I Can Parse You: Grammars for Dialogs

Martin Hirzel, Louis Mandel, Avraham Shinnar, Jérôme Siméon, Mandana Vaziri
IBM Research, Yorktown Heights, NY, USA

9 May 2017, SNAPL 2017 Conference
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Circular Bot, Hello!

Hello, Human! I am a chat-bot that talks about chat-bots. What can I do for you?
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Circular Bot, that’s great!

Can you just give my talk for me?

I am sorry, I don’t understand. Please rephrase.
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Circular Bot, what can you do?

I can:
• Answer common questions about chat bots
• Order pizza
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Circular Bot, what’s a chat bot?

We chat bots are computer programs that can have a natural-language dialog with a human. We’re also known as conversational agents.
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We have lots of use-cases, including question answering, controlling devices, customer service, and ordering pizzas.
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Chicken and mushrooms. What kind of crust?
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Chicken and mushrooms. What kind of crust?

I just told you, a small pizza with a thin crust.

Thin crust. What size?
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Toppings?

A small chicken and mushrooms pizza on a thin crust.

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Small size.

I am sorry, I don’t understand. Choices are individual-size, medium, or large. What size?
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I am sorry, I don’t understand. Choices are individual-size, medium, or large. What size?

Individual-size.

So that’s an individual-size chicken and mushrooms pizza on a thin crust, correct?
Chicken and mushrooms. What kind of crust?
I just told you, a small pizza with a thin crust.

Thin crust. What size?
Small size.

I am sorry, I don’t understand. Choices are individual-size, medium, or large. What size?
Individual-size.

So that’s an individual-size chicken and mushrooms pizza on a thin crust, correct?
Yes.

Would you like to add some blue cheese at no additional cost?
I like thin crust. What size?

Small size.

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Individual-size.

So that’s an individual-size chicken and mushrooms pizza on a thin crust, correct?

Yes.

Would you like to add some blue cheese at no additional cost?

No! I don’t like blue cheese.

Okay, adding blue cheese.
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Individual-size.

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Yes.

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No! I don’t like blue cheese.

Okay, adding blue cheese.

No, you idiot!

No insults please. I’m limited to my programming.
Circular bot, why do consumers want chat-bots?

Consumers who said “yes” to being contacted via a chat-bot gave the following reasons:

- Resolve problems more quickly: 53%
- No need for separate app: 45%
- Keep a record of the interaction: 36%

(Source: http://www.businessinsider.com/amazon-joins-the-chatbot-conversation-2016-12)
Why do service providers want chatbots?

Service providers use chatbots to:
- Increase customer satisfaction
- Reduce the need for live agents
- Be flexible about features

Why do consumers want chatbots?

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<table>
<thead>
<tr>
<th>Reason</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Resolve problems more quickly</td>
<td>53%</td>
</tr>
<tr>
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Circular bot, do chat bots really increase customer satisfaction?

I refuse to incriminate myself. How about you give a normal talk for a bit?

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Who creates chat bots?

- Low-code developer
- Subject matter expert
- Full stack developer
- Data scientist
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- Subject matter expert
- Full stack developer
- Data scientist

Typical chat bot architecture

- Automated Speech Recognition (ASR)
- Natural Language Understanding (NLU)
- Dialog Controller
- Natural Language Generation (NLG)
- Text to Speech (TTS)
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Programming languages for the dialog controller
Typical chat bot architecture

Finite automata, e.g.:

Programming languages for the dialog controller
Finite automata, e.g.:

```
start
-> not @size

@size
---
@size

not @size / print "What size?"; read input

help / print "Choices are individual-size, medium, or large."

not understood / print "I am sorry, I don’t understand."
```

Frames, e.g.:

<table>
<thead>
<tr>
<th>Slot</th>
<th>Input</th>
<th>Prompt</th>
<th>Help text</th>
</tr>
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<tr>
<td>$size</td>
<td>@size = enum { individual size, medium, large }</td>
<td>What size?</td>
<td>Choices are individual-size, medium, or large.</td>
</tr>
<tr>
<td>$crust</td>
<td>@crust = enum { thin / New York style, thick / Chicago style }</td>
<td>What crust?</td>
<td>Choices are thin or thick.</td>
</tr>
<tr>
<td>$toppings</td>
<td>Need a sub-dialog for collecting list here ...</td>
<td>What toppings?</td>
<td>You can pick zero or more of ...</td>
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Chat bots should be coherent.

Work towards a goal, e.g.:

- Question answering
- Command-and-control
- Form filling
- Diagnosis, problem resolution
- Query formulation

Goal-driven patterns, see paper
Chat bots should be coherent.

Work towards a goal, e.g.:
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Chat bots should be flexible.

Handle deviations from the goal, e.g.:
- Anaphora and ellipsis
- Repair
- Disambiguation
- Elaboration
- Stopping a discussion
- Digression, interleaved dialog

$\texttt{crust}$

\begin{verbatim}
@crust = enum {thin / New York style, thick / Chicago style}
\end{verbatim}

What crust?
Choices are thin or thick.

$\texttt{toppings}$

\begin{verbatim}
Need a sub-dialog for collecting list here ...
\end{verbatim}

What toppings?
You can pick zero or more of …
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Coherence-flexibility dilemma

Techniques that improve coherence reduce flexibility and vice versa.
Idea: grammars as DSL for chat bots

Specify linear sequence of interactions, concise, flexible, with error correction.

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Add-on patterns, see paper.

Goal-driven patterns, see paper.

Goal-driven patterns:
• Form filling
• Diagnosis, problem resolution
• Query formulation

Add-on patterns:
• Command-and-control

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Chat-bot / parser analogy
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Chat-bot / parser analogy

Grammar example

\[
\text{pizza ::= topping}^* \crust \text{ size} \\
\text{topping ::= ‘chicken’| ‘mushrooms’| ‘blue cheese’} \\
\text{crust ::= ‘thin’/‘New York style’} \\
| ‘thick’/‘Chicago style’ \\
\text{size ::= ‘individual-size’| ‘medium’| ‘large’}
\]
Grammar example

```plaintext
pizza ::= topping* crust size
topping ::= ‘chicken’|‘mushrooms’|‘blue cheese’
crust ::= ‘thin’/‘New York style’
       |‘thick’/‘Chicago style’
size ::= ‘individual-size’|‘medium’|‘large’
```

Broader issues with Cognitive Systems

- Safety and trust
- Modularity and reuse
- Lifecycle management
- Boot-strapping
Thank you all for your attention, and thank you Circular Bot for your help!

Your blue-cheese pizza is ready now.

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Grammar example

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Just kidding.