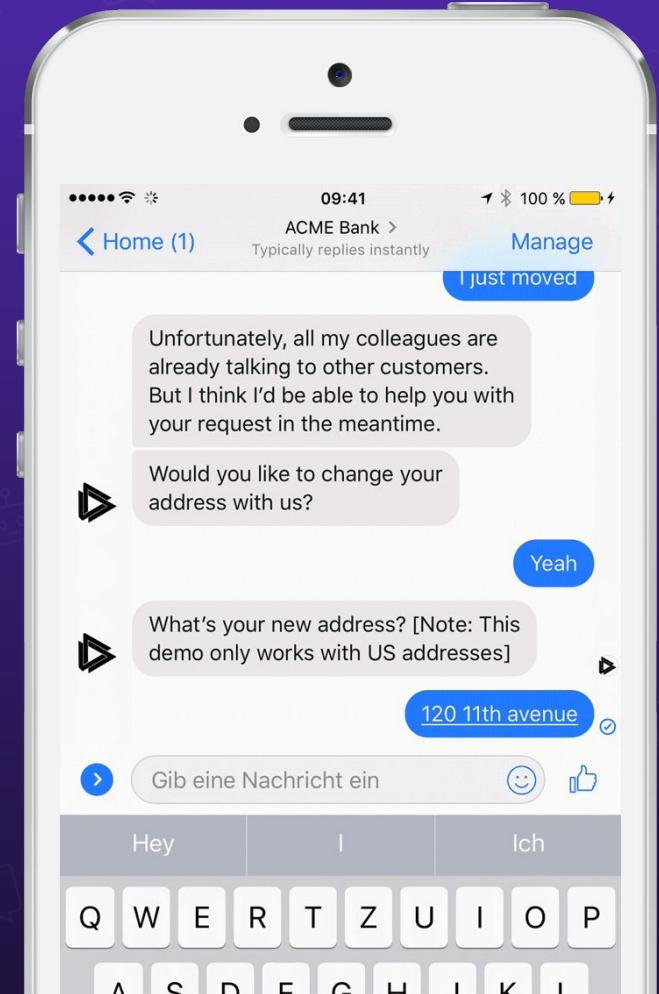


Deprecating the state machine: building conversational AI with Rasa stack

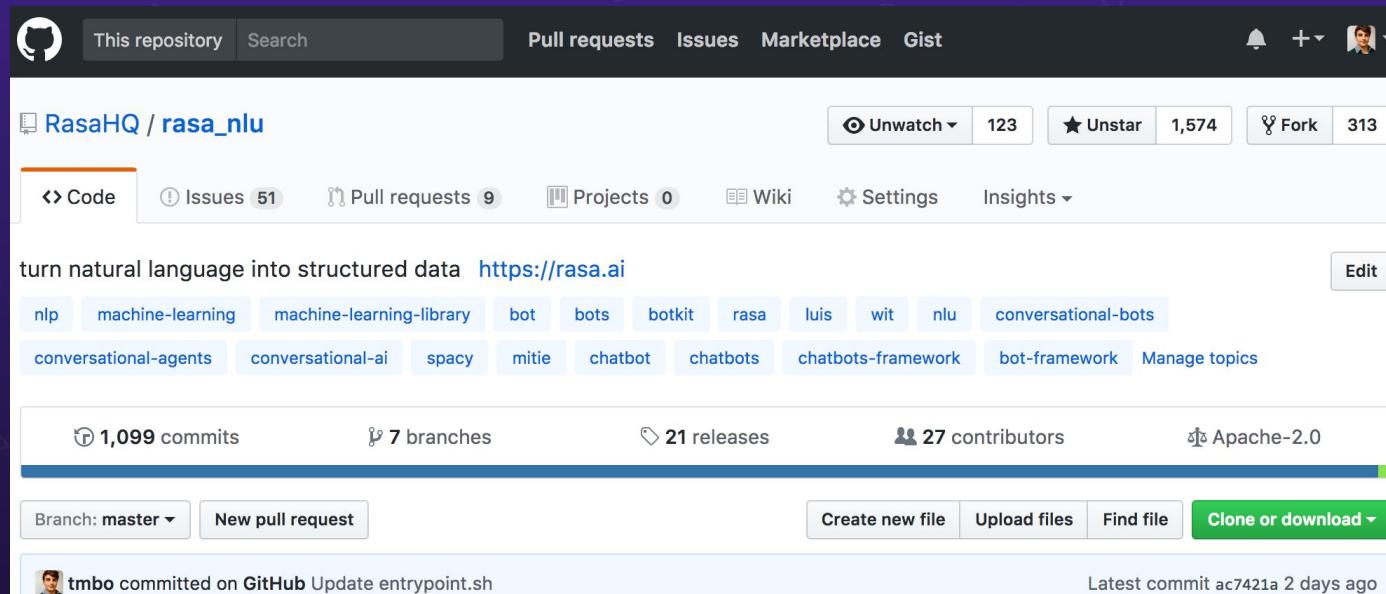
Justina Petraityte, Developer Advocate

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 issues. It features 9 pull requests and 0 projects. The repository 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.

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

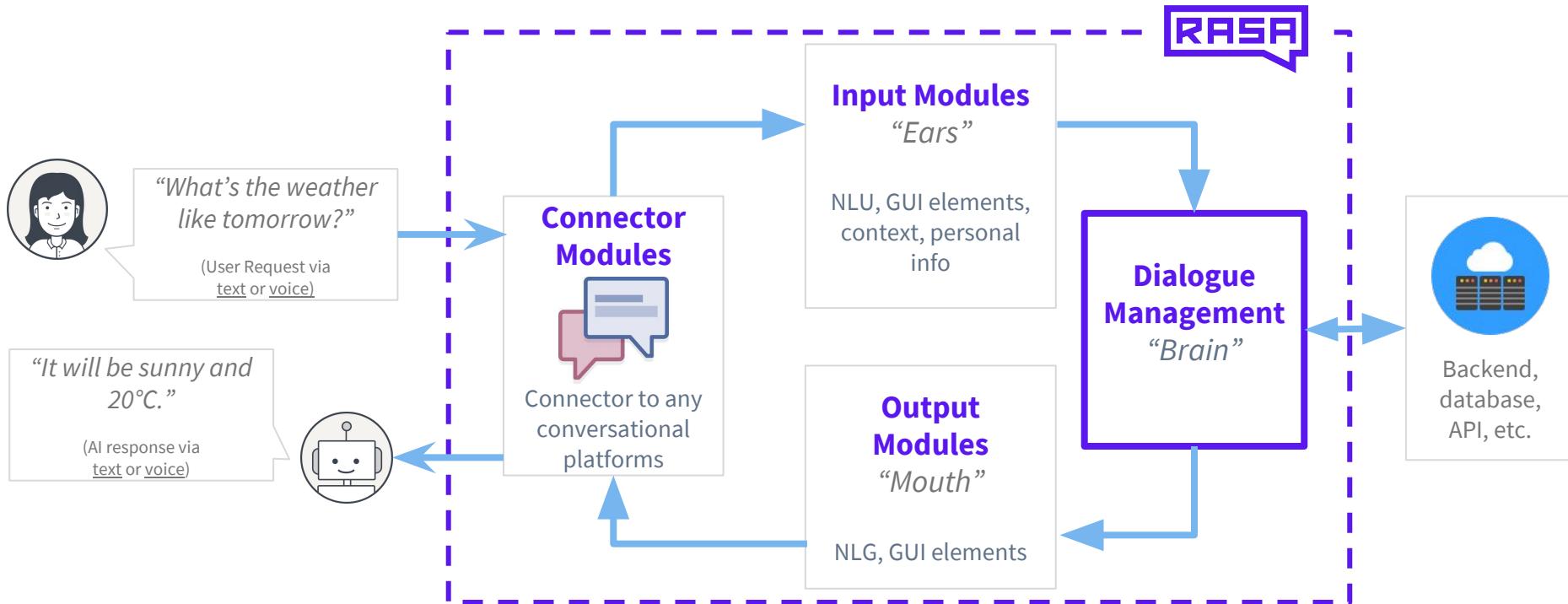
conversational-agents conversational-ai spacy mitie chatbot chatbots chatbots-framework bot-framework Manage topics

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

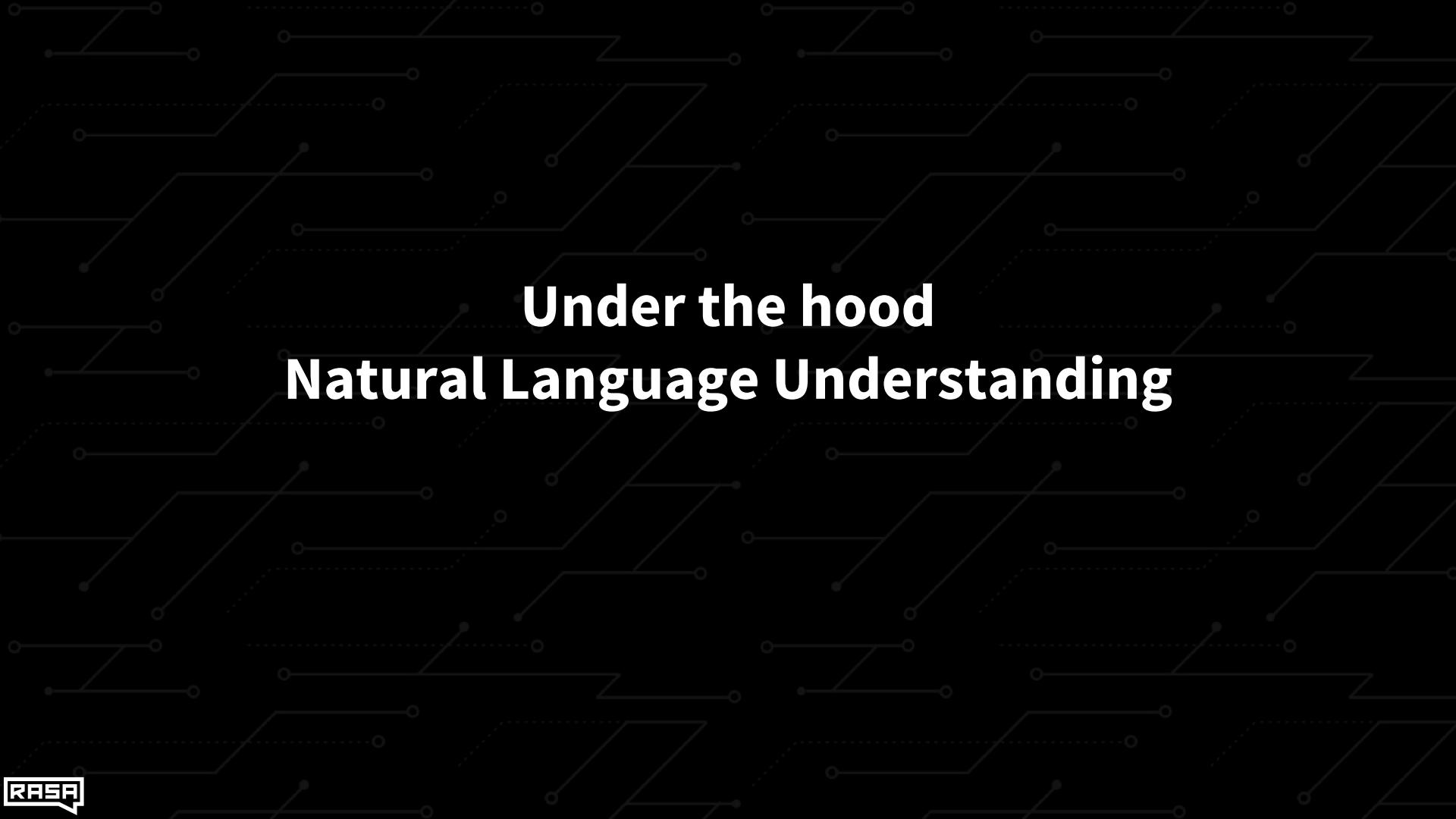
Roadmap:

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

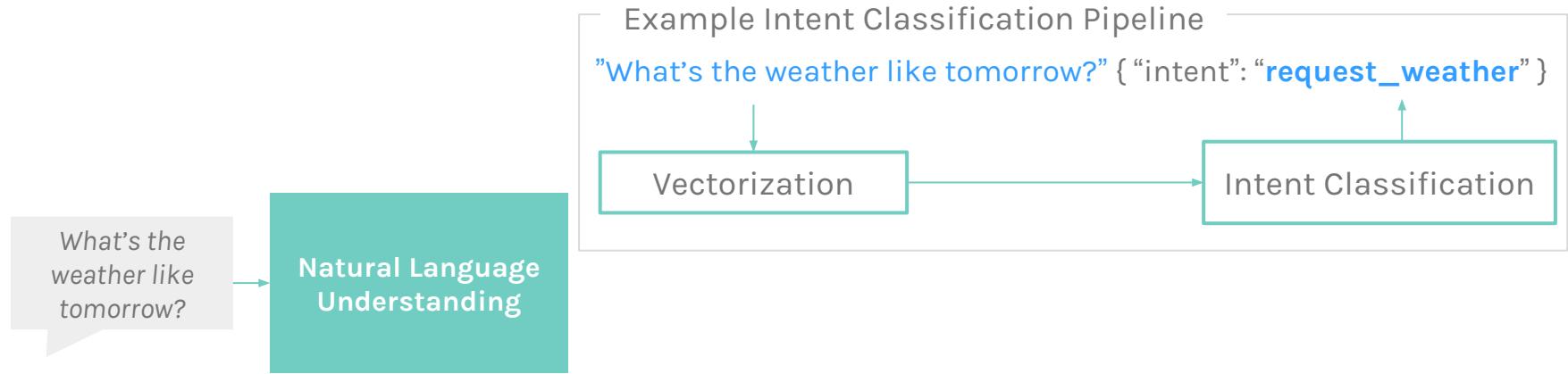
New Entity



Intent

address_change

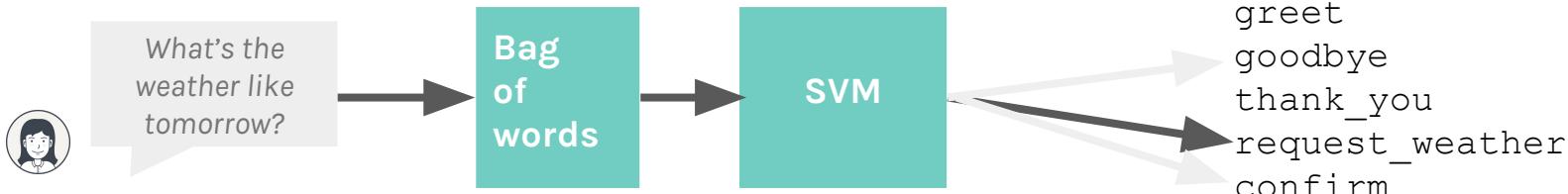
Natural Language Understanding



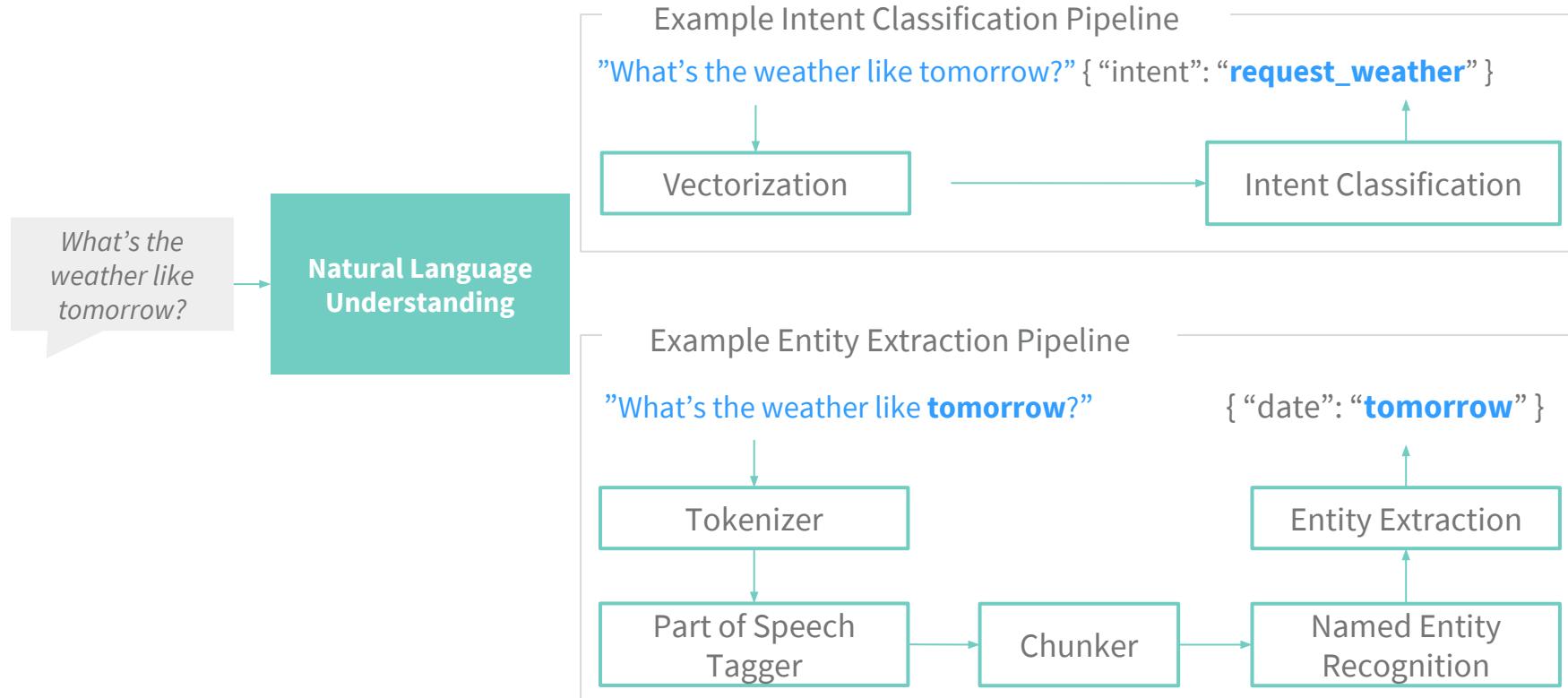
Rasa NLU: Natural Language Understanding

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

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

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



Let's code!



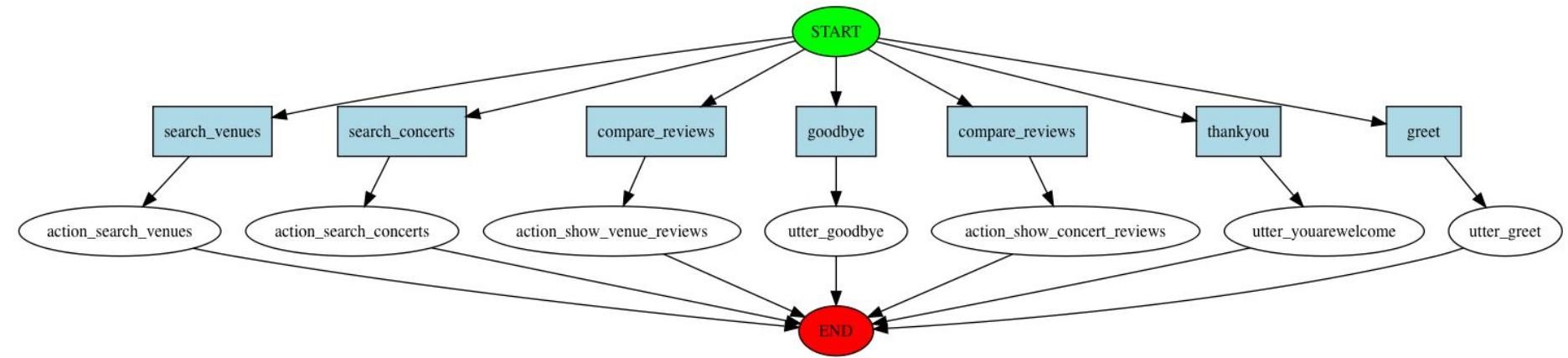
Under the hood Dialogue Management

Why Dialogue Handling with Rasa Core?

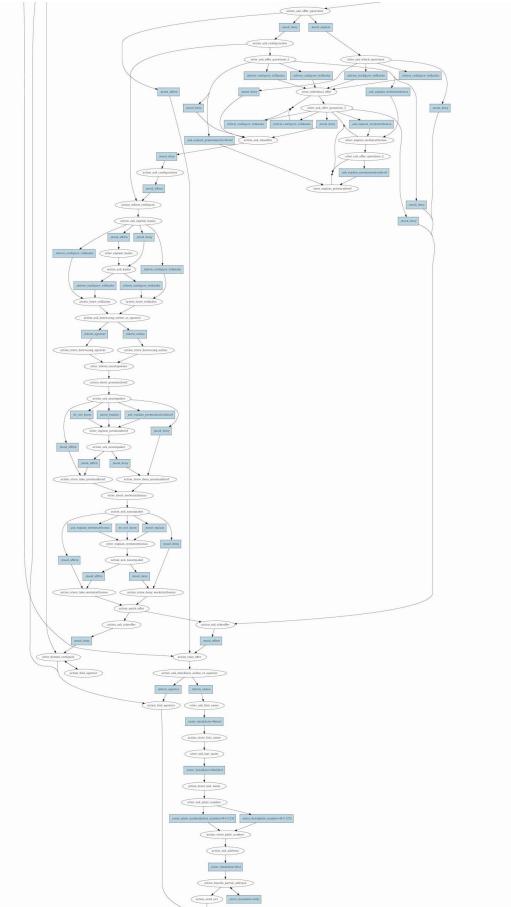
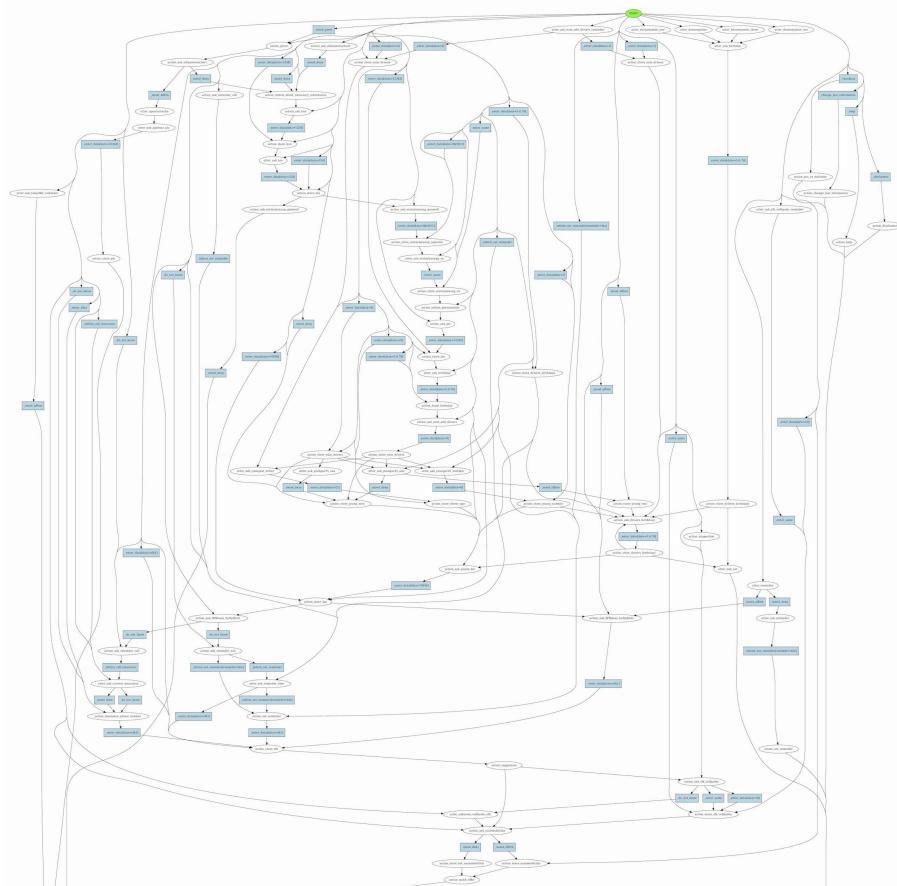
- No more state machines!
- Reinforcement Learning: too much data, reward functions...
- Need a simple solution for everyone



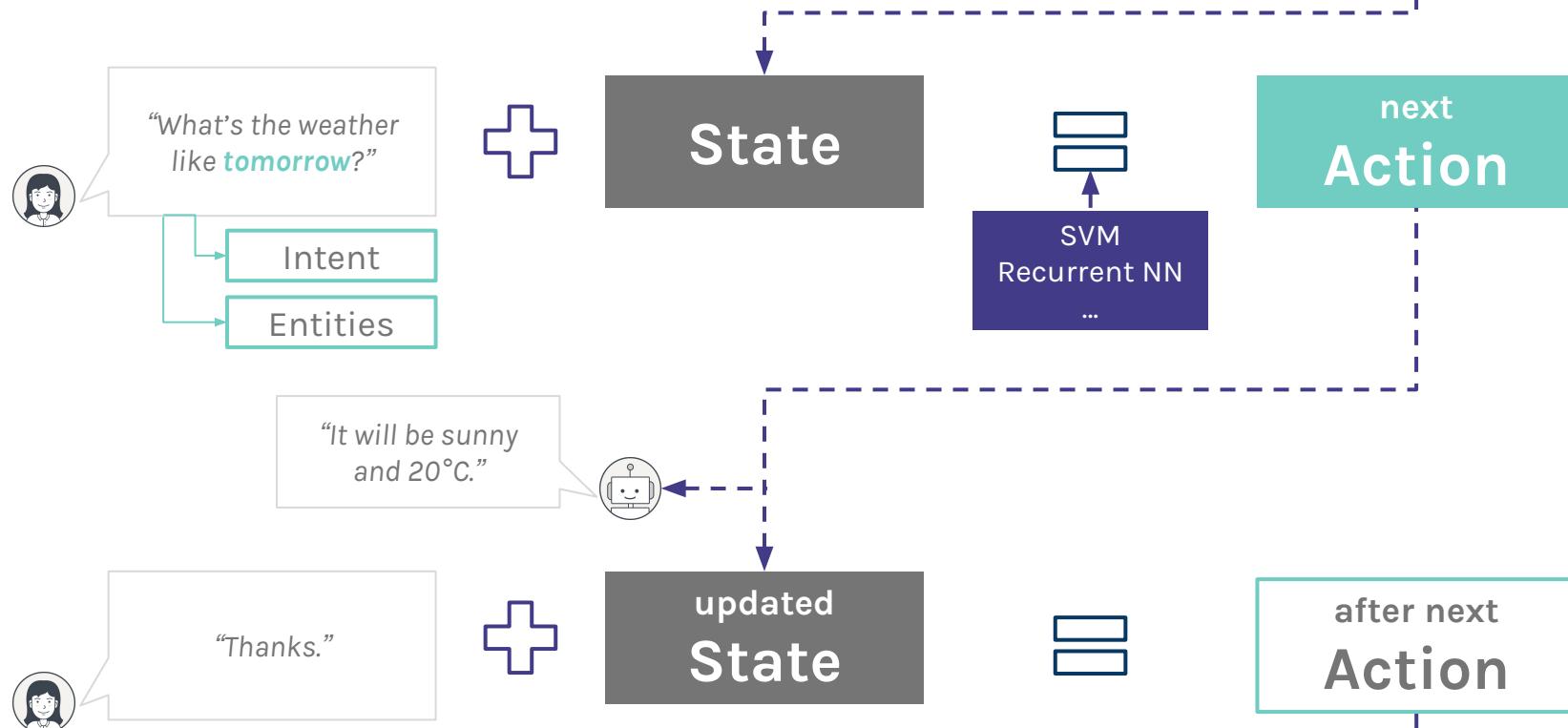
Why Machine Learning?



State Machines are infeasible

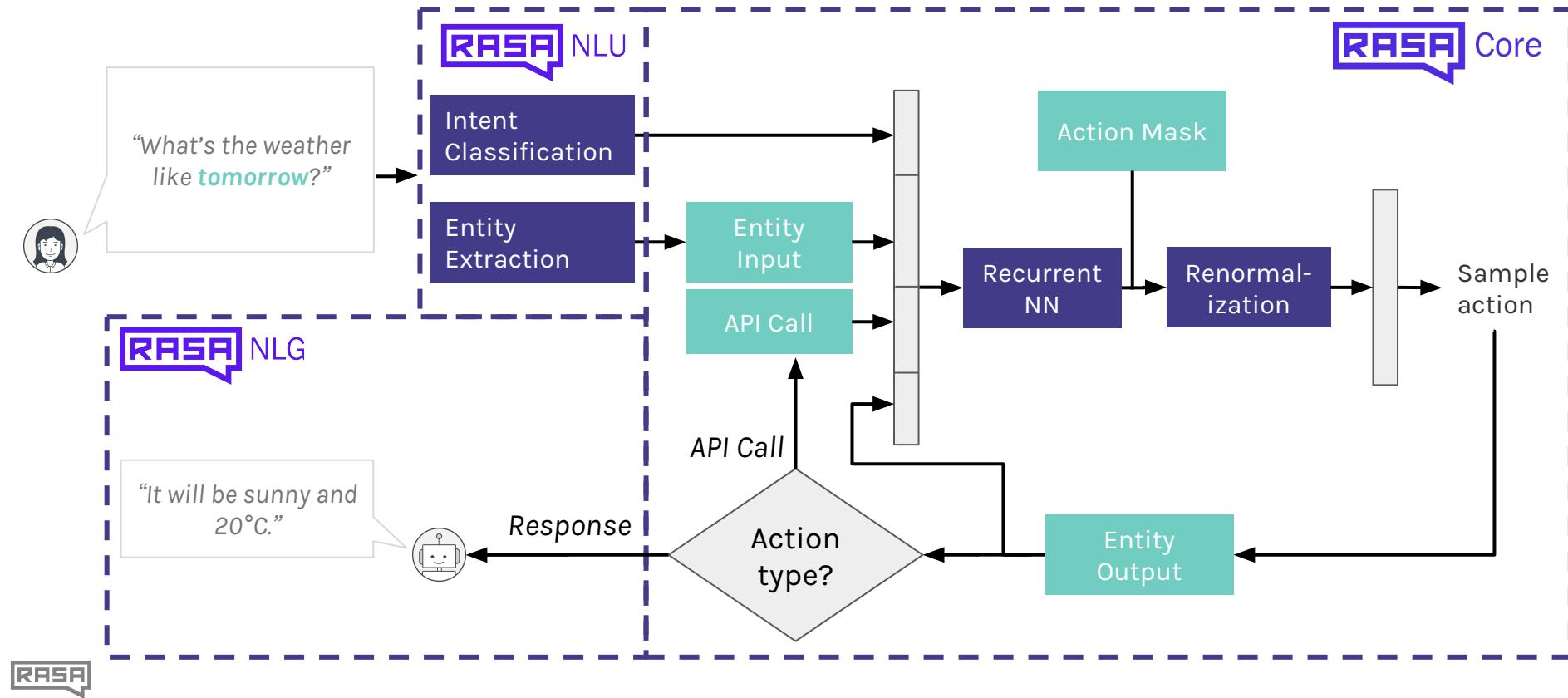


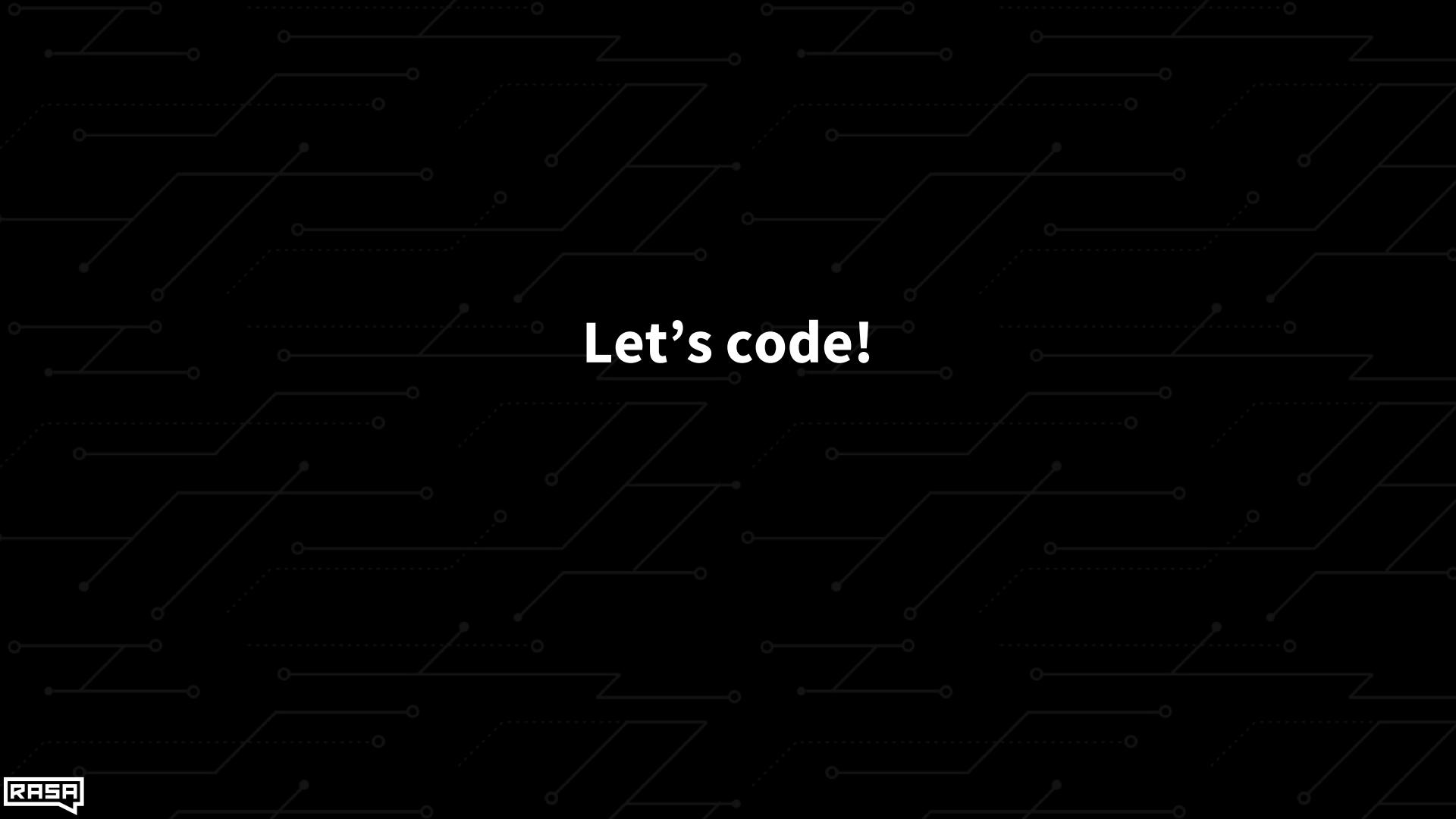
Rasa Core: Dialogue Handling



Rasa Core: Dialogue Handling

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





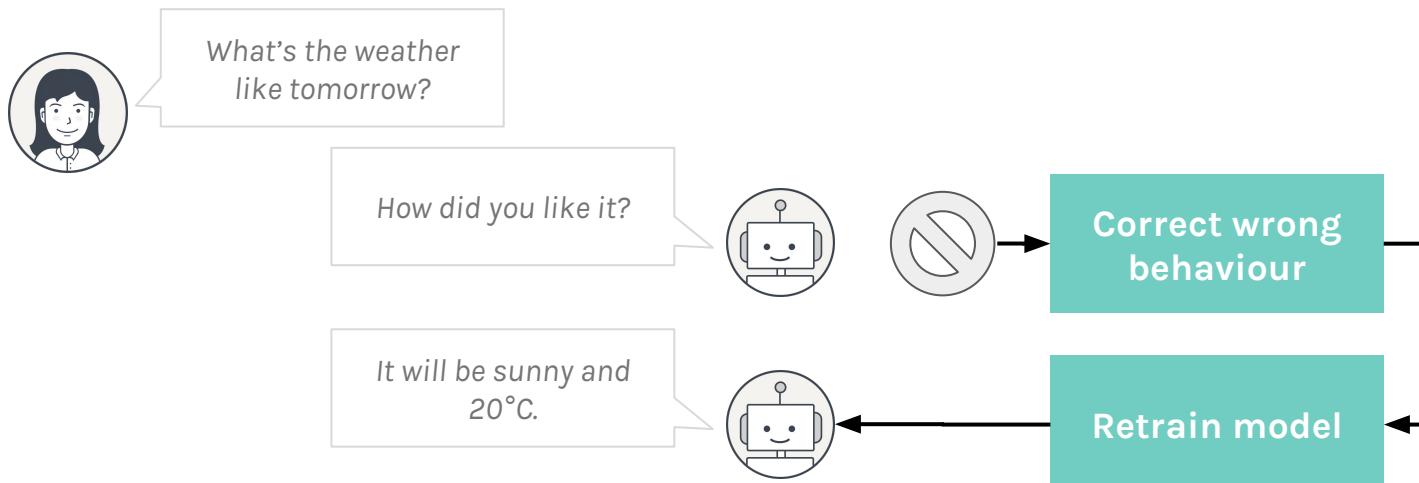
Let's code!

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!

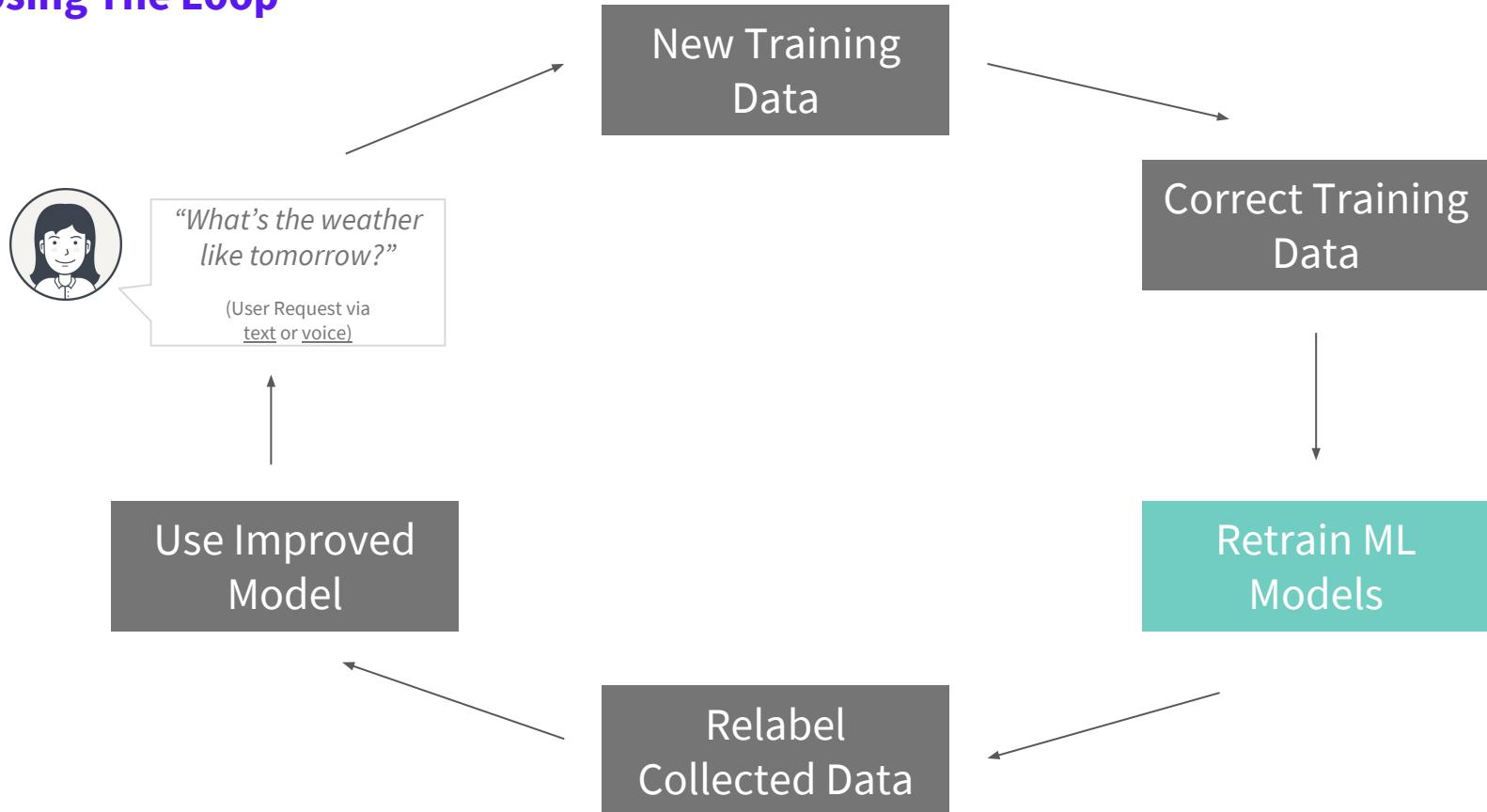
```
## hotel explain 1.3
* request_hotel
  - utter_ask_details
* inform{"location": "paris"}
  - utter_ask_people
* inform{"people": "4"}
  - utter_ask_price
* explain
  - utter_explain_price_hotel
  - utter_ask_price
```

```
## 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!



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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.

