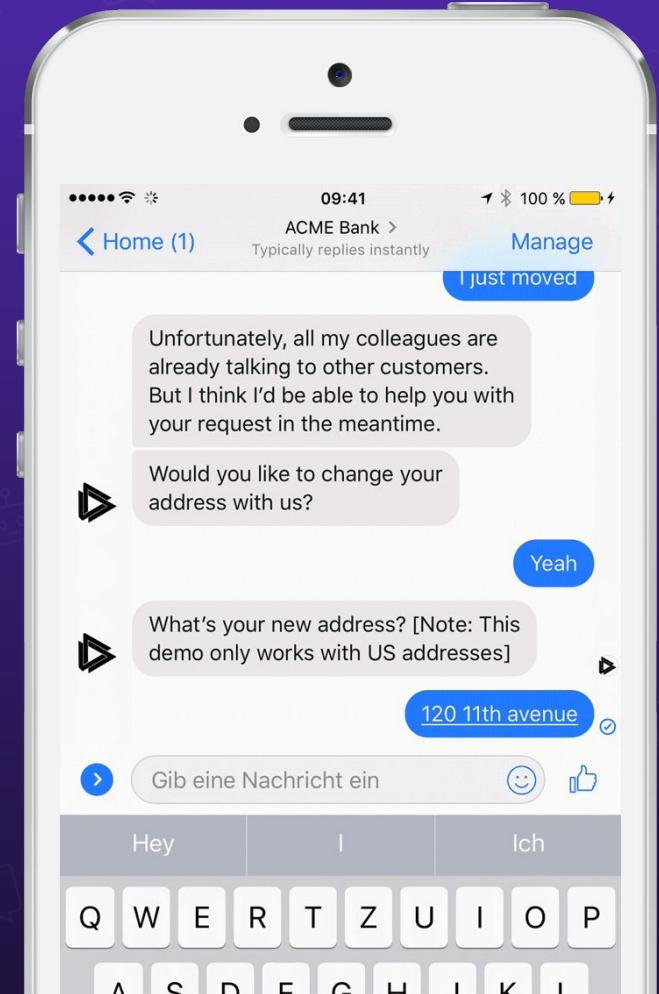


Deprecating the state machine: building conversational AI with Rasa stack

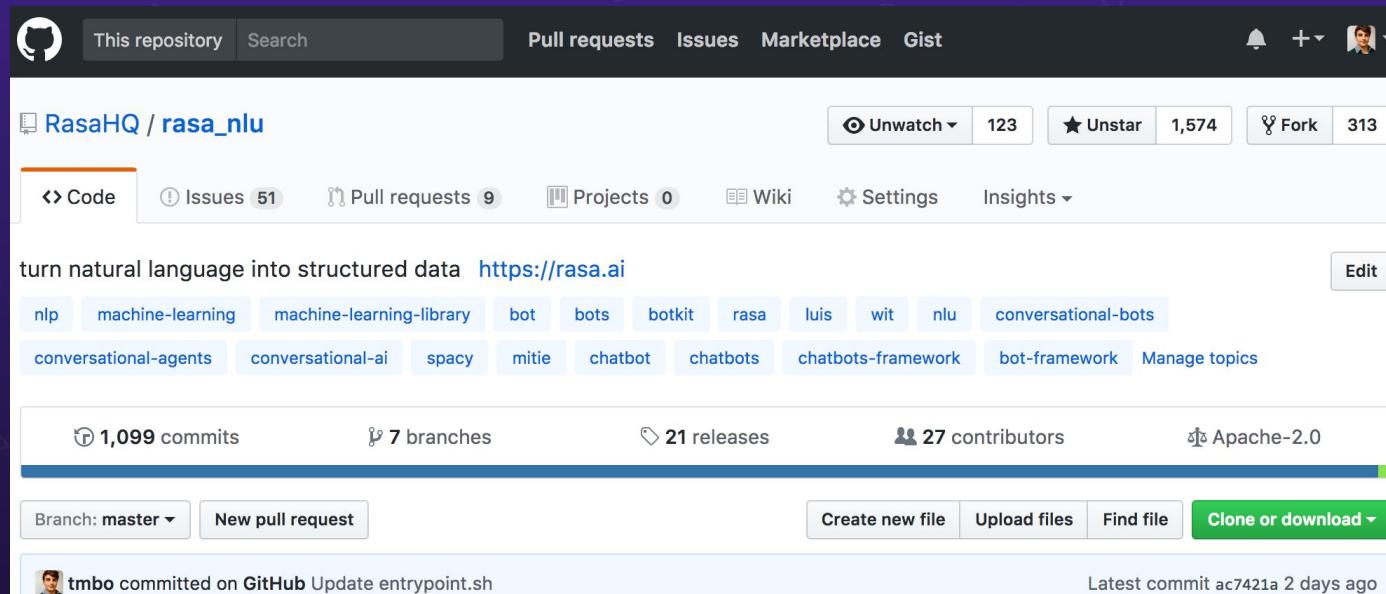
Justina Petraityte, Developer Advocate

Conversational AI will **dramatically change how** **your customers interact** **with you.**

Example of a live Skill:
A customer can change her address via Facebook Messenger



An open source, highly scalable ML framework to build conversational software



The screenshot shows the GitHub repository page for RasaHQ / rasa_nlu. The repository has 123 stars, 1,574 forks, and 313 open issues. It features 9 pull requests and 0 projects. The repository's purpose is described as "turn natural language into structured data" with a link to <https://rasa.ai>. The repository uses Apache-2.0 licensing and has 27 contributors. The master branch is selected, and there is a "New pull request" button. The repository is associated with the RASA project, as indicated by the logo in the bottom left corner.

This repository Search Pull requests Issues Marketplace Gist

RasaHQ / rasa_nlu Unwatch 123 Star 1,574 Fork 313

Code Issues 51 Pull requests 9 Projects 0 Wiki Settings Insights

turn natural language into structured data <https://rasa.ai>

nlp machine-learning machine-learning-library bot bots botkit rasa luis wit nlu conversational-bots

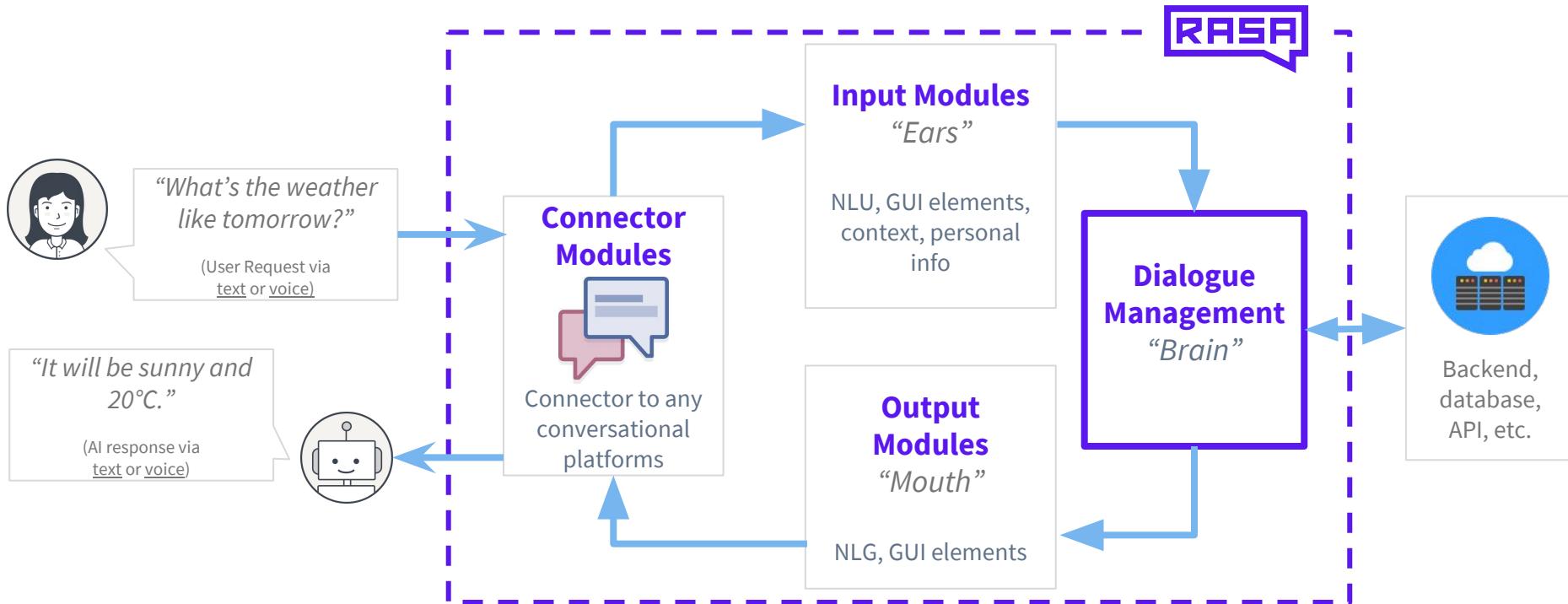
conversational-agents conversational-ai spacy mitie chatbot chatbots chatbots-framework bot-framework Manage topics

1,099 commits 7 branches 21 releases 27 contributors Apache-2.0

Branch: master New pull request Create new file Upload files Find file Clone or download

tmbo committed on GitHub Update entrypoint.sh Latest commit ac7421a 2 days ago

Rasa the OSS to build conversational software with ML



Alternatives: Dialogflow

wit.ai



Why Rasa?



Runs Locally

- No Network Overhead
- Control QoS
- Deploy anywhere



Own Your Data

- Don't hand data over to big tech co's
- Avoid vendor lock-in



Hackable

- Tune models for your use case

What we are focusing on today

Goal:



build & understand a bot based on machine learning

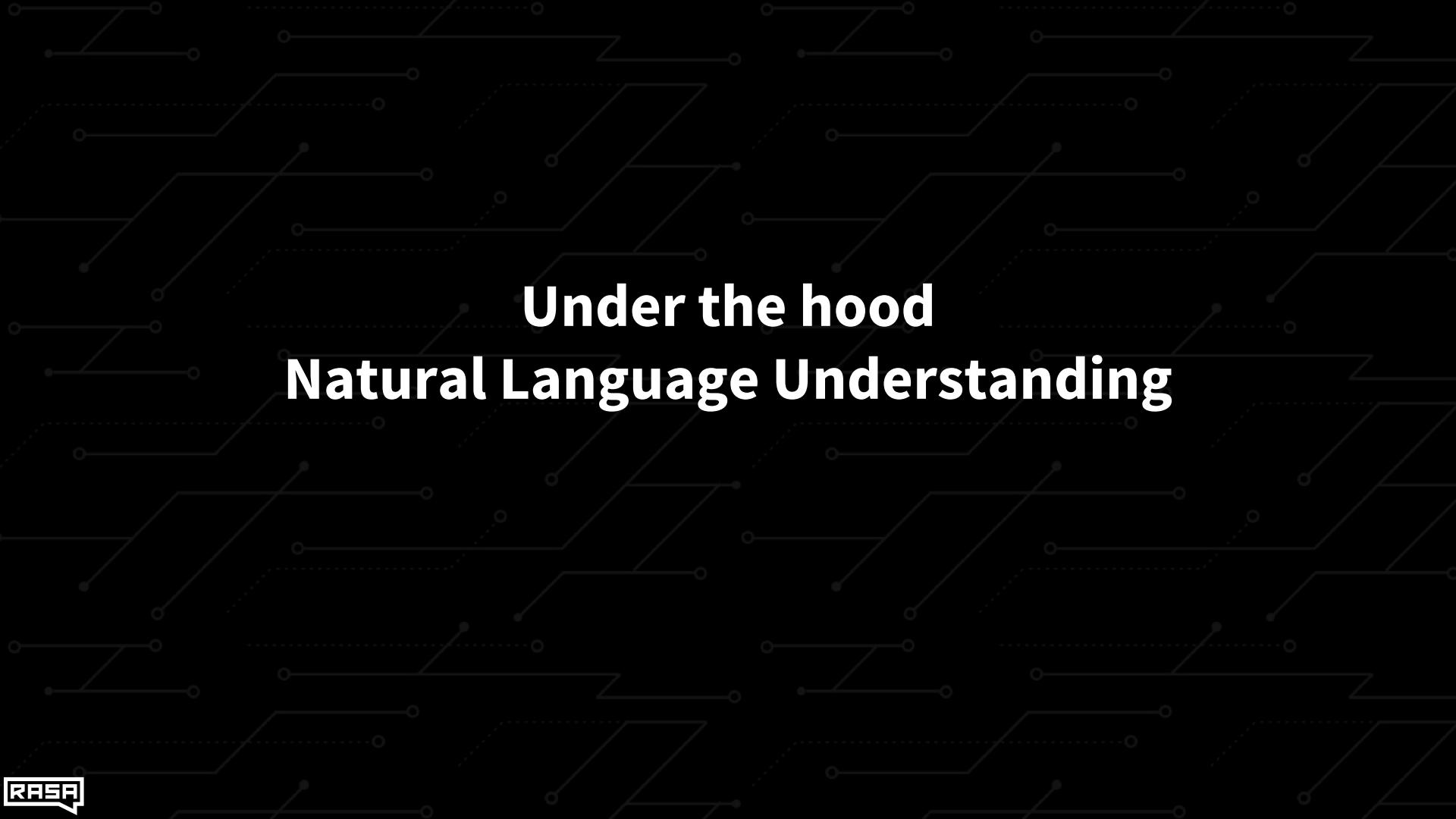
Roadmap:

1. Natural Language Understanding
 - i. Theory
 - ii. Let's Code
2. Dialogue Handling
 - i. Theory
 - ii. Let's Code
3. Research
4. Questions

Setup

1. Jupyter notebook in python 3.6 (2.7 should work as well)

2. Download:
Repository: <https://github.com/RasaHQ/rasa-workshop-pydata-berlin>



Under the hood Natural Language Understanding

Rasa NLU: Natural Language Understanding

Goal: create structured data



*I have a new address, it's
709 King St, San Francisco*



i just moved

i have a new address, it

how do i change my ad

i need to update my add

I have a new address, it's

709 King St, San Francisco

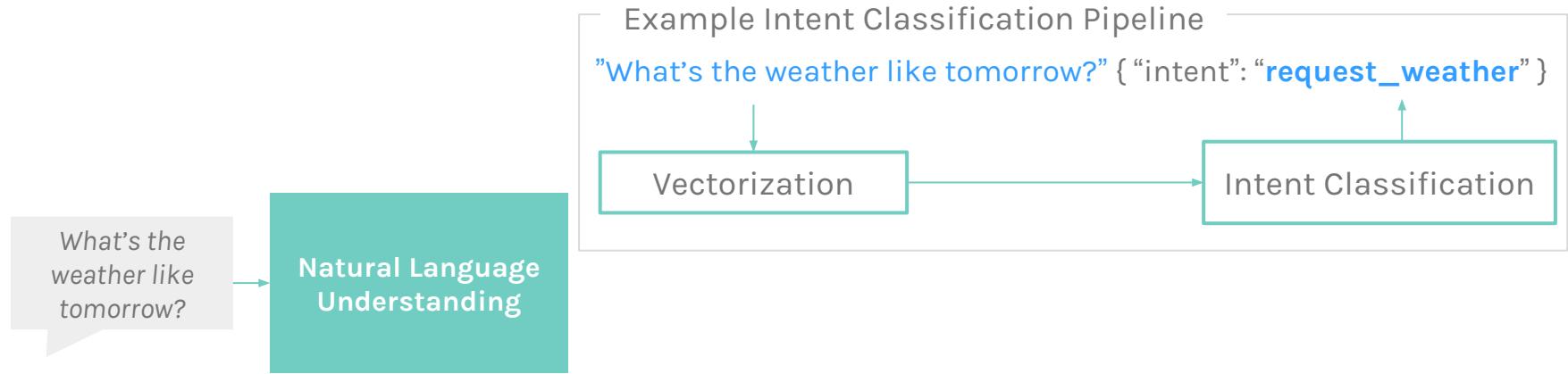
Address

New Entity

Intent

address_change

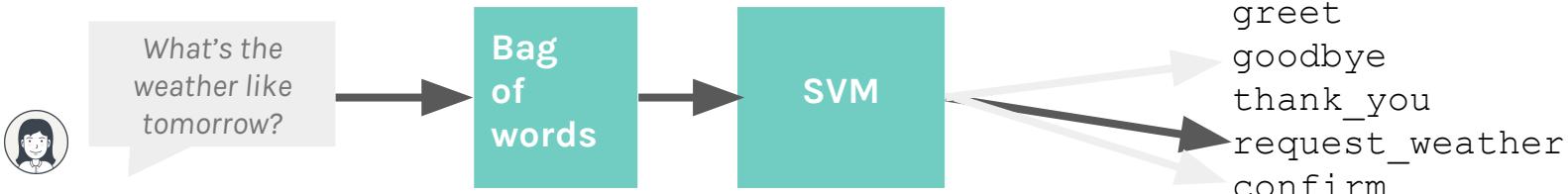
Natural Language Understanding



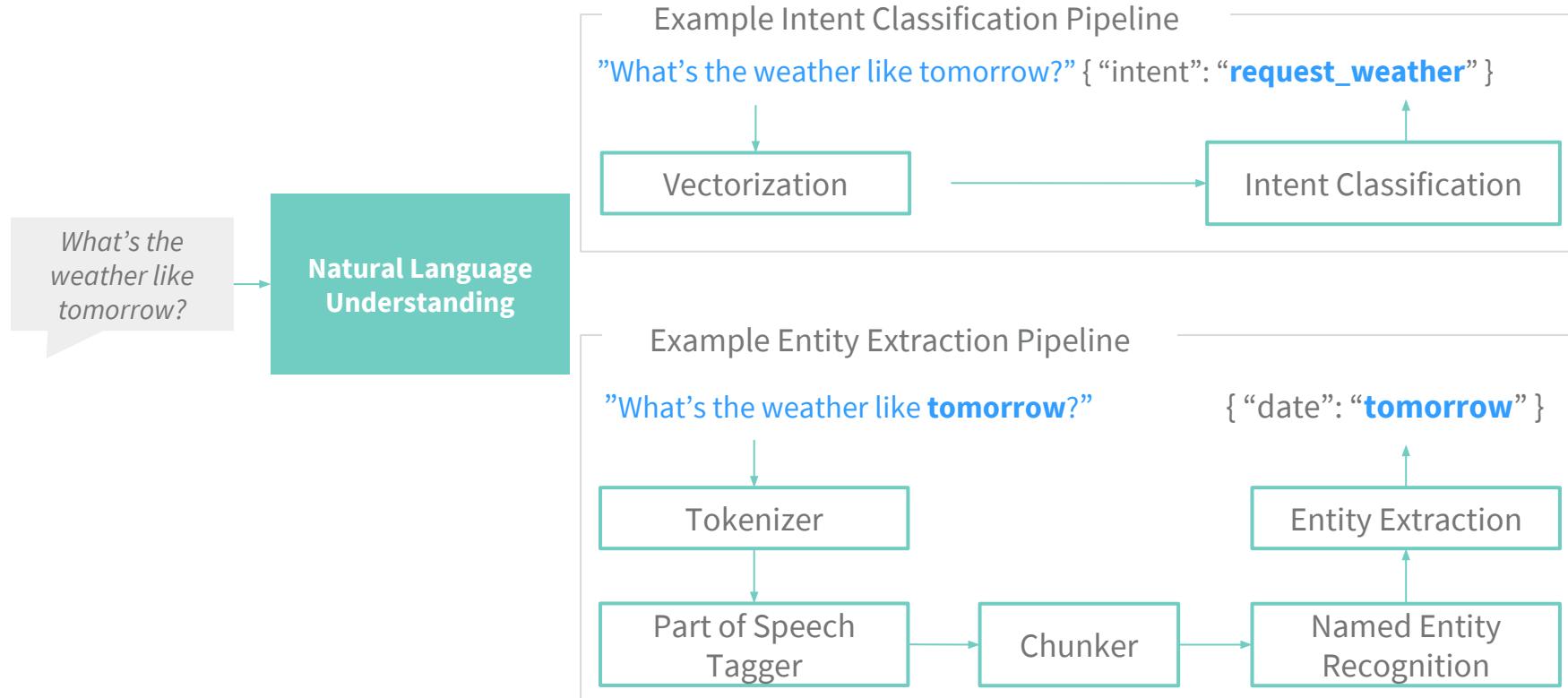
Rasa NLU: Natural Language Understanding

Bags are your friend

$$\{v_1, \dots, v_s\} \rightarrow \frac{1}{s} \sum_i v_i$$



Rasa NLU: Natural Language Understanding



Rasa NLU: Entity Extraction

Where can I get a burrito in the 2nd arrondissement ?



cuisine



location

averaged perceptron

$$y = \text{sign} \left(\sum_{k=1}^K c^{(k)} \left(w^{(k)} \cdot \hat{x} + b^{(k)} \right) \right)$$

1. Binary classifier is _entity & then entity_classifier
2. Direct structured prediction

Let's code!



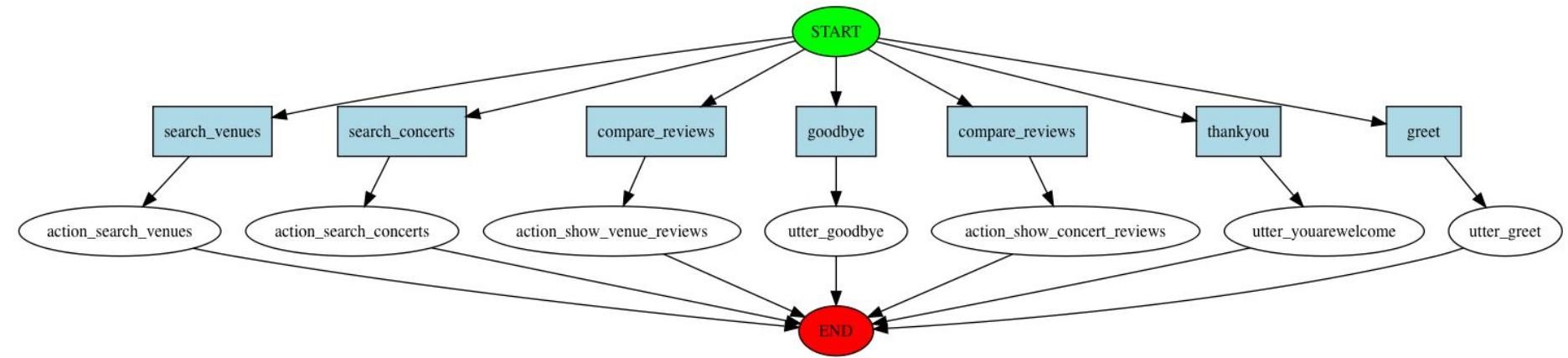
Under the hood Dialogue Management

Why Dialogue Handling with Rasa Core?

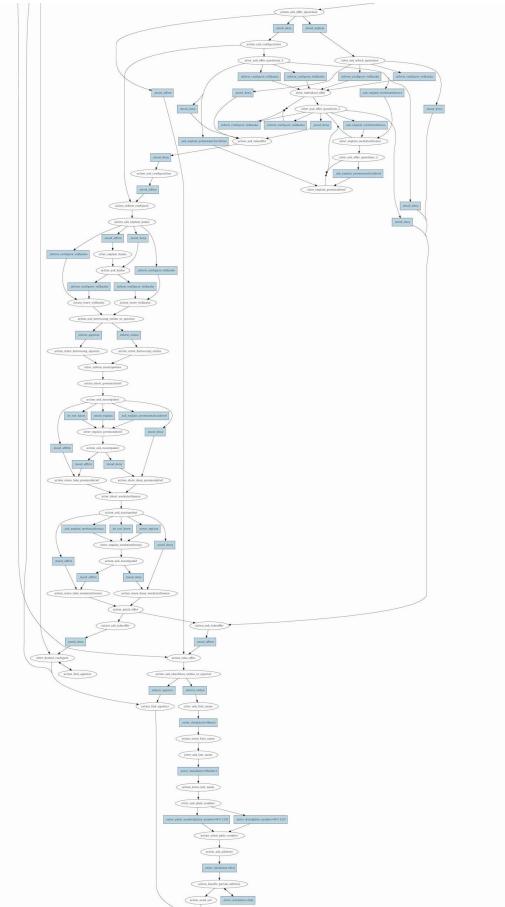
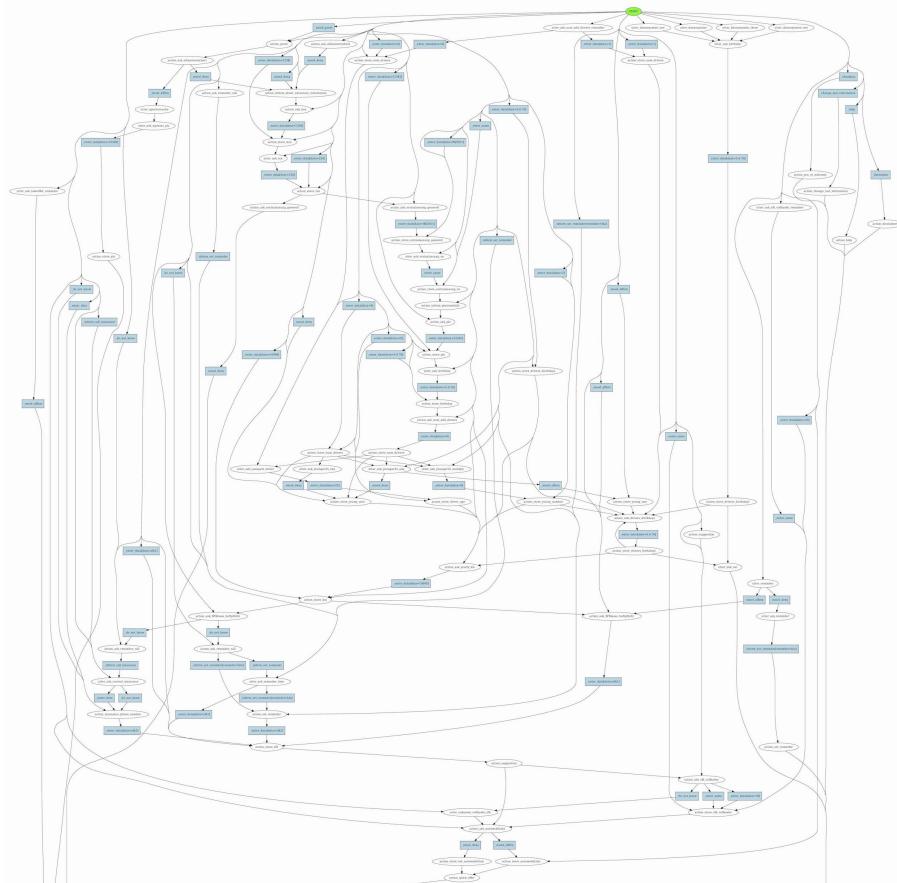
- No more state machines!
- Reinforcement Learning: too much data, reward functions...
- Need a simple solution for everyone



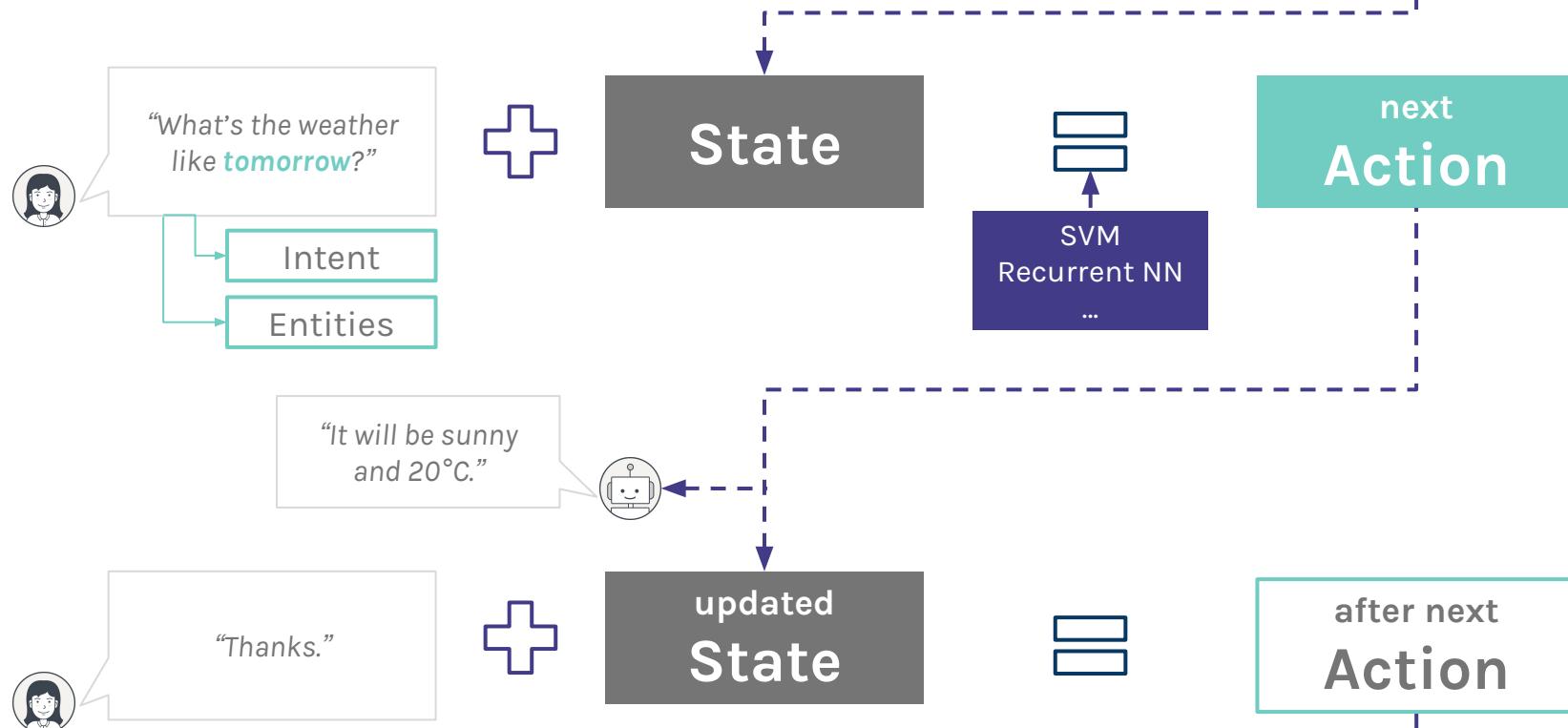
Why Machine Learning?



State Machines are infeasible

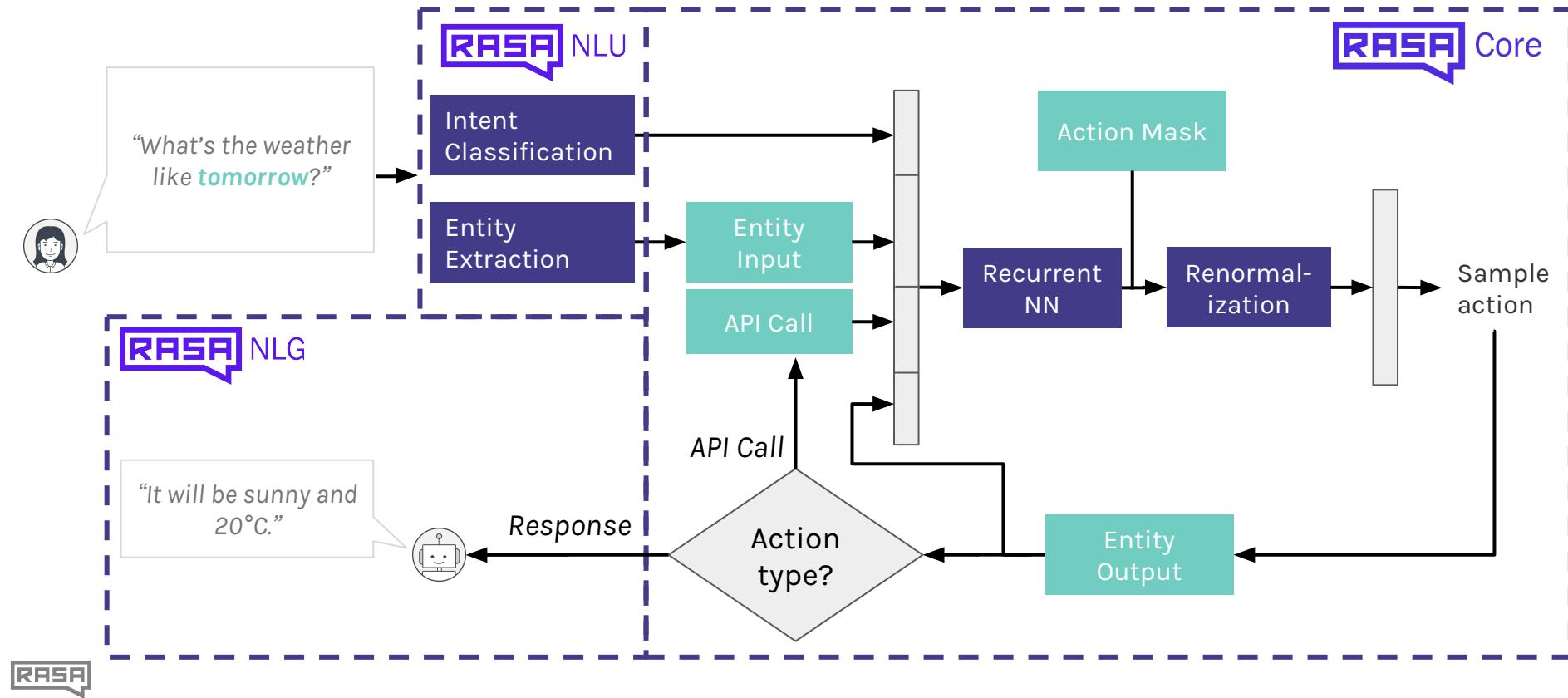


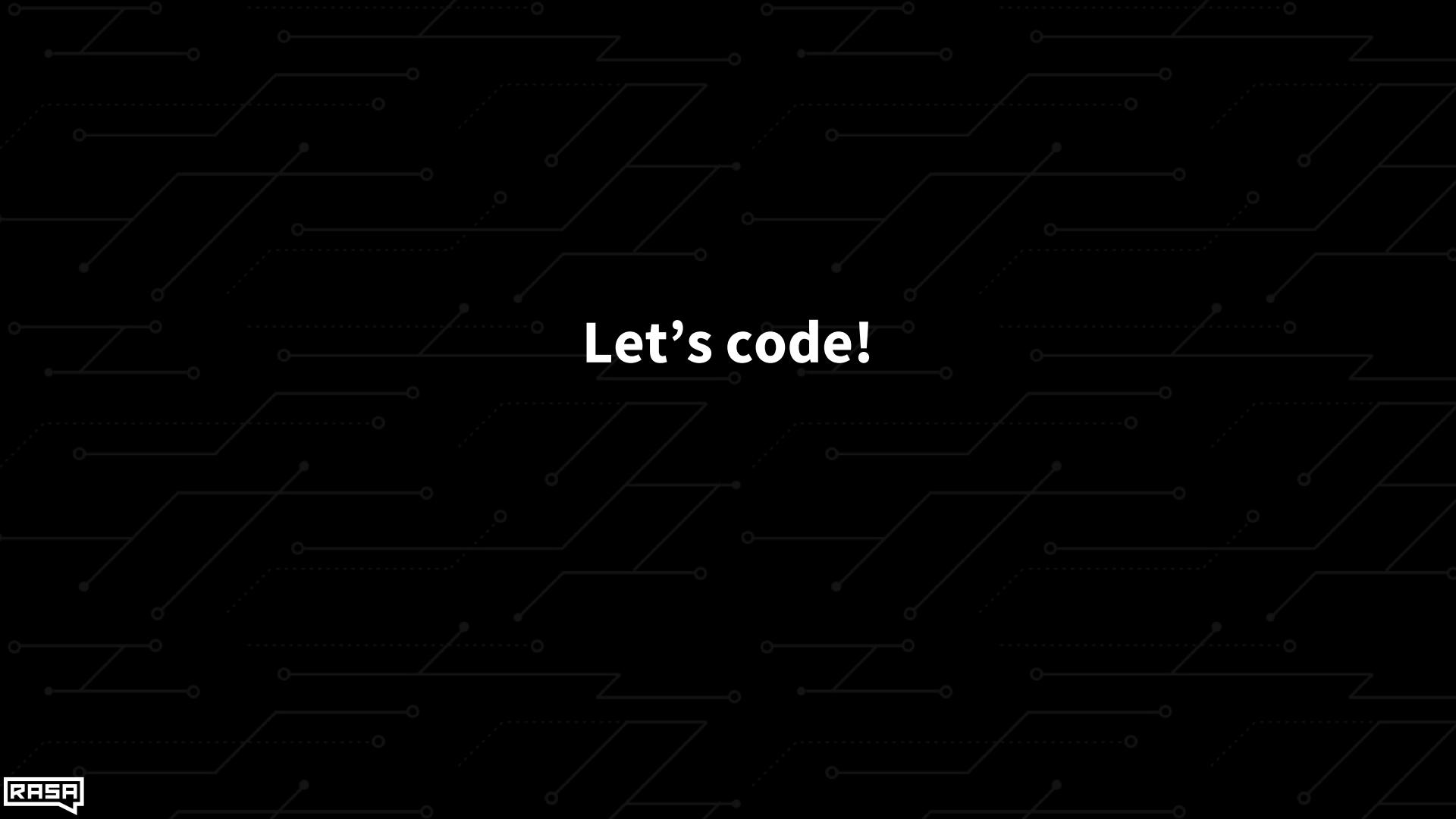
Rasa Core: Dialogue Handling



Rasa Core: Dialogue Handling

Similar to LSTM-dialogue prediction paper: <https://arxiv.org/abs/1606.01269>





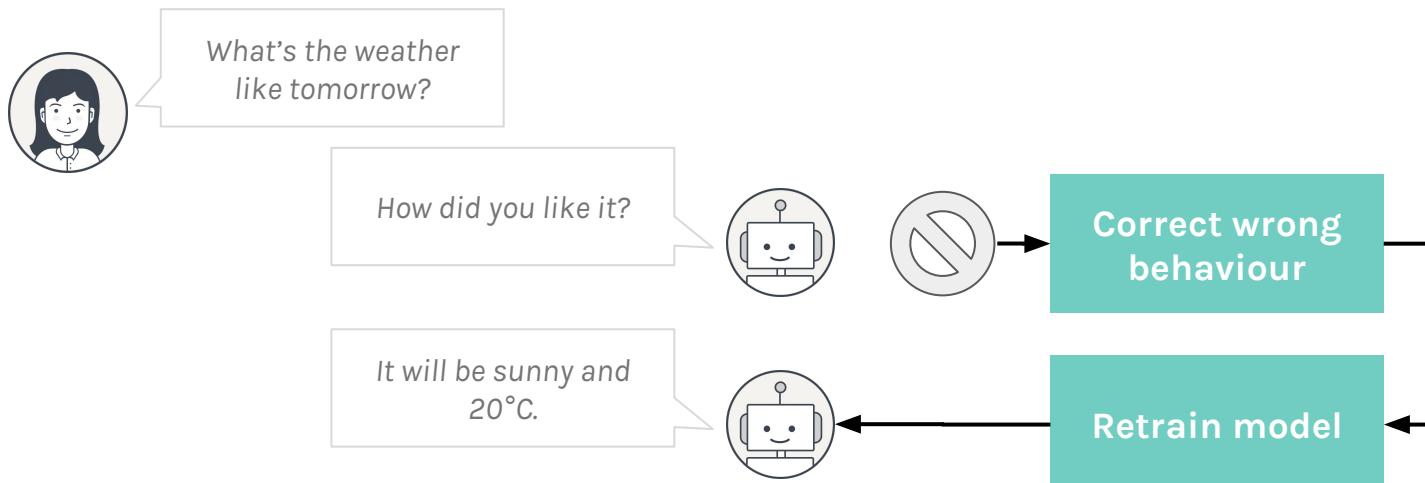
Let's code!

Rasa Core: Dialogue Training

Issue: How to get started?



Online Learning





Let's Code

Interactive Learning

Research

Training NLU models without initial word vectors

Goal: Learn an **embedding** for the intent labels based on the user messages

- Learns joined embeddings for intents & words at the same time
- Allows multi-intent labels
- Knows about similarity between intent labels
- Based on Starspace Paper

<https://medium.com/rasa-blog/supervised-word-vectors-from-scratch-in-rasa-nlu-6daf794efcd8>

<https://medium.com/rasa-blog/how-to-handle-multiple-intents-per-input-using-rasa-nlu-tensorflow-pipeline-75698b49c383>

Training NLU models without initial word vectors

Goal: Learn an **embedding** for the intent labels based on the user messages

Multi-Intent:

Text	Intent
Hey how are you? i don't really care	greet+dontcare
ok something else then? thanks a bunch	deny+thankyou
cool! Who is the mayor or New York City?	state_happy+random

Evaluation:

Pipeline	train F1-score	test F1-score
spacy (small)	0.684 (0.020)	0.325 (0.018)
tensorflow_embedding	0.984 (0.001)	0.898 (0.017)

Generalisation across dialogue tasks

Why do we need this complex architecture? For generalisation between domains!

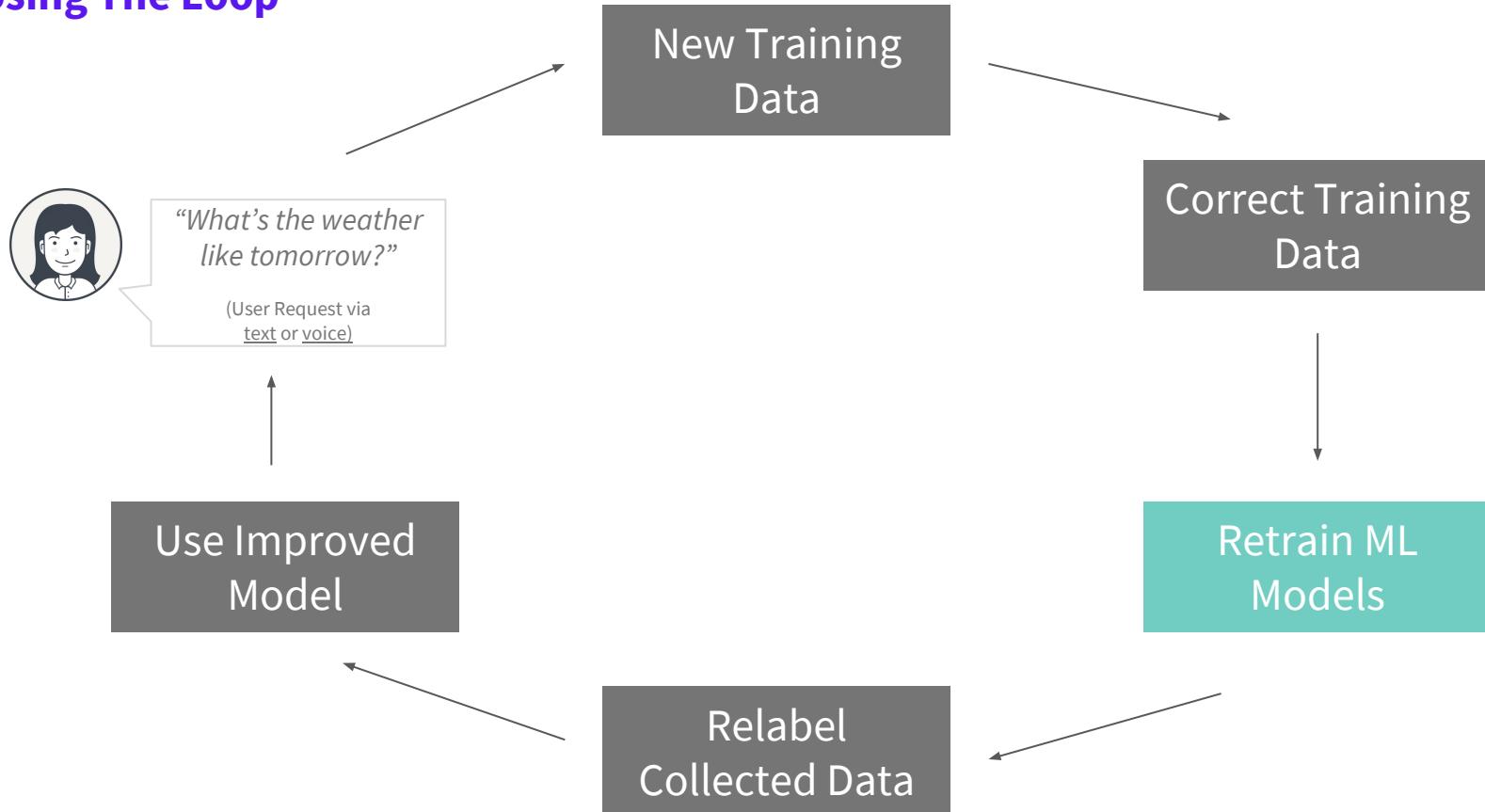
```
## hotel explain 1.3
* request_hotel
  - utter_ask_details
* inform{"location": "paris"}
  - utter_ask_people
* inform{"people": "4"}
  - utter_ask_price
* explain
  - utter_explain_price_hotel
  - utter_ask_price
```

```
## restaurant explain 1.3
* request_restaurant
  - utter_ask_details
* inform{"location": "paris"}
  - utter_ask_people
* inform{"people": "4"}
  - utter_ask_price
* explain
  - utter_explain_price_restaurant
  - utter_ask_price
```

Final Thoughts

Final Thoughts

Closing The Loop



Open challenges

For those that are curious:

- Handling OOV words
- Multi language entity recognition
- Combination of dialogue models

We're constantly working on improving our models!

Current Research

Good reads for a rainy day:

- Last Words: Computational Linguistics and Deep Learning ([blog](#))
<https://goo.gl/lGSRuj>
- Starspace Embeddings ([paper](#))
<https://arxiv.org/abs/1709.03856>
- End-to-End dialogue system using RNN ([paper](#))
<https://arxiv.org/pdf/1604.04562.pdf>
- MemN2N in python ([github](#))
<https://github.com/vinhkhuc/MemN2N-babi-python>
- Sentence Embeddings ([blog](#))
<https://medium.com/huggingface/universal-word-sentence-embeddings-ce48ddc8fc3a>

Summary

4 take home thoughts:

- Techniques to handle small data sets are key to get started with conversational AI
- Deep ML techniques help advance state of the art NLU and conversational AI
- Combine ML with traditional Programming and Rules where appropriate
- Abandon flow charts

Get in touch!



Justina Petraityte
Developer Advocate

juste@rasa.ai
@juste_petr

We are hiring!

ML Product
Success Engineer

Help the teams who are
using Rasa Platform
succeed.

ML Engineer

Help us push the limits of
the conversational AI
software.