Chatbots: Under the Hood

Chatbots & Intelligent Conversational Interfaces (PDX)

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Agenda

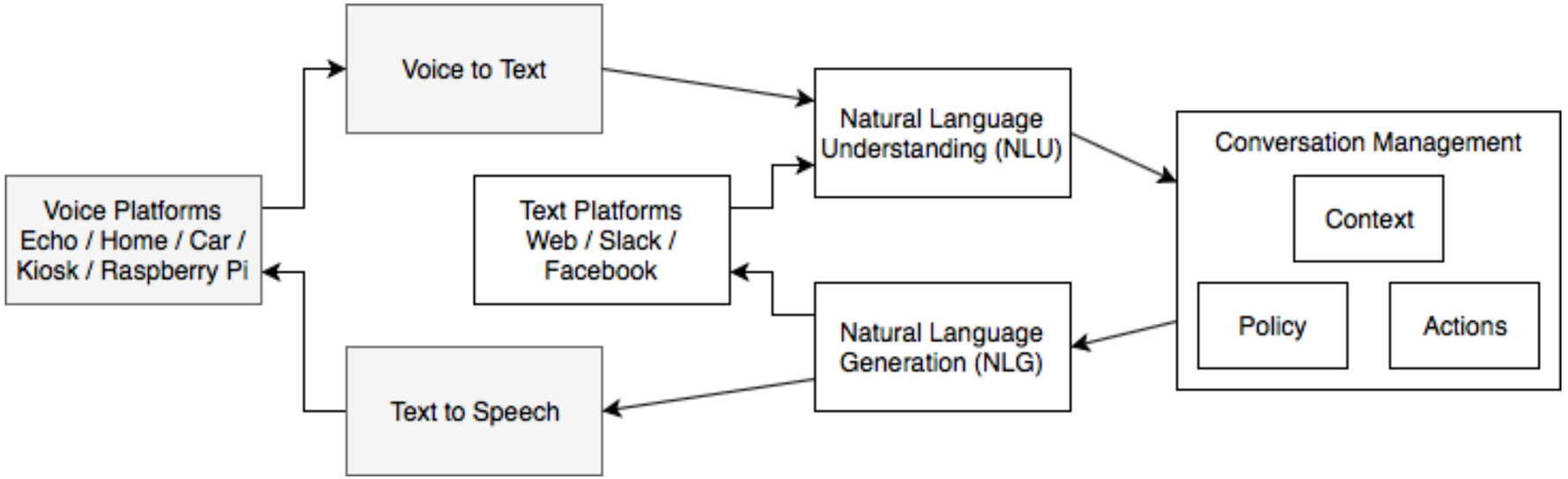
Examine the various subsystems of a chat/dialog system.

Discuss the purpose and possible design options of the subsystems.

Why Rasa?

- Privacy - data stays on your system
- Security - easily access other systems
- Network / latency - "embedded"
- Hackable

A dialog system



Voice platform

- Echo
- Google Home
- Siri
- Raspberry Pi
- Your car

Anatomy of an AI System

Speech recognition / generation

Speech recognition - Aws Lex, Kaldi

Speech generation - Aws Polly, Wavenet

https://github.com/Uberi/speech_recognition

say on Mac

Natural Language Understanding (NLU)

Very little understanding going on!

Goal is to create structured data:

1) Text to *intent* - classification
2) Entity Extraction - NER

Intent Classification / Entity Extraction

"I am looking for a Mexican restaurant in the center of town"

```
{
  "intent": "search_restaurant",
  "entities": {
    "cuisine" : "Mexican",
    "location" : "center"
  }
}
```

Specifying Intents

Defined in `nlu.md`

```
## intent: greet
- hi
- hello

## intent: appointment
- I'd like to make an appointment.
- I'd like to schedule a visit.

## intent: affirm+askcost
- Yes. How much is that?
```

Conversation management

Conversation management

Takes intents and current state of conversation:
- decides what to do
- runs actions
- handles return values / utterances

Rasa Stories

Specified in `stories.md`

```
## opening
* greet
- utter_greeting

## closing
* goodbye
- utter_bye
```

Natural Language Generation (NLG)

Today simple template based system.

Could create custom system to generate coherent sentences from data.

"Seahawks won"
- vs -
"Seahawks were down at half time but came back thanks to a 30 yard run by the rookie running back."

Rasa templates

Specified in `domain.yml`

```
templates:
  utter_greeting:
  - text: "Hello {name}!"
  - text: "Howdy doo!"
```

Simplest example

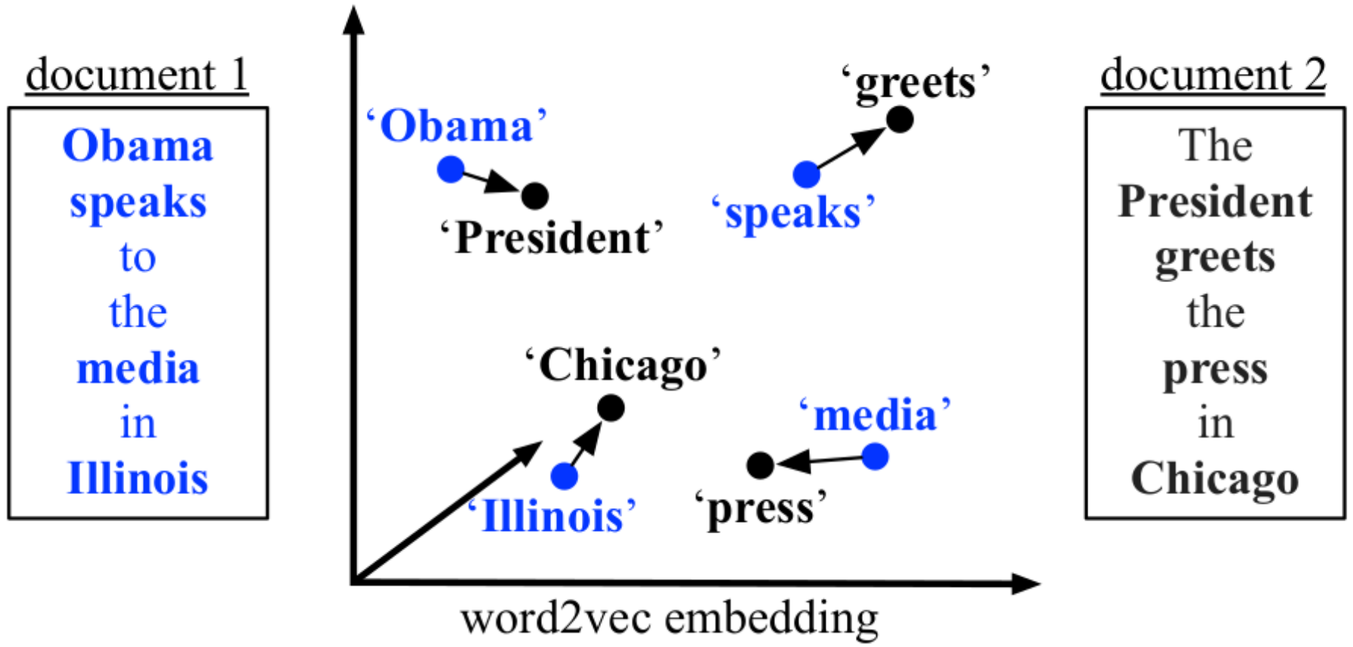
- create files:
  - domain.yml, nlu.md, stories.md, nlu_config.yml
- train and run

NLU - Intent classification

- String matching
- Regular expressions
- Bag of words
- Pretrained word vectors
- Custom Embeddings - StarSpace

Word Embeddings

Words are mapped to vectors in multi-dimensional space.
Words that are used in a similar way are located 'close' together.



Pretrained embeddings

Free to use datasets trained on:

- Wikipedia
- Twitter
- The internet

Easy to train your own if you have enough data.

StarSpace

- From Facebook AI Research (FAIR)
- Good performance with low resource requirements
- General purpose embedding tool
  - Text embeddings and classification
  - Ranking
  - Collaborative and content based recommendations
  - Graphs - inferring edges, semantic clustering
  - Knowledge base (triples)

Named Entity Recognition (NER)

The task of extracting *named entities* (the named things) from text.

```
I went to New York City.

I'd like to open a savings account.
```

NER Options

- Regular expressions
- sklearn crf
- Spacy
- Lookup tables

Prototypical NLU Pipeline

- Tokenizer, Part of Speech (POS) tagger, Chunker
- Named Entity Recognition (NER) extraction, synonyms
- Intent classifier

Dialog management

- User / conversation state
- Policy
- Actions

State management

- None - direct response to intent
- Explicit rules
- State machine
- Machine learning - Recurrent Neural Net, etc.

Slots

The memory of your bot. Can be filled by:

- An NER in an intent
- A custom action
- A form action

Can be used in actions and responses/utterances

Policies

Decide what actions to take.

- Keras - LSTM
- Memoization
- Customizable

Actions

What your bot does in resonse to input.

- Utterances - specify template
- Custom action - write code to do anything you want

Custom Actions

```
class MyCustomAction(Action):
    def name(self):
        return 'my_custom_action'

    def run(self, dispatcher, tracker, domain):
        // do whatever you want
        SlotSet('foo','bar')
        dispatch.utter_message('Your foo is bar')
```

Summary

NLU
- Text to intent
- Entity extraction

Dialog manager
- State - slots, previous intent, etc.
- Policy - how to decide what action (stories)
- Actions - running code

NLG
- Text generation

Resources

Rasa.com
https://github.com/snipsco/snips-nlu
StarSpace https://arxiv.org/abs/1709.03856

Thank You!

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Questions?