Intent Features for Rich Natural Language Understanding

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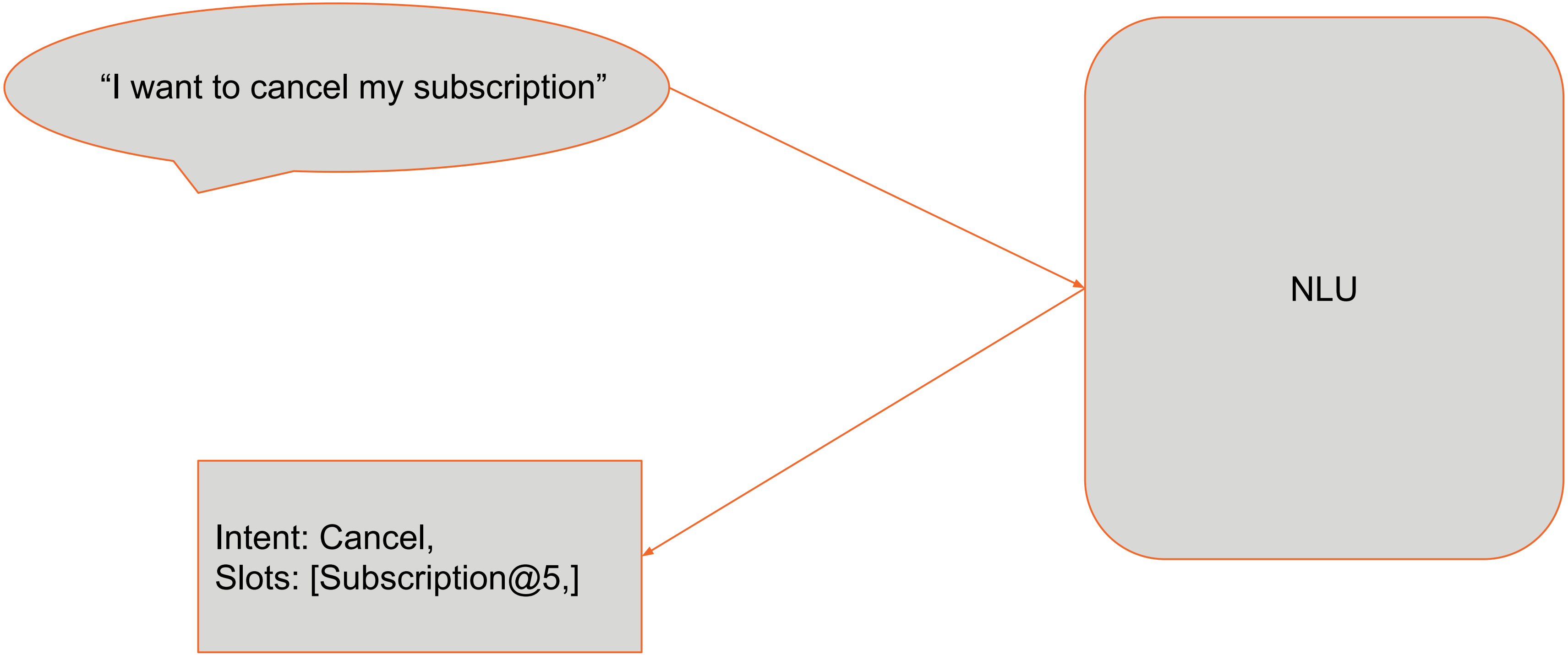
NAACL 2021 Industry Track

Natural Language Understanding (NLU) in Dialogue Systems



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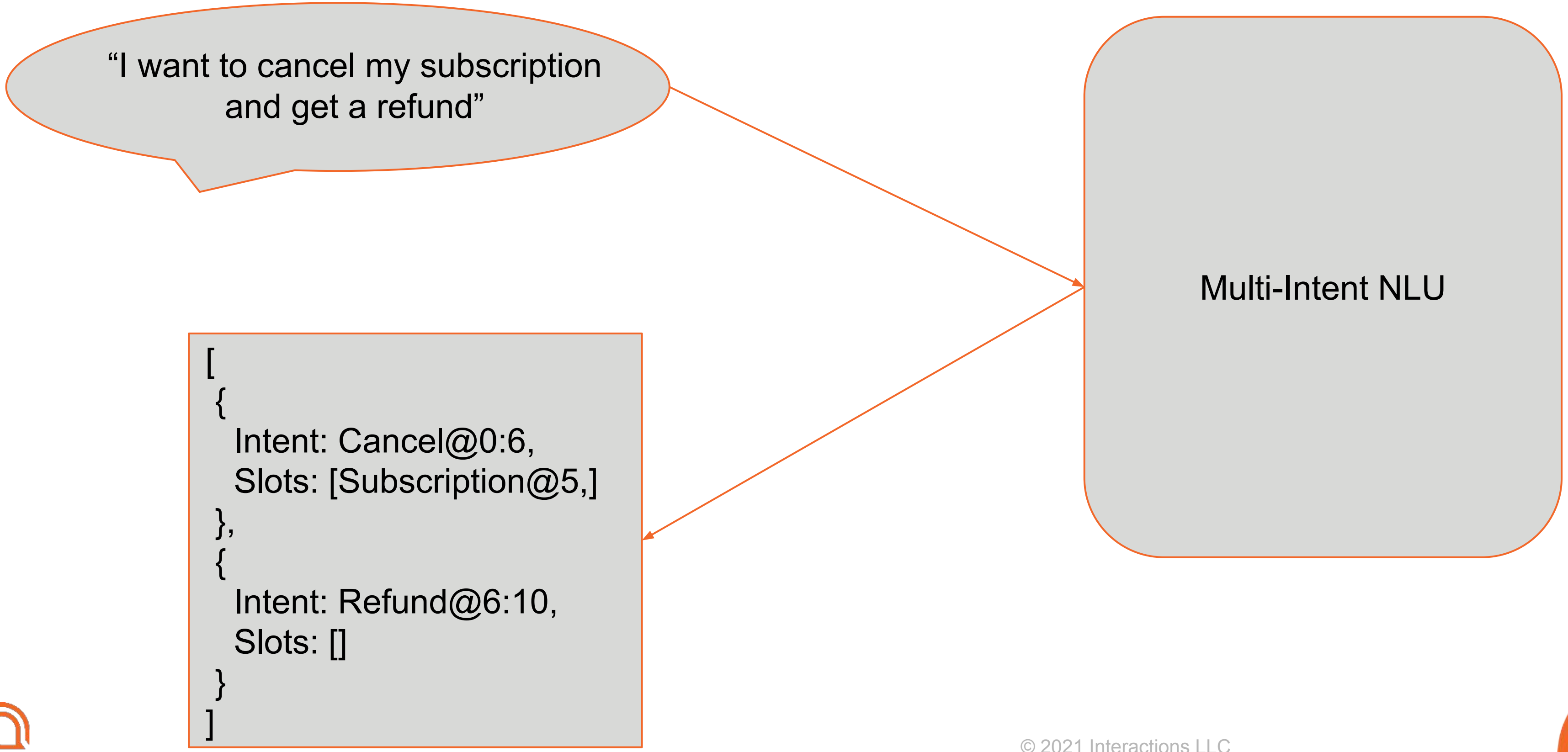
Multi-Intent NLU in Dialogue Systems



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Similar, but Distinct, Situations

“I want to cancel my subscription”

“I am thinking about canceling my subscription”

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Possible Solution

One possible solution is splitting the intent space, creating different intents.

- `cancel`
- `think-cancel`

This has several problems

- Explosion of the intent space.
  - Hard to think about as dialogue designers
  - Hard to remember all while labeling
- Data Sparsity
  - Some versions of intents are much more rare
- Loss of compositionality
  - These are now different classes, you don't get to apply what you know about `cancel` to `think-cancel`

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Intent Features

Lets factor these differences out into another, general label:

- “I am thinking about canceling my subscription” -> `cancel`, `modal-poss`
- “I want to cancel my subscription” -> `cancel`, `other`

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Intent Features

- Communicative Functions
- Attribution
- Negation
- Tense
- Modality

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Communicative Features

- `inform`
- `issue`
- `request-action`
- `request-confirm`
- `request-info`

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`inform`

“I am installing the program but it keeps saying I have an error”

“I am installing the program” -> `install`, `inform`

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`issue`

“I am installing the program but it keeps saying I have an error”

“it keeps saying I have an error” -> `general`, `issue`

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```
request-action
```

"I would like to install the program"

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`request-confirm`

“Is the program installed”

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`request-info`

“How do I install the program?”

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Attribution

- `attr-cf`
  - `self`
  - `other`
- `attr-ev`
  - `self`
  - `other`

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Attribution CF

Who is the primary source of information about the event

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Attribution Ev

Who is the cause of the action in the event.

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Attribution Example

Utterance	Attribution CF	Attribution Ev
I have paid $70.00	self	self
I got an email confirming I paid $70.00	other	self
I was charged $70.00	self	other
I got an email confirming I was charged $70.00	other	other

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Negation

- `positive`
- `negative`

“The program works on Android” -> `compatibility`, `positive`
“The program doesn’t work on the i-Phone” -> `compatibility`, `negative`

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Tense

- `past`
- `present`
- `future`

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Modality

- `modal-poss`
- `modal-try`
- `other`

"I'm trying to install the program" -> `modal-try`

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Intent Feature Annotation

Each utterance has multiple intent span annotated, each intent span in then annotated with intent features.

```
[I am trying to cancel /cancel/modal-try/present/...] and [get a refund
/refund/other/present]
```

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Models for Intent Features

- BiLSTM-CRF
- BiLSTM-CRF with intent boundary features
- Span-level convolutional neural networks
- Global-Local model

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BiLSTM-CRF with and without Intent Boundaries

Surface	Intent	Modality	Intent-Boundaries
I	B-cancel	B-modal-try	B-intent
am	I-cancel	I-modal-try	I-intent
trying	I-cancel	I-modal-try	I-intent
to	I-cancel	I-modal-try	I-intent
cancel	E-cancel	E-modal-try	E-intent
and	O	O	O
get	B-refund	B-other	B-intent
a	I-refund	I-other	I-intent
refund	E-refund	E-other	E-intent

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Span-level Convolutional Neural Networks

A single multi-intent utterance

```
[I am trying to cancel /cancel/modal-try] and [get a refund /refund/other]
```

becomes two examples, without context

```
I am trying to cancel -> modal-try
get a refund          -> other
```

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Global-Local Model

A single multi-intent utterance

```
[I am trying to cancel /cancel/modal-try] and [get a refund /refund/other]
```

becomes two examples, that retain context

```
I am trying to cancel and get a refund -> modal-try
1 1  1      1  1      0   0   0 0

I am trying to cancel and get a refund -> other
0 0  0      0  0      0   1   1 1
```

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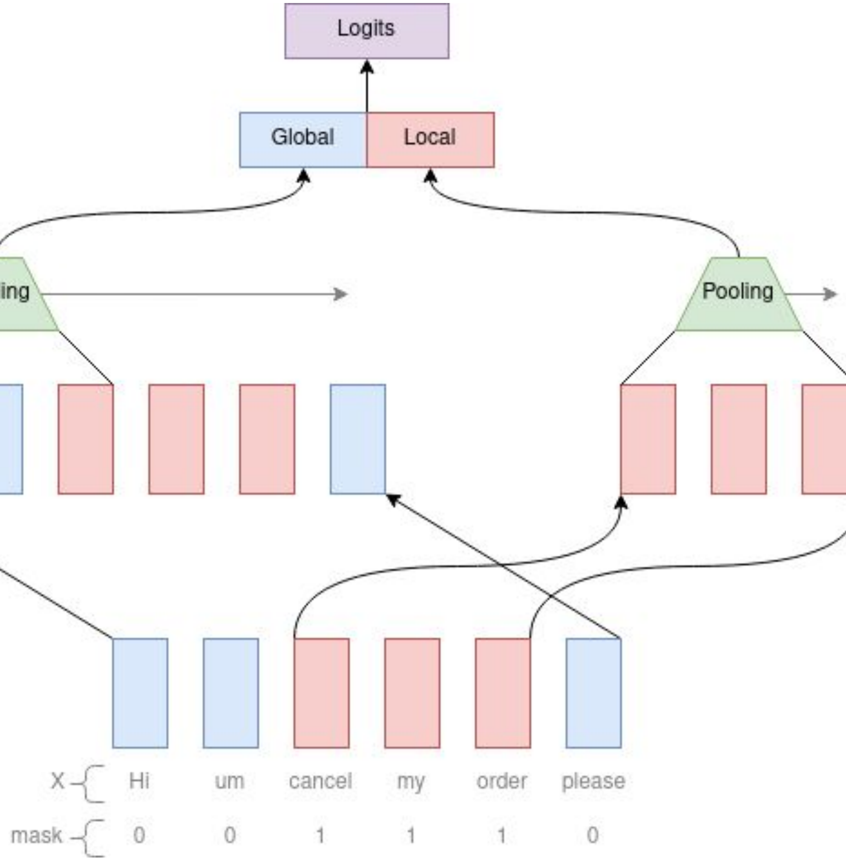
Global-Local Model



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Results

Feature	BiLSTM-CRF	BiLSTM-CRF Cascaded Tagger	Span-level Convolutional	Global-Local
Attribution CF	78.63	91.90	95.37	**97.69**
Attribution EV	80.06	92.27	95.86	**98.16**
Communicative Function	69.07	89.22	90.12	**91.92**
Modality	79.31	92.61	96.60	**99.36**
Tense	73.49	86.01	89.31	**92.59**
Negation	78.47	94.45	95.86	**98.73**

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Ablations

Model	Attribution CF	Attribution Ev	CF	Modality	Tense	Negation
Global-Local	**97.69**	**98.16**	**91.91**	**99.36**	**92.59**	**98.73**
– Global Context	93.55	95.47	90.14	96.74	87.18	95.74
– Shared Embedding	97.65	96.63	91.43	98.34	90.17	96.36

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Conclusion

- Intent Features allow one to factor out small differences in situations, that need to be addressed, while keeping a general data-rich intent space.
    - Intent Features are being used in the NLU component of a production dialogue system
- The Global-Local model is an effective approach for classification of subsequences while including information from the whole sequence.

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Thanks for watching!

Hopefully you'll be able to use intent features, or at least the global local model, somewhere!

- Twitter: https://twitter.com/blester125
- Site: https://blester125.com/
- Global Local Model Code: https://github.com/blester125/global-local-model

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