



人工智慧交談機器人 與對話式商務

(AI Chatbots and Conversational Commerce)

Time: 2017/12/25 (Mon) (10:00-12:00) Place: 國立臺北護理健康大學 (台北市明德路365號) 親仁樓 B425 Host: 祝國忠 院長 (健康科技學院院長)



<u>Min-Yuh Day</u> <u>戴敏育</u> Assistant Professor 專任助理教授

Dept. of Information Management, Tamkang University

淡江大學 資訊管理學系



http://mail. tku.edu.tw/myday/ 2017-12-25



戴敏育博士 (Min-Yuh Day, Ph.D.) 淡江大學資管系專任助理教授 中央研究院資訊科學研究所訪問學人 國立台灣大學資訊管理博士

Publications Co-Chairs, IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2013-)

Program Co-Chair, IEEE International Workshop on Empirical Methods for Recognizing Inference in TExt (IEEE EM-RITE 2012-) Workshop Chair, The IEEE International Conference on Information Reuse and Integration (IEEE IRI)







• Artificial Intelligence (AI)

- Chatbots
- Conversational Commerce

Artificial Intelligence **(AI)**

Definition of

Artificial Intelligence (A.I.)

Artificial Intelligence

"... the SCIENCE and engineering of making intelligent machines" (John McCarthy, 1955)

Artificial Intelligence

"... technology that thinks and acts like humans"

Artificial Intelligence

"... intelligence exhibited by machines or software"

4 Approaches of Al



4 Approaches of Al

Thinking Humanly	Thinking Rationally
"The exciting new effort to make con ers think machines with minds, in full and literal sense." (Haugeland, 1	 "The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985)
"[The automation of] activities that associate with human thinking, activities such as decision-making, problem ing, learning" (Bellman, 1978)	t we "The study of the computations that make vities it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	Acting Rationally
"The art of creating machines that form functions that require intellig when performed by people." (Kurz 1990)	per- ence "Computational Intelligence is the study of the design of intelligent agents." (Poole weil, <i>et al.</i> , 1998)
"The study of how to make computer things at which, at the moment, people better." (Rich and Knight, 1991)	e are "AI is concerned with intelligent be- havior in artifacts." (Nilsson, 1998)

4 Approaches of Al

2.	3.
Thinking Humanly:	Thinking Rationally:
The Cognitive	The "Laws of Thought"
Modeling Approach	Approach
1.	4.
Acting Humanly:	Acting Rationally:
The Turing Test	The Rational Agent
Approach (1950)	Approach

Al Acting Humanly: The Turing Test Approach (Alan Turing, 1950)

- Natural Language Processing (NLP)
- Knowledge Representation
- Automated Reasoning
- Machine Learning (ML)
- Computer Vision
- Robotics

Boston Dynamics: Atlas



#13 ON TRENDING What's new, Atlas?

https://www.youtube.com/watch?v=fRj34o4hN4I

Humanoid Robot: Sophia



https://www.youtube.com/watch?v=S5t6K9iwcdw

Artificial Intelligence (A.I.) Timeline

A.I. TIMELINE



1961





TURING TEST

Computer scientist Alan Turing proposes a intelligence' is coined test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955

A.I. BORN UNIMATE Term 'artificial First industrial robot, Unimate, goes to work by computer scientist, at GM replacing John McCarthy to describe "the science assembly line and engineering of making intelligent machines"

1964

Pioneering chatbot developed by Joseph Weizenbaum at MIT with humans

1966 **A.I.**

WINTER

playing computer from Many false starts and dead-ends leave A.I. out champion Garry Kasparov

1998

Cynthia Breazeal at MIT introduces KISmet, an IBM defeats world chess emotionally intelligent robot insofar as it detects and responds to people's feelings

🔅 AlphaGo



1999

AIBO

Sony launches first consumer robot pet dog autonomous robotic AiBO (Al robot) with skills and personality that develop over time



ODD

and clean homes

2011

Apple integrates Siri, an intelligent virtual vacuum cleaner from assistant with a voice iRobot learns to navigate interface, into the iPhone 4S



2011

WATSON

IBM's question answering computer Watson wins first place on popular \$1M prize television guiz show

2014

The 'first electronic

Shakey is a general-

that reasons about

its own actions

person' from Stanford,

purpose mobile robot

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



Amazon launches Alexa, Microsoft's chatbot Tay an intelligent virtual assistant with a voice interface that completes inflammatory and shopping tasks

2016

1997

DEEP BLUE

Deep Blue, a chess-

goes roque on social media making offensive racist

2017

ALPHAGO

Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2¹⁷⁰) of possible positions

Artificial Intelligence Machine Learning & Deep Learning

ARTIFICIAL INTELLIGENCE



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Artificial Intelligence (AI) is many things



Source: https://www.i-scoop.eu/artificial-intelligence-cognitive-computing/

Artificial Intelligence (AI) Intelligent Document Recognition algorithms



Deep Learning Evolution



Source: http://www.erogol.com/brief-history-machine-learning/



and Cognitive Computing

Source: http://research.ibm.com/cognitive-computing/

Intelligent Chatbots

Conversational Commerce

From **E-Commerce** to **Conversational Commerce: Chatbots** and Virtual Assistants

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

Question Answering

Dialogue System

Chatbot





machines

think?

(Alan Turing ,1950)

Source: Cahn, Jack. "CHATBOT: Architecture, Design, & Development." PhD diss., University of Pennsylvania, 2017.

Chatbot **"online human-computer** dialog system with natural language."

Source: Cahn, Jack. "CHATBOT: Architecture, Design, & Development." PhD diss., University of Pennsylvania, 2017.

Chatbot Conversation Framework



From **E-Commerce** to **Conversational Commerce: Chatbots** and Virtual Assistants

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

H&M's chatbot on Kik



Uber's chatbot on Facebook's messenger



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



	• —	
NETWORK Gack	3:33 PM SAVINGSBOT	100%
Soveet \$	9,50	
1	2	3
4	5	6
7	8	9
	0	
⊘ Type a r	nessage	
VIEW CREDI	T OPTIONS ASI	K BUDGETBOT
	\bigcirc	



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.



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


DESIGNED BY JON CIFUENTES

Bots Landscape





Connectors/ Shared Services



Bot Discovery



Analytics

Analytics

-

ġ

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







🕁 RECAST.AL Messenger Bot Landscape

May 2017

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

The Bot Lifecycle



Chatbots

Bot Maturity Model

Customers want to have simpler means to interact with businesses and

get faster response to a question or complaint.



Source: https://www.capgemini.com/2017/04/how-can-chatbots-meet-expectations-introducing-the-bot-maturity/

Integration

System Architecture of

Intelligent Dialogue and Question Answering System



Question Answering



IMTKU **Question Answering System** for **World History Exams** at NTCIR-13 QALab-3

NTCIR-13 Conference, December 5-8, 2017, Tokyo, Japan



Tamkang University





IMTKU Question Answering System for World History Exams at NTCIR-13 QALab-3

Department of Information Management Tamkang University, Taiwan





Min-Yuh Day

Chao-Yu Chen



Wanchu Huang



Shi-Ya Zheng



I-Hsuan Huang



Tz-Rung Chen



Min-Chun Kuo





Yi-Jing Lin

myday@mail.tku.edu.tw

NTCIR-13 Conference, December 5-8, 2017, Tokyo, Japan

IMTKU System Architecture for NTCIR-12 QALab2





NTCIR-12 Conference, June 7-10, 2016, Tokyo, Japan

IMTKU System Architecture for NTCIR-13 QALab-3





NTCIR-13 Conference, December 5-8, 2017, Tokyo, Japan

Tamkang University







IMTKU Textual Entailment System for Recognizing Inference in Text at NTCIR-9 RITE

Department of Information Management Tamkang University, Taiwan



Min-Yuh Day Chun Tu myday@mail.tku.edu.tw

NTCIR-9 Workshop, December 6-9, 2011, Tokyo, Japan

Tamkang University







IMTKU Textual Entailment System for Recognizing Inference in Text at NTCIR-10 RITE-2

Department of Information Management Tamkang University, Taiwan



Chun Tu



Hou-Cheng Vong



Shih-Wei Wu



Shih-Jhen Huang

myday@mail.tku.edu.tw

NTCIR-10 Conference, June 18-21, 2013, Tokyo, Japan

IMTKU Textual Entailment System for Recognizing Inference in Text at NTCIR-11 RITE-VAL

Tamkang University



2014





Min-Yuh Day



Ya-Jung Wang



Che-Wei Hsu



En-Chun Tu



Huai-Wen Hsu



Yu-An Lin



Shang-Yu Wu



Yu-Hsuan Tai



Cheng-Chia Tsai

NTCIR-11 Conference, December 8-12, 2014, Tokyo, Japan

Tamkang University



2016 **IMTKU Question Answering System for** World History Exams at NTCIR-12 QA Lab2

Department of Information Management Tamkang University, Taiwan

Sagacity Technolog



Min-Yuh Day Cheng-Chia Tsai Wei-Chun Chung Hsiu-Yuan Chang

Tzu-Jui Sun

Yuan-Jie Tsai



Cheng-Hung Lee



Yu-Ming Guo

NTCIR



Yue-Da Lin

Wei-Ming Chen Yun-Da Tsai



Cheng-Jhih Han



Yi-Jing Lin Yi-Heng Chiang Ching-Yuan Chien

myday@mail.tku.edu.tw

NTCIR-12 Conference, June 7-10, 2016, Tokyo, Japan



2017





IMTKU Question Answering System for World History Exams at NTCIR-13 QALab-3

Department of Information Management Tamkang University, Taiwan





Min-Yuh Day

Chao-Yu Chen







I-Hsuan Huang



Tz-Rung Chen

NTCIR-13 Conference, December 5-8, 2017, Tokyo, Japan







Yi-Jing Lin

Wanchu Huang

Shi-Ya Zheng

myday@mail.tku.edu.tw

Min-Chun Kuo

Can a robot pass a university entrance exam? Noriko Arai at TED2017



https://www.youtube.com/watch?v=XQZjkPyJ8KU

Watson DeepQA Architecture



Source: Ferrucci, David, Eric Brown, Jennifer Chu-Carroll, James Fan, David Gondek, Aditya A. Kalyanpur, Adam Lally et al. "Building Watson: An overview of the DeepQA project." *AI magazine* 31, no. 3 (2010): 59-79.

Dialogue System



Source: Serban, I. V., Lowe, R., Charlin, L., & Pineau, J. (2015). A survey of available corpora for building data-driven dialogue systems. *arXiv* preprint arXiv:1512.05742.

Chat-oriented Dialogue System



Source: Banchs, R. E., & Li, H. (2012, July). IRIS: a chat-oriented dialogue system based on the vector space model. In *Proceedings of the ACL 2012 System Demonstrations* (pp. 37-42). Association for Computational Linguistics.

AIML Dialogue System



Source: Morales-Rodríguez, María Lucila, Rogelio Florencia Juárez, Hector J. Fraire Huacuja, and José A. Martínez Flores. "Emotional conversational agents in clinical psychology and psychiatry." In *Mexican International Conference on Artificial Intelligence*, pp. 458-466. Springer Berlin Heidelberg, 2010.

ALICE and AIML

ARTIFICIAL INTELLIGENCE FOUNDATION PROMOTING THE DEVELOPMENT AND ADOPTION OF ALICE AND AIML FREE SOFTWARE ALI.C.E. Silver Edition DAVE E.S.L. bot C.L.A.U.D.I.O Personality Test Free Live Chat with the award winning A. I. chat robot A. L. I. C. E.		
Get Started	AIML: Artificial Intelligence Markup Language	Subscription Bots
Chat with A.L.I.C.E.	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.	A.L.I.C.E. Silver Edition DAVE E.S.L. Bot
Chat with Fake Kirk	The most important units of AIML are:	CLAUDIO Personality Test
What is AIML? Foundation Bot Directory	 <aiml>: the tag that begins and ends an AIML document</aiml> 	
Bot Industry Survey	 <category>: the tag that marks a "unit of knowledge" in an Alicebot's knowledge base</category> 	
	 <pattern>: used to contain a simple pattern that matches what a user may say or type to an Alicebot</pattern> 	
Software	 <template>: contains the response to a user input</template> 	Build native
Downloads Bot Hosting	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 quide to AIML can be found in the AIML Primer .	iOS, Android,
AIML Sets AIML 1.1 Specification	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:	and Windows
AIML 2.0 Working Draft	<category></category>	apps in C#
Superbot - New!	<pre><pattern>WHAT ARE YOU</pattern> <pre><pre><pre><pre>ctemplate></pre></pre></pre></pre></pre>	
Links	<pre><think><set name="topic">Me</set></think> L am the latest result in artificial intelligence</pre>	
ESL	which can reproduce the capabilities of the human brain	C#
Books Film and TV		
Recent Press		
Popular Culture Web Ontologies	(The opening and closing <aiml> tags are not shown here, because this is an excerpt from the middle of a document.)</aiml>	
ALICE and A.I. History Scholarly Research and	template. (It can also contain a <that> tag, but we won't get into that here.)</that>	Ctt
Teaching	The pattern shown will match only the exact phrase "what are you" (capitalization is ignored).	Cir
Site Info alicebot.org Bank: 257.092	But it's possible that this category may be invoked by another category, using the <srai> tag (not shown) and the principle of reductionism.</srai>	
Links in: 638	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</think>	

AIML

(Artificial Intelligence Markup Language)

<category>

<pattern>HELLO</pattern>

<template>Hi, I am a robot</template>

</category>

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

AIML

(Artificial Intelligence Markup Language)

<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>

Humorist Chat-bot



Deep Learning for Dialogues

Intent Classification Intent LSTM

LSTM (Long-Short Term Memory) GRU (Gated Recurrent Unit)

Source: Hakkani-Tür, Dilek, Gokhan Tur, Asli Celikyilmaz, Yun-Nung Chen, Jianfeng Gao, Li Deng, and Ye-Yi Wang. "Multi-domain joint semantic frame parsing using bi-directional RNN-LSTM." In *Proceedings of The 17th Annual Meeting of the International Speech Communication Association*. 2016.

Dialogue Utterance

W find comedies recent james by cameron S **B**-date **B-dir** I-dir **B**-genre \mathbf{O} movies D find_movie

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.

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



Source: Chen, Yun-Nung, Dilek Hakkani-Tür, Gokhan Tur, Jianfeng Gao, and Li Deng. "End-to-end memory networks with knowledge carryover for multi-turn spoken language understanding." In *Proceedings of Interspeech*. 2016.

- **D** communication
- I send_email



Source: Chen, Yun-Nung, Dilek Hakkani-Tür, Gokhan Tur, Jianfeng Gao, and Li Deng. "End-to-end memory networks with knowledge carryover for multi-turn spoken language understanding." In *Proceedings of Interspeech*. 2016.

Deep Learning for SLU (Spoken Language Understanding)









Source: Hakkani-Tür, Dilek, Gokhan Tur, Asli Celikyilmaz, Yun-Nung Chen, Jianfeng Gao, Li Deng, and Ye-Yi Wang. "Multi-domain joint semantic frame parsing using bi-directional RNN-LSTM." In *Proceedings of The 17th Annual Meeting of the International Speech Communication Association*. 2016.

Encoder-decoder model for joint intent detection and slot filling



(a) with no aligned inputs.

Source: Liu, Bing, and Ian Lane. "Attention-Based Recurrent Neural Network Models for Joint Intent Detection and Slot Filling." arXiv preprint arXiv:1609.01454 (2016).

Encoder-decoder model for joint intent detection and slot filling



(b) with aligned inputs.

Source: Liu, Bing, and Ian Lane. "Attention-Based Recurrent Neural Network Models for Joint Intent Detection and Slot Filling." arXiv preprint arXiv:1609.01454 (2016).

Encoder-decoder model for joint intent detection and slot filling



(c) with aligned inputs and attention

Source: Liu, Bing, and Ian Lane. "Attention-Based Recurrent Neural Network Models for Joint Intent Detection and Slot Filling." *arXiv preprint arXiv:1609.01454* (2016).

End-to-End Task-Completion Neural Dialogue Systems



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

Source: Li, Xuijun, Yun-Nung Chen, Lihong Li, and Jianfeng Gao. "End-to-end task-completion neural dialogue systems." *arXiv preprint arXiv:1703.01008* (2017).

Slot Intent



Source: Li, Xuijun, Yun-Nung Chen, Lihong Li, and Jianfeng Gao. "End-to-end task-completion neural dialogue systems." *arXiv preprint arXiv:1703.01008* (2017).

Slot Intent

Annotations		
Intent	request, inform, deny, confirm_question, confirm_answer, greeting, closing, not_sure, multiple_choice, thanks, welcome	
Slot	actor, actress, city, closing, critic_rating, date, description, distanceconstraints, greeting, implicit_value, movie_series, moviename, mpaa_rating, numberofpeople, numberofkids, taskcomplete, other, price, seating, starttime, state, theater, theater_chain, video_format, zip, result, ticket, mc_list	

Source: Li, Xuijun, Yun-Nung Chen, Lihong Li, and Jianfeng Gao. "End-to-end task-completion neural dialogue systems." *arXiv preprint arXiv:1703.01008* (2017).
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

Source: Li, Xuijun, Yun-Nung Chen, Lihong Li, and Jianfeng Gao. "End-to-end task-completion neural dialogue systems." *arXiv preprint arXiv:1703.01008* (2017).

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.

Source: Li, Xuijun, Yun-Nung Chen, Lihong Li, and Jianfeng Gao. "End-to-end task-completion neural dialogue systems." *arXiv preprint arXiv:1703.01008* (2017).

```
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"
```

Source: Li, Xuijun, Yun-Nung Chen, Lihong Li, and Jianfeng Gao. "End-to-end task-completion neural dialogue systems." *arXiv preprint arXiv:1703.01008* (2017).

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**

MILABOT Dialogue manager control flow



R: "I am an Alexa Prize Socialbo"

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

MILABOT Computational graph for scoring model



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

LSTM/GRU Utterance Classifer



Source: Ravuri, Suman, and Andreas Stolcke. "A comparative study of recurrent neural network models for lexical domain classification." In Acoustics, Speech and Signal Processing (ICASSP), 2016 IEEE International Conference on, pp. 6075-6079. IEEE, 2016.

RNN and LSTM cell



Source: Hori, Chiori, Takaaki Hori, Shinji Watanabe, and John R. Hershey. "Context-Sensitive and Role-Dependent Spoken Language Understanding using Bidirectional and Attention LSTMs." *Interspeech 2016* (2016): 3236-3240.

Basic Chat Bot Components



Traditional Chat Bots



Chatbots with Machine Learning



How Brain Works

Parallelism: performing a task at separated areas



Information Pathway During Conversation



Idea from Structure



Al Deep Learning Chatbot Architecture



Model Chain Order



Model Chain Order



AI Deep Learning for Chatbot





Data Converter for Chatbot Subtitle Files from Movie



Jeongkyu Shin (2016), Building AI Chat bot with Python 3 and TensorFlow, PyCon APAC 2016

Data Converter for Chatbot Subtitle Files from Movie



Conversation Bot Model

- Embedding RNN Sequence-to-sequence model
 - Testing
 - 4-layer to 8-layer swallow learning (without input/output layer)
- Use tensorflow.contrib.learn (formally sklearn package)
 - Simpler and easier than traditional handcrafted RNN
 - Seq2seq, LSTMCell, GRUCell

Chatbot Architectures

- Information Retrieval based Bot (IR-Bot)
- Task Oriented Bot (Task-Bot)
- Chitchat-Bot (Chatbot)

Ask Me Anything: Dynamic Memory Networks for **Natural Language** Processing

- I: Jane went to the hallway.
- I: Mary walked to the bathroom.
- I: Sandra went to the garden.
- I: Daniel went back to the garden.
- I: Sandra took the milk there.
- Q: Where is the milk?

- I: Jane went to the hallway.
- I: Mary walked to the bathroom.
- I: Sandra went to the garden.
- I: Daniel went back to the garden.
- I: Sandra took the milk there.
- Q: Where is the milk?
- A: garden

- I: Jane went to the hallway.
- I: Mary walked to the bathroom.
- I: Sandra went to the garden.
- I: Daniel went back to the garden.
- I: Sandra took the milk there.
- Q: Where is the milk?
- A: garden
- I: It started boring, but then it got interesting.
- Q: What's the sentiment?
- A: positive
- Q: POS tags?
- A: PRP VBD JJ , CC RB PRP VBD JJ .





Question: Where was Mary before the Bedroom?

Facts	Episode 1	Episode 2	Episode 3
Yesterday Julie traveled to the school.			
Yesterday Marie went to the cinema.			
This morning Julie traveled to the kitchen.			
Bill went back to the cinema yesterday.			
Mary went to the bedroom this morning.			
Julie went back to the bedroom this afternoon.			
[done reading]			

Question: Where was Mary before the Bedroom? Answer: Cinema.

Facts	Episode 1	Episode 2	Episode 3
Yesterday Julie traveled to the school.			
Yesterday Marie went to the cinema.			
This morning Julie traveled to the kitchen.			
Bill went back to the cinema yesterday.			
Mary went to the bedroom this morning.			
Julie went back to the bedroom this afternoon.			
[done reading]			

Dynamic Memory Networks for Visual and Textual Question Answering

Question Answering with Dynamic Memory Network (DMN+)



Source: Xiong, Caiming, Stephen Merity, and Richard Socher. "Dynamic memory networks for visual and textual question answering." arXiv preprint arXiv:1603.01417 (2016).



Source: Xiong, Caiming, Stephen Merity, and Richard Socher. "Dynamic memory networks for visual and textual question answering." *arXiv preprint arXiv:1603.01417* (2016).

Episodic Memory Module of the DMN+



Source: Xiong, Caiming, Stephen Merity, and Richard Socher. "Dynamic memory networks for visual and textual question answering." *arXiv preprint arXiv:1603.01417* (2016).
Differentiable Neural Computer (DNC)



Source: Graves, A., Wayne, G., Reynolds, M., Harley, T., Danihelka, I., Grabska-Barwińska, A., ... & Badia, A. P. (2016). Hybrid computing using a neural network with dynamic external memory. *Nature*, *538*(7626), 471-476

Facebook Al Research : bAbl Project

- The (20) QA bAbl 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

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

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 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 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 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 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 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

Source: Weston, Jason, Antoine Bordes, Sumit Chopra, Alexander M. Rush, Bart van Merriënboer, Armand Joulin, and Tomas Mikolov. "Towards Al-complete question answering: A set of prerequisite toy tasks." *arXiv preprint arXiv:1502.05698* (2015).

Task 7: Counting	Task 8: Lists/Sets
Daniel picked up the football.	Daniel picks up the football.
Daniel dropped the football.	Daniel drops the newspaper.
Daniel got the milk.	Daniel picks up the milk.
Daniel took the apple.	John took the apple.
How many objects is Daniel holding? A: two	What is Daniel holding? milk, football
Task 9: Simple Negation	Task 10: Indefinite Knowledge
Sandra travelled to the office.	John is either in the classroom or the playground.
Fred is no longer in the office.	Sandra is in the garden.
Is Fred in the office? A:no	Is John in the classroom? A:maybe
Is Sandra in the office? A:yes	Is John in the office? A:no
Task 11: Basic Coreference	Task 12: Conjunction
Danial was in the kitchen	Mary and Loff want to the kitchen
Then he went to the studio	Then Leff went to the park
Sandra was in the office	Where is Mary? A: kitchen
Where is Daniel? A studio	Where is leff? A: park
	Where is self : At park
Task 13: Compound Coreference	Task 14: Time Reasoning
Daniel and Sandra journeyed to the office.	In the afternoon Julie went to the park.
Then they went to the garden.	Yesterday Julie was at school.
Sandra and John travelled to the kitchen.	Julie went to the cinema this evening.
After that they moved to the hallway.	Where did Julie go after the park? A:cinema
Where is Daniel? A: garden	Where was Julie before the park? A:school

Source: Weston, Jason, Antoine Bordes, Sumit Chopra, Alexander M. Rush, Bart van Merriënboer, Armand Joulin, and Tomas Mikolov. "Towards Al-complete question answering: A set of prerequisite toy tasks." *arXiv preprint arXiv:1502.05698* (2015).

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

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 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

Source: Weston, Jason, Antoine Bordes, Sumit Chopra, Alexander M. Rush, Bart van Merriënboer, Armand Joulin, and Tomas Mikolov. "Towards Al-complete question answering: A set of prerequisite toy tasks." *arXiv preprint arXiv:1502.05698* (2015).

Learning End-to-End Goal-Oriented Dialog

Facebook bAbl 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



Task 5 Conducting full dialogs

Source: Bordes, Antoine, and Jason Weston. "Learning End-to-End Goal-Oriented Dialog." *arXiv preprint arXiv:1605.07683* (2016). 117

The Dialog bAbl Tasks



The Dialog bAbl Tasks



Let's do it!

Task 3 **Displaying options**

The Dialog bAbl Tasks



Task 5 Conducting full dialogs



Source: http://ntcirstc.noahlab.com.hk/STC2/stc-cn.htm



Source: http://ntcirstc.noahlab.com.hk/STC2/stc-cn.htm

Summary • Artificial Intelligence (AI)

Chatbots

Conversational Commerce

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A & **O**

(AI Chatbots and Conversational Commerce)

Time: 2017/12/25 (Mon) (10:00-12:00) Place: 國立臺北護理健康大學 (台北市明德路365號) 親仁樓 B425 Host: 祝國忠 院長 (健康科技學院院長)



<u>Min-Yuh Day</u> <u>戴敏育</u> Assistant Professor 專任助理教授

Dept. of Information Management, Tamkang University

淡江大學 資訊管理學系



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