Kecerdasan Bisnis Terapan

AI Chatbots and Conversational Commerce

Husni
Lab. Riset JTIF UTM

Sumber awal: http://mail.tku.edu.tw/myday/teaching/1071/BI/1071BI12_Business_Intelligence.pptx
Business Intelligence (BI)

1. Introduction to BI and Data Science
2. Descriptive Analytics
3. Predictive Analytics
4. Prescriptive Analytics
5. Big Data Analytics
6. Future Trends
AI Chatbots and Conversational Commerce
Outline

• AI Chatbots
• Conversational Commerce
• Bot Platform Ecosystem
AI and Cognitive Computing

Source: http://research.ibm.com/cognitive-computing/
Artificial Intelligence (A.I.) Timeline

1950
**TURING TEST**
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence.

1955
**A.I. BORN**
Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines."

1961
**UNIMATE**
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line.

1964
**ELIZA**
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans.

1966
**SHAKEY**
The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions.

A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold.

1997
**DEEP BLUE**
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov.

1998
**KISMET**
Cynthia Breazeal at MIT introduces Kismet, an emotionally intelligent robot insofar as it detects and responds to people's feelings.

1999
**AIBO**
Sony launches first consumer robot pet dog AIBO (A1 robot) with skills and personality that develop over time.

2002
**ROOMBA**
First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes.

2011
**SIRI**
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S.

2011
**WATSON**
IBM's question answering computer Watson wins first place on popular $1M prize television quiz show Jeopardy.

2014
**EUGENE**
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human.

2014
**ALEXA**
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks.

2016
**TAY**
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments.

2017
**ALPHAGO**
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions.

# Chatbots: Evolution of UI/UX

<table>
<thead>
<tr>
<th>Paradigm</th>
<th>mid - 80s</th>
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<th>mid - 00s</th>
<th>mid - 10s</th>
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<td>DOS, Windows, Mac OS</td>
<td>Mosaic, Explorer, Chrome</td>
<td>iOS, Android</td>
<td>WhatsApp, Messenger, Slack</td>
</tr>
<tr>
<td>Applications</td>
<td>Clients</td>
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<tr>
<td></td>
<td>Excel, PPT, Lotus</td>
<td>Yahoo, Amazon</td>
<td>Angry Birds, Instagram</td>
<td>Weather, Travel</td>
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<tr>
<td>UI/UX</td>
<td>Native Screens</td>
<td>Web Pages</td>
<td>Native Mobile Screens</td>
<td>Message</td>
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<td>S/w Dev</td>
<td>Client-side</td>
<td>Server-side</td>
<td>Client-side</td>
<td>Server-side</td>
</tr>
</tbody>
</table>

AI Chatbot for Conversational Commerce
Chatbot
Dialogue System
Intelligent Agent
Chatbot

Source: https://www.mdsdecoded.com/blog/the-rise-of-chatbots/
Dialogue System

Automatic Speech Recognizer → Natural Language Interpreter → Dialogue State Tracker

Text-To-Speech Synthesizer ← Natural Language Generator ← Dialogue Response Selection

Can machines think? (Alan Turing, 1950)

Chatbot

“online human-computer dialog system with natural language.”

Chatbot Conversation Framework

- **Open Domain**
  - Impossible
  - General AI [Hardest]
- **Closed Domain**
  - Rules-Based [Easiest]
  - Smart Machine [Hard]

**Responses**

Source: https://chatbotslife.com/ultimate-guide-to-leveraging-nlp-machine-learning-for-you-chatbot-531ff2dd870c
Conversational Commerce
From E-Commerce to Conversational Commerce: Chatbots and Virtual Assistants

Source: http://www.guided-selling.org/from-e-commerce-to-conversational-commerce/
Conversational Commerce: eBay AI Chatbots

Hotel Chatbot

**Intents**
An intent performs an action in response to natural language user input.

**Utterances**
Spoken or typed phrases that invoke your intent.

**Slots**
Slots are input data required to fulfill the intent.

**Fulfillment**
Fulfillment mechanism for your intent.

- I’d like to book a hotel
- Sure, which city?
- New York City
- What date are you leaving?
- November 30th, 2016
- Are you sure you want to book the hotel in NYC?
- Yes
- Thank you. The reservation went through successfully.

Source: https://sdtimes.com/amazon/guest-view-capitalize-amazon-lex-available-general-public/
H&M’s Chatbot on Kik

Source: http://www.guided-selling.org/from-e-commerce-to-conversational-commerce/
Uber’s Chatbot on Facebook’s Messenger

One main benefit: it loads much faster than the Uber app.

Source: http://www.guided-selling.org/from-e-commerce-to-conversational-commerce/
Savings Bot

Mastercard Makes Commerce More Conversational

How much did I spend on Uber in September?

Let's see. You spent $343.30. I searched for:
Merchant: Uber
Date: between 09/01/2016 and 09/30/2016

Shall I break that down?

How about October?

Let's see. You spent $197.32.
I searched for:
Merchant: Uber
Date: between 10/01/2016 and 10/31/2016

Want to see the transactions?

Type a message...

POWERED BY

Kasisto

Bot
Platform
Ecosystem
The bot platform ecosystem and the emerging giants

Nearly every large software company has announced some sort of bot strategy in the last year. Here’s a look at a handful of leading platforms that developers might use to send messages, interpret natural language, and deploy bots, with the emerging bot-ecosystem giants highlighted.

General AI agents with platforms
Developer access available now or announced

Source: https://www.oreilly.com/ideas/infographic-the-bot-platform-ecosystem
Bot frameworks and deployment platforms

- Wit.ai
  - Facebook
- BotKit
  - Howdy
- Chatfuel
- Automat
  - Bot Framework
  - Microsoft
- Api.ai
  - Google
- Pandorabots
- MindMeld
- Gupshup
- Sequel

Source: https://www.oreilly.com/ideas/infographic-the-bot-platform-ecosystem
Bots Landscape

Connectors/Shared Services

AI Tools: Natural Language Processing, Machine Learning, Speech & Voice Recognition

Bot Discovery

Bot developer frameworks and tools

Analytics

Messaging

Messenger Bot Landscape

Food
The Wise Parent
Plum
Peasantry Kitchen
Hungry
Fossie
Fitmeal
Ernle
Chatbook
Make My Sushi
Vosame

Communication
TangoTalk
Typeform
Anony
Trigzify
Ragecz
Rescue
Messenger Match
Sensay
LangLeoneBot
ChatChab
Lingo Translate
Decoderejji
UReport Global
Tugga

Utilities
Pancho
Catebot
Smokey
DotCom
Santa Monstaring
English Dictionary
YouTube Search
Video Bot
Glimbot
Instant Translator

Design
ColoristaBot
Connie Digital
AWARDS
Mr. Norman
Graphic Design
SnapBot

News
CNN
TIA
Digg
WSJ
Reddit Bot
Al Jazeera

Travel
Grindbase
KLM
British Airways
Space Explorer
Austrian Airlines
SnapTravel
Skyscanner
Kayak
TicketBot
Rediph

Entertainment
Spotify
Kim Kardashian
La Brique
50 Cent
Escalba Real
Lindsay Lohan
Maroon 5
MTV News
Aamir
Ariana Grande
Red Bull TV
StarBot
Star Wars Bot
Clima
Pokedex

Developer Tools
HackerOne
Wiredelta
RedBot

Education
Genius
Kimui
MemoryBot
Aristotle

Source: https://medium.com/@RecastAI/2017-messenger-bot-landscape-a-public-spreadsheet-gathering-1000-messenger-bots-f017fdb1448a
The Bot Lifecycle

The Lifecycle of a bot

Source: https://chatbotsmagazine.com/the-bot-lifecycle-1ff357430db7
Customers want to have simpler means to interact with businesses and get faster response to a question or complaint.
Chatbot Architectures

• Information Retrieval based Bot (IR-Bot)
• Task Oriented Bot (Task-Bot)
• Chitchat-Bot (Chatbot)
Watson DeepQA Architecture

ALICE and AIML

AIML: Artificial Intelligence Markup Language
AIML (Artificial Intelligence Markup Language) is an XML-compliant language that's easy to learn, and makes it possible for you to begin customizing an Alicebot or creating one from scratch within minutes.

The most important units of AIML are:

- `<aiml>`: the tag that begins and ends an AIML document
- `<category>`: the tag that marks a "unit of knowledge" in an Alicebot's knowledge base
- `<pattern>`: used to contain a simple pattern that matches what a user may say or type to an Alicebot
- `<template>`: contains the response to a user input

There are also 20 or so additional more tags often found in AIML files, and it's possible to create your own so-called "custom predicates". Right now, a beginner's guide to AIML can be found in the AIML Primer.

The free A.L.I.C.E. AIML includes a knowledge base of approximately 41,000 categories. Here's an example of one of them:

```
<category>
    <pattern>WHAT ARE YOU</pattern>
    <template>
        <think><set name="topic">Me</set></think>
        I am the latest result in artificial intelligence,
        which can reproduce the capabilities of the human brain
        with greater speed and accuracy.
    </template>
</category>
```

(The opening and closing `<aiml>` tags are not shown here, because this is an excerpt from the middle of a document.)

Everything between `<category>` and `</category>` is -- you guessed it -- a category. A category can have one pattern and one template. (It can also contain a `<that>` tag, but we won't get into this here.)

The pattern shown will match only the exact phrase "what are you" (capitalization is ignored).

But it's possible that this category may be invoked by another category, using the `<srail>` tag (not shown) and the principle of reductionism.

In any case, if this category is called, it will produce the response "I am the latest result in artificial intelligence..." shown above. In addition, it will do something else interesting. Using the `<think>` tag, which causes Alicebot to perform whatever it contains but hide the result from the user, the Alicebot engine will set the "topic" in its memory to "Me". This allows any categories elsewhere with an
AIML
(Artificial Intelligence Markup Language)

<category>
  <pattern>HELLO</pattern>
  <template>Hi, I am a robot</template>
</category>

Source: http://www.alicebot.org/aiml.html
AIML
(Artificial Intelligence Markup Language)

• `<aiml>`
  – the tag that begins and ends an AIML document

• `<category>`
  – the tag that marks a "unit of knowledge" in an Alicebot's knowledge base

• `<pattern>`
  – used to contain a simple pattern that matches what a **user** may say or type to an Alicebot

• `<template>`
  – contains the **response** to a user input

Source: http://www.alicebot.org/aiml.html
WHAT ARE YOU

I am the latest result in artificial intelligence, which can reproduce the capabilities of the human brain with greater speed and accuracy.

Source: http://www.alicebot.org/aiml.html
Deep Learning for Dialogues

Intent Classification

Intent LSTM

LSTM (Long-Short Term Memory)

GRU (Gated Recurrent Unit)

An example utterance with annotations of semantic slots in IOB format (S), domain (D), and intent (I), B-dir and I-dir denote the director name.

End-to-end Memory Network Model for Multi-turn SLU

D  communication
I  send_email

U  just sent email to bob about fishing this weekend
   ↓  ↓  ↓  ↓  ↓  ↓  ↓
S  O  O  O  O  O  O
    B-contact_name  B-subject  l-subject  l-subject

→ send_email(contact_name="bob", subject="fishing this weekend")

U₁ send email to bob
   ↓
S₁ B-contact_name
→ send_email(contact_name="bob")

U₂ are we going to fish this weekend
   ↓  ↓  ↓  ↓  ↓  ↓  ↓
S₂ B-message  l-message  l-message  l-message  l-message  l-message
   ↓  ↓  ↓  ↓  ↓
   l-message  l-message  l-message

→ send_email(message="are we going to fish this weekend")

Encoder-decoder model for joint intent detection and slot filling

(a) with no aligned inputs.

Encoder-decoder model for joint intent detection and slot filling

(b) with aligned inputs.

Encoder-decoder model for joint intent detection and slot filling

(c) with aligned inputs and attention

End-to-End Task-Completion Neural Dialogue Systems

Reinforcement learning is used to train all components in an end-to-end fashion.

Slot Intent

## Slot Intent

<table>
<thead>
<tr>
<th>Annotations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intent</td>
</tr>
<tr>
<td>request, inform, deny, confirm_question, confirm_answer, greeting, closing, not_sure, multiple_choice, thanks, welcome</td>
</tr>
<tr>
<td>Slot</td>
</tr>
<tr>
<td>actor, actress, city, closing, critic_rating, date, description, distanceconstraints, greeting, implicit_value, movie_series, moviename, mpaa_rating, numberofpeople, numberофkids, taskcomplete, other, price, seating, starttime, state, theater, theater_chain, video_format, zip, result, ticket, mc_list</td>
</tr>
</tbody>
</table>

Sample dialogues generated by rule-based and RL agents

**Rule-based agent**

User: Can I get some tickets for zoolander 2?
Agent: What movie are you interested in?
User: I want to watch zoolander 2.
Agent: What time would you like to see it?
User: I want to watch at 9:25 pm.
Agent: What city you would like?
User: I want to watch at seattle.
Agent: What date would you like to watch it?
User: I want to set it up tomorrow.
Agent: Which theater would you like?
User: I want to watch at regal meridian 16.
Agent: How many tickets do you need?
User: I want 2 tickets please!
Agent: Great - I was able to purchase 2 tickets for you to see zoolander 2 tomorrow at regal meridian 16 theater in seattle at 9:25 pm.
User: Thank you.
Agent: Thank you.

---

**Success**

Sample dialogues generated by rule-based and RL agents

**RL agent**

**User**: Can I get tickets for zoolander 2 tomorrow?

**Agent**: Which city would you like?

**User**: I want to watch at seattle.

**Agent**: How many tickets do you need?

**User**: I want 2 tickets please!

**Agent**: 9:25 pm is available.

**User**: I want to watch at regal meridian 16.

**Agent**: Great - I was able to purchase 2 tickets for you to see zoolander 2 tomorrow at regal meridian 16 theater in seattle at 9:25 pm.

**User**: Thank you.

**Agent**: Thank you.

**Success**

Sample dialogues generated by rule-based and RL agents

New episode, user goal:
{
    "request_slots": {
        "ticket": "UNK"
    },
    "inform_slots": {
        "city": "seattle",
        "numberofpeople": "2",
        "theater": "regal meridian 16",
        "starttime": "9:25 pm",
        "date": "tomorrow",
        "moviename": "zoolander 2"
    }
}

A Deep Reinforcement Learning Chatbot

Iulian V. Serban, Chinnadhurai Sankar, Mathieu Germain, Saizheng Zhang, Zhouhan Lin, Sandeep Subramanian, Taesup Kim, Michael Pieper, Sarath Chandar, Nan Rosemary Ke, Sai Mudumba, Alexandre de Brebisson Jose M. R. Sotelo, Dendi Suhubdy, Vincent Michalski, Alexandre Nguyen, Joelle Pineau and Yoshua Bengio

Montreal Institute for Learning Algorithms, Montreal, Quebec, Canada
A Deep Reinforcement Learning Chatbot

MILABOT: Chatbot developed by the Montreal Institute for Learning Algorithms (MILA) for the Amazon Alexa Prize competition

Q: “What is your name?”
R: "I am an Alexa Prize Socialbo"
<table>
<thead>
<tr>
<th>Dialogue</th>
<th>Dialogue</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSTEM: Hi. This is an Alexa Prize socialbot. USER: Hi</td>
<td>USER: Let’s talk about movies. SYSTEM: What’s your favorite movie? USER: star wars movie</td>
</tr>
<tr>
<td>USER: Do you have pets? USER: Yes, I have two rabbits.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Candidate Responses</th>
<th>Candidate Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>BoWEscapePlan: I don’t have an answer for this.</td>
<td>BoWEscapePlan: I don’t have an answer for this.</td>
</tr>
<tr>
<td>BoWFactGenerator: Did you know that male rabbits are called bucks, females are does?</td>
<td>BoWFactGenerator: Here’s an interesting fact. The international telephone dialing code for Antarctica is 672.</td>
</tr>
<tr>
<td>GRUQuestionGenerator: How about the American family of it? Initiatorbot: Do you believe in love at first sight?</td>
<td>GRUQuestionGenerator: how about your New York City? Initiatorbot: How was your day?</td>
</tr>
<tr>
<td>LSTMClassifierMSMarco: Mar 23, 2017 Two Parts: Learning What to Feed Your Rabbit Learning How to ...</td>
<td>LSTMClassifierMSMarco: A third Anthology film will be released in 2020.</td>
</tr>
<tr>
<td>DualEncoderRedditNews: bye doggie</td>
<td>DualEncoderRedditNews: Now whisper it to me , one more time bby.</td>
</tr>
<tr>
<td>DualEncoderRedditPolitics: Who’s edger u u shboys?</td>
<td>DualEncoderRedditPolitics: hahaha on mobile this ain’t even close. I wish I could show you but this looks awful I’m sorry man.</td>
</tr>
<tr>
<td>Alicebot: Hurrah! Two is a good number of rabbits. Elizabot: OK, but can you elaborate a bit?</td>
<td>Alicebot: What did you like about the robots in that movie?</td>
</tr>
<tr>
<td>VHREDRedditMovies: Hmm. Nope, never heard of it. VHREDSubtitles: Would you like to see them?</td>
<td>Elizabot: How does that make you feel?</td>
</tr>
<tr>
<td>VHREDSubtitles: Would you like to see them? HelpResponse: I would really like to talk about news, politics or movies.</td>
<td>VHREDRedditMovies: Oh please. Please. Pleeease. Let this happen.</td>
</tr>
<tr>
<td>HelpResponse: I would really like to talk about news, politics or movies.</td>
<td>HelpResponse: I would really like to talk about news, politics or movies.</td>
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</tbody>
</table>

MILABOT
Computational graph for scoring model

model selection policies based on both action-value function and stochastic policy parametrizations

Facebook AI Research : bAbI Project

• The (20) QA bAbI tasks
• The (6) dialog bAbI tasks
• The Children’s Book Test
• The Movie Dialog dataset
• The WikiMovies dataset
• The Dialog-based Language Learning dataset
• The SimpleQuestions dataset

Source: https://research.fb.com/projects/babi/
Facebook bAbI QA Datasets

1 Mary moved to the bathroom.
2 John went to the hallway.
3 Where is Mary? bathroom 1
4 Daniel went back to the hallway.
5 Sandra moved to the garden.
6 Where is Daniel? hallway 4
7 John moved to the office.
8 Sandra journeyed to the bathroom.
9 Where is Daniel? hallway 4
10 Mary moved to the hallway.
11 Daniel travelled to the office.
12 Where is Daniel? office 11
13 John went back to the garden.
14 John moved to the bedroom.
15 Where is Sandra? bathroom 8
1 Sandra travelled to the office.
2 Sandra went to the bathroom.
3 Where is Sandra? bathroom 2

Source: https://research.fb.com/projects/babi/
Facebook bAbI QA Datasets

**Task 1: Single Supporting Fact**
- Mary went to the bathroom.
- John moved to the hallway.
- Mary travelled to the office.
- Where is Mary? A: office

**Task 2: Two Supporting Facts**
- John is in the playground.
- John picked up the football.
- Bob went to the kitchen.
- Where is the football? A: playground

**Task 3: Three Supporting Facts**
- John picked up the apple.
- John went to the office.
- John went to the kitchen.
- John dropped the apple.
- Where was the apple before the kitchen? A: office

**Task 4: Two Argument Relations**
- The office is north of the bedroom.
- The bedroom is north of the bathroom.
- The kitchen is west of the garden.
- What is north of the bedroom? A: office
- What is the bedroom north of? A: bathroom

**Task 5: Three Argument Relations**
- Mary gave the cake to Fred.
- Fred gave the cake to Bill.
- Jeff was given the milk by Bill.
- Who gave the cake to Fred? A: Mary
- Who did Fred give the cake to? A: Bill

**Task 6: Yes/No Questions**
- John moved to the playground.
- Daniel went to the bathroom.
- John went back to the hallway.
- Is John in the playground? A: no
- Is Daniel in the bathroom? A: yes

### Facebook bAbI QA Datasets

<table>
<thead>
<tr>
<th>Task 7: Counting</th>
<th>Task 8: Lists/Sets</th>
</tr>
</thead>
</table>
| Daniel picked up the football.  
Daniel dropped the football.  
Daniel got the milk.  
Daniel took the apple.  
How many objects is Daniel holding? A: two | Daniel picks up the football.  
Daniel drops the newspaper.  
Daniel picks up the milk.  
John took the apple.  
What is Daniel holding? milk, football |

<table>
<thead>
<tr>
<th>Task 9: Simple Negation</th>
<th>Task 10: Indefinite Knowledge</th>
</tr>
</thead>
</table>
| Sandra travelled to the office.  
Fred is no longer in the office.  
Is Fred in the office? A: no  
Is Sandra in the office? A: yes | John is either in the classroom or the playground.  
Sandra is in the garden.  
Is John in the classroom? A: maybe  
Is John in the office? A: no |

<table>
<thead>
<tr>
<th>Task 11: Basic Coreference</th>
<th>Task 12: Conjunction</th>
</tr>
</thead>
</table>
| Daniel was in the kitchen.  
Then he went to the studio.  
Sandra was in the office.  
Where is Daniel? A: studio | Mary and Jeff went to the kitchen.  
Then Jeff went to the park.  
Where is Mary? A: kitchen  
Where is Jeff? A: park |

<table>
<thead>
<tr>
<th>Task 13: Compound Coreference</th>
<th>Task 14: Time Reasoning</th>
</tr>
</thead>
</table>
| Daniel and Sandra journeyed to the office.  
Then they went to the garden.  
Sandra and John travelled to the kitchen.  
After that they moved to the hallway.  
Where is Daniel? A: garden | In the afternoon Julie went to the park.  
Yesterday Julie was at school.  
Julie went to the cinema this evening.  
Where did Julie go after the park? A: cinema  
Where was Julie before the park? A: school |

Facebook bAbI QA Datasets

Task 15: Basic Deduction
Sheep are afraid of wolves.
Cats are afraid of dogs.
Mice are afraid of cats.
Gertrude is a sheep.
What is Gertrude afraid of? A: wolves

Task 16: Basic Induction
Lily is a swan.
Lily is white.
Bernhard is green.
Greg is a swan.
What color is Greg? A: white

Task 17: Positional Reasoning
The triangle is to the right of the blue square.
The red square is on top of the blue square.
The red sphere is to the right of the blue square.
Is the red sphere to the right of the blue square? A: yes
Is the red square to the left of the triangle? A: yes

Task 18: Size Reasoning
The football fits in the suitcase.
The suitcase fits in the cupboard.
The box is smaller than the football.
Will the box fit in the suitcase? A: yes
Will the cupboard fit in the box? A: no

Task 19: Path Finding
The kitchen is north of the hallway.
The bathroom is west of the bedroom.
The den is east of the hallway.
The office is south of the bedroom.
How do you go from den to kitchen? A: west, north
How do you go from office to bathroom? A: north, west

Task 20: Agent’s Motivations
John is hungry.
John goes to the kitchen.
John grabbed the apple there.
Daniel is hungry.
Where does Daniel go? A: kitchen
Why did John go to the kitchen? A: hungry

Learning End-to-End Goal-Oriented Dialog
Facebook bAbI Dialogue Datasets

1 hi hello what can i help you with today
2 can you make a restaurant reservation with italian cuisine for six people in a cheap price range i'm on it
3 <SILENCE> where should it be
4 rome please ok let me look into some options for you
5 <SILENCE> api_call italian rome six cheap

Source: https://research.fb.com/projects/babi/
Hi!

*Hello, what can I help you with today?*

I'd like to book a table for six people in an expensive price range with British food.

*I'm on it!*

*Where should it be?*

In London.

*Ok, let me look into some options for you.*

`api call(British, London, Six, Expensive)`

Actually i would prefer for four.

*Sure. Is there anything else to update?*

No.

*Ok let me look into some options for you.*

`api call(British, London, Four, Expensive)`

`* The Place R_phone The_Place_phone
* The Place R_cuisine british
* The Place R_address The_Place_address
* The Place R_location London
* The Place R_availability four
* The Place R_price expensive
* The Place R_rating 7
* The Fancy Pub R_phone The_Fancy_Pub_phone
* The_Fancy_Pub R_cuisine british
* The_Fancy_Pub R_address The_Fancy_Pub_address
* The_Fancy_Pub R_location London
* The_Fancy_Pub R_availability four
* The_Fancy_Pub R_price expensive
* The_Fancy_Pub R_rating 8`

*What do you think of this option: The_Fancy_Pub*

No, I don't like that.

*Sure, let me find an other option for you.*

*What do you think of this option: The_Place*

Let's do it!

*Great let me do the reservation.*

Can you provide me the address?

*Here it is: The_Place_address.*

You rock!

*Is there anything else I can help you with?*

No thanks.

*You're welcome.*

---

**Task 1**
Issuing API calls

**Task 2**
Updating API calls

**Task 3**
Displaying options

**Task 4**
Providing extra-information

**Task 5**
Conducting full dialogs
The Dialog bAbI Tasks

Task 1
Issuing API calls

<table>
<thead>
<tr>
<th>Dialogue Content</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi!</td>
<td></td>
</tr>
<tr>
<td>Hello, what can I help you with today?</td>
<td></td>
</tr>
<tr>
<td>I'd like to book a table for six people in an expensive price range with British food.</td>
<td></td>
</tr>
<tr>
<td>I'm on it!</td>
<td></td>
</tr>
<tr>
<td>Where should it be?</td>
<td></td>
</tr>
<tr>
<td>In London.</td>
<td></td>
</tr>
<tr>
<td>Ok, let me look into some options for you.</td>
<td></td>
</tr>
<tr>
<td>api_call(British, London, Six, Expensive)</td>
<td>Task 2 Updating API calls</td>
</tr>
<tr>
<td>Actually I would prefer for four.</td>
<td></td>
</tr>
<tr>
<td>Sure. Is there anything else to update?</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td></td>
</tr>
<tr>
<td>Ok let me look into some options for you.</td>
<td></td>
</tr>
<tr>
<td>api_call(British, London, Four, Expensive)</td>
<td></td>
</tr>
</tbody>
</table>

The Dialog bAbI Tasks

**Task 3**
Displaying options

- The Place R_phone The Place_phone
- The Place R_cuisine british
- The Place R_address The Place_address
- The Place R_location london
- The Place R_availability four
- The Place R_price expensive
- The Place R_rating 7
- The Fancy_Pub R_phone The Fancy_Pub_phone
- The Fancy_Pub R_cuisine british
- The Fancy_Pub R_address The Fancy_Pub_address
- The Fancy_Pub R_location london
- The Fancy_Pub R_availability four
- The Fancy_Pub R_price expensive
- The Fancy_Pub R_rating 8

What do you think of this option: The Fancy_Pub

No, I don't like that.

Sure, let me find another option for you.

What do you think of this option: The Place

Let's do it!

Great let me do the reservation.
The Dialog bAbI Tasks

Task 4
Providing extra-information

Task 5 Conducting full dialogs
Short Text Conversation (STC)
Short Text Conversation Task (STC-3)
Chinese Emotional Conversation Generation (CECG) Subtask

Source: http://coai.cs.tsinghua.edu.cn/hml/challenge.html
# NTCIR Short Text Conversation

**STC-1, STC-2, STC-3**

<table>
<thead>
<tr>
<th></th>
<th>Japanese</th>
<th>Chinese</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTCIR-12 STC-1</td>
<td>Twitter, Retrieval</td>
<td>Weibo, Retrieval</td>
<td></td>
</tr>
<tr>
<td>22 active</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>participants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NTCIR-13 STC-2</td>
<td>Yahoo! News, Retrieval+</td>
<td>Weibo, Retrieval+</td>
<td></td>
</tr>
<tr>
<td>27 active</td>
<td>Generation</td>
<td>Generation</td>
<td></td>
</tr>
<tr>
<td>participants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NTCIR-14 STC-3</td>
<td></td>
<td></td>
<td>Weibo, Generation for given emotion categories</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weibo+English translations, distribution estimation for subjective annotations</td>
</tr>
</tbody>
</table>

- **Chinese Emotional Conversation Generation (CECG) subtask**
- **Dialogue Quality (DQ) and Nugget Detection (ND) subtasks**

**Source:** [https://waseda.app.box.com/v/STC3atNTCIR-14](https://waseda.app.box.com/v/STC3atNTCIR-14)

- Single-turn, Non task-oriented
- Multi-turn, task-oriented (helpdesk)
Short Text Conversation (NTCIR-13 STC2)

Retrieval-based retrieval-based method

Given a new post, can a coherent and useful comment be returned by searching a post-comment repository?

Short Text Conversation
(NTCIR-13 STC2)

Generation-based

generation-based method

Given a new post, can a fluent, coherent and useful comment be generated?

The Trained Generator

post

Generating

Understanding

generated comment
generated comment
generated comment

post

post-comment repository

post

comment

post

comment

comment

comment

comment

comment

comment

comment

comment

Short Text Conversation (STC-3)

• Emotional Conversation Generation
• Dialogue Quality
• Nugget Detection subtasks using Chinese and English dialogue data

Source: [http://research.nii.ac.jp/ntcir/ntcir-14/tasks.html](http://research.nii.ac.jp/ntcir/ntcir-14/tasks.html)
NTCIR-14

Short Text Conversation Task (STC-3)

• Three new subtasks
  – Chinese Emotional Conversation Generation (CECG)
  – Dialogue Quality (DQ) (for Chinese and English)
  – Nugget Detection (ND) (for Chinese and English)

Source: http://research.nii.ac.jp/ntcir/ntcir-14/tasks.html
Given post:

The man who cooks and loves dogs is very handsome!

<table>
<thead>
<tr>
<th>Response</th>
<th>Chinese / Translated English</th>
<th>Emotion Class</th>
<th>Coherence and Fluency</th>
<th>Emotion Consistency</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response 1</td>
<td>会做饭的男人是很帅的啊。The man who cooks is handsome.</td>
<td>喜欢 Like</td>
<td>Yes</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>Response 2</td>
<td>哈哈，我也觉得。Haha, I feel the same way.</td>
<td>喜欢 Like</td>
<td>Yes</td>
<td>No</td>
<td>1</td>
</tr>
<tr>
<td>Response 3</td>
<td>这是哪部电影里的？Which movie is this from?</td>
<td>厌恶 Disgust</td>
<td>No</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Response 4</td>
<td>哈哈,你也是。Haha, the same to you.</td>
<td>喜欢 Like</td>
<td>No</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Response 5</td>
<td>我爱你会。I love you, will you.</td>
<td>厌恶 Disgust</td>
<td>No</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Response 6</td>
<td>这是同主义同的道！This is the same way of the same doctrine!</td>
<td>厌恶 Disgust</td>
<td>No</td>
<td>No</td>
<td>0</td>
</tr>
</tbody>
</table>

NLPCC Emotion Classification Challenge
6 classes (64%)

- 0: Other
- 1: Like
- 2: Sadness
- 3: Disgust
- 4: Anger
- 5: Happiness

Source: http://coai.cs.tsinghua.edu.cn/hml/challenge/dataset_description/
<table>
<thead>
<tr>
<th>Post (Given)</th>
<th>Emotion Category (Given)</th>
<th>Response (to be generated)</th>
</tr>
</thead>
</table>
| 爱狗还会做饭的男人，最帅了！
The man who cooks and loves dogs is very handsome! | 喜欢 Like | 会做饭的男人是很帅的啊。
The man who cooks is handsome. |
| 爸爸，明天是六一啦，带我出去玩吧！
Daddy, tomorrow is June 1th Children’s Day. Please take me out to play! | 喜欢 Like | 好，一定带。
Yes, of course. |
| 被特别在乎的人忽略，会很难过，而装做不在乎，会更难过。
It's sad to be ignored by someone that you really care, and it's harder to pretend that you don't care. | 悲伤 Sadness | 因为在乎，所以在乎。
I am concerned with it, because I care about it. |
| 冰天雪地的哈尔滨！你要冻死我咋地？！？！
Harbin is in the snow! Are you going to freeze me to death?!?!

| 喜欢 Like | 注意保暖，小心别感冒!
Keep warm. Watch out for getting cold! |
| 本来想学一把沧桑，结果令我更忧伤。
I wanted to learn the vicissitudes of life, but I became sadder. | 悲伤 Sadness | 这是一个悲伤的故事。
It a sad story. |
| 今天一整天都在海边训练。虽然很累，但还是很开心的！
I have been training at the seaside all day. Though very tired, I still very happy! | 快乐 Happiness | 是的呢，开心！
Yeah, happy! |

Chinese Emotional Conversation Generation (CECG) Dataset

- 1,110,000 Weibo post-response pairs
  - [[[post,post_label],[response,response_label]],
    [[post,post_label],[response,response_label]],...].

Source: http://coai.cs.tsinghua.edu.cn/hml/challenge/dataset_description/
Fluency judgement on responses with repetitive words

<table>
<thead>
<tr>
<th>Response</th>
<th>Fluency</th>
</tr>
</thead>
<tbody>
<tr>
<td>悲哀，悲哀，悲哀。</td>
<td>Yes</td>
</tr>
<tr>
<td>飘逸，飘逸，飘逸！</td>
<td>Yes</td>
</tr>
<tr>
<td>好可爱，好可爱！</td>
<td>Yes</td>
</tr>
<tr>
<td>哈哈哈，当然啦</td>
<td>Yes</td>
</tr>
<tr>
<td>疯了。疯了。全疯了</td>
<td>Yes</td>
</tr>
<tr>
<td>对的对的对的对的对的对的对的对的对的对的对的</td>
<td>No</td>
</tr>
<tr>
<td>我骗骗骗骗我骗你信不信不信不信不信我反正信了</td>
<td>No</td>
</tr>
<tr>
<td>中国的教育教育教育教育教育教育教育教育教育教育</td>
<td>No</td>
</tr>
<tr>
<td>矮贱贱贱贱贱贱贱贱贱，你爱你，我也不爱你了</td>
<td>No</td>
</tr>
<tr>
<td>不关我事不关我事不关我事不关我事不关我事不关我事不关我事不关我事</td>
<td>No</td>
</tr>
</tbody>
</table>
Sample responses generated by Seq2Seq and ECM (Emotional Chatting Machine)

<table>
<thead>
<tr>
<th>Post</th>
<th>Model</th>
<th>Response (Original)</th>
<th>Response (Translated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>承诺，就是一个骗子说给一个傻子听的。A promise is what a cheater says to a fool.</td>
<td>Seq2Seq</td>
<td>承诺，就是一个骗子说给一个傻子听的。</td>
<td>A promise is what a cheater says to a fool.</td>
</tr>
<tr>
<td>像我一个单心的傻子</td>
<td>Like</td>
<td>像我一个单心的傻子</td>
<td>Promise is a single-minded fool</td>
</tr>
<tr>
<td>我就是个开心的傻子</td>
<td>Happy</td>
<td>我就是个开心的傻子</td>
<td>I'm just a happy fool</td>
</tr>
<tr>
<td>我就是一个悲伤的傻子</td>
<td>Sad</td>
<td>我就是一个悲伤的傻子</td>
<td>I am a sad fool</td>
</tr>
<tr>
<td>一个骗子说给一个傻子听</td>
<td>Disgust</td>
<td>一个骗子说给一个傻子听</td>
<td>A cheat says to a fool</td>
</tr>
<tr>
<td>不管你信不信，反正我信了！</td>
<td>Angry</td>
<td>不管你信不信，反正我信了！</td>
<td>Whatever you believe or not, I trust in it!</td>
</tr>
<tr>
<td>知道真相的我眼泪掉下来。After knowing the truth, I burst into tears.</td>
<td>Seq2Seq</td>
<td>知道真相的我眼泪掉下来。</td>
<td>After knowing the truth, I burst into tears.</td>
</tr>
<tr>
<td>太可爱了, 太可爱了！</td>
<td>Like</td>
<td>太可爱了, 太可爱了！</td>
<td>Too lovely, it’s too lovely.</td>
</tr>
<tr>
<td>笑得我眼泪都出来了。</td>
<td>Happy</td>
<td>笑得我眼泪都出来了。</td>
<td>I can’t help laugh myself to tears.</td>
</tr>
<tr>
<td>知道真相的我眼泪掉下来。</td>
<td>Sad</td>
<td>知道真相的我眼泪掉下来。</td>
<td>After knowing the truth, I burst into tears.</td>
</tr>
<tr>
<td>这是真的还是假的？</td>
<td>Disgust</td>
<td>这是真的还是假的？</td>
<td>Is this true?</td>
</tr>
<tr>
<td>什么意思？没看懂。</td>
<td>Angry</td>
<td>什么意思？没看懂。</td>
<td>What do you mean? I don’t understand.</td>
</tr>
</tbody>
</table>

Sample responses generated by Seq2Seq and ECM (Emotional Chatting Machine)

<table>
<thead>
<tr>
<th>Post</th>
<th>Model</th>
<th>Response(Original)</th>
</tr>
</thead>
</table>
| 承诺，就是一个骗子说给一个傻子听的。  
A promise is what a cheater says to a fool. | Seq2Seq | 承诺，就是一个骗子说给一个傻子听的。 |
| 骄傲说的？                     | ECM    | 承诺是一个卒一的傻子              |
| 美好的谎言                   |        | 我就是一个开心的傻子              |
| 痛苦的回忆                   |        | 我就是一一个悲伤的傻子            |
| 厌恶的感叹                   |        | 一个骗子说给一个傻子听            |
| 愤怒的呐喊                   |        | 不不管你信不信，反正我信了！      |

## Emotional Short Text Conversation (ESTC) Dataset

<table>
<thead>
<tr>
<th></th>
<th>Posts</th>
<th>217,905</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Posts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Angry</td>
<td>234,635</td>
</tr>
<tr>
<td></td>
<td>Disgust</td>
<td>689,295</td>
</tr>
<tr>
<td></td>
<td>Happy</td>
<td>306,364</td>
</tr>
<tr>
<td></td>
<td>Like</td>
<td>1,226,954</td>
</tr>
<tr>
<td></td>
<td>Sad</td>
<td>537,028</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>1,365,371</td>
</tr>
<tr>
<td>Validation</td>
<td>Posts</td>
<td>1,000</td>
</tr>
<tr>
<td>Test</td>
<td>Posts</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Conversations with/without considering emotion

Emotional Chatting Machine (ECM)

- User: *Worst day ever. I arrived late because of the traffic.*
  1. Basic Seq2Seq: You were late.
  2. ECM (Like): I am always here to support you.
  3. ECM (Happy): Keep smiling! Things will get better.
  4. ECM (Sad): It’s depressing.
  5. ECM (Disgust): Sometimes life just sucks.
  6. ECM (Angry): The traffic is too bad!

Overview of Emotional Chatting Machine (ECM)

Emotion Classifier

Training Data

ECM

Emotion Embedding
Internal Memory
External Memory

Overview of Emotional Chatting Machine (ECM)

Overview of Emotional Chatting Machine (ECM)

Data flow of the decoder with an internal memory

Data flow of the decoder with an external memory

Sample responses generated by Seq2Seq and ECM (Emotional Chatting Machine)

<table>
<thead>
<tr>
<th>Post</th>
<th>Model</th>
<th>Response(Original)</th>
</tr>
</thead>
<tbody>
<tr>
<td>知道真相的我眼泪笑下来 Knowing the truth, I laughed myself to tears</td>
<td>Seq2Seq</td>
<td>知道真相的我眼泪掉下来。</td>
</tr>
<tr>
<td></td>
<td>ECM</td>
<td>太可爱了，太可爱了！</td>
</tr>
<tr>
<td></td>
<td>Like</td>
<td>太可爱了，太可爱了！</td>
</tr>
<tr>
<td></td>
<td>Happy</td>
<td>笑得我眼泪都出来了。</td>
</tr>
<tr>
<td></td>
<td>Sad</td>
<td>知道真相的我眼泪掉下来。</td>
</tr>
<tr>
<td></td>
<td>Disgust</td>
<td>这是真的还是假的？</td>
</tr>
<tr>
<td></td>
<td>Angry</td>
<td>什么意思？没看懂。</td>
</tr>
</tbody>
</table>

Chinese Emotional Conversation Generation (CECG) Evaluation Metric

- **Emotion Consistency**
  - whether the emotion class of a generated response is the same as the pre-specified class.

- **Coherence**
  - whether the response is appropriate in terms of both logically coherent and topic relevant content.

- **Fluency**
  - whether the response is fluent in grammar and acceptable as a natural language response.

Chinese Emotional Conversation Generation (CECG) Evaluation Metric

IF Coherence and Fluency
   IF Emotion Consistency
      LABEL 2
   ELSE
      LABEL 1
ELSE
   LABEL 0

Source: http://coai.cs.tsinghua.edu.cn/hml/challenge/evaluation_metric/
Sequence-to-sequence Learning with Attention for Generation-based STC

Post: 梅里 雪山 的 真容 只给 善良 的 人 看。
Only those who are kind can see the real view of Meili snow mountain.

Encoder Module $E$

Decoder Module $D$

Generated response: 这是 没 被 登顶 的 雪山
The summit of this snow mountain hasn’t been reached.

General Framework of Controllable Short-Text-Conversation Generation with External Memory

### Controllable Short Text Conversation Examples

<table>
<thead>
<tr>
<th>Post</th>
<th>NRM</th>
<th>MrRNN</th>
</tr>
</thead>
<tbody>
<tr>
<td>李娜太牛了! 中国第一个世界网球大满贯冠军! Li Na is great! China’s first World Tennis Grand Slam champion!</td>
<td>李娜是世界冠军! Li Na is the world champion!</td>
<td>Come on, Li Na. Come on!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESED</th>
<th>Key-Word</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>世界</td>
<td>李娜是世界上最棒的! Li Na is the best in the world!</td>
<td></td>
</tr>
<tr>
<td>world</td>
<td>Li Na is the best in the world!</td>
<td></td>
</tr>
<tr>
<td>中国</td>
<td>李娜是中国的骄傲! Li Na is the pride of China!</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>Li Na is the pride of China!</td>
<td></td>
</tr>
<tr>
<td>网球</td>
<td>中国网球公开赛, 加油! China Tennis Open, come on!</td>
<td></td>
</tr>
<tr>
<td>tennis</td>
<td>China Tennis Open, come on!</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post</th>
<th>NRM</th>
<th>MrRNN</th>
</tr>
</thead>
<tbody>
<tr>
<td>感人器官捐献广告, 请感谢那些给你第二次生命的人. A touching organ donation advertisement, please thank those who gave you a second life.</td>
<td>给我第二次生命的人。 A man who gives me a second life.</td>
<td>感谢每一个人! Thanks for everyone!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESED</th>
<th>Key-Word</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>生命</td>
<td>感谢生命给予的一切! Thanks for everything given by life!</td>
<td></td>
</tr>
<tr>
<td>life</td>
<td>Thanks for everything given by life!</td>
<td></td>
</tr>
<tr>
<td>器官</td>
<td>感谢那些器官捐赠者。 Thanks for those organ donors.</td>
<td></td>
</tr>
<tr>
<td>organ</td>
<td>Thanks for those organ donors.</td>
<td></td>
</tr>
<tr>
<td>广告</td>
<td>非常感人的广告! A very touching advertisement!</td>
<td></td>
</tr>
<tr>
<td>advertisement</td>
<td>A very touching advertisement!</td>
<td></td>
</tr>
</tbody>
</table>

Comments Generated Using Different Semantic key Mapping Methods

| Post | 美好的社会应该由善良的人组成。  
A good society should be composed of people of kindness. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mapping-Method</strong></td>
<td><strong>Key-Word</strong></td>
</tr>
</tbody>
</table>
| Identity Mapper | 善良 kindness | 善良是一种信仰。  
Kindness is a belief. |
| Synonym | 友善 friendliness | 善良是一种美德。  
Kindness is a virtue. |
| Antonym | 丑恶 evil | 没有丑恶的社会,更可怕。  
A society without evils is more terrifying. |
| Embedding | 乐观 optimism | 乐观是一种生活态度。  
Optimism is an attitude of life. |
| Common-Reply | 真 really | 真的吗?  
Really? |
| Random | 人 person | 每个人都有善良的一面。  
Every person has a side of kindness. |
| | 中国 China | 中国的贫富差距太大了。  
The gap between the wealthy and the poor in China is too big. |

### Generated Responses of Knowledge

**Introduction by External Memory**

| Post | 你最喜欢哪个星座？
What is your favorite constellation? |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semantic-Key</strong></td>
<td><strong>Key-Word</strong></td>
</tr>
<tr>
<td>摩羯座</td>
<td>Key-Word</td>
</tr>
<tr>
<td>Capricorn</td>
<td>I love Capricorn.</td>
</tr>
<tr>
<td>射手座</td>
<td>Key-Word</td>
</tr>
<tr>
<td>Sagittarius</td>
<td>I am a Sagittarius and I like it.</td>
</tr>
</tbody>
</table>
| 今天周杰伦的电影,太好看了。
Jay Chou’s movie is so nice today. |
| **Semantic-Key** | **Key-Word** | **Response** |
| 歌 | Key-Word | Response |
| song | Jay Chou’s songs are nice too. |
| 梵高的画,很漂亮。
Van Gogh’s paintings are very beautiful. |
| **Semantic-Key** | **Key-Word** | **Response** |
| 向日葵 | Key-Word | Response |
| sunflower | The Sunflower by Van Gogh. |
| 荷兰 | Key-Word | Response |
| Holland | Van Gogh’s paintings are very beautiful. |

Chatbot Frameworks and AI Services

• Bot Frameworks
  – Botkit
  – Microsoft Bot Framework
  – Rasa NLU

• AI Services
  – Wit.ai
  – api.ai
  – LUIS.ai
  – IBM Watson

# Chatbot Frameworks

## Comparison Table of Most Prominent Bot Frameworks

<table>
<thead>
<tr>
<th>Feature</th>
<th>Botkit</th>
<th>Microsoft Bot Framework</th>
<th>RASA NLU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in Integration with messaging platforms</td>
<td>✅</td>
<td>✅</td>
<td>✗</td>
</tr>
<tr>
<td>NLP support</td>
<td>✗, but possible to integrate with middlewares</td>
<td>✗, but have close bonds with LUIS.ai</td>
<td>✅</td>
</tr>
<tr>
<td>Out-of-box bots ready to be deployed</td>
<td>✅</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Programming Language</td>
<td>JavaScript (Node)</td>
<td>JavaScript (Node), C#</td>
<td>Python</td>
</tr>
</tbody>
</table>

*Created by ActiveWizards*

## Comparison of Most Prominent AI Services

<table>
<thead>
<tr>
<th>Feature</th>
<th>wit.ai</th>
<th>api.ai</th>
<th>LUIS.ai</th>
<th>IBM Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of charge</td>
<td>✅</td>
<td>✅ but has paid enterprise version</td>
<td>✅ it is in beta and has transaction limits</td>
<td>30 days trial then priced for enterprise use</td>
</tr>
<tr>
<td>Text and Speech processing</td>
<td>✅</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Machine Learning Modeling</td>
<td>✅</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Support for Intents, Entities, Actions</td>
<td>✅ Intents used as trait entities, actions are combined operations</td>
<td>✅ Intents is the main prediction mechanism. Domains of entities, intents and actions</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Pre-build entities for easy parsing of numbers, temperature, date, etc.</td>
<td>✅</td>
<td>✅</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration to messaging platforms</td>
<td>✗ web service API</td>
<td>✗ also has facility for deploying to heroku. Paid environment</td>
<td>✗ integrated to Azure</td>
<td>✗ possible via API</td>
</tr>
<tr>
<td>Support of SDKs</td>
<td>✅ includes SDKs for Python, Node.js, Rust, C, Ruby, iOS, Android, Windows Phone</td>
<td>✅ C#, Xamarin, Python, Node.js, iOS, Android, Windows Phone</td>
<td>✅ enables building with Web Service API, Microsoft Bot Framework integration</td>
<td>✗ Proprietary language “AlchemyLanguage”</td>
</tr>
</tbody>
</table>

Rasa

Conversational AI
Open source tools to build contextual AI assistants

The Rasa Stack is a set of open source machine learning tools for developers to create contextual chatbots and assistants. Supported by thousands of community members.

https://rasa.com/
Rasa Platform
Rasa Stack

https://rasa.com/
Rasa Core High-Level Architecture

Source: https://rasa.com/docs/core/architecture/
Rasa the OSS to build conversational software with ML

"What's the weather like tomorrow?"
(User Request via text or voice)

"It will be sunny and 20°C."
(AI response via text or voice)

Input Modules
"Ears"
NLU, GUI elements, context, personal info

Dialog Management
"Brain"

Output Modules
"Mouth"
NLG, GUI elements

Connector Modules
Connector to any conversational platforms

Alternatives: Dialogflow, wit.ai, 9


https://github.com/RasaHQ/asa-workshop-pydata-berlin
Rasa NLU: 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 Core: Dialogue Handling

Under The Hood

Rasa Core: Dialogue Handling

“What’s the weather like tomorrow?”

Intent
Entities

“It will be sunny and 20°C.”

updated State

SVM
Recurrent NN
...

previous Action

next Action

“Thanks.”

after next Action

Rasa Core: Dialogue Handling

Rasa Core: Dialogue Training

Issue: How to get started? ➔ Online Learning

What’s the weather like tomorrow?

How did you like it?

It will be sunny and 20°C.

Correct wrong behaviour

Retrain model

Build natural and rich conversational experiences

Give users new ways to interact with your product by building engaging voice and text-based conversational interfaces, such as voice apps and chatbots, powered by AI. Connect with users on your website, mobile app, the Google Assistant, Amazon Alexa, Facebook Messenger, and other popular platforms and devices.

Powered by Google's machine learning
Dialogflow incorporates Google's machine learning expertise and products such as Google Cloud Speech-to-Text.

Built on Google infrastructure
Dialogflow is backed by Google and runs on Google Cloud Platform, letting you scale to hundreds of millions of users.

Optimized for the Google Assistant
Dialogflow is the most widely used tool to build Actions for more than 400M+ Google Assistant devices.

https://dialogflow.com/
Learning Semantic Textual Similarity from Conversations

Semantically Different

- How are you?
  - Great.
- How old are you?
  - I am 20 years old.

Semantically Similar

- What is your age?
  - I am 20 years old.

TF-Hub Modules

Sentence Embedding

Universal Sentence Encoder

Text embedding

universal-sentence-encoder  By Google
Text embedding  DAN  English
Encoder of greater-than-word length text trained on a variety of data.

universal-sentence-encoder-large  By Google
Text embedding  Transformer  English
Encoder of greater-than-word length text trained on a variety of data.

elmo  By Google
Text embedding  1 Billion Word Benchmark  ELMo  English
Embeddings from a language model trained on the 1 Billion Word Benchmark.

View more text embeddings

Image feature vectors

imagenet/inception_v3/feature_vector  By Google
Image feature vector  ImageNet (ILSVRC-2012-CLS)  Inception V3

https://tfhub.dev/
Semantic Similarity with TF-Hub University Sentence Encoder

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\[ 1 \text{ cells hidden} \]

### Universal Sentence Encoder

This notebook illustrates how to access the Universal Sentence Encoder and use it for sentence similarity and sentence classification tasks.

The Universal Sentence Encoder makes getting sentence level embeddings as easy as it has historically been to lookup the embeddings for individual words. The sentence embeddings can then be trivially used to compute sentence level meaning similarity as well as to enable better performance on downstream classification tasks using less supervised training data.

### Getting Started

This section sets up the environment for access to the Universal Sentence Encoder on TF Hub and provides examples of applying the encoder to words, sentences, and paragraphs.

```
# Install the latest Tensorflow version.
!pip3 install --quiet "tensorflow>=1.7"
# Install TF-Hub.
!pip3 install --quiet tensorflow-hub
```
Semantic Textual Similarity

**anaGo**

**Sequence Labeling (NER)**

**anaGo**

`anaGo` is a Python library for sequence labeling (NER, PoS Tagging,...), implemented in Keras.

`anaGo` can solve sequence labeling tasks such as named entity recognition (NER), part-of-speech tagging (POS tagging), semantic role labeling (SRL) and so on. Unlike traditional sequence labeling solver, `anaGo` don’t need to define any language dependent features. Thus, we can easily use `anaGo` for any languages.

As an example of `anaGo`, the following image shows named entity recognition in English:

**anaGo Demo**

![Image of named entity recognition example](https://github.com/Hironsan/anago)
GRAM-CNN

BioNER

• GRAM-CNN is a novel end-to-end approach for biomedical NER tasks. To automatically label a word, this method uses the local information around the word. Therefore, the GRAM-CNN method doesn't require any specific knowledge or feature engineering and can be theoretically applied to all existing NER problems.

• The GRAM-CNN approach was evaluated on three well-known biomedical datasets containing different BioNER entities. It obtained an F1-score of 87.38% on the Biocreative II dataset, 86.65% on the NCBI dataset, and 72.57% on the JNLPBA dataset. Those results put GRAM-CNN in the lead of the biological NER methods.

• Pre-trained embedding are from:
  – https://github.com/valdersoul/GRAM-CNN

Summary

• AI Chatbots
• Conversational Commerce
• Bot Platform Ecosystem
References