Constrained Language Models Yield Few-Shot Semantic Parsers

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Semantic parsing

What time am I getting coffee with Megan? → Model → `findEvent( subject="coffee", attendees=includes( findPerson(name="Megan") ) ).start.time`

Utterance — Meaning representation

Goal: low-resource semantic parsing

Training data

"What time am I getting coffee with Megan?" → `findEvent( subject="coffee", attendees=includes( findPerson(name="Megan") ) ).start.time`

"Who's coming to the weekly standup?" → `findEvent( subject="weekly standup" ).attendees`

...

× ~~10^5–10^6~~ (tens of thousands)

× 10^2–10^3 (hundreds)

Motivation: prototyping domains, developing new features

Pre-trained language models

BART GPT-3

🏆 State-of-the-art performance on many tasks

What time am I getting coffee with Megan? → `findEvent( subject="coffee", attendees=includes( findPerson(name="Megan") ) ).start.time`

Utterance — Meaning representation

What is the best way to leverage pre-trained language models for low-resource semantic parsing?

Pitfalls:
1. Pre-trained on language, rather than on meaning representations (code)
2. LMs don't know what functionality is available in the domain

Approach

Learn to **map to canonical utterances**

"What time am I getting coffee with Megan?" (Utterance) → "What is the start time of the event titled "coffee" with attendee "Megan"?" (Canonical utterance) ↔ `findEvent( subject="coffee", attendees=includes( findPerson(name="Megan") ) ).start.time` (Meaning representation)

Deterministic mapping ↔ SCFG

Paraphrasing into a controlled sublanguage

SCFG:

S → What is the start time of **E**?	↔ **E**.start.time
E → the event **P***	↔ findEvent(**P***)
P → titled "**T**"	↔ subject="**T**"
P → with attendee "**N**"	↔ attendees=includes(findPerson(name="**N**"))

Dynamically select relevant examples for GPT-3 prompt

u_1 … u_n — *training examples*; u — *test utterance*

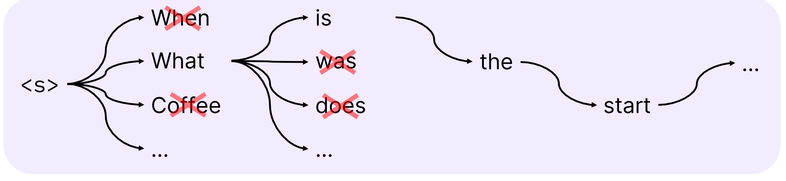
Find the top 20 examples by: $P_{\text{GPT-3}}(u \mid u_i)$

Prompt-based learning: $P_{\text{GPT-3}}(\ldots \mid$

```
Input: What time am I getting coffee with Megan?
Output: What is the start time of the event titled "Coffee" with attendee "Megan"?
Input: Who's coming to the weekly standup?
Output: Who is attending the event titled "weekly standup"?
...
Input: Who will join the event with Damon?
Output:
```

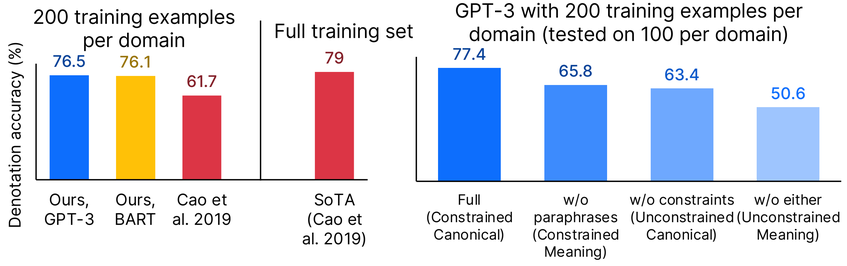
Top 20 training examples / *Test utterance* $)$

Constrained decoding to predict canonical utterance covered by SCFG

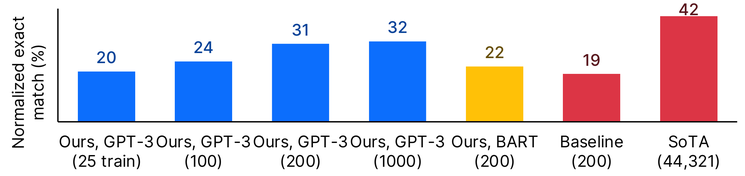


Case studies

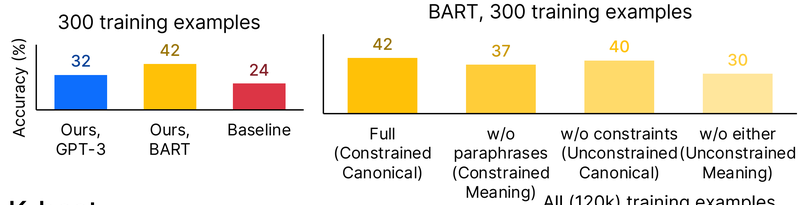
Overnight: semantic parsing, contains 8 different domains



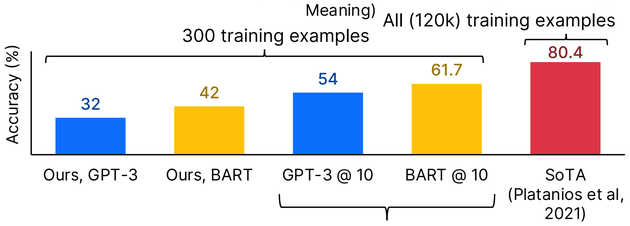
Break: question understanding, aggregates 10 benchmarks



SMCalFlow: task-oriented dialogue dataset



K-best lists for data collection



Annotators can find the correct output among 10 choices more than half the time