NLP
Deep Learning

Neural Generation
Neural Generation

- Very recent work (e.g., EMNLP 2015)

Semantically Conditioned LSTM-based Natural Language Generation for Spoken Dialogue Systems

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3.1 Semantic Controlled LSTM cell

Figure 1: Semantic Controlled LSTM cell proposed in this paper. The upper part is a traditional LSTM cell in charge of surface realisation, while the lower part is a sentence planning cell based on a sigmoid control gate and a dialogue act (DA).

[Wen et al. 2015]
Table 5: Samples of top 5 realisations from the deep SC-LSTM (+deep) system output.

<table>
<thead>
<tr>
<th>#</th>
<th>Example Dialogue Acts and Realizations from SF Restaurant Domain</th>
</tr>
</thead>
</table>
| 1 | inform(name="red door cafe", goodform="breakfast", area="cathedral hill", kidsallowed="no")
red door cafe is a good restaurant for breakfast in the area of cathedral hill and does not allow children.
red door cafe is a good restaurant for breakfast in the cathedral hill area and does not allow children.
red door cafe is a good restaurant for breakfast in the cathedral hill area and does not allow kids.
red door cafe is good for breakfast and is in the area of cathedral hill and does not allow children.
red door cafe does not allow kids and is in the cathedral hill area and is good for breakfast. |
| 2 | informonly(name="dosa on fillmore and kiss seafood", pricerange="expensive", near="lower pacific heights")
there is no place other than dosa on fillmore and kiss seafood that are expensive near to lower pacific heights.
dosa on fillmore and kiss seafood is the only expensive restaurant near lower pacific heights.
the only listed restaurant near lower pacific heights in the expensive price range is dosa on fillmore and kiss seafood.
i apologize, dosa on fillmore and kiss seafood is the only expensive restaurant near lower pacific heights.
i apologize, dosa on fillmore and kiss seafood are the only expensive restaurants near lower pacific heights. |

<table>
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<tr>
<th>#</th>
<th>Example Dialogue Acts and Realizations from SF Hotel Domain</th>
</tr>
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</table>
| 3 | inform(type="hotel", count="182", dogsallowed="don't care")
there are 182 hotels if you do not care whether dogs are allowed.
there are 182 hotels if you do not care whether they allow dogs.
182 hotels are available if dogs allowed or not is not an issue.
there are 182 hotels if allowing dogs or not is not an issue.
there are 182 hotels if whether dogs are allowed does not matter. |
| 4 | informonly(name="red victorian bed breakfast", acceptcreditcards="yes", near="haight", hasinternet="yes")
red victorian bed breakfast is the only hotel near haight and accepts credit cards and has internet.
red victorian bed breakfast is the only hotel near haight and has internet and accepts credit cards.
red victorian bed breakfast is the only hotel near haight that accept credit cards and offers internet.
the red victorian bed breakfast has internet and near haight, it does accept credit cards.
the red victorian bed breakfast is the only hotel near haight that accepts credit cards, and offers internet. |

[Wen et al. 2015]
Table 1: Ontologies used in the experiments.

<table>
<thead>
<tr>
<th></th>
<th>SF Restaurant</th>
<th>SF Hotel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>act</strong> type</td>
<td>inform, inform_only, reject, confirm, select, request, reqmore, goodbye</td>
<td></td>
</tr>
<tr>
<td><strong>shared</strong></td>
<td>name, type, *pricerange, price, phone, address, postcode, *area, *near</td>
<td></td>
</tr>
<tr>
<td><strong>specific</strong></td>
<td>*food</td>
<td>*hasinternet</td>
</tr>
<tr>
<td></td>
<td>*goodformeal</td>
<td>*acceptscards</td>
</tr>
<tr>
<td></td>
<td>*kids-allowed</td>
<td>*dogs-allowed</td>
</tr>
</tbody>
</table>

**bold**=binary slots, **=slots can take “don’t care” value

[Wen et al. 2015]
Figure 2: The Deep LSTM generator structure by stacking multiple LSTM layers on top of the DA cell. The skip connection was adopted to mitigate the vanishing gradient, while the dropout was applied on dashed connections to prevent co-adaptation and overfitting.

[Wen et al. 2015]
(a) An example realisation from SF restaurant domain

(b) An example realisation from SF hotel domain

[Wen et al. 2015]
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