Towards Intelligent Voice Assistants for SPNs

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Intelligent Voice Assistants

Consumer

- **General-purpose** queries
- Basic functionality for many tasks

Domain-Specific

- Understands **domain-specific** queries
- Deep functionality for complex tasks
- **Knows your data**: analyzes, summarizes, and explains
Voice-Enabled Dashboards and Query Engines

User

What is the average uplink utilization in the last 5 mins?

Dashboard

Conversational Agent

DB
Voice-Enabled Dashboards and Query Engines

User

```
What is the average uplink utilization in the last 5 mins?
```

Dashboard

Conversational Agent

Agent calls Google Cloud Speech API.

DB
Voice-Enabled Dashboards and Query Engines

User

Dashboard

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DB

What is the average uplink utilization in the last 5 mins?

Agent then performs Natural Language Understanding (NLU).

Intent: “Link Statistics”
Entities: {'Average', 'Uplink', 'last', 300.0}
Voice-Enabled Dashboards and Query Engines

User: What is the average uplink utilization in the last 5 mins?

Dashboard:

Conversational Agent:
Agent writes appropriate query and calls DB.

SELECT AVG(utilization) FROM Link_Statistics WHERE time_adverb = 'last' AND to_time = 300 AND direction = 'uplink'
Voice-Enabled Dashboards and Query Engines

User

Dashboard

Conversational Agent

DB

Updates the results on the Dashboard

DB executes the query.
Voice-Enabled Dashboards and Query Engines

User

Dashboard

Conversational Agent

DB

Show me the full buffers.

Google Dialogflow NLU

Intent: “Play Animation”
Entities: {time_range: ‘full buffers’}

Wrong answer!
Need to provide the agent knowledge of networking terminology!
Case Study: Words similar to “buffer”

- **GoogleNews Embeddings**
  - cushion: 0.546
  - vegetative: 0.500
  - zone: 0.517
  - landscaped: 0.489
  - windbreak: 0.444
  - firebreak: 0.425

- **Networking Embeddings**
  - drop: 0.849
  - gap: 0.823
  - overflow: 0.829
  - queue: 0.806
  - probing: 0.802
  - smooth: 0.789

Want domain-specific context
Case Study: Words similar to “queue”

<table>
<thead>
<tr>
<th>GoogleNews Embeddings</th>
<th>Networking Embeddings</th>
</tr>
</thead>
<tbody>
<tr>
<td>• snaking: 0.611</td>
<td>• buffer: 0.806</td>
</tr>
<tr>
<td>• orderly: 0.458</td>
<td>• busy: 0.795</td>
</tr>
<tr>
<td>• waiting: 0.451</td>
<td>• overflows: 0.791</td>
</tr>
<tr>
<td>• impatiently: 0.449</td>
<td>• round-robin: 0.772</td>
</tr>
<tr>
<td>• turnstile: 0.422</td>
<td>• FIFO: 0.746</td>
</tr>
<tr>
<td>• traffic-jam: 0.414</td>
<td>• output: 0.728</td>
</tr>
</tbody>
</table>

How do we get from general context to domain-specific context?
Networking Spoken Language Corpus

Need to use **Text Corpus + Spoken Language**

⇒ Use online lectures with transcripts

Used materials from the following courses:
- CS144, McKeown + Levis, Stanford
- 6.02, Balakrishnan + Verghese, MIT
- CS 8001, Feamster, Princeton
- Computer Networks, Wetherall
General and Domain-specific Vector Embeddings of Words

Networking Emb. Subspace (15 Dimensions)

GoogleNews Emb. Subspace (300 Dimensions)

- wireshark
- FIFO
- Buffer
- Bottleneck
- Switch
- Carpenter
- Pizza
Results – Intent Classification

Training Set: 282 Samples
Test Set: 45 Samples

Test Set composed of domain-specific queries

- “Can I see the links that are most congested?”
- “Which lines carry the most traffic?”
- “Where are the queueing delays high?”
Future Work

• Going beyond Q/A
  • Intelligent summarization

• Proactive analysis of data using ML
  • Determine and surface anomalies
  • Troubleshooting and resolution