Neural Response Ranking for Social Conversation: A Data-Efficient Approach

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Outline

- Introduction. Amazon Alexa Prize
- Alana, HWU's Alexa Prize socialbot
- Training signals in conversational data
- Alana's neural response ranker
- Data efficiency aspect of the response ranker
- Results and discussion
Amazon Alexa Prize

- **Goal**: long, coherent, and engaging conversations with the socialbot
- **Grand prize** ($1,000,000) - for a 20 minute-long engaging conversation
- **2017**: >100 applications → 12 teams competing → HWU took 3rd place
- **2018**: >200 applications → 8 teams competing → **Finals Nov 2018!**
Alana, An Ensemble Dialogue Model with Ranking

Alana: Hi, [...] What would you like to talk about?  
User: Music  
Alana: Great! Who is your favorite singer?  
User: Bob Dylan  
Alana: Bob Dylan is an American songwriter, singer, painter, and writer. What are your opinions on Bob Dylan?  
User: When was he born?  
Alana: Bob Dylan was born on Saturday May 24th 1941.  
User: I love him!  
Alana: Great! What else do you like?  
User: Cooking  
Alana: I heard that every day, Americans eat an estimated 18 acres of pizza.

Rating: 2, Length: 11
# Training Signals in Conversational Data

Signals correlation study (Pearson coefficient)

<table>
<thead>
<tr>
<th></th>
<th>User feedback (positive)</th>
<th>User feedback (negative)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rating</strong></td>
<td>0.11</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td><strong>0.67</strong></td>
<td><strong>0.49</strong></td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rating</strong></td>
<td>0.11</td>
<td></td>
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</tbody>
</table>
GRU with word_bot and NE features encodes context utterances (3 previous user+system turns) and response candidates.

**Target score** is a point-wise prediction for a `<context, response_candidate>` pair.

**Predictor MLP** augments the representation with additional dialogue features and outputs the target value.
Hi, [...] What would you like to talk about?
User: Music
Alana: [Persona] Great! Who is your favorite singer?
User: Bob Dylan
Alana: [Evi + driver] Bob Dylan is an American songwriter, singer, painter, and writer. What are your opinions on Bob Dylan?
User: When was he born?
Alana: [Evi + anaphora resolution] Bob Dylan was born on Saturday May 24th 1941.
User: I love him!
Alana: [Persona] Great! What else do you like?
User: Cooking
Alana: [Facts] I heard that every day, Americans eat an estimated 18 acres of pizza.

Rating: 2, Length: 11
Alana: Hi, [...] What would you like to talk about?
User: Music
Alana: [Persona] Great! Who is your favorite singer?
User: Bob Dylan

Alana: [Evi + driver] Bob Dylan is an American songwriter, singer, painter, and writer. What are your opinions on Bob Dylan?

User: You're so smart! When was he born?

Alana: [Coherence] So, talking about movies, What famous actor or actress would you like to meet? I would love to meet Will Smith. He's just so funny!
# Interim Results

<table>
<thead>
<tr>
<th>Ranker</th>
<th>Precision@1</th>
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</thead>
<tbody>
<tr>
<td>Handcrafted</td>
<td>0.478</td>
</tr>
<tr>
<td>Linear@length(^1)</td>
<td>0.742</td>
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<tr>
<td>Linear@rating(^1)</td>
<td>0.773</td>
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<tr>
<td>DualEncoder@length(^2)</td>
<td>0.365</td>
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<td>DualEncoder@rating(^2)</td>
<td>0.584</td>
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<tr>
<td>Neural@length</td>
<td>0.824</td>
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<tr>
<td>Neural@rating</td>
<td><strong>0.847</strong></td>
</tr>
</tbody>
</table>

## Training stage
Trainset size: 500,000 turns (for each target)

## Evaluation stage
Eval set: ~24,000 tuples of the form 
<context, gold answer, fake answer, target>
Gold answers - those followed by explicit positive user feedback (prev. slide)

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[1] VowpalWabbit library
Results on Extended Datasets
Discussion

- User ratings are very sparse and noisy, and expensive to obtain
- Length can be a proxy for user engagement
- A deep learning-based response ranker introduced
  - Ranking performance is superior to both handcrafted baseline and a perceptron-based (VowpalWabbit)
    - Training from two supervision signals explored
- Given a large amount conversational data, user ratings collection can be avoided if optimizing for user engagement
Thank you!

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🔗 bit.ly/alana_learning_to_rank

🐦 @alanathebot
References

2. Lu et al. A practical approach to dialogue response generation in closed domains, 2017