

# 人工智慧投資分析



Tamkang  
Universit  
淡江大學

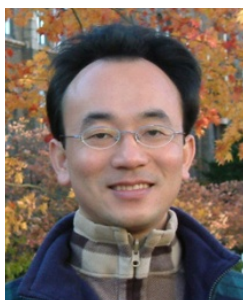
## Artificial Intelligence for Investment Analysis

# 機器人理財顧問與AI交談機器人 (Robo-Advisors and AI Chatbots)

1071AIIA03

EMBA, IMTKU (M2399) (8540)

Thu 12,13,14 (19:20-22:10) (D503)



Min-Yuh Day

戴敏育

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/>

2018-09-27



# 課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
1	2018/09/13	人工智慧投資分析課程介紹 (Course Orientation on Artificial Intelligence for Investment Analysis)
2	2018/09/20	AI 金融科技: 金融服務創新應用 (AI in FinTech: Financial Services Innovation and Application)
3	2018/09/27	機器人理財顧問與AI交談機器人 (Robo-Advisors and AI Chatbots)
4	2018/10/04	投資心理學與行為財務學 (Investing Psychology and Behavioral Finance)
5	2018/10/11	財務金融事件研究法 (Event Studies in Finance)
6	2018/10/18	人工智慧投資分析個案研究 I (Case Study on Artificial Intelligence for Investment Analysis I)

# 課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
7	2018/10/25	Python AI投資分析基礎 (Foundations of AI Investment Analysis in Python)
8	2018/11/01	Python Pandas 量化投資分析 (Quantitative Investing with Pandas in Python)
9	2018/11/08	Python Scikit-Learn 機器學習 (Machine Learning with Scikit-Learn In Python)
10	2018/11/15	期中報告 (Midterm Project Report)
11	2018/11/22	TensorFlow 深度學習財務時間序列預測 I (Deep Learning for Financial Time Series Forecasting with TensorFlow I)
12	2018/11/29	TensorFlow 深度學習財務時間序列預測 II (Deep Learning for Financial Time Series Forecasting with TensorFlow II)

# 課程大綱 (Syllabus)

週次 (Week)    日期 (Date)    內容 (Subject/Topics)

- 13 2018/12/06 人工智慧投資分析個案研究 II  
(Case Study on Artificial Intelligence for Investment Analysis II)
- 14 2018/12/13 TensorFlow 深度學習財務時間序列預測 III  
(Deep Learning for Financial Time Series Forecasting with TensorFlow III)
- 15 2018/12/20 投資組合最佳化與程式交易  
(Portfolio Optimization and Algorithmic Trading)
- 16 2018/12/27 自然語言處理 (Natural Language Processing)
- 17 2019/01/03 期末報告 I (Final Project Presentation I)
- 18 2019/01/10 期末報告 II (Final Project Presentation II)

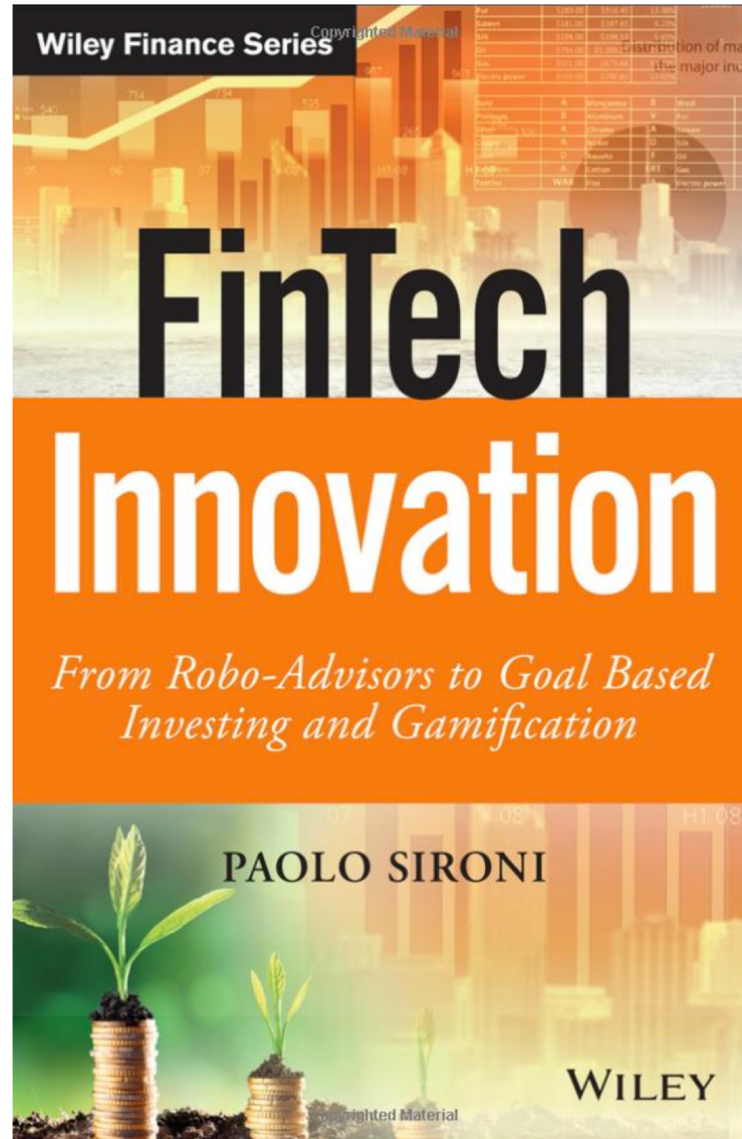
# **Robo-Advisors and AI Chatbots**

# Robo- Advisors

# FinTech Innovation:

## From Robo-Advisors to Goal Based Investing and Gamification,

Paolo Sironi, Wiley, 2016



# Financial Technology

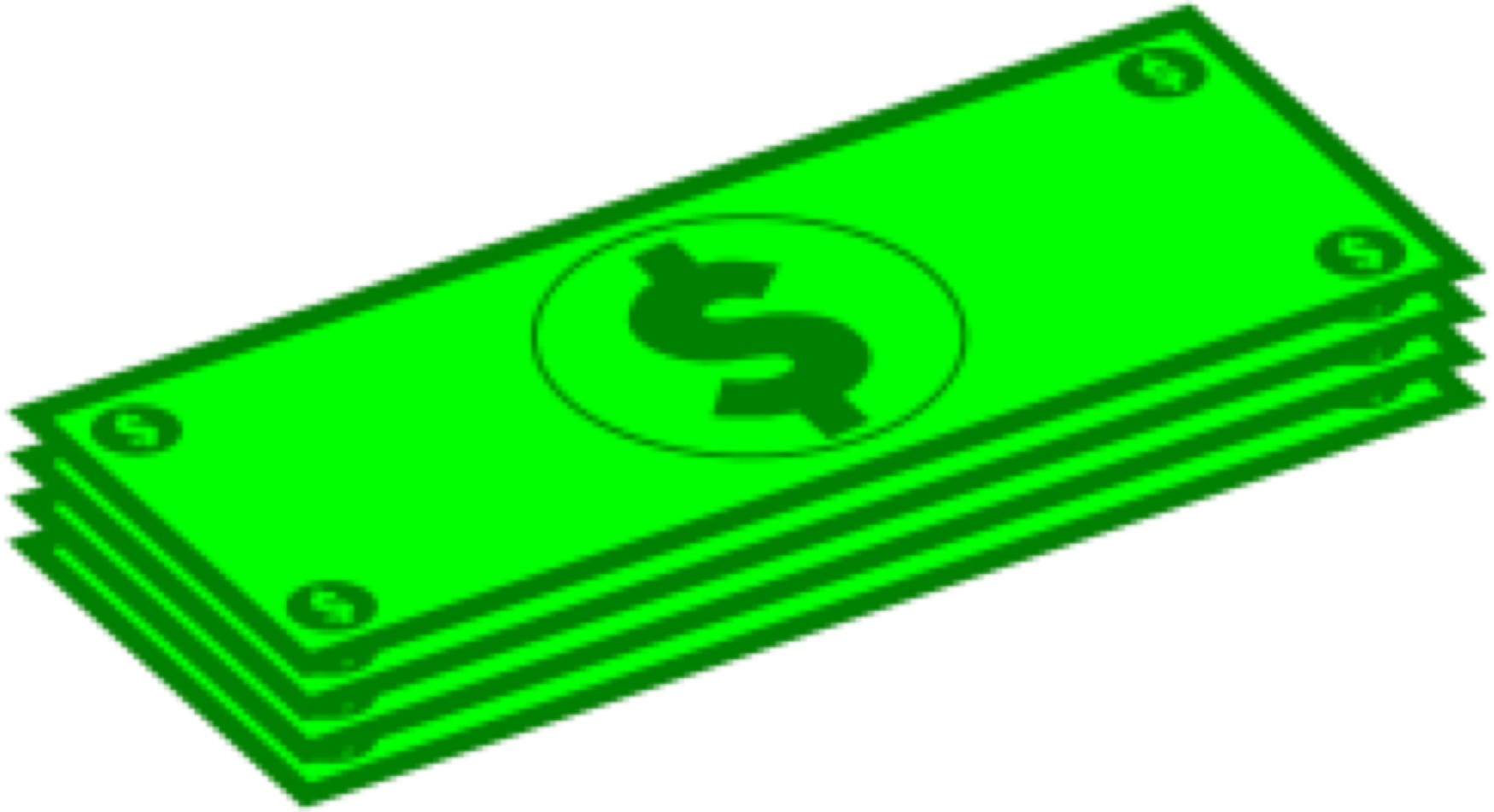
## FinTech

“providing  
financial services  
by making use of  
software and  
modern technology”

# Financial Services

# Money

# Money



**Money**

**Makes**

**Money**

# Treasure



# Wealth Management

# Investment Analysis

**Time Value of Money**

**Risk**

**Return**

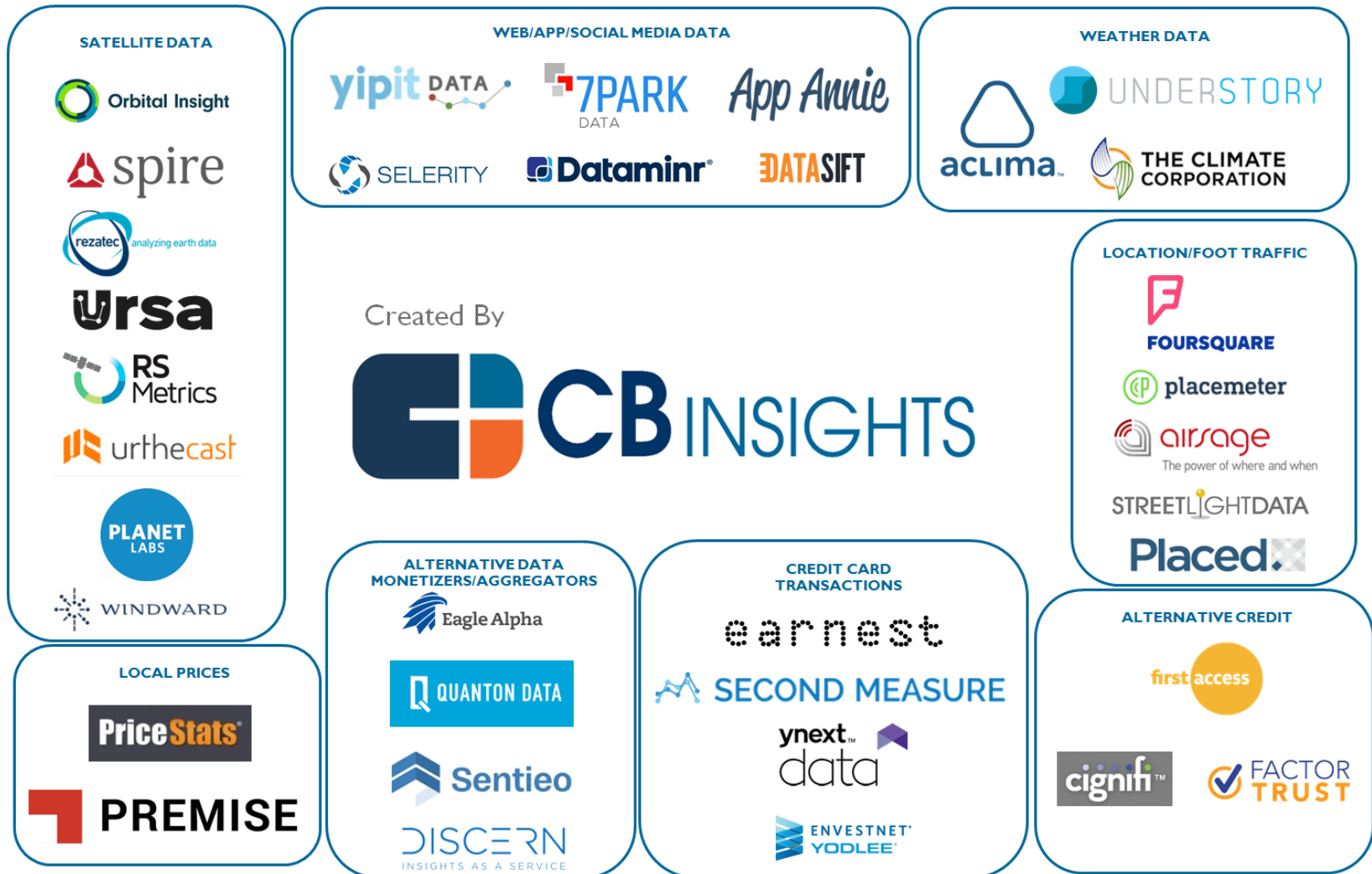
# **Fintech Robo Advisors**

# The **New Alpha**: 30+ Startups Providing Alternative Data For Sophisticated Investors

New sources of **data mined** by startups like **Foursquare**, **Premise**, and **Orbital Insight** are letting investors understand **trends** before they happen.

# The New Alpha: 30+ Startups Providing Alternative Data For Sophisticated Investors

## Alternative Data Sources



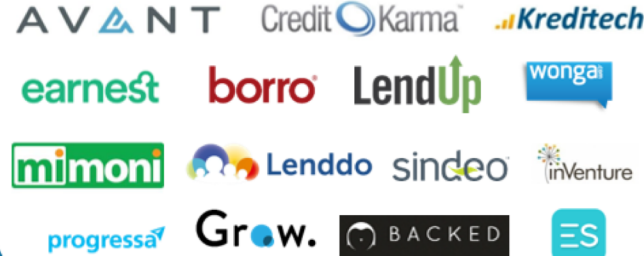
# Lending, Investments, And Personal Finance: 102 Startups Attacking The Retail Banking Value Chain

## The Digital Banking Market Map

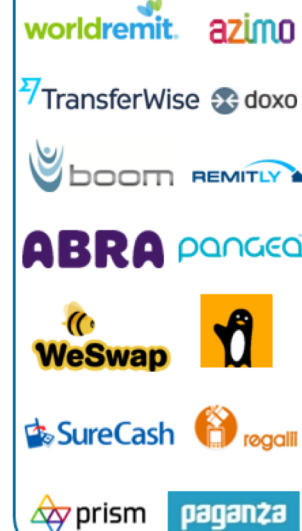
### Marketplace Lending



### Direct Lending & Underwriting



### Bill Pay / Money Transfer



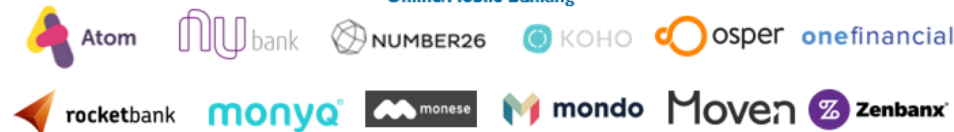
### Investment Management



Created By



### Online/Mobile Banking



### Personal Finance



### Robo-advisor



# From Point-Of-Sale To Money Transfers: 109 Startups Disrupting The Payments Industry

## The Payments Market Map



# Insurance Tech Rising: 135+ Insurance Startups Across P2P, Life, Commercial & More

## Insurance Tech Rising: 130+ Startups Across P2P, Life, Renters, & More



# Targeting Millennials

## Fin Tech Startups for Millennials



# Fintech for Millennials

Fintech Category	#Company
Crowdfunding	2
Insurance (Non-Health)	4
Loans & Credit Risk	20
Mobile Banking & Payments	8
Personal Investing	10
Savings & Finances Tracking	10
Wealth Management	9
Total	63

# Fintech: Wealth Management

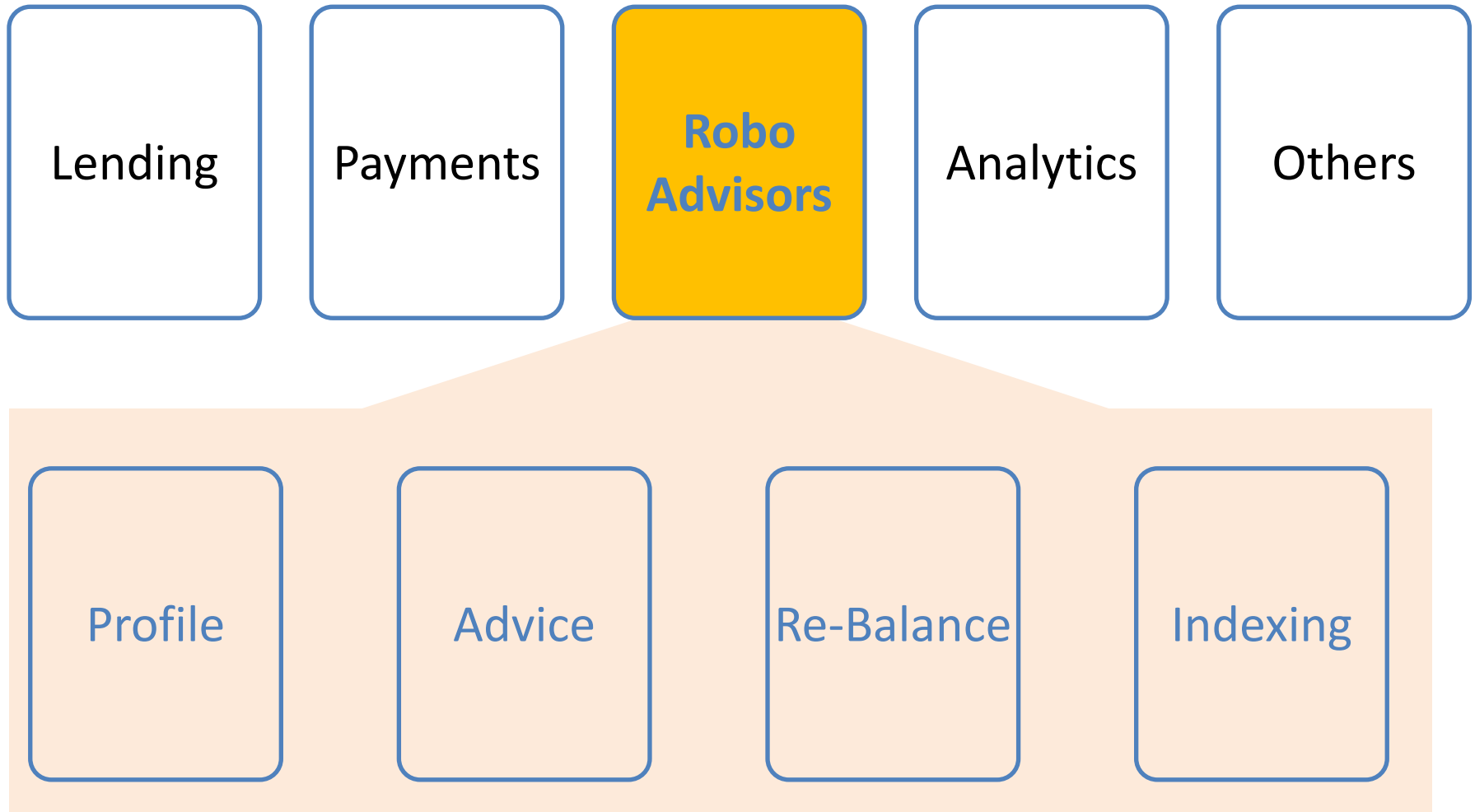
Company	Select Investors
Wealthfront	DAG Ventures, Index Ventures, Greylock Partners, The Social+Capital Partnership
Betterment	Bessemer Venture Partners, Athemis Group, Menlo Ventures
SigFig	Doll Capital Management, Union Square Ventures, Bain Capital Ventures
Aspiration	Renren, GSV Capital, Capricorn Investment Group, IGSB
Bloom	Commerce Ventures, DST Systems, Hyde Park VP, QED Investors, UMB Financial
Rebalance IRA	N/A
Hedgeable	SixThirty
WiseBanyan	VegasTech Fund
Personal Capital	Institutional Venture Partners, Venrock, Crosslink Capital

# Fintech: Personal Investing

Company	Select Investors
eToro	BRM Group, Ping An Ventures, Spark Capital
Openfolio	FinTech Collective
DriveWealth	Route 66 Ventures
Tip'd Off	Raj Parekh, Bill Crane, Shaun Coleman
Kapitall	Bendigo Partners, Linden Venture Fund
Stash	N/A
Stox	SingulariTeam
Robinhood	Google Ventures, Index Ventures, Andreessen Horowitz, Ribbit Capital, NEA
Motif Investing	Norwest Venture Partners, Foundation Capital, Ignition Capital, Goldman Sachs
Loyal3	DNS Capital

# **Big Data Driven Disruption: Robo-Advisor**

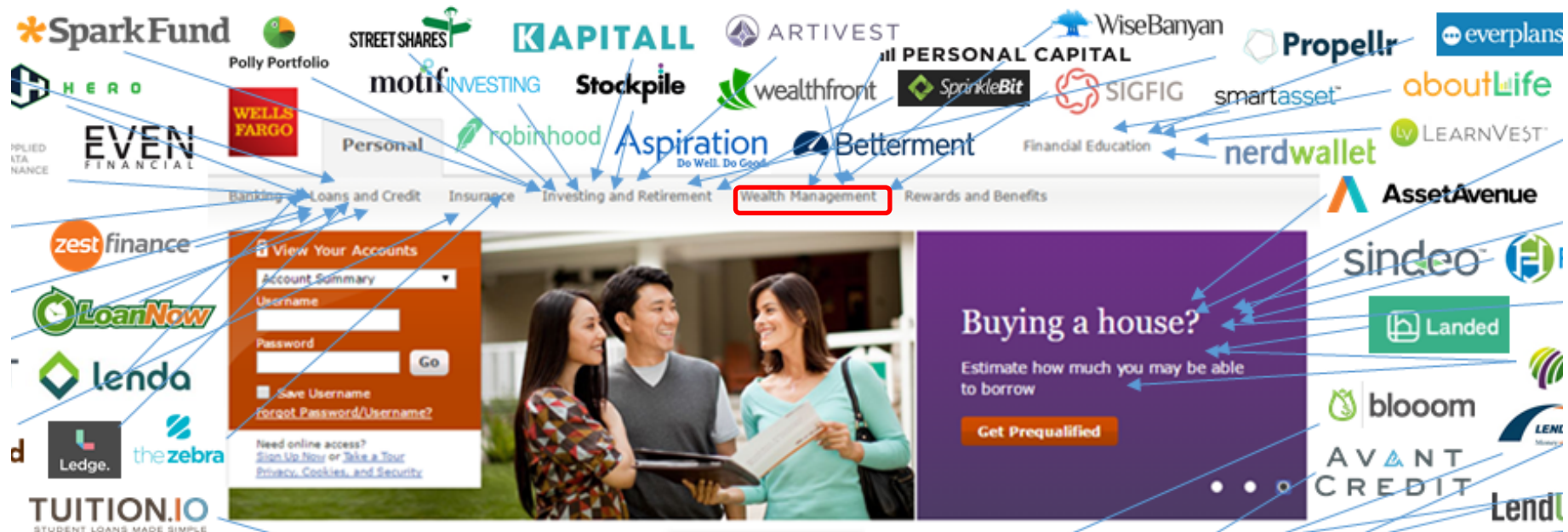
# FinTech high-level classification



# Fintech: Unbundling the Bank

## Wealth Management: Wealthfront

### Unbundling of a Bank



# Wealthfront: Fintech Robo Advisor



Why Wealthfront ▾

Products ▾

Who we are ▾

Help Center

Blog

Log In

Invest now

The most tax-efficient, low-cost, hassle-free  
way to invest

Invest with Wealthfront

See Our Journey

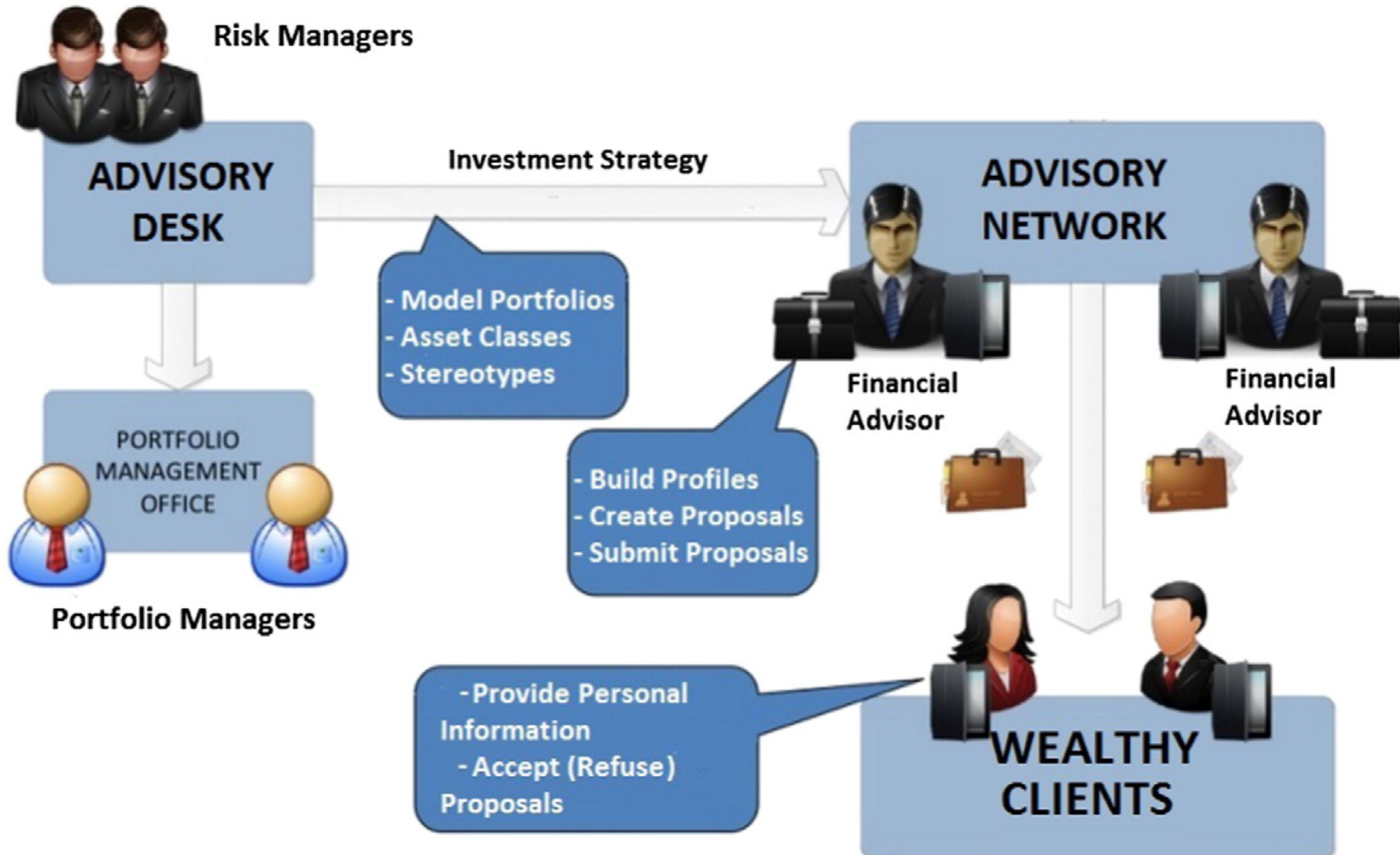


Do you have the time to invest well?

Wealthfront invests your money for you with a minimal amount of work. We monitor your portfolio every day to look for opportunities to rebalance or harvest tax losses. Are you doing the same?

<https://www.wealthfront.com/>

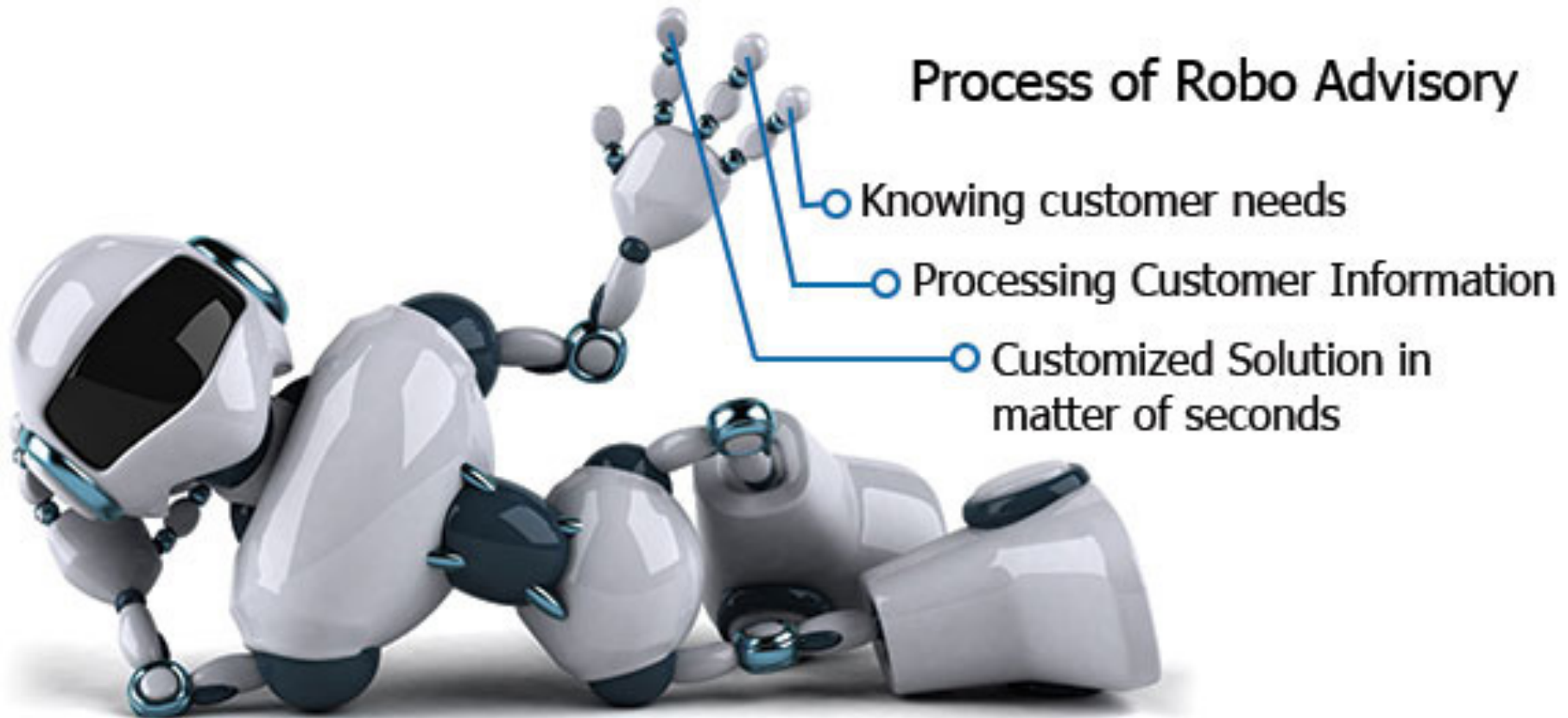
# A classic workflow for financial recommendations



Source: Musto, C., Semeraro, G., Lops, P., de Gemmis, M., & Lekkas, G. (2015).

Personalized finance advisory through case-based recommender systems and diversification strategies. *Decision Support Systems*, 77, 100-111.

# Process of Robo Advisors



# Benefits of Robo Advisors

## Benefits of Robo Advisors

- Unbiased Advice ——
- No minimum Investment required ——
- Low Charges ——
- Transparency ——
- Customised Solutions ——



# Robo-Advisor Business Models

- **Full service online Robo-advisor**
  - 100% automated without any human element
- **Hybrid Robo-advisor model**
  - being pioneered by firms like Vanguard & Charles Schwab
- **Pure online advisor**
  - primarily human in nature

# Robo-Advisor Business Models

- **Full service online Robo-advisor**
  - 100% automated without any human element
- **Hybrid Robo-advisor model**
  - being pioneered by firms like Vanguard & Charles Schwab
- **Pure online advisor**
  - primarily human in nature

# Usecases of Robo-Advisors

1. Determine individual **Client profiles & preferences**
2. Identify **appropriate financial products**
3. Establish correct **Investment Mix** for the client's profile
4. Using a **algorithmic approach**, choose the appropriate **securities** for each client account
5. Continuously **monitor the portfolio & transactions** within it to tune performance
6. Provide **value added services**
7. Ensure the **best user experience** by handling a whole range of financial services

# Business Requirements for a Robo-Advisor (RA)

1. Collect Individual Client Data
2. Client Segmentation
3. Algorithm Based Investment Allocation
4. Portfolio Rebalancing
5. Tax Loss Harvesting
6. A Single View of a Client's Financial History

# Algorithms for a Robo-Advisor (RA)

- Leverage **data science** & **statistical modeling** to automatically allocate client wealth across different asset classes (such as domestic/foreign stocks, bonds & real estate related securities) to **automatically rebalance portfolio** positions based on changing market conditions or client preferences.
  - These investment decisions are also made based on detailed **behavioral understanding** of a client's **financial journey metrics**
    - Age, Risk Appetite & other related information.

# Algorithms for a Robo-Advisor (RA)

- RA platforms also provide 24×7 tracking of market movements to use that to track rebalancing decisions from not just a portfolio standpoint but also from a taxation standpoint.

# Algorithms for a Robo-Advisor (RA)

- A **mixture** of different **algorithms** can be used such as **Modern Portfolio Theory (MPT)**, **Capital Asset Pricing Model (CAPM)**, the **Black Litterman Model**, the **Fama-French** etc.
  - These are used to allocate assets as well as to adjust positions based on market movements and conditions.

# Robo-Advisor (RA) Sample Portfolios

## Sample Portfolios – for an aggressive investor

### 1. Equity – 85%

A) US Domestic Stock (50%)

– Large Cap – 30%, Medium Cap – 10% , Small Cap – 10%, Dividend Stocks – 0%

B) Foreign Stock – (35%)

– Emerging Markets – 18%, Developed Markets – 17%

### 2. Fixed Income – 5%

A) Developed Market Bonds – 2%

B) US Bonds – 1%

C) International Bonds – 1%

D) Emerging Markets Bonds – 1%

### 3. Other – 5%

A) Real Estate – 3%

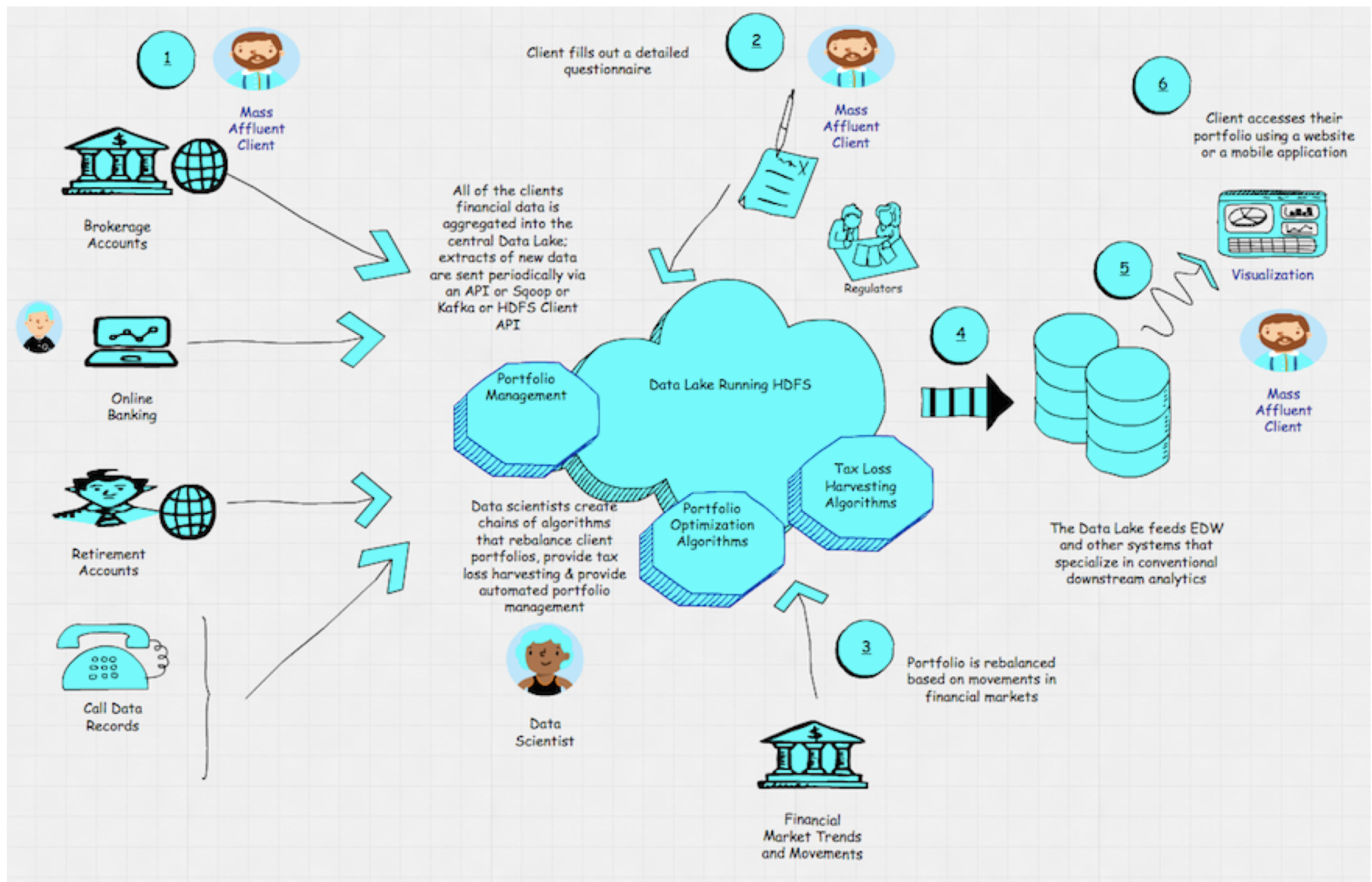
B) Currencies – 0%

C) Gold and Precious Metals – 0%

D) Commodities – 2%

### 4. Cash – 5%

# Architecture of a Robo-Advisor (RA)



# Robo-Advisor



# Wealthfront: Fintech Robo Advisor



Why Wealthfront ▾

Products ▾

Who we are ▾

Help Center

Blog

Log In

Invest now

Introducing Portfolio Line of Credit - get cash quickly at a low rate. [Learn more](#) →

Plan your future  
Grow your wealth  
Invest in your life

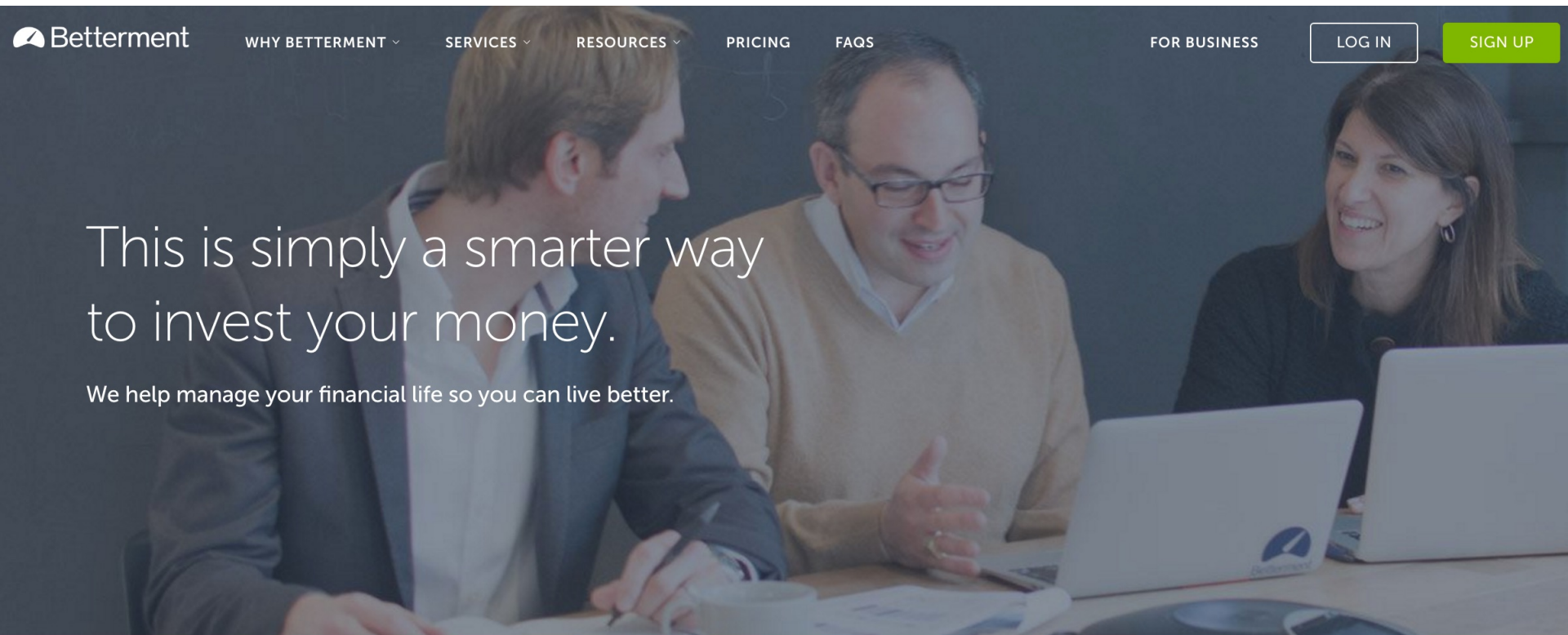
Access proven investment strategies, tailored advice, and premium financial services - all powered by technology.

Invest with Wealthfront

Explore your options



# Betterment: Fintech Robo Advisor



 Betterment

WHY BETTERMENT ▾

SERVICES ▾

RESOURCES ▾

PRICING

FAQS

FOR BUSINESS

LOG IN

SIGN UP

This is simply a smarter way  
to invest your money.

We help manage your financial life so you can live better.



We can help you get started. Schedule your free 15 minute call today. [Schedule a call >](#)



Increase after-tax returns.



No hidden fees.





Satisfaction guaranteed.



Access to licensed experts.

# Betterment vs. Wealthfront

	 Betterment	 wealthfront
Robo-Advisor		
Investor Junkie Rating	4.5 star	5 star
Promotions	<u><a href="#">One Month Free</a></u>	<u><a href="#">First \$15k for Free</a></u>
Fees	0.25%/yr	None first \$10k;
		0.25%/yr for more
Minimum Deposit	None	\$500
Human Advisors	Yes — Additional Fee	No
Automatic Rebalancing	Yes	Yes
Tax Loss Harvesting	Yes	Yes
Direct Indexing	No	Yes
Fractional Shares	Yes	No
Assets Under Management	\$8.0B	\$5.0B

# Wealthfront:

0.25%

## Flat annual advisory fee

- No trading commissions or hidden fees
- Portfolio of low-cost ETFs
- Your first \$10,000 managed free

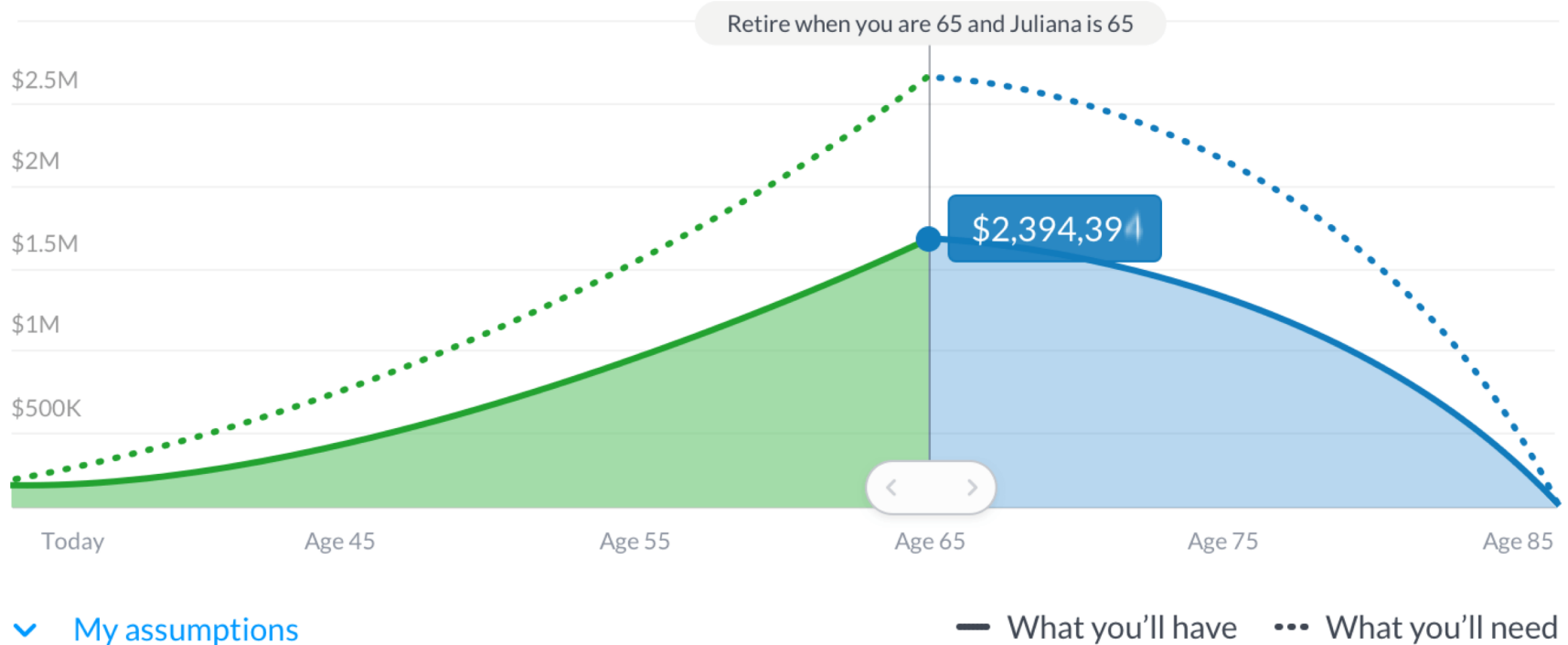
# Wealthfront

Powering your financial life with technology

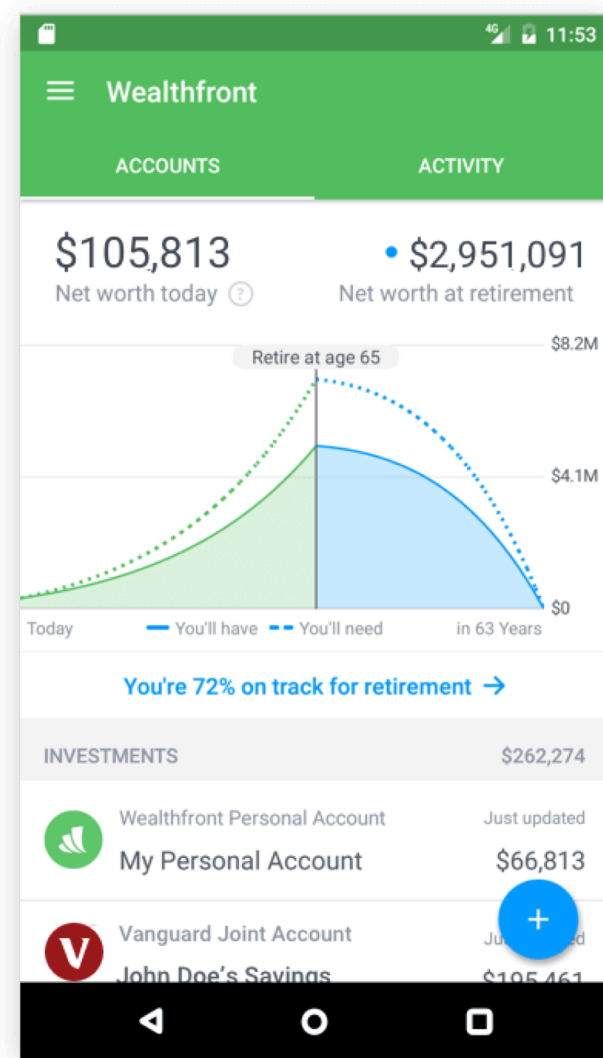
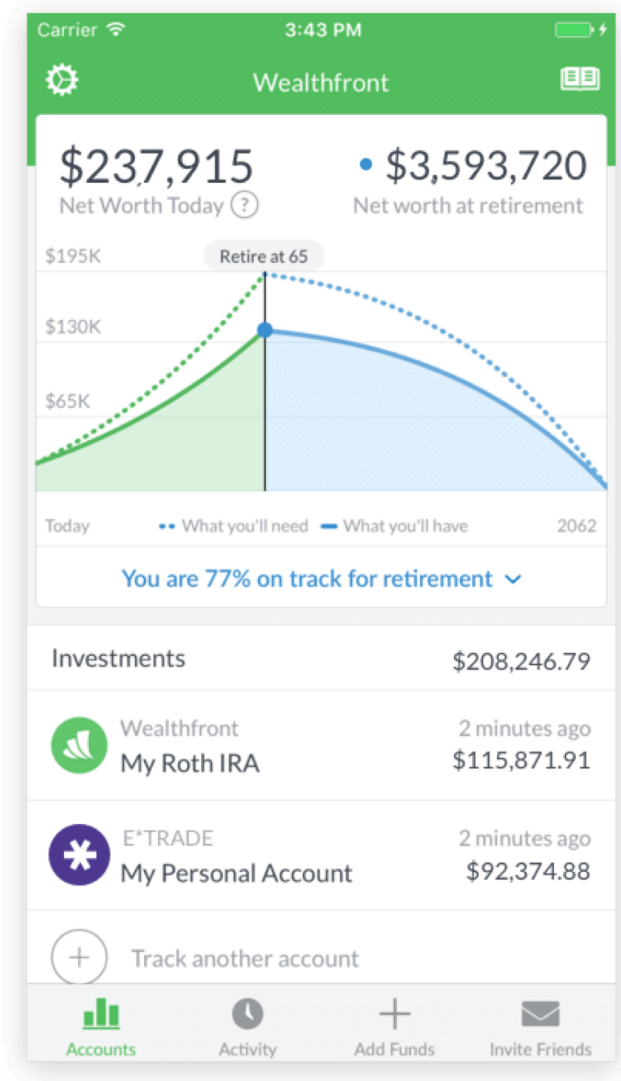


# Wealthfront Robo Advisor

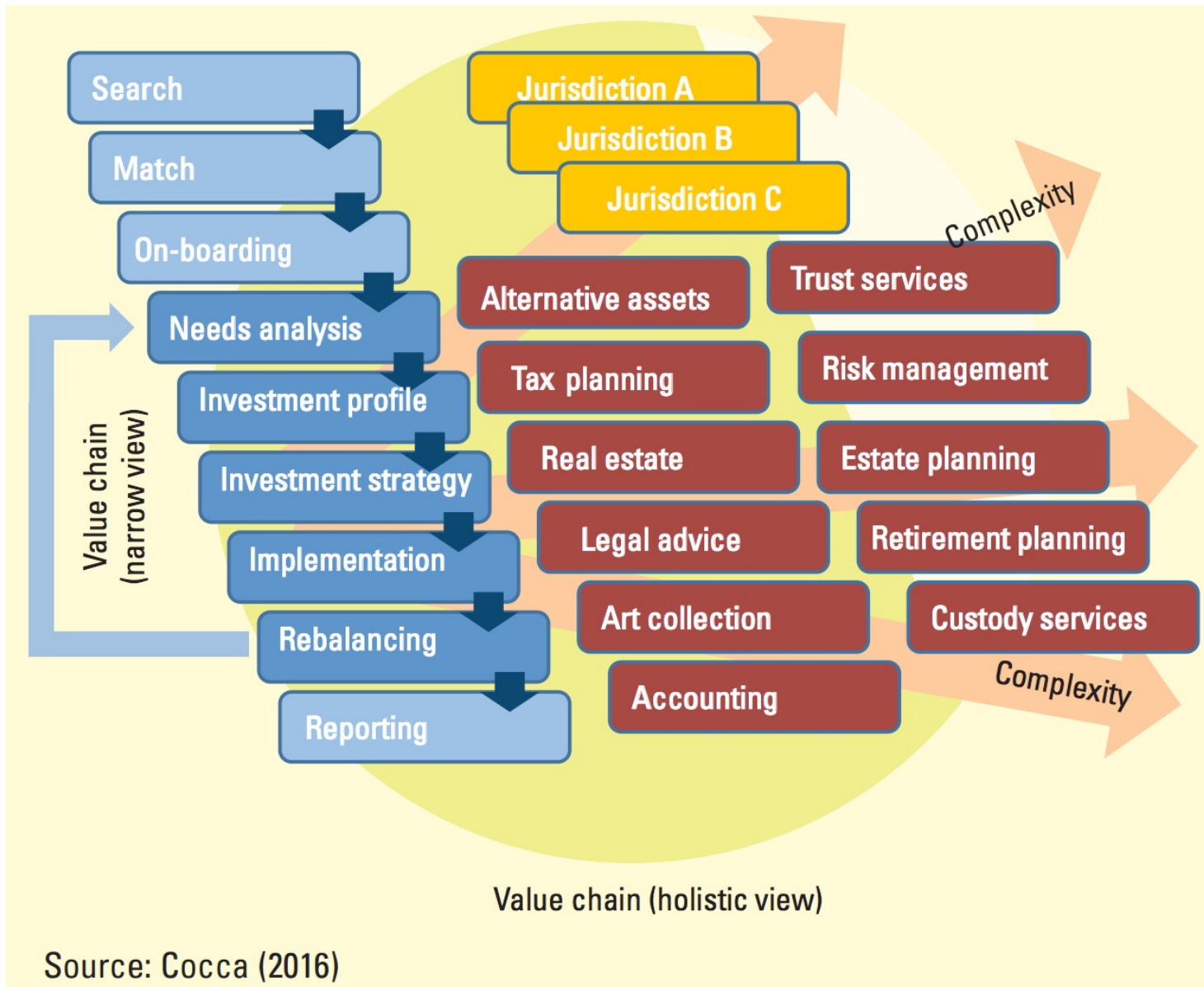
You're on track to have \$8,000 per month to spend in retirement. That's 76% of your target.



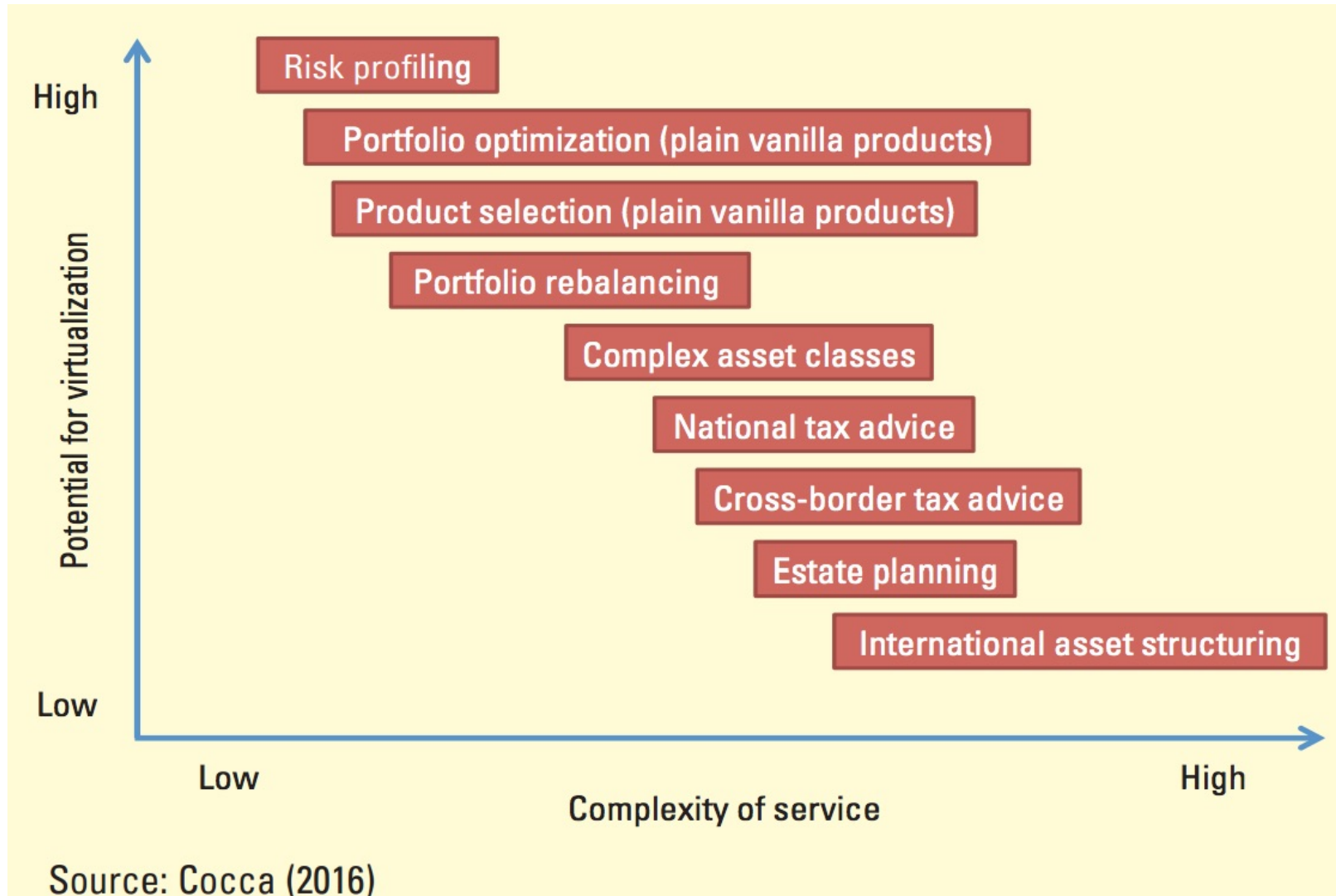
# Wealthfront Robo Advisor



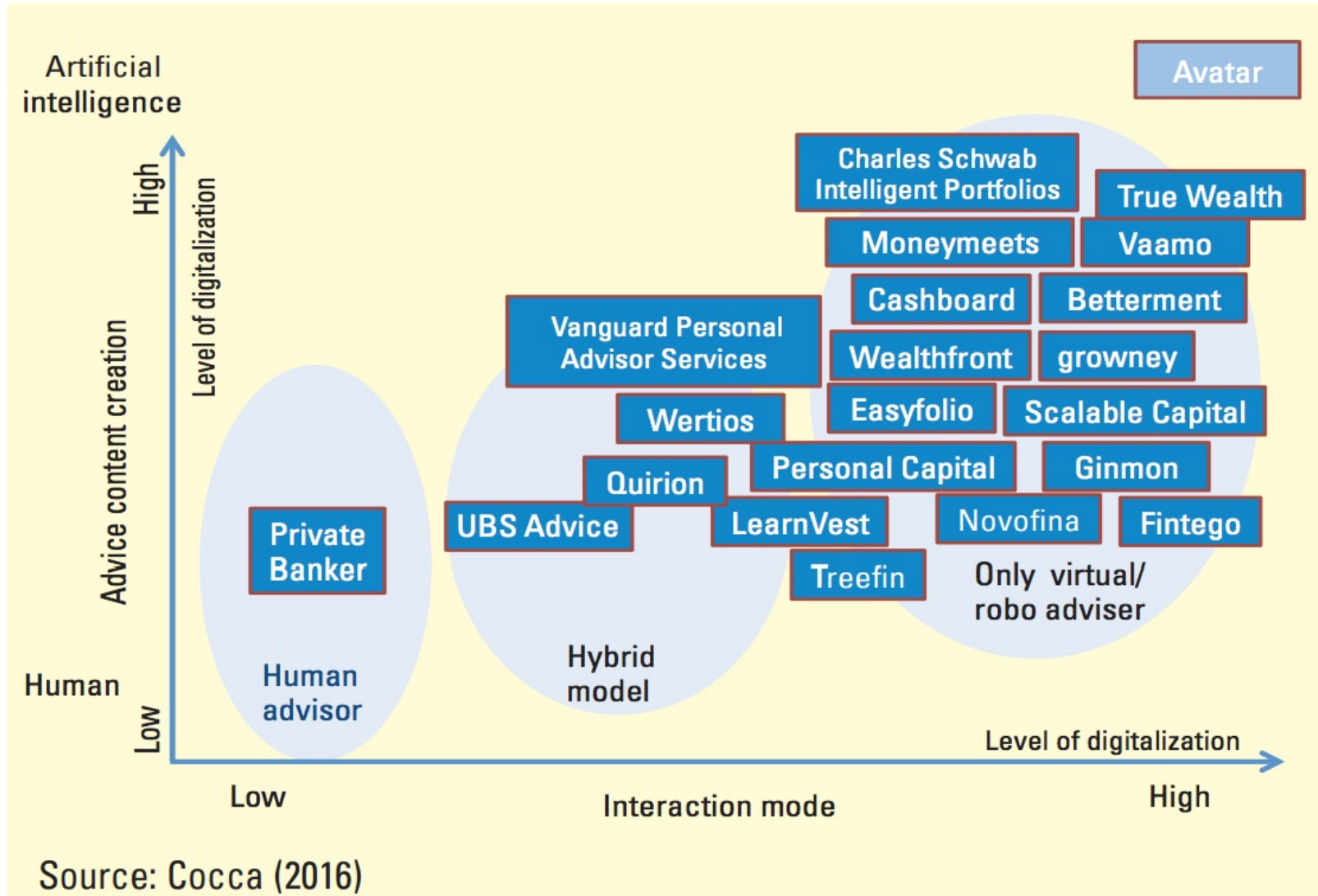
# Wealth Management Value Chain



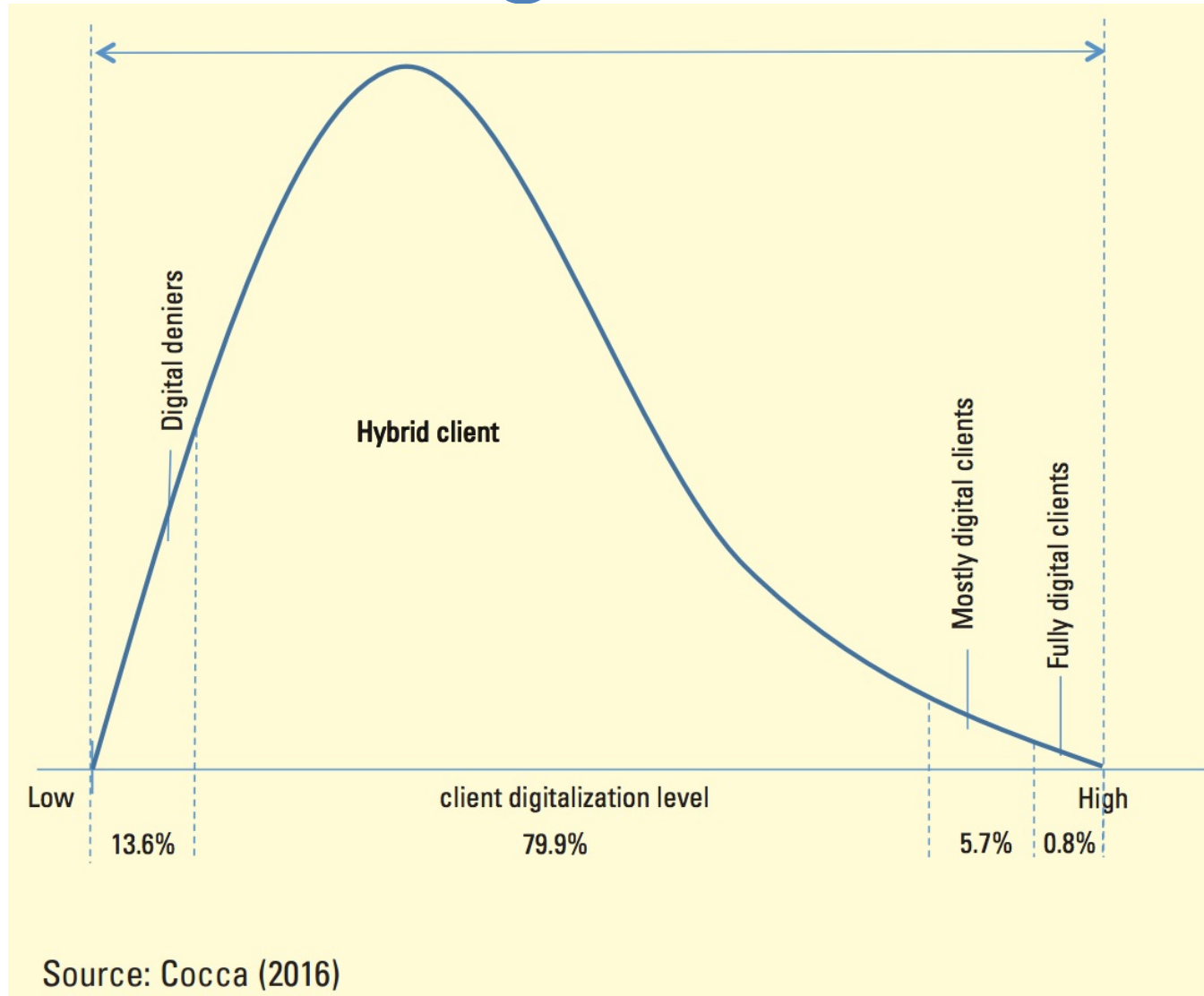
# Wealth Management Service and Potential for virtualization



# AI and Robo Advisor Virtualization Dimensions

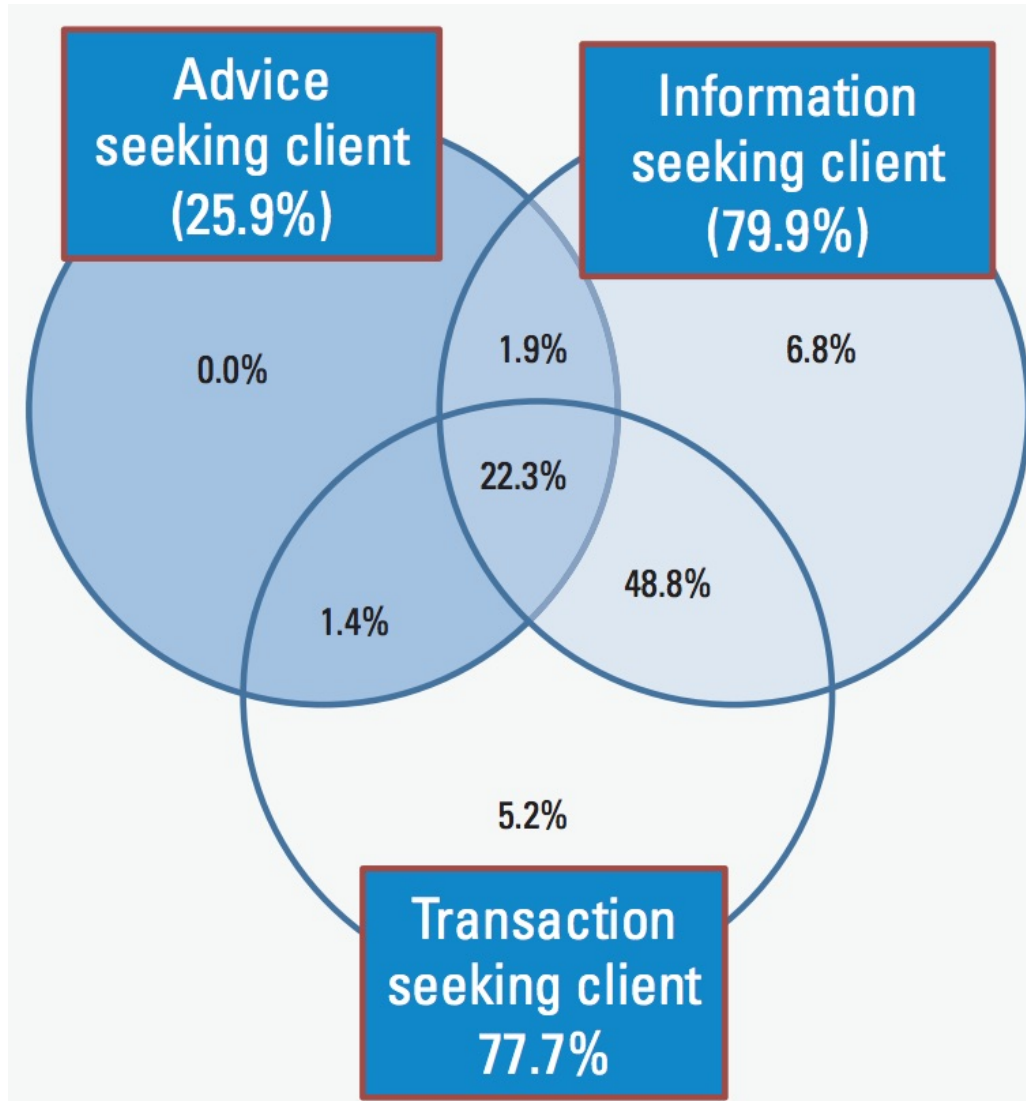


# Degree of Digitalization of Wealth Management Customers



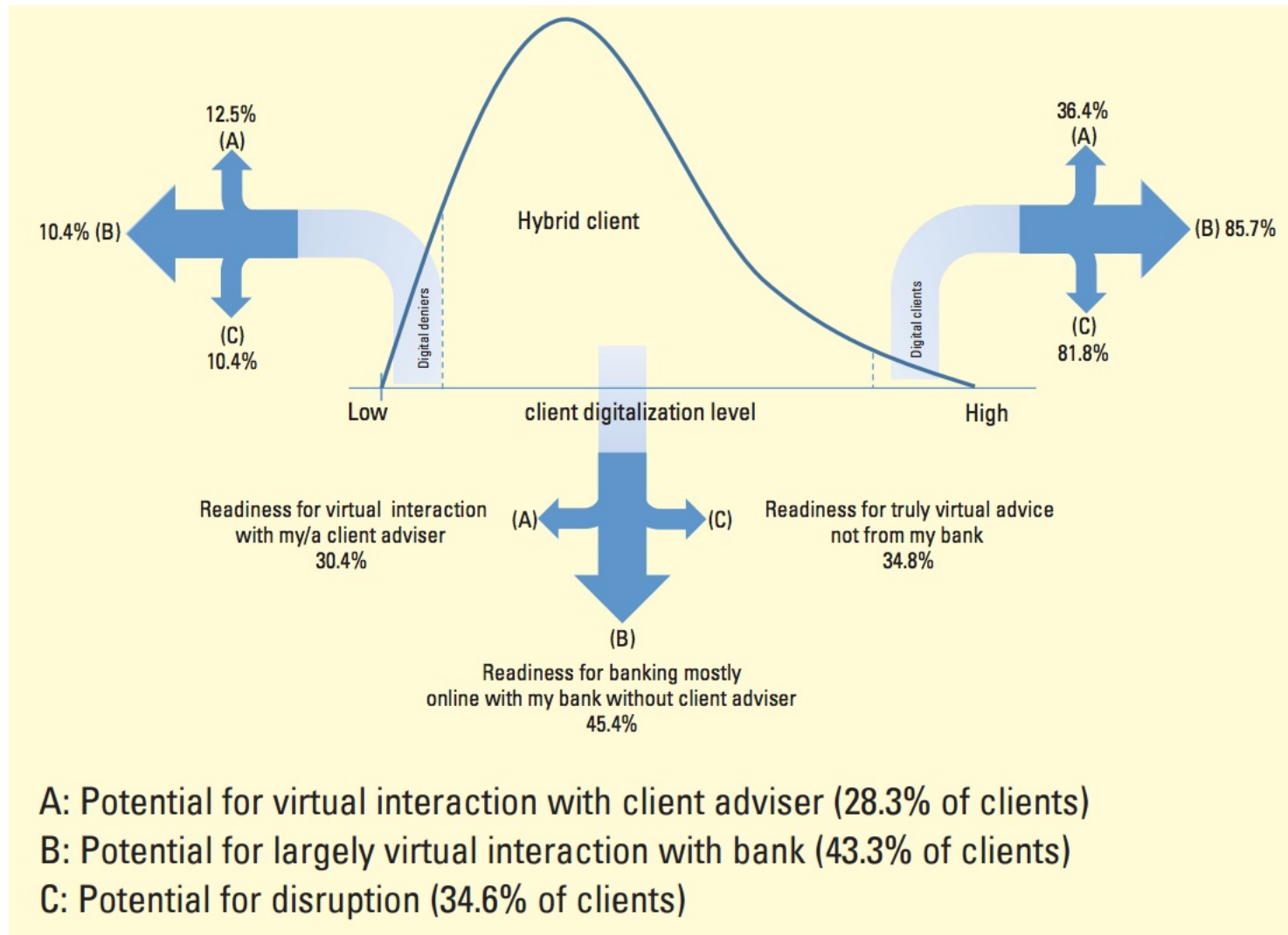
Source: Cocca, Teodoro (2016). "Potential and Limitations of Virtual Advice in Wealth Management." Journal of Financial Transformation, 44, 45-57.

# Use of Online Services by Hybrid Customers

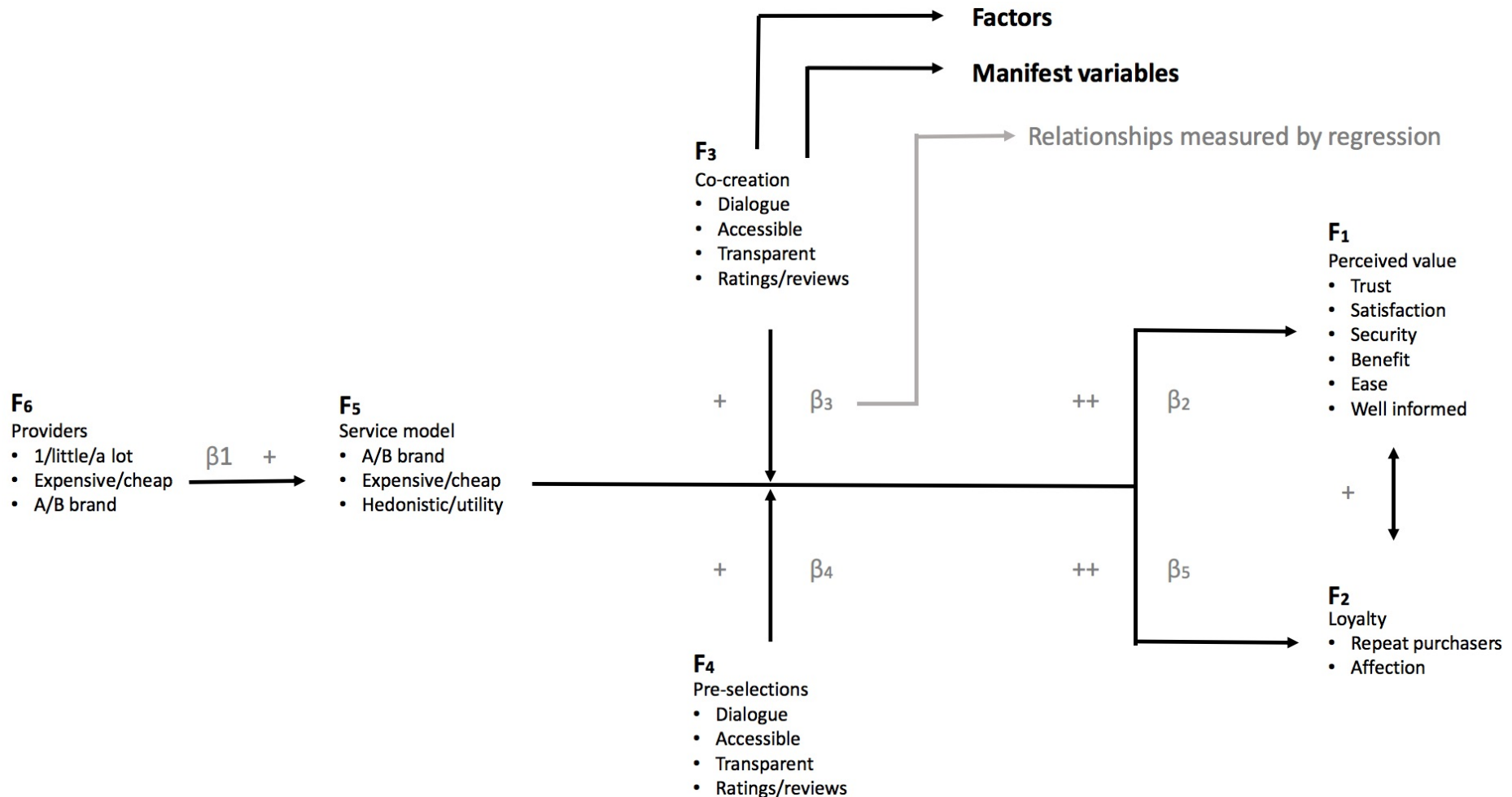


Source: Cocca, Teodoro (2016). "Potential and Limitations of Virtual Advice in Wealth Management." Journal of Financial Transformation, 44, 45-57.

# Use of Online Services by Hybrid Customers



# Explaining Customer Experience of Digital Financial Advice



# Modern Portfolio Theory and Investment Analysis

- Financial Securities
- Financial Markets
- The Characteristics of the Opportunity Set Under Risk
- Delineating Efficient Portfolios
- Techniques for Calculating the Efficient Frontier

# Modern Portfolio Theory and Investment Analysis

- The Correlation Structure of Security Returns:
  - The Single-Index Model
  - Multi-Index Models and Grouping Techniques
- Simple Techniques for Determining the Efficient Frontier
- Estimating Expected Returns
- How to Select Among the Portfolios in the Opportunity Set

# Modern Portfolio Theory and Investment Analysis

- International Diversification
- The Standard Capital Asset Pricing Model
- Nonstandard Forms of Capital Asset Pricing Models
- Empirical Tests of Equilibrium Models
- The Arbitrage Pricing Model APT
  - A Multifactor Approach to Explaining Asset Prices

# Modern Portfolio Theory and Investment Analysis

- Efficient Markets
- The Valuation Process
- Earnings Estimation
- Behavioral Finance, Investor Decision Making, and Asset Prices
- Interest Rate Theory and the Pricing of Bonds
- The Management of Bond Portfolios

# Modern Portfolio Theory and Investment Analysis

- Option Pricing Theory
- The Valuation and Uses of Financial Futures
- Mutual Funds
- Evaluation of Portfolio Performance
- Evaluation of Security Analysis
- Portfolio Management Revisited

# AI Chatbots

# Conversational Commerce

# Chatbots: Evolution of UI/UX

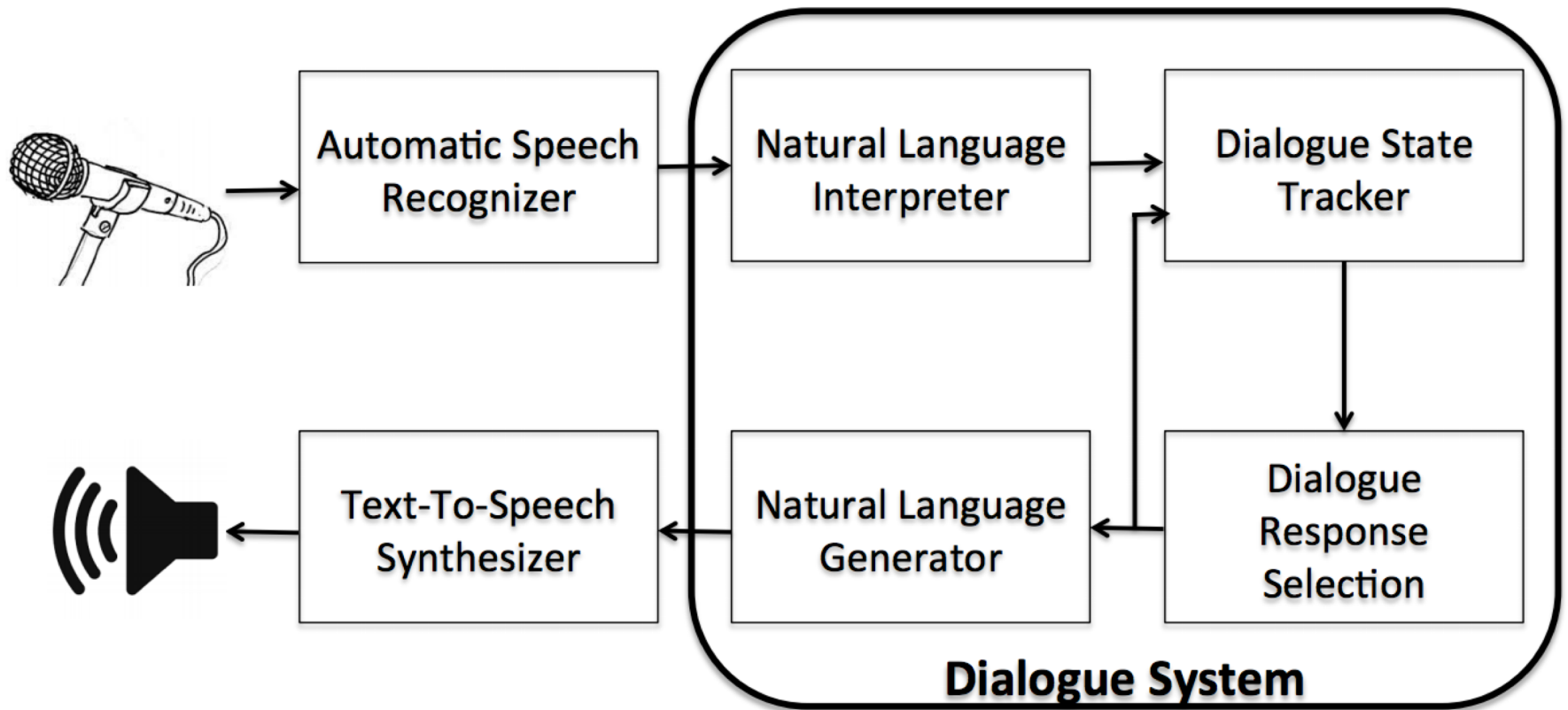
Paradigm	mid - 80s PC	mid - 90s Web	mid - 00s Smartphone	mid - 10s Messaging
Platform Examples	Desktop DOS, Windows, Mac OS	Browser Mosaic, Explorer, Chrome	Mobile OS iOS, Android	Messaging Apps WhatsApp, Messenger, Slack
Applications Examples	Clients Excel, PPT, Lotus	Website Yahoo, Amazon	Apps Angry Birds, Instagram	Bots Weather, Travel
UI/UX	Native Screens	Web Pages	Native Mobile Screens	Message
S/w Dev	Client-side	Server-side	Client-side	Server-side

**Chatbot**  
**Dialogue System**  
**Intelligent Agent**

# Chatbot



# Dialogue System



# Can machines think?

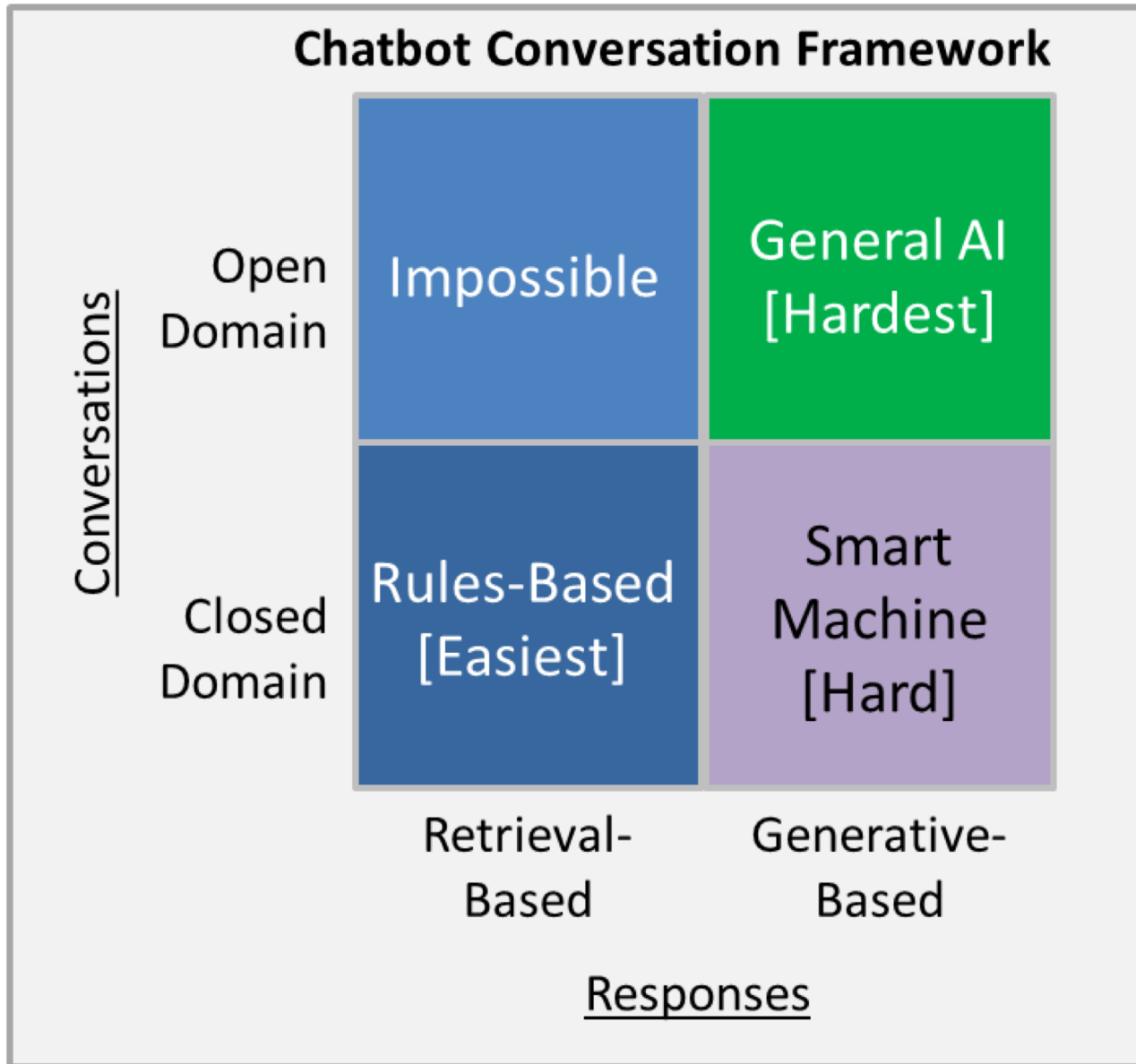
**(Alan Turing ,1950)**

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

# Chatbot

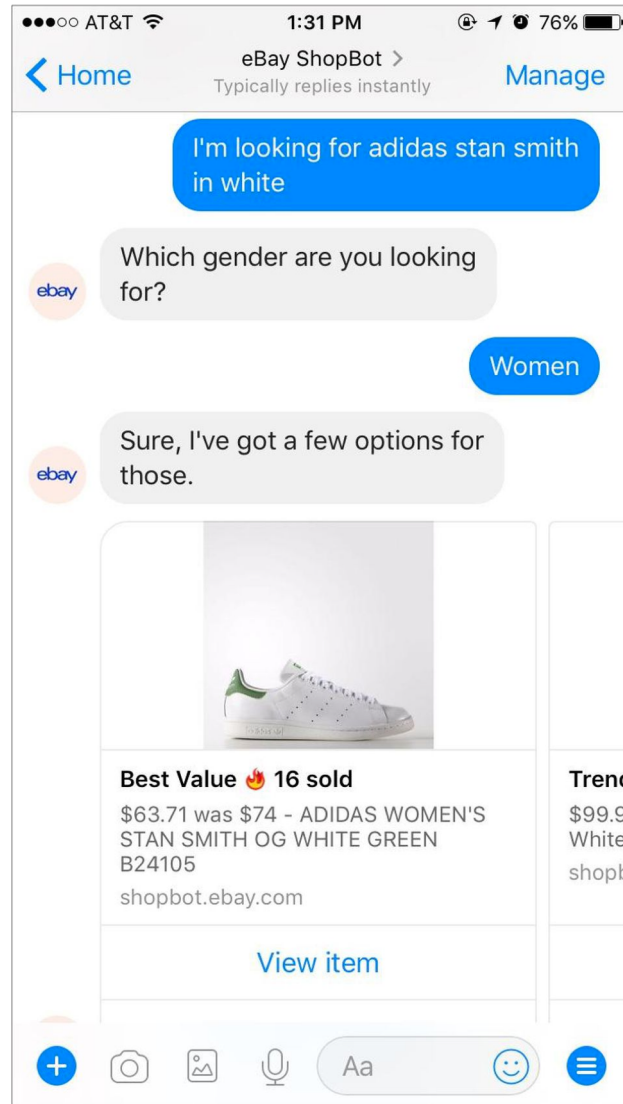
**“online human-computer  
dialog system  
with  
natural language.”**

# Chatbot Conversation Framework

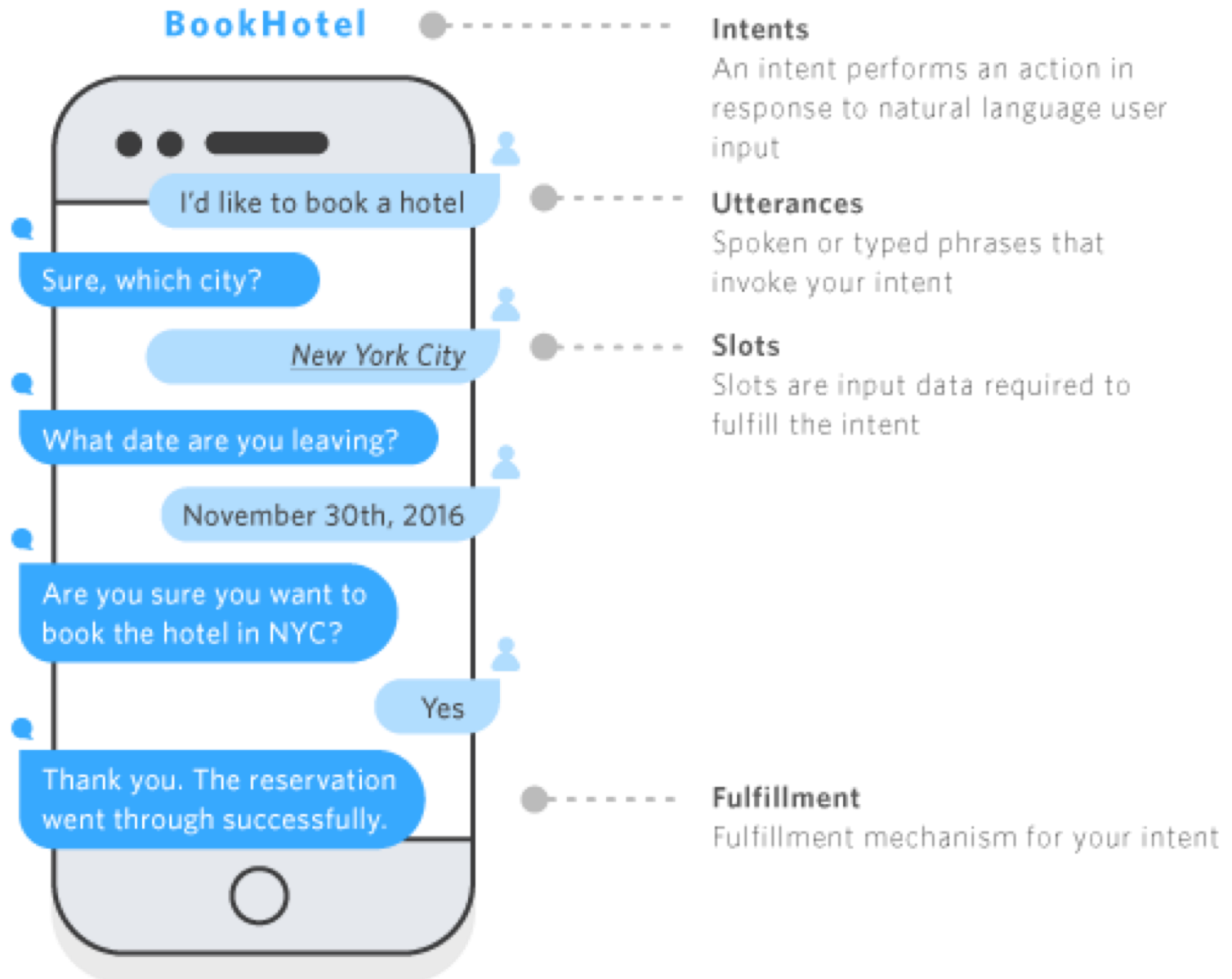


**From  
E-Commerce  
to  
Conversational Commerce:  
Chatbots  
and  
Virtual Assistants**

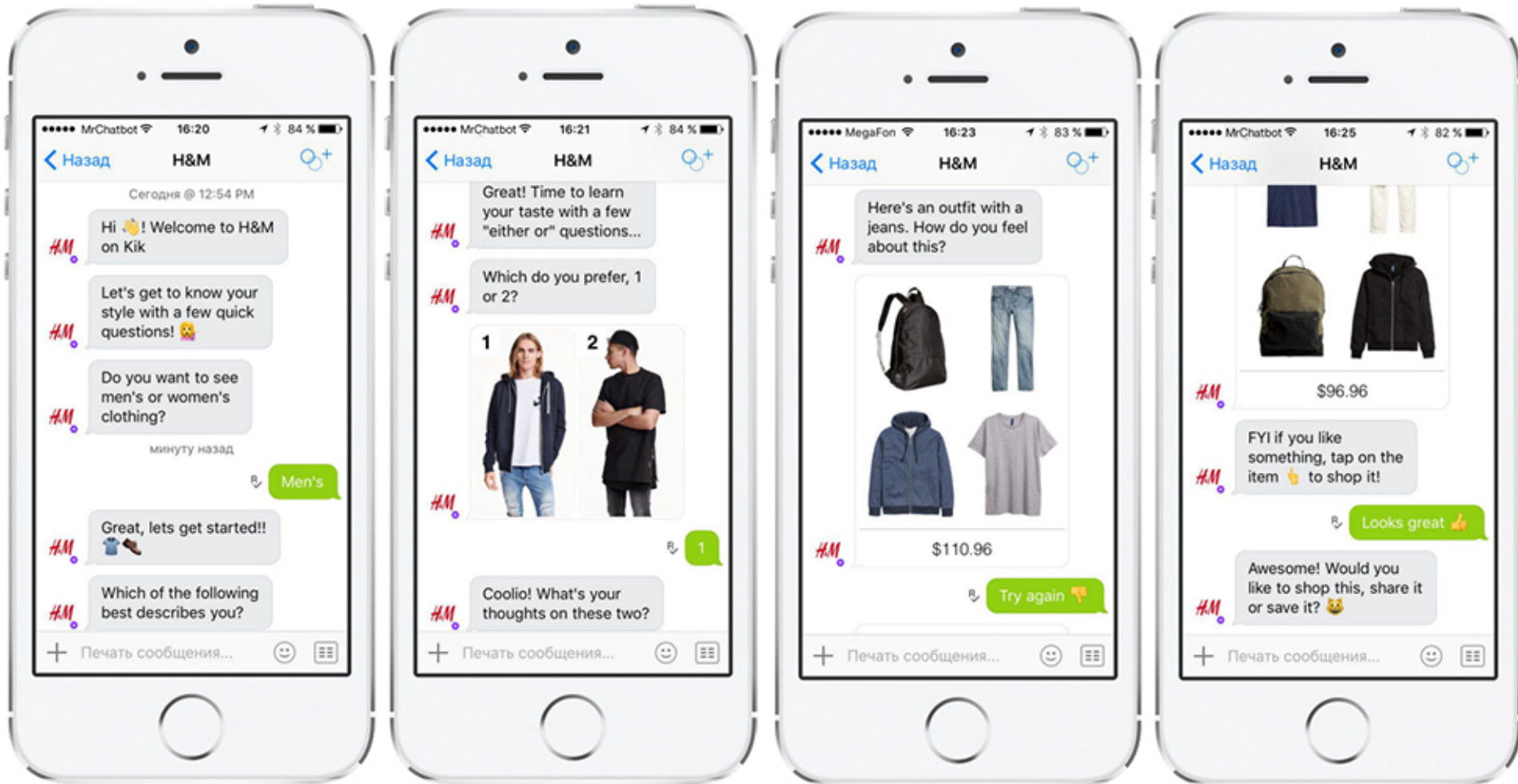
# Conversational Commerce: eBay AI Chatbots



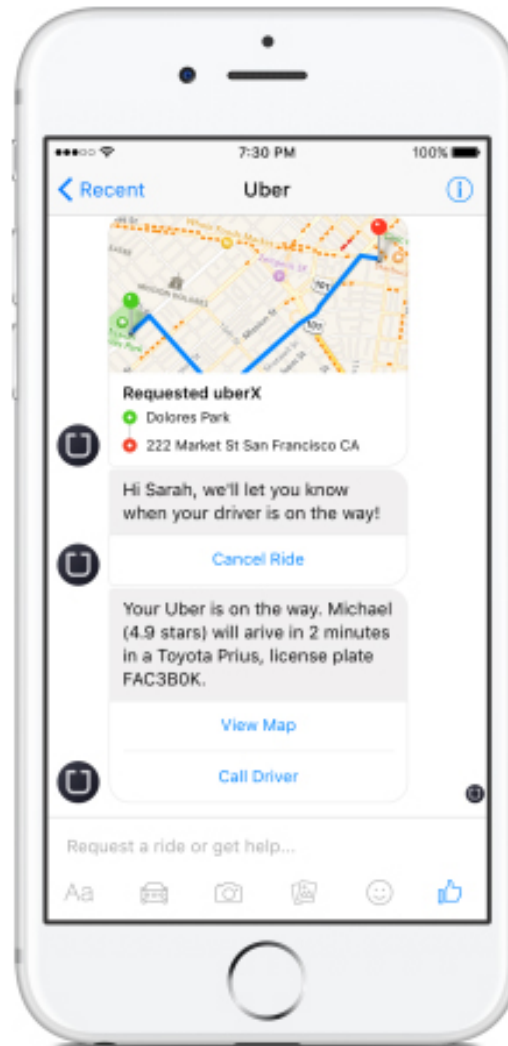
# Hotel Chatbot



# H&M's Chatbot on Kik



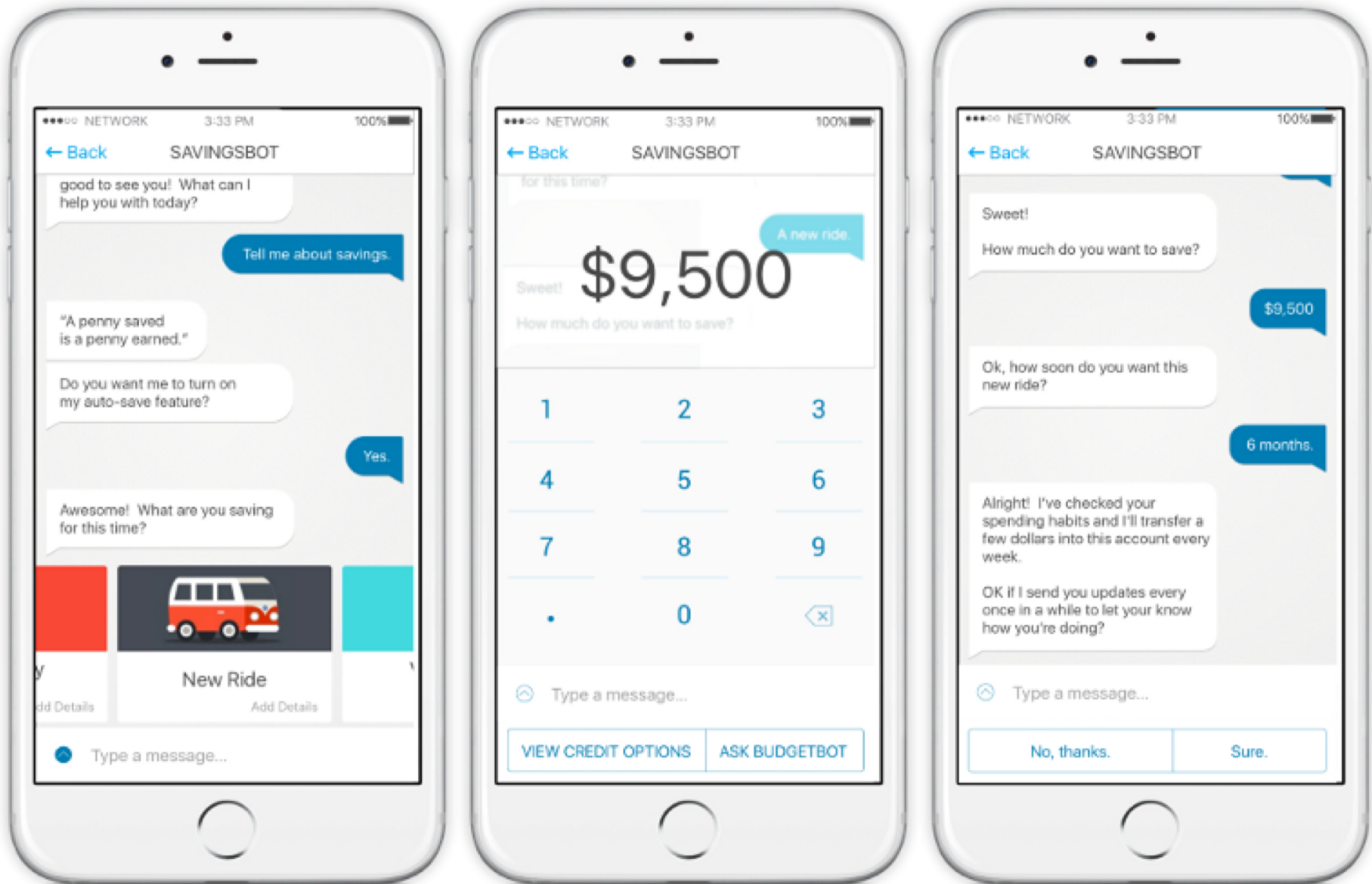
# Uber's Chatbot on Facebook's Messenger



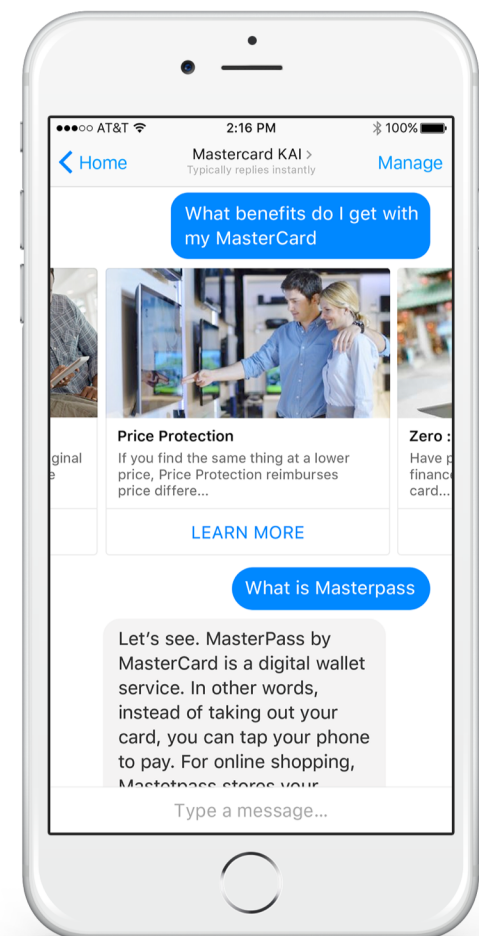
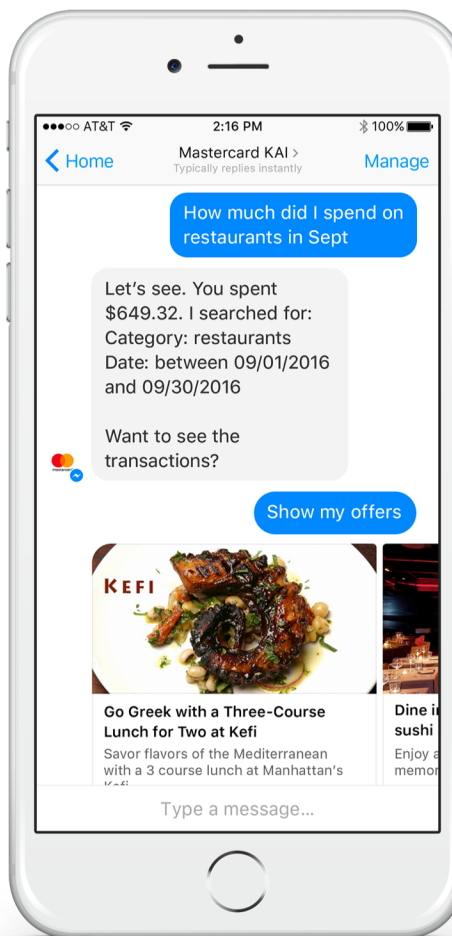
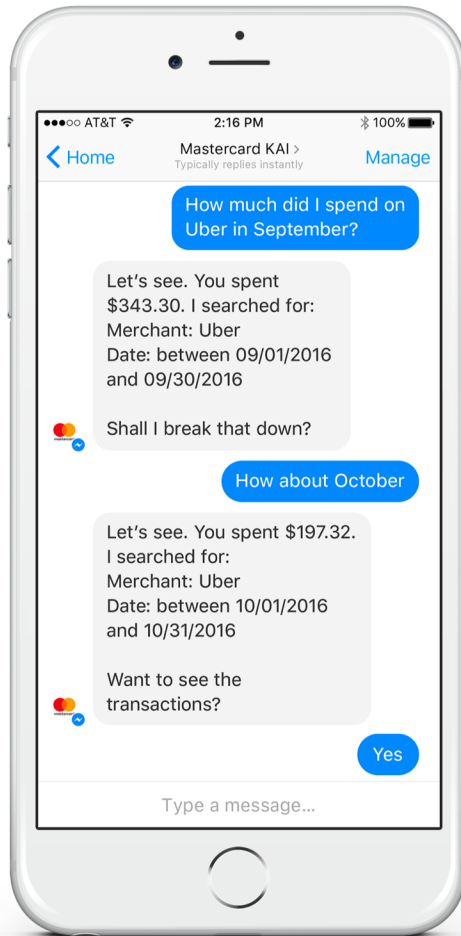
- Uber's chatbot on Facebook's messenger
- one main benefit: it loads much faster than the Uber app

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

# Savings Bot



# Mastercard Makes Commerce More Conversational



POWERED BY  
**Kasisto**

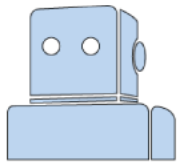
# Bot Platform Ecosystem

# 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.



## Bot frameworks and deployment platforms



Wit.ai  
Facebook



BotKit  
Howdy



Chatfuel

Automat

Automat



Bot Framework  
Microsoft



Api.ai  
Google



Pandorabots



MindMeld



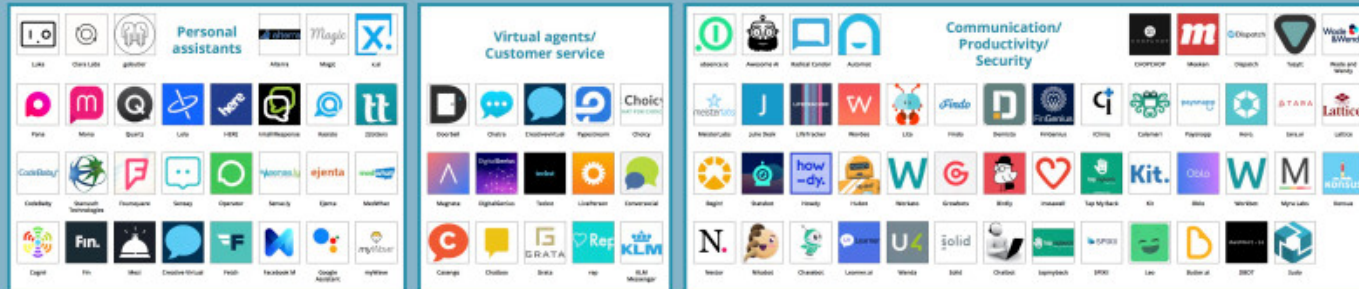
Gupshup



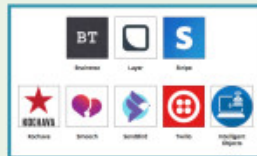
Sequel

# Bots Landscape

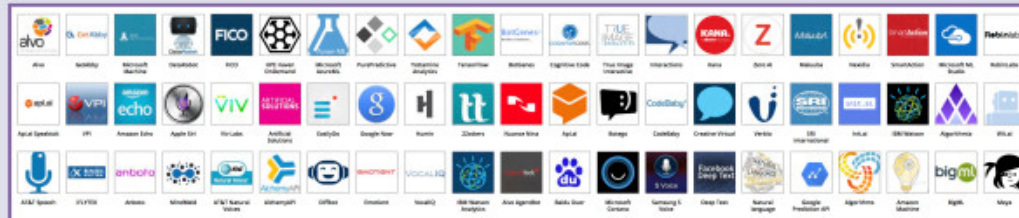
## Bots with traction



## Connectors/ Shared Services



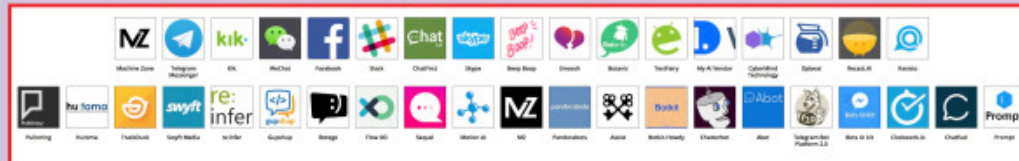
## AI Tools: Natural Language Processing, Machine Learning, Speech & Voice Recognition



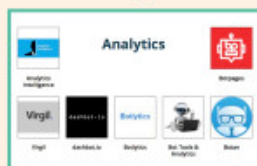
## Bot Discovery



## Bot developer frameworks and tools



## Analytics



## Messaging



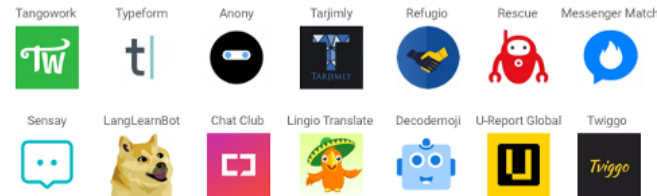
# RECAST.AI Messenger Bot Landscape

May 2017

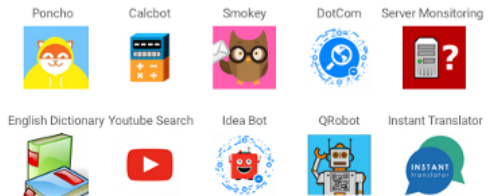
## Food



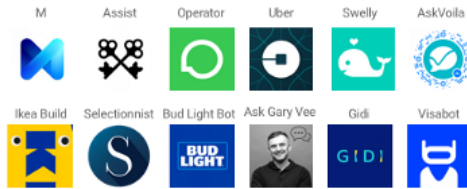
## Communication



## Utilities



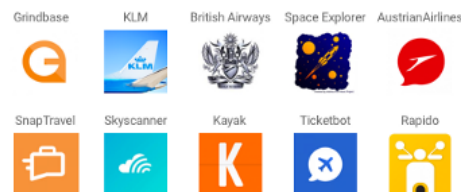
## Personal



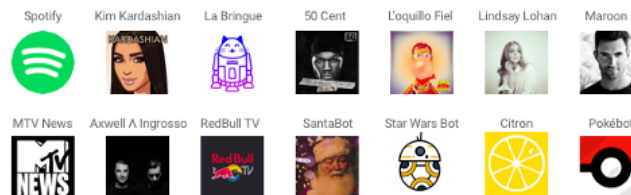
## Analytics



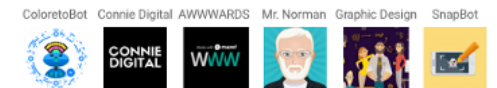
## Travel



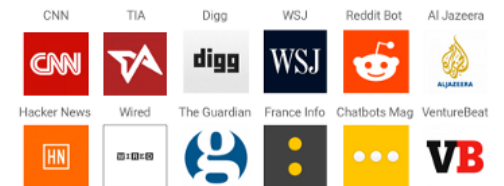
## Entertainment



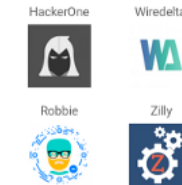
## Design



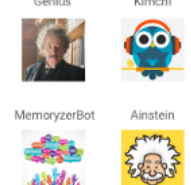
## News



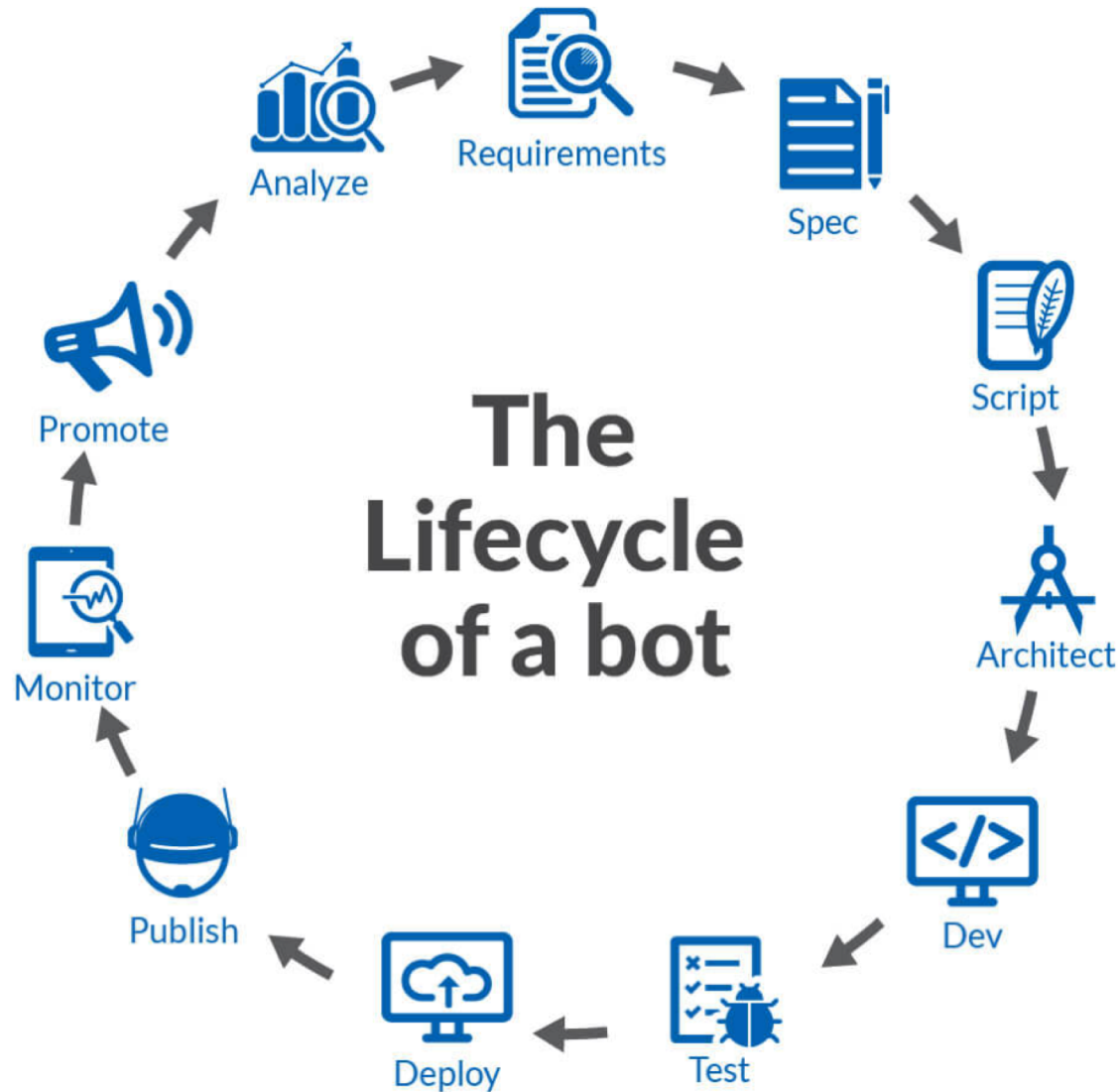
## Developer Tools



## Education



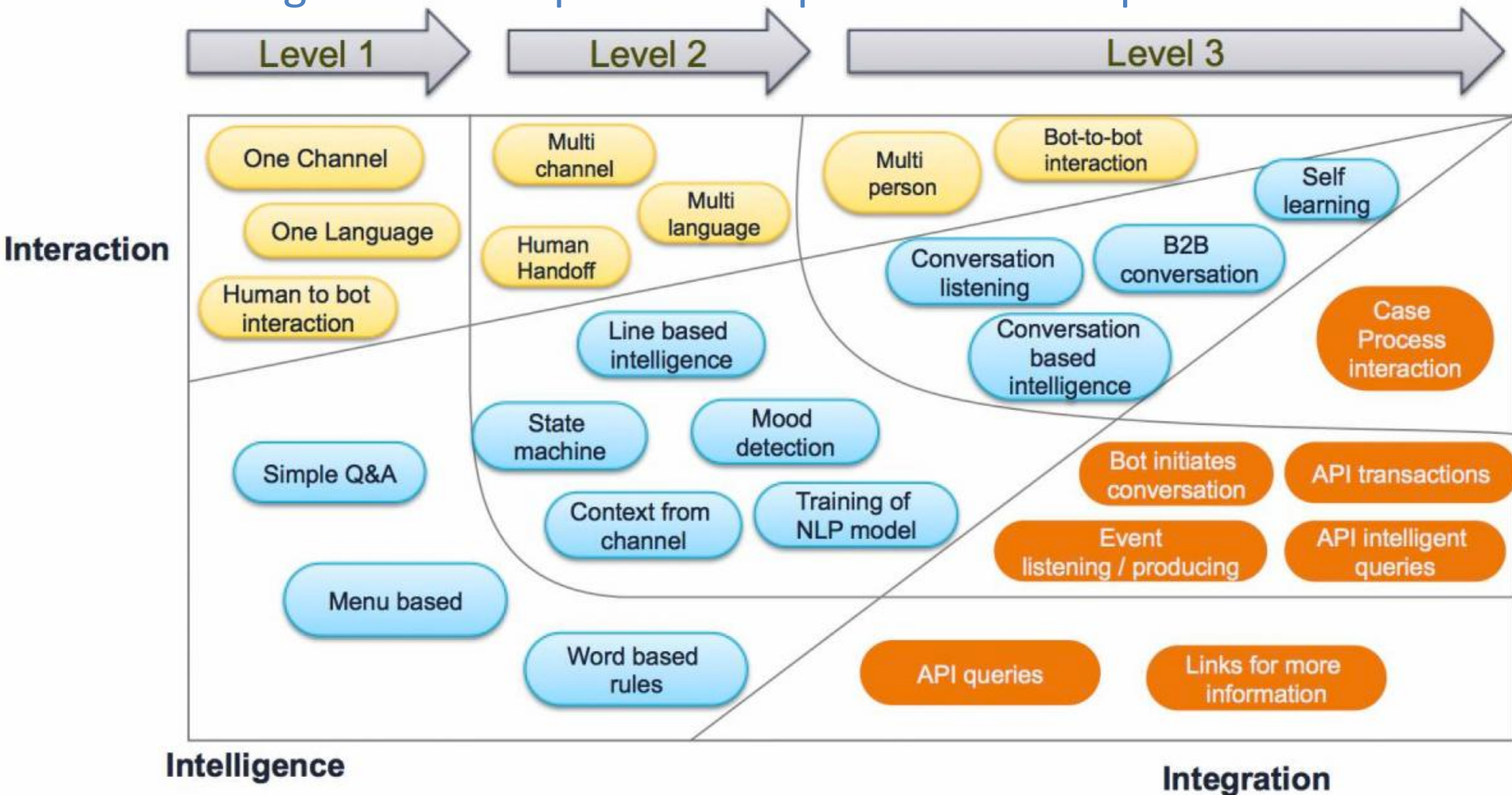
# The Bot Lifecycle



# Chatbots

## Bot Maturity Model

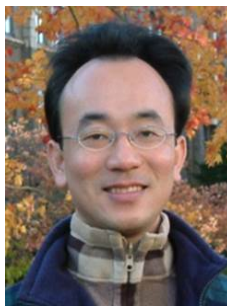
Customers want to have simpler means to interact with businesses and get faster response to a question or complaint.



# Question Answering (QA)

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

Department of Information Management  
Tamkang University, Taiwan



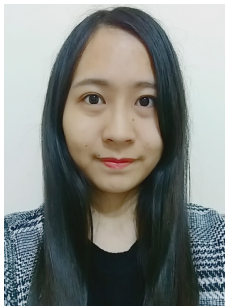
Min-Yuh Day



Chao-Yu Chen



Wanchu Huang



Shi-Ya Zheng



I-Hsuan Huang



Tz-Rung Chen



Min-Chun Kuo



Yue-Da Lin



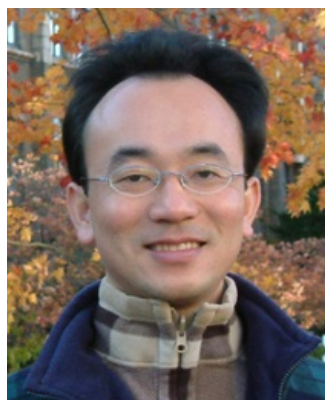
Yi-Jing Lin

[myday@mail.tku.edu.tw](mailto:myday@mail.tku.edu.tw)

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

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

Department of Information Management  
Tamkang University, Taiwan



Min-Yuh Day

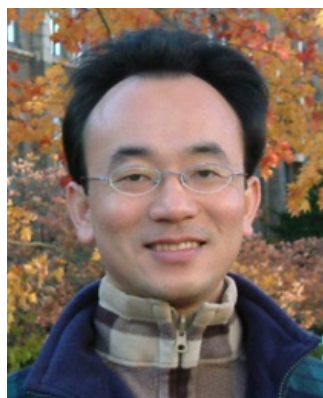
[myday@mail.tku.edu.tw](mailto:myday@mail.tku.edu.tw)



Chun Tu

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

Department of Information Management  
Tamkang University, Taiwan



Min-Yuh Day



Chun Tu



Hou-Cheng Vong

[myday@mail.tku.edu.tw](mailto:myday@mail.tku.edu.tw)



Shih-Wei Wu



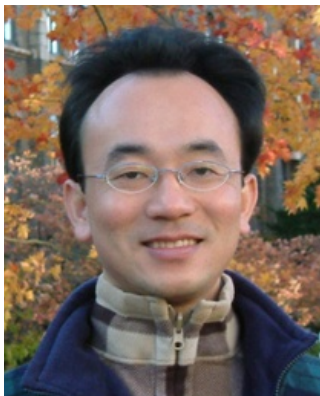
Shih-Jhen Huang

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

**Tamkang University**

淡江大學

# 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**



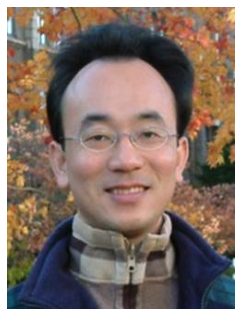
**Cheng-Chia Tsai**

2016

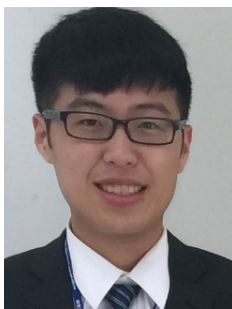
# IMTKU Question Answering System for World History Exams at NTCIR-12 QA Lab2

Department of Information Management  
Tamkang University, Taiwan

Sagacity Technology



Min-Yuh Day



Cheng-Chia Tsai



Wei-Chun Chung



Hsiu-Yuan Chang



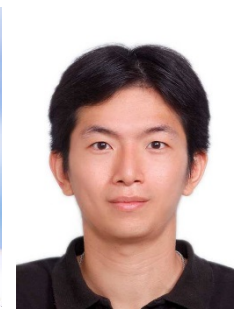
Tzu-Jui Sun



Yuan-Jie Tsai



Jin-Kun Lin



Cheng-Hung Lee



Yu-Ming Guo



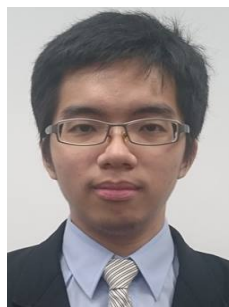
Yue-Da Lin



Wei-Ming Chen



Yun-Da Tsai



Cheng-Jhih Han



Yi-Jing Lin



Yi-Heng Chiang



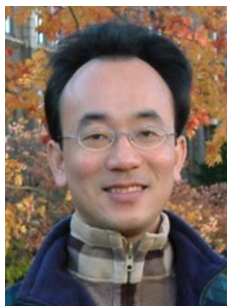
Ching-Yuan Chien

[myday@mail.tku.edu.tw](mailto:myday@mail.tku.edu.tw)

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

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

Department of Information Management  
Tamkang University, Taiwan



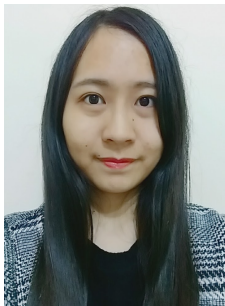
Min-Yuh Day



Chao-Yu Chen



Wanchu Huang



Shi-Ya Zheng



I-Hsuan Huang



Tz-Rung Chen



Min-Chun Kuo



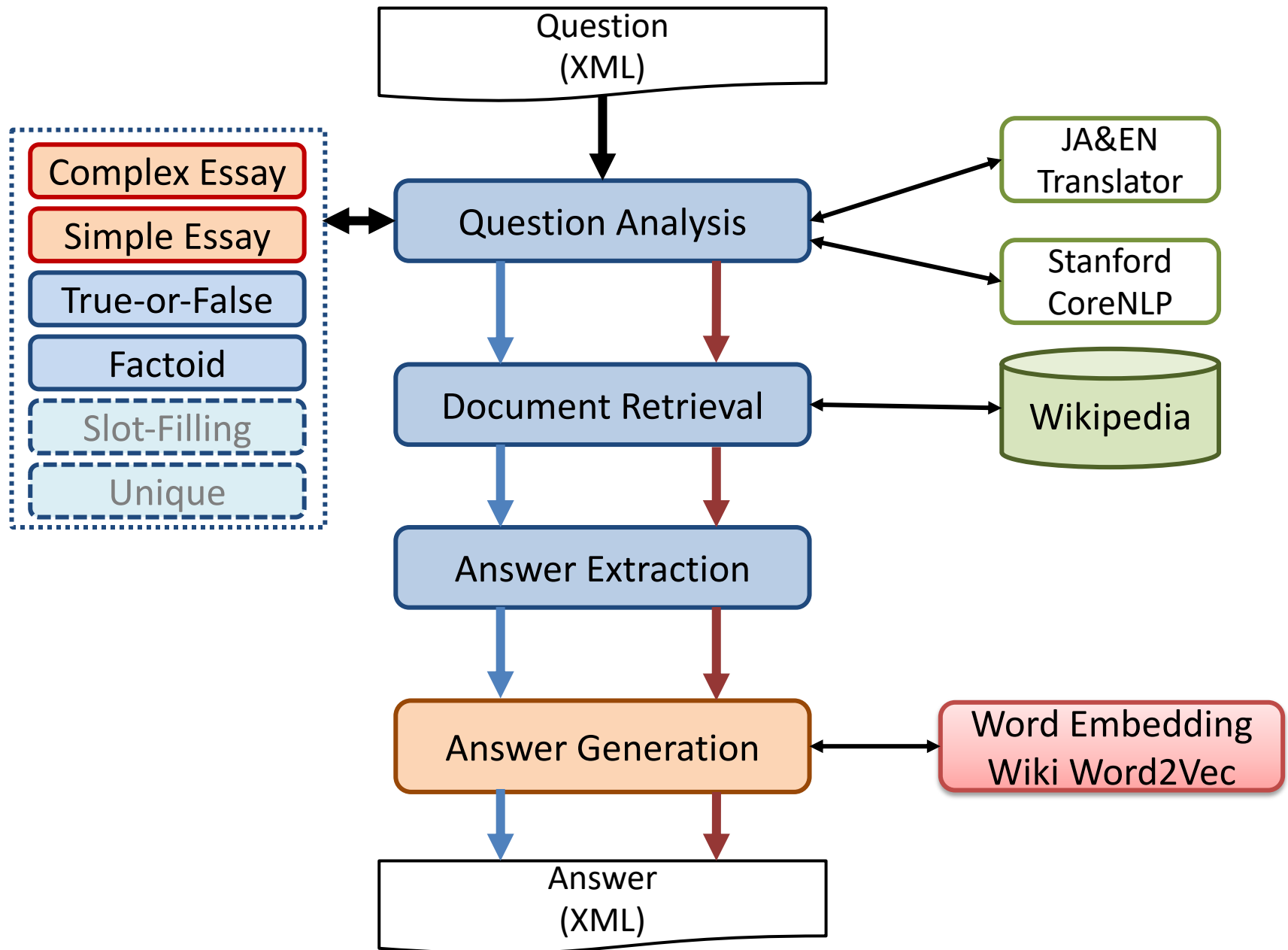
Yue-Da Lin



Yi-Jing Lin

[myday@mail.tku.edu.tw](mailto:myday@mail.tku.edu.tw)

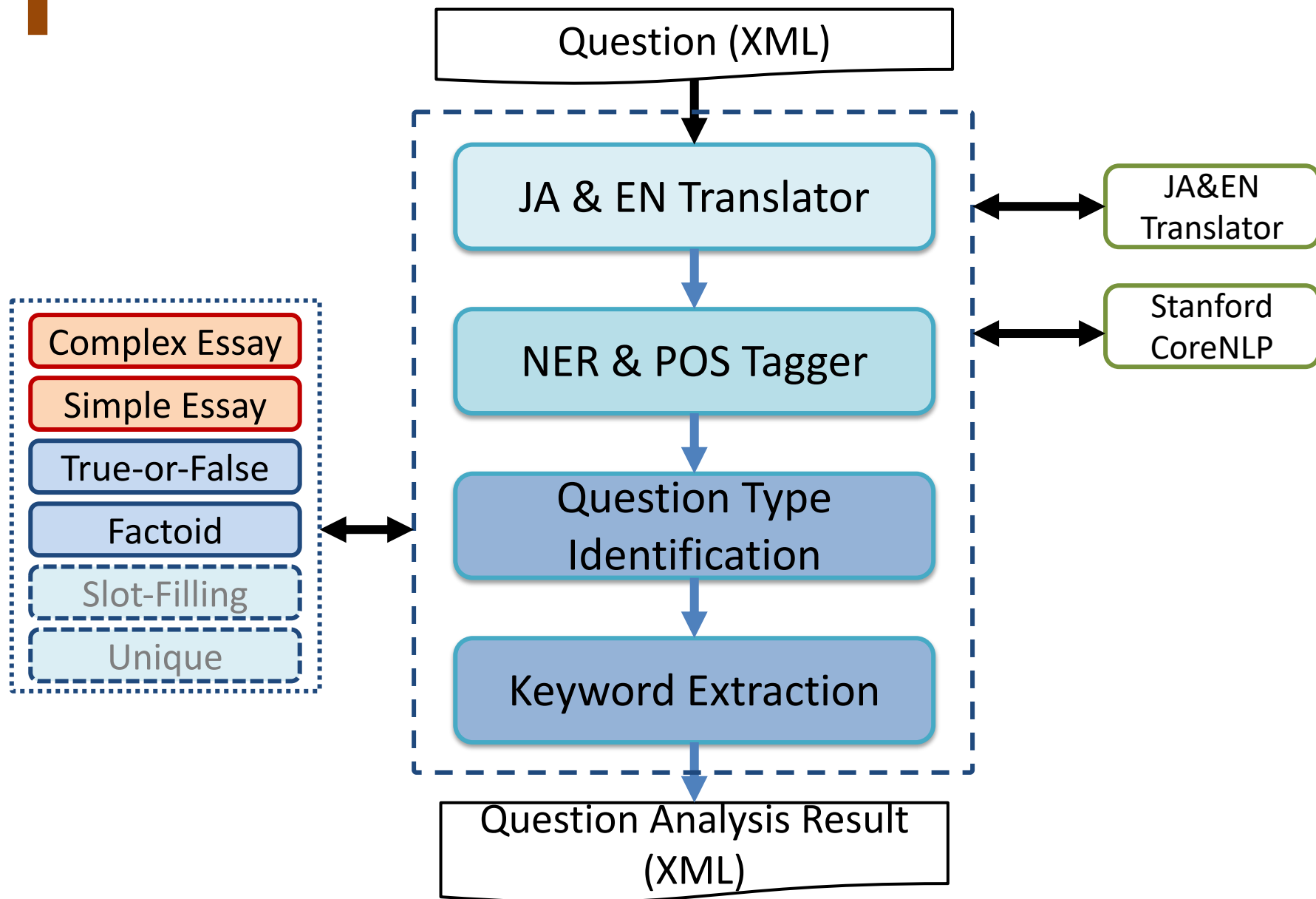
# IMTKU System Architecture for NTCIR-13 QALab-3



# IMTKU

# System Description

# Question Analysis



# JA & EN Translator

JA&EN  
Translator

## Japanese:

古代メソポタミアと古代エジプトにおける  
暦とその発達の背景について，3行以内で  
説明しなさい。

## English (JA & EN Translator by Google Translate):

Explain the calendar in ancient Mesopotamia  
and ancient Egypt and the background of its  
development within 3 lines.

# NER & POS tagger

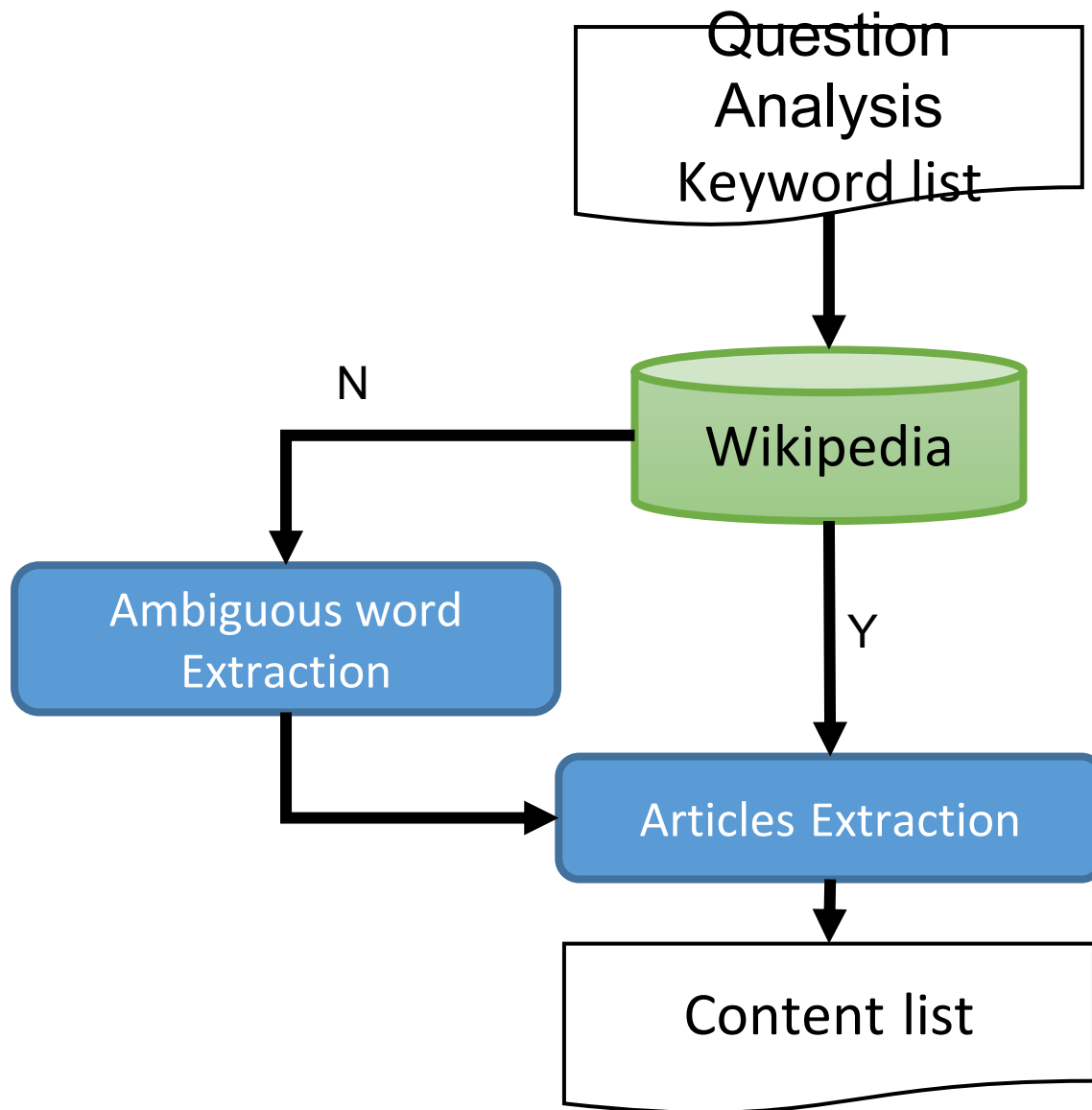
Stanford  
CoreNLP

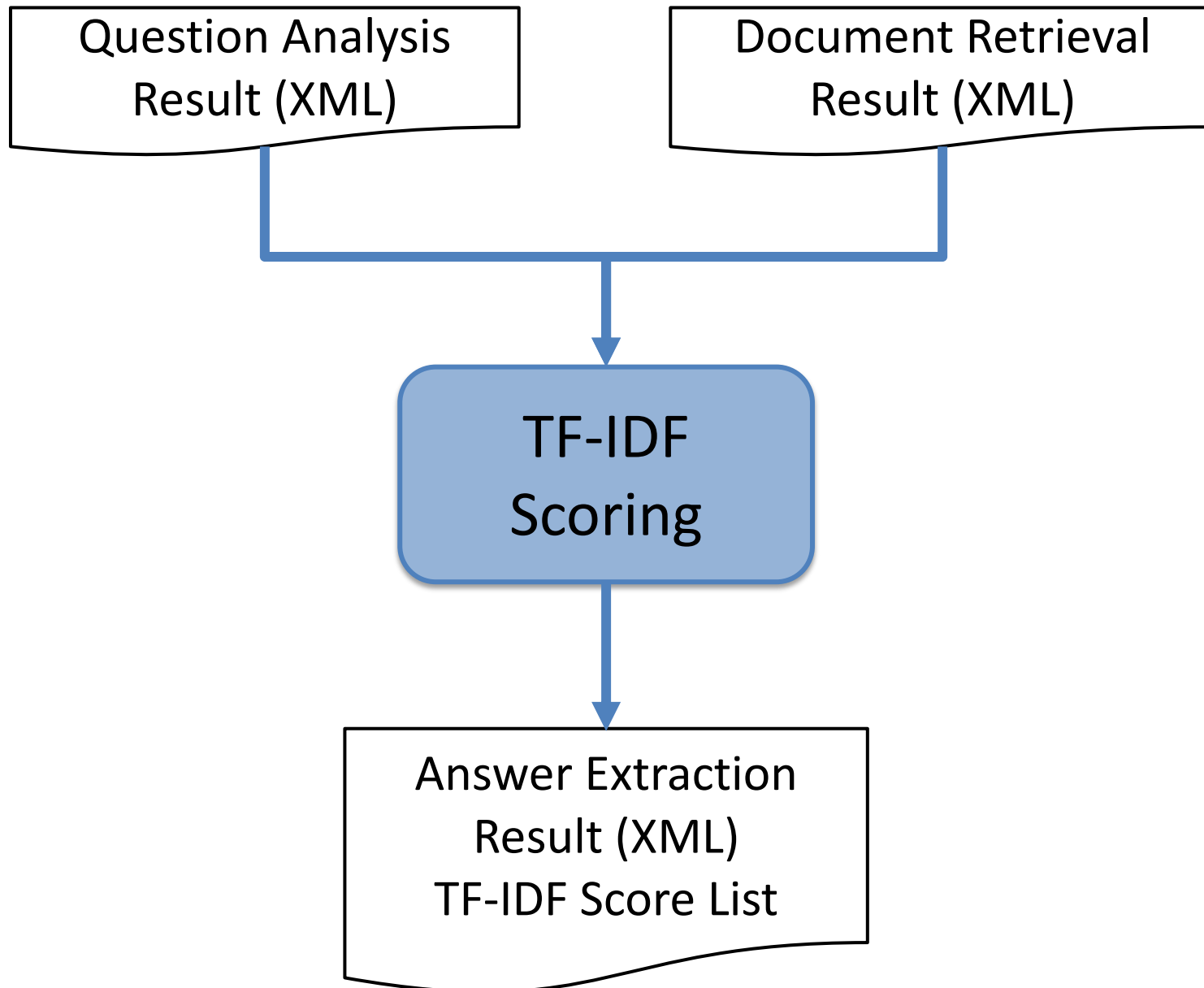
## Raw Data:

Wang Anshi, who lived during the Song period, carried out reforms called the New Policies (xin fa).

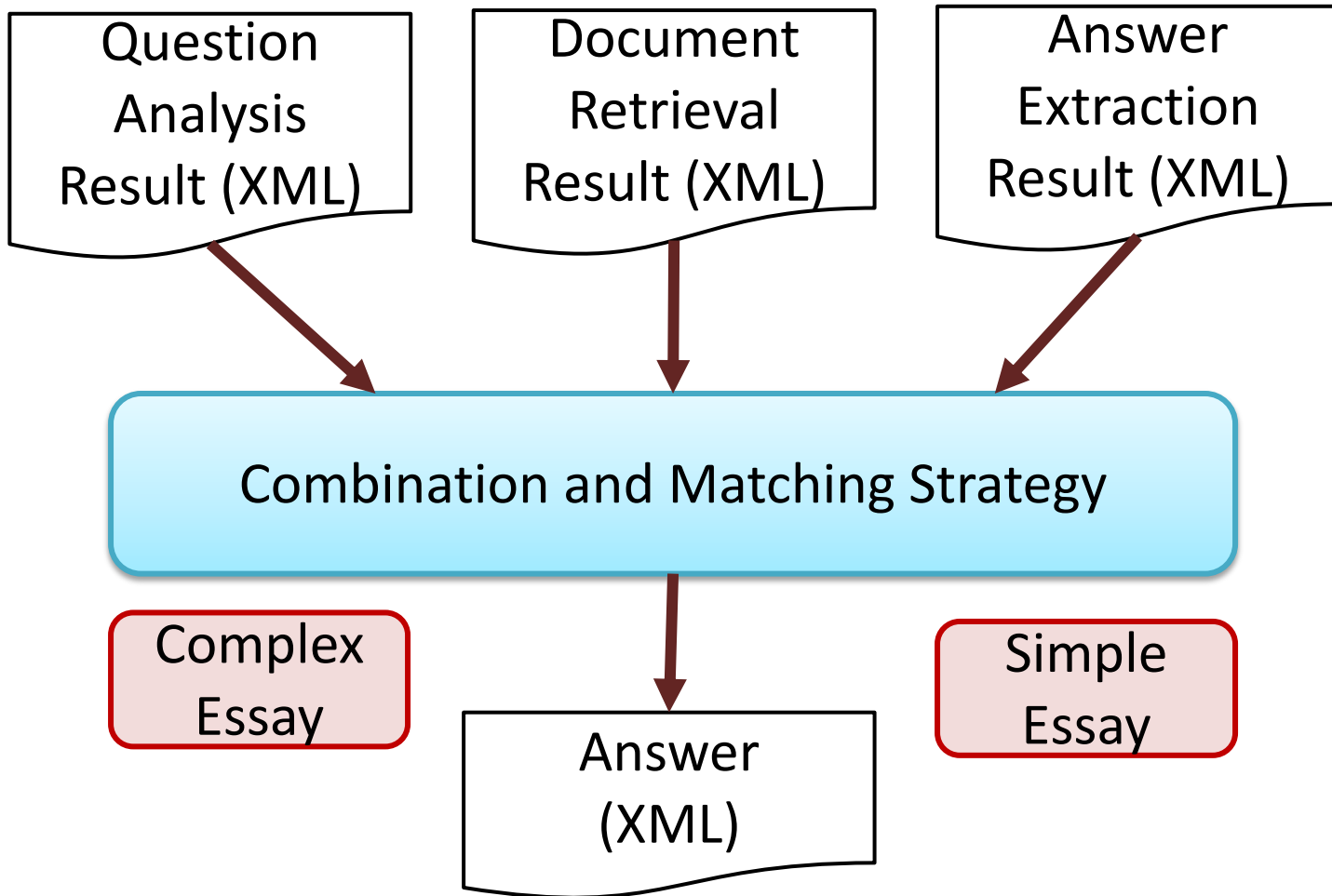
## POS tagger and NER:

Wang/PERSON/NNP Anshi/PERSON/NNP ,/O/, who/O/WP  
lived/O/VBD during/O/IN the/O/DT Song/O/NN  
period/O/NN ,/O/, carried/O/VBD out/O/RP  
reforms/O/NNS called/O/VBD the/O/DT New/O/JJ  
Policies/O/NNS -LRB-/O/-LRB- xin/O/FW fa/O/FW -RRB-  
/O/-RRB- ./O/.



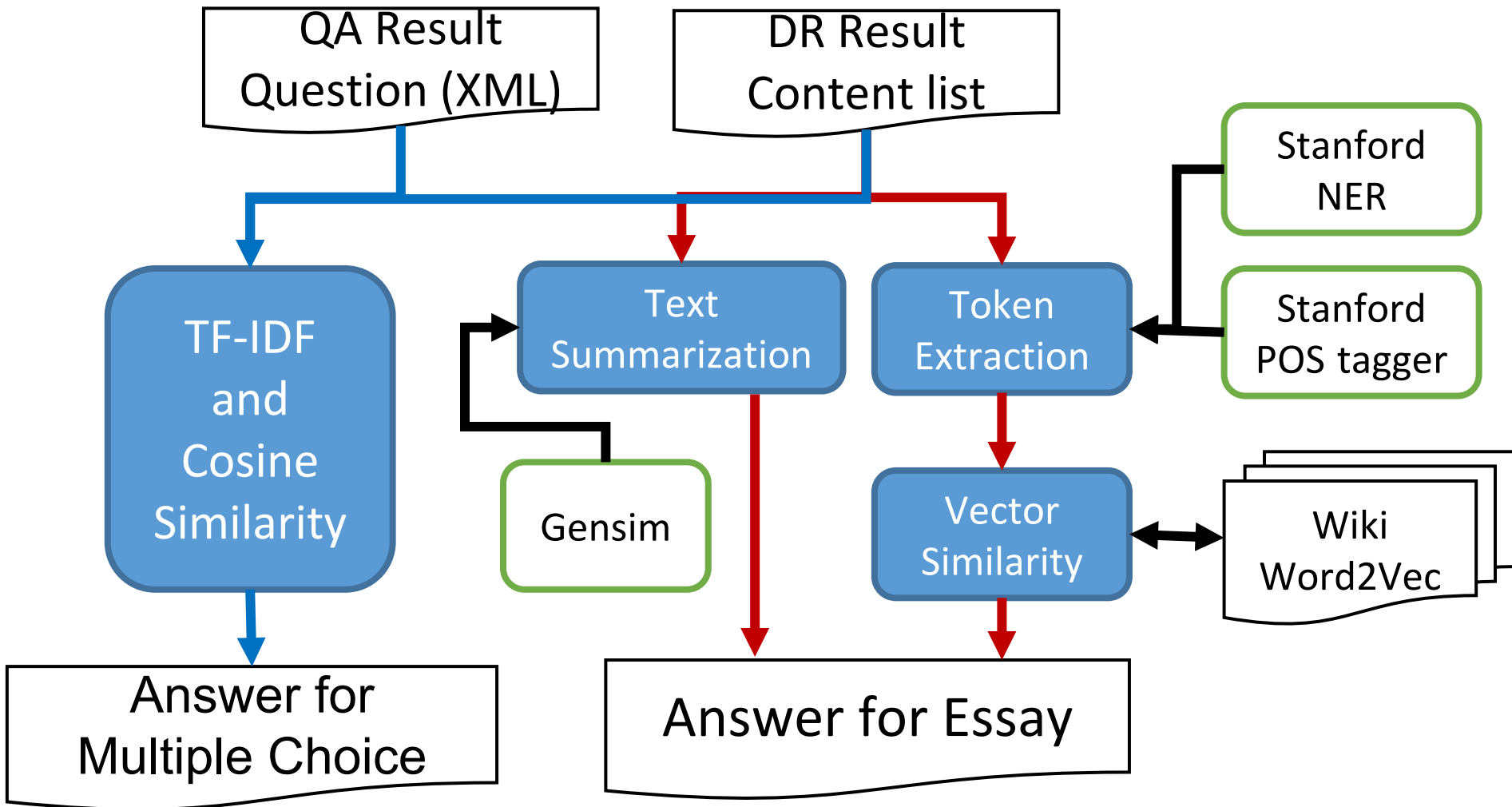


# Answer Generation

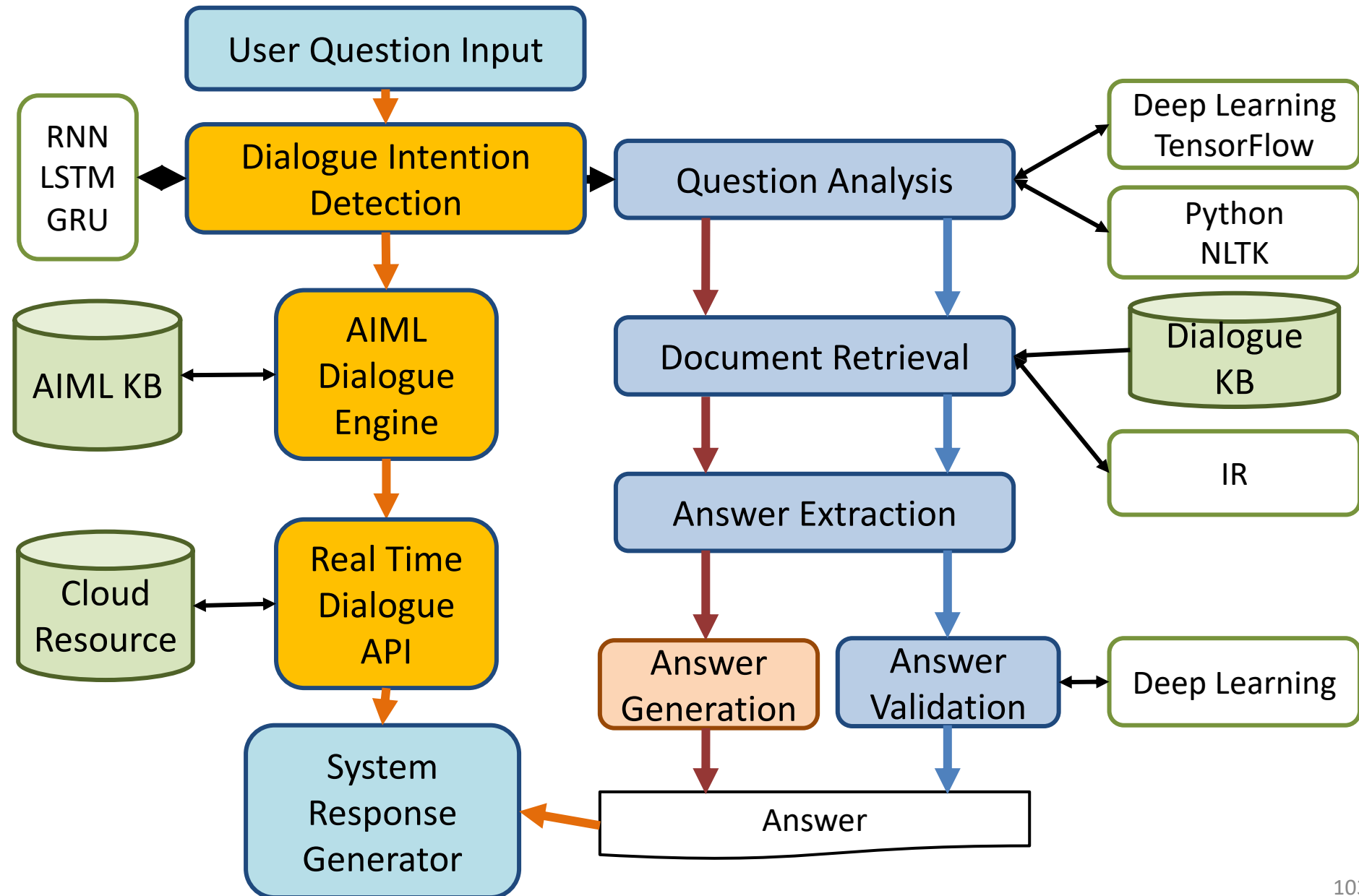


## 4

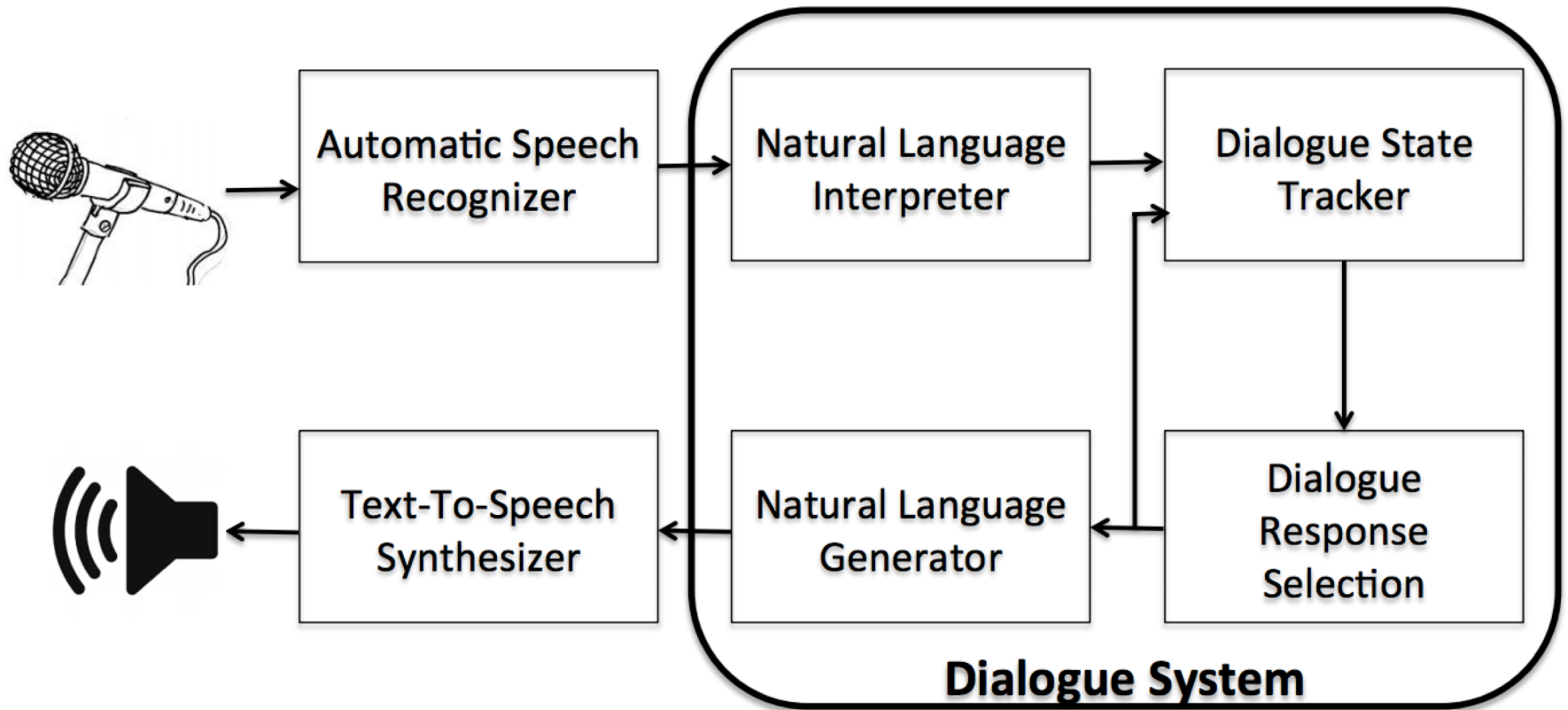
# Answer Generation



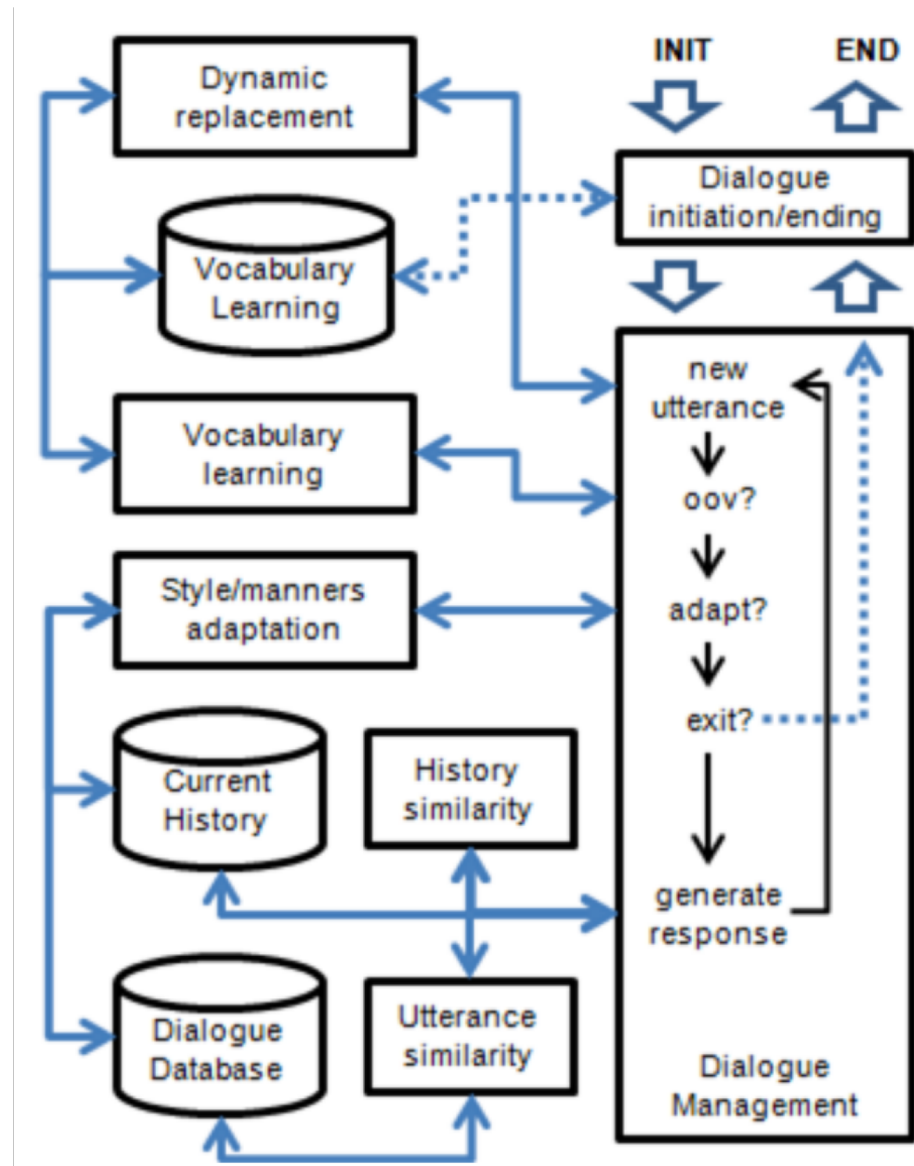
# System Architecture of Intelligent Dialogue and Question Answering System



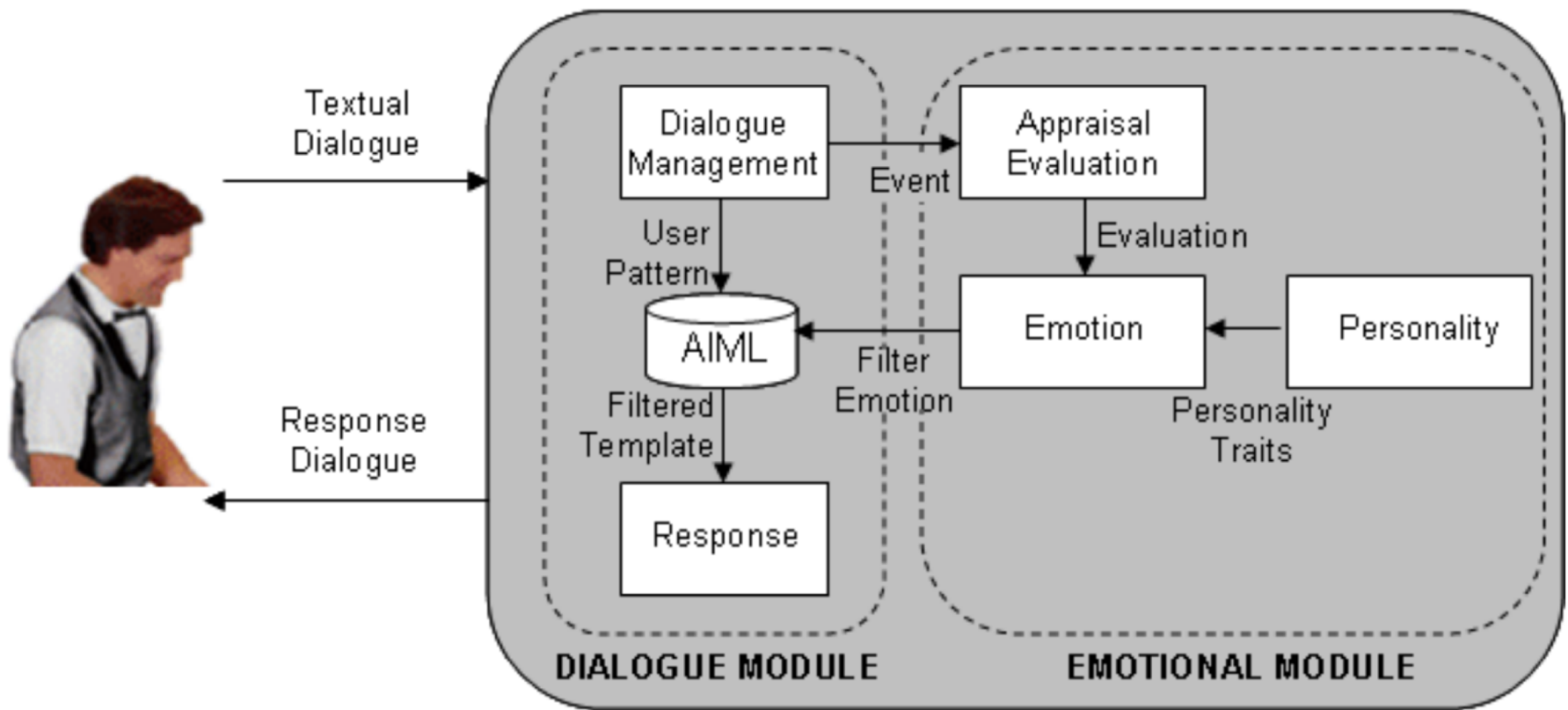
# Dialogue System



# Chat-oriented Dialogue System



# AIML Dialogue System



# ALICE and AIML



A.L.I.C.E. Silver Edition

DAVE E.S.L. bot

C.L.A.U.D.I.O Personality Test

GET SITEPAL AVATARS

**Free Live Chat** with the award winning A. I. chat robot **A. L. I. C. E.**

## Get Started

[Chat with A.L.I.C.E.](#)

[Chat with Fake Kirk](#)

[What is AIML?](#)  
[Foundation Bot Directory](#)  
[Bot Industry Survey](#)  
[AIML Overview](#)

## Software

[Downloads](#)  
[Bot Hosting](#)  
[AIML Sets](#)  
[AIML 1.1 Specification](#)  
[AIML 2.0 Working Draft](#)  
[Documentation](#)  
[Superbot - New!](#)

## Links

[ESL](#)  
[Books](#)  
[Film and TV](#)  
[Recent Press](#)  
[Popular Culture](#)  
[Web Ontologies](#)  
[ALICE and A.I. History](#)  
[Scholarly Research and Teaching](#)

### Site Info

alicebot.org

Rank: 257,092

Links in: 638

## 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 that 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 `<srai>` 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

## Subscription Bots

[A.L.I.C.E. Silver Edition](#)  
[DAVE E.S.L. Bot](#)  
[CLAUDIO Personality Test](#)



Build native  
iOS, Android,  
and Windows  
apps in C#



# 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>

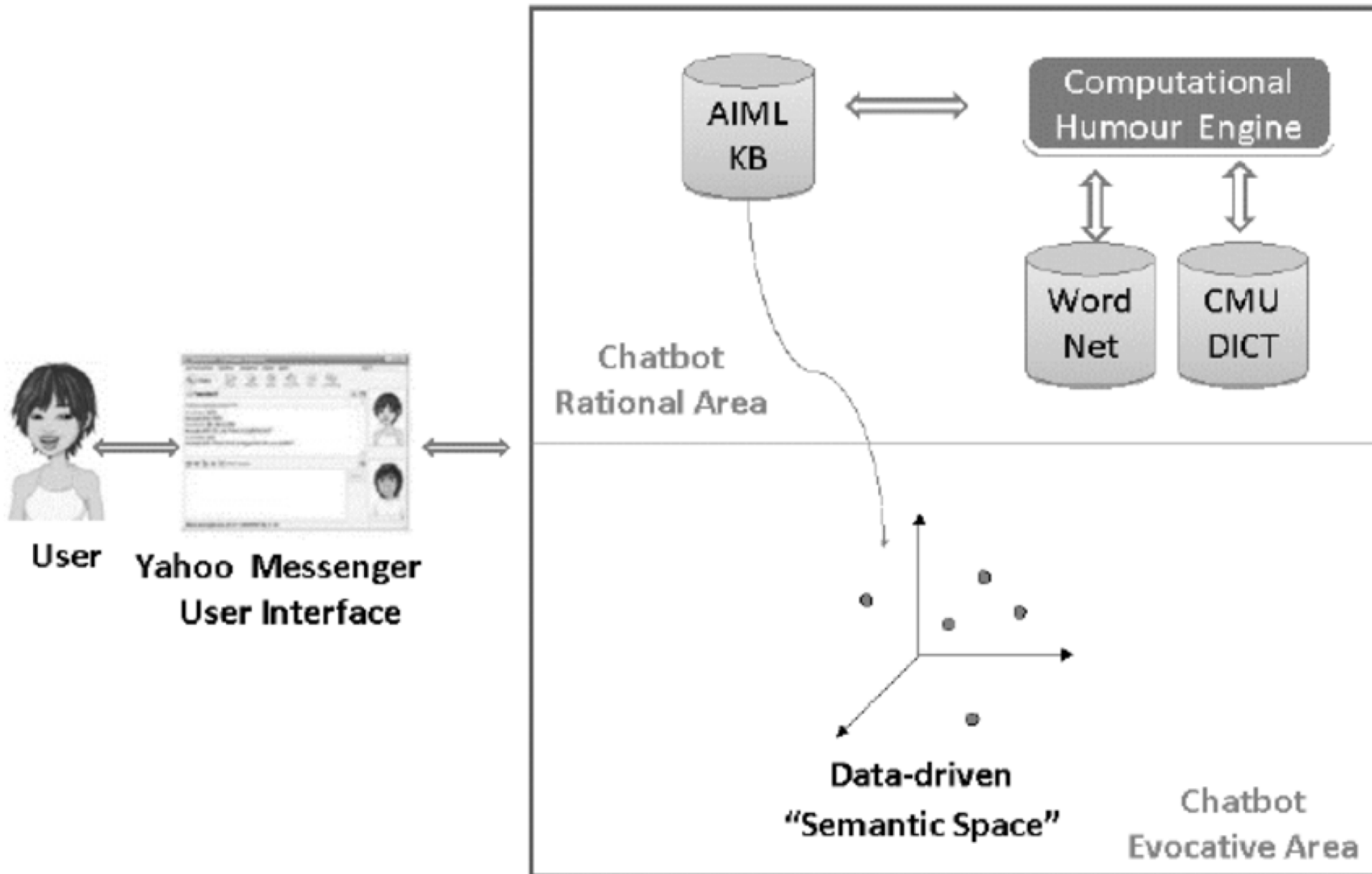
<think><set name="topic">Me</set></think>

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



# Short Text Conversation (STC)



# Short Text Conversation Task (STC-3)

## Chinese Emotional Conversation Generation (CECG) Subtask

# NTCIR Short Text Conversation

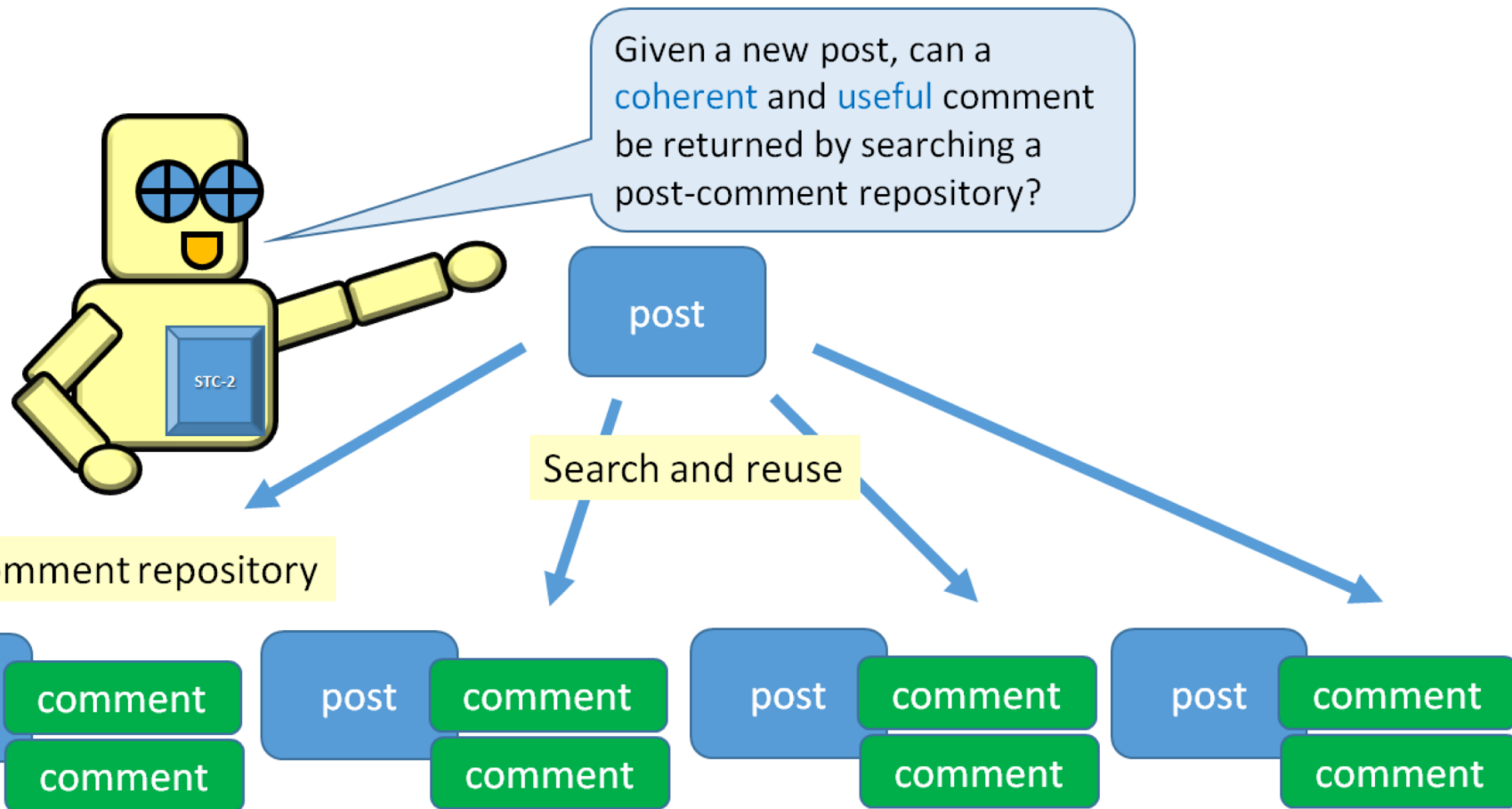
## STC-1, STC-2, STC-3

	Japanese	Chinese	English	
NTCIR-12 STC-1 22 active participants	Twitter, Retrieval	Weibo, Retrieval		Single-turn, Non task-oriented
NTCIR-13 STC-2 27 active participants	Yahoo! News, Retrieval+ Generation	Weibo, Retrieval+ Generation		
NTCIR-14 STC-3		Weibo, Generation for given emotion categories		Multi-turn, task-oriented (helpdesk)
Chinese Emotional Conversation Generation (CECG) subtask				
Dialogue Quality (DQ) and Nugget Detection (ND) subtasks		Weibo+English translations, distribution estimation for subjective annotations		

Source: <https://waseda.app.box.com/v/STC3atNTCIR-14>

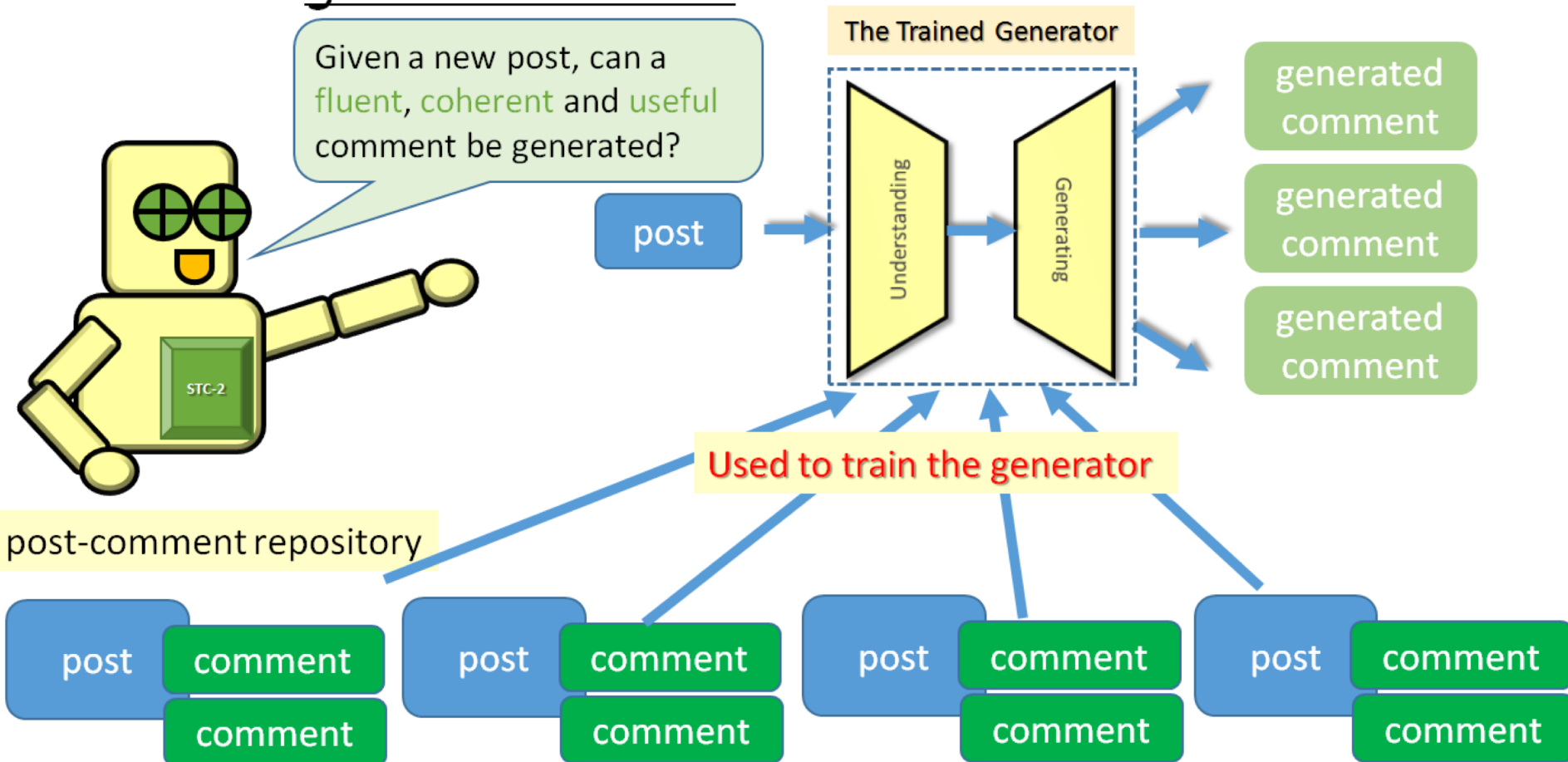
# Short Text Conversation (NTCIR-13 STC2) Retrieval-based

retrieval-based method



# Short Text Conversation (NTCIR-13 STC2) Generation-based

generation-based method



# Short Text Conversation (STC-3)

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

# 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)

# NTCIR-14 STC-3 CECG

## Time Schedule

- CECG
  - Aug 31, 2018 CECG registration due
  - Sep 15, 2018 Training data released
  - Nov 15, 2018 Test data released
  - Nov 25, 2018 Run submissions due
- ALL
  - Dec 20, 2018 Evaluation results and draft overview released
  - Feb 1, 2019 Participant paper submissions due
  - Mar 1, 2019 Acceptance notification
  - Mar 20, 2019 All camera-ready papers due
  - Jun 2019 NTCIR-14 Conference & EVIA 2019 in NII, Tokyo

# Given post:

爱狗还会做饭的男人，最帅了！

The man who cooks and loves dogs is very handsome!

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

# NLPCC

## Emotion Classification Challenge

### 6 classes (64%)

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

# Chinese Emotional Conversation Generation (CECG)

Post (Given)	Emotion Category (Given)	Response (to be generated)
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
  - $[[[post, post\_label], [response, response\_label]],$   
 $[[post, post\_label], [response, response\_label]], \dots]$ .

# Fluency judgement on responses with repetitive words

Response	Fluency
悲哀，悲哀，悲哀。	Yes
飘逸，飘逸，飘逸！	Yes
好可爱，好可爱！	Yes
哈哈，当然啦	Yes
疯了。疯了。全疯了	Yes
对的对的对的对的对的对的对的对的对的	No
我骗骗骗骗我骗你信不信不信不信我反正信了	No
中国的教育教育教育教育教育教育教育教育教育教育 教育教育教育教育教育教育教育教育教育教育教育	No
矮贱贱贱贱贱贱贱，你爱你，我也不爱你了	No
不关我事不关我事不关我事不关我事不关我事！	No

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

Post	Model		Response(Original)	Response(Translated)
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。	A promise is what a cheater says to a fool.
	ECM	Like	承诺是一个 <b>专一</b> 的傻子	Promise is a <b>single-minded</b> fool
		Happy	我就是个 <b>开心</b> 的傻子	I'm just a <b>happy</b> fool
		Sad	我就是个 <b>悲伤</b> 的傻子	I am a <b>sad</b> fool
		Disgust	一个 <b>骗子</b> 说给一个 <b>傻子</b> 听	A <b>cheater</b> says to a <b>fool</b>
		Angry	不管你信不信，反正我信了！	Whatever you believe or not, I trust in it!
知道真相的我眼泪笑下来 Knowing the truth, I laughed myself to tears	Seq2Seq		知道真相的我眼泪掉下来。	After knowing the truth, I burst into tears.
	ECM	Like	太 <b>可爱</b> 了，太 <b>可爱</b> 了！	Too <b>lovely</b> , it's too <b>lovely</b> .
		Happy	笑得我眼泪都出来了。	I can't help laugh myself to tears.
		Sad	知道真相的我 <b>眼泪</b> 掉下来。	After knowing the truth, I burst into <b>tears</b> .
		Disgust	这是真的还是假的？	Is this true?
		Angry	什么意思？没看懂。	What do you mean? I don't understand.

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

Post	Model		Response(Original)
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。
	ECM	Like	承诺是一个 <b>专一</b> 的傻子
		Happy	我就是个 <b>开心</b> 的傻子
		Sad	我就是个 <b>悲伤</b> 的傻子
		Disgust	一个 <b>骗子</b> 说给一个 <b>傻子</b> 听
		Angry	不管你信不信，反正我信了！

# Emotional Short Text Conversation (ESTC) Dataset

Training	Posts	217,905	
	Responses	Angry	234,635
		Disgust	689,295
		Happy	306,364
		Like	1,226,954
		Sad	537,028
		Other	1,365,371
Validation	Posts	1,000	
Test	Posts	1,000	

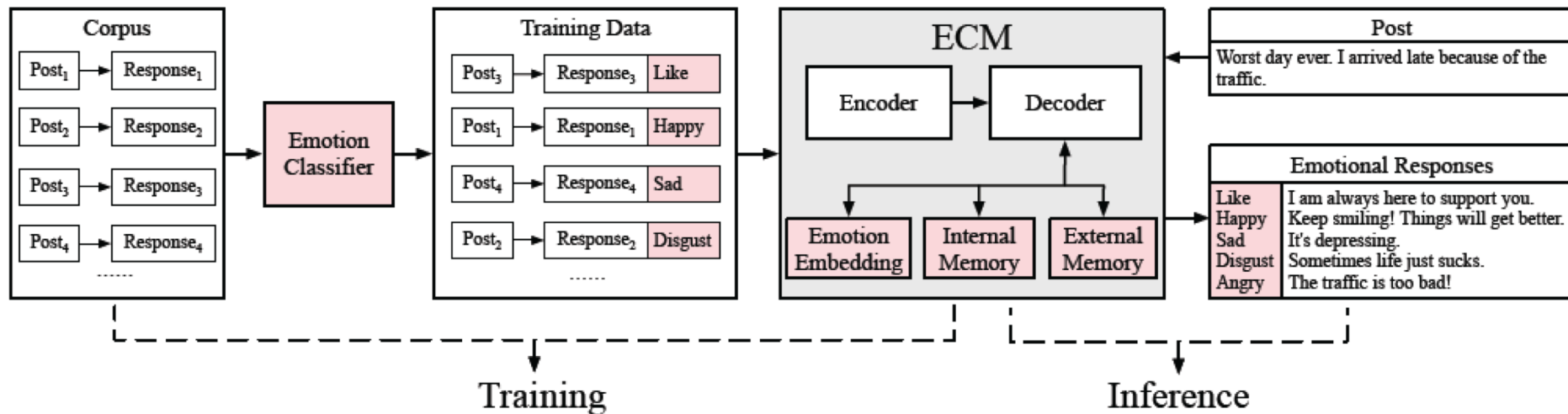
Source: Zhou, Hao, Minlie Huang, Tianyang Zhang, Xiaoyan Zhu, and Bing Liu. "Emotional chatting machine: emotional conversation generation with internal and external memory." *arXiv preprint arXiv:1704.01074* (2017).

# Conversations with/without considering emotion

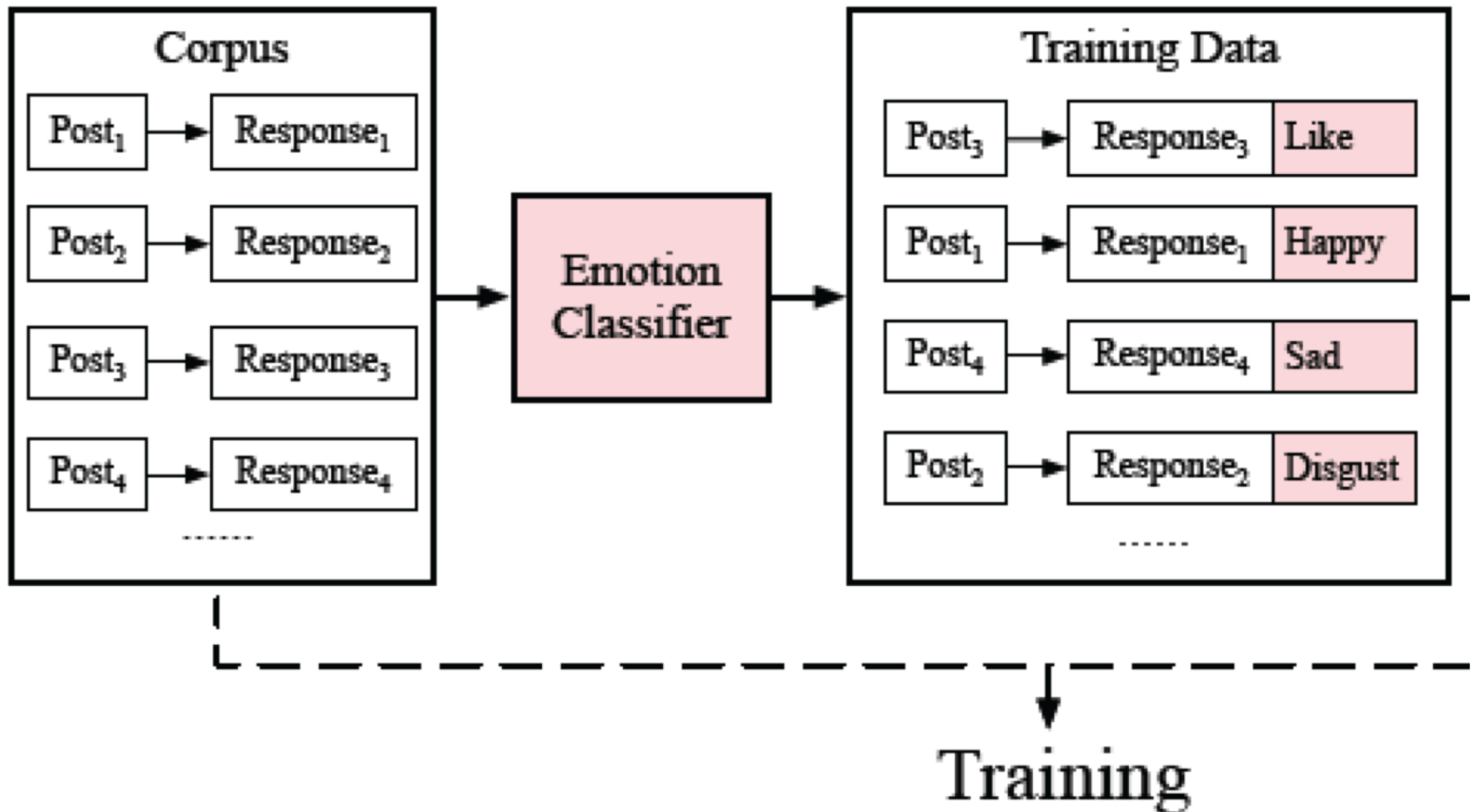
## Emotional Chatting Machine (ECM)

- 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!

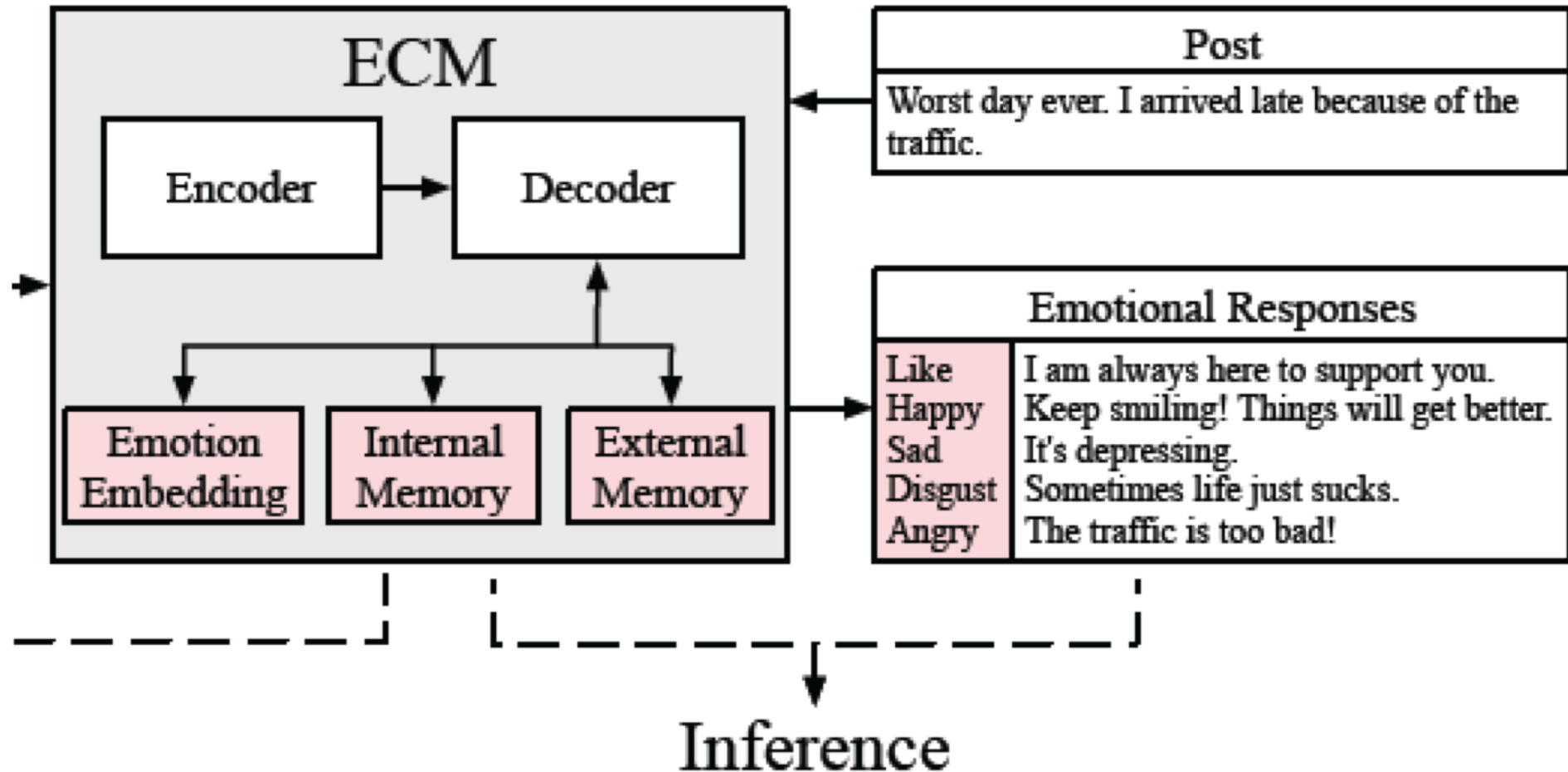
# Overview of Emotional Chatting Machine (ECM)



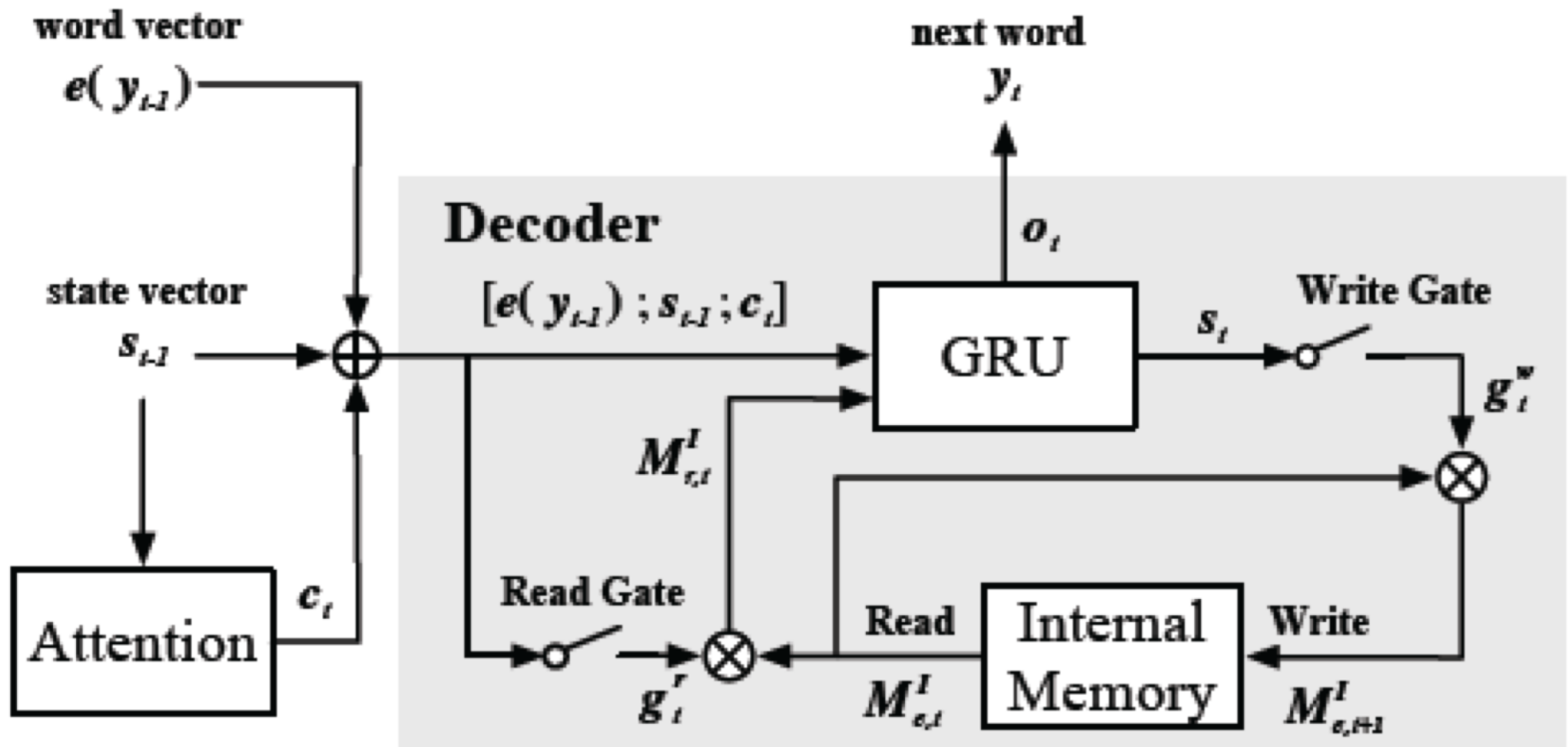
# Overview of Emotional Chatting Machine (ECM)



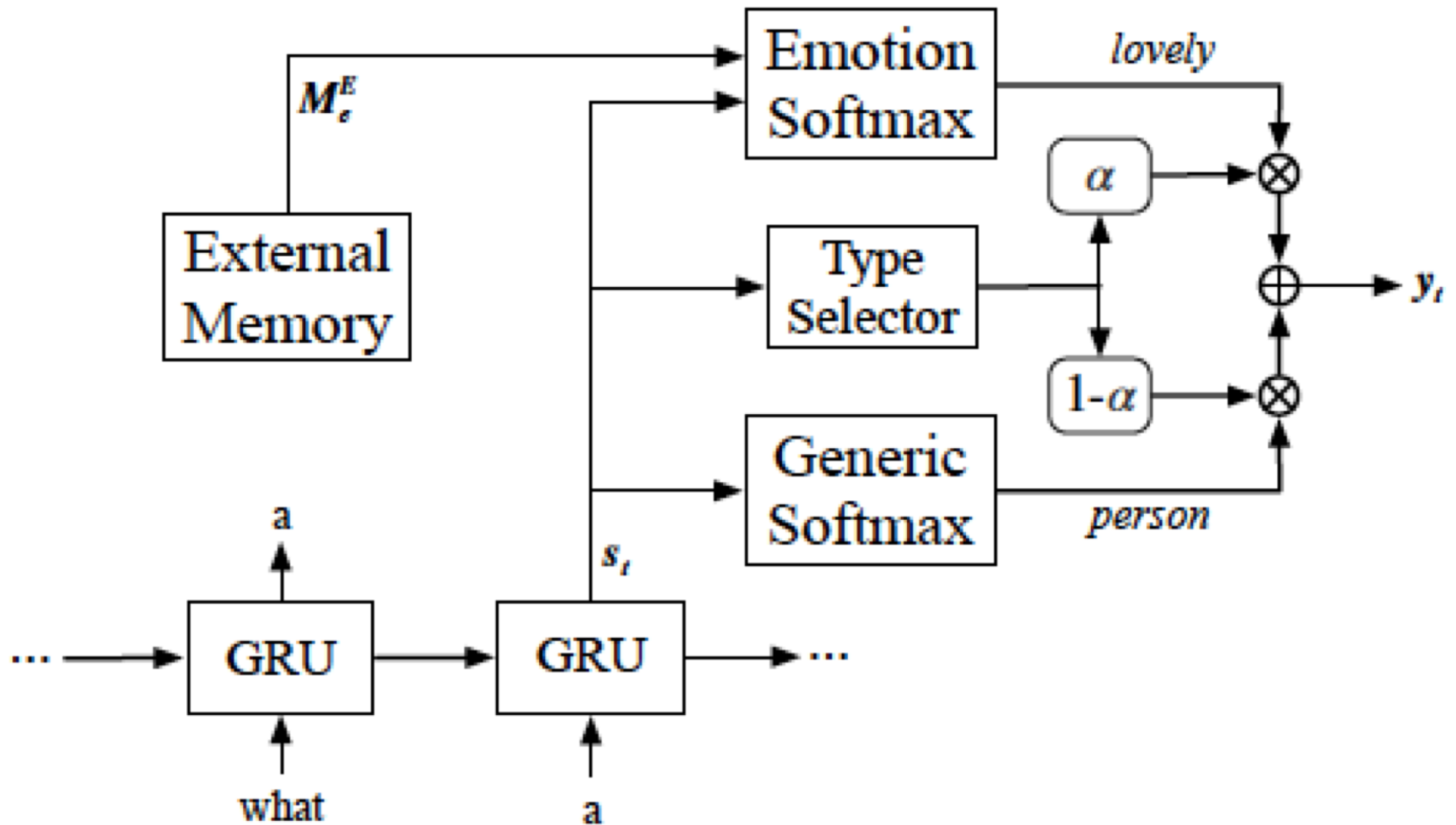
# Overview of Emotional Chatting Machine (ECM)



# Data flow of the decoder with an internal memory



# Data flow of the decoder with an external memory



Source: Zhou, Hao, Minlie Huang, Tianyang Zhang, Xiaoyan Zhu, and Bing Liu. "Emotional chatting machine: emotional conversation generation with internal and external memory." *arXiv preprint arXiv:1704.01074* (2017).

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

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

# 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

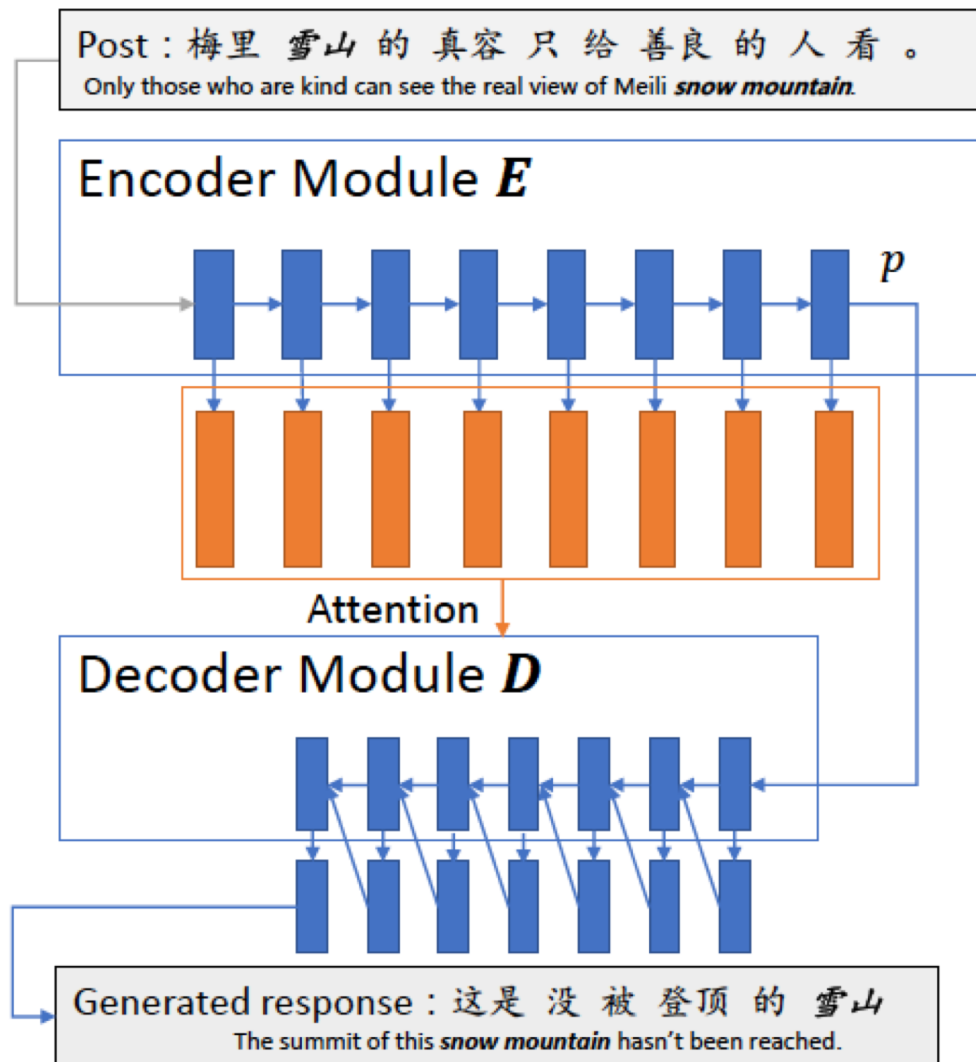
ELSE

LABEL 1

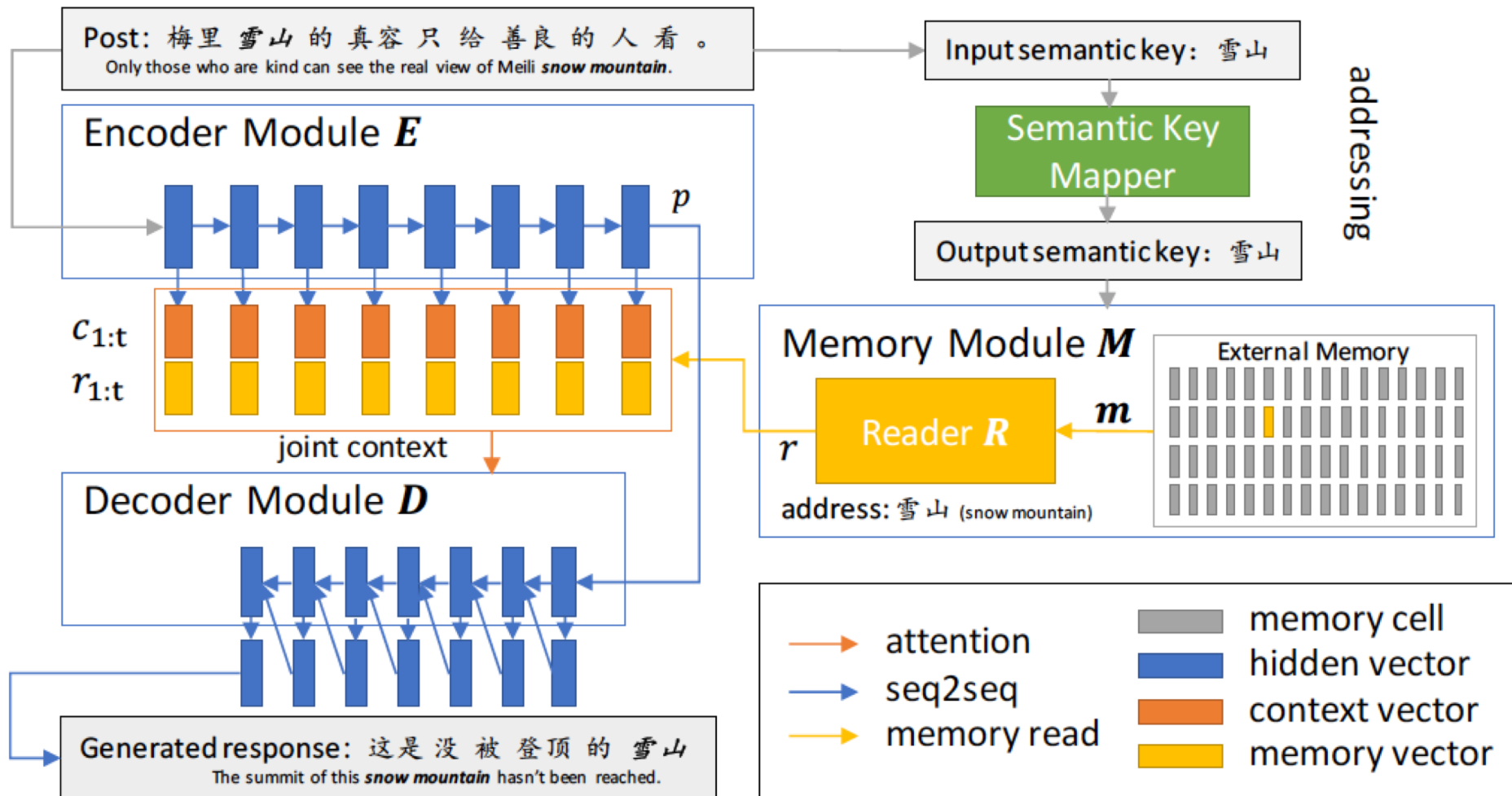
ELSE

LABEL 0

# Sequence-to-sequence Learning with Attention for Generation-based STC



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



# Controllable Short Text Conversation Examples

Post	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!	
NRM	李娜是世界冠军! Li Na is the world champion!	
MrRNN	李娜加油,加油! Come on, Li Na. Come on!	
ESED	Key-Word	Response
	世界 world	李娜是世界上最棒的! Li Na is the best in the world!
	中国 China	李娜是中国的骄傲! Li Na is the pride of China!
	网球 tennis	中国网球公开赛,加油! China Tennis Open, come on!
Post	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.	
NRM	给我第二次生命的人。 A man who gives me a second life.	
MrRNN	感谢每一个人! Thanks for everyone!	
ESED	Key-Word	Response
	生命 life	感谢生命给予的一切! Thanks for everything given by life!
	器官 organ	感谢那些器官捐赠者。 Thanks for those organ donors.
	广告 advertisement	很感人的广告! A very touching advertisement!

Source: Yu, Kai, Zijian Zhao, Xueyang Wu, Hongtao Lin, and Xuan Liu. "Rich Short Text Conversation Using Semantic Key Controlled Sequence Generation." *IEEE/ACM Transactions on Audio, Speech, and Language Processing* (2018).

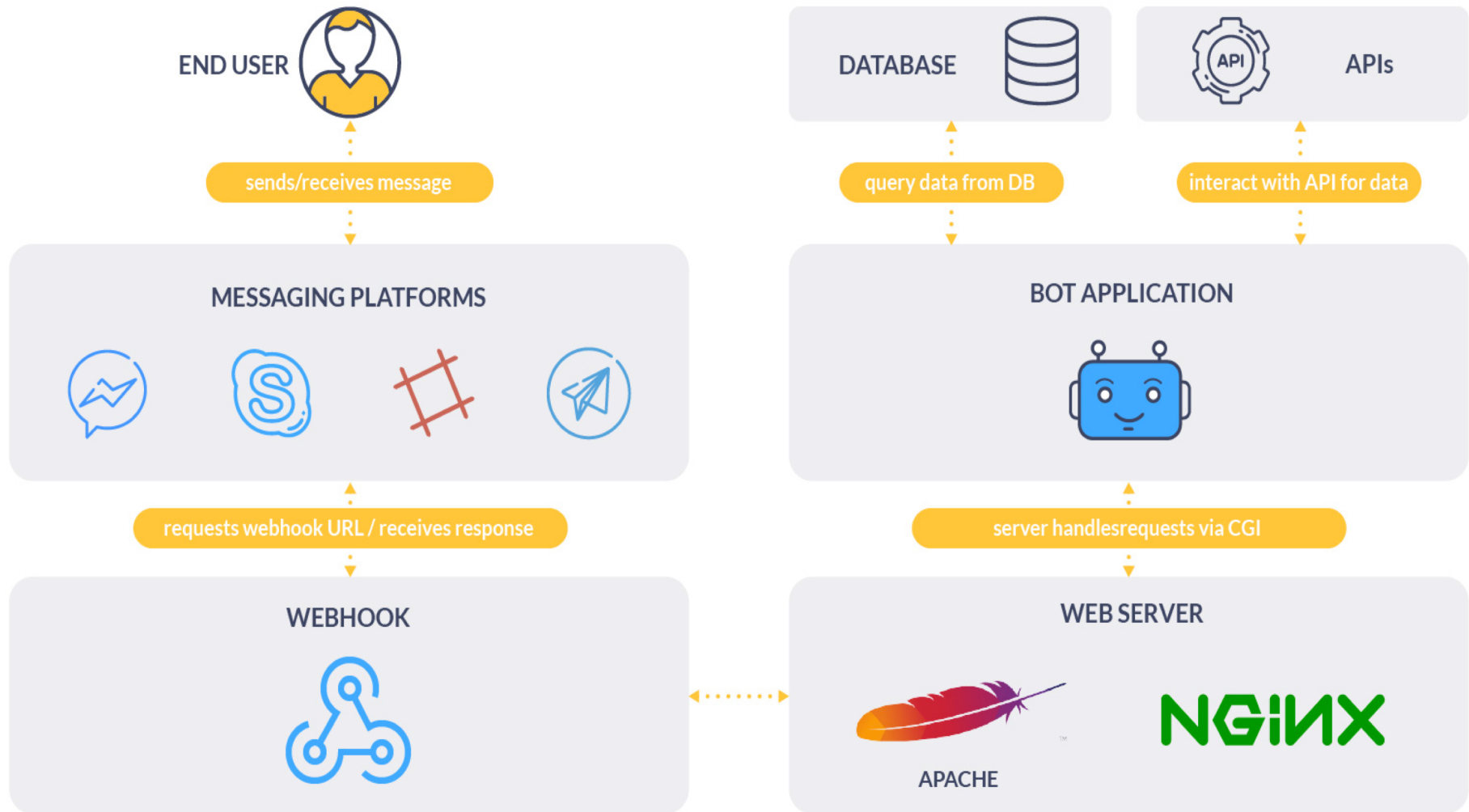
# Comments Generated Using Different Semantic key Mapping Methods

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.	
Mapping-Method	Key-Word	Response
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?
	对 right	对的,对的。 Right, right.
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	你最喜欢那个星座? What is your favorite constellation?	
Semantic-Key	Key-Word	Response
	摩羯座 Capricorn	我最喜欢摩羯座。 I love Capricorn.
	射手座 Sagittarius	我是射手座,我喜欢。 I am a Sagittarius and I like it.
Post	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 song	杰伦的歌也很好听。 Jay Chou's songs are nice too.
Post	梵高的画,很漂亮。 Van Gogh's paintings are very beautiful.	
Semantic-Key	Key-Word	Response
	向日葵 sunflower	梵高笔下的向日葵。 The Sunflower by Van Gogh.
	荷兰 Holland	梵高的画,很漂亮。 Van Gogh's paintings are very beautiful.

# How to Build Chatbots



# 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



Botkit



Microsoft Bot Framework



Built-In Integration with messaging platforms	✓	✓	✗
NLP support	✗ but possible to integrate with middlewares	✗ but have close bonds with LUIS.ai	✓
Out-of-box bots ready to be deployed	✓	✗	✗
Programming Language	JavaScript (Node)	JavaScript (Node), C#	Python

Created by  ActiveWizards

# Comparison of Most Prominent AI Services

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

Created by **ActiveWizards**

# References

- Paolo Sironi (2016), "FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification", Wiley.
- Musto, C., Semeraro, G., Lops, P., de Gemmis, M., & Lekkass, G. (2015). Personalized finance advisory through case-based recommender systems and diversification strategies. *Decision Support Systems*, 77, 100-111.
- Rubino, J. (2016). My Favorite Robot. *CFA Institute Magazine*, 27(3), 43-46.
- Makoto P. Kato and Yiqun Liu (2017), "Overview of NTCIR-13." In *Proceedings of the 13th NTCIR Conference*.
- Min-Yuh Day, Chao-Yu Chen, Wan-Chu Huang, I-Hsuan Huang and Shi-Ya Zheng, Tz-Rung Chen, Min-Chun Kuo, Yue-Da Lin, and Yi-Jing Lin (2017), "IMTKU Question Answering System for World History Exams at NTCIR-13 QA Lab-3." *The 13th NTCIR Conference on Evaluation of Information Access Technologies (NTCIR-13)*, Tokyo, Japan, December 5-8, 2017.
- Minlie Huang, Zuoxian Ye, and Hao Zhou (2017). "Overview of the NLPCC 2017 Shared Task: Emotion Generation Challenge." In *National CCF Conference on Natural Language Processing and Chinese Computing (NLPCC)*, pp. 926-936. Springer
- Hao Zhou, Minlie Huang, Tianyang Zhang, Xiaoyan Zhu, and Bing Liu (2017). "Emotional chatting machine: emotional conversation generation with internal and external memory." *arXiv preprint arXiv:1704.01074*.
- Kai Yu, Zijian Zhao, Xueyang Wu, Hongtao Lin, and Xuan Liu (2018), "Rich Short Text Conversation Using Semantic Key Controlled Sequence Generation." *IEEE/ACM Transactions on Audio, Speech, and Language Processing*.