Conversational Question Answering on Heterogeneous Sources

**Philipp Christmann, Rishiraj Saha Roy, Gerhard Weikum**
Conversational Question Answering

Who played Jaime Lannister in Game of Thrones?
Nikolaj Coster-Waldau

What about the dwarf?
Peter Dinklage

When was he born?
11 June 1969

Release date of first season?
17 April 2012

Duration of an episode?
50-82 minutes

⇒ Information left *implicit*
⇒ Must be derived from *conversational context*
Conversational Question Answering

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⇒ Heterogeneous information sources for broader coverage
⇒ Leverage redundancy of information sources
Pipeline Overview

Question Understanding (QU)

Evidence Retrieval and Scoring (ERS)

Heterogeneous Answering (HA)

Current Question

Conversation History

Intent-explicit Representation

Top-e Evidences

Who played Jaime Lannister in Game of Thrones?

Nikolaj Coster-Waldau

Release date of first season?
Desiderata and Contributions

Leverage **heterogeneous** information sources for conversational QA
★ General 3-staged pipeline for this task

**No restriction to specific information source**
★ **CONVINSE**: Intent-explicit **structured representation** of questions

Make process **explainable**
★ **Intermediate** representations in **symbolic** space

Avoid expensive annotations
★ **Distant supervision** from **raw** sequences of **QA-pairs**
Structured Representation (SR)

⇒ Capture information need in a **structured** way, based solely on the conversation
⇒ Relaxed **categorization** into

\[
\langle \text{context} \mid \text{entity} \mid \text{relation} \mid \text{answer type} \rangle
\]

⇒ **Context** makes the entity more **explicit**
=> **Context** not always required
=> **Relaxed** notion of a relation
Structured Representation Module

⇒ Sequence generation task

Conversational history

Current question

Nikolaj Coster-Waldau

Who played Jaime Lannister in Game of Thrones?

Release date of first season?

Fine-tuned BART [Lewis et al. ACL 2020]
for conditional sequence generation

⟨__ | Game of Thrones | release date of first season | date⟩

Structured representation
Conversational Flow Graph (CFG)

Who played Jaime Lannister in Game of Thrones?
- Nikolaj Coster-Waldau

What about the dwarf?
- Peter Dinklage

How old is he?
- 51

⇒ Adds explainability to developers and end users
System Overview

- Question Understanding (QU)
- Structured Representation (SR)
- Evidence Retrieval and Scoring (ERS)
- Heterogeneous Answering (HA)

Current Question:
- Who played Jaime Lannister in Game of Thrones?
- Release date of first season?

Conversation History:
- Nikolaj Coster-Waldau

Question:
- Who played Jaime Lannister in Game of Thrones?
- Release date of first season?

Structured Representation (SR):

Evidence Retrieval and Scoring (ERS):

Top-\(e\) Evidences:

Heterogeneous Answering (HA):

Answer:

- Game of Thrones
- release date of first season
- date

( _, Game of Thrones, release date of first season, date )
Evidence Retrieval

Structured representation

CLOCQ [Christmann et al. WSDM 2022]

KB-facts

Text-snippets

Table-records

Infobox-entries

Entity-centric Wikipedia retrieval

Question entities

Game of Thrones

A song of ice and fire

KB-facts

Game of Thrones

release date of first season

date

⟨ _ | Game of Thrones | release date of first season | date ⟩
Game of Thrones is an American fantasy drama television series created by David Benioff and D. B. Weiss for HBO.
Evidence Retrieval and Scoring

Verbalized/processed form

Game of Thrones, instance of, television series

Game of Thrones, Game of Thrones is an American fantasy drama television series created by David Benioff and D. B. Weiss for HBO.

Game of Thrones, Season is Season 1, Ordered is March 2, 2010, Filming is Second half of 2010...

Game of Thrones, Genre, Fantasy, Serial drama, Tragedy

BM25 scoring

⇒ Bag-of-words retrieval
⇒ Query: Structured representation
⇒ Documents: Evidences
Evidence Retrieval and Scoring

CLOCQ
[Christmann et al. WSDM 2022]

Question entities
Entity-centric Wikipedia retrieval

KB-facts
Text-snippets
Table-records
Infobox-entries

Evidences
BM25 scoring

Top-e Evidences

⟨ _ | Game of Thrones | release date of first season | date ⟩

Game of Thrones
A song of ice and fire
System Overview

Question Understanding (QU)

Structured Representation (SR)

Evidence Retrieval and Scoring (ERS)

Heterogeneous Answering (HA)

Answer

Who played Jaime Lannister in Game of Thrones? Nikolaj Coster-Waldau

Release date of first season?

( _, Game of Thrones, release date of first season, date )
Heterogeneous Answering

**Fusion-in-Decoder** [Izacard et al. EACL 2021]

★ **Generative answering:** seq2seq model that encodes evidence-SR pairs

★ Decodes *autoregressively* to generate answer

★ We normalize to KB for comparability

Structured representation

( _, Game of Thrones | release date of first season | date )

17 April 2011
System Overview

1. **Conversation History**
2. **Current Question**
   - Who played Jaime Lannister in Game of Thrones?
   - Nikolaj Coster-Waldau
3. **Question Understanding (QU)**
4. **Structured Representation (SR)**
   - \( \langle _\_ | \text{Game of Thrones} | \text{release date of first season} | \text{date} \rangle \)
5. **Evidence Retrieval and Scoring (ERS)**
6. **Top-\(e\) Evidences**
7. **Heterogeneous Answering (HA)**
8. **Answer**
   - 17 April 2011
Distant Supervision

Only **raw** sequence of **QA-pairs** given
⇒ But **SRs required!**

**Idea:**
⇒ Augment follow-up with parts from history
⇒ **Check whether** this makes the information need **complete**
Distant Supervision

Only raw sequence of QA-pairs given
⇒ But SRs required!

Idea:
⇒ Augment follow-up with parts from history
⇒ Check whether this makes the information need complete
Distant Supervision

⇒ Detect **expansions** that trigger **new answering evidences**
⇒ **Merge** such expansions to get ‘gold’ **structured representation**

Using our **entity-centric retrieval**, we understand ‘**why**’ evidences are retrieved
⇒ For which entity (all evidences), for which KB-item (KB-facts)
⇒ Allows for **structuring** the target **SR**
ConvMix

First dataset for conversational QA over heterogeneous sources

⇒ 3,000 conversations
⇒ 16,000 questions
⇒ 5 domains: Books, Movies, Music, TV series, Soccer

Collected data:
★ Completed (intent-explicit) forms
★ Paraphrases
★ Question entities
★ Answers (free-text and normalized)
★ Answer source
ConvMix

Heterogeneity

★ Let users **detect answers** to their questions naturally

★ **Collect information source** they found the answer in
  ⇒ Wikidata; Wikipedia Text, Table, or Infobox

★ Only ensure that users cover **each information source at least once** per task (5 conversations)
Experimental Setup

**Baselines:** Question Understanding

☆ Prepend *initial* turn
☆ Prepend *last* turn
☆ Prepend *initial* and *last* turn
☆ Prepend *all* previous turns

☆ **Question Resolution** – Add relevant terms from history to query  [Voskarides et al. SIGIR 2020]
☆ **Question Rewriting** – Rewrite to full-fledged grammatical question  [Raposo et al. ECIR 2022]

⇒ **ERS** and **HA** kept static across baselines (adapting baselines to task)
Results – Precision at 1

CONVINSE outperforms baselines significantly

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Results – Precision at 1

Heuristic baselines perform quite solid

- Prepend init
- Prepend prev
- Prepend init+prev
- Prepend all
- Question Resolution
- Question Rewriting
- CONVINSE

P@1

- 0.254
- 0.257
- 0.312
- 0.300
- 0.282
- 0.271
- 0.342*
Results – Per Information Source(s)

Adding additional input sources always helps

<table>
<thead>
<tr>
<th>Information Source</th>
<th>P@1</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB</td>
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<tr>
<td>ALL</td>
<td>0.342</td>
</tr>
</tbody>
</table>

P@1
Anecdotal Example

Intent-explicit forms

⭐ Question Resolution  What actor portrayed Magneto? x-men movie
⭐ Question Rewriting  Which actor played the character Magneto in the X-Men movie?
★ CONVINSE  
{ X-Men | Magneto | actor portrayed | human }
**Conclusion**

**CONVINSE:** First method for ConvQA over heterogeneous sources
- Propose a general 3-staged pipeline for this task
- Intent-explicit **structured representation** of questions
- Distant supervision from raw sequences of QA-pairs
- Intermediate representations can add **explainability**

**ConvMix:** First ConvQA benchmark for heterogeneous sources
- 3,000 conversations
- 16,000 questions

**Code&Data:** convinse.mpi-inf.mpg.de

Thank you!