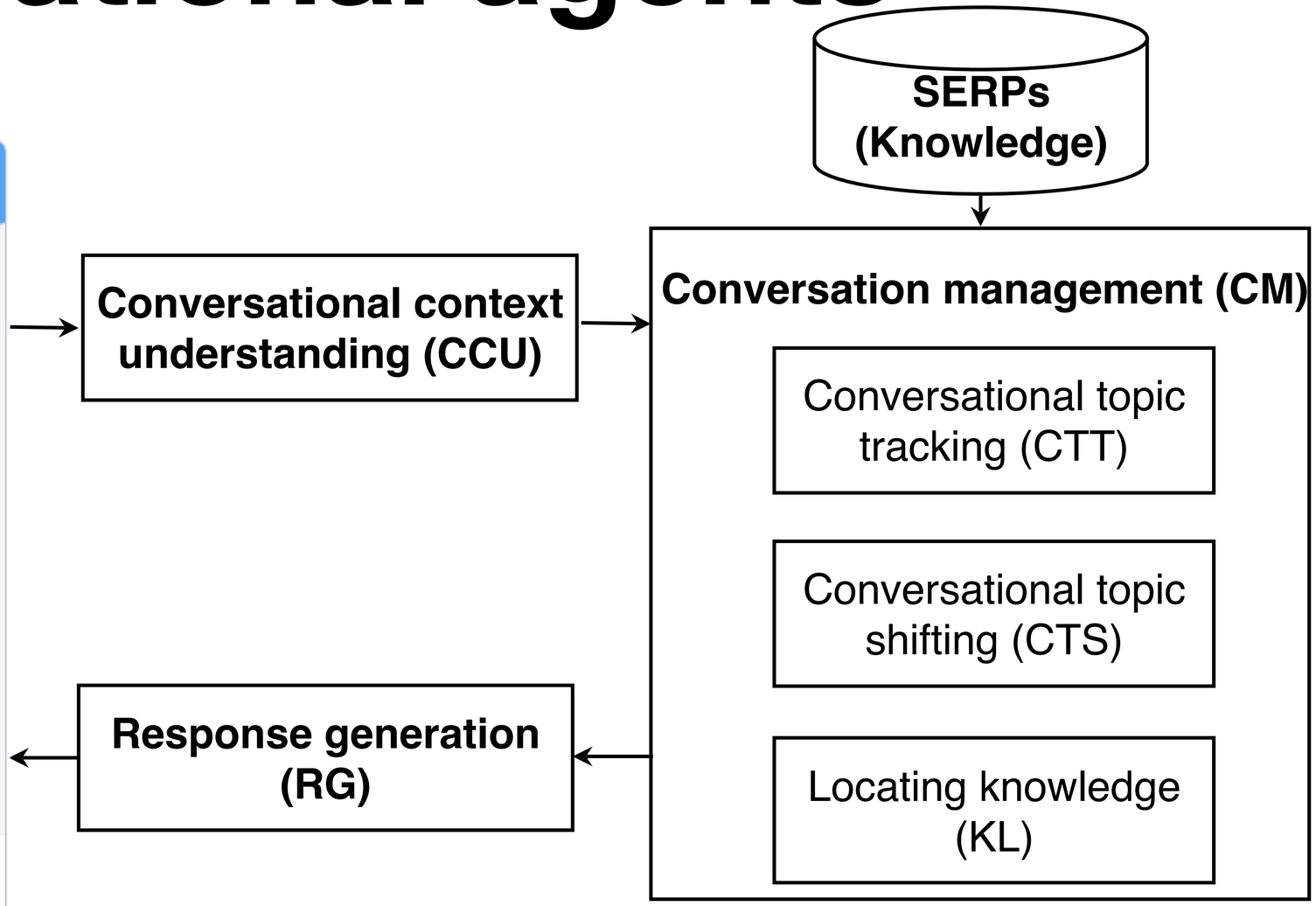
Thomas Edison, 1894

End of interaction.

Outline

- Introduction
- **Recent advances**
- Available datasets
- Challenges and ambitions

SERP grounded conversational agents

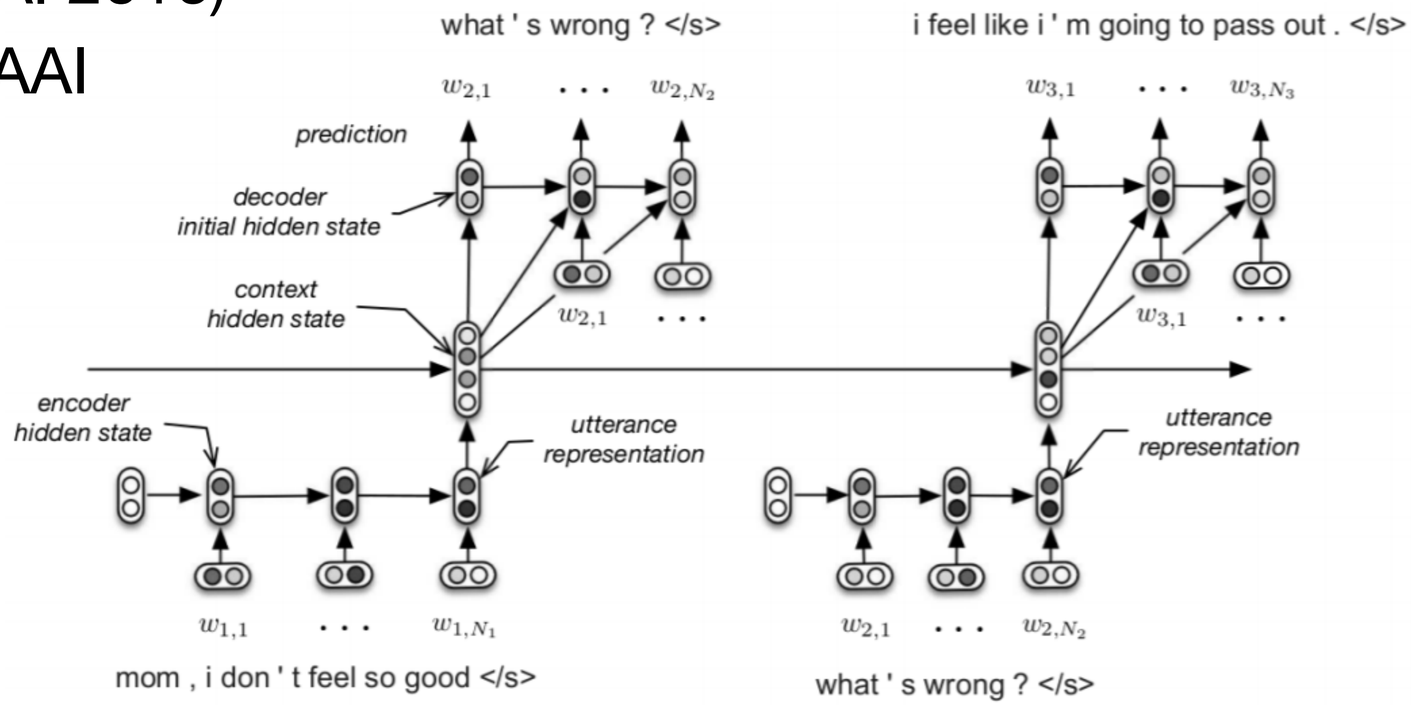


CCU: Conversational context encoding

- **Non-hierarchical context modeling**
  - Concatenate previous utterances into one sequence

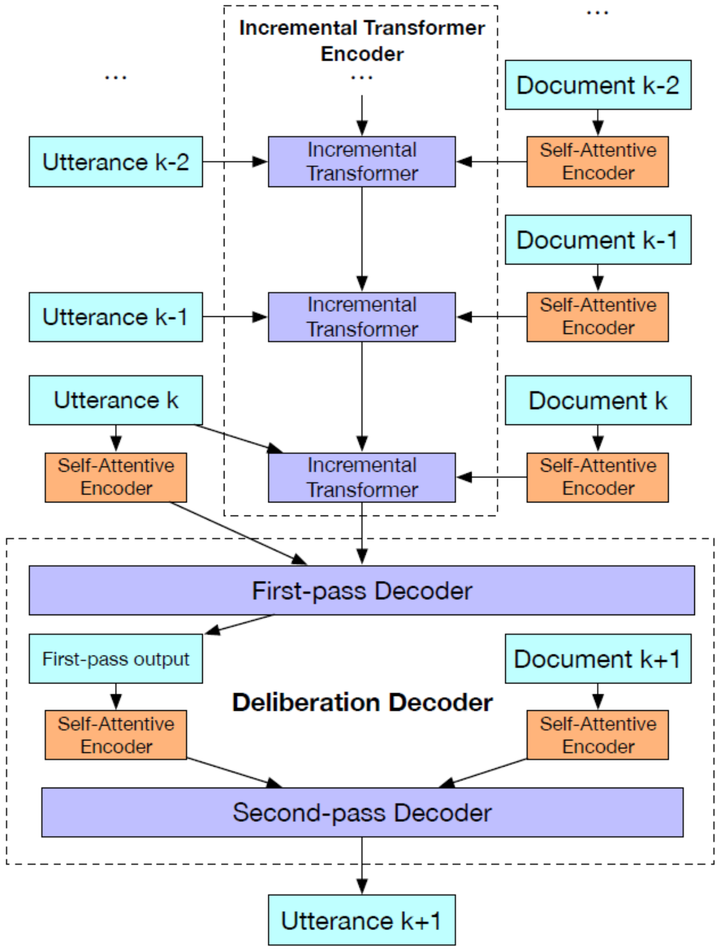
CCU: Conversational context encoding

- **Hierarchical context modeling**
  - HRED (Serban et al., AAAI 2016)
  - VHRED (Serban et al., AAAI 2017)



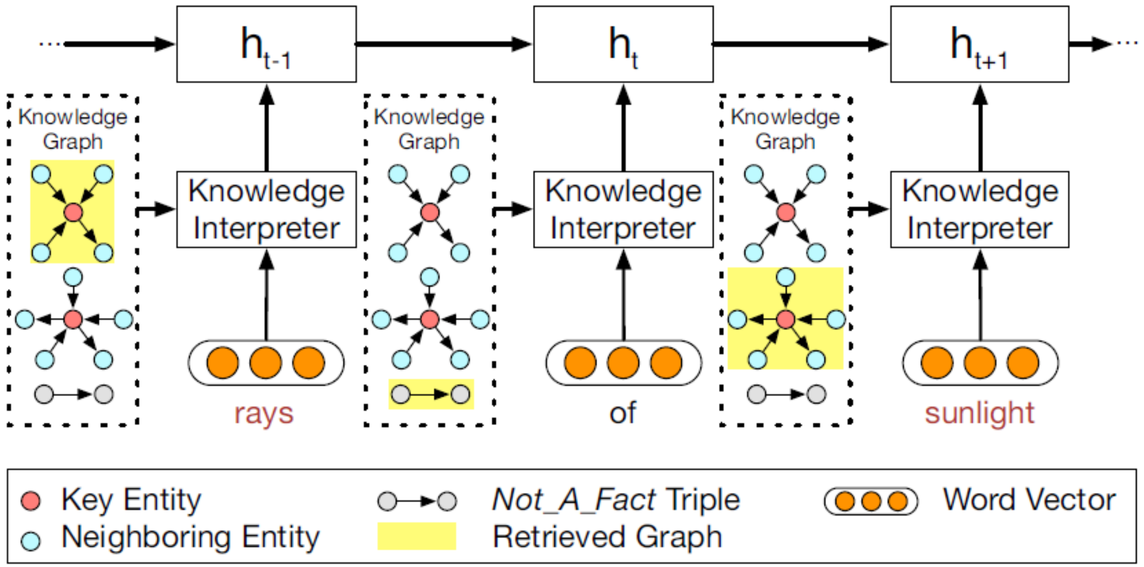
CCU: Conversational context encoding

- **Incremental context modeling**
  - Incremental Transformer Encoder (ITE)
  - (Li et al., ACL 2019)



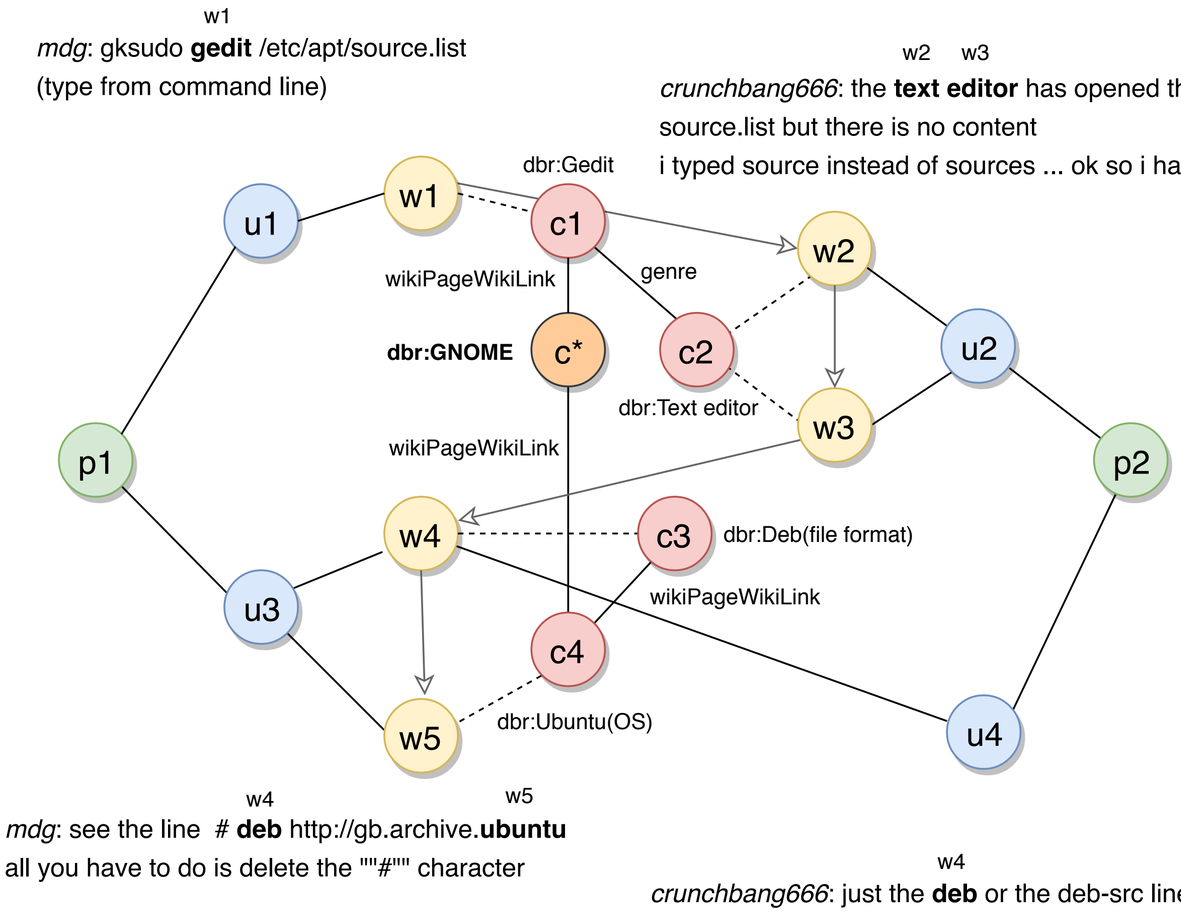
CCU: Conversational context encoding

- **Knowledge enhanced context modeling**
  - Commonsense conversational model (CCM)
  - (Li et al. ACL 2019)



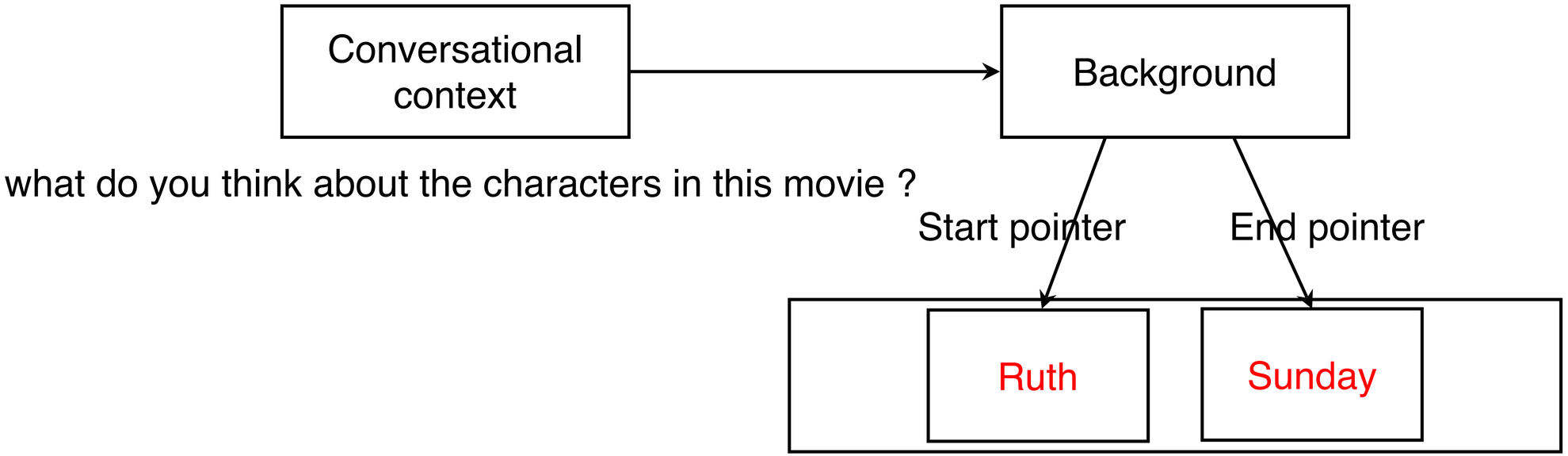
CTT: Conversational topic tracking

- **Use a dialogue graph representation**
  - Capture relation within dialogue corpus using semantic relations from background knowledge
- Semantic coherence measuring as a binary classification task
- Top-*k* shortest path induced subgraphs
- (Vakulenko et al., ISWC 2018)



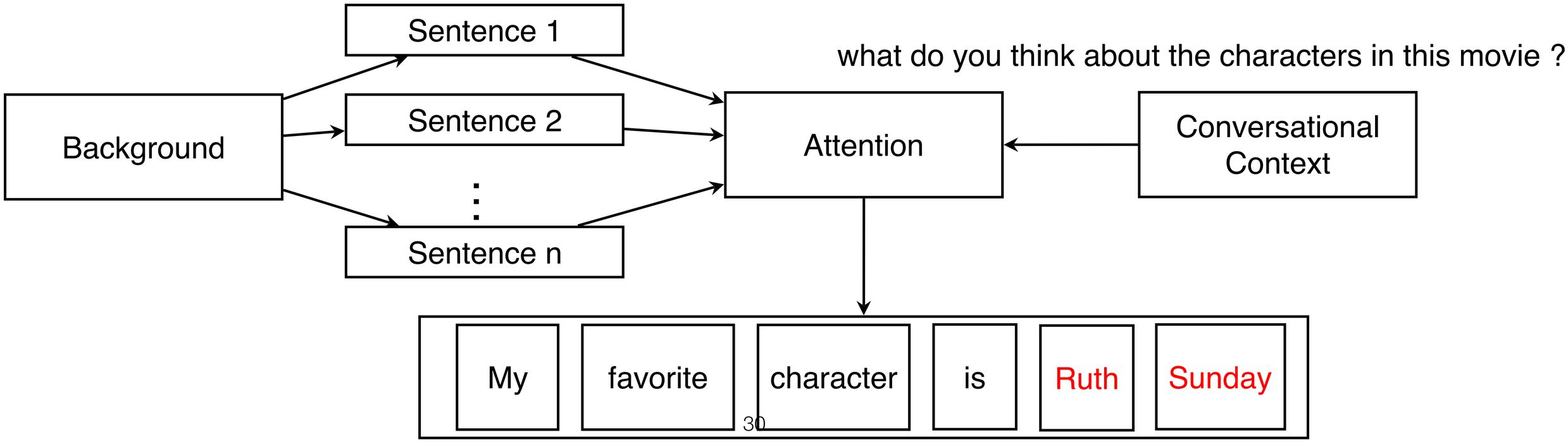
KL: Knowledge selection

- **Span level selection**
  - Reading comprehension models, e.g., BiDAF
  - (Seo et al., ICLR 2017)



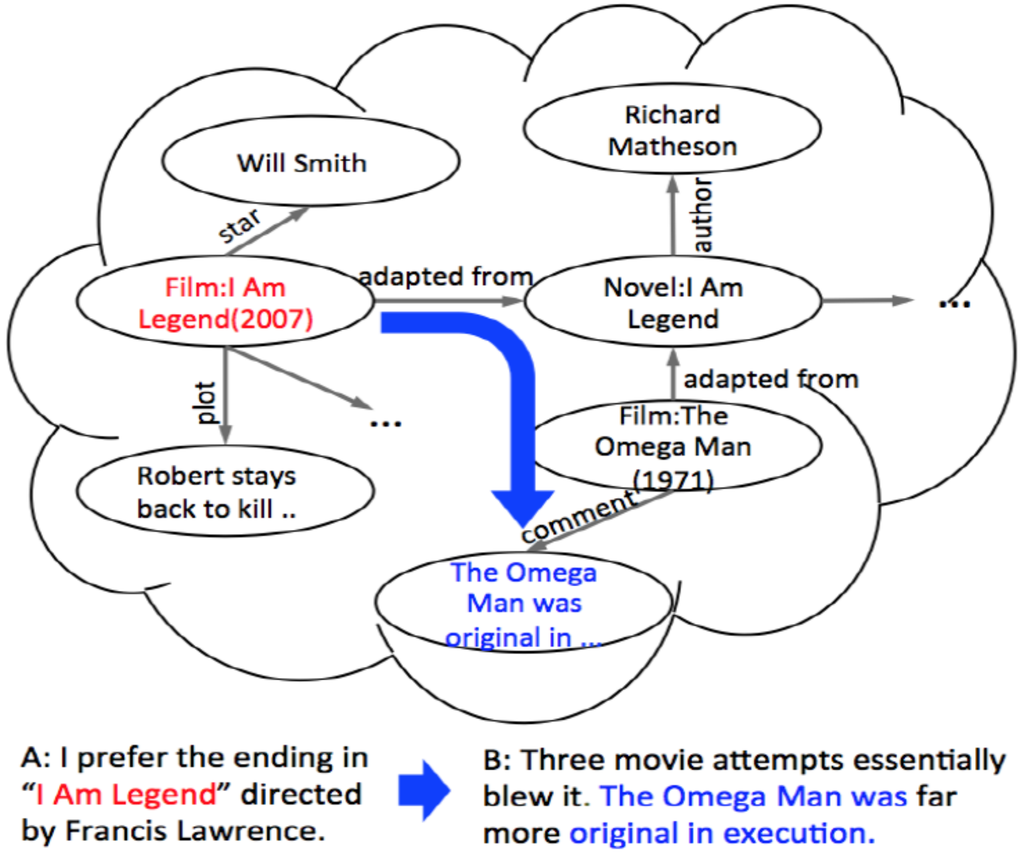
KL: Knowledge selection

- **Sentence level selection**
  - Sentence ranking → response generation
  - (Dinan et al., ICLR 2019)
  - (Lian et al., arXiv 2019)



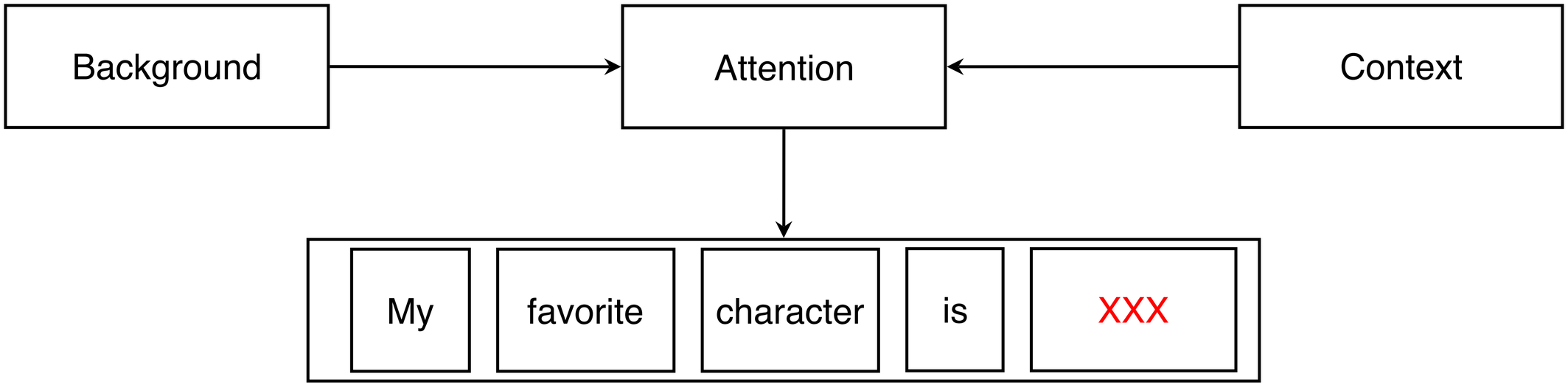
KL: Knowledge selecting → reasoning

- **Multi-hop walking on knowledge graph**
  - (Liu et al., arXiv 2019)
  - (Moon et al., ACL 2019)



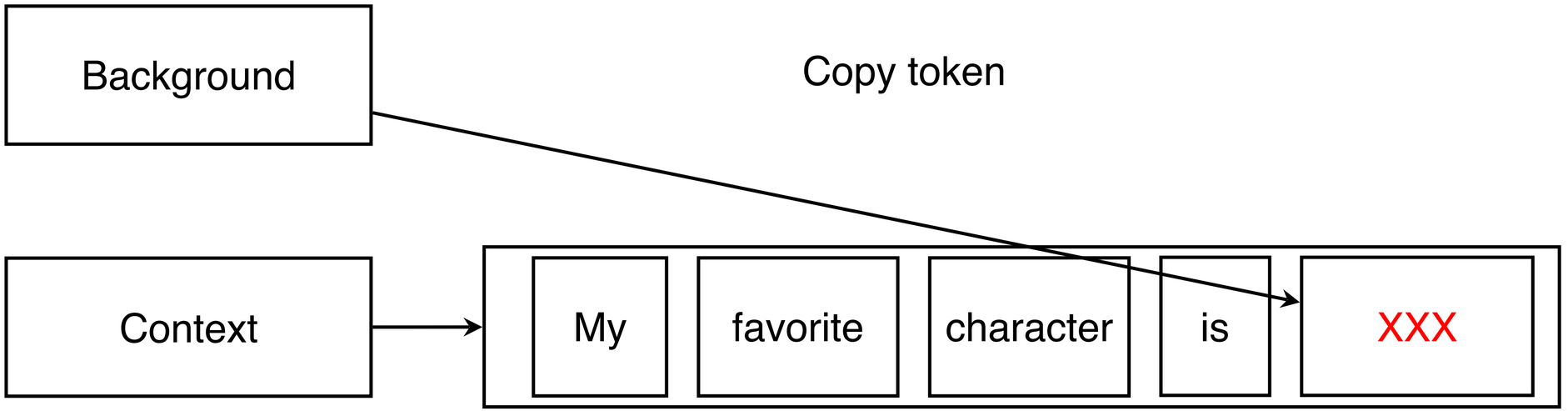
RG: Knowledge enhanced response generation

- **Attentive generation**



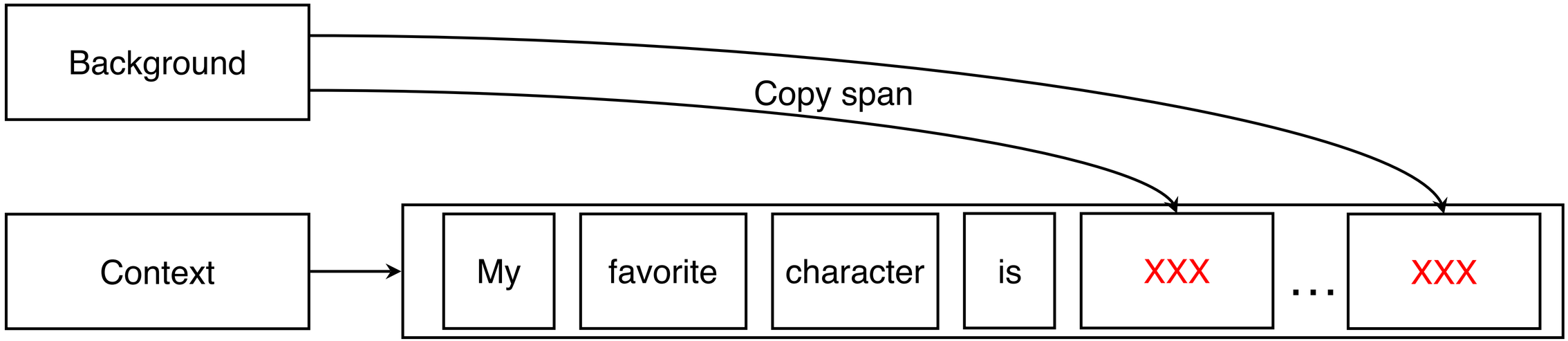
RG: Knowledge enhanced response generation

- **Token copying generation**
  - Pointer network (See et al., ACL 2017)
  - CaKe (Zhang et al., SCAI 2019)



RG: Knowledge enhanced response generation

- **Span copying generation**
  - RefNet (Meng et al., arXiv 2019)

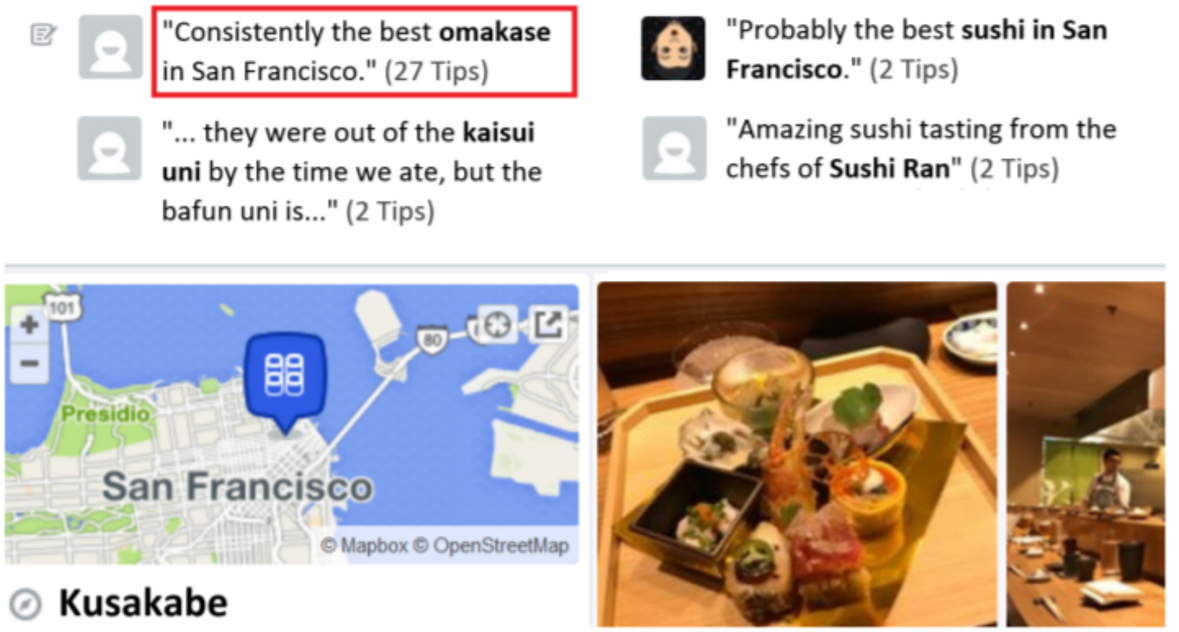


Outline

- Introduction
- Recent advances
- **Available datasets**
- Challenges and ambitions

Dataset

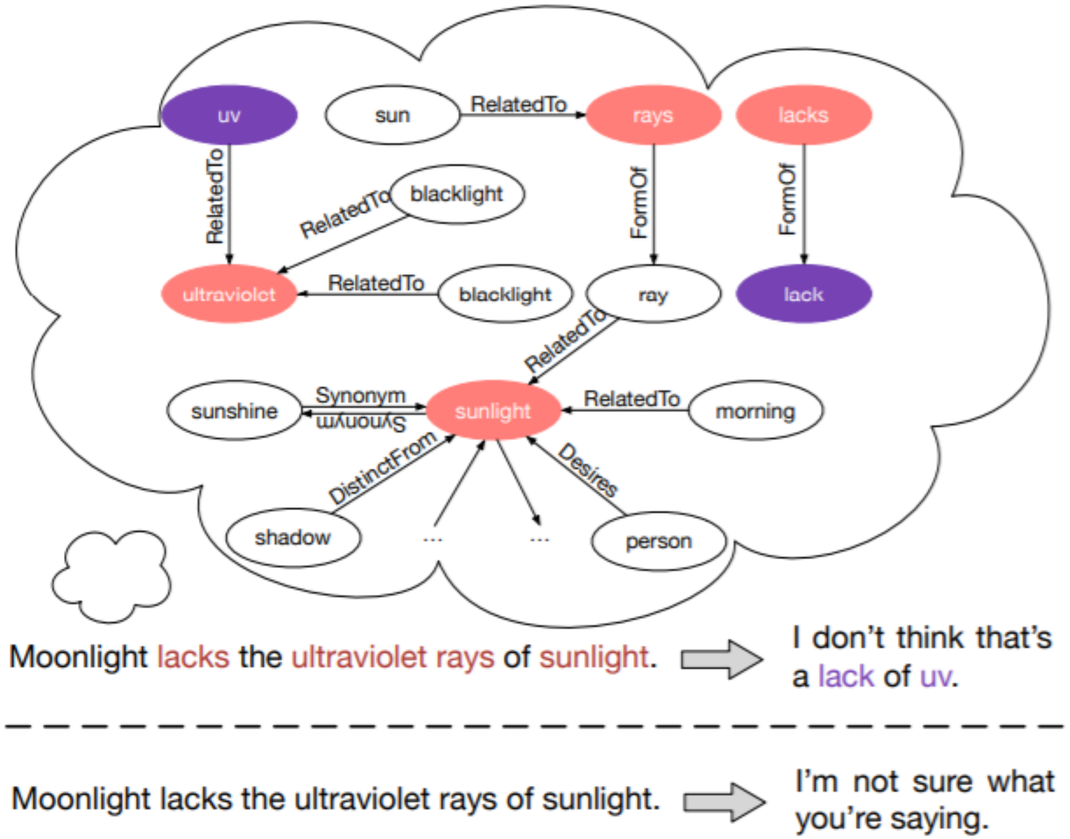
- User reviews as knowledge
- (Ghazvininejad et al., AAAI 2018)



User input: *Going to Kusakabe tonight.*
Neural model: Have a great time!
Human: You'll love it! Try omasake, the best in town.

Dataset

- Common sense as knowledge
- (Zhou et al., IJCAI 2018)



Dataset

- User persona as knowledge
- (Zhang et al., ACL 2018)

Persona 1	Persona 2
I like to ski	I am an artist
My wife does not like me anymore	I have four children
I have went to Mexico 4 times this year	I recently got a cat
I hate Mexican food	I enjoy walking for exercise
I like to eat cheetos	I love watching Game of Thrones

[PERSON 1:] Hi
[PERSON 2:] Hello ! How are you today ?
[PERSON 1:] I am good thank you , how are you.
[PERSON 2:] Great, thanks ! My children and I were just about to watch Game of Thrones.
[PERSON 1:] Nice ! How old are your children?
[PERSON 2:] I have four that range in age from 10 to 21. You?
[PERSON 1:] I do not have children at the moment.
[PERSON 2:] That just means you get to keep all the popcorn for yourself.
[PERSON 1:] And Cheetos at the moment!
[PERSON 2:] Good choice. Do you watch Game of Thrones?
[PERSON 1:] No, I do not have much time for TV.
[PERSON 2:] I usually spend my time painting: but, I love the show.

Dataset

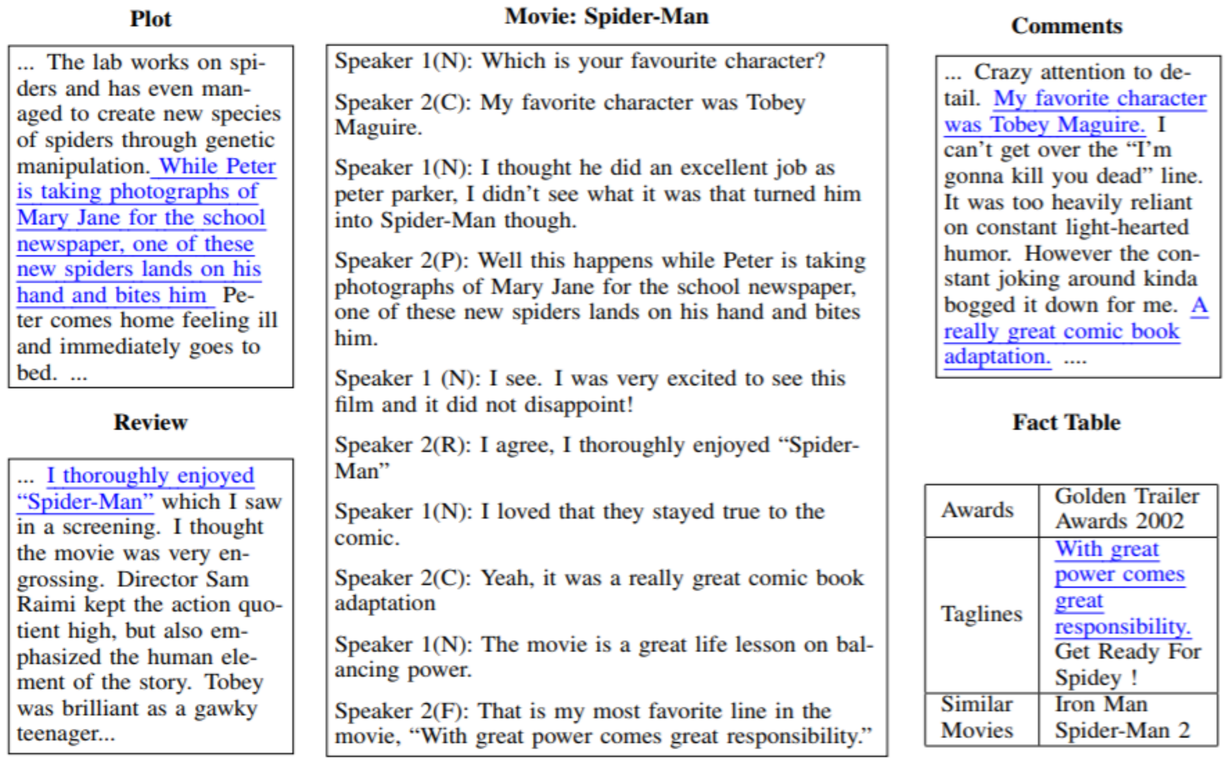
- Wikipedia movie articles as knowledge
- (Zhou et al., EMNLP 2018)

Name	The Shape of Water
Year	2017
Director	Guillermo del Toro
Genre	Fantasy, Drama
Cast	Sally Hawkins as Elisa Esposito, a mute cleaner who works at a secret government laboratory. Michael Shannon as Colonel Richard Strickland, a corrupt military official, Richard Jenkins as Giles, Elisa's closeted neighbor and close friend who is a struggling advertising illustrator. Octavia Spencer as Zelda Delilah Fuller, Elisa's co-worker and friend who serves as her interpreter., Michael Stuhlbarg as Dimitri Mosenkov, a Soviet spy working as a scientist studying the creature, under the alias Dr. Robert Hoffstetler.
Critical Response	one of del Toro's most stunningly successful works, also a powerful vision of a creative master feeling totally, joyously free. Even as the film plunges into torment and tragedy, the core relationship between these two unlikely lovers holds us in thrall. Del Toro is a world-class film artist. There's no sense trying to analyze how he does it. The Shape of Water has tenderness uncommon to del Toro films. While The Shape of Water isn't groundbreaking, it is elegant and mesmerizing. refer Sally Hawkins' mute character as 'mentally handicapped' and for erroneously crediting actor Benicio del Toro as director.
Introduction	The Shape of Water is a 2017 American fantasy drama film directed by Guillermo del Toro and written by del Toro and Vanessa Taylor. It stars Sally Hawkins, Michael Shannon, Richard Jenkins, Doug Jones, Michael Stuhlbarg, and Octavia Spencer. Set in Baltimore in 1962, the story follows a mute custodian at a high-security government laboratory who falls in love with a captured humanoid amphibian creature.
Rating	Rotten Tomatoes: 92% and average: 8.4/10 Metacritic Score: 87/100 CinemaScore: A

Conversation	
user1:	Hi
user2:	Hi
user2:	I thought The Shape of Water was one of Del Toro's best works. What about you?
user1:	Did you like the movie?
user1:	Yes, his style really extended the story.
user2:	I agree. He has a way with fantasy elements that really helped this story be truly beautiful.
user2:	It has a very high rating on rotten tomatoes, too. I don't always expect that with movies

Dataset

- Wikipedia movie articles and IMDb movie reviews as knowledge
- (Moghe et al., EMNLP 2018)



Plot

... The lab works on spiders and has even managed to create new species of spiders through genetic manipulation. While Peter is taking photographs of Mary Jane for the school newspaper, one of these new spiders lands on his hand and bites him. Peter comes home feeling ill and immediately goes to bed. ...

Review

... I thoroughly enjoyed "Spider-Man" which I saw in a screening. I thought the movie was very engrossing. Director Sam Raimi kept the action quotient high, but also emphasized the human element of the story. Tobey was brilliant as a gawky teenager...

Movie: Spider-Man

Speaker 1(N): Which is your favourite character?

Speaker 2(C): My favorite character was Tobey Maguire.

Speaker 1(N): I thought he did an excellent job as peter parker, I didn't see what it was that turned him into Spider-Man though.

Speaker 2(P): Well this happens while Peter is taking photographs of Mary Jane for the school newspaper, one of these new spiders lands on his hand and bites him.

Speaker 1 (N): I see. I was very excited to see this film and it did not disappoint!

Speaker 2(R): I agree, I thoroughly enjoyed "Spider-Man"

Speaker 1(N): I loved that they stayed true to the comic.

Speaker 2(C): Yeah, it was a really great comic book adaptation

Speaker 1(N): The movie is a great life lesson on balancing power.

Speaker 2(F): That is my most favorite line in the movie, "With great power comes great responsibility."

Comments

... Crazy attention to detail. My favorite character was Tobey Maguire. I can't get over the "I'm gonna kill you dead" line. It was too heavily reliant on constant light-hearted humor. However the constant joking around kinda bogged it down for me. A really great comic book adaptation. ....

Fact Table

Awards	Golden Trailer Awards 2002
Taglines	With great power comes great responsibility. Get Ready For Spidey !
Similar Movies	Iron Man Spider-Man 2

Dataset

- Wikipedia articles as knowledge
- (Dinan et al., ICLR 2019)

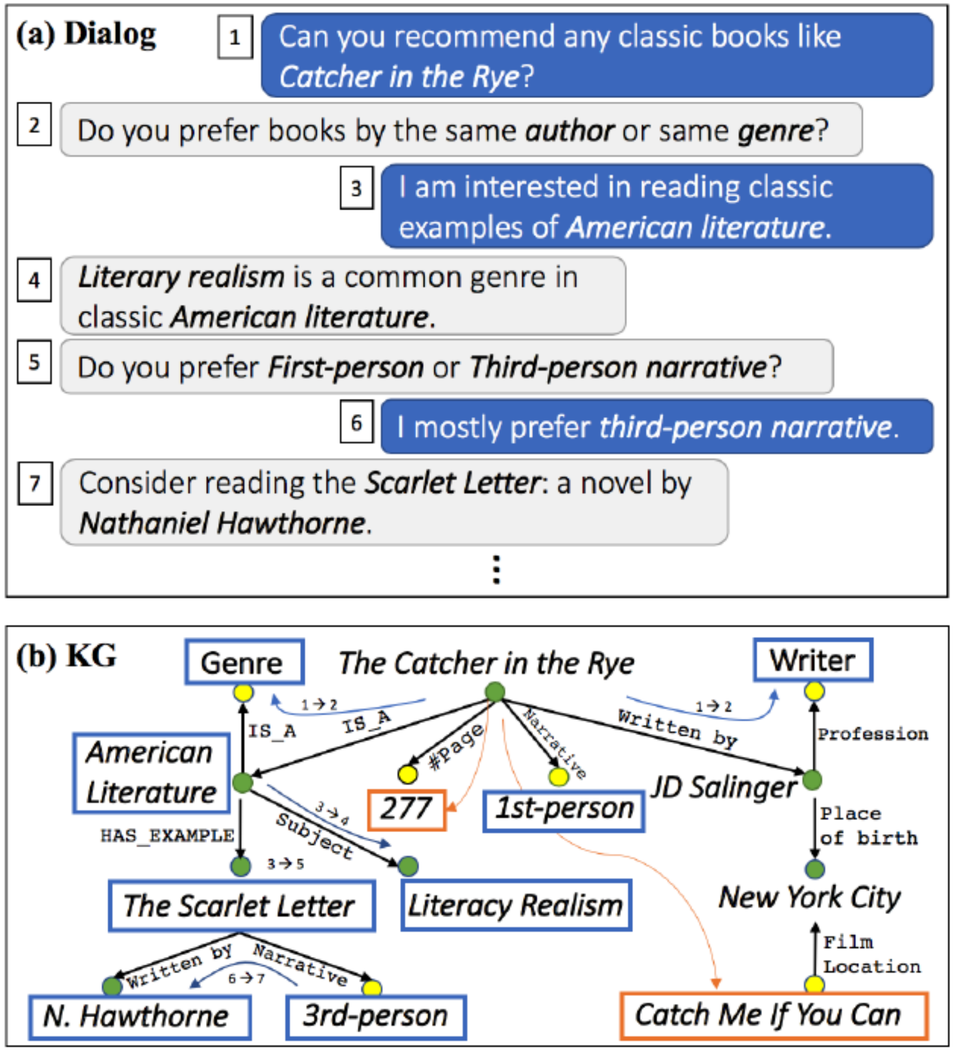
Topic:	Lifeguard
Apprentice:	So I am a lifeguard. Know anything about saving lives in water?
Wizard:	I'm impressed! It's a big responsibility to supervise other people's safety in the water! Tell me more.
Apprentice:	Well, I help make sure people do not drown or get injured while in or near the water!
Knowledge:	A lifeguard is a rescuer who supervises the safety and rescue of swimmers, surfers, . . . Lifeguards are strong swimmers and trained in CPR/AED first aid, certified in water . . . . . . In some areas, the lifeguard service also carries out mountain rescues, or may function as the primary EMS provider.
Wizard:	I've heard that in some places, lifeguards also help with other sorts of emergencies, like mountain rescues! Is that part of your job too?
Apprentice:	I have! I feel like you know much about this! What brings you to know so much?
Wizard:	Oh, that's about the extent of my knowledge. I've just been around beaches and I've always admired lifeguards. I'm not a super strong swimmer myself.

Dataset

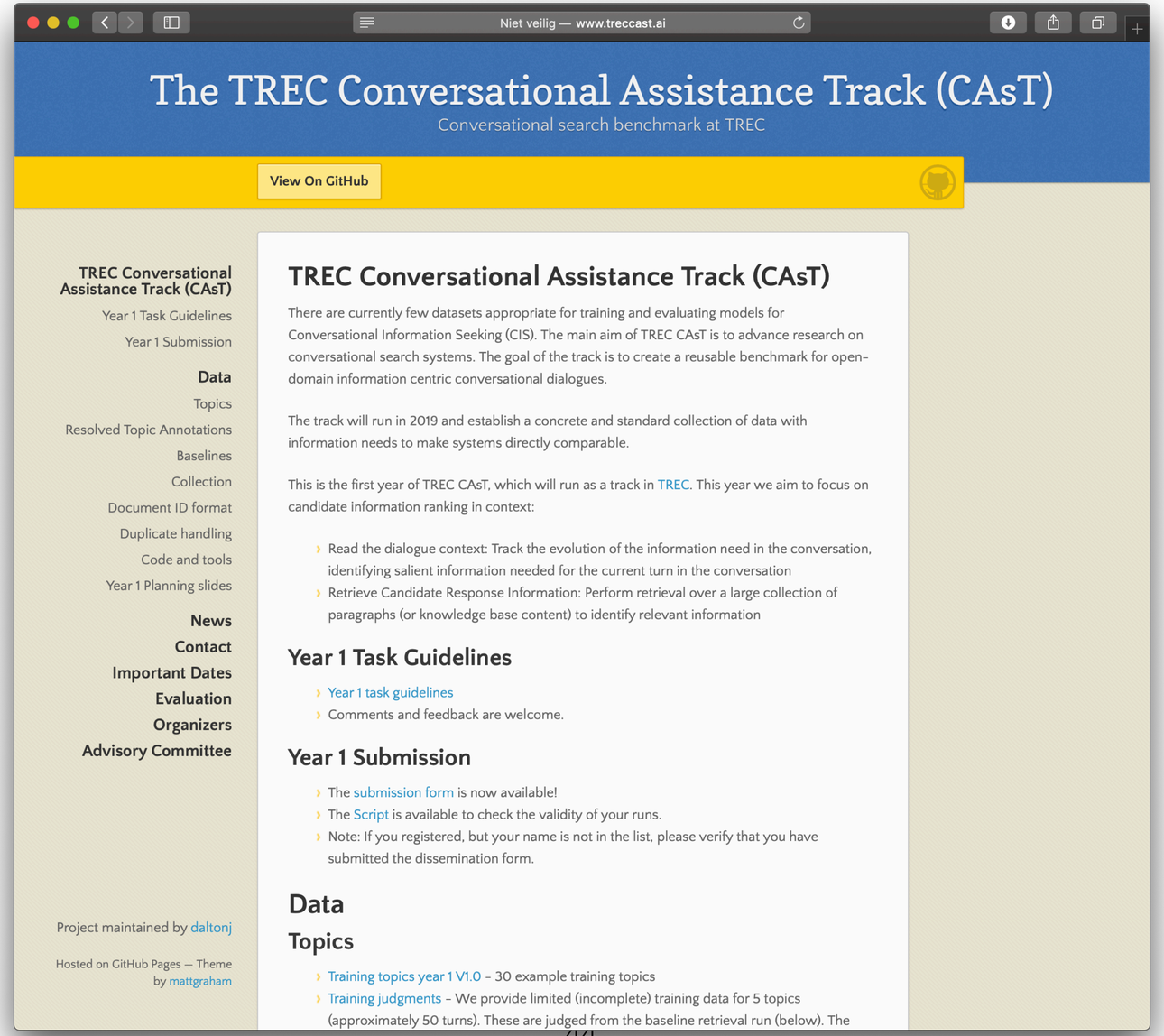
- Wikipedia articles as knowledge grounded to Reddit conversations
- (Qin et al., ACL 2019)

Dataset

- Knowledge graph as knowledge
- (Moon et al., ACL 2019)



Dataset



http://www.treccast.ai

Make it more interactive.

What is CatVideoFest?

Niet veilig — www.catvideofest.com

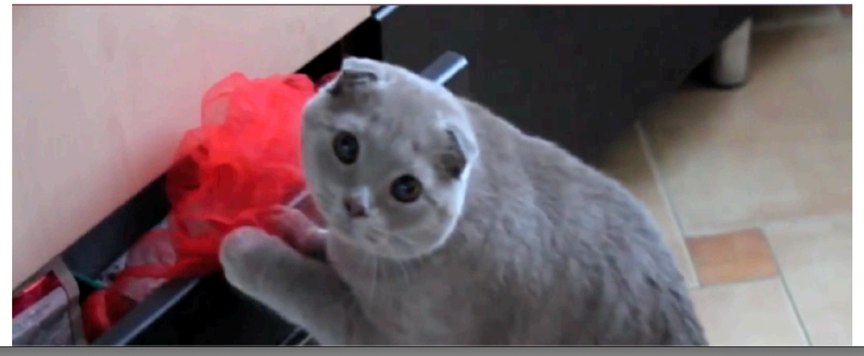
CatVideoFest

Bringing the joy of cat videos to the masses and raising money for cats in need.

CatVideoFest

- Where To Watch
- About
- Submit a Video
- Merchandise
- Contact
- Partners
- Get Updates
- Press Materials

CAT VIDEO FEST



End of interaction.

Outline

- Introduction
- Recent advances
- Available datasets
- **Challenges and ambitions**

Challenges and ambitions

- **Conversational topic shifting**
  - What to talk about next?
    - Different from web search, user inputs are conversational, support exploration, serendipity
  - No single correct answer
    - Different from machine reading comprehension, user inputs are not always questions with definitive answers.

New challenges for modeling as well as evaluation

Challenges and ambitions

- **Heterogeneous SERPs**
  - Dealing with multiple intents
  - Text vs. image/video vs. knowledge cards vs. …
  - Structured vs. unstructured
  - Static blogs/articles vs. live news/reports

  New challenges for knowledge locating (selecting and reasoning) across heterogeneous resources

Challenges and ambitions

- **Interpretable conversations**
  - Explainable for developers
    - Failure analysis
    - Identifying influential (online) training instances
    - Reasoning path on knowledge graph as explanations (Moon et al., ACL 2019, Liu et al., arXiv 2019)
  - Explainable for users
    - Response/answer explanation

      Human: which is your favorite character in this ?
      Bot: my favorite character was obviously the main character because through his perseverance he was able to escape a dangerous situation .

Wrap-up

- SERP-grounded conversations
- General idea, recent advances, challenges and ambitions
- **Work in progress**

References

- Belkin Anomalous states of knowledge as a basis for information retrieval. Canadian J. Information Science, 1980
- Dinan et al. Wizard of Wikipedia: Knowledge-Powered Conversational agents. ICLR 2019
- Ghazvininejad et al. A Knowledge-Grounded Neural Conversation Model. AAAI 2018
- Kiseleva and de Rijke. Evaluating Personal Assistants on Mobile Devices. CAIR 2017
- Li et al. Incremental Transformer with Deliberation Decoder for Document Grounded Conversations. ACL 2019
- Lian et al. Learning to Select Knowledge for Response Generation in Dialog Systems. arXiv 2019
- Liu et al. Knowledge Aware Conversation Generation with Explainable Reasoning on Augmented Graphs. arXiv 2019
- Meng et al. RefNet: A Reference-aware Network for Background Based Conversation. arXiv 2019
- Moghe et al. Towards Exploiting Background Knowledge for Building Conversation Systems. EMNLP 2018
- Moon et al. OpenDialKG: Explainable Conversational Reasoning with Attention-based Walks over Knowledge Graphs. ACL 2019
- Qin et al. Conversing by Reading: Contentful Neural Conversation with On-demand Machine Reading. ACL 2019
- Radlinski and Craswell. A Theoretical Framework for Conversational Search. CHIIR 2017
- See et al. Get To The Point: Summarization with Pointer-Generator Networks. ACL 2017
- Seo et al. Bidirectional Attention Flow for Machine Comprehension. ICLR 2017
- Serban et al. Building End-To-End Dialogue Systems Using Generative Hierarchical Neural Network Models. AAAI 2016
- Serban et al. A Hierarchical Latent Variable Encoder-Decoder Model for Generating Dialogues. AAAI 2017
- Vakulenko et al. Conversational Exploratory Search via Interactive Storytelling. SCAI 2017
- Vakulenko et al. Measuring Semantic Coherence of a Conversation. ISWC 2018
- Vakulenko et al. Conversational Browsing: Dialog-based Access to Structured Information Sources. *Under review*, 2019
- Zhang et al. Personalizing Dialogue Agents: I have a dog, do you have pets too? ACL 2018
- Zhang et al. Improving Background Based Conversation with Context-aware Knowledge Pre-selection. SCAI 2019.
- Zhou et al. Commonsense Knowledge Aware Conversation Generation with Graph Attention. IJCAI 2018
- Zhou et al. A Dataset for Document Grounded Conversations. EMNLP 2018