

大数据人工智能

余凯



WHAT THE WORLD IS GOING TO PLAY.

[See the top 50 upcoming games ▶](#)



Baidu is a fixture of online life in China, but it wants to become a global power. Can one of the world's leading artificial-intelligence researchers help it challenge Silicon Valley's biggest companies?

A Chinese Internet Giant Starts to Dream

2014年8月14日，麻省理工学院科技评论杂志介绍百度的人工智能之梦

自诞生第一天起，百度就是一家人工智能公司



搜索数据
Mega Data

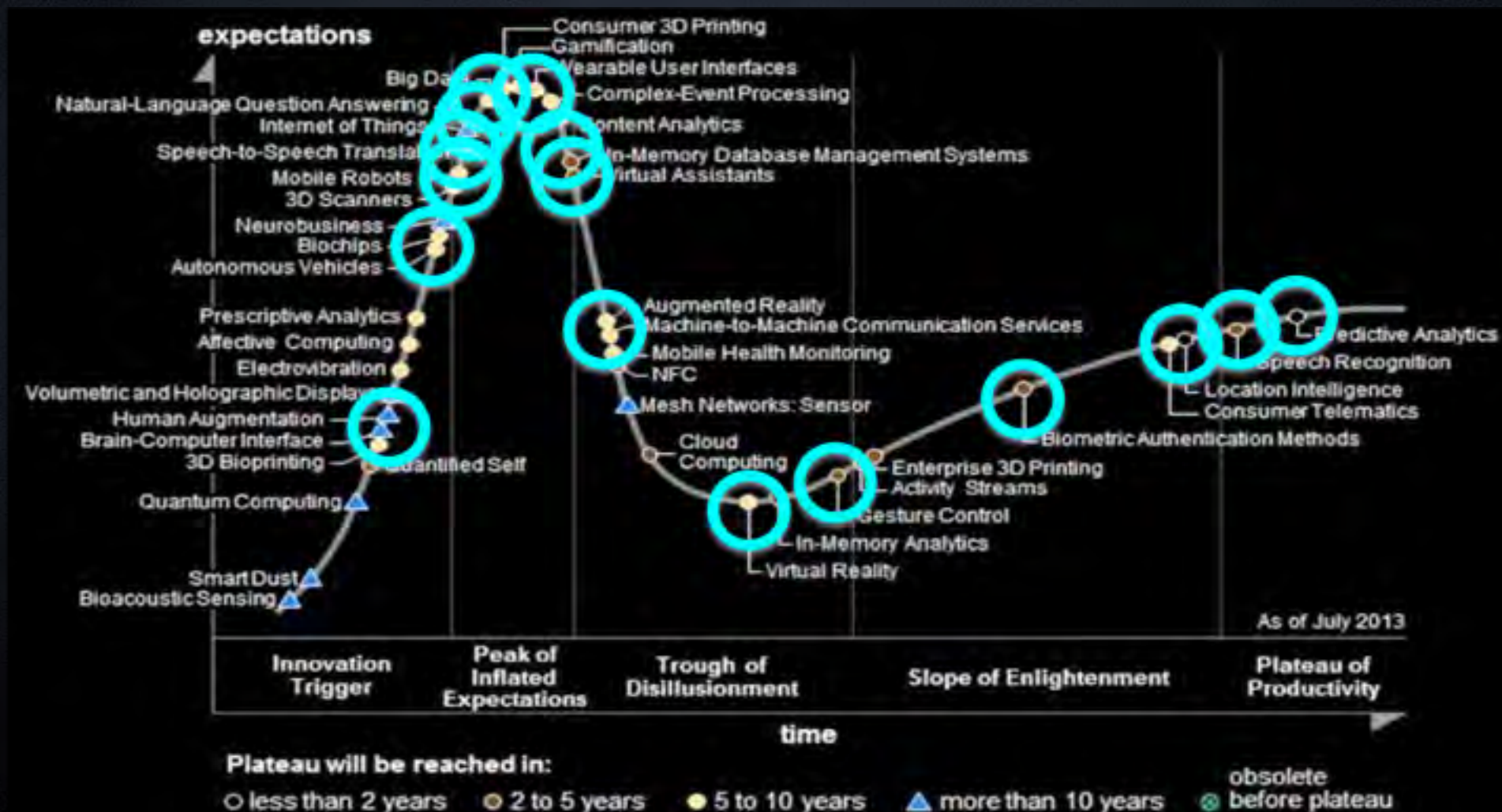


大数据人工智能
Data - driven AI



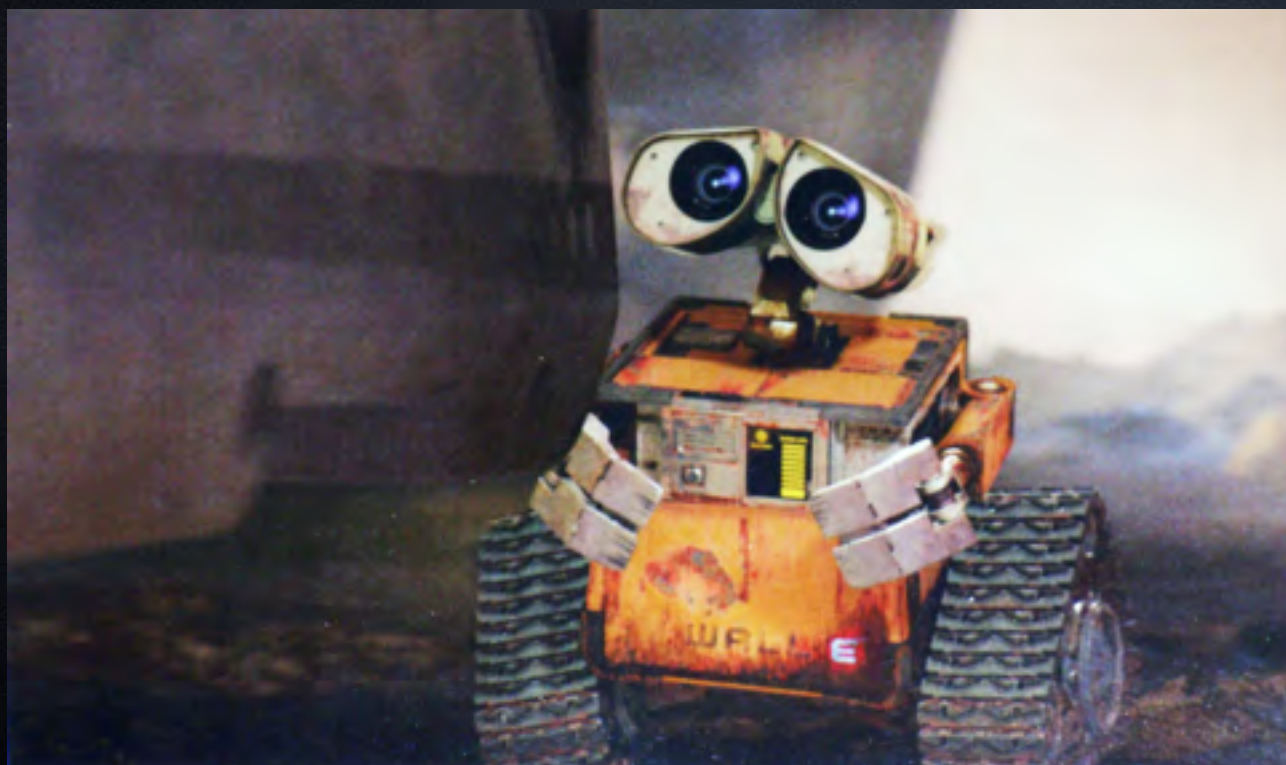
商业价值
Monetization

人工智能，正在成为科技创新的主战场





什么是
人工智能？



感知
思考
控制

无处不在的“智能XX”

智能手机



智能手表



智能水杯



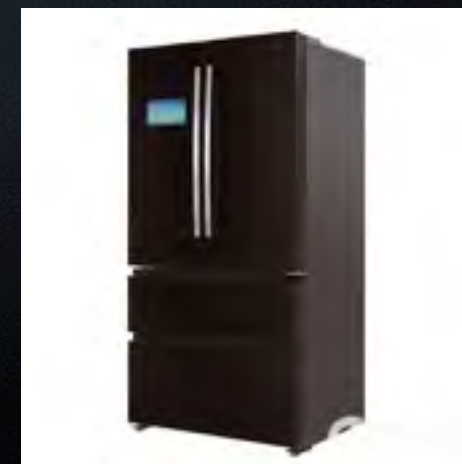
智能汤匙



智能手环



智能冰箱



如何区分这些产品是否真的智能？



VS.



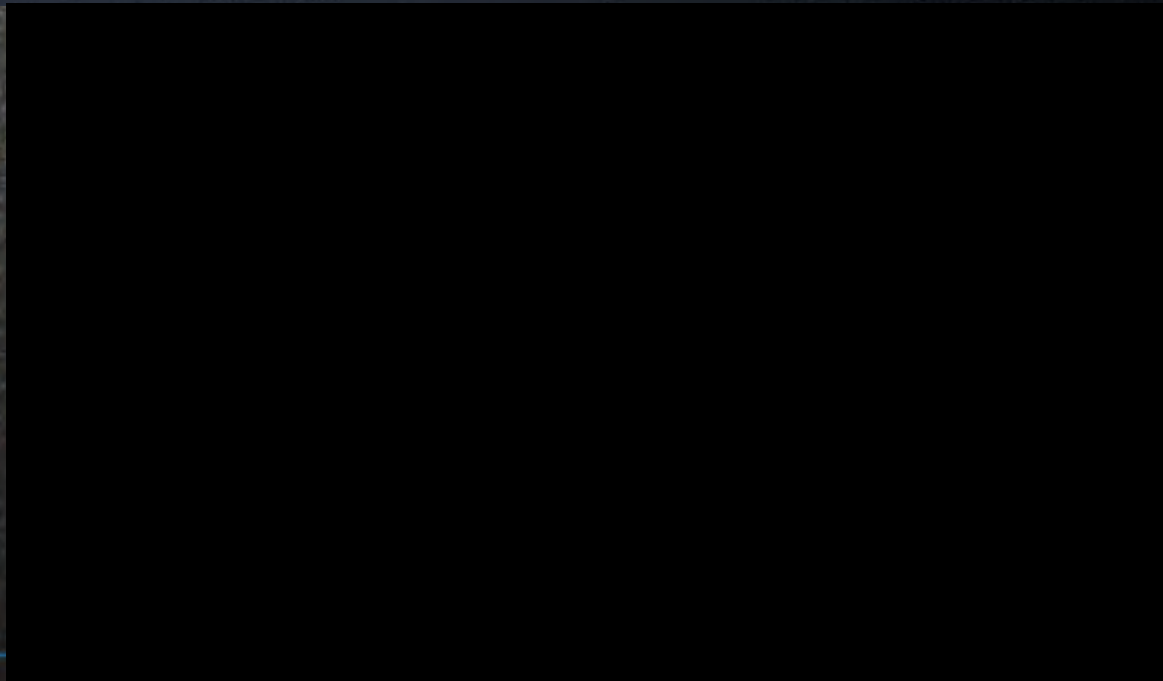
随着经验演化，越变越聪明



学习的能力，是智能的本质！

一个时代正在来临

移动设备上的摄像头，逐渐成为人类眼睛的延伸



移动设备上的摄像头，逐渐成为人类眼睛的延伸



移动时代 万物互联

260亿 互联设备



万物互联 数据暴增

40ZB 数据量

2004 2006 2008 2010 2012 2014 2016 2018 2020

数据来源: IDC



万物互联

万物智能

大数据时代



深度学习为2013年十大技术突破之首

The screenshot shows the MIT Technology Review website's '10 Breakthrough Technologies 2013' page. The navigation bar includes 'HOME', 'MENU', 'CONNECT', 'THE LATEST', 'POPULAR', and 'MOST SHARED'. The main header features the MIT Technology Review logo and the title '10 BREAKTHROUGH TECHNOLOGIES 2013'. Below the title are links for 'Introduction', 'The 10 Technologies', and 'Past Years'. The main content area is a grid of 10 technology categories, each with a title and a brief description:

- Deep Learning**: With massive amounts of computational power, machines can now recognize objects and translate speech in real time. Artificial intelligence is finally getting smart.
- Temporary Social Media**: Messages that quickly self-destruct could enhance the privacy of online communications and make people freer to be spontaneous.
- Prenatal DNA Sequencing**: Reading the DNA of fetuses will be the next frontier of the genomic revolution. But do you really want to know about the genetic problems or musical aptitude of your unborn child?
- Additive Manufacturing**: Skeptical about 3-D printing? GE, the world's largest manufacturer, is on the verge of using the technology to make jet parts.
- Baxter: The Blue-Collar Robot**: Rodney Brooks's newest creation is easy to interact with, but the complex innovations behind the robot show just how hard it is to get along with people.
- Memory Implants**
- Smart Watches**
- Ultra-Efficient Solar Power**
- Big Data from Cheap Phones**
- Supergrids**

深度学习迅速影响了最前沿的高科技公司

Google



Microsoft



Facebook



百度IDL—中国第一家深度学习研发机构



- ◆ 百度历史上第一次成立研究院
- ◆ Institute of Deep Learning (IDL)
- ◆ 聚焦大数据驱动的人工智能



国际上最早把深度学习上升为战略技术方向的四家公司的之一

世界领先的

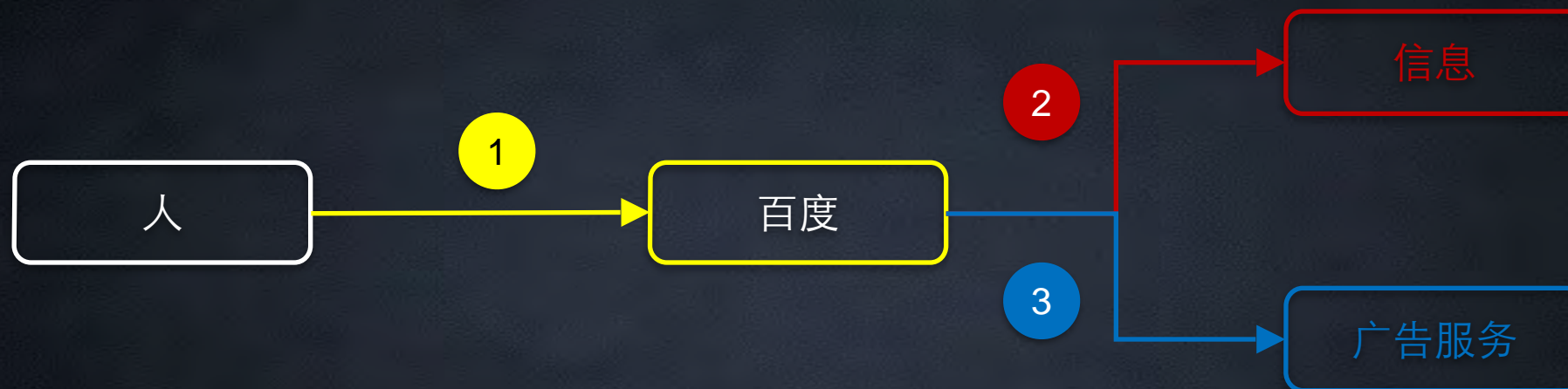
深度学习算法：
语音识别，图像识别，
自然语言理解，广告精
准匹配，用户建模，
...



无时无刻
在学习和演进

百亿级参数
构建世界上最大规模
深度神经网络

百度大脑，让连接变得更智能



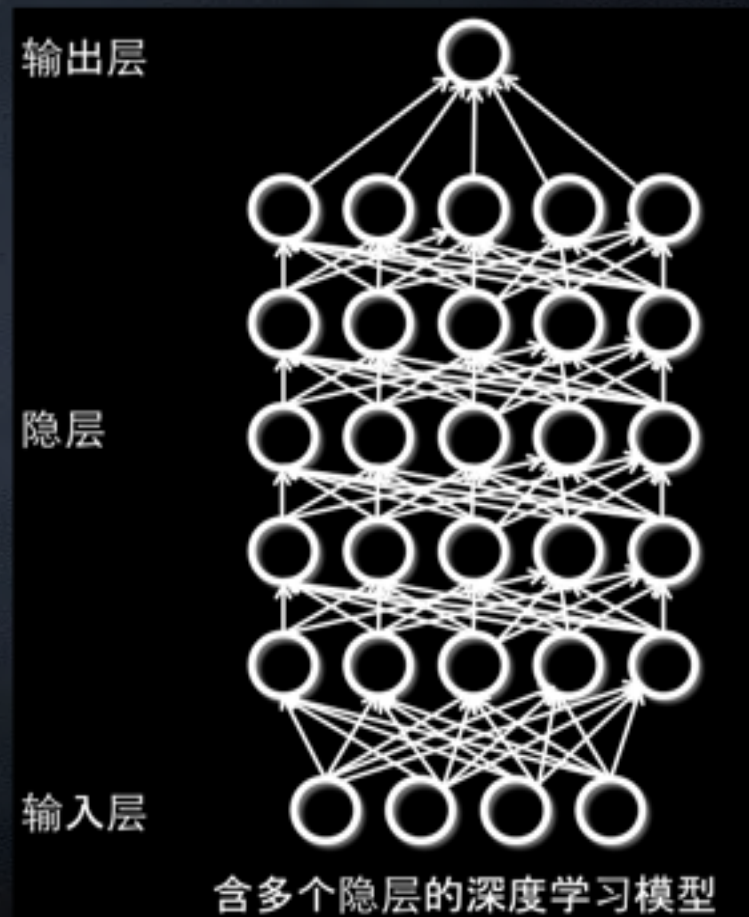
1. **理解用户意图**：文本分析，图像识别，语音识别，...

2. **匹配用户需求**：优化搜索结果的人工智能排序，...

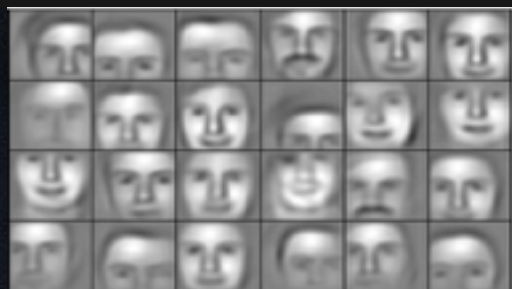
3. **精准推送广告和服务**：估计和优化点击率和转化率，...

为什么深度学习受到重视?

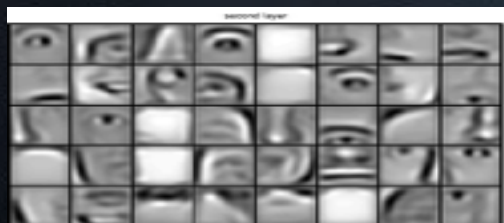
- 模拟大脑的行为
- 特别适合大数据
- End-to-end学习
- 提供一套建模语言



模拟人类大脑的分层结构以及行为



整个物体



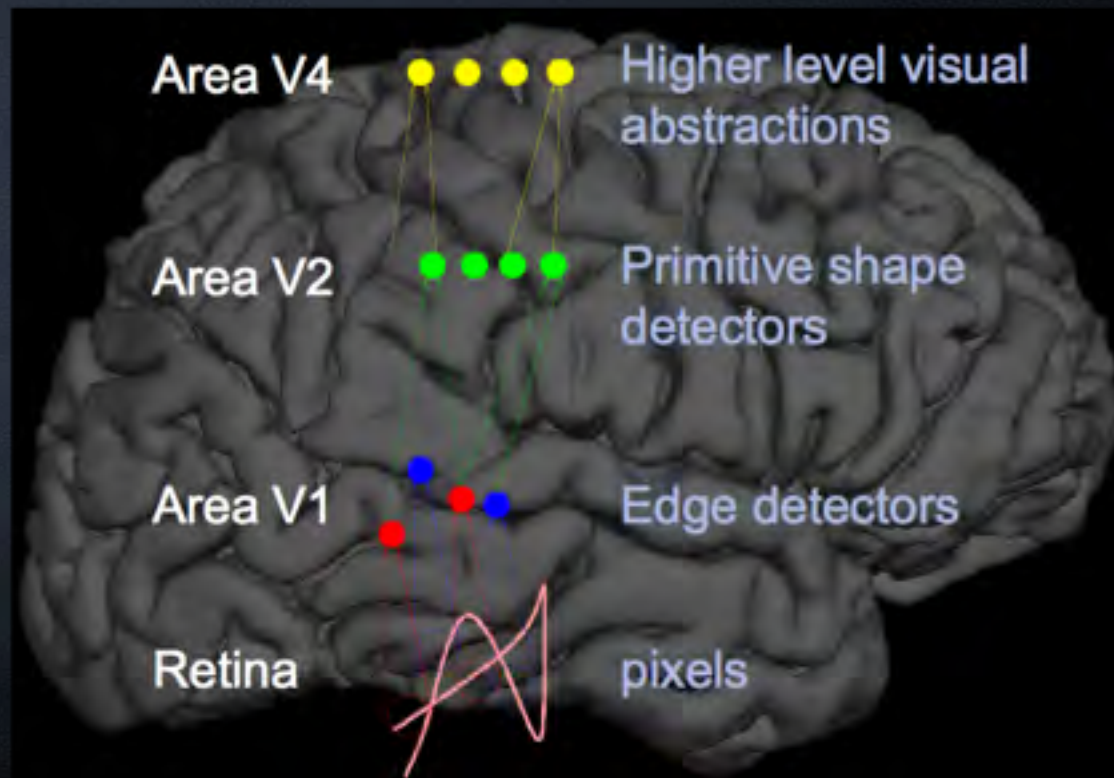
物体的各个部位



不同方向的边界



图像像素



统计和计算方面的原因

$$\text{推广误差} = A + E$$

- Approximation error – model class
- Estimation error – data size

统计学习理论的范畴 – 假设无限计算资源

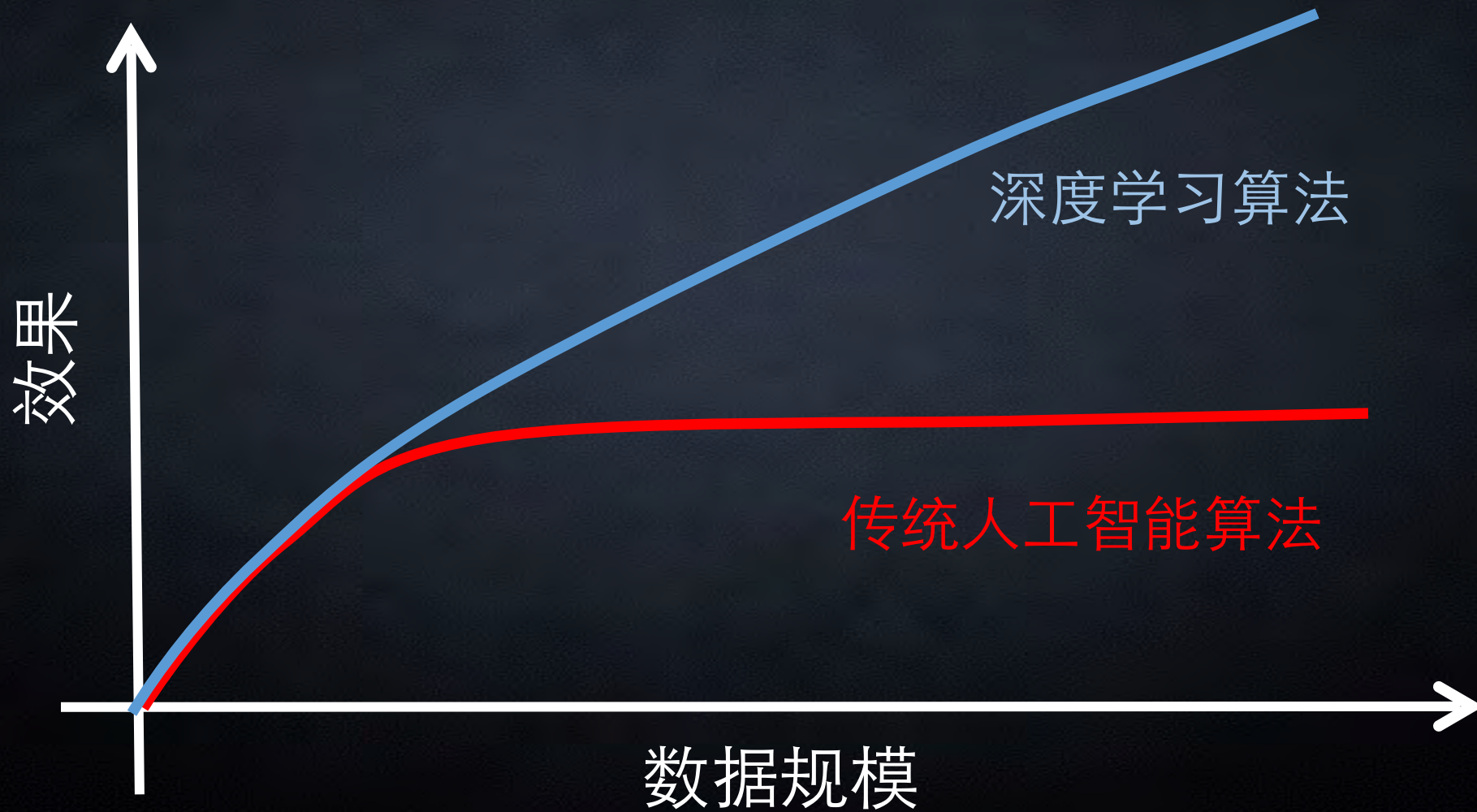
$$\text{推广误差} = A + E + O$$

- Approximation error – model class
- Estimation error – data size
- Optimization error – **algorithm**

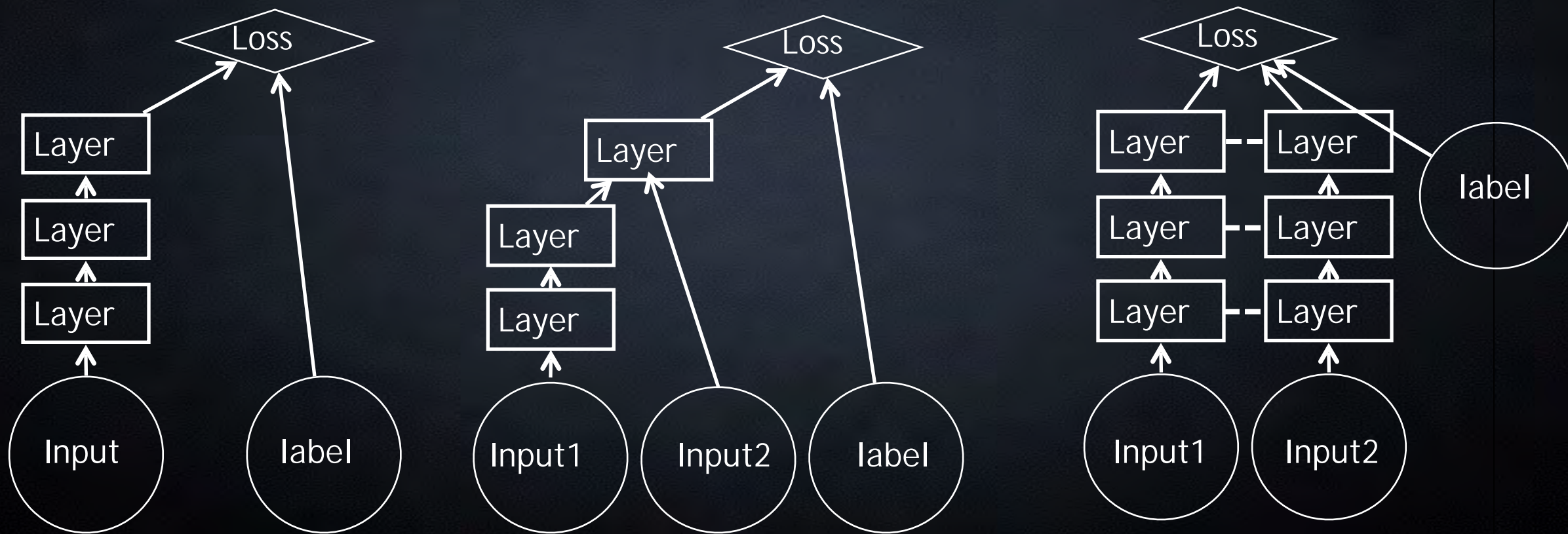
CS的范畴：考虑计算的不完美

$$\text{推广误差} = A + E + O$$

- Approximation error – model class: **use complex model**
- Estimation error – data size : **collect big data**
- Optimization error – algorithm : **design “an OK algorithm”**



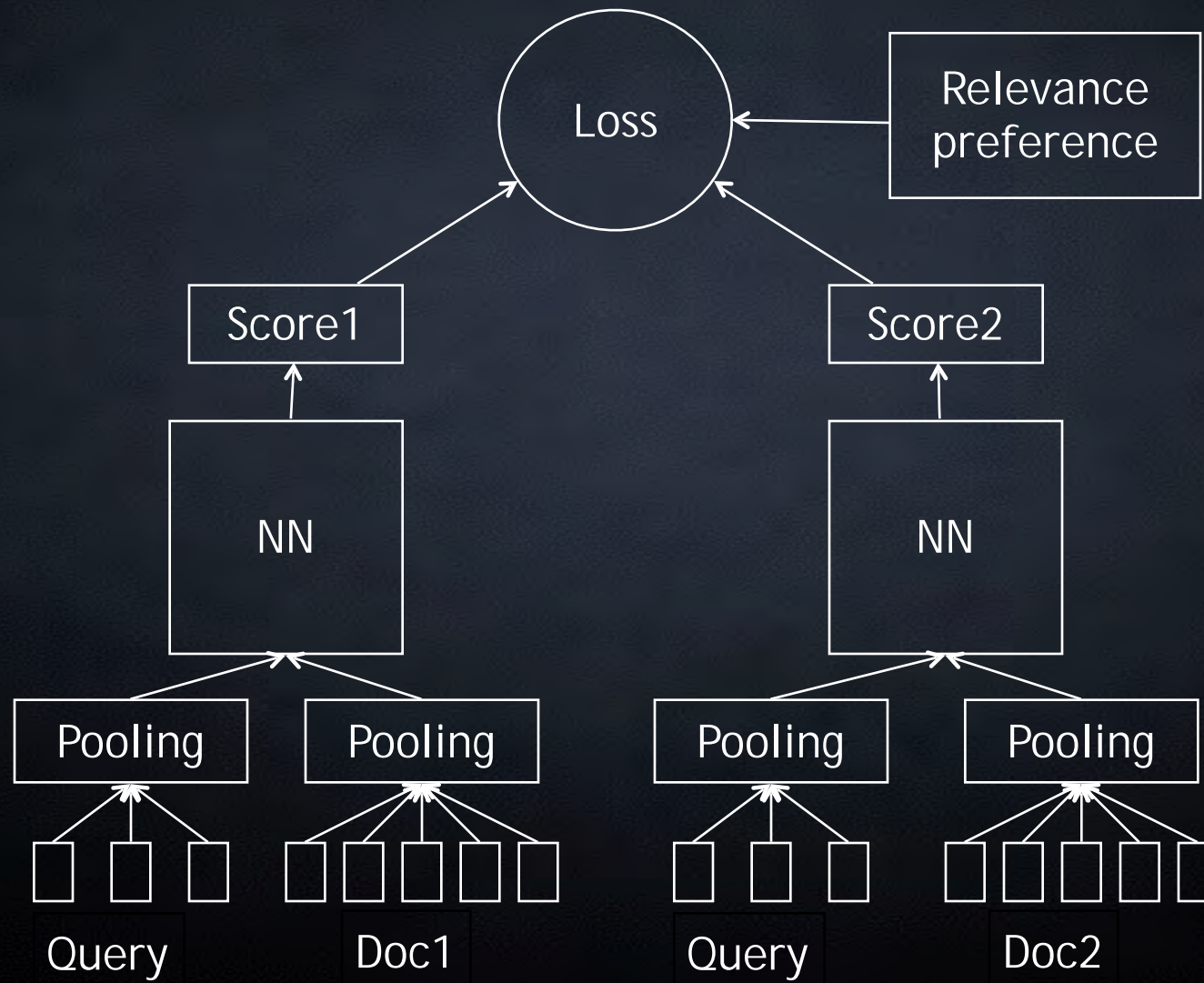
深度学习是一套灵活的建模语言



深入百度大脑： A deep model for image recognition

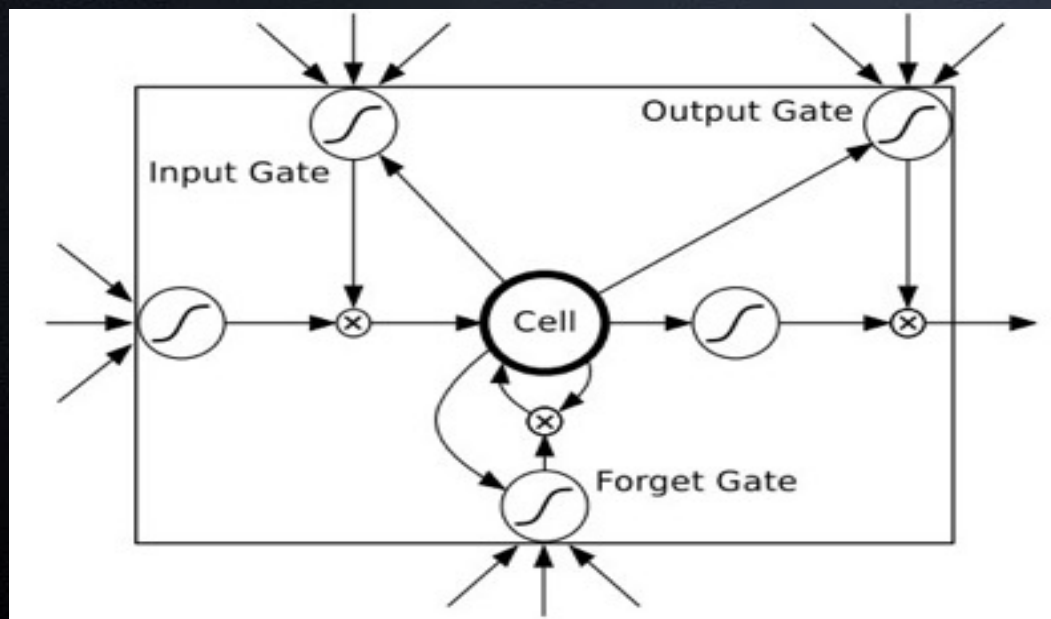


深入百度大脑： DL model for query-doc relevance



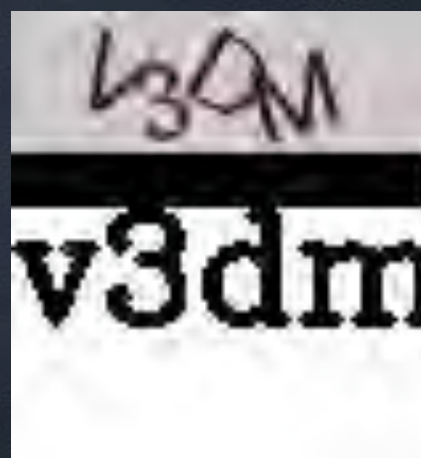
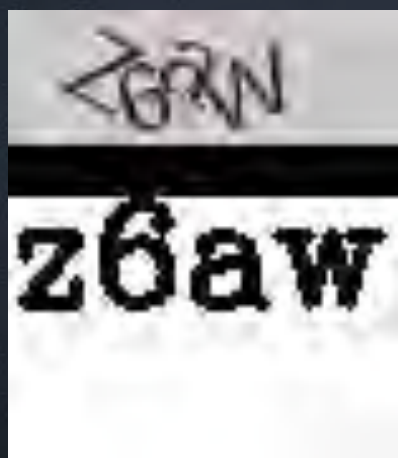
深入百度大脑： Long-short term memory for time series

It uses linear memory cells surrounded by multiplicative gate units to store read, write and reset information



Input gate: scales input to cell (write)
Output gate: scales output from cell (read)
Forget gate: scales old cell value (reset)

网上抢票验证码识别



运单手写电话号码识别

686888515
02081399071

1836144721
13724538705

021-55951406
13951562509

述说图片的故事



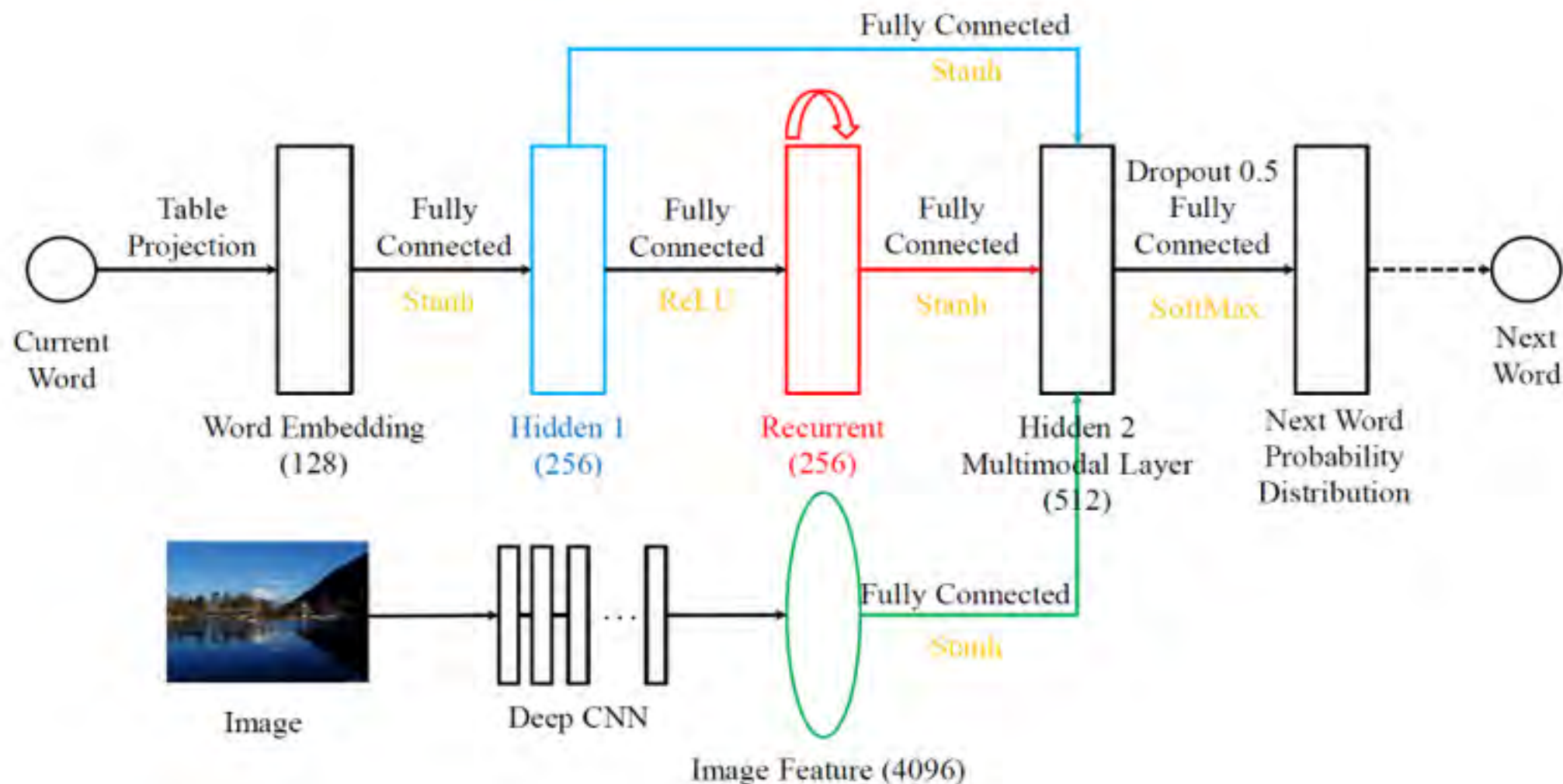
A yellow bus driving down a road with green trees and green grass in the background.



Living room with white couch and blue carpeting. The room in the apartment gets some afternoon sun.

这些字幕是深度学习程序写的

深入百度大脑：同时理解图像和自然语言



深度学习的成功应用

深度学习显著提升了百度凤巢广告系统

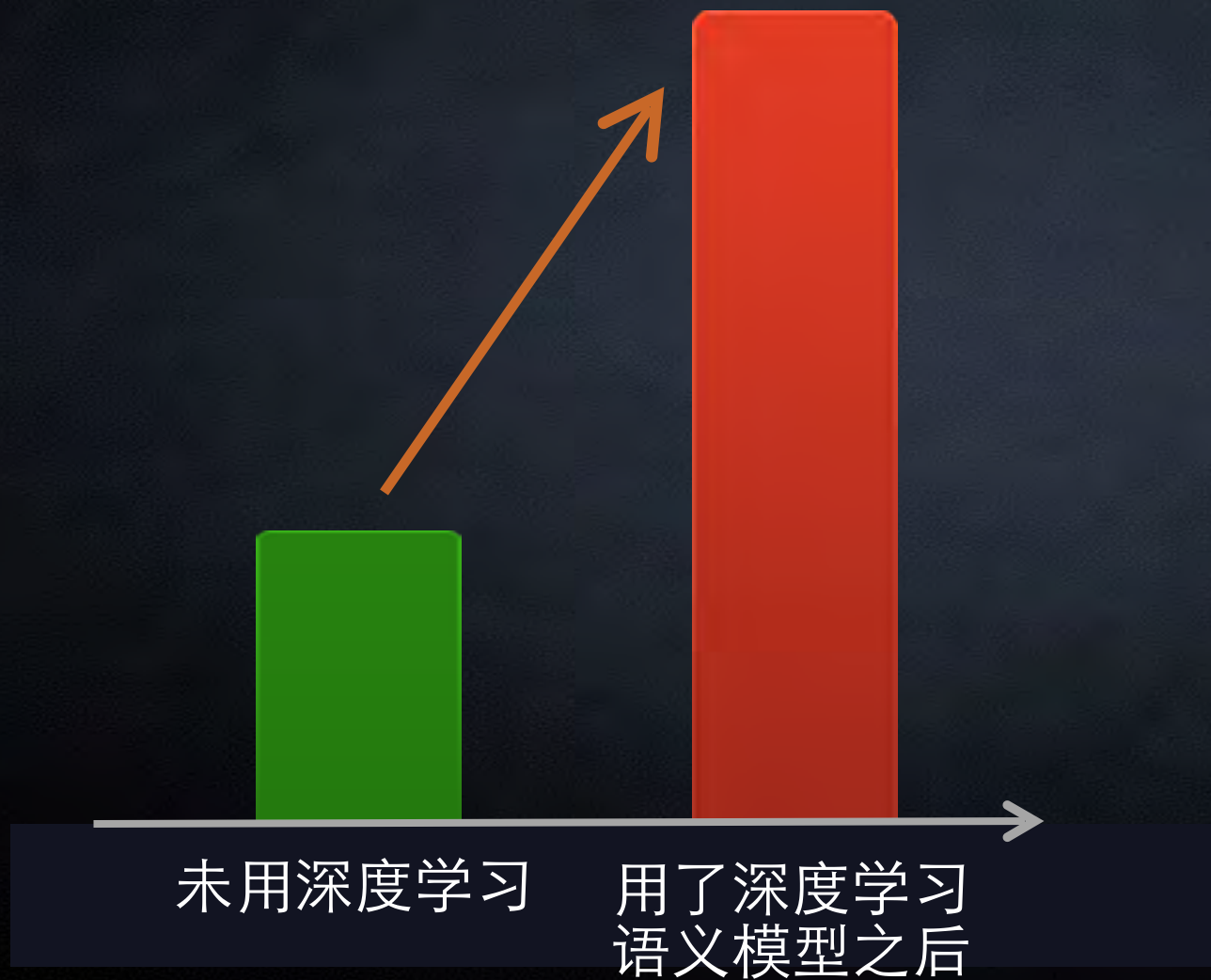


世界上首次深度学习
成功应用于广告变现

凤巢系统从浅层模型
时代到深度模型时代

显著提升CTR达
XX.X%

深度学习显著提升了百度搜索满意度**领先优势**



世界上首次将深度学习成功应用搜索引擎

迄今为止深度神经网络作用于自然语言最成功的例子。

Speech recognition in many products

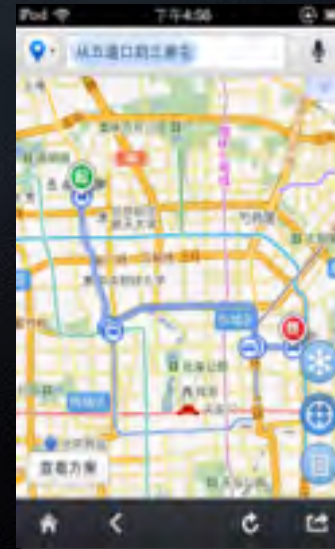
Voice Search

Voice Type-setting

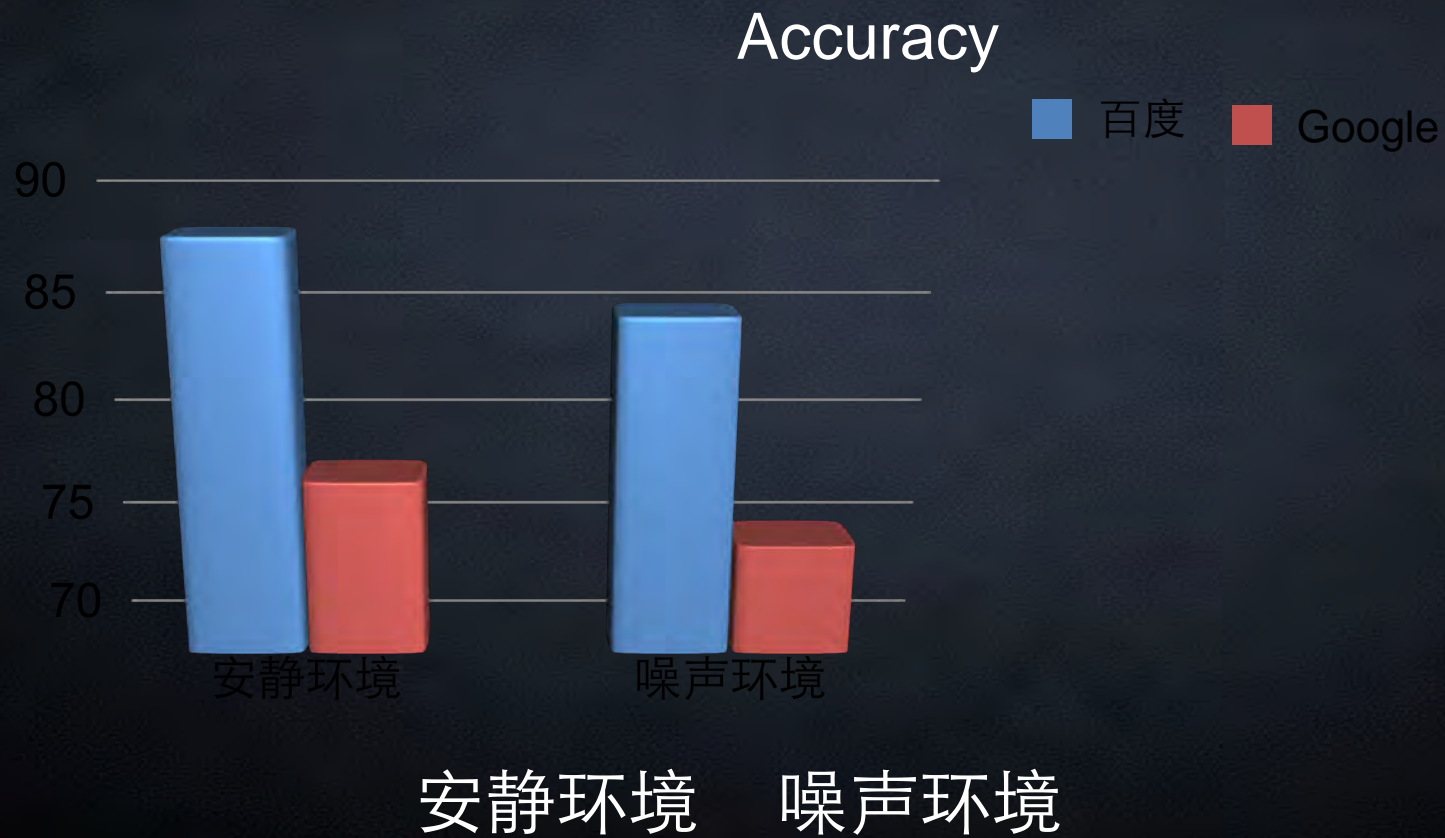


Voice Assis-tant

LBS voice service



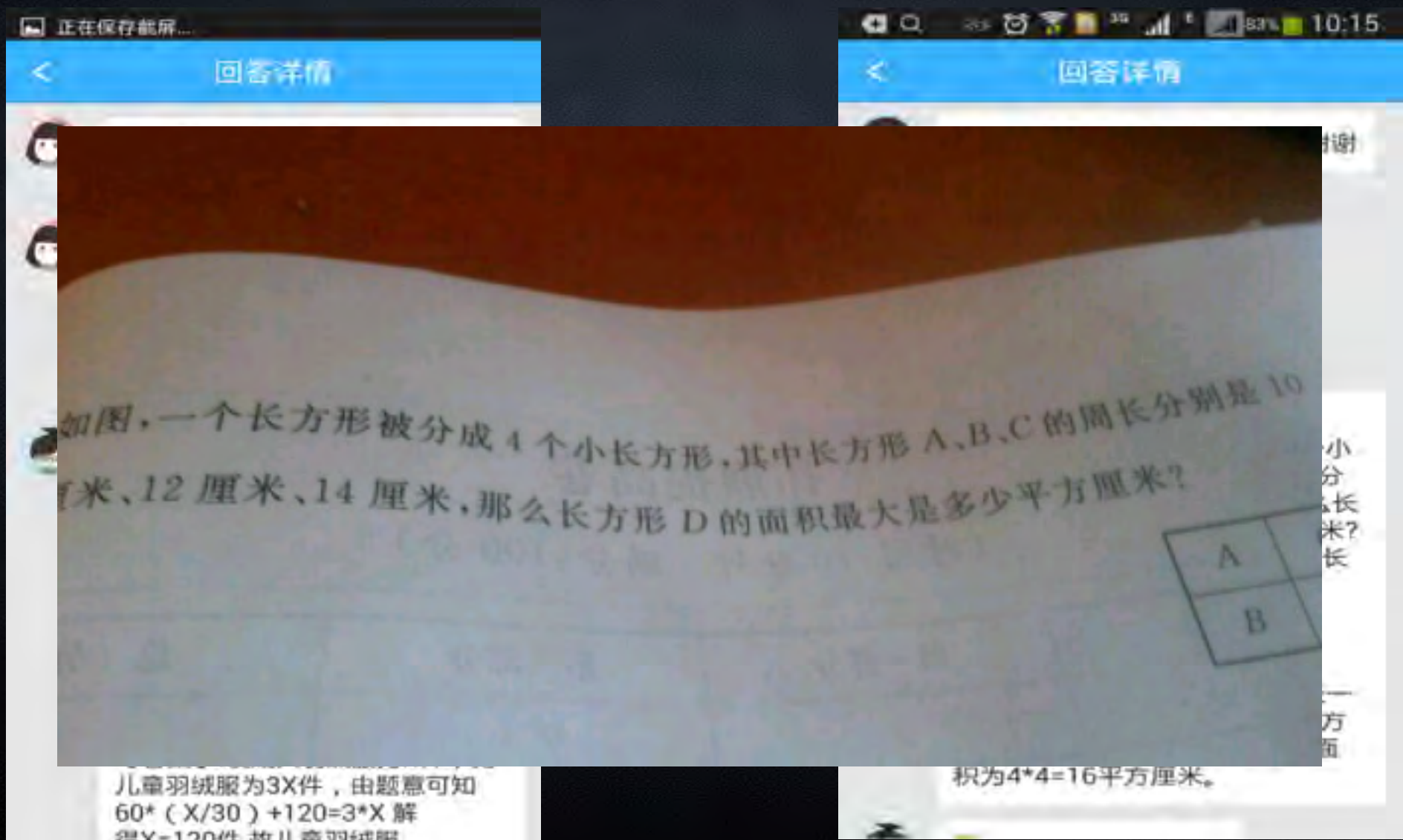
移动语音搜索，世界首屈一指的中文语音识别率



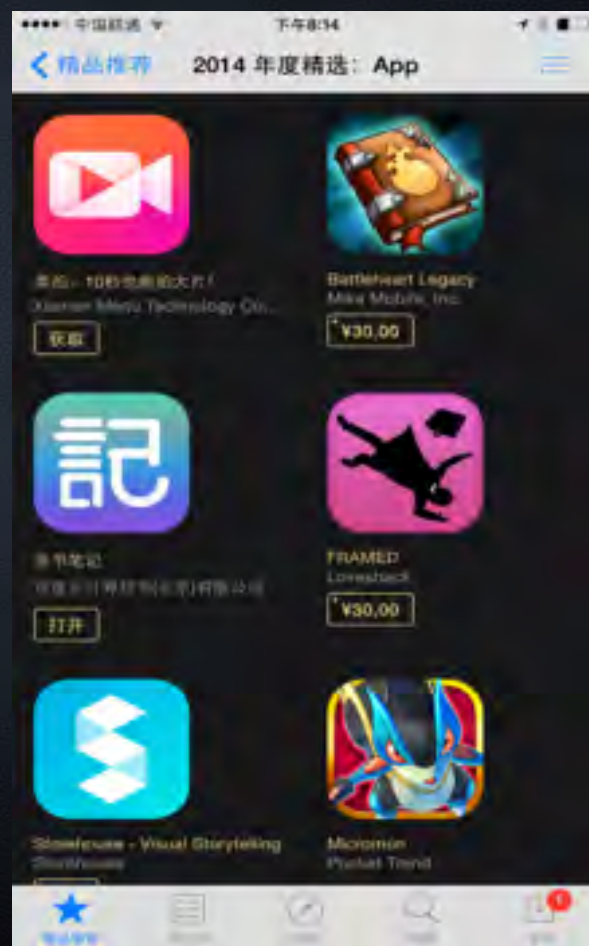
自然图片OCR： 百度翻译



自然图片OCR：百度作业帮



涂书笔记 – iOS应用商店2014年度精选



百度魔图：基于深度学习的人脸识别技术



高峰时用户一天上传9000万张照片，连续三周iOS应用商店总榜排行第一

百度魔图：基于深度学习的人脸识别技术

 百度魔图

相似度: 74.41%
布死痕象啊~绳命作弄人~(>_<)~



A side-by-side comparison of two photos. On the left is a user's photo of a man with grey hair wearing a checkered shirt. On the right is a photo of actor Daniel Craig in a light blue shirt. A pink circular sticker with 'PK' and '大啵' is placed between the two photos.

我的照片 丹尼尔·克雷格

 快来下载百度魔图
看看你最像哪位明星吧!

 百度魔图

相似度: 85.65%
加把劲儿，马上你也是明星了!



A side-by-side comparison of two photos. On the left is a user's photo of a man in a blue t-shirt. On the right is a photo of actor Cai Wen Sheng in a white shirt. A pink circular sticker with 'PK' and '大啵' is placed between the two photos.

我的照片 蔡文胜

 快来下载百度魔图
看看你最像哪位明星吧!

百度魔图：基于深度学习的人脸识别技术



百度魔图：基于深度学习的人脸识别技术

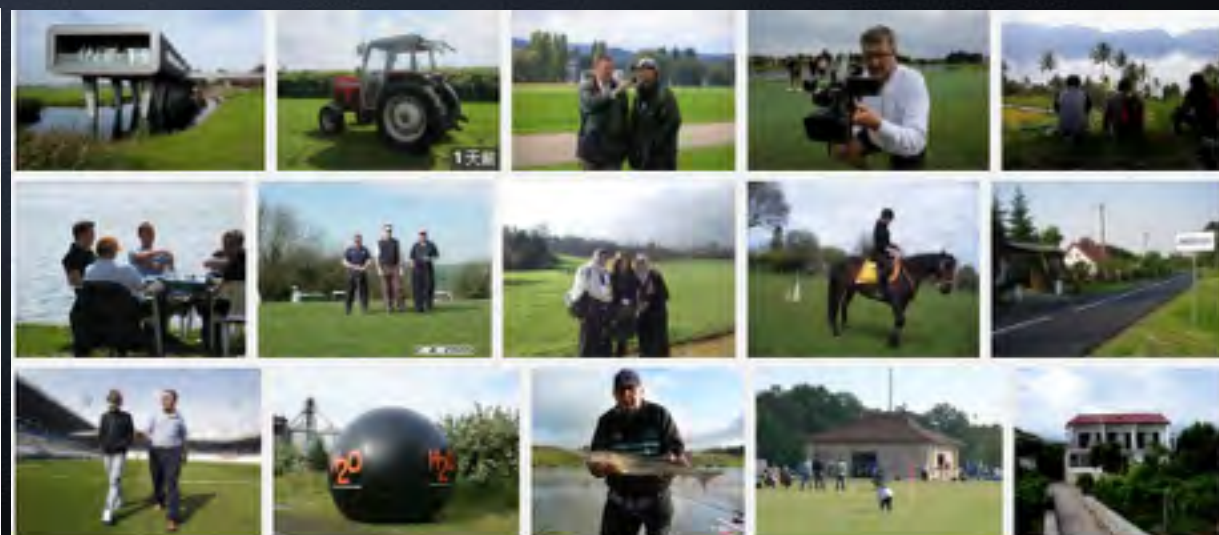


百度拥有世界领先的基于内容的图像搜索技术

输入检索图片



百度结果



竞品结果

百度拥有世界领先的基于内容的图像搜索技术

输入检索图片



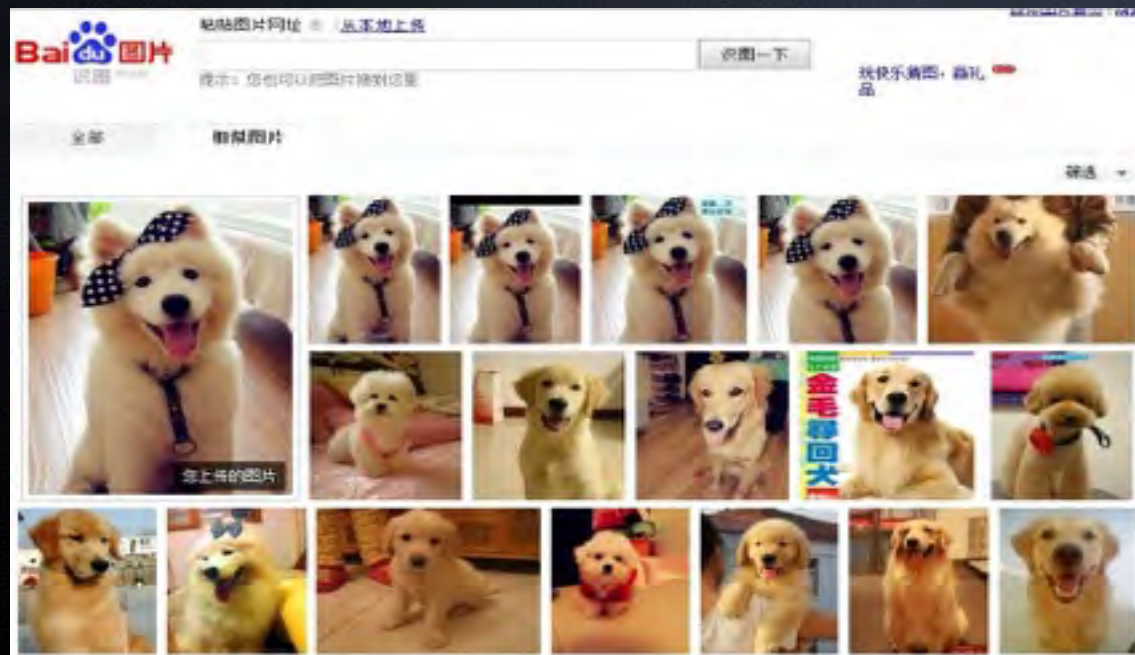
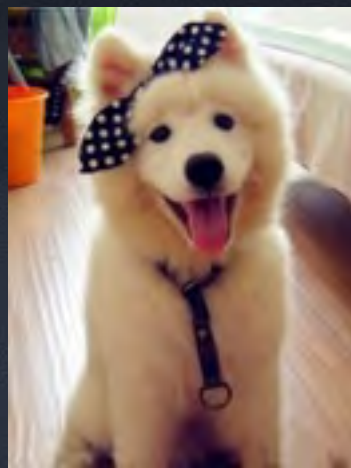
百度结果



竞品结果

百度拥有世界领先的基于内容的图像搜索技术

输入检索图片

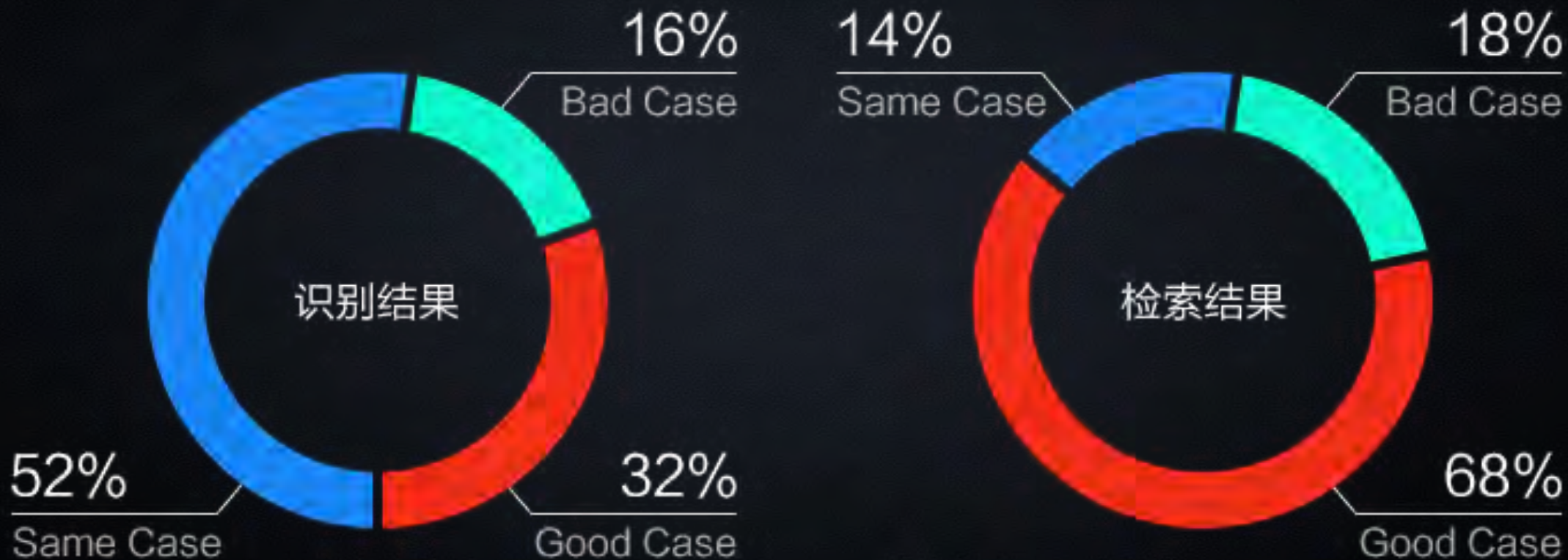


百度结果



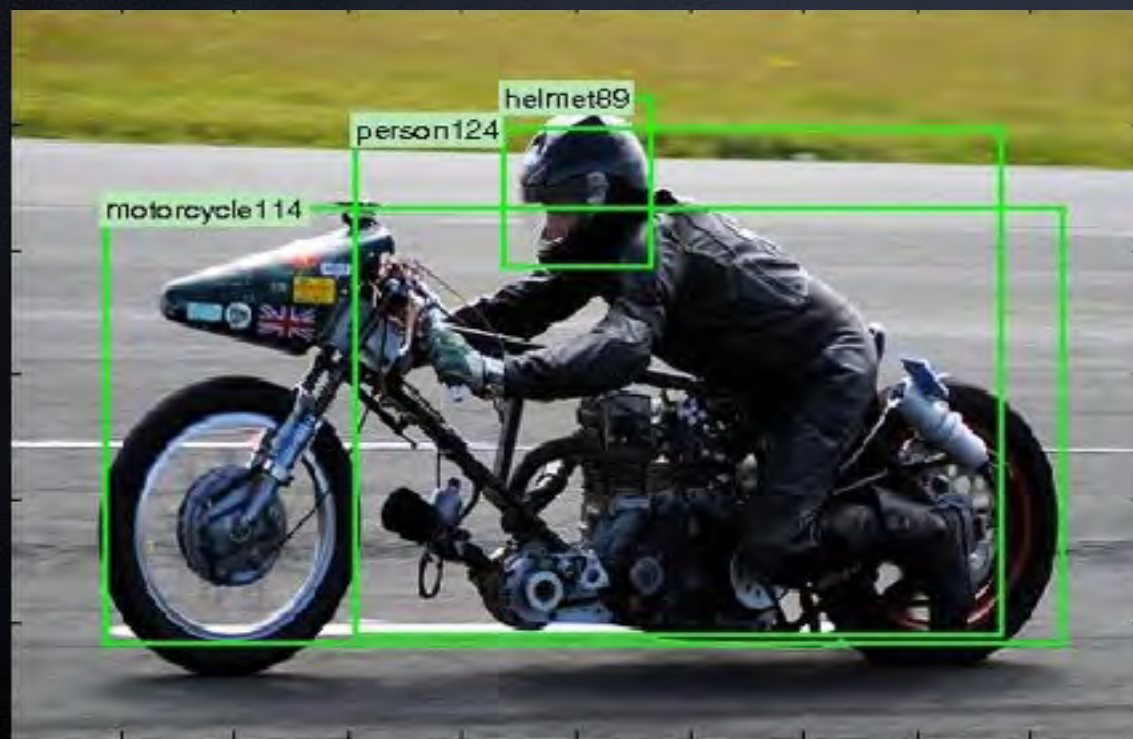
竞品结果

百度拥有世界领先的基于内容的图像搜索技术



与Google对比

全球最好的物体检测模型



Mean Average Precision



手机百度v5.5 – 拍照实物搜索

书籍

蔬果

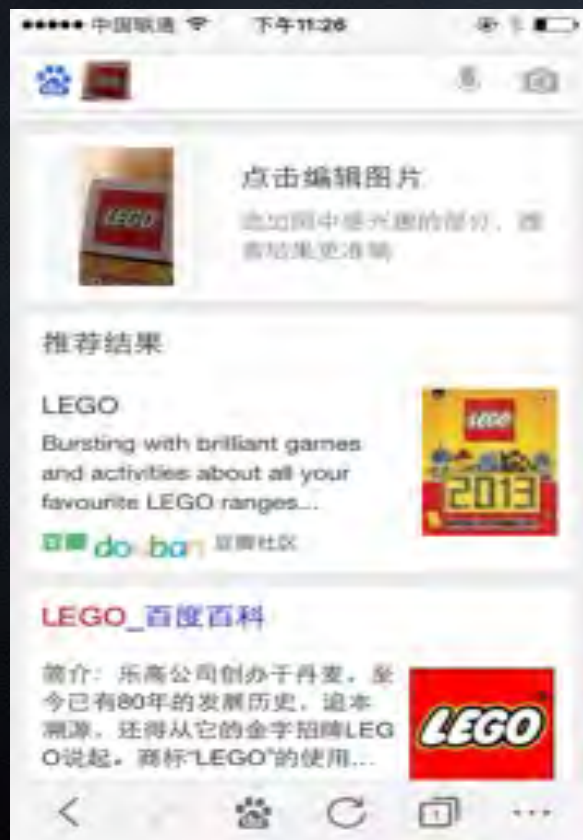
玩具



世界上第一款基于深度学习的拍照实物搜索

手机百度v5.5 – 拍照实物搜索

Logo



服饰



包包



世界上第一款基于深度学习的拍照实物搜索

2014年谷歌深度学习负责人Andrew Ng加盟百度

MIT
Technology
Review

Chinese Search Giant Baidu Hires Man Behind the “Google Brain”

Leading AI researcher Andrew Ng, previously associated with Google, will lead a new effort by China's Baidu to create software that understands the world.

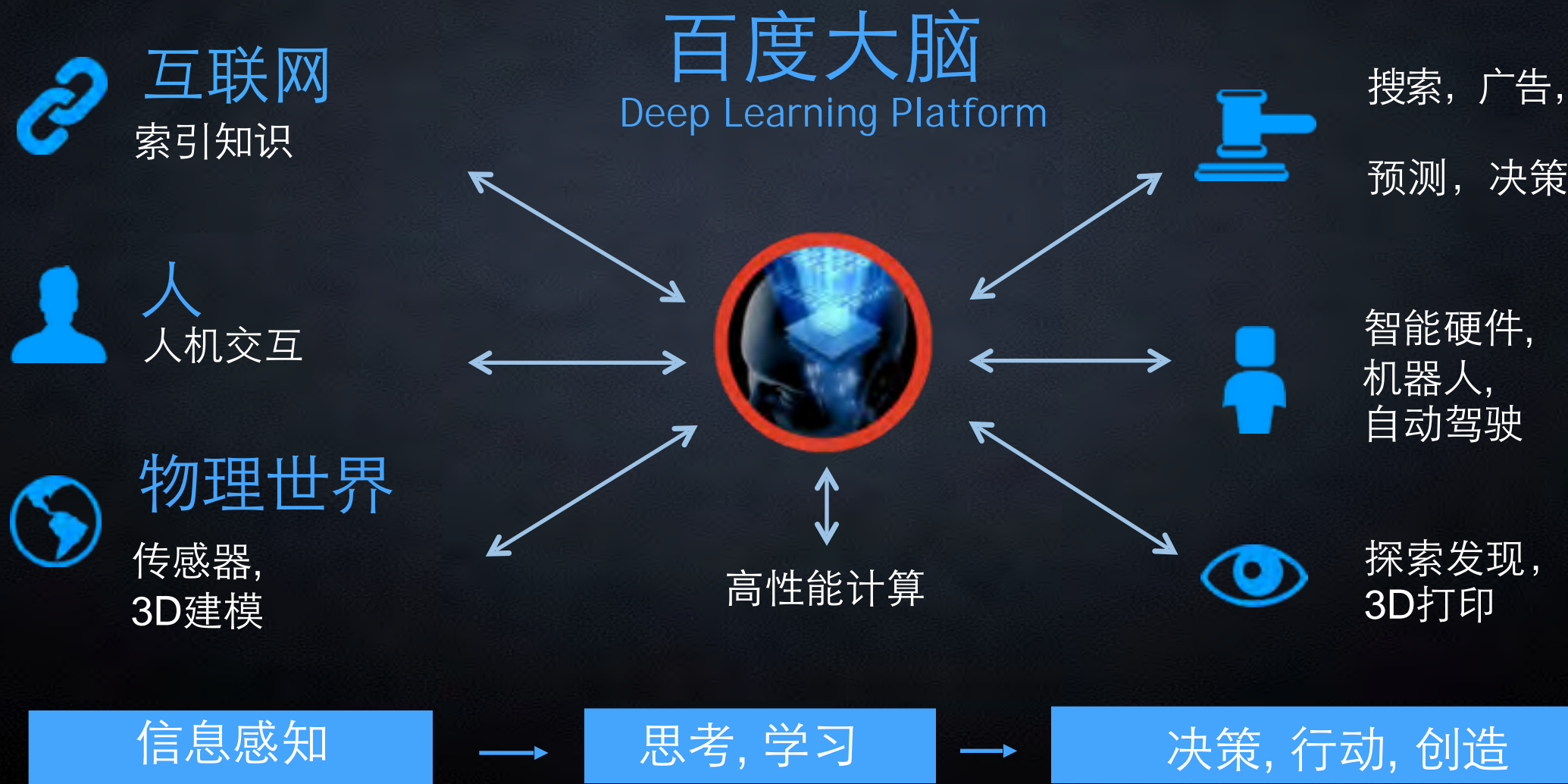
By Tom Simonite on May 16, 2014



“I thought the best place to advance the AI mission is at Baidu”

MIT Technology Review, May 16th, 2014

全景图：基于百度大脑的人工智能



Human Brain vs. Supercomputer

1.5kg, 2% of body weight, but consume 20% energy

100 billion neurons

Each neuron has 5000 synapses

firing rate: 200 per second

Computation capacity:

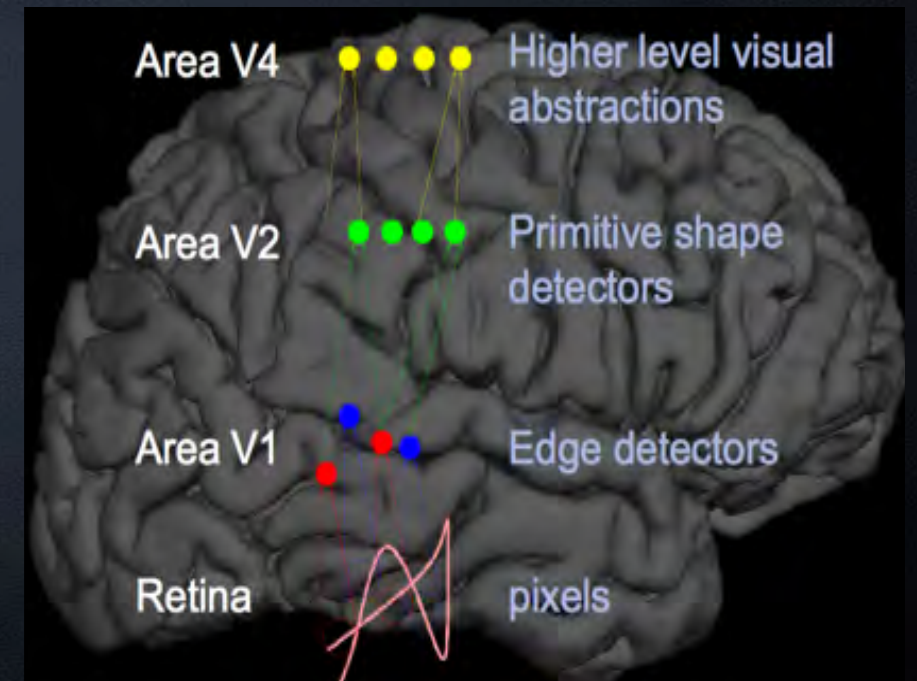
- $10^{11} * 5000 * 200 = 10^{17} = 100$ petaflops

-20W, 5petaflops/w

The most powerful supercomputer(天河二号)

-33.86 petaflops

- $18 * 10^6$ w, 2.14Gflops/w



Baidu Eye







百度自行车DuBike

打造出互联网生态下的**环保、绿色出行**的新体验

通过**Dubike OS系统**（百度大脑为核心）**助力传统自行车厂实现智能改造**

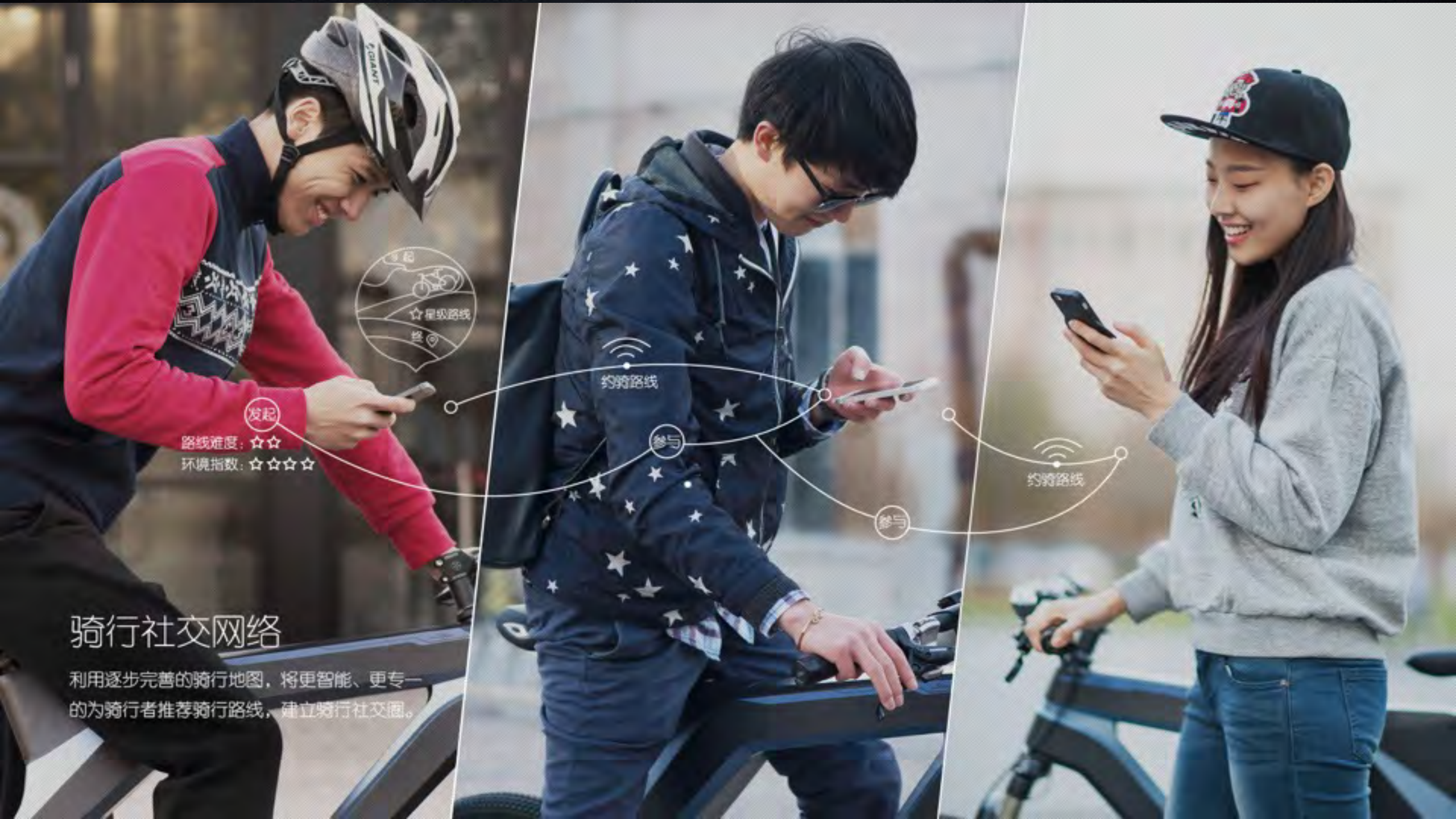
骑行健康指导

通过心率、踏频、速度、座压、踏压等传感器多维采集数据，实时或在骑行后通过蓝牙同步给手机APP进行健康分析，结合百度大脑强大的分析能力，给予您最专业的骑行健康指导。









发起

路线难度: ☆☆
环境指数: ☆☆☆☆

约骑路线

参与

参与

约骑路线

骑行社交网络

利用逐步完善的骑行地图，将更智能、更专一的为骑行者推荐骑行路线，建立骑行社交圈。

百度高度自动驾驶项目



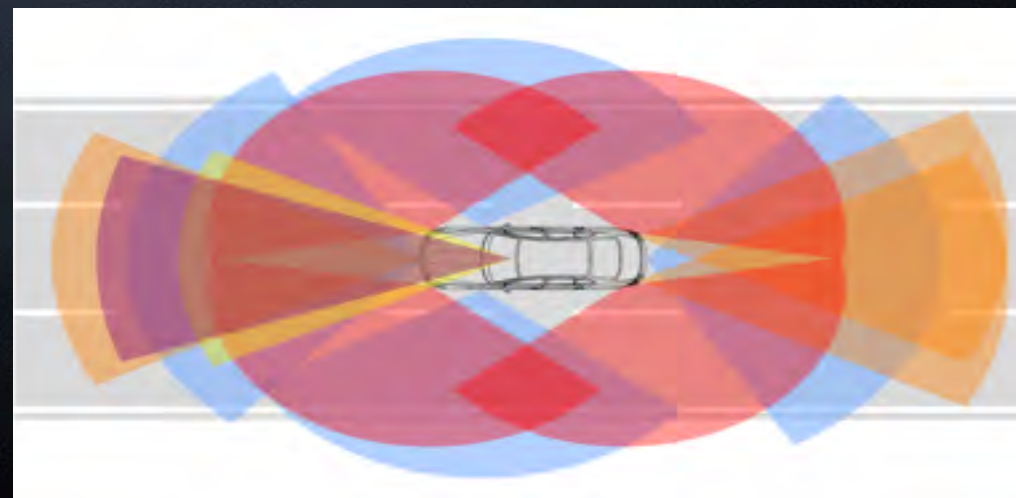
Remodeled LBS street-view car



Two BMW 335i



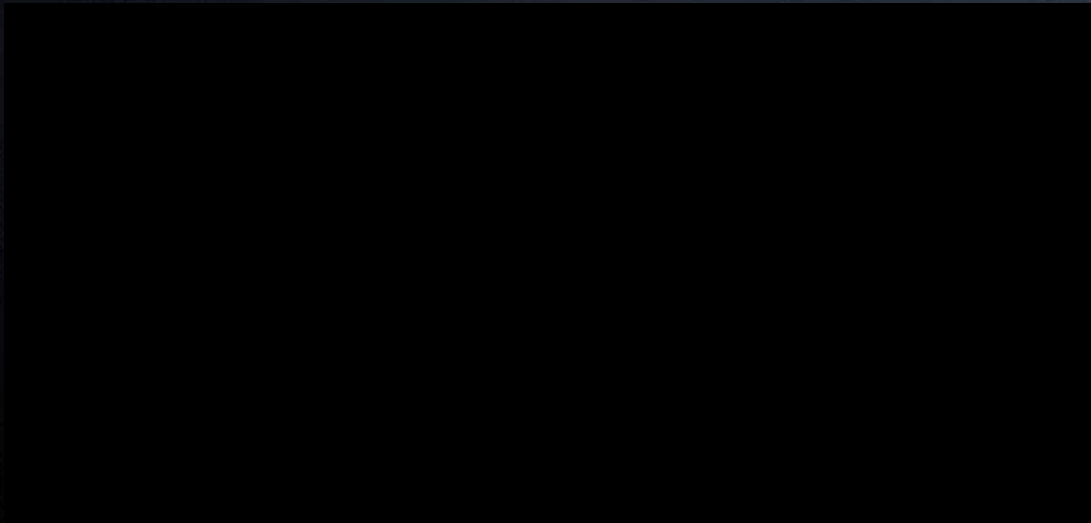
The ATV car as a quick test bed



LiDAR + Camera + Radar + GPS/IMU

三维高精度地图和感知定位

- 开发大规模的三维高精度地图技术(已完成G7和五环)
- 达到业界最领先精度**10~20 厘米**
- 高精度定位是包括自动驾驶在内的很多应用的核心技术



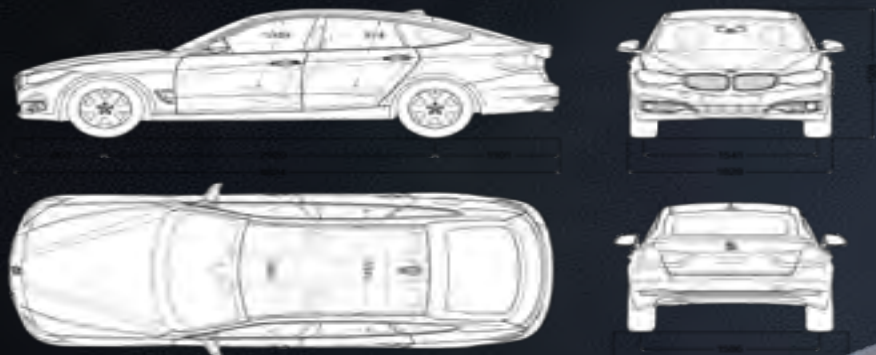
3D point clouds around the Baidu headquarter



A 3D high-precision map of the G7 highway

百度自动驾驶项目-动力控制系统建模仿真

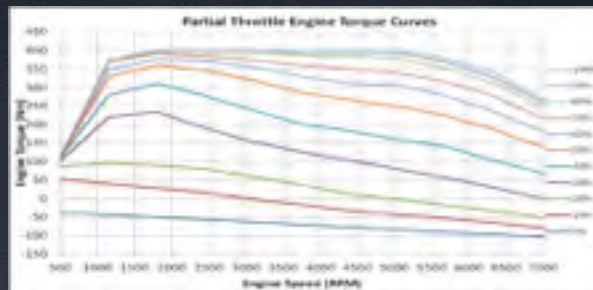
Geometry and Physics Parameters



Curb Weight: 1650kg
Wheelbase: 2.92m
Turning Circle: 11.8m



* by estimation



Engine Model and Parameters



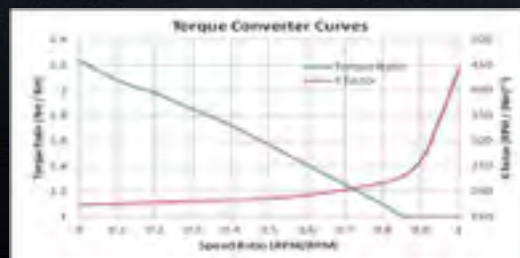
BMW N55B30 3L



Transmission Model and Parameters

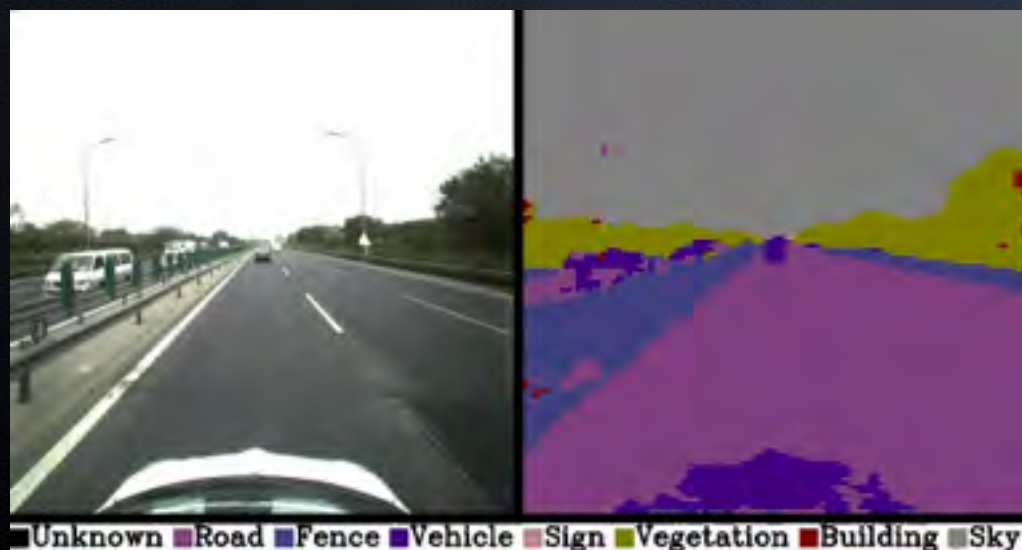


Suspension Model and Parameters



基于图像的实时道路场景理解

- 利用深度学习开发各种图像识别技术
- 低成本的摄像头和其他感知设备是关键(compare to Google).

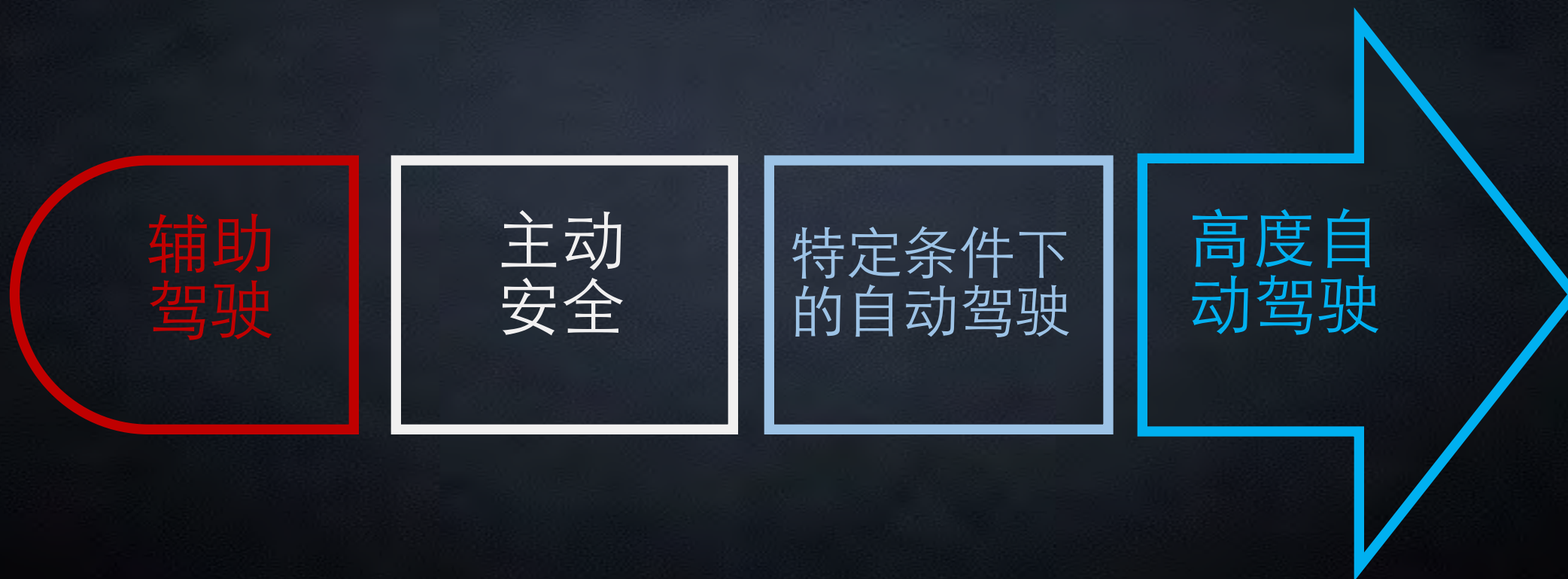


Scene parsing with CDNN



Real-time vehicle detection

从辅助驾驶到高度自动驾驶



PK大咖

百度魔图

相似度: **84.47%**

偶霸, 明星style!



我的照片 李妍熙

快来下载百度魔图
看看你最像哪位明星吧!



VS.

拍照写诗

手机百度客户端
Baidu Mobile Search APP

为写诗

诗意指数 **75**分

富若向千金姐, 不及吾侬为你痴



富翁成乞丐, 贫穷是王侯。
世界无穷尽, 人间任自由。

扫一扫 杜甫来为你写诗!





图灵测试指导下的人工智能研究，
致力于研发能取代人的机器

导致机器和人的PK

关于人与机器



VS.

Baidu 百度

Google

关于技术的思考




VS.



伟大的技术

不在于让机器更伟大

而在于让每个平凡的人变得更伟大

A photograph of a man and a woman in Mao suits. The man is in the foreground, wearing a dark blue Mao suit, and the woman is behind him, wearing a red Mao suit. Both have small circular pins on their chests. The background is a plain, light-colored wall. Overlaid on the image is white text in Chinese characters.

世界是我们的，
也是机器人的，
但归根结底，是属于会做机器人的人的