COMP 9322
Software Service Design and Engineering

Lecture 5 ChatBots

Disclaimer

- the slides are taken from Cognitive Services Engineering presentation by Sci Prof Boualem Benatallah and Shayan Zamani

ChatBots Future

- “Gartner estimates that by 2020, chatbots will be handling 85 percent of customer-service interactions; they are already handling about 30 percent of transactions now”

http://www.eweek.com/big-data-and-analytics/state-of-chatbots-in-2018-rapidly-moving-into-the-mainstream

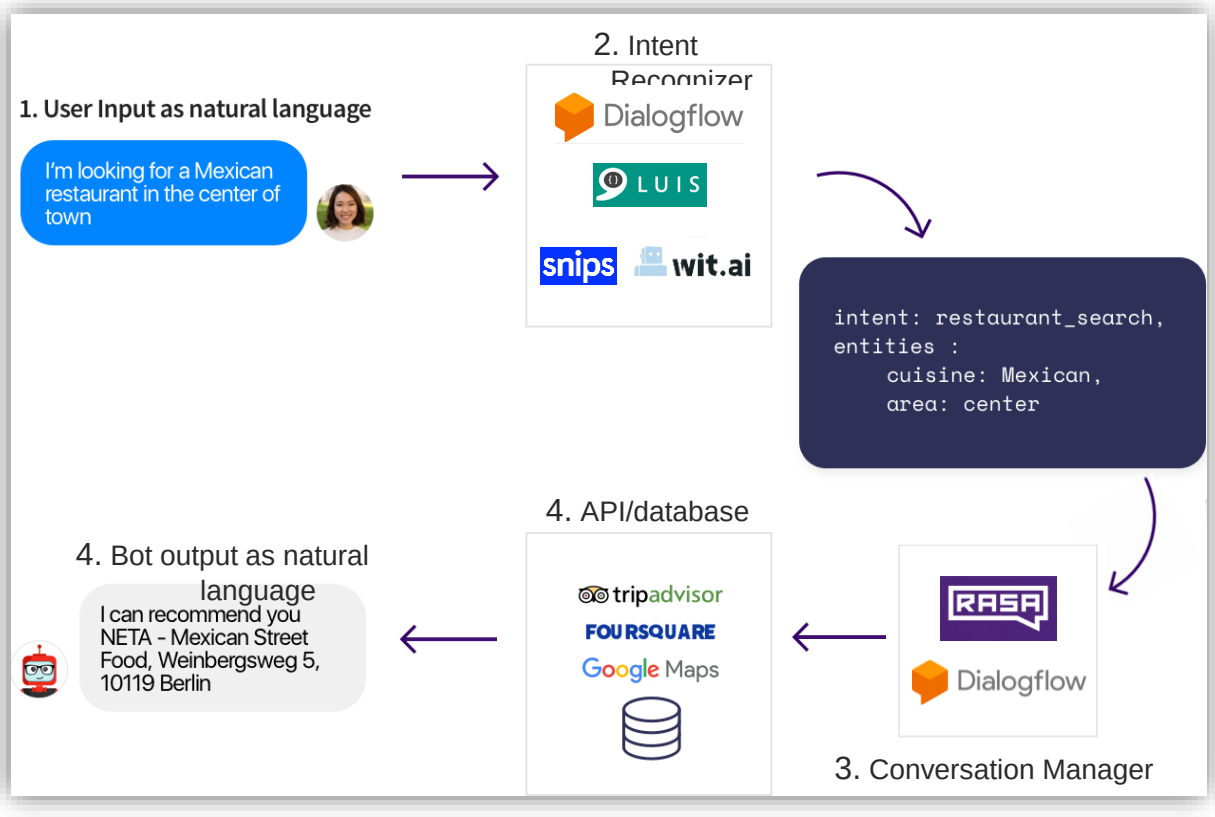
Types of Bots

- Template based (Rule Based)
- Machine Learning Based

Machine Learning-Based Bots

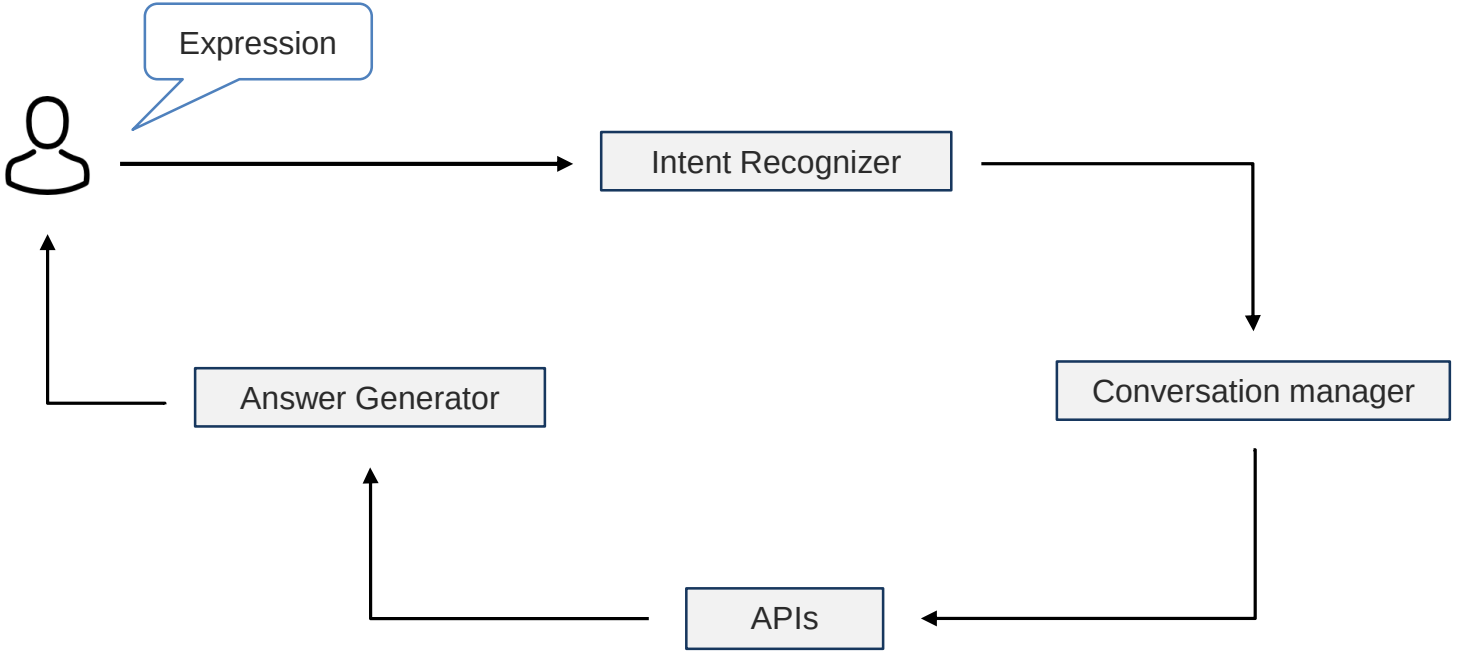
- Need training dataset (user expressions) to train the NLU model
- Need backend-coding (define functions to handle different user intentions)
- Not 100% accurate
- Could be smart enough (amount of training expressions is important)
- Communicates in natural manner (can be controlled/non-controlled natural language)
- For simple/advanced use cases (e.g. order pizza, flight booking, schedule tasks)

Architecture

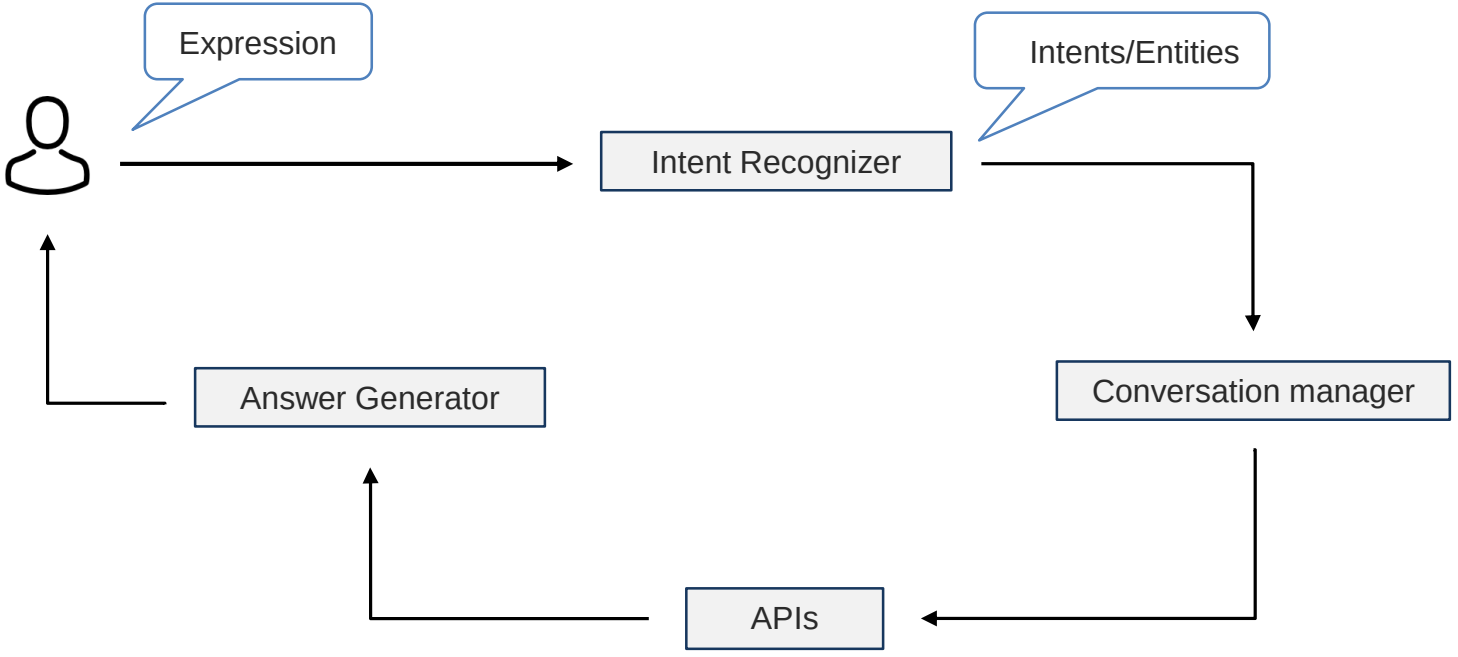


Source: https://www.techcrunch.com

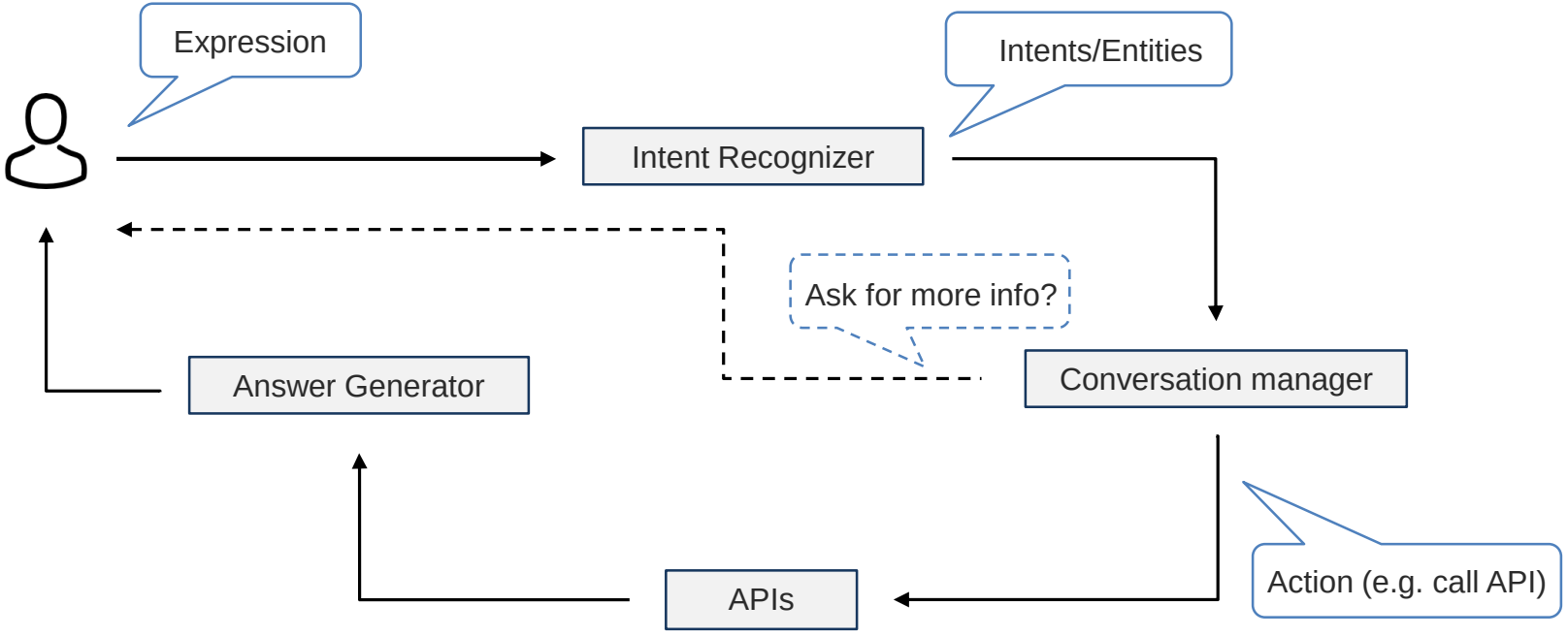
Machine Learning-Based Bots Example Flow



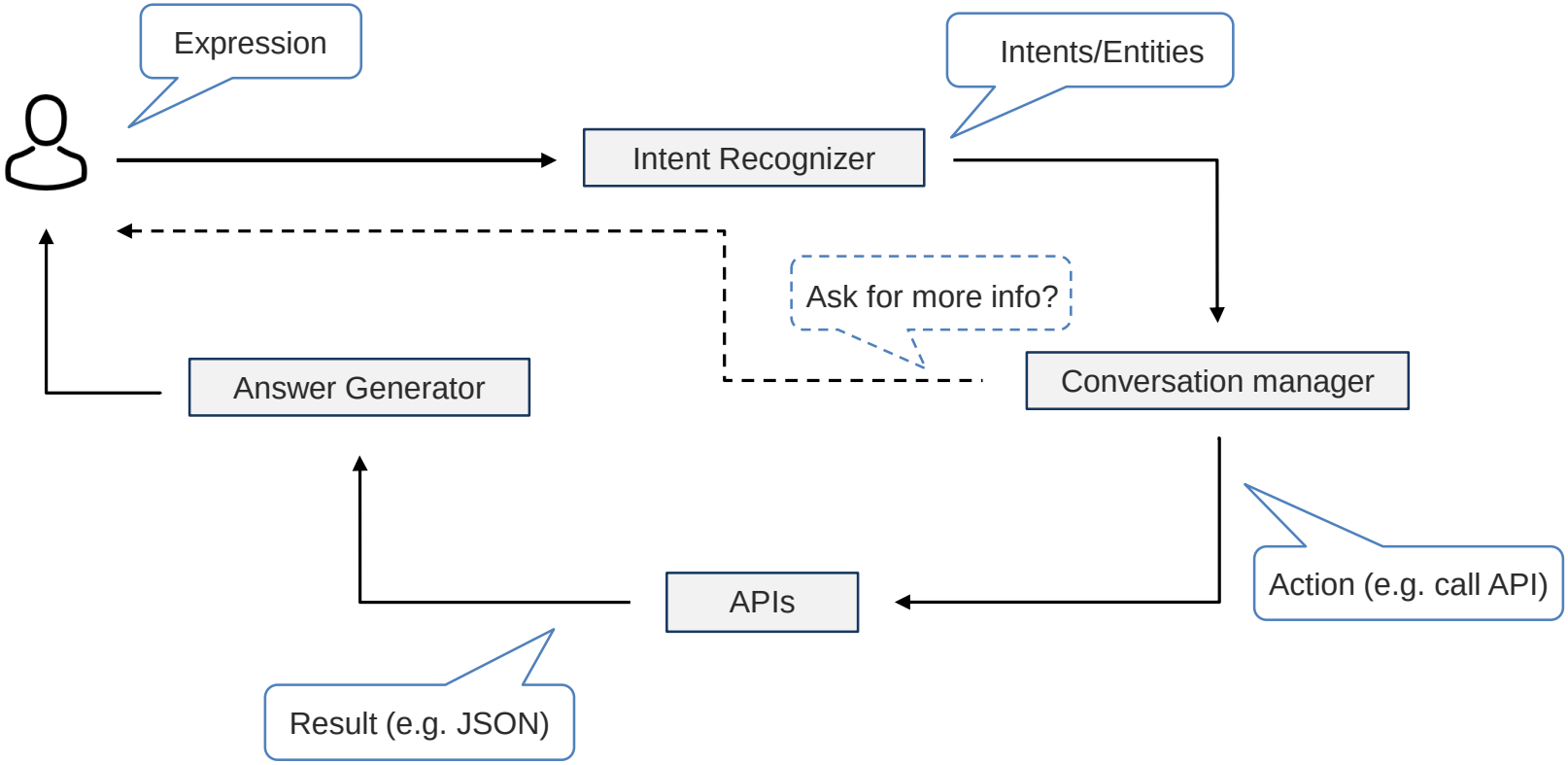
Machine Learning-Based Bots Example Flow



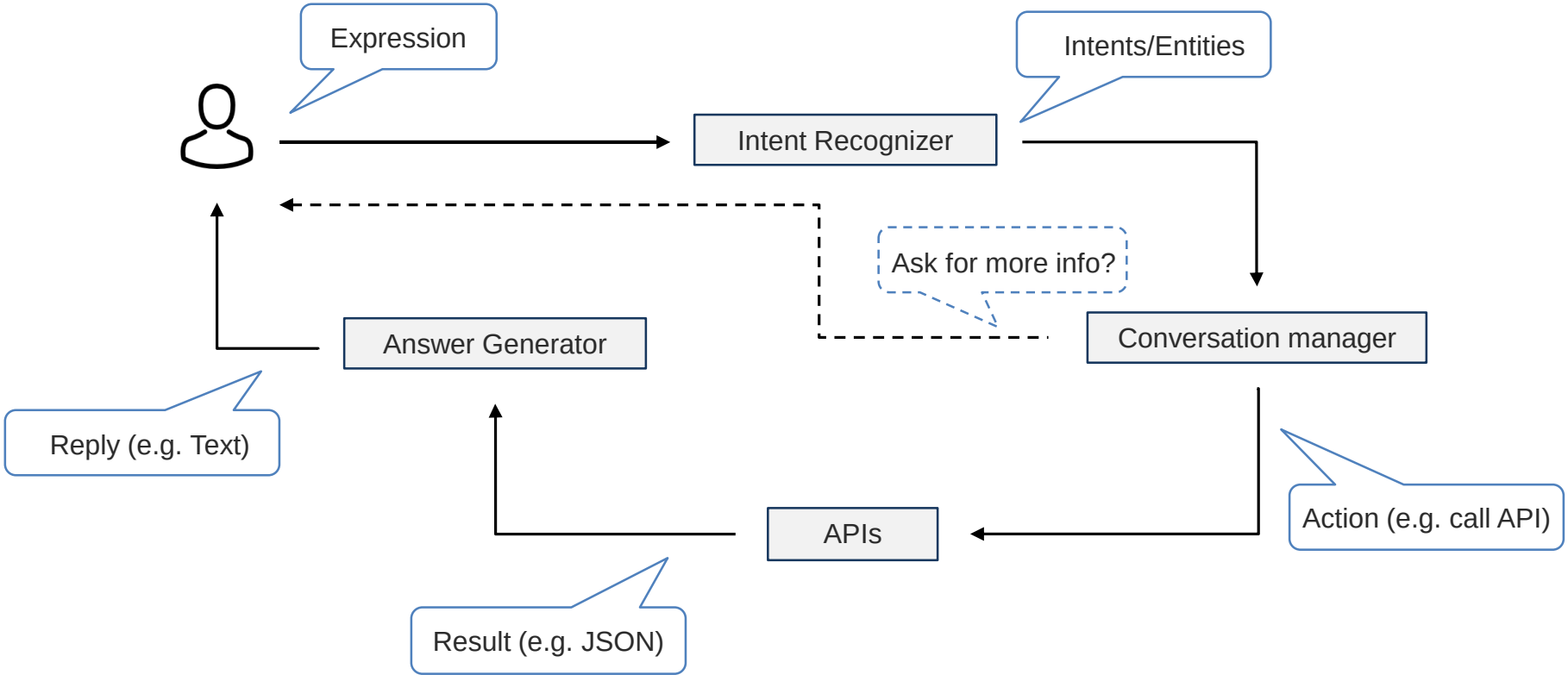
Machine Learning-Based Bots Example Flow



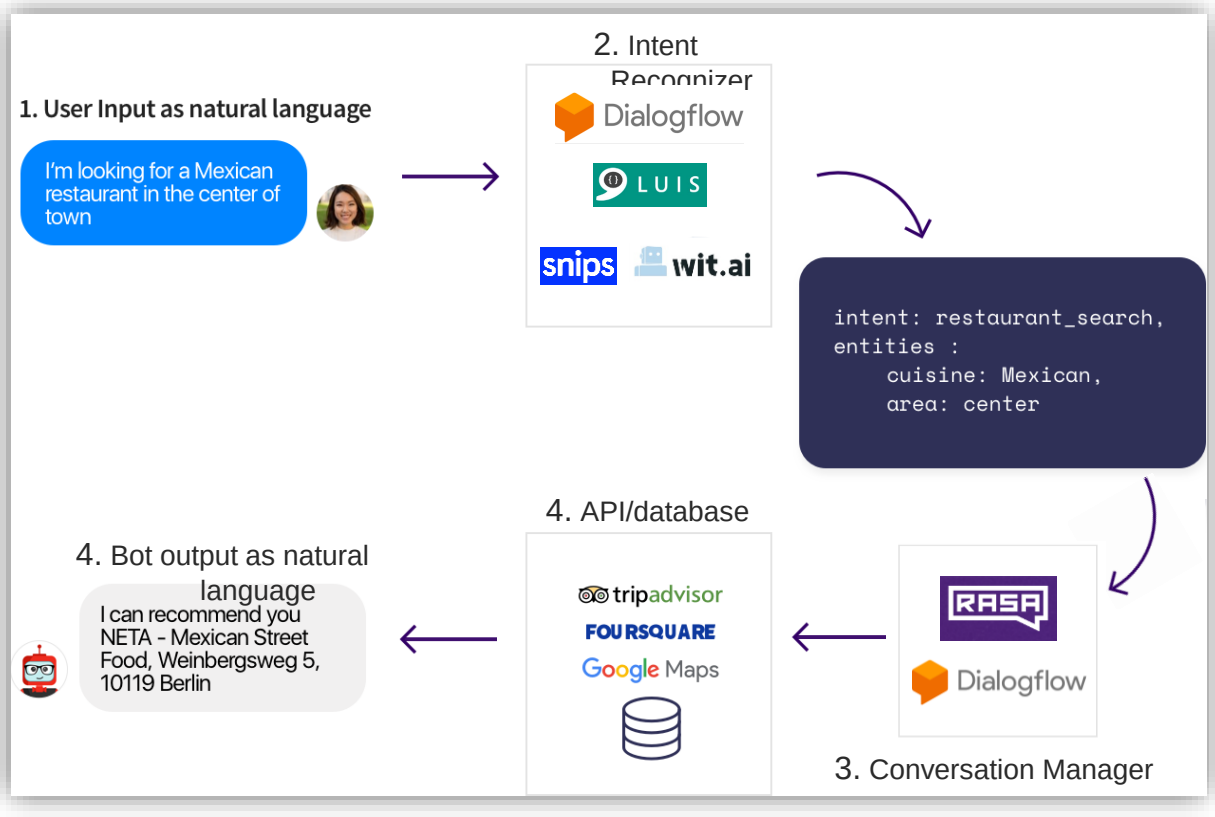
Machine Learning-Based Bots Example Flow



Machine Learning-Based Bots Example Flow



Architecture



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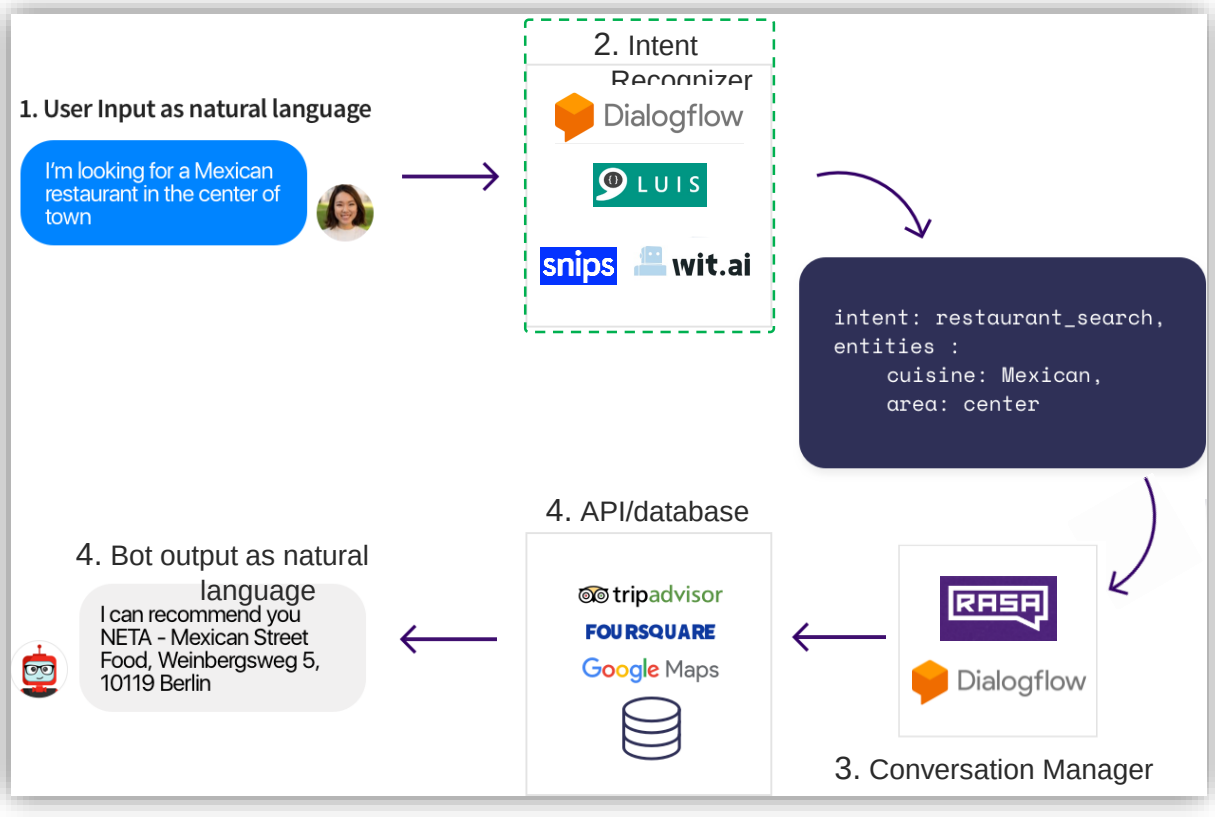
Architecture



Source: https://www.techcrunch.com

Intent Recognizer - Training

Training data for **FindRestaurant** intent

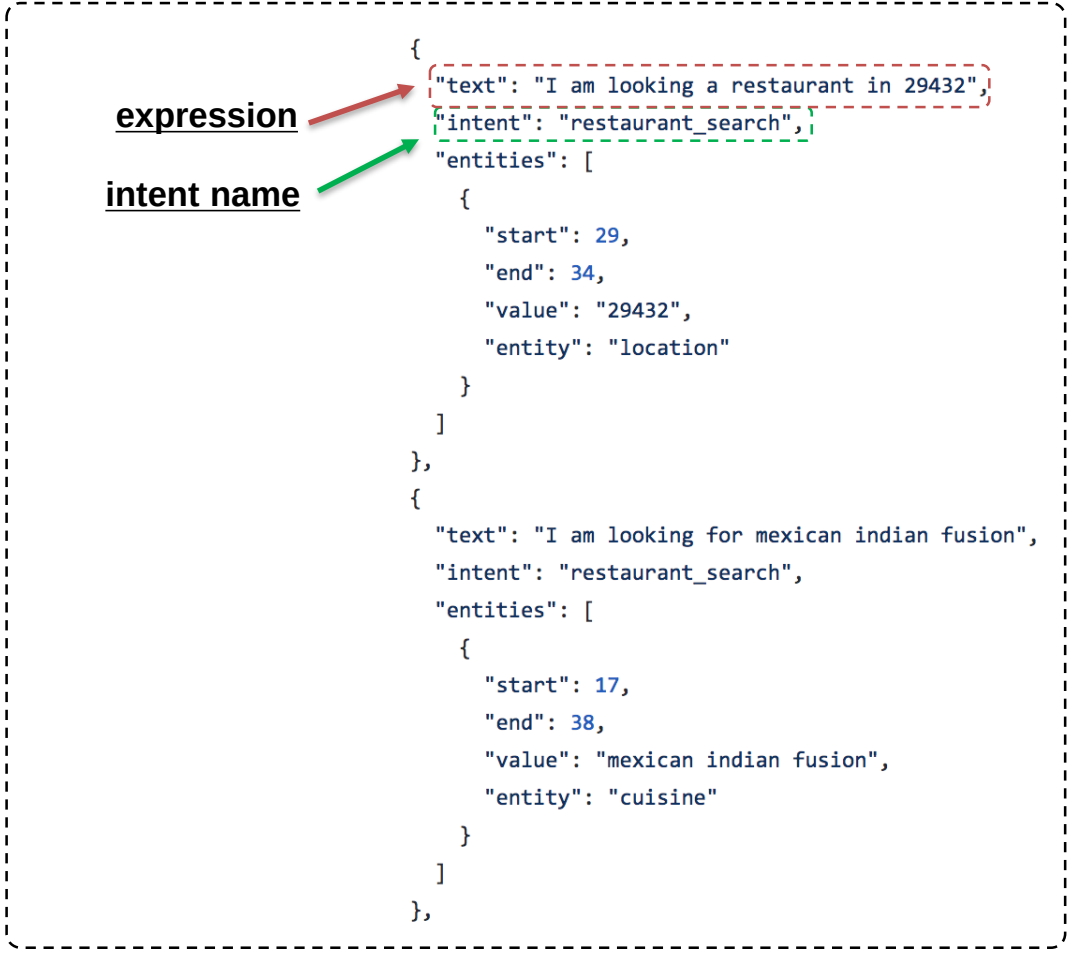

```
{
  "text": "I am looking a restaurant in 29432",
  "intent": "restaurant_search",
  "entities": [
    {
      "start": 29,
      "end": 34,
      "value": "29432",
      "entity": "location"
    }
  ]
},
{
  "text": "I am looking for mexican indian fusion",
  "intent": "restaurant_search",
  "entities": [
    {
      "start": 17,
      "end": 38,
      "value": "mexican indian fusion",
      "entity": "cuisine"
    }
  ]
},
```

Intent Recognizer - Training

Training data for **FindRestaurant** intent

Intent Recognizer - Training

Training data for **FindRestaurant** intent



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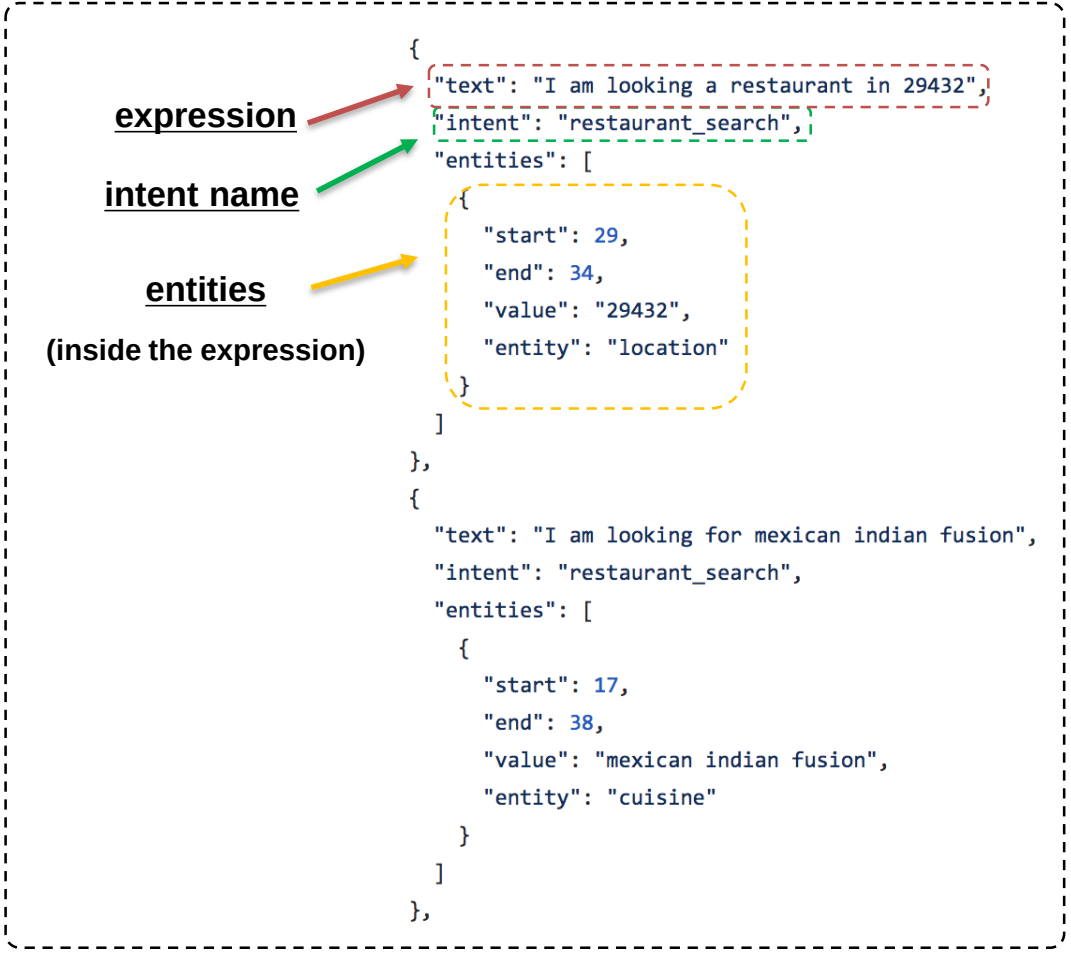

Intent Recognizer - Training

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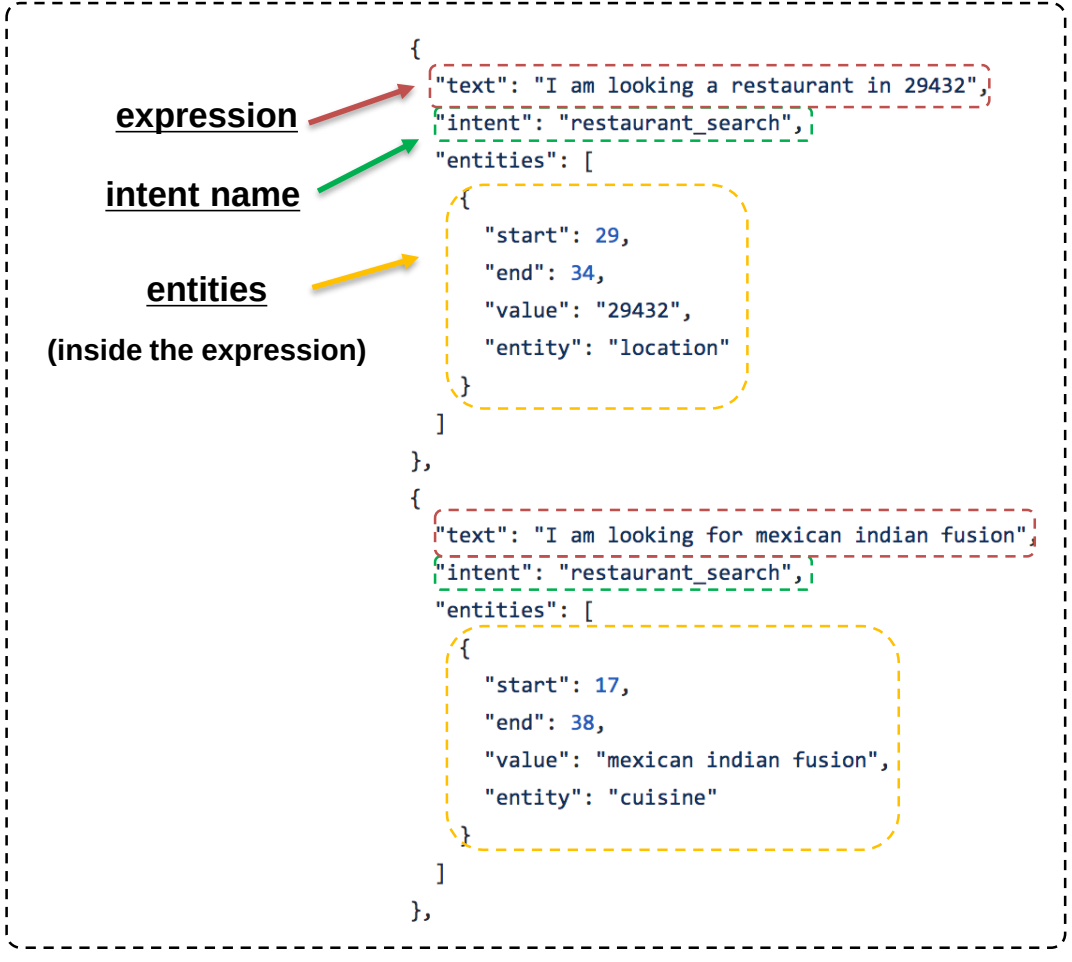


Intent Recognizer - Training

Training data for **Greeting** intent

expression

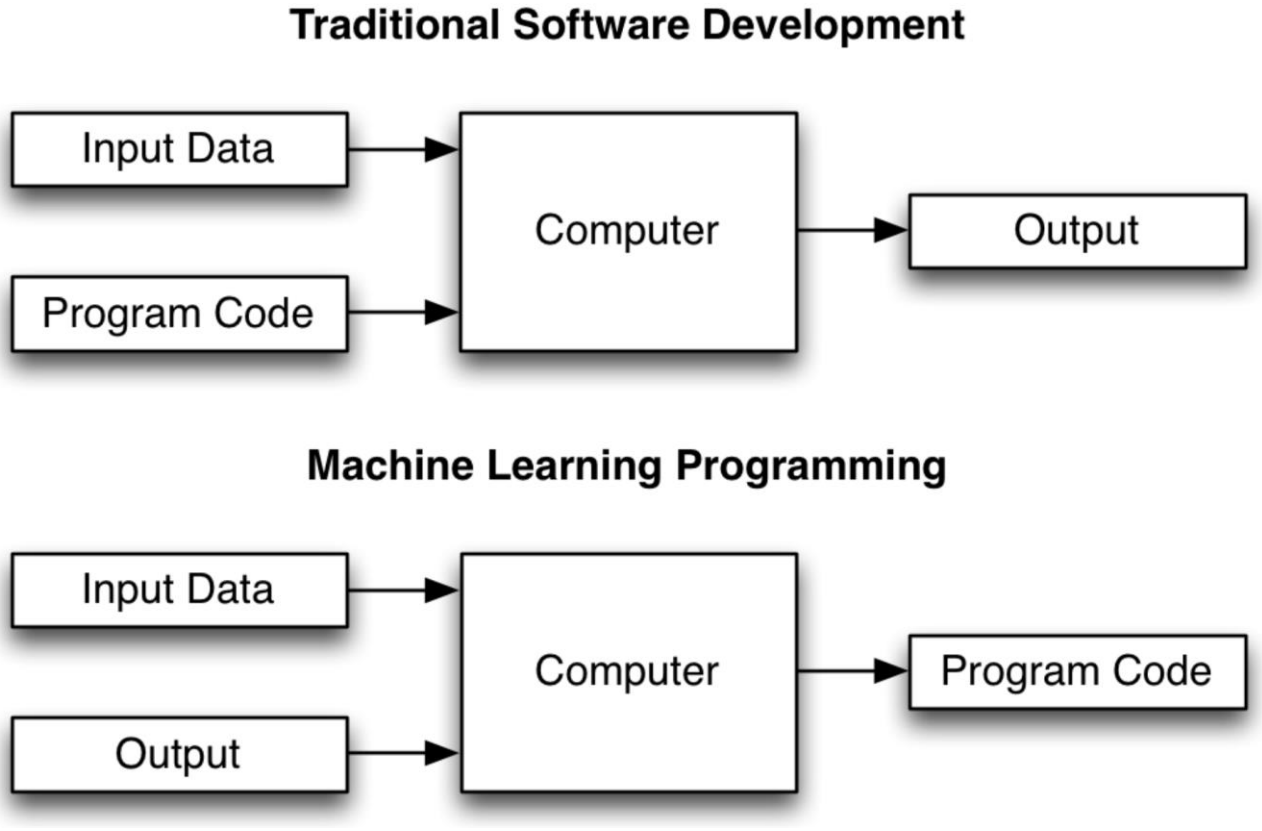
intent name

entities

(inside the expression)

```
{
  "text": "hey",
  "intent": "greet",
  "entities": []
},
{
  "text": "howdy",
  "intent": "greet",
  "entities": []
},
{
  "text": "hey there",
  "intent": "greet",
  "entities": []
},
{
  "text": "hello",
  "intent": "greet",
  "entities": []
},
{
  "text": "hi",
  "intent": "greet",
  "entities": []
},
```

Intent Recognizer - A Machine Learning Model



Source: Applications of Deep Neural Network – Jeff Heaton

Machine Learning Methods

- Linear regression based methods
- Neural Network
- Bayesian Network
- Support Vector Machine (SVM)
- Decision Tree based methods
- Nearest Neighbor
- Logistic Regression
- Naive Bayes
- K-Means
- Random Forest
- Dimensionality Reduction methods
- …

Machine Learning Models

- **Predictive Modeling**: Predict the output using input values
- **Computer Vision**: Detect patterns in visual data
- **Time Series**: Detect patterns in in time e.g. financial applications, speech recognition

Source: Applications of Deep Neural Network – Jeff Heaton

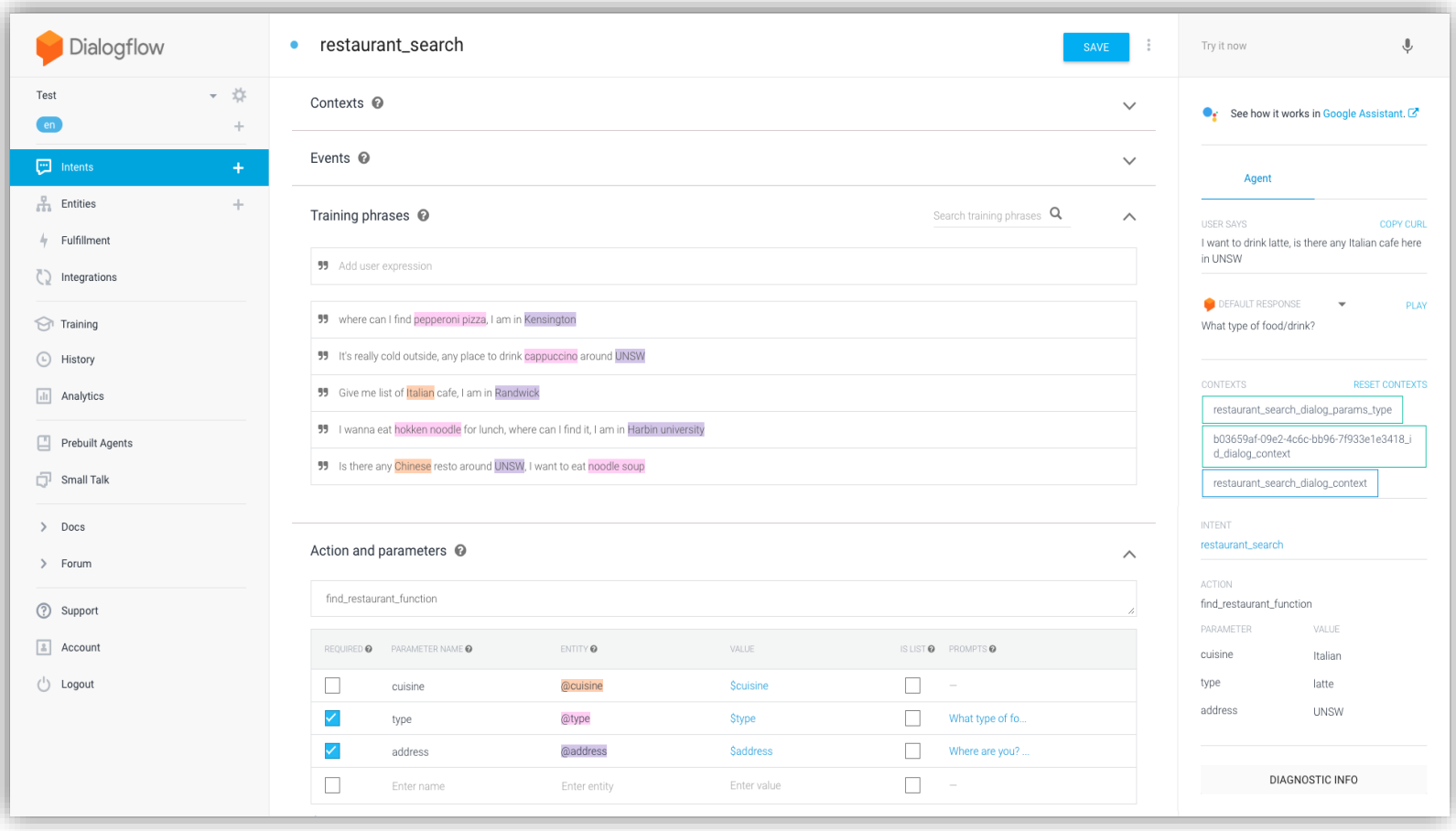
Intent Recognizer - A Machine Learning Model

- Intent Classification
  - MITIE intent classifier - multi class linear SVM, Nearest Neighbors, Neural Embedding intent classifier, Sklearn intent classifier - Linear SVM, Naive Bayes…
- Entity Recognition
  - CRF (conditional random field), Duckling, MITIE, Spacy - BILUO transition model,

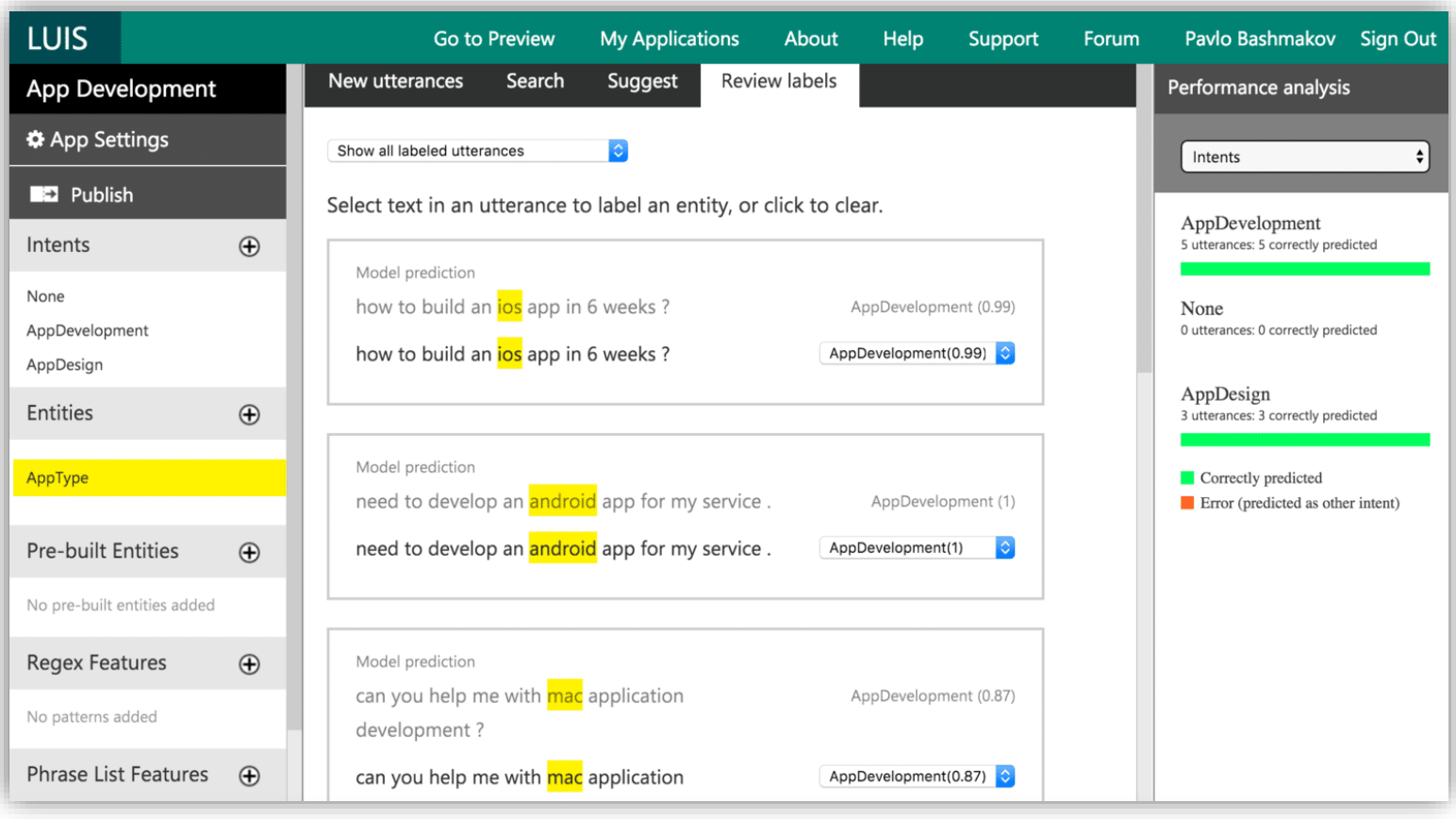
Intent Recognizer - Acquisition

- **Experts**
  - **Expensive/Quality is high**
- **Crowds**
  - **Cheaper/Quality is less than expert training**
- **Algorithms**
  - **Automatic Generating/Quality depends on algorithm**
  - **Examples: Chatito, Tracy**

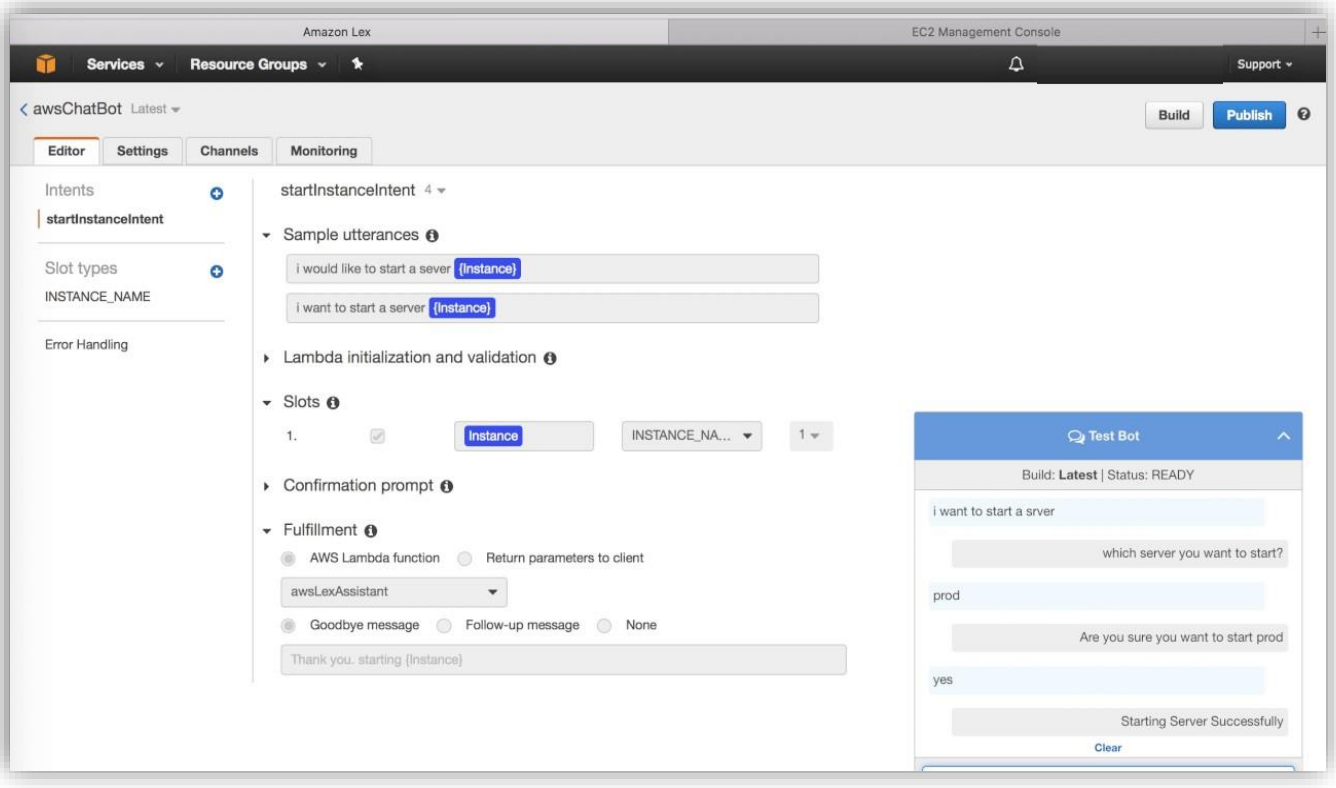
Intent Recognizer (DialogFlow)



Intent Recognizer (LUIS)

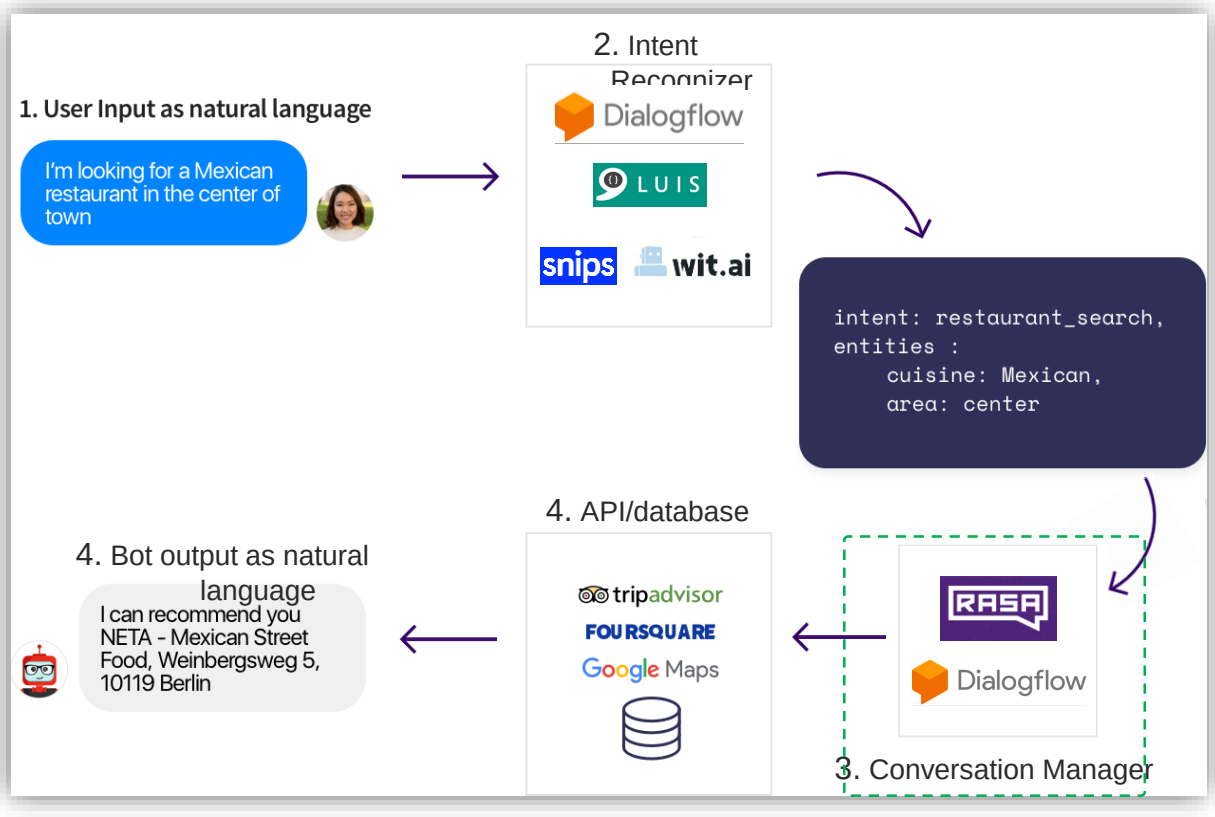


Intent Recognizer (LEX)



Intent Recognizer Examples

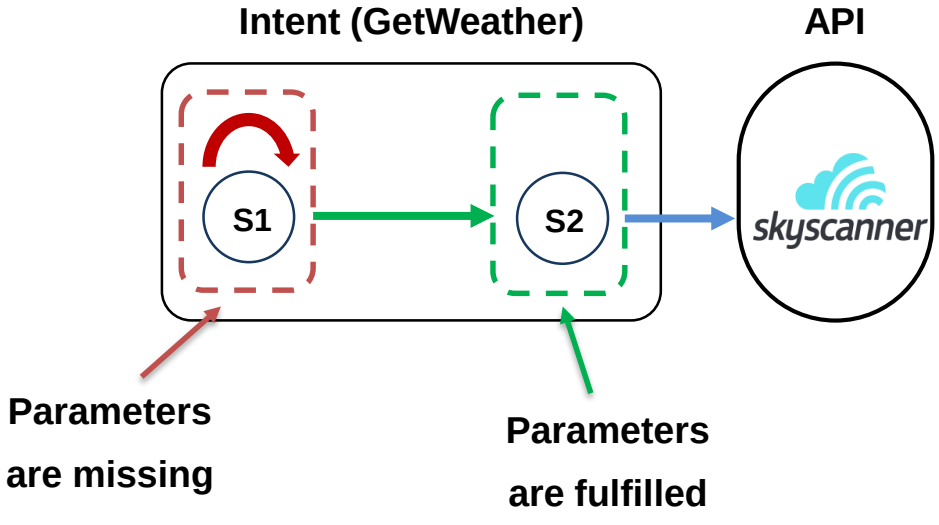
Architecture



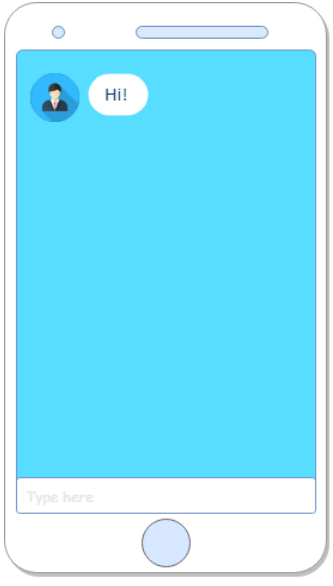
Source: https://www.techcrunch.com

Conversation Manager

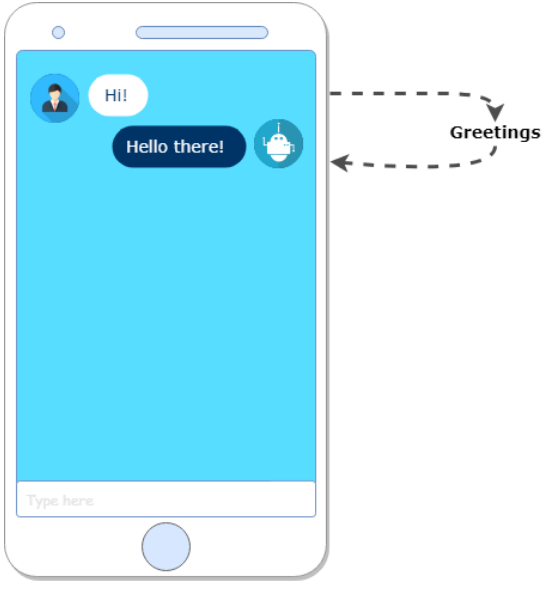
- Each intent (e.g. Get Weather) is a state machine
- Conversation Manager moves between states (to fill missing information)



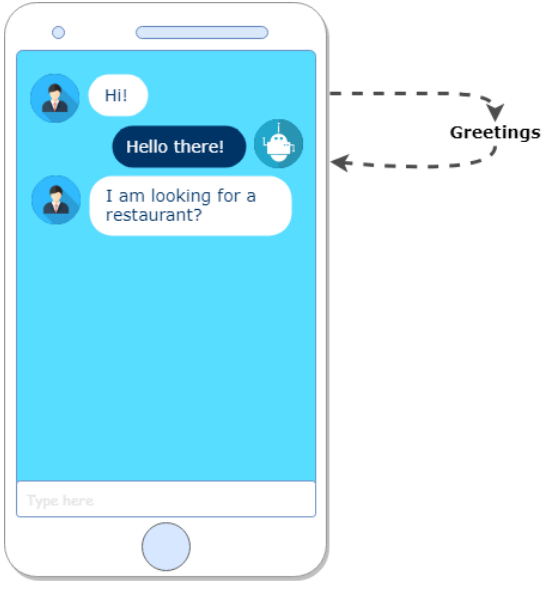
Conversation Manager



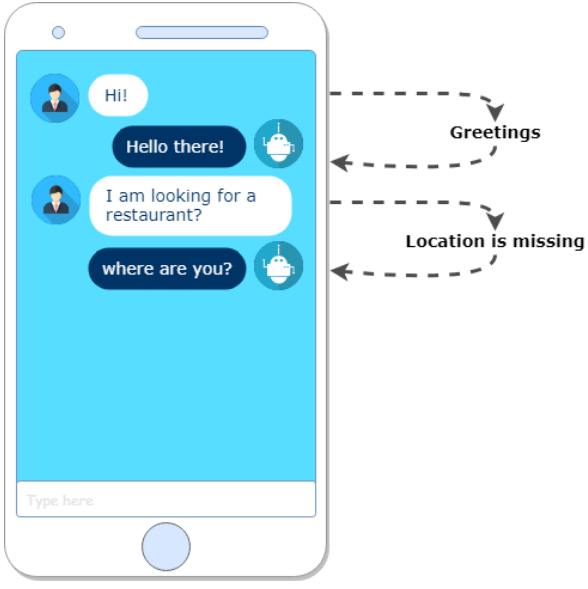
Conversation Manager



Conversation Manager

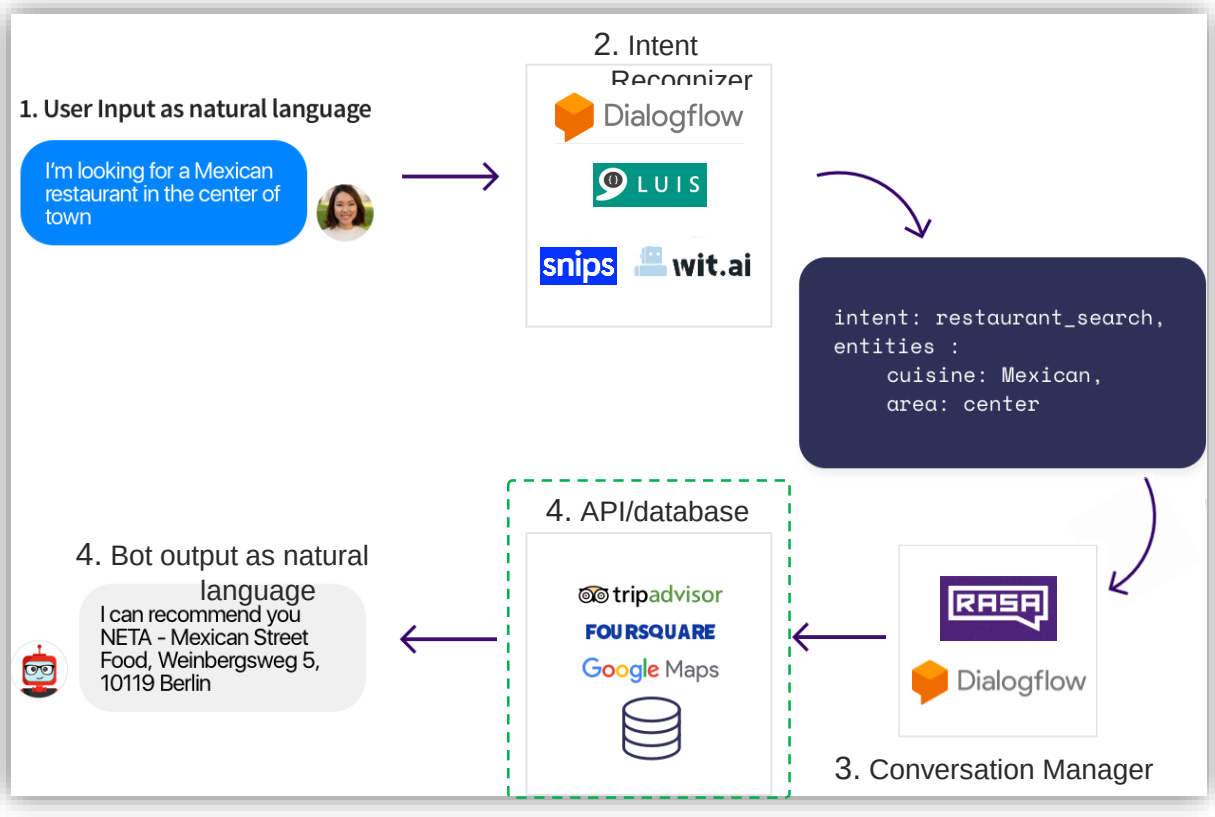


Conversation Manager



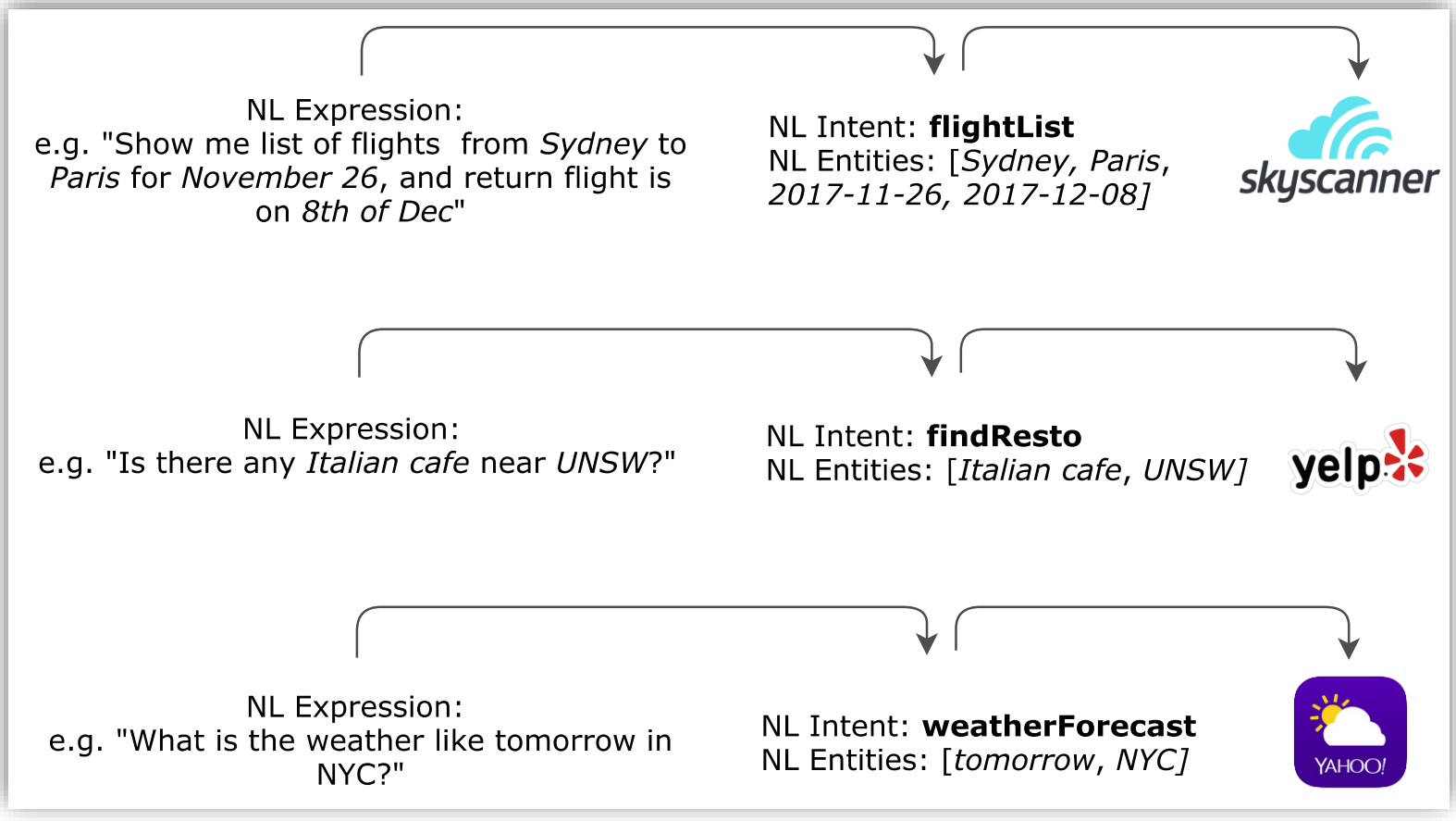
Conversation Manager

Architecture

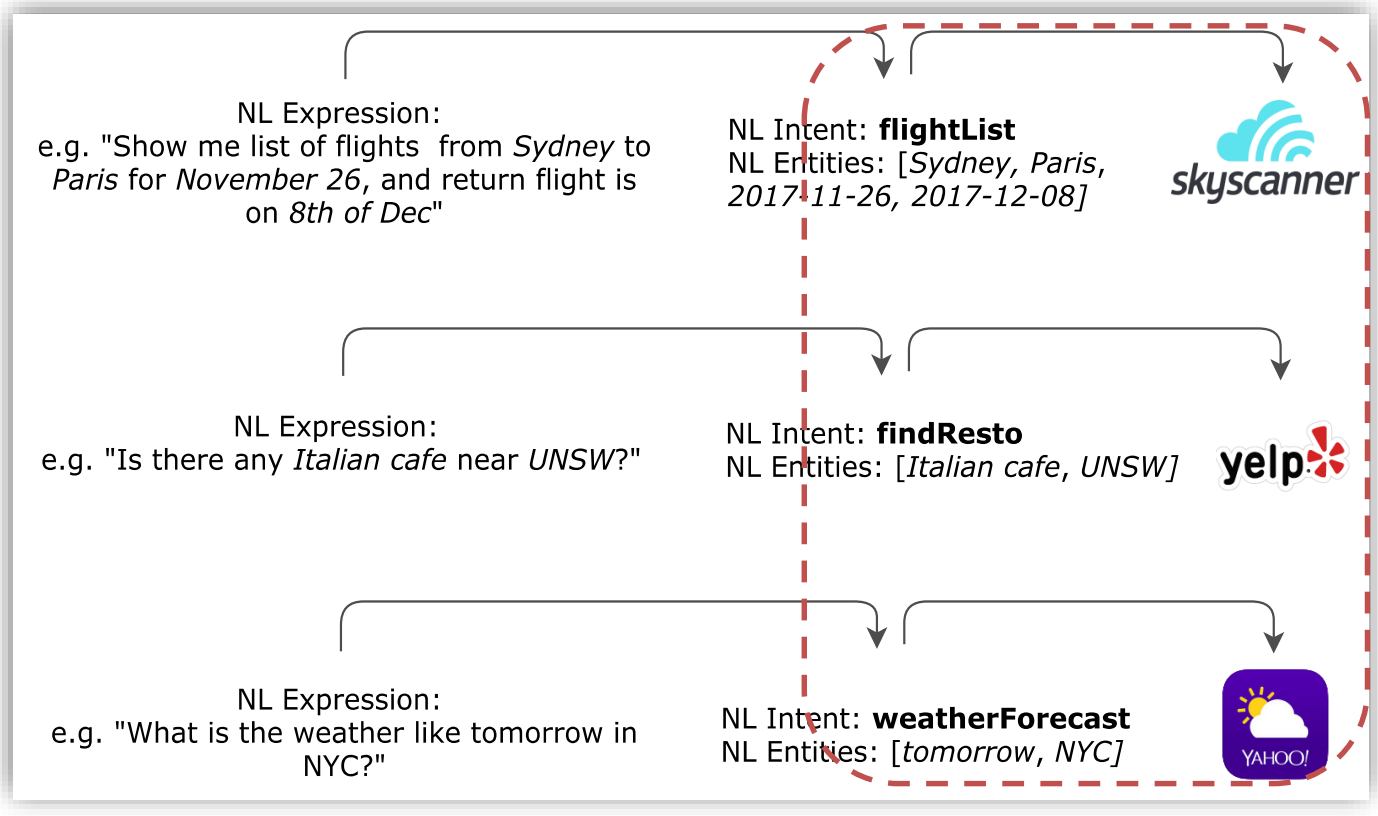


Source: https://www.techcrunch.com

User Utterances | Intents | APIs Integration



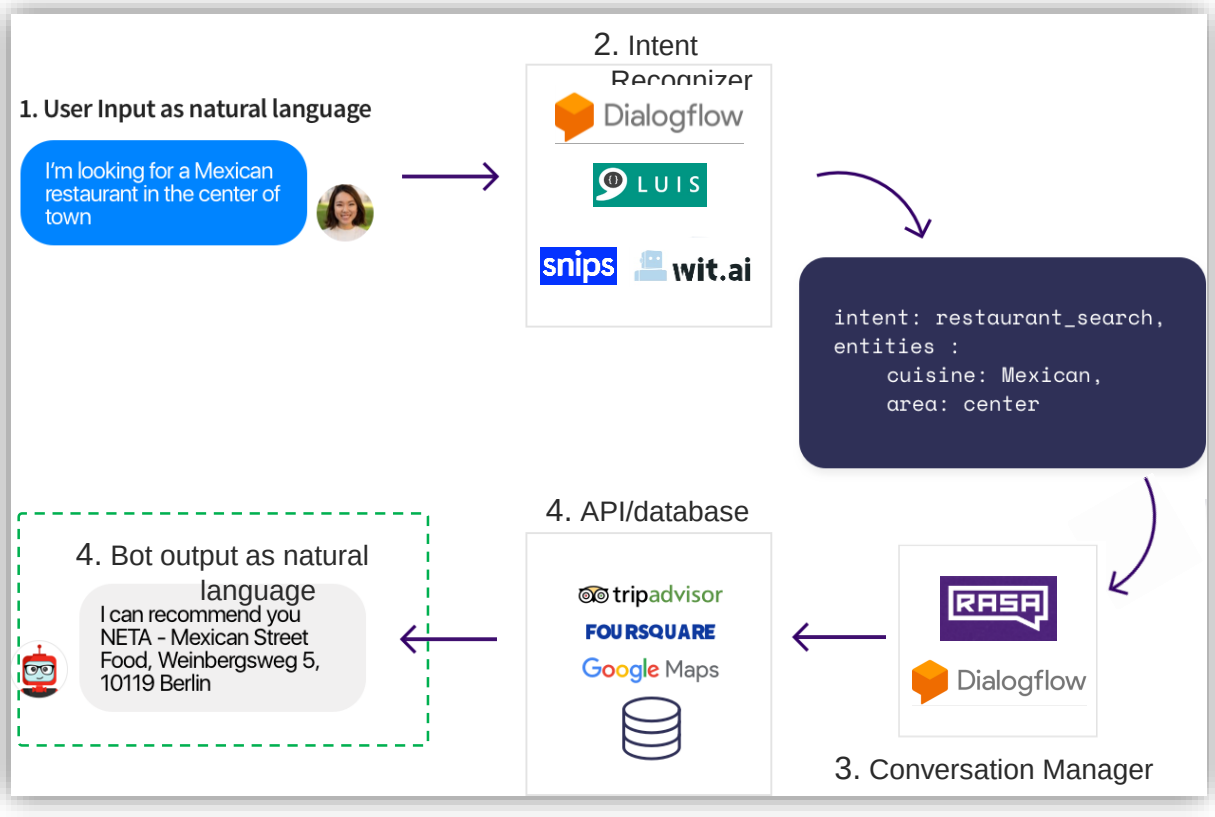
User Utterances | Intents | APIs Integration



Static Hardcoded Mappings (e.g., Alexa Skills)

Google DialogFlow, Facebook Wit.ai, Amazon Lex, Microsoft LUIS

Architecture



Source: https://www.techcrunch.com

Answer Generator

```
templates
    weather_condition:
        - text: "The weather in {city} is {weather_description}."
```

Template


```
"coord": {
    "lon": 126.62,
    "lat": 45.77
},
"weather": [
    {
        "id": 800,
        "main": "Clear",
        "description": "clear sky",
        "icon": "01d"
    }
],
"base": "stations",
"main": {
    "temp": 302.15,
    "pressure": 1007,
    "humidity": 58,
    "temp_min": 302.15,
    "temp_max": 302.15
},
"visibility": 10000,
"wind": {
    "speed": 2,
    "deg": 130
},
"clouds": {
    "all": 0
},
"dt": 1531303200,
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```
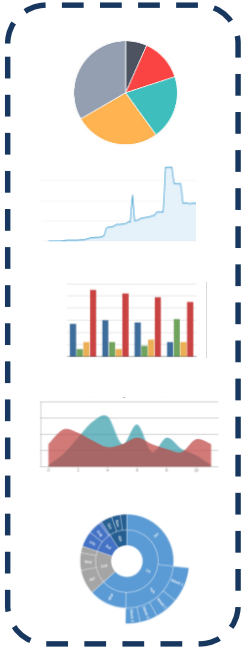


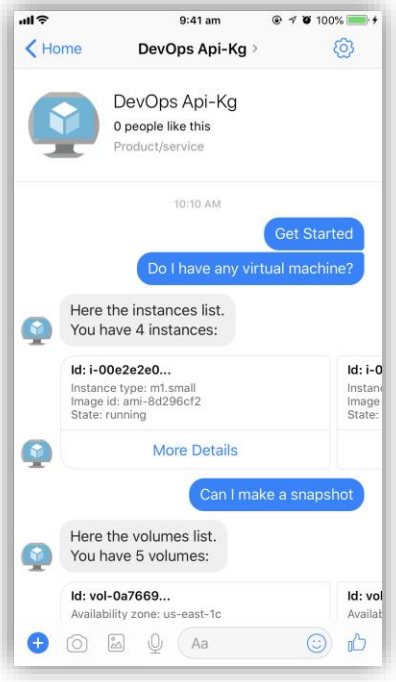
Dump output

(e.g. JSON)



Widgets

DevOps bot

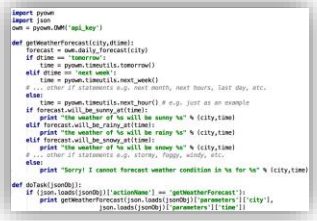


Messaging Interface (Messenger)

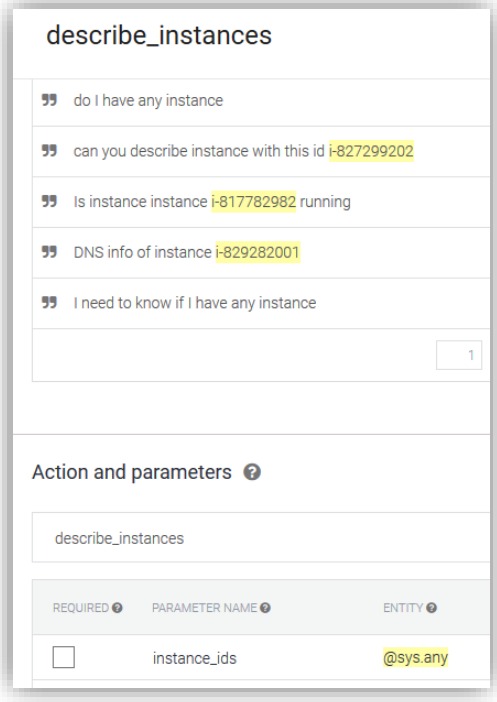
1

amazon web services™

aws API Backend

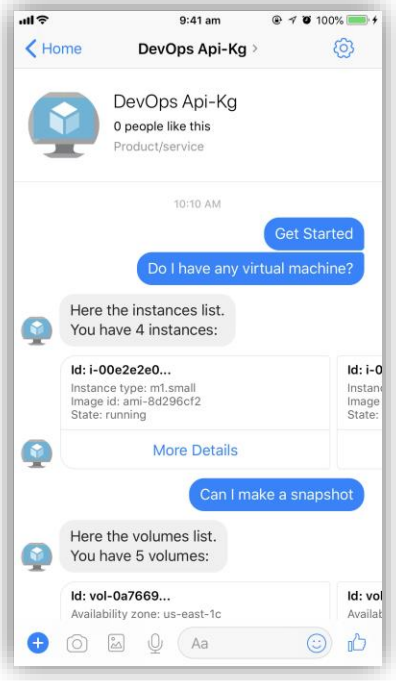


Webhook (NodeJS)



Intent Recognizer (Dialogflow)

DevOps bot

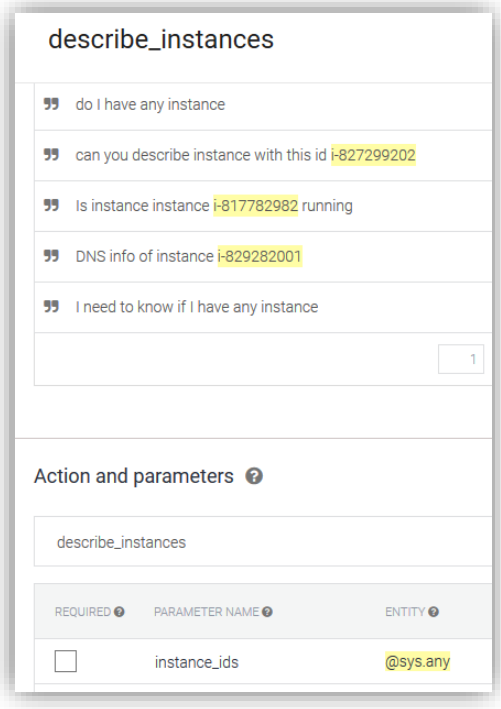


Messaging Interface (Messenger)

1

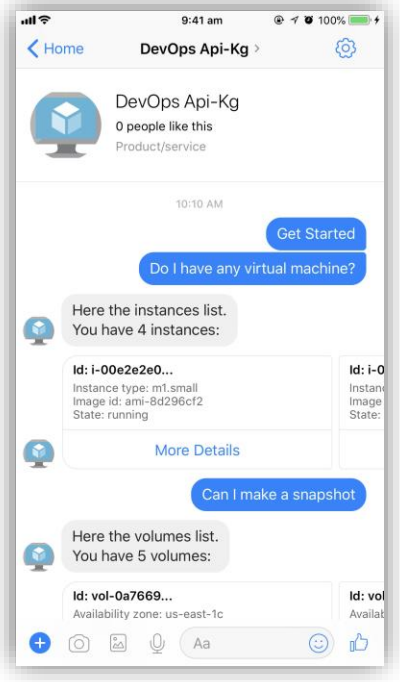
2

Webhook (NodeJS)



Intent Recognizer (Dialogflow)

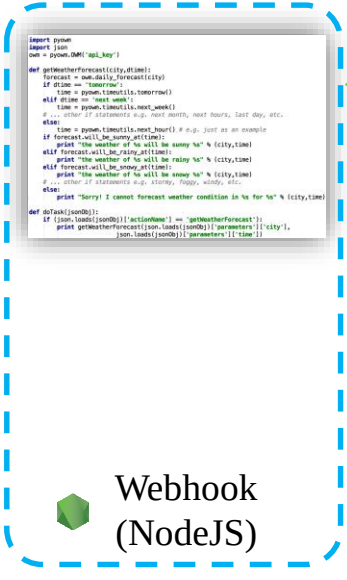
DevOps bot



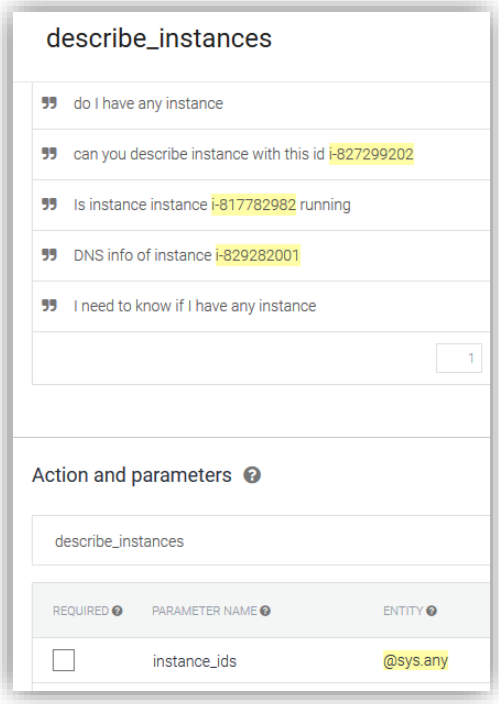
Messaging Interface (Messenger)

1

3

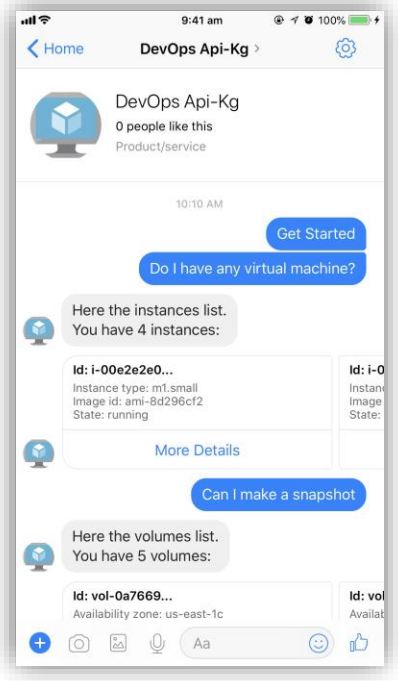


2



Intent Recognizer (Dialogflow)

DevOps bot



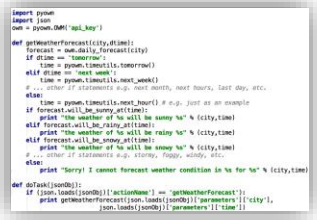
Messaging Interface (Messenger)

1

3

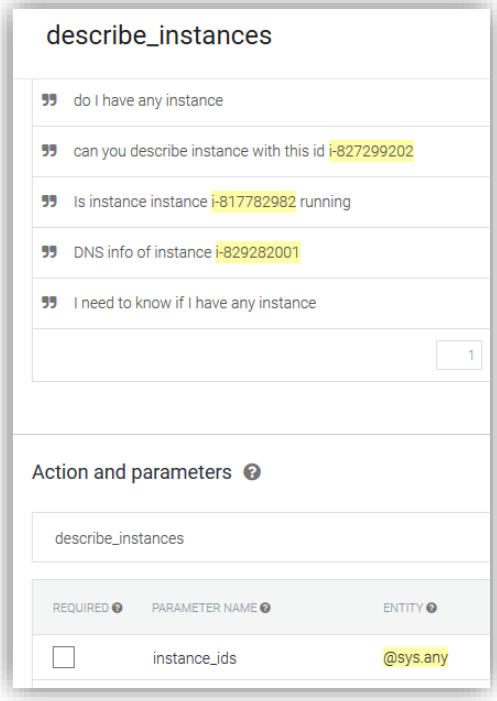
4

aws API Backend



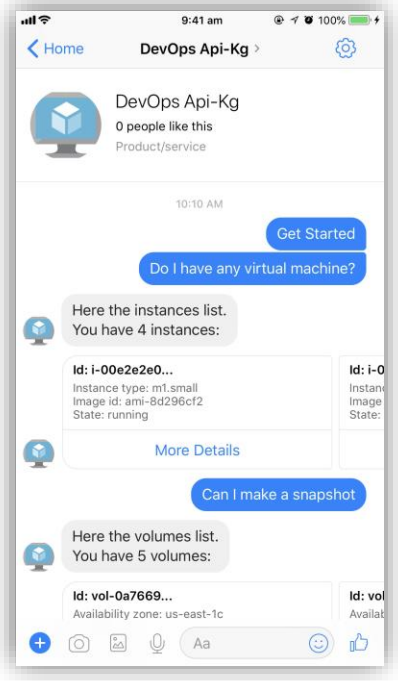
2

Webhook (NodeJS)



Intent Recognizer (Dialogflow)

DevOps bot

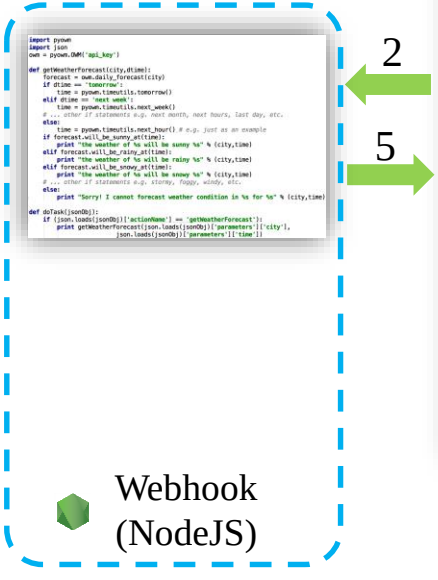


Messaging Interface (Messenger)

1

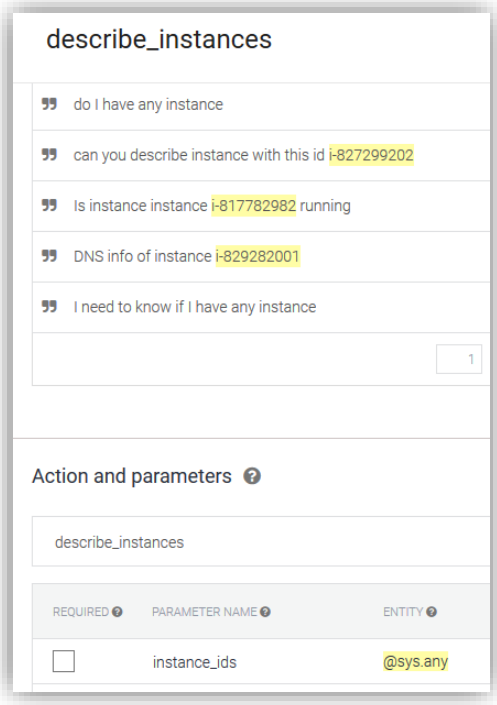
3

4



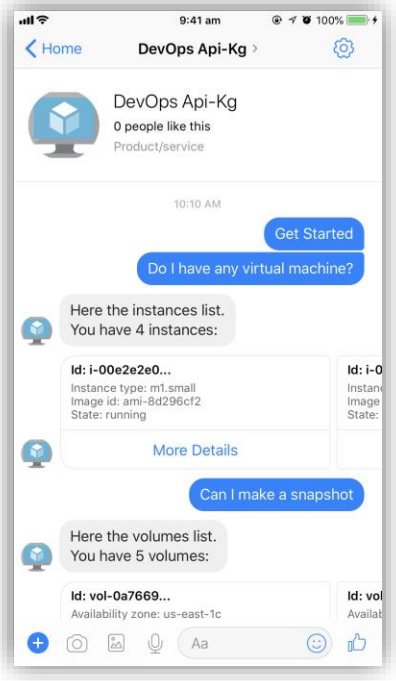
2

5

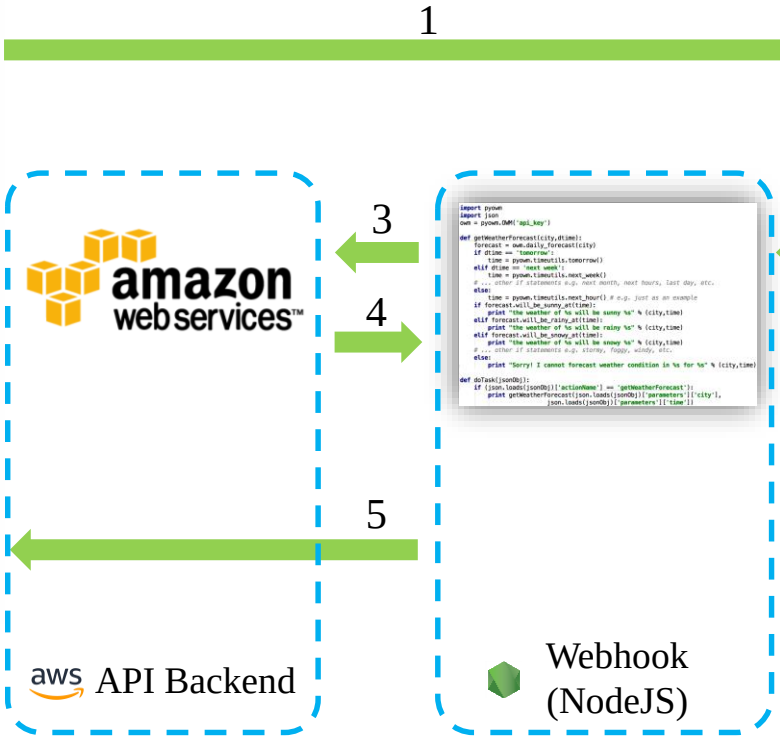


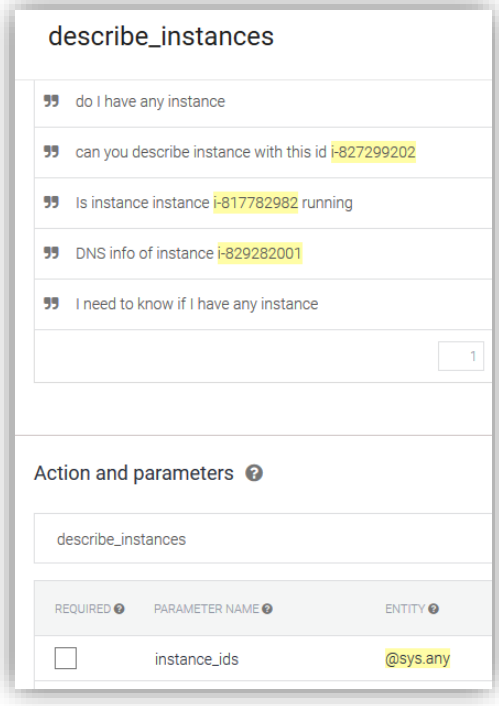
Intent Recognizer (Dialogflow)

DevOps bot



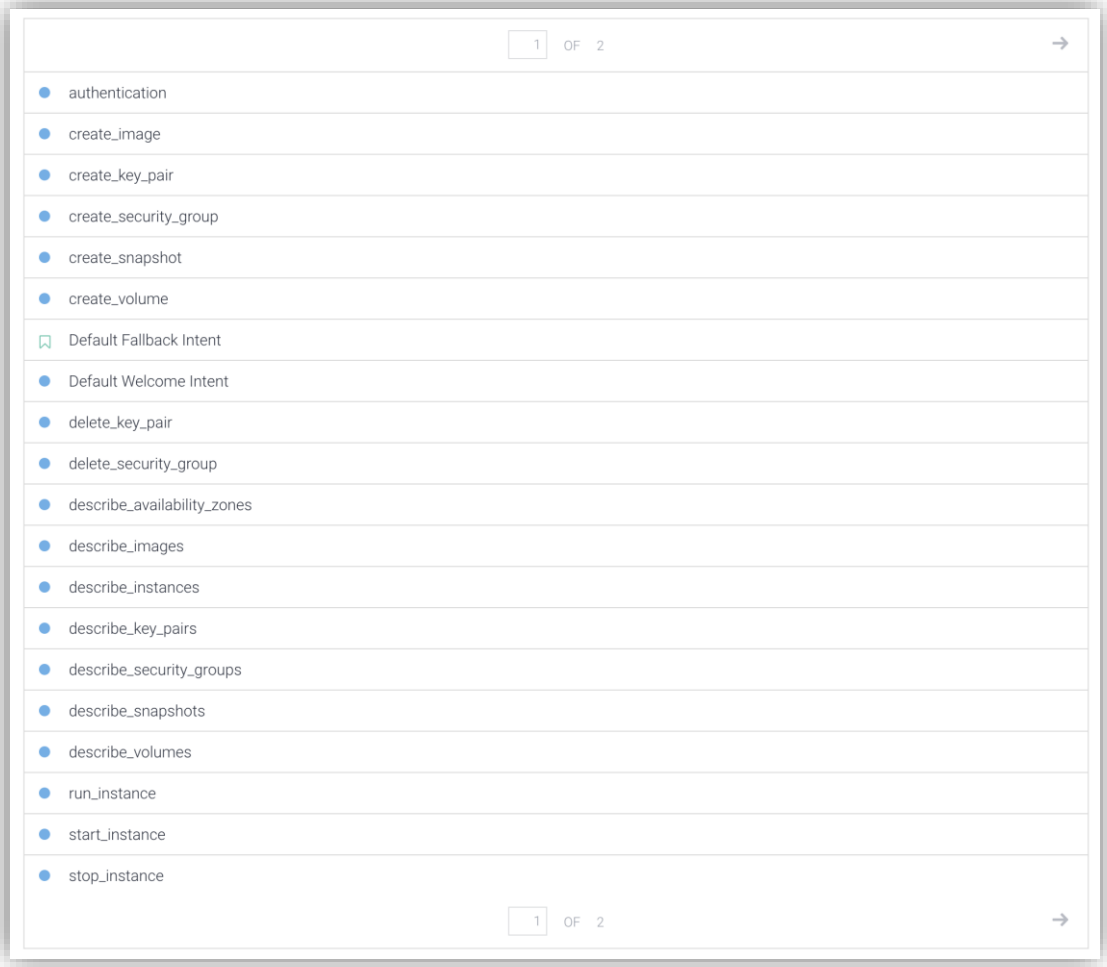
Messaging Interface
(Messenger)





Intent Recognizer
(Dialogflow)

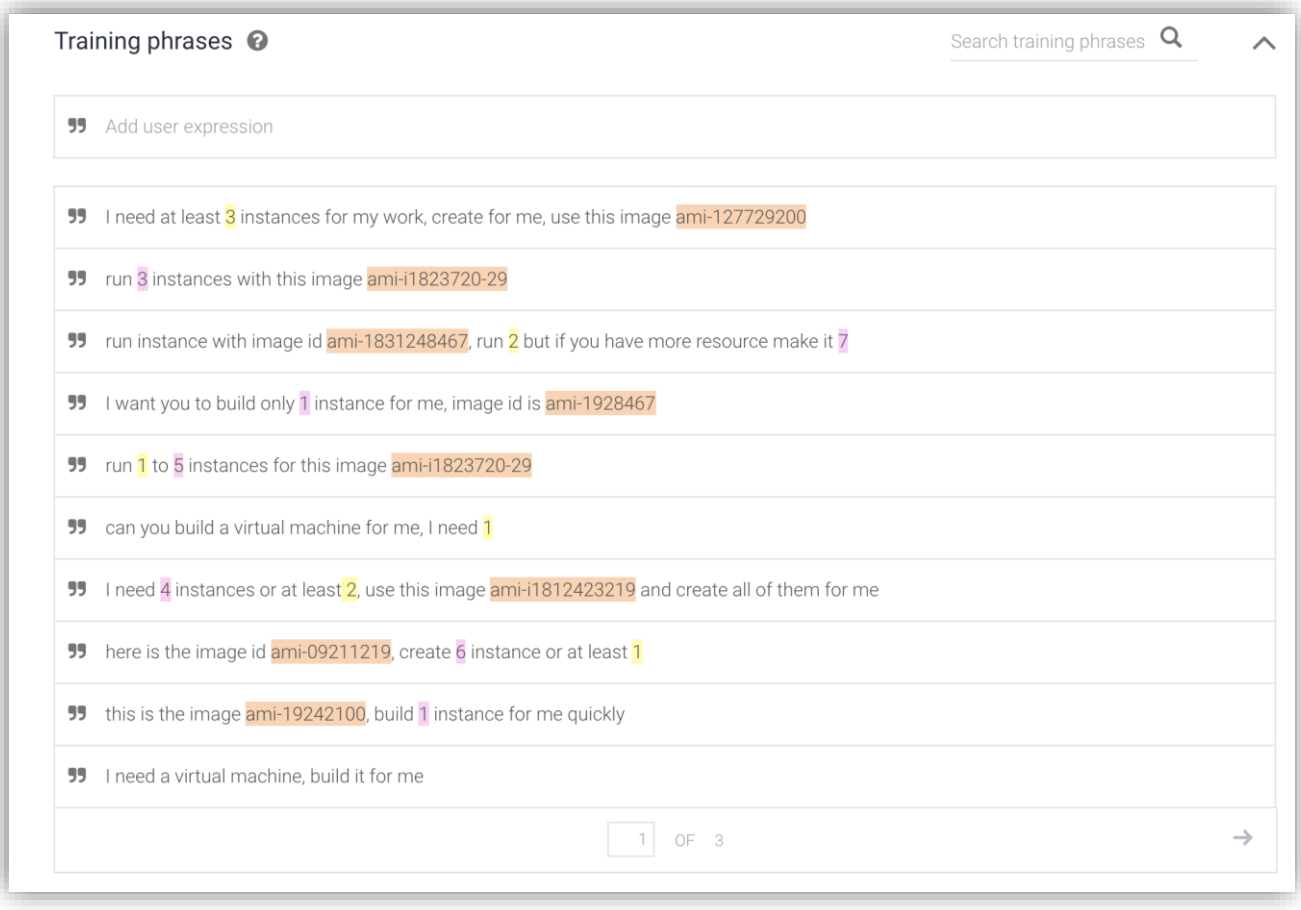
DevOps bot - Intents



DevOps bot - Entities

@aws_zone
@image_name
@instance_id
@instance_type_entity
@key_pair_name
@security_group_name

DevOps bot - Training



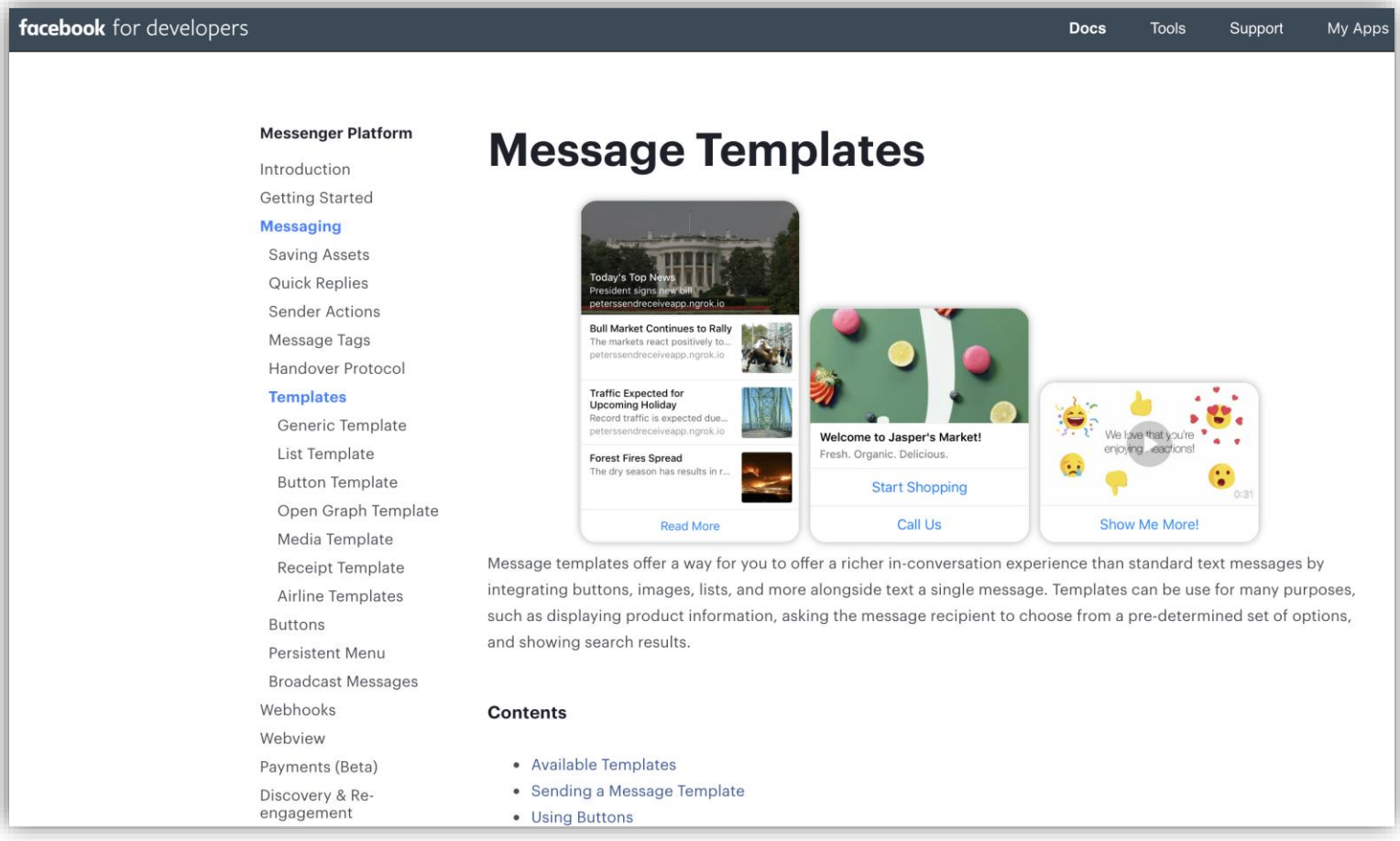
DevOps bot - Conversation Manager

```
// This function run the specified instance with the specified parameters
var runInstance = function(senderId, agentName, generalContext){
    var ec2 = authParameterAWS_EC2();

    var imageId = generalContext.parameters.image_id;
    var maxCount = generalContext.parameters.max_count;
    var minCount = generalContext.parameters.min_count;
    var keyName = generalContext.parameters.key_pair_name;
    var instanceType = generalContext.parameters.instance_type;
    var zone = generalContext.parameters.zone;

    if (!minCount) {
        generalContext.parameters.request_parameter = 'min_count';
        generalContext.parameters.next_function = 'run_instance';
        var quickReplies = quickRepliesNumbers('payloadMinCount', 'number');
        var message = {
            'text': 'Give me the minimum number of instances, please.\nIf you need a different number, please specify only the number.',
            'quick_replies': quickReplies
        };
        sendTextToMessenger(senderId,message,agentName);
        saveContext(senderId, agentName, generalContext);

    } else if (!maxCount) {
        generalContext.parameters.request_parameter = 'max_count';
        generalContext.parameters.next_function = 'run_instance';
        var quickReplies = quickRepliesNumbers('payloadMaxCount', 'number');
```

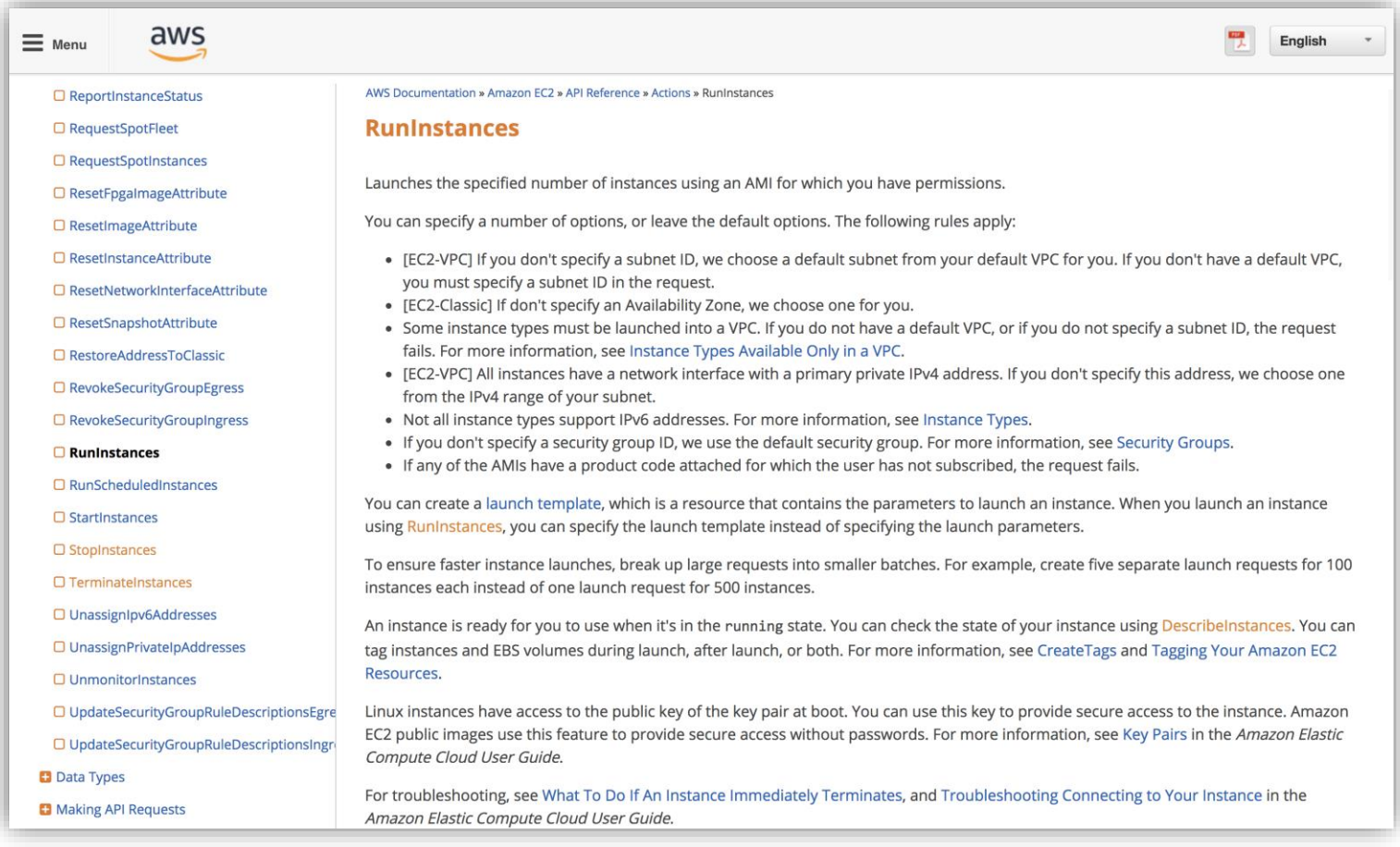
DevOps bot - Conversation Manager

```
// This function terminate the specified instance with the specified parameters
var terminateInstance = function(senderId, agentName, generalContext){
    var ec2 = authParameterAWS_EC2();

    var instances = generalContext.parameters.instance_ids;

    if (typeof instances !== 'undefined' && instances.length > 0) {
        var params = {
            InstanceIds: instances,
        };

        ec2.terminateInstances(params, function(err, data) {
            if (err){
                var message = {
                    'text': err.message
                };
                console.log(err, err.stack); // an error occurred
                sendTextToMessenger(senderId,message,agentName);
            }
            else {
                generalContext.parameters.request_parameter = '';
                generalContext.parameters.next_function = '';
                generalContext.parameters.instance_ids = [];

                var terminateInstances = data.TerminatingInstances;
```

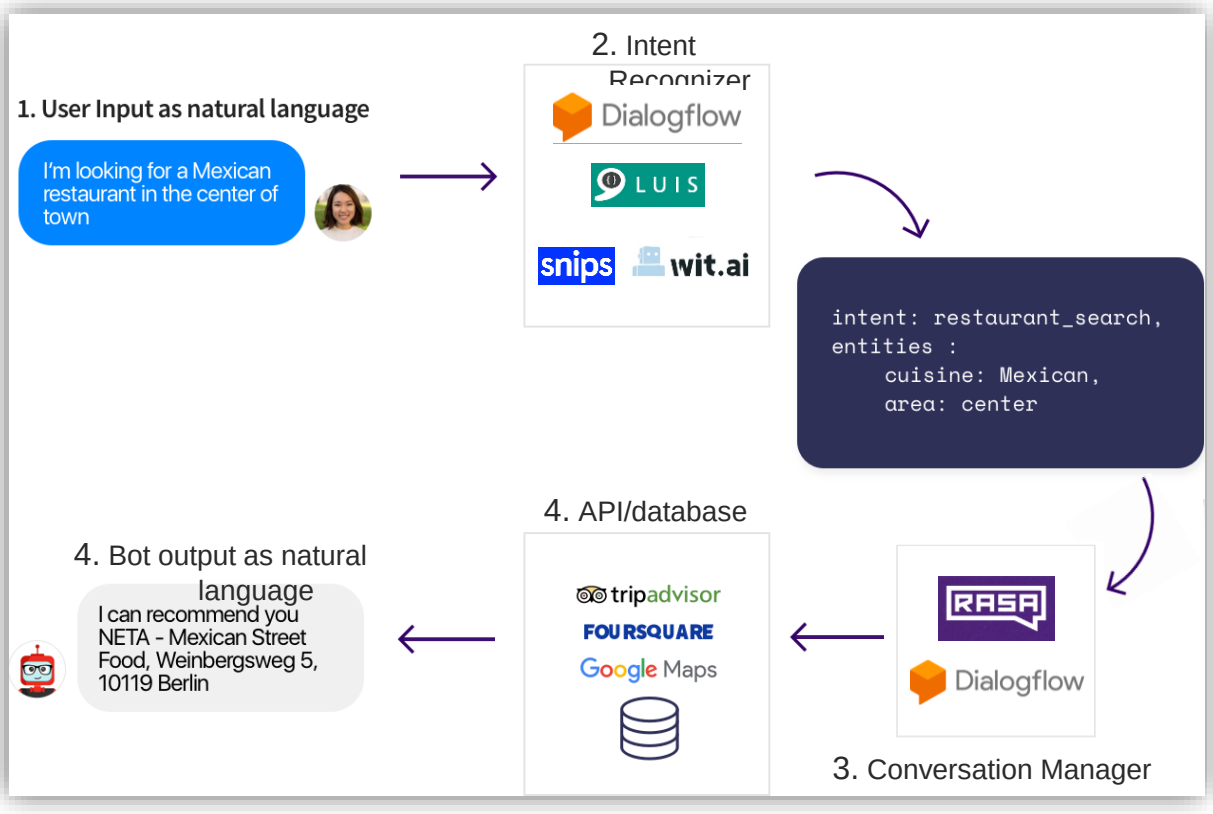
DevOps bot - Answer Generator



Building Bot | API Integration - DevOps bot – API Endpoints

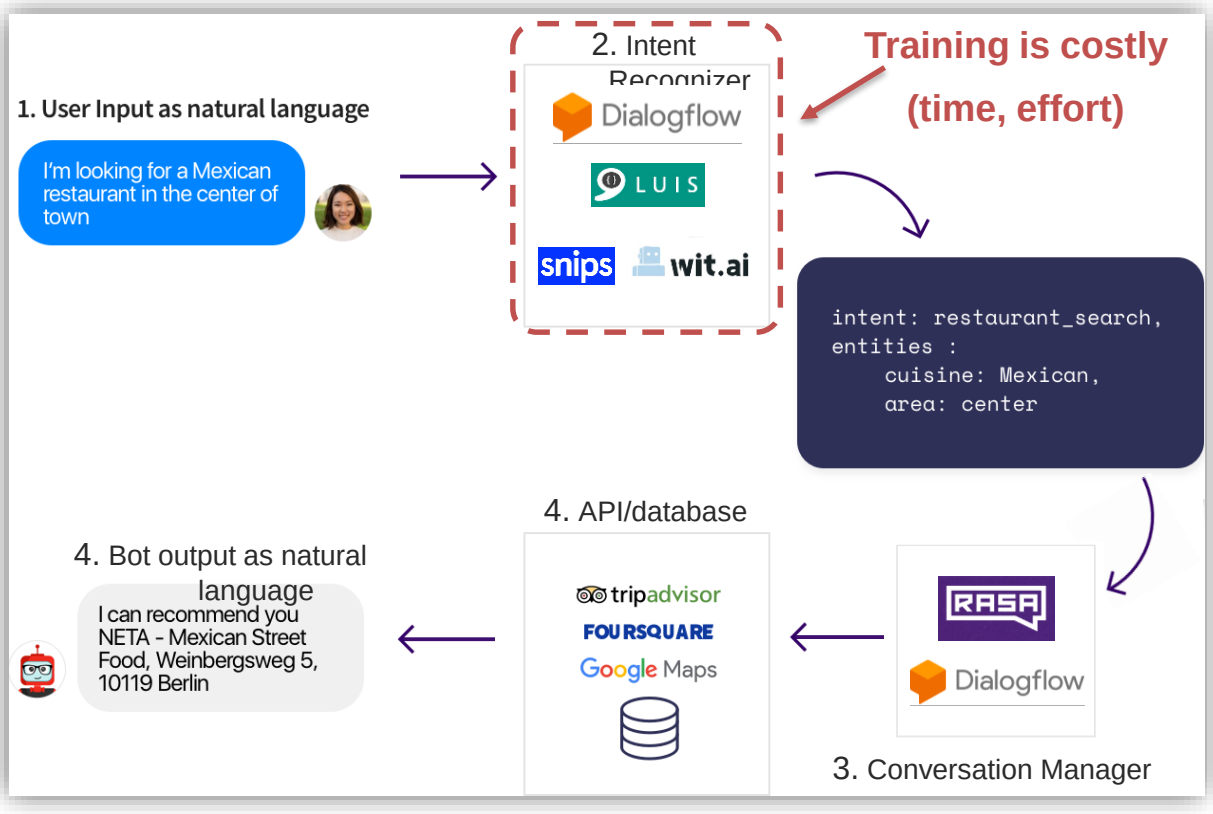


Machine Learning-Based Bots



Source: https://www.techcrunch.com

Machine Learning-Based Bots



Source: https://www.techcrunch.com

Intent|APIs Integration Challenges

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- **APIs | Composition constructs are not meant to be intuitive** (variables, control flow, symbols)

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*"**Mapping Intents to APIs requires more knowledge than API descriptions**"*

Where we are now

- SOA
- Web Services and Web APIs
- Microservices
- Cloud Services
- Cognitive Services

How do they affect Organizations?

IT Architecture

- An IT architecture provides the necessary technical foundation for an effective IT strategy, which is the core of any successful modern business strategy
- Specifically, an IT architecture defines the **components or *building blocks*** that make up the overall information system. It provides a plan from which products can be procured, and systems developed that will work together to implement the overall system. It thus enables you to manage your IT investment in a way that meets the needs of your business.

http://www.opengroup.org/public/arch/p1/oview/index.htm#1

So How is this Relevant to What We have Learned

- Understanding software development styles and technologies, their benefits, opportunities and limitations can help in:
  - Defining the principles that guide technology decisions for the enterprise
  - Analysis of the current IT ecosystem to detect critical deficiencies and recommend solutions for improvement
  - Development of technology infrastructure that can be highly leveraged across multiple enterprise solutions
  - And more…

https://ist.mit.edu/sites/default/files/about/org/roles/Architecture_Position_Description_v4.pdf

Questions?