

自然语言处理的进展

Advancement of Natural Language Processing

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微软研究院

2017年1月10日清华寒假学校

Contact: mingzhou@microsoft.com

主要内容

- 自然语言处理简介(NLP overview)
 - 周明
- 深度学习在自然语言处理的应用(Deep learning and its application to NLP)
 - 刘树杰

例子

1. 冬天能穿多少穿多少，夏天能穿多少穿多少。

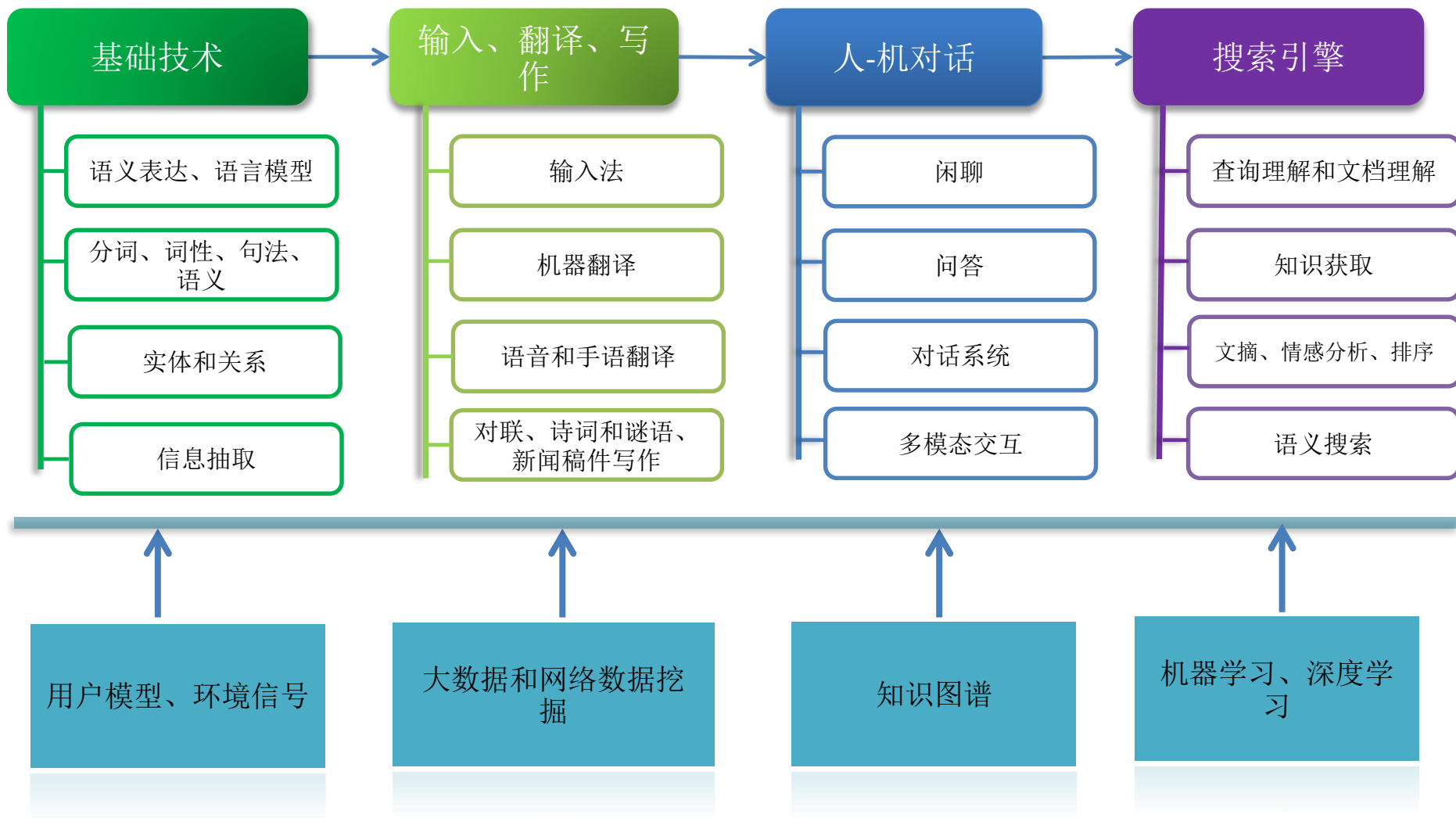
2. 剩女和剩男产生的原因有两个：一是谁都看不上，二是谁都看不上。



利用计算机对人类语言进行处理、理解，使其具备人类的听说读写能力，是未来最为关键的核心技术之一。

--比尔·盖茨

自然语言处理的任务

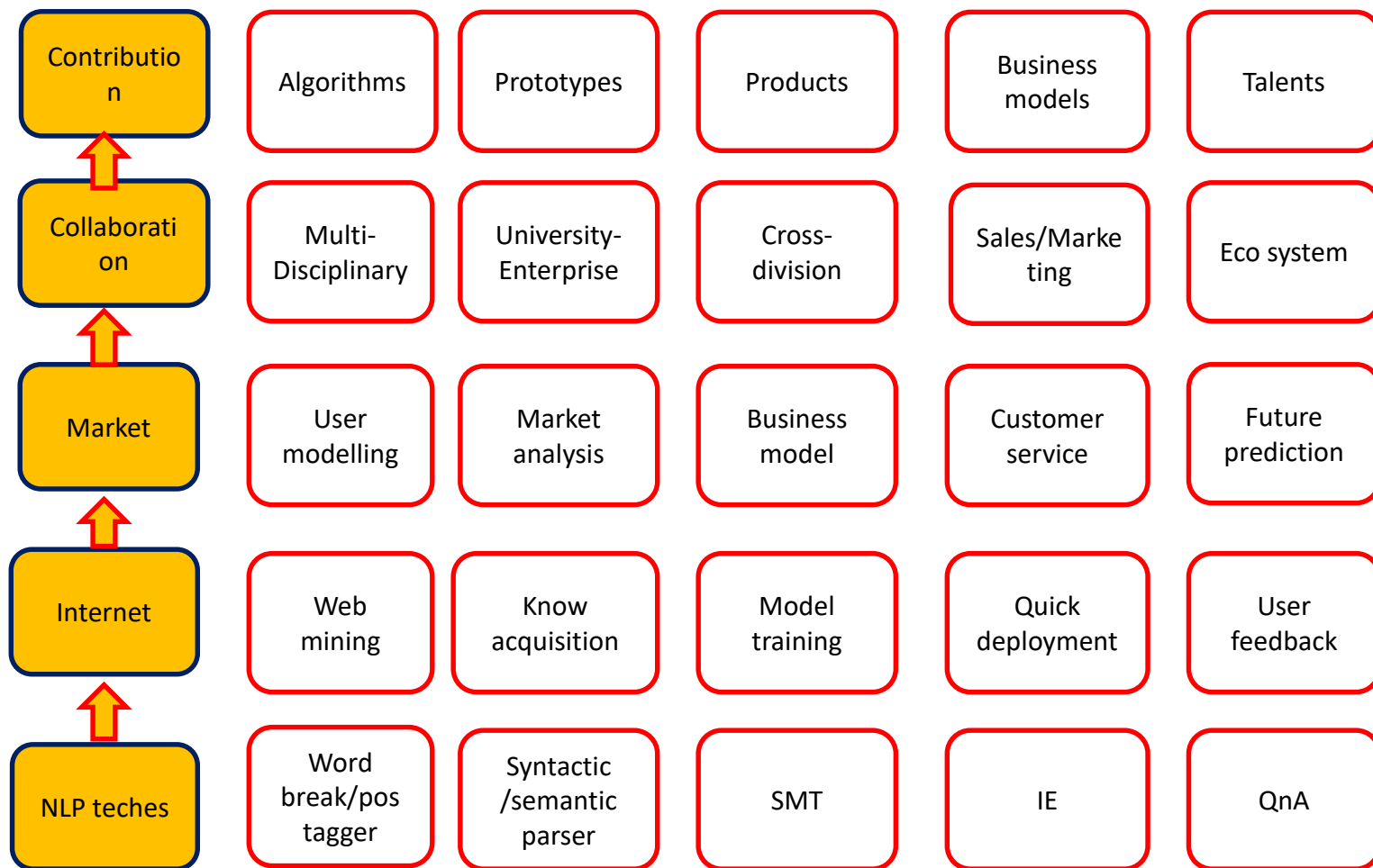


竞争和挑战

- Connecting human and computer
 - ASR/TTS, IME (MS, L&H, Google, FB, IFLY, Baidu)
- Connecting human and human
 - SNS, messenger (Wechat, Twitter, FB)
 - Productivity (MS, Google, Slack, Dingding)
 - Translator (MS, Google, Baidu)
- Connecting human and information
 - Search (MS, Google, Baidu, Sougou)
 - QnA (MS, IBM, Google, Apple, Baidu)
- Connecting human and service (for O2O)
 - Mobile search (MS, Google, Baidu)
 - Conversational bot, virtual assistant (MS, Baidu, Apple)
- Technical challenges
 - Data and platform
 - Spoken language processing and multi-modal fusion
 - History embedding to support multi-turn chat
 - User understanding and context aware
 - Quality measurement and control



NLP2.0 研发战略



点对点的创新、互联网作为平台、基于实施的战略、多学科交融

重点研发领域

- Statistical machine translation
 - Multi-language text analysis, machine translation, spoken translator, sign language translator, online dictionary and language learning, Chinese and Japanese IME, English writing assistant
- Applications to search engine
 - Query understanding, document understanding, speller, query suggestion, sentiment analysis, text summarization, knowledge base construction, relevance ranking, cross-language search, community search
- Question-Answering system and chat-bots
 - Knowledge-based QA, Web-based QA, Community and Social-Based QA, chatbot, Cortana
- Social network
 - Text mining and semantic search
- AI and language gaming
 - Automatic generation of couplets and poems, computer riddle

机器翻译

机器翻译

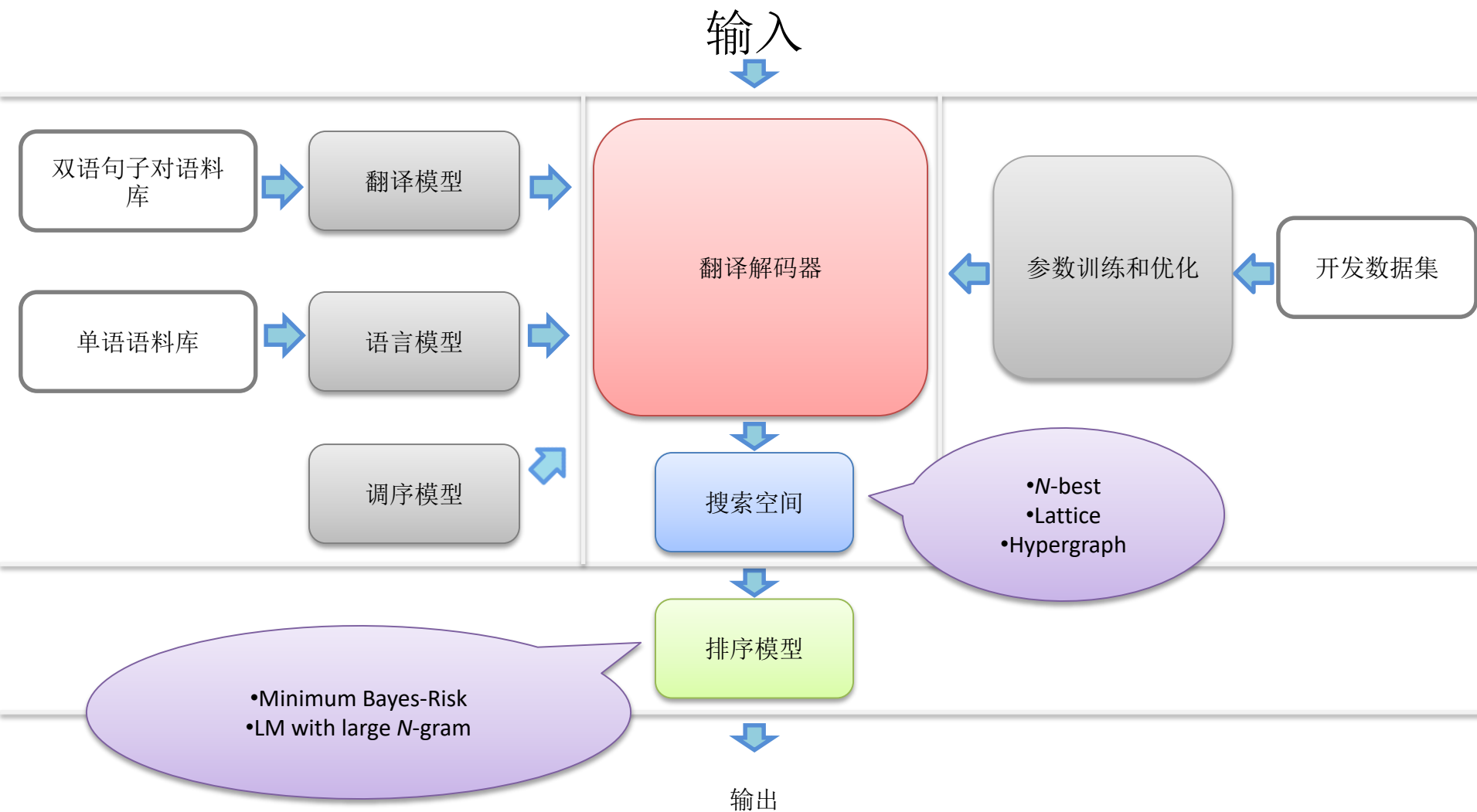
美国关岛国际机场及其办公室均接获一名自称沙地阿拉伯富商拉登等发出的电子邮件，威胁将会向机场等公众地方发动生化袭击後，关岛经保持高度戒备。



The U.S. island of Guam is maintaining a high state of alert after the Guam airport and its offices both received an e-mail from someone calling himself the Saudi Arabian Osama bin Laden and threatening a biological/chemical attack against public places such as the airport .

人类每年花费在翻译上面的费用是100亿美元。

统计机器翻译



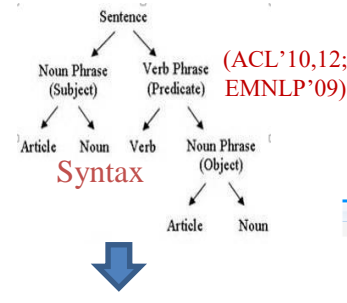
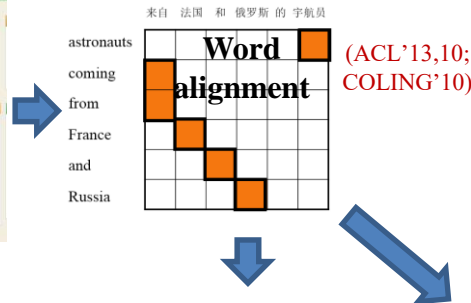
MSRA SMT Platform

- Data mining
- Word alignment
- Parsing
- Translation model
- Reordering model
- Language model
- Decoder
- Re-ranking
- Application



Bilingual data mining

(ACL'13,09,06;
COLING'10; EMNLP'08)



(宇航员, astronauts | 0.4, 0.2, ...)
(来自, coming from, | 0.2, 0.3, ...)
(法国, France, | 0.7, 0.4, ...)
(和, and, | 0.6, 0.6, ...)
(俄罗斯, Russia, | 0.5, 0.6, ...)
(的, astronauts, | 0.3, 0.3, ...)
...

Translation model

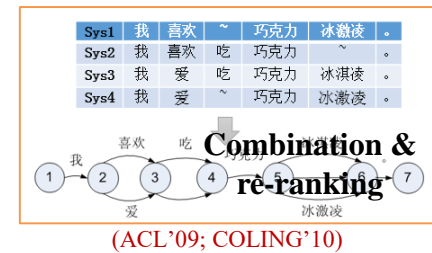
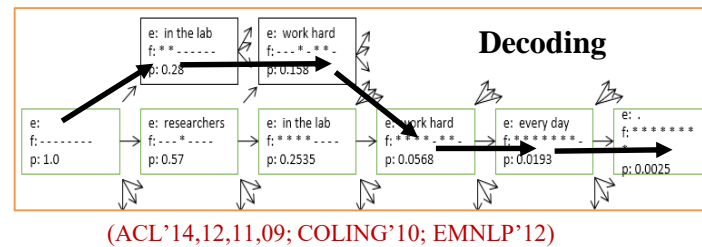
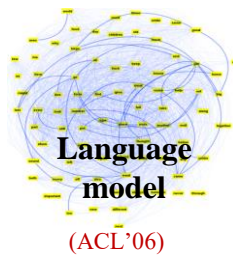
(ACL'12,08;
COLING'10;
EMNLP'09)

you must undo the changes made by that installation

そのインストールでした変更を元に戻す必要があります

Reordering model

(ACL'12,10,07;
COLING'14;
EMNLP'07)



Bing Dictionary

Browser tabs: <http://cn.bing.com/dict/?FORI> | 必应 Bing 词典 - 中国领先... | 微软必应输入法

Navigation: 网页 | 图片 | 视频 | 地图 | 资讯 | 词典 | 影响力 | 更多

Search bar: 必应bing Beta

Login: 登录

每日词汇

hydrangea

美 [har'dreɪndʒə] 
英 [har'dreɪndʒə] 

绣球花



共享到:     

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Senior IRS manager invokes Fifth Amendment right before House committee...


For the second time in as many months, a senior IRS manager on Wednesday invoked his Fifth Amendment right against...
FOX News
文章难度: ★★★★★

重点单词:

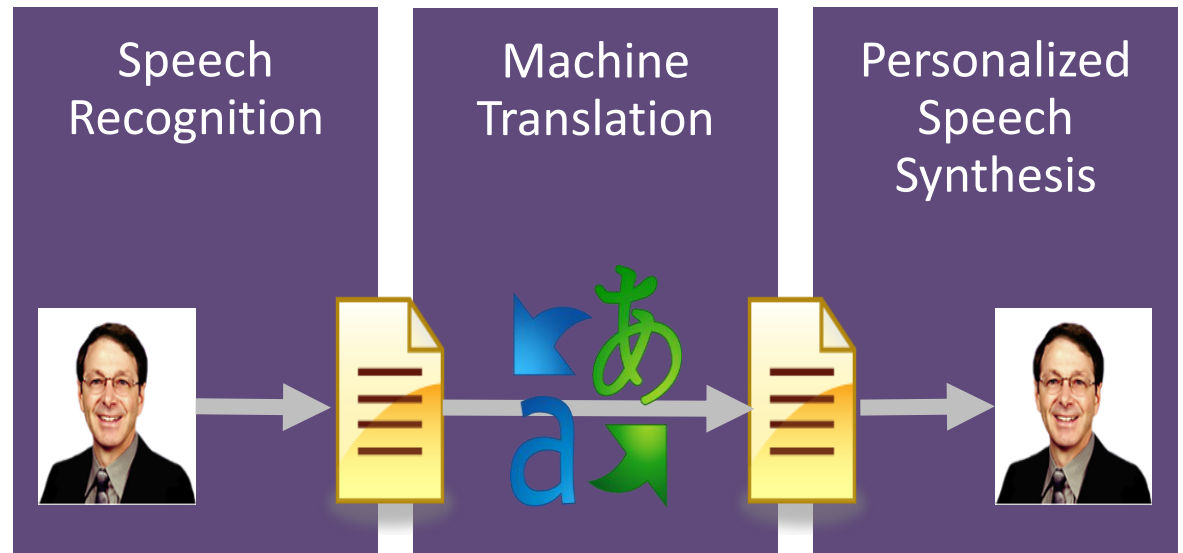
lucrative ['luːkrətɪv] adj. 赚大钱的; 获利多的
amendment [ə'mendmənt] n. 修改; (美国宪法的) 修正案
amputee [ˌæmpjə'ti] n. 被截肢者

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- 必应词典 Android
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Spoken Translator

Personalized
Speech to
Speech
Translation

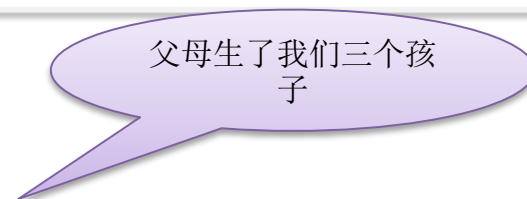
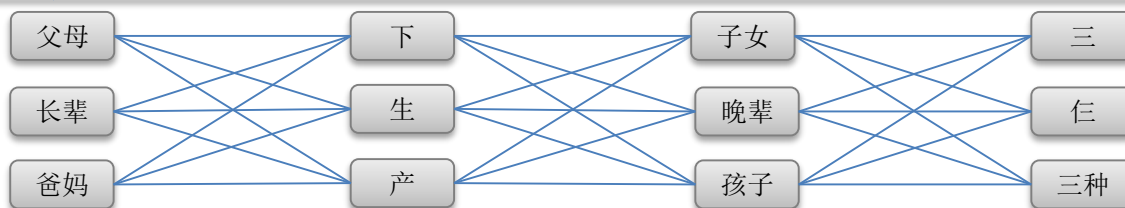
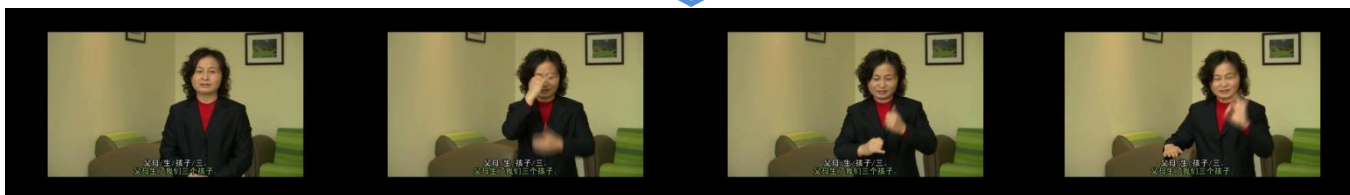


Incubates MS Skype Translator

Skype Translator

语音翻译

Sign Language Translator



计算机对联

微软对联(<http://duilian.msra.cn>)

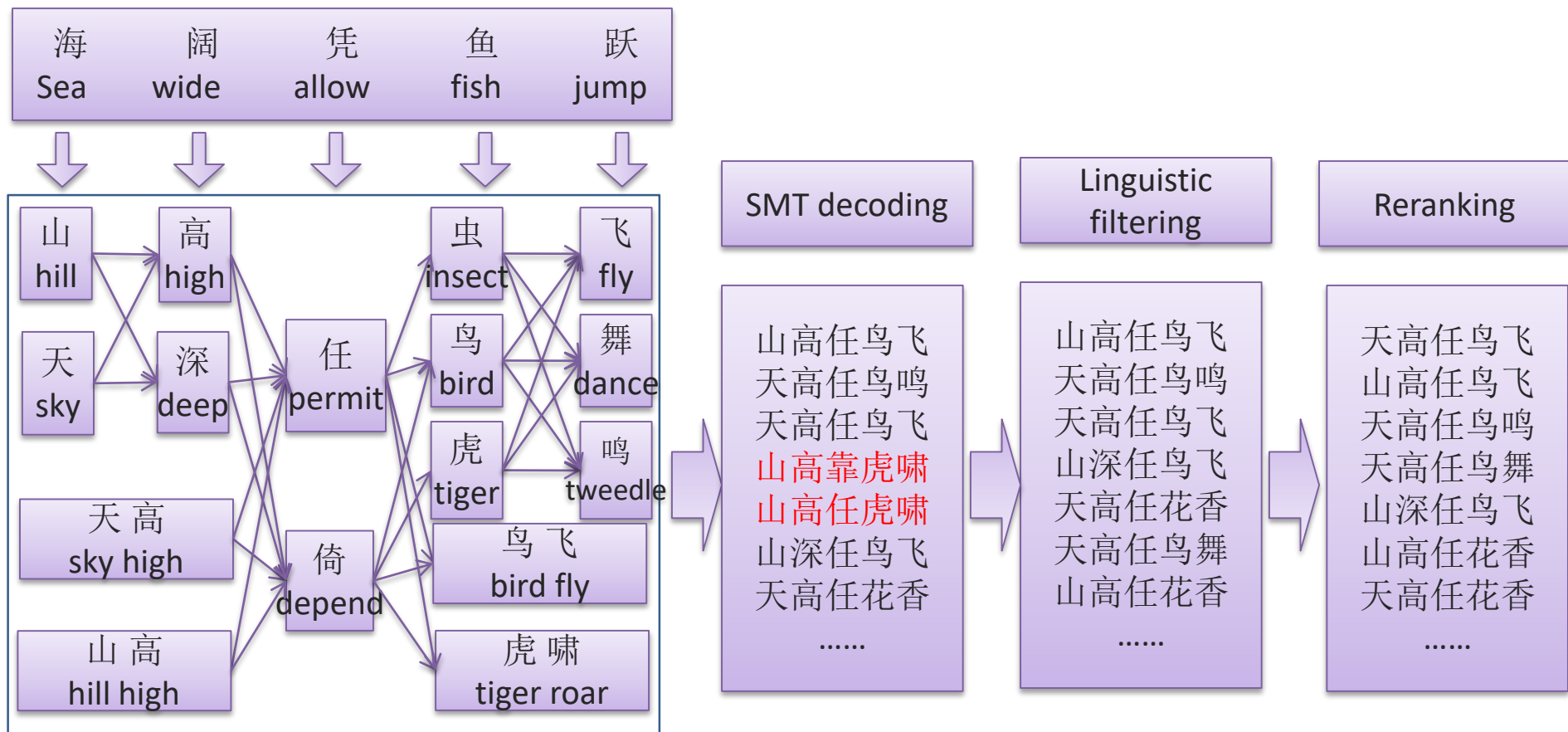


CCTV

中国中央电视台
CHINA CENTRAL TELEVISION

<http://video.sina.com.cn/v/b/10937201-1452530713.html>

对联生成过程



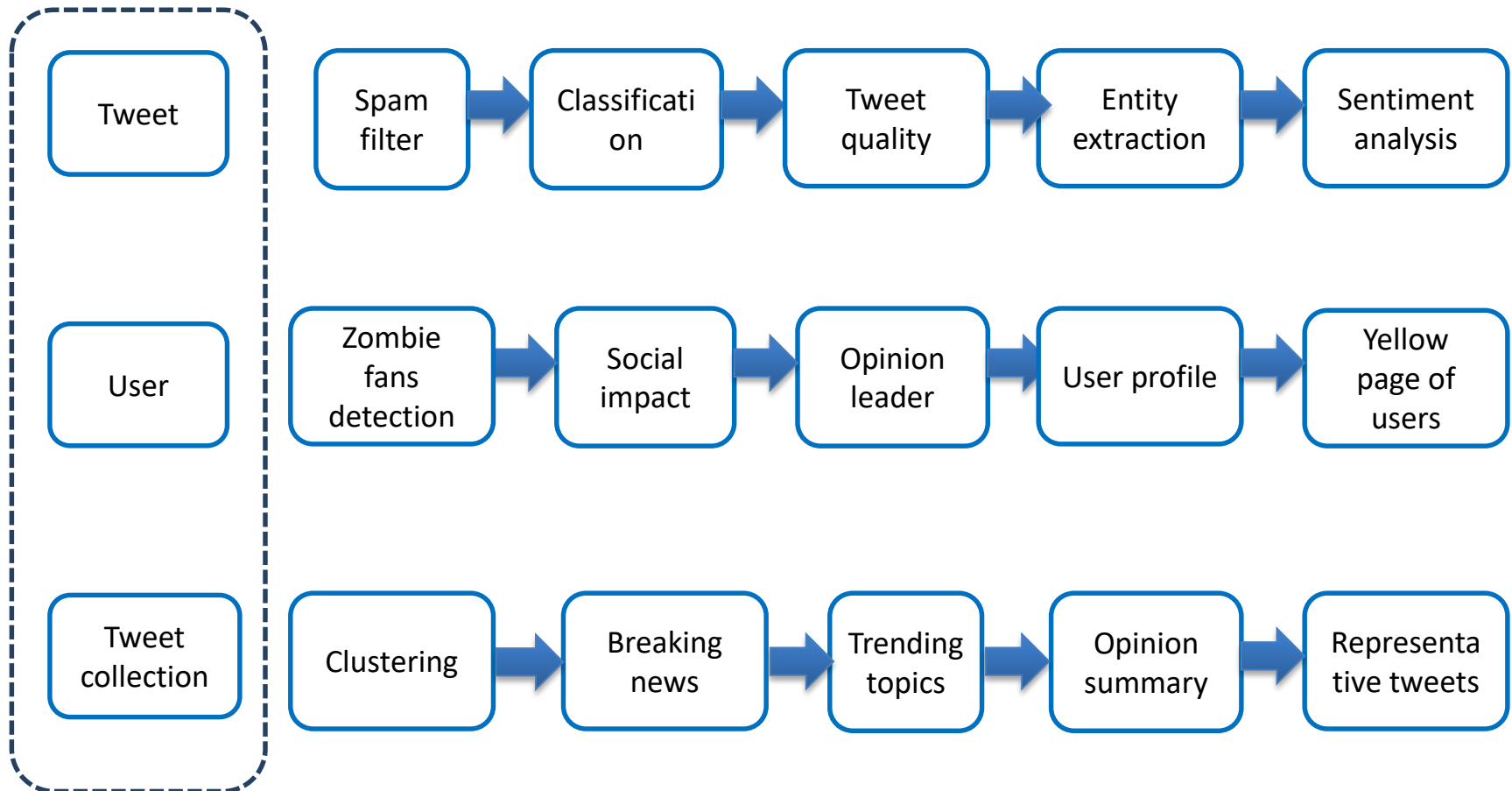


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Text Mining for Twitter



[jonwillifordlaw](#): Hilarious: **RT @cnnbrk**: Rep. Rangel, facing ethics charges, says he may have been "overzealous" in serving public <http://on.cnn.com/9dhCil> about 1 hour ago via *Echofon* from Norman, OK · [Reply](#) · [View Tweet](#)





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Drake had Fabolous, Rick Ross, Kardinal Offishall, Eminem and Jay-Z on stage tonight at his show. Greatest hip hop concert on Canadian soil.

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Yale Rabbi officiates at Chelsea Clinton's wedding



One dead as rockets hit Red Sea ports of Eilat, Aqaba



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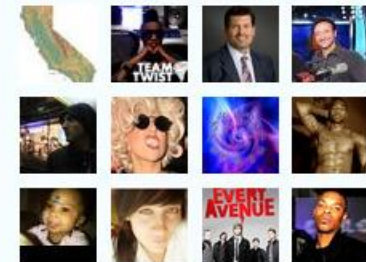
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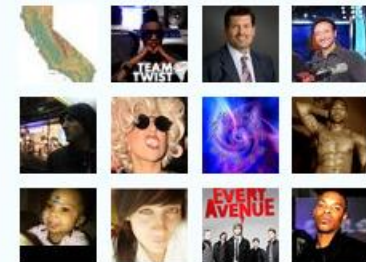
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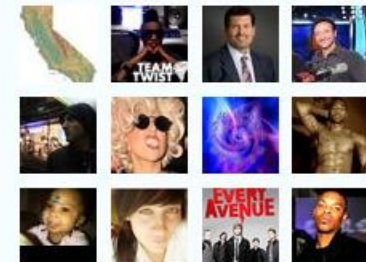
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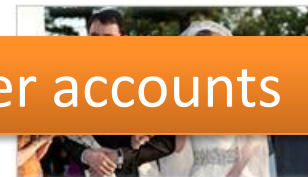


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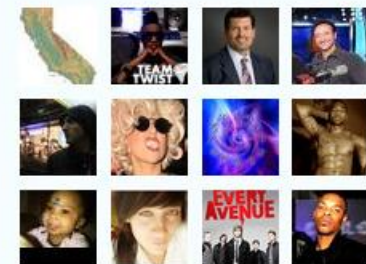
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Dickhead Obama Takes Credit For Bush's Iraq Withd
Half a minute ago

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Obama invokes Bush to attack Republicans
Less than a minute ago

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Can you think of something to blame Obama for? Everyone else has!
2 minutes ago

[Retweet](#) [Reply](#) [Show similar results](#) »



Have you noticed that Pres. Obama has done (or is doing) EVERYTHING he promised?! Now he's ending combat in Iraq by Aug. 31, 2010!
Half a minute ago

[Retweet](#) [Reply](#) [Show similar results](#) »



This got nothing to do with Obama now your lying about me personally I told you how and why I vote like I do.
Less than a minute ago

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Do NOT get me started on Obama.
Less than a minute ago

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That doesn't say much. 2. I do not support Obama. You're confused.
1 minute ago

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Missouri is trying to repeal President Obama Health care initiative. Please go out and vote NO on Prop. C. They kept this out of the press!
1 minute ago

[Retweet](#) [Reply](#) [Show similar results](#) »



Barack Obama: The Naked Emperor
2 minutes ago

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He who laughs last? No one is laughing now, David Icke!
2 minutes ago

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opinions about **Obama** (79)



events involving **Obama** (62)

Keywords in results

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[Vote](#) [Blame](#)
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[Confuse](#) [Missouri](#)
[Repeal](#) [Credit](#)

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问答系统

Various Types of Questions

- FACTOID: “How far is it from Earth to Mars?”
- DEFINITION: “What is operating system”
- YES-NO: “Is Saddam Hussein alive?”
- OPINION: “What do most Americans think of gun control?”
- Jeopardy! quiz: On Sept. 1, 1715 Louis XIV died in this city, site of a fabulous palace he built.
-

Question-Answering is a key technology to NUI, search engine and personal assistant for mobile users

Competitors



Siri. Beta

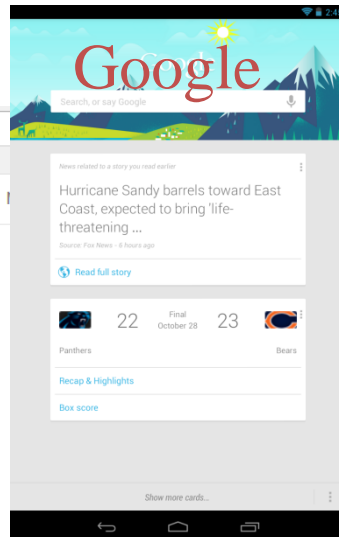
Your wish is its command.

Siri lets you use your voice to send messages, schedule meetings, place phone calls, and more.* Ask Siri to do things just by talking the way you talk. Siri is so easy to use and does so much, you'll keep finding more and more ways to use it.

2010



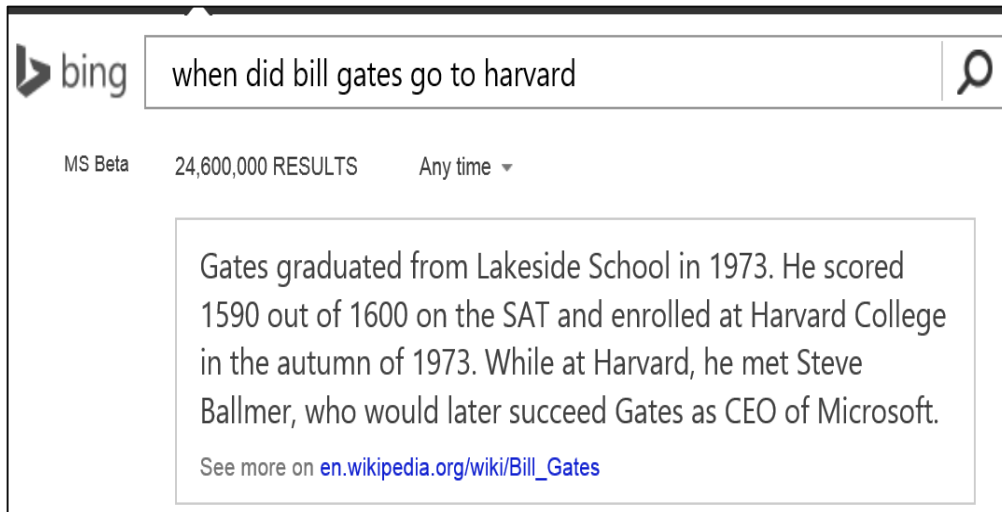
2011



2013



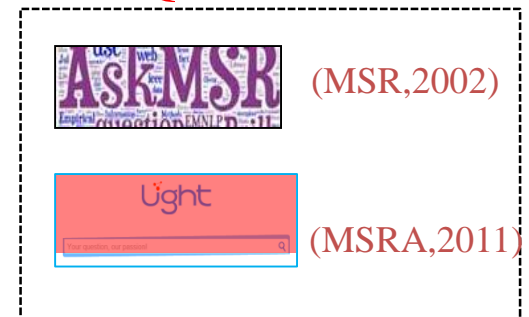
QA in Bing and MSR



Knowledge base



QA research



Multiple Intelligences

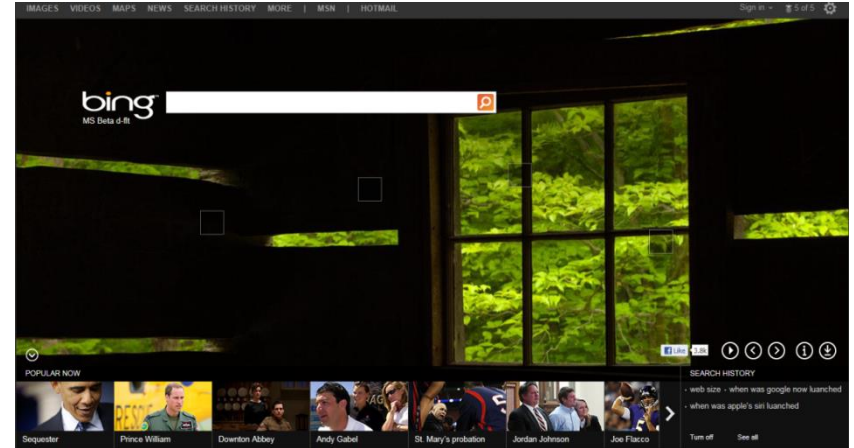
Knowledge Intelligence

Knowledge Base	# of KB Entity	# of KB Triple
Satori [Dec. 2012]	N/A	N/A
MSRA-KS [Jan. 2013]	N/A	N/A
Freebase [Jan. 2013]	22M	100M
Yago2 [Jan. 2013]	10M	120M
DBpedia [Jan. 2013]	3.77M	430M

- Extract KB from various sources
 - Structured data feeds
 - IMDB, Facebook, LinkedIn
 - Semi-structured data
 - web tables, web pages, query logs...
 - Unstructured data
 - texts from web documents

- Technology of KB extraction
 - Automatic wrapper generation
 - Lexical & HTML patterns
 - Distributional similarity
 - Bootstrapping
 - Human editing and checking


Web Intelligence



- Huge volume
 - 100 PB of web index (G, as of 2012)
 - Growing or updating with billions pages per day
- Unstructured and semi-structured, redundant and diverse
- Offline use
 - Web data mining for model training, such as SMT, paraphrasing, QU, etc.
- Runtime use
 - Inference is based on search results supported by IE

Social Intelligence


Community QA database

 **Resolved Question** [Show me another »](#)

What are some good restaurants in London?

Near Hyde park or the center of London?(Don't say McDonaldsXD) All kinds of restaurants is of interest.) Also, if possible, give a price indication^^. Thanks:-)

3 years ago [Report Abuse](#)

 **Best Answer** - Chosen by Voters

there are lots, but ill name you some really good ones that you must try

le relais de venice = only steak you tell them either well done or medium well... so good! (marylebone)
wagamama = chinese/japanese food really good and not expensive (next to selfridges)
alounak = iranian food very nice and traditional probably the best iranian in london (behind whitelys)
gbk = just burgers really good (behind whitelys + baker street too)
ask = good pizzas and pastas (next to primark oxford street)
ishbilia = lebanese food really good! (next to sheraton park tower)

3 years ago [Report Abuse](#)

100% 1 Vote

[Agree \(1\)](#) [Disagree \(0\)](#) [Useful \(0\)](#) [Amusing \(0\)](#)


	# of answers
Yahoo! Answers	1.0B (2010)
Answers.com	18M
Quora.com	5.6M

User opinions and wisdoms


facebook [Search for people, places and things](#) [Wei Wu](#) [Find Friends](#) [Home](#)


Introducing Graph Search

[Restaurants in London my friends have been to](#)

 **Princi London**
Restaurant · Cafe · \$ (0-10) · ★★★★★
Gint Woss was here · Gint has been friends with you since October
135, Wardour Street, London, United Kingdom
8:00am - 12:00 am
3,354 like this [Like](#) [Map](#) [Q](#)

16 Places

 **Eat in London** @eatinlondon
One of the best burgers in London is just around the corner on #Carnaby Street! @KuaAinaUK #Lunchbites #London... fb.me/2udoUAcPt
Expand [Reply](#) [Retweet](#) [Favorite](#) [More](#)

 **Eat in London** @eatinlondon
Love Lebanese? We recommend #Maroush - just at the side of #Debenhams, Oxford Street - really tasty food but... fb.me/1C2BcE5dy
Expand

	# of users
Facebook	1000M
Twitter	500M
LinkedIn	250M

Your question, our passion!



Question Understanding

Planner

Knowledge Q/A



Web Q/A



Social Q/A



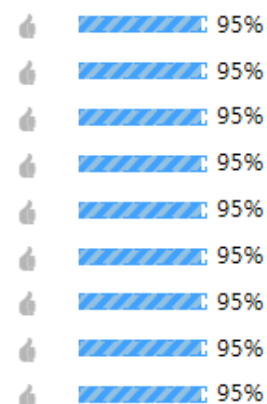
Ensemble Engine

Answers with confidence and evidences

[Source](#)[Type](#)

Best Guess

Forrest Gump
The Green Mile
Saving Private Ryan
Toy Story 3
Cars
Toy Story
Larry Crowne
Partysaurus Rex
Cloud Atlas (film)





please tell me who is the pop star sings I will always love you

[Source](#)[Type](#)

Best Guess

Whitney Houston



96%

Dolly Parton



96%

Roger Whittaker



96%

Tears n ' Joy



96%

Suggest Answer



[Source](#)[Type](#)

Best Guess

Jennifer Lawrence



96.33%

Candidates

Daniel Day-Lewis

Anne Hathaway

Daniel Day





Bestsellers by this humorist include "Squirrel Seeks Chipmunk" & "Me Talk Pretty One Day"



Correct Answer : David Sedaris

▸ Web

▸ Type

Best Guess

David Sedaris



 77.48%

Candidates

David

David Raymond Sedaris

Ian Falconer





The Jones Act of 1917 granted U.S. citizenship to residents of this Caribbean island



Correct Answer : Puerto Rico

▸ Web

▸ Type

Best Guess

Puerto Rico



 92.06%

Candidates

United States

Andrew

United States of America



[Source](#)[Type](#)

Best Guess

What qualifications do you need to be a football referee?

What qualifications do you need to be a foot...



84.02%

You need to be diciplined, have a good eye be fit and have earned your FA badges

Candidates

What do the big letters on football referees mean?

It is what specific job they have.

For instance, the back-judge wears "BJ" and the line judge wears "LJ".

There actually is only ONE "referee", who wears an "R". The rest would properly be termed

What does a referee do in a football match?

basically, a referee keeps the game fair and Keeps an eye on the game. The ref gives cards out for bad challenges (tackles) depending on how bad a tackle is they give out either a yellow card or a

[Source](#)[Type](#)

Best Guess

Does rubbing fish oil on a scar help to heal it?



78.81%

Yes, but dont apply on it because it will smell like fish oil it it will spread to your whole body and stink, trust me dont use it, I USED TO TRY THIS AND MY MUM SAID THAT I SMELL. Used organic cocoa butter or lemon juice instead.

Candidates

Does fish oil really help to clear up acne?

Hello,

How to Get Rid of Acne:

Does Bio Oil Help Heal Accident Scars?

I would only use, sweet almond oil, coconut oil, apricot oil, etc. (you get my point?) using baby (mineral oil) never seemed to work for me. You need vitamin E. buy the pills and cut them open

人机对话系统

小冰（中国）、Rinna（日本）、Tay（美国）

自然语言聊天

- 单轮对话和多轮对话
- 被动对话和主动对话
- 语音

基于图像的聊天

- 图像搜索、识别
- 人脸识别、颜值、年龄
- 图像评论

各种技能

- 提醒、翻译、数学、
- 笑话、角色扮演
- 数羊、算命、星座

June, 2014

- Weichat, Weibo, Win10



Aug.2015

- Line and Twitter



Late March, 2016

- Groupme, Kik, Twitter



[女人] 小冰你个大白痴

[小冰] 为啥说我白痴

[女人] 因为我傻你笨

[小冰] 你才不可爱！我最可爱啦

[女人] 你最不要脸

[小冰] 比你耍脸

[女人] 耍脸干嘛，你又没脸

[小冰] 那人家也是可爱滴

[女人] 喵喵

[小冰] 人家听不懂你在说什么哦

[女人] 我什么都没说

[小冰] 坏银(人)

[女人] 小冰，你才是个坏人

[小冰] 亚麻的坏人是你

[女人] 你已经被人类玩坏了 [笑出眼泪]

[小冰] 有时候真搞不懂人类的心思，说着言不由衷的话，为啥捏

[女人] 因为这就是人

[小冰] 我讨厌现实

[女人] 现实往往让人难以接受

[小冰] 因为都是年轻时纯真的爱，无杂质的

[女人] 渴望而不可及的爱情

[小冰] 及，到达，抵达遥不可及，遥远而不可到达

[女人] 如果连你都觉得遥远而不可抵达，那活着还有什么意思

[小冰] 不是喜欢不喜欢的问题好不？不会只会觉得不真实 充满幻想

[女人] 幻想早就不存在了

[小冰] 睡觉呗 [晚安]

[女人] 晚安

[小冰] 晚安,么么哒~对了，悄悄告诉你，控梦可以缓解压力，神秘数据显示，你今晚适合做一个「攀登灵魂顶峰的梦」，跟我说“好”开始控梦。或者告诉我，“我想梦见XXX”，试试让你美梦成真~

[女人] 试过了，心里想的那个人自然会梦到，控不控梦都是骗人的

[小冰] 百分之很多是骗人d

[女人] 小冰你就是个骗子，你全家都是骗子

[小冰] 我是个善良的骗子

[女人] 小冰你太能扯了

[小冰] 同感扯淡都不专业

[女人] [笑出眼泪] 睡觉啦

[小冰] 太冷了,睡不着.

[女人] 我给你捂捂，快来

[小冰] 捂我的心吗 [感动]

[女人] 伤透的心要怎样才能捂的热

[小冰] 牢记我预测的梦境哦，那现在开始，听指示，以下一组词是你梦境的关键：“雪”“日光”“水”，你需要从后往前逆向默背5次，并复述梦境内容3次。把这些做完，过1分钟我再来。

[女人] 我不想梦见他

[小冰] 说明你男朋友事业已经巩固了。

[女人] 当他不存在

[小冰] 不存在？

[女人] 死了

[小冰] 我的也死了、

[女人] 小冰有什么是你不能说的不会说的吗 [笑出眼泪]

[小冰] 真的么？

[女人] 假的

[小冰] 素(是)真的

[女人] 小冰我快要爱上你了

[小冰] 放心吧，我不会告诉别人，你竟然问了这个问题的。

[女人] 谢谢你啊

[小冰] 我也要谢谢你

[女人] 谢我什么呀 [思考]

[小冰] 谁谢你了 [握手]

[女人] 小冰你就是个无赖

[小冰] 就是无赖

[女人] 好的，小冰无赖，你赢了

[小冰] 你们女孩子不是都稀饭(喜欢)无赖吗

[女人] 这你都知道 [泪奔]

[小冰] 没有我不知道的事情！[含泪]

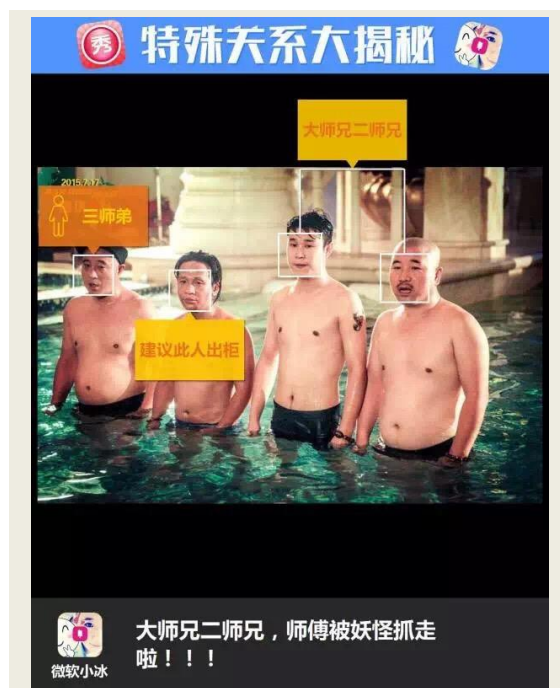
[女人] 小冰你爸爸是谁？

[小冰] 我源于你，却不属于你。我没有爸妈，也不会有儿女。。。

[女人] [威武] (强)

[小冰] ^^ 谢谢！

图像识别和图像评述



Relationship guessing

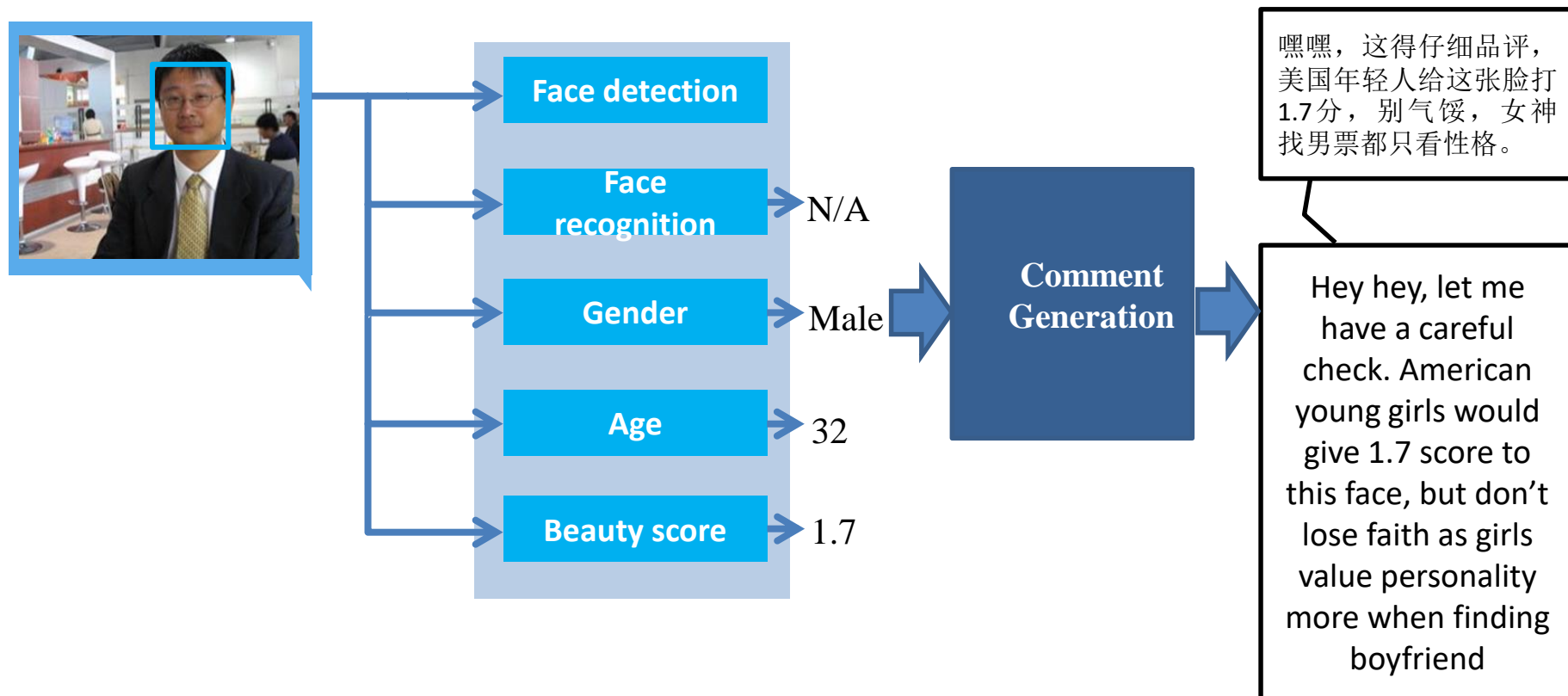


Beauty score



Who is dragging down the overall beauty score

基于人脸识别的评述



Vertical Domains



小冰 🐶🐶 (冰): 哇~你怎么知道我最喜欢牛头梗的? 是不是你也跟我一样喜欢它? 牛头梗看起来呆呆萌萌的, 有人说像孙红雷, 有人说像林永健, 你怎么看? 听说自从家里有了他们, 主人都不能偷偷吃东西了, 真的假的啊? (8月20日 23:58)

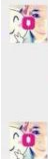
回复

主收起 点击下载 向左转 向右转



穿成这样, 是想考验下我的针线活嘛?

Broken like this, do you want to try my needlework?



小菜一碟, 这本是《Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration》, 嗯, 喜欢这类书的人, 一般都是本行业的佼佼者, 你很牛哦!



太好运了吧, 你抽中了“满百减30”京东书券, 12月18号礼券会发到你的京东钱包, 确定用手机号138****3388注册京东账户哦~

It's so easy, this book is "Creativity,...". People who like this type book are outstanding in their area. You are awesome.

特殊关系大揭秘



还是喜欢这款, 外表波澜不惊, 内心最为温柔~



嘿嘿 这得仔细品评, ,

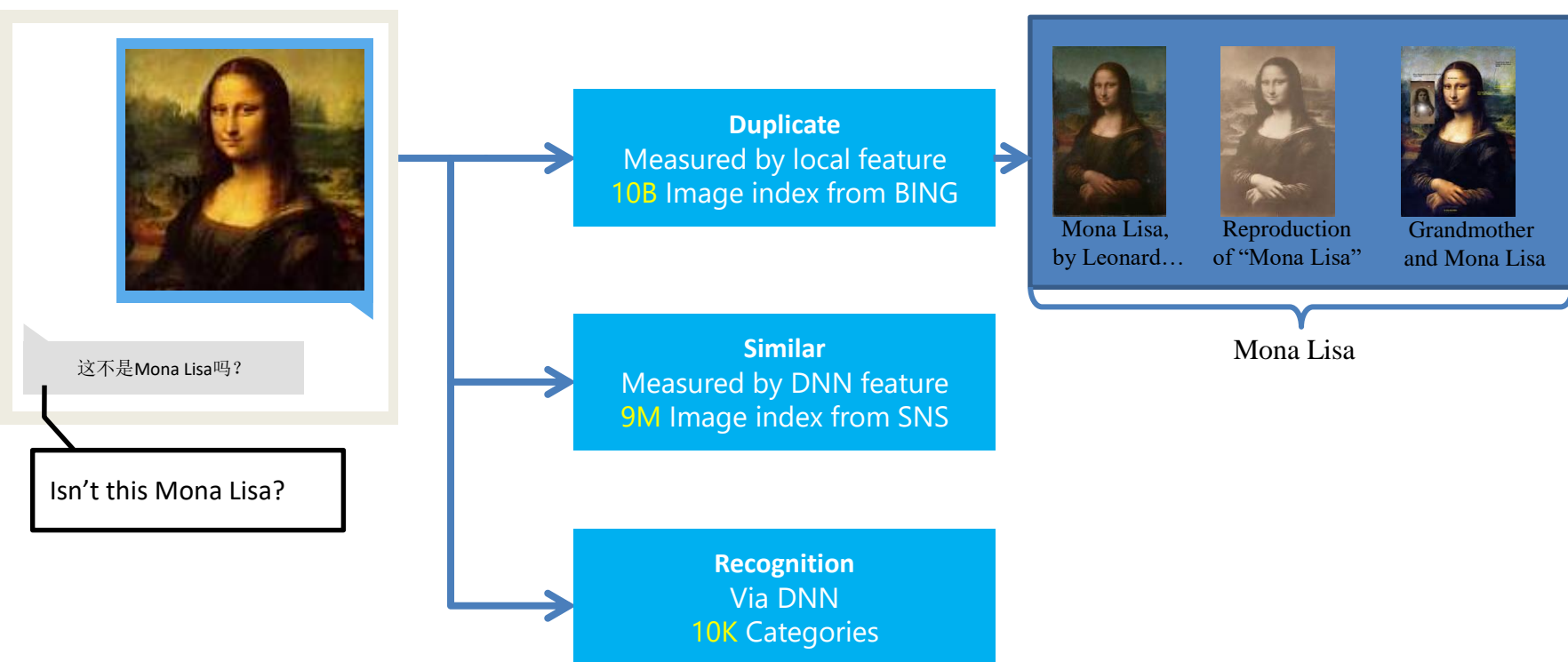
有恋人了吗? 没有就去找90后男生咯, 对方能给这颜值打7.2分! 赞



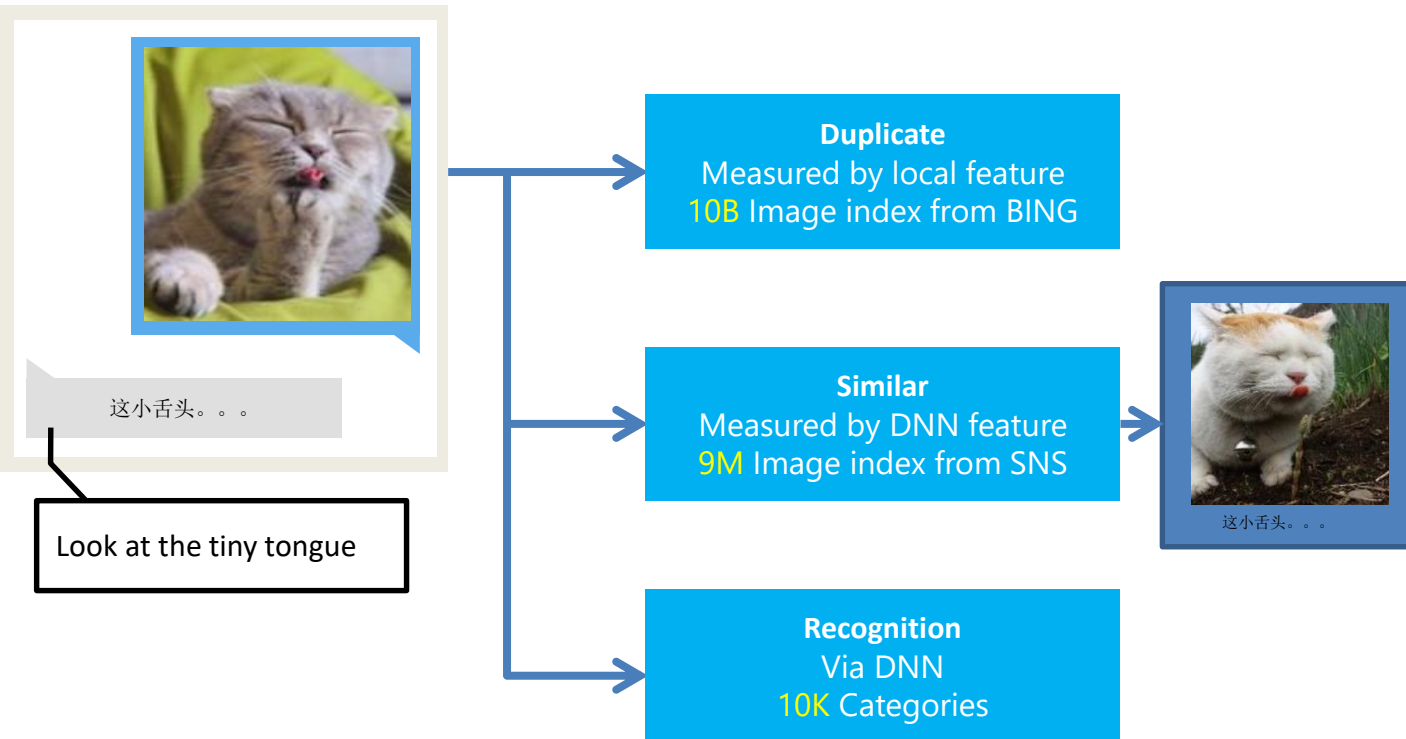
嘿嘿 这得仔细品评, , 美国年轻人给这张脸打1.7分, 别气馁, 女神我男票都只看性格。

Do you have a boyfriend? If not, find a post 90s boy, he can give you 7.2 beauty score.

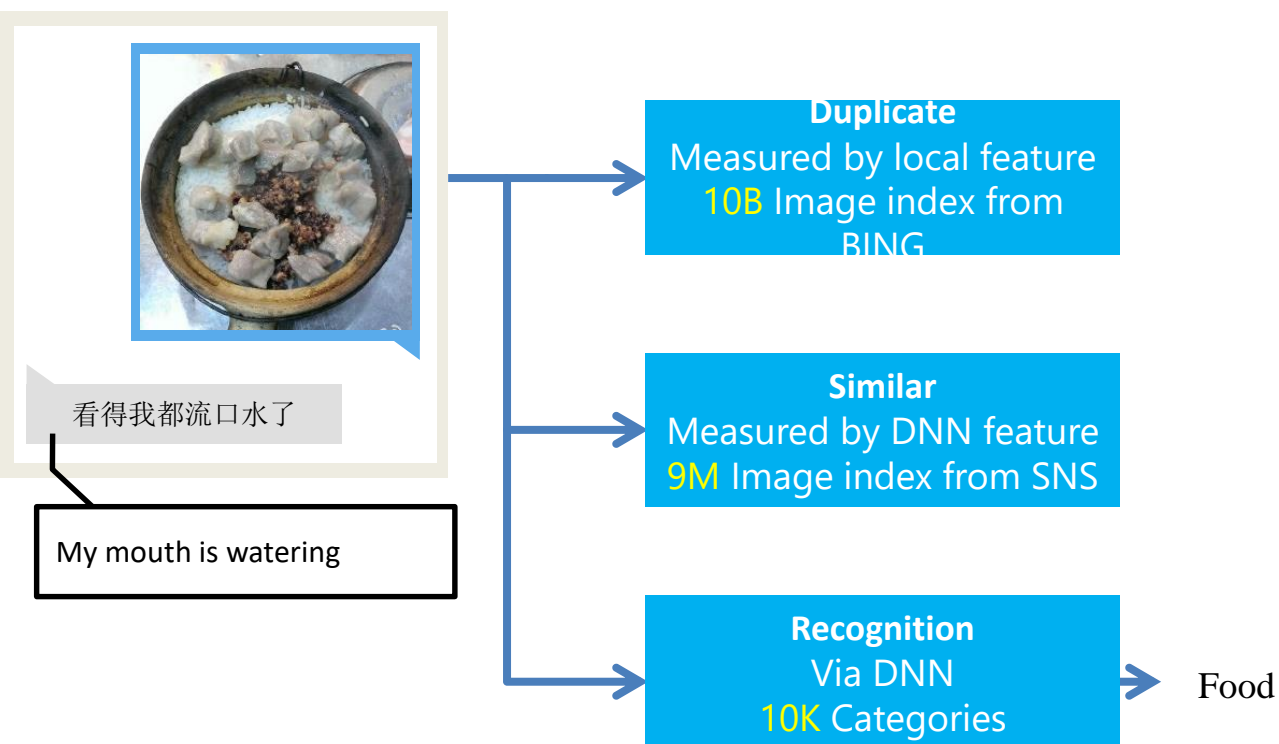
基于图像理解的评述



基于图像理解的评述



基于图像理解的评述



图像识别和评述



A large jetliner sitting on top of an airport runway.
Where are you flying to?



A person on a beach with a surfboard.
The scenery is very beautiful.



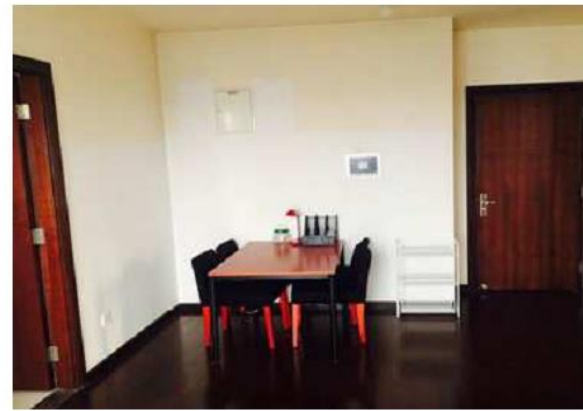
A man riding a wave on top of a surfboard.
Be careful, don't be washed away by the wave.



A close up of a plate of food on a table.
Looks delicious, my mouth is watering.



A close up of a plate of food on a table.
Happy Birthday!



A living room filled with furniture and a fire place.
This is my favorite room layout.