Towards World-Level Understanding for Conversational Agents

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Conversational Agents – Many Possible Uses!

**Corollary:** probably little data for your particular domain and application!
Robust and Useful Conversational Agents

Robust – Should not require much additional engineering for every word, entity, domain, genre, task

Useful – Should understand and correctly process:
• Events, entities, relations
• Beliefs, intentions, desires
• Sentiment, emotions, attitudes

Do our current neural network models satisfy these desiderata?
Case Study: Predicting Dialogue Success

We created a dataset from stackoverflow.com for predicting success in goal-driven human-human dialogues.

User A: I accidentally closed the Stack Trace window in the Visual Studio 2008 debugger. How do I redisplay this window?

User B: While debugging: Debug\Windows\Call stack

User A: Thanks, I don’t know how I overlooked it.

Noseworthy, Cheung, Pineau, SIGDIAL 2017
What Do Current Methods Capture?

Long Short-Term Memory Networks (Hochreiter and Schmidhuber, 1997) and variants, trained in a standard supervised setup:

- Suggests LSTM model is mostly capturing discourse cues
- Task-specific supervised learning focuses on useful cues for this task only!
- Much harder: understanding whether information need in question was satisfied

Noseworthy, Cheung, Pineau, SIGDIAL 2017

<table>
<thead>
<tr>
<th>Information Given</th>
<th>Success F1</th>
<th>Failure F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full conversation thread</td>
<td>89</td>
<td>73</td>
</tr>
<tr>
<td>Only the last comment</td>
<td>86</td>
<td>68</td>
</tr>
<tr>
<td>Without last comment</td>
<td>83</td>
<td>38</td>
</tr>
</tbody>
</table>
Incorporating World Knowledge

Incorporate additional sources of information outside of task-specific training

- Wikipedia pages, WordNet, specialized dictionaries, TV show descriptions, product descriptions

World knowledge can make our systems more robust to new entities, events, and tasks
Wikilinks Rare Entity Prediction

Wikilinks Corpus

- Dataset for coreference resolution (Singh et al., 2012)
- Web corpus where spans are annotated with links to Wikipedia pages
- We enhance this with definitions from Freebase/Wikipedia

William Blake, who lived from 1757 to 1827, was admired by a small group of intellectuals and artists in his day, but never gained general recognition as either a poet or painter. Yet today his poems and the extraordinary depictions of his visions are etched into the British psyche in a way that few others can match. Jerusalem stirs deep emotions, especially when sung, and poems

William Blake
From Wikipedia, the free encyclopedia

For other people named William Blake, see William Blake (disambiguation).

William Blake (28 November 1757 – 12 August 1827) was an English poet, painter, and printmaker. Largely unrecognised during his lifetime, Blake is now considered a seminal figure in the history of the poetry and visual arts of the Romantic Age. His so-called prophetic works were said by 20th century critic Northrop Frye to form "what is in proportion to its merits the least read body of poetry in the

Long, Bengio, Lowe, Cheung, Precup, EMNLP 2017
Plausibility Cloze Task

- Predict which entity from a document fits into a blank, given entity definitions

**Context**

[... ] _____, who lived from 1757 to 1827, was
admired by a small group of intellectuals and
artists in his day, but never gained general recog-
nition as either a poet or painter. [...] 

**Candidate Entities**

**Peter Ackroyd:** Peter Ackroyd is an English biog-
graher, novelist and critic with a particular inter-
est in the history and culture of London. [...] 

**William Blake:** William Blake was an English
poet, painter, and printmaker. [...] 

**Emanuel Swedenborg:** Emanuel Swedenborg
was a Swedish scientist, philosopher, theologian,
revelator, and mystic. [...] 

Drawn from the same original document
A Double Encoder Model (DoubEnc)

- LSTM networks to encode the context and the definition, then combine the information from both

\[ P(e = \tilde{e} | C_i, L_e) = \sigma((h_i^e)^T W d_e + b) \]

- Further model that exploits long-range dependencies between choices with a hierarchical model (HierEnc)
Rare Entity Prediction Results

- Random: 30.1
- ContEnc: 39.6
- DoubEnc: 54.0
- HierEnc: 56.6

Randomly predict an entity
Standard LSTM language model
Double encoder model
Hierarchical encoder model
Rare and Unseen Entities

Correct Answer: Larnaca

Dataset frequencies:
Istanbul (86); Larnaca (2, 0 in training)

Context & Prediction

[...] We heard from Audrey Bone, who is with the Free Gaza movement. She was in _____, Cyprus. [...]

**ContEnc:** Istanbul  
**HierEnc:** Larnaca

Candidate Set

**Istanbul:** Istanbul is the most populous city in Turkey, and the country’s economic, cultural, and historical center.

**Larnaca:** Larnaca is a city on the southern coast of Cyprus and the capital of eponymous district.

**Ben Macintyre:** Ben Macintyre is a British author, historian, reviewer and columnist writing for The Times newspaper.

*(Other candidate entities......)*
Expectations for the Future

Moving beyond end-to-end training for a single task!
Modularized and reusable components

Current work:

• External information about entities and events
• Common sense reasoning
• Reusable components for language generation (grammaticality, content selection, style transfer)
Thank You!

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Jackie Chi Kit Cheung

Reasoning and Learning Lab @ McGill
References


• Michael Noseworthy, Jackie CK Cheung, and Joelle Pineau. 2017. Predicting Success in Goal-Driven Human-Human Dialogues. *SIGDIAL.*