

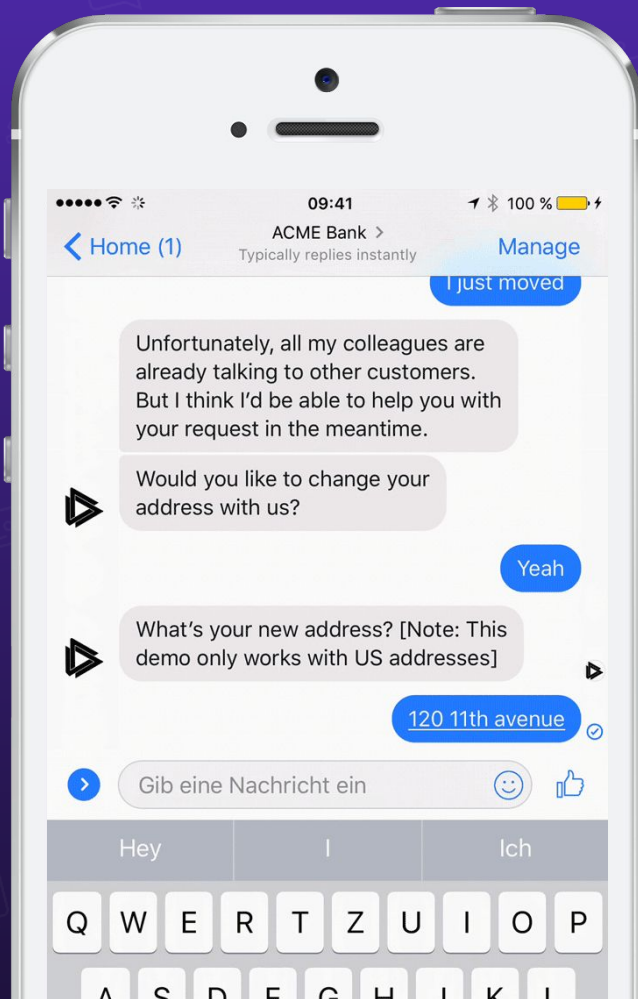
Deprecating the state machine: building conversational AI with Rasa stack

Justina Petraityte, Developer Advocate

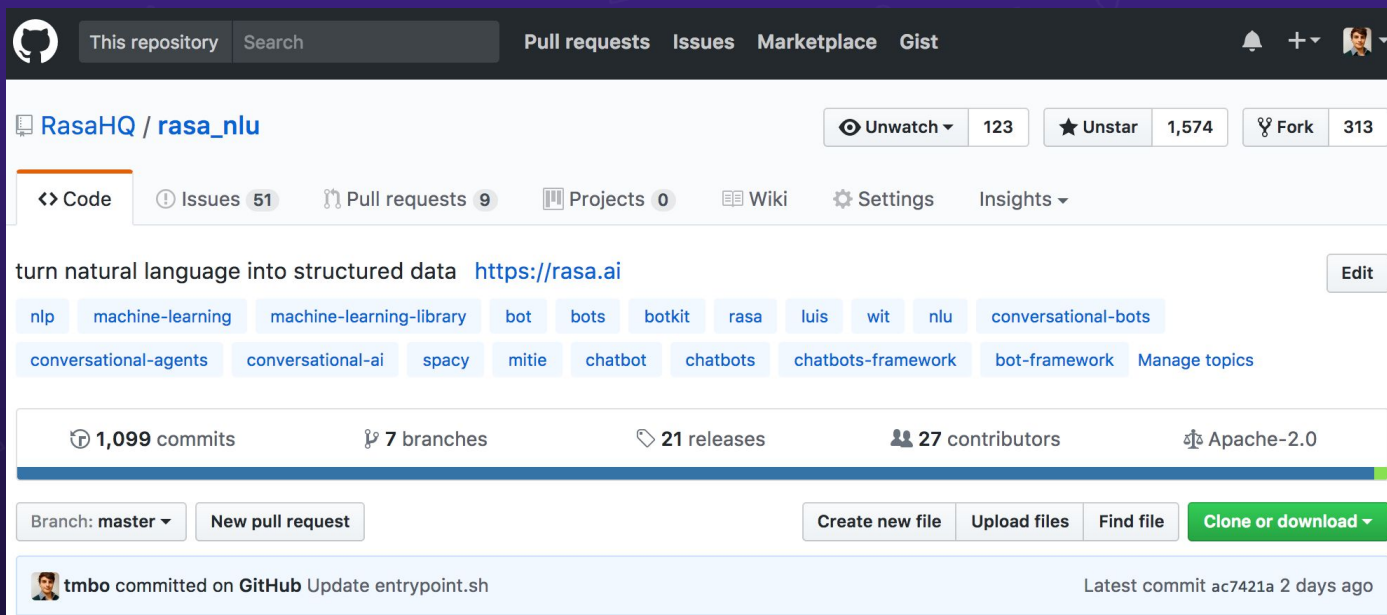
Conversational AI will dramatically change how your customers interact with you.

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



This screenshot shows the GitHub repository page for RasaHQ/rasa_nlu. The repository is described as "turn natural language into structured data" with the URL <https://rasa.ai>. It features a list of tags including 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, and Manage topics. The repository statistics show 1,099 commits, 7 branches, 21 releases, 27 contributors, and the Apache-2.0 license. At the bottom, a commit by tmbo is shown, dated 2 days ago.

GitHub repository page for **RasaHQ / rasa_nlu**.

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

Tags: 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

Repository statistics:

- 1,099 commits
- 7 branches
- 21 releases
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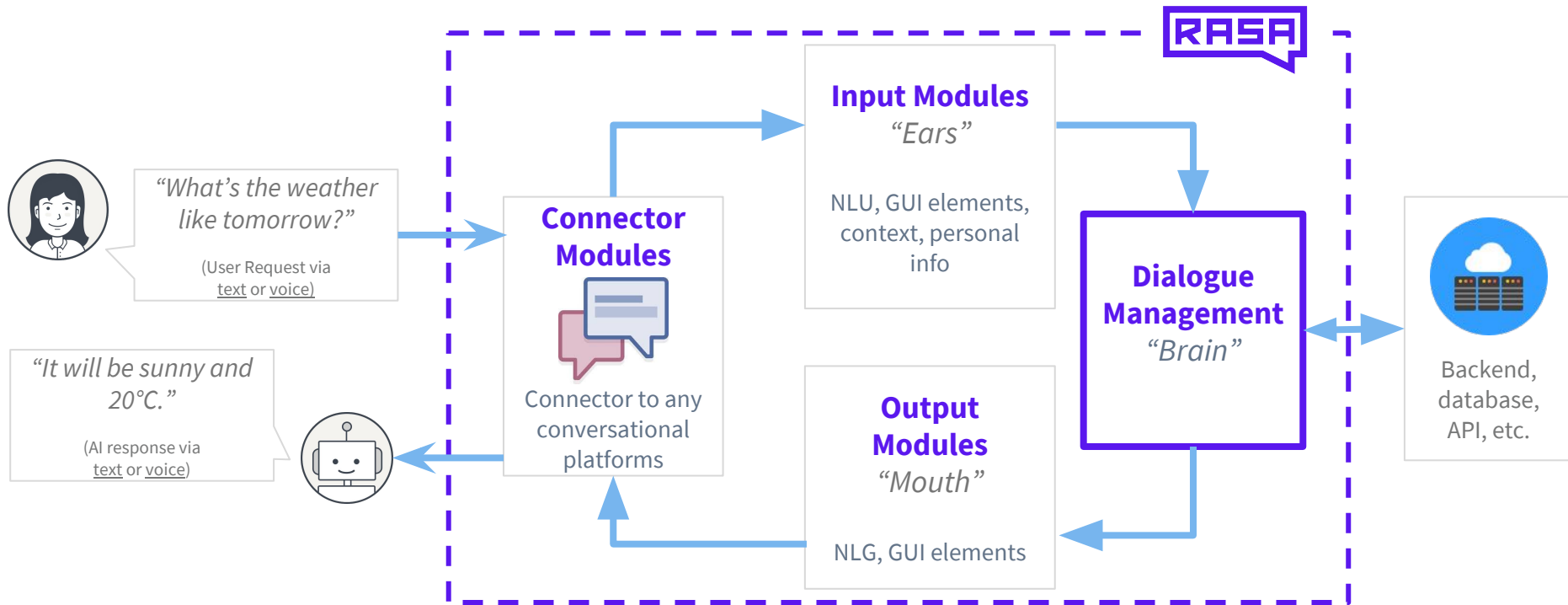
Branch: master | New pull request

Create new file | Upload files | Find file | Clone or download

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

Introduction

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 ad

I have a new address, it's

709 King St, San Francisco

Address

New Entity



Intent

address_change

Natural Language Understanding



What's the
weather like
tomorrow?

Natural Language
Understanding

Example Intent Classification Pipeline

"What's the weather like tomorrow?" { "intent": "request_weather" }

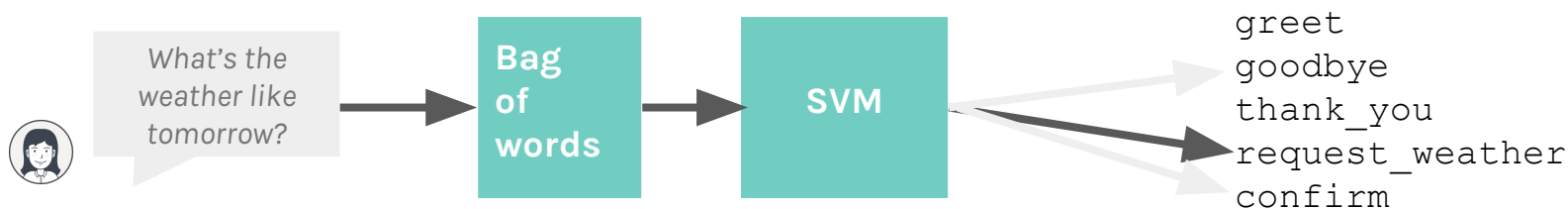
Vectorization

Intent Classification

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



What's the
weather like
tomorrow?

Natural Language
Understanding

Example Intent Classification Pipeline

"What's the weather like tomorrow?" { "intent": "**request_weather**" }

Vectorization

Intent Classification

Example Entity Extraction Pipeline

"What's the weather like **tomorrow**?"

{ "date": "**tomorrow**" }

Tokenizer

Part of Speech
Tagger

Chunker

Entity Extraction

Named Entity
Recognition

Rasa NLU: Entity Extraction

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

↑
cuisine

↑
location

averaged perceptron

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

1. Binary classifier `is_entity` & then `entity_classifier`
2. Direct structured prediction



Let's code!

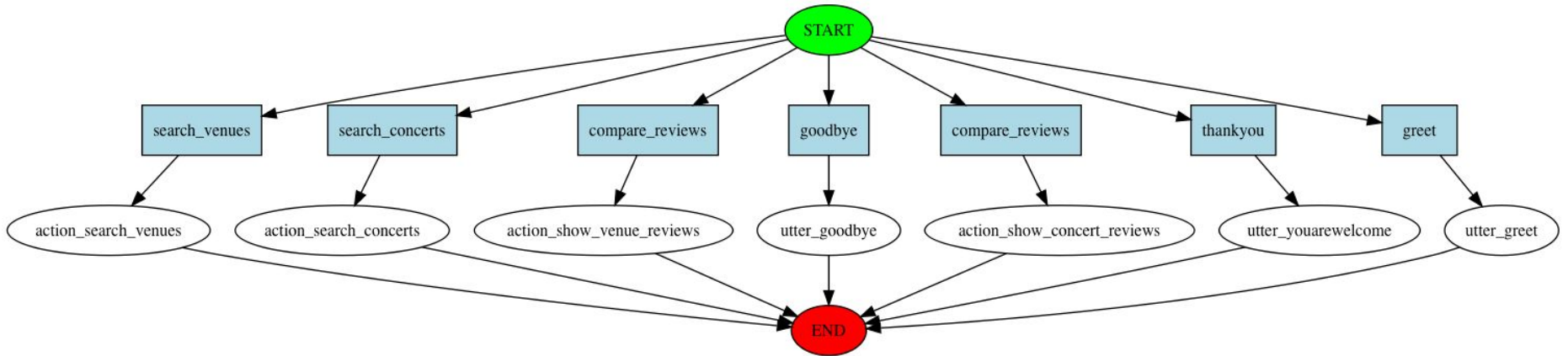
Under the hood Dialogue Management

Why Dialogue Handling with Rasa Core?

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

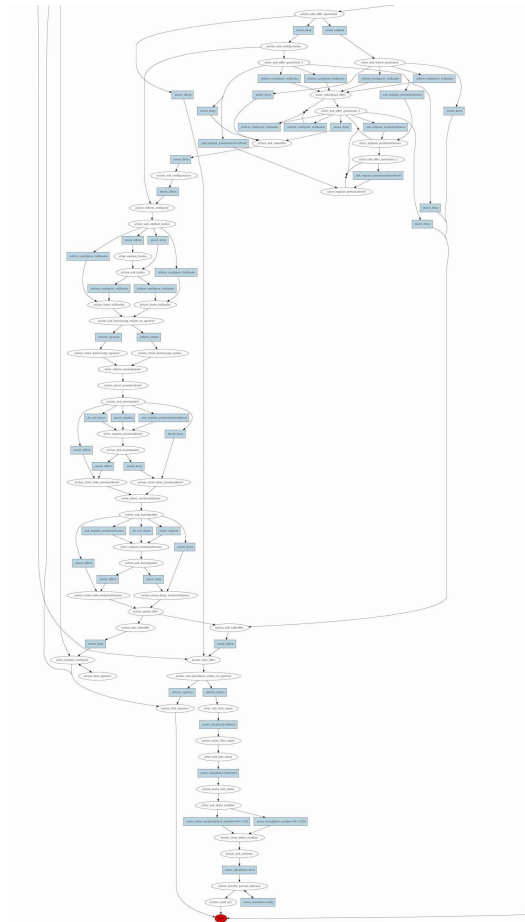
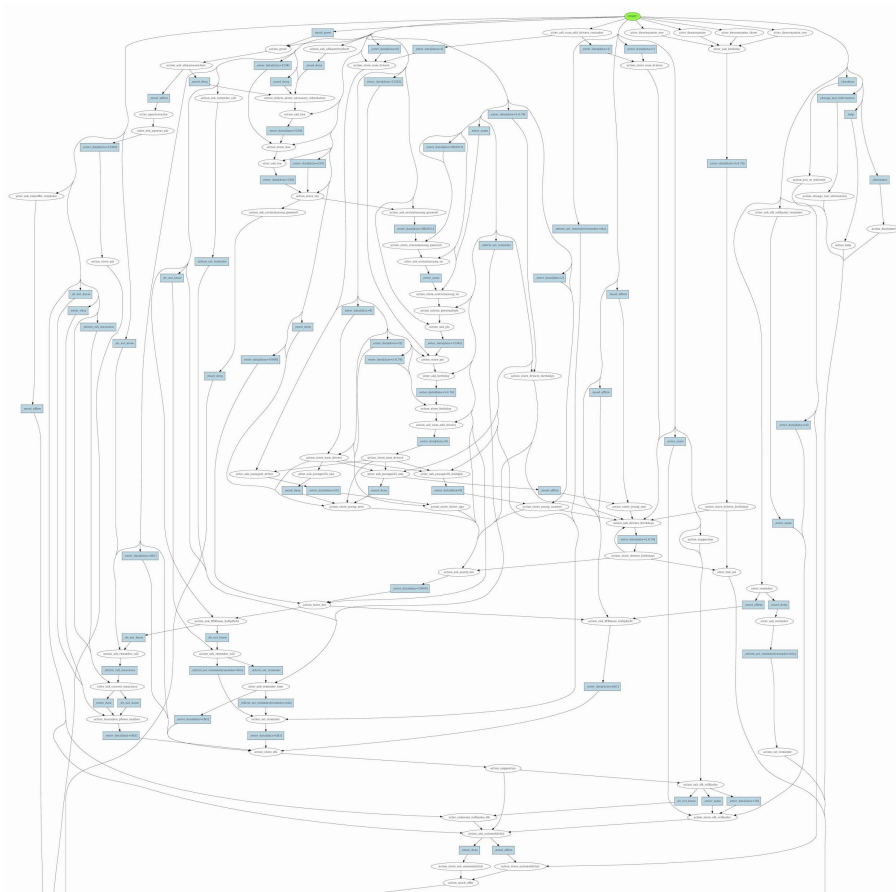


Why Machine Learning?

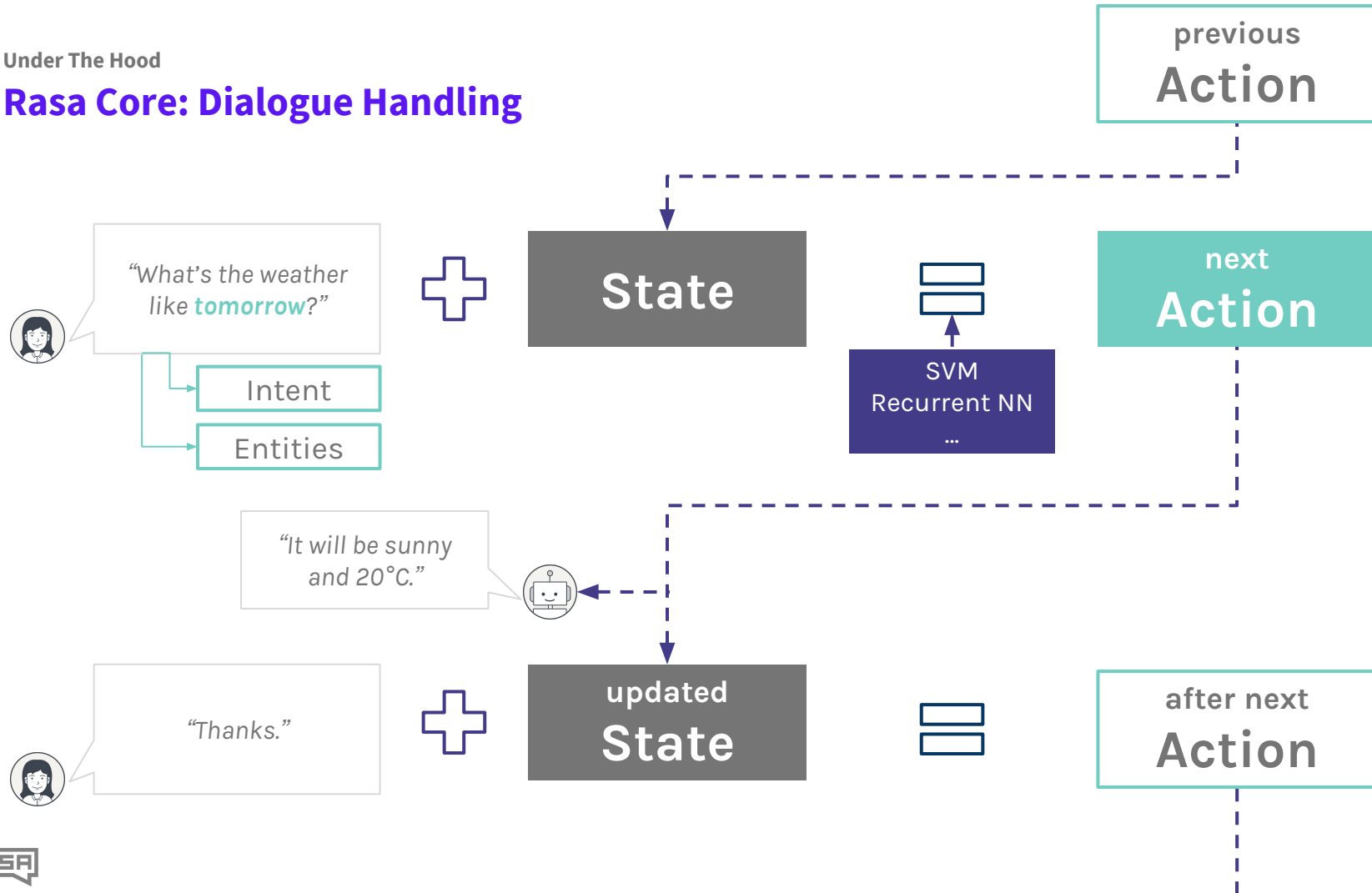


Under The Hood

State Machines are infeasible

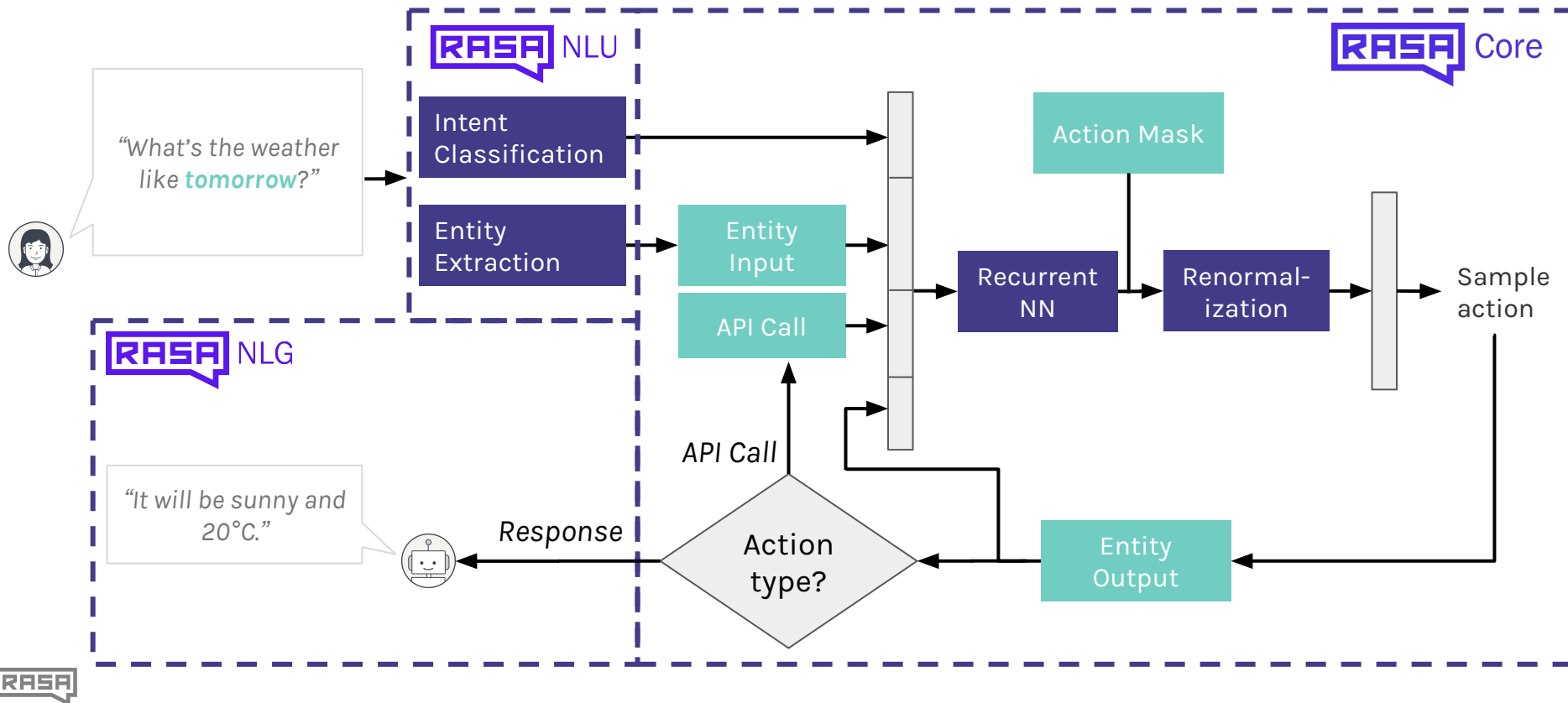


Rasa Core: Dialogue Handling



Rasa Core: Dialogue Handling

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





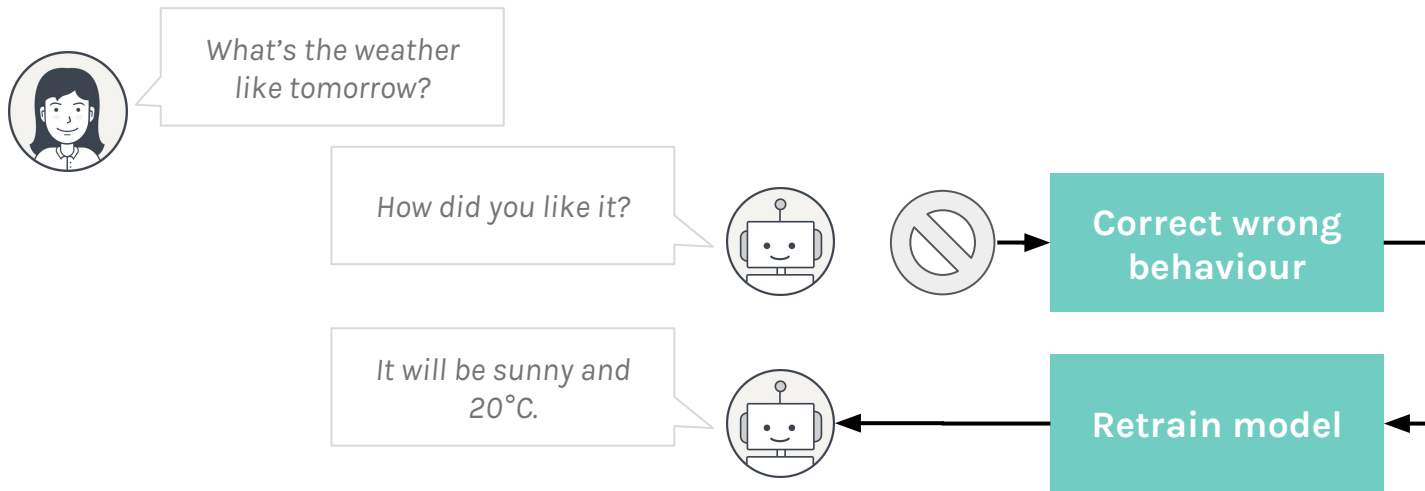
Let's code!

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	<code>greet+dontcare</code>
ok something else then? thanks a bunch	<code>deny+thankyou</code>
cool! Who is the mayor or New York City?	<code>state_happy+random</code>

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

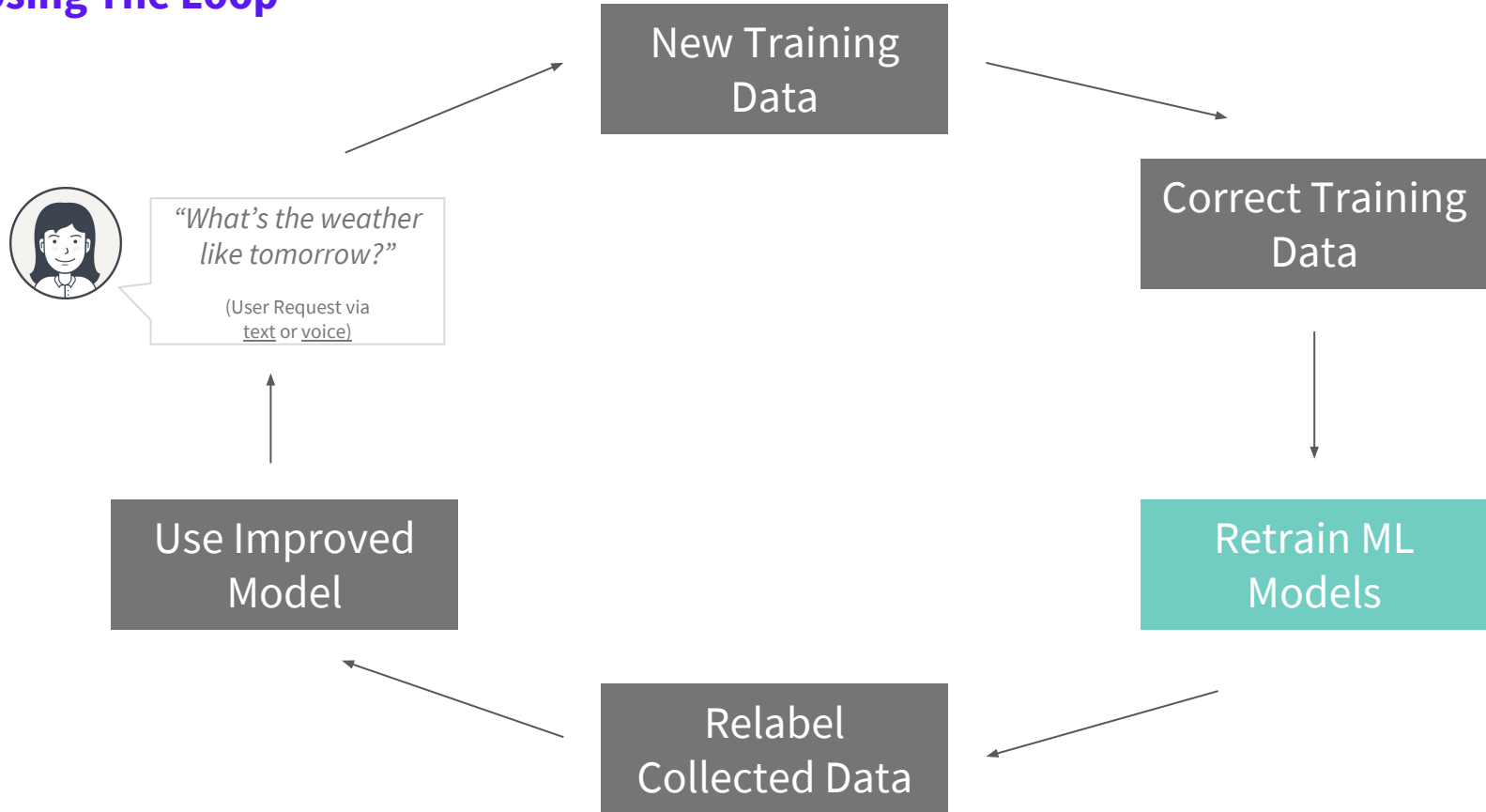
Why do we need this complex architecture? For generalisation between domains!

```
## 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

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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@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.

