QDMR Parsing

- NL question → QDMR

$x : \text{What keywords have appeared in more than 100 ACL papers?}$

$S : \ 1. \text{return papers} \\
   2. \text{return \#1 in ACL} \\
   3. \text{return keywords of \#2} \\
   4. \text{return number of \#2 for each \#3} \\
   5. \text{return \#3 where \#4 is more than 100}$

Each step is a single logical operation

Words are either:
1. question words
2. function words
3. variables

$G_S :$

1. select “papers”
2. filter “\#1 in ACL”
3. project “keywords of \#2”
4. group “number of \#2 for each \#3”
5. comparative “\#3 where \#4 is more than 100”
Break Dataset

• Over 60,000 question + QDMR pairs
  • Questions over text, images and databases
  • Taken from 10 different QA datasets
• Will release data
Build a QDMR Parser

• Challenge - beat Break!
• Best model only 20% EM
• Compare with similar challenges:
  • Semantic parsing to SQL – 61.9% EM
  • Dependency parsing – over 96%

<table>
<thead>
<tr>
<th>Data</th>
<th>Metric</th>
<th>COPY</th>
<th>RULEBASED</th>
<th>SEQ2SEQ</th>
<th>S2SDYNAMIC</th>
<th>COPYNET</th>
<th>COPYNET (test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QDMR</td>
<td>Exact Match</td>
<td>0.001</td>
<td>0.003</td>
<td>0.144</td>
<td>0.173</td>
<td>0.209</td>
<td>0.200</td>
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<tr>
<td></td>
<td>SARI ↑</td>
<td>0.429</td>
<td>0.532</td>
<td>0.719</td>
<td>0.747</td>
<td>0.767</td>
<td>0.759</td>
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<tr>
<td></td>
<td>GED ↓</td>
<td>0.930</td>
<td>0.739</td>
<td>0.362</td>
<td>0.319</td>
<td>0.312</td>
<td>0.318</td>
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<tr>
<td></td>
<td>GED+ ↓</td>
<td>1.783</td>
<td>1.628</td>
<td>1.151</td>
<td>0.991</td>
<td>0.903</td>
<td>0.976</td>
</tr>
</tbody>
</table>
Build a QDMR Parser

• **Neural models:**
  • *Seq2Seq* – sequence-to-sequence neural model with LSTM encoder + attention at decoding time
  • *Copynet* – Seq2Seq model with copy mechanism
    • Allows copying tokens from the input sequence
Build a QDMR Parser

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  • **Seq2Seq** – sequence-to-sequence neural model with LSTM encoder + attention at decoding time
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\[ x : \text{What keywords have appeared in more than 100 ACL papers?} \]
Build a QDMR Parser

• How to build a better QDMR parser?
• Plenty of different approaches:
  • **Semantic parsing – structured prediction**
    • QDMR grammar based decoding
Build a QDMR Parser

• How to build a better QDMR parser?
• Plenty of different approaches:
  • **Text editing – edit the NL question into QDMR**
    • Encode, Tag, Realize: High-Precision Text Editing (Malmi et al., EMNLP 2019)
    • DiscoFuse: A Large-Scale Dataset for Discourse-Based Sentence Fusion (Geva et al. NAACL 2019)

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Build a QDMR Parser

• How to build a better QDMR parser?

• Plenty of different approaches:
  • **Graph neural networks** – QDMR can be modeled as a graph
    • Generating Logical Forms from Graph Representations of Text and Entities (Shaw et al. ACL 2019)
    • Encoding Sentences with Graph Convolutional Networks for Semantic Role Labeling (Marcheggiani and Titov, EMNLP 2017)
Build a QDMR Parser

• How to build a better QDMR parser?
• Plenty of different approaches:
  • **Use neural language models - BERT**
Build a QDMR Parser

• What about **evaluating** QDMR parsing
  • Exact match, Graph edit distance

• Think about better ways to evaluate results:
  • Use QDMR structure - operators

What shape object is partially hidden by a ball?

<table>
<thead>
<tr>
<th>GOLD</th>
<th>PRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ball</td>
<td>1. object</td>
</tr>
<tr>
<td>2. object partially hidden by #1</td>
<td>2. #1 that is partially hidden by a ball</td>
</tr>
<tr>
<td>3. shape of #2</td>
<td>3. shape of #2</td>
</tr>
</tbody>
</table>
Good Luck!