

清华大学计算机科学与技术系
“大模型与生成式人工智能”课程（编号：80240802-0）

人工智能概况

刘洋



人工智能

- 人工智能是引领新一轮科技革命和产业变革的战略性技术。

人工智能是计算机科学技术的一个分支，利用计算机模拟人类智力活动。

-- 《现代汉语词典》

Artificial Intelligence is the intelligence of machines or software, as opposed to the intelligence of human beings or animals.

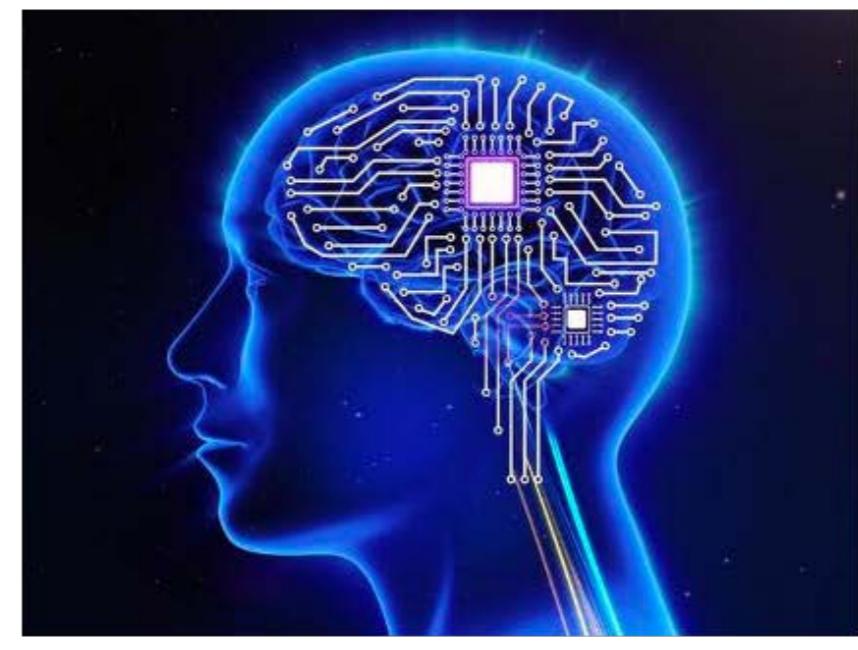
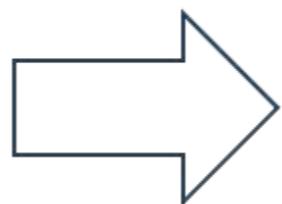
-- Wikipedia

Artificial Intelligence is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

-- Britannica

人工智能与仿人智能

- 机器实现“智能”的方式不需要跟人一样。



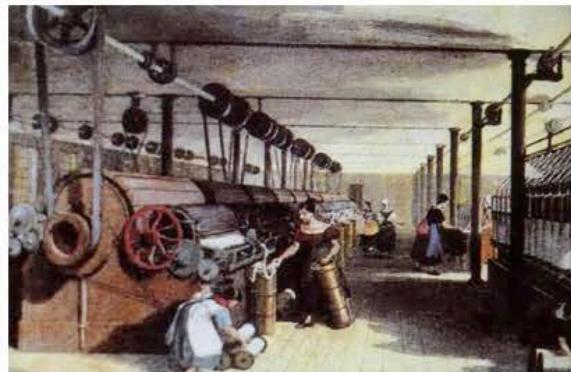
第四次工业革命：智能时代

- 人工智能是第四次工业革命的核心技术，战略意义重大。

第一次工业革命

(1760-1840)

蒸汽时代

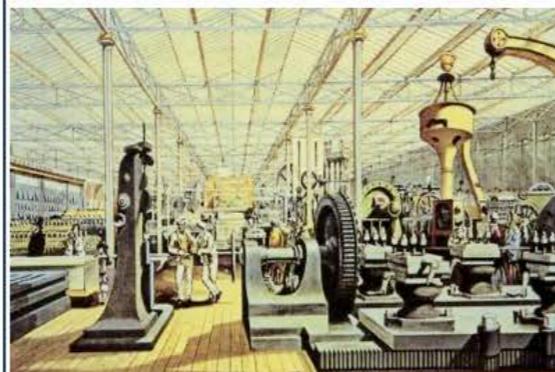


核心技术：蒸汽机

第二次工业革命

(1840-1945)

电气时代



核心技术：发电机

第三次工业革命

(1945-2022)

信息时代



核心技术：计算机

第四次工业革命

(2022至今)

智能时代



核心技术：人工智能

英国

美国

美国

?

人工智能应用：ChatGPT



simplilearn

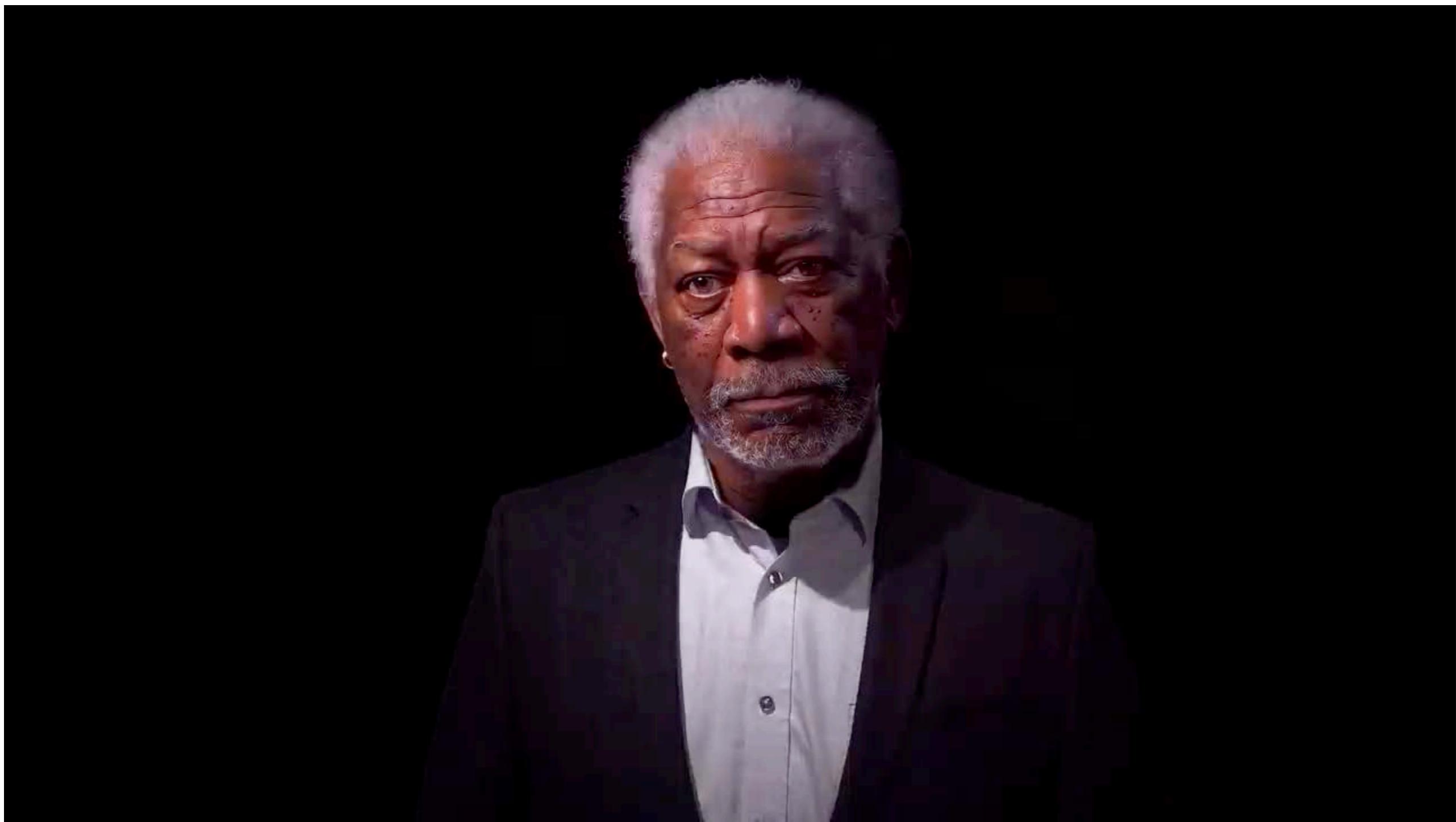
ChatGPT

人工智能应用：AI换脸



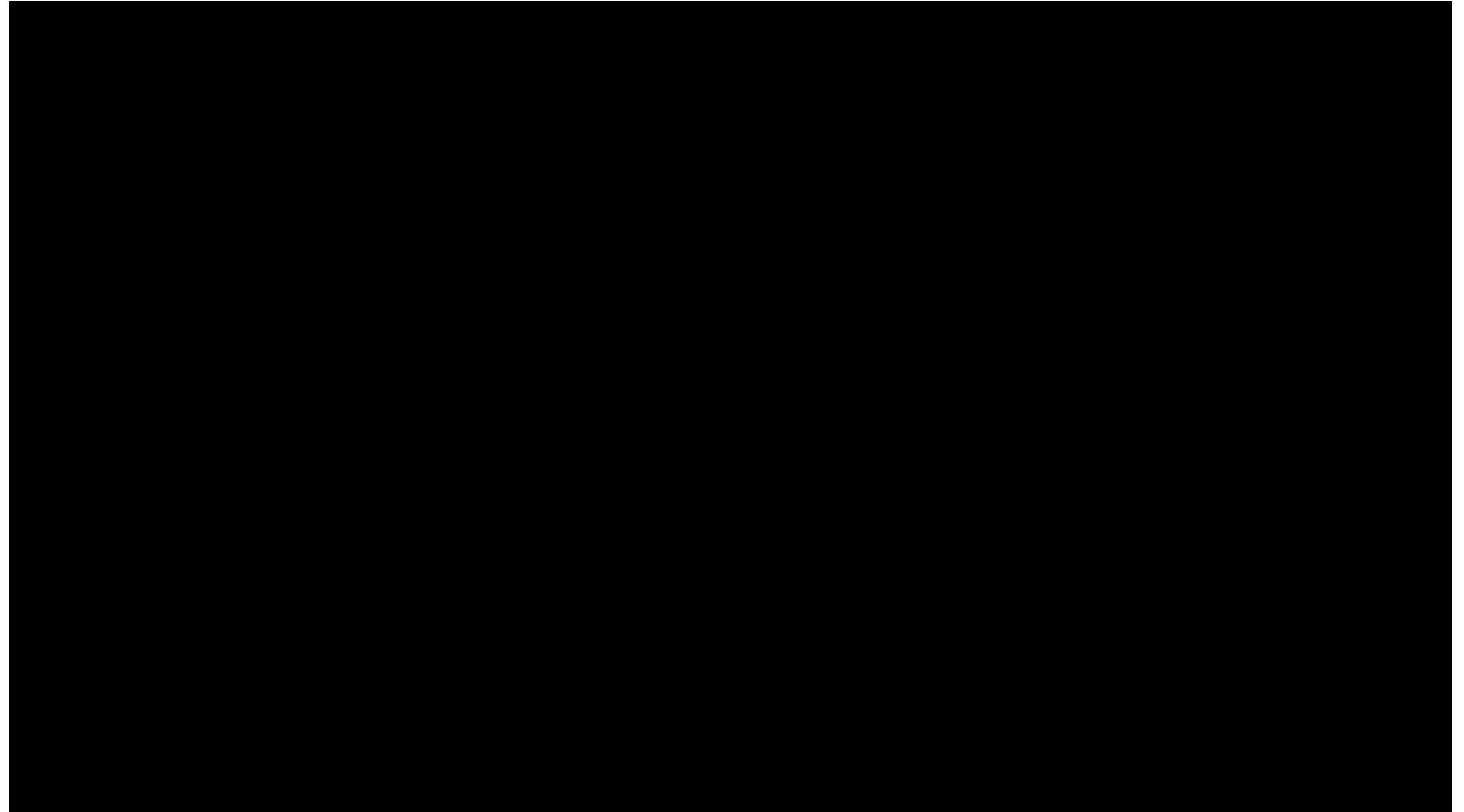
<https://v.qq.com/x/page/p08427i7m3c.html>

人工智能应用：AI换脸



https://www.youtube.com/watch?v=oxXpB9pSETo&ab_channel=DiepNep

人工智能应用：多模态模型Gemini



人工智能应用：Sora

Prompt: A stylish woman walks down a Tokyo street filled with warm glowing neon and animated city signage. She wears a black leather jacket, a long red dress, and black boots, and carries a black purse. She wears sunglasses and red lipstick. She walks confidently and casually. The street is damp and reflective, creating a mirror effect of the colorful lights. Many pedestrians walk about.

提示：一位时尚的女士走在东京的街道上，街道上充满了温暖的霓虹灯和生动的城市标志。她穿着黑色皮夹克、红色长裙和黑色靴子，手里拿着一个黑色钱包。她戴着太阳镜和红色口红。她走路自信而随意。街道潮湿且反光，形成了彩色灯光的镜面效果。许多行人走来走去。

OpenAI Sora

人工智能应用：Sora



OpenAI Sora

人工智能应用：Sora

Prompt: A movie trailer featuring the adventures of the 30 year old space man wearing a red wool knitted motorcycle helmet, blue sky, salt desert, cinematic style, shot on 35mm film, vivid colors.

提示：一部电影预告片，讲述了这位30岁的太空人的冒险故事，他戴着红色羊毛针织摩托车头盔，蓝天，盐沙漠，电影风格，用35毫米胶片拍摄，色彩生动。

OpenAI Sora

人工智能应用：Sora



OpenAI Sora

人工智能应用：Sora

Prompt: Reflections in the window of a train traveling through the Tokyo suburbs.

提示：穿过东京郊区的火车车窗里的倒影。

OpenAI Sora

人工智能应用：Sora



OpenAI Sora

人工智能应用：Sora

Prompt: Archeologists discover a generic plastic chair in the desert, excavating and dusting it with great care.

提示：考古学家在沙漠中发现了一把普通的塑料椅子，他们非常小心地挖掘和除尘。

OpenAI Sora

人工智能应用：Sora



OpenAI Sora

OpenAI Sora

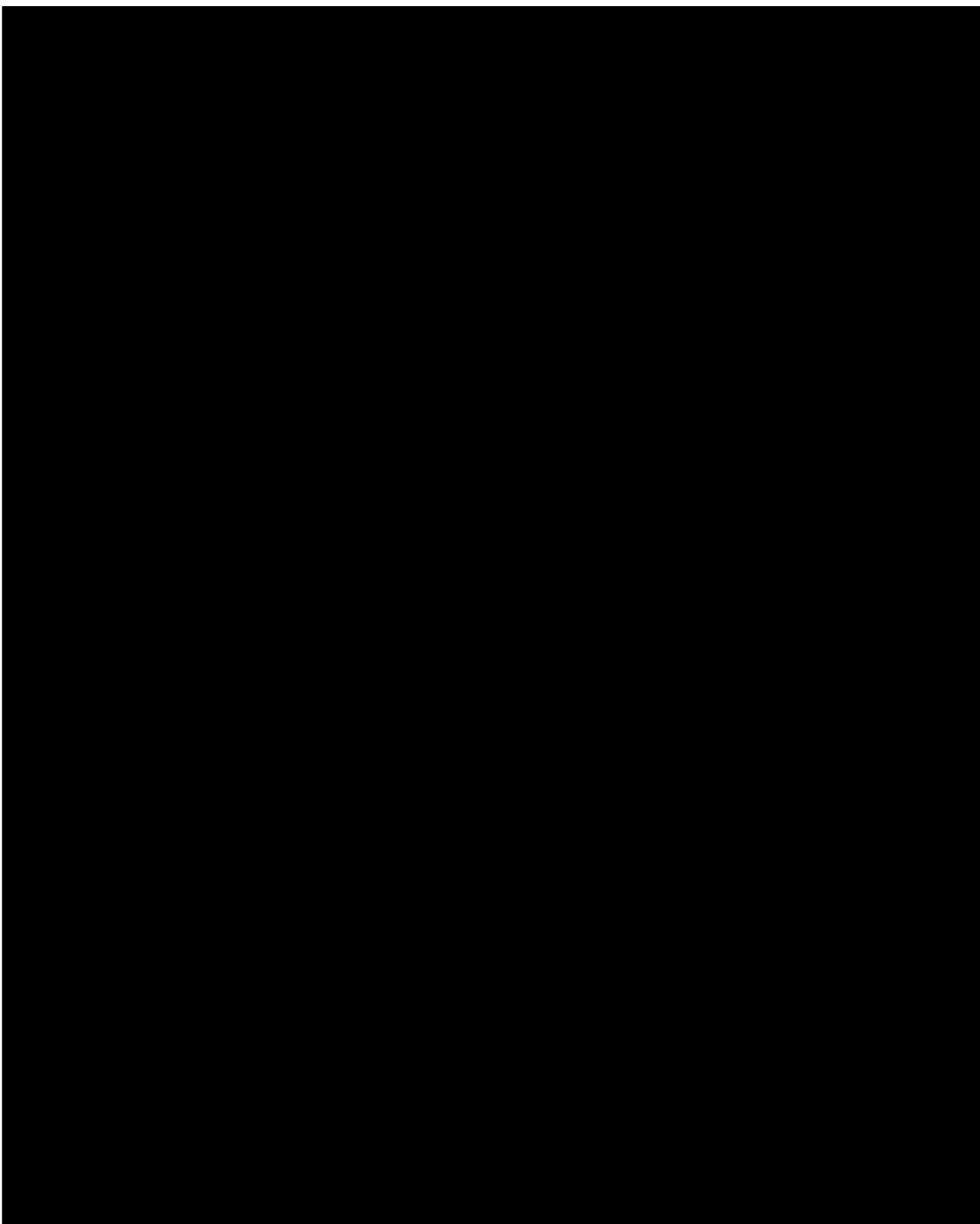
人工智能应用：Vidu



Vidu

清华大学朱军教授团队成果

人工智能应用：自动游戏



<https://deepmind.com/research/publications/2019/playing-atari-deep-reinforcement-learning>

人工智能应用：对抗作战



清华大学朱军团队研究成果

人工智能应用：机械手弹钢琴



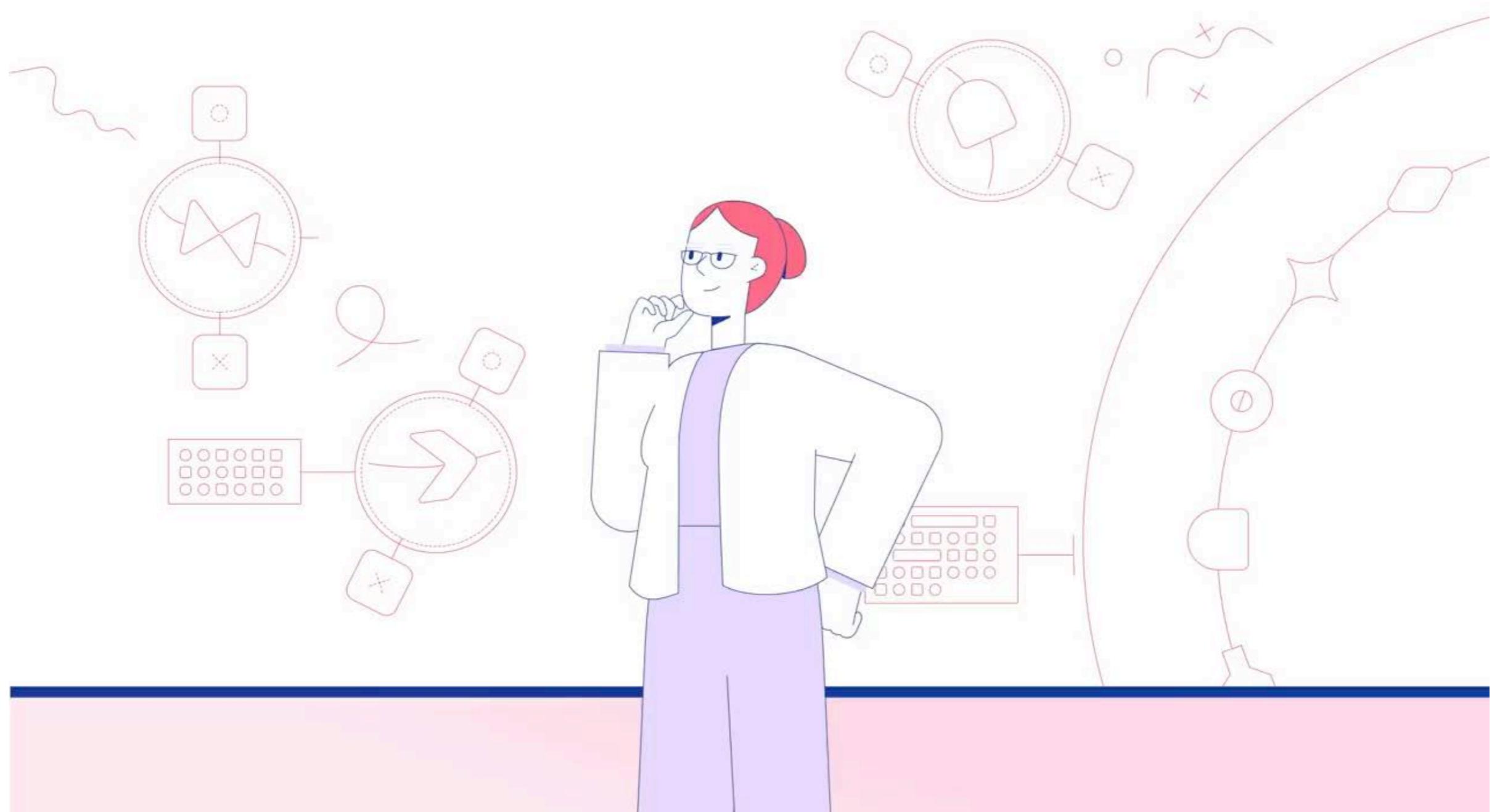
清华大学孙富春团队研究成果

人工智能应用：机器狗



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

人工智能应用：蛋白质折叠



AlphaFold2

人工智能应用：Agent Hospital

Agent Hospital

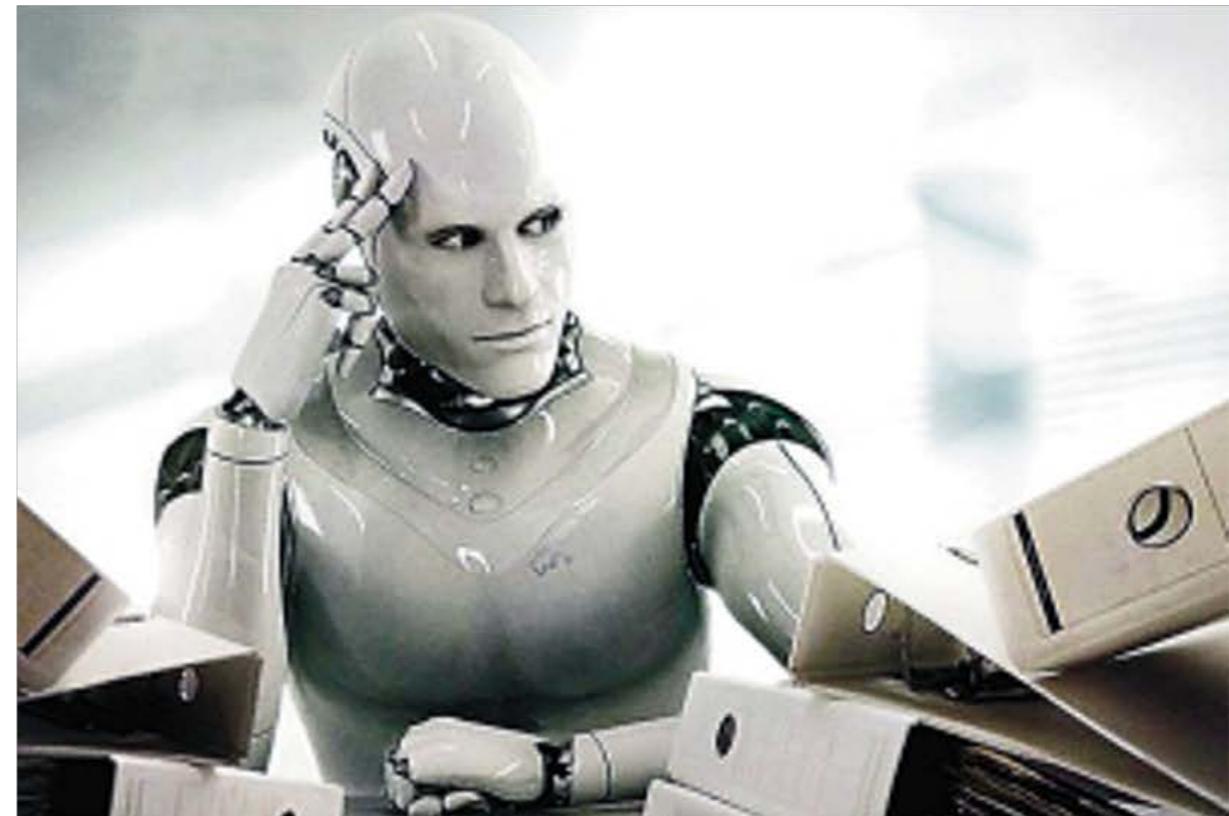
<https://www.tairex.cn/>

如何实现人工智能

- 符号主义和联结主义是人工智能的两大主流方法。



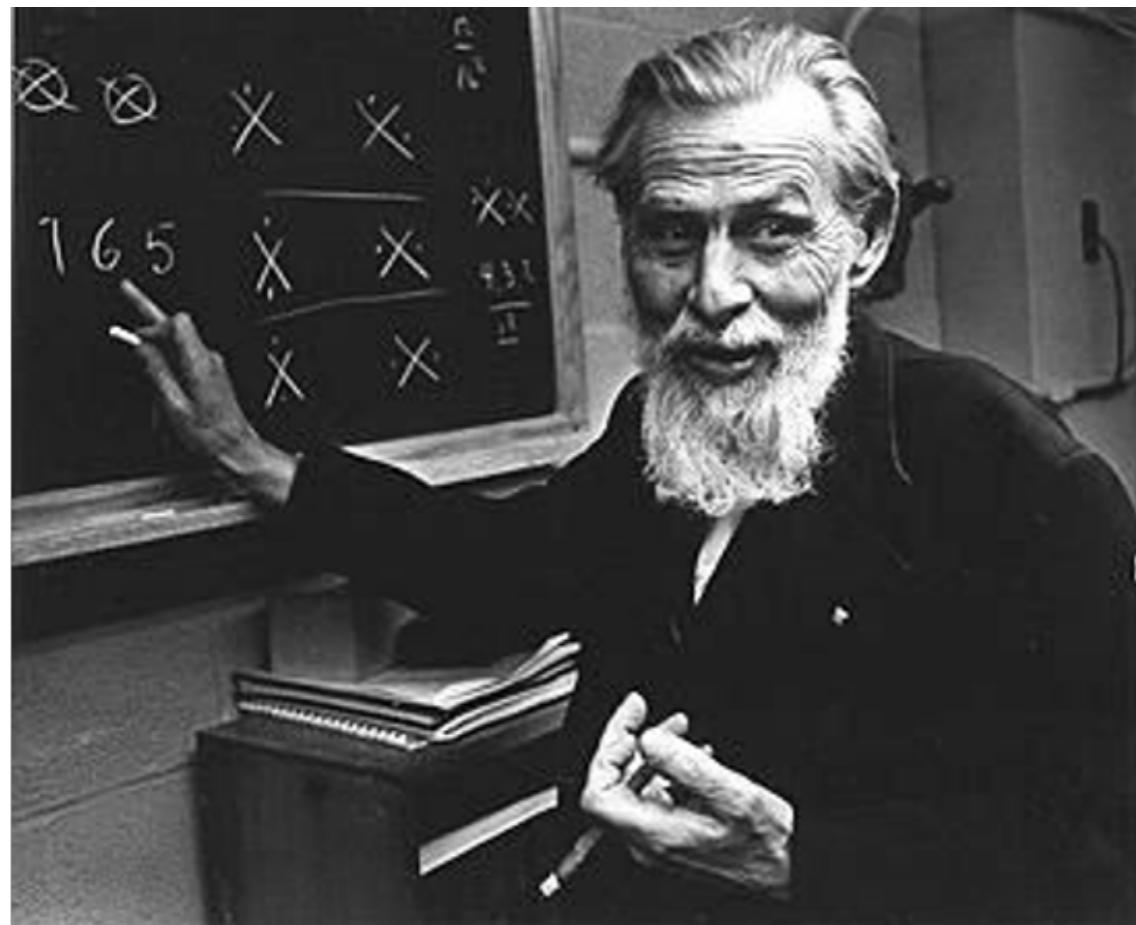
人教机器



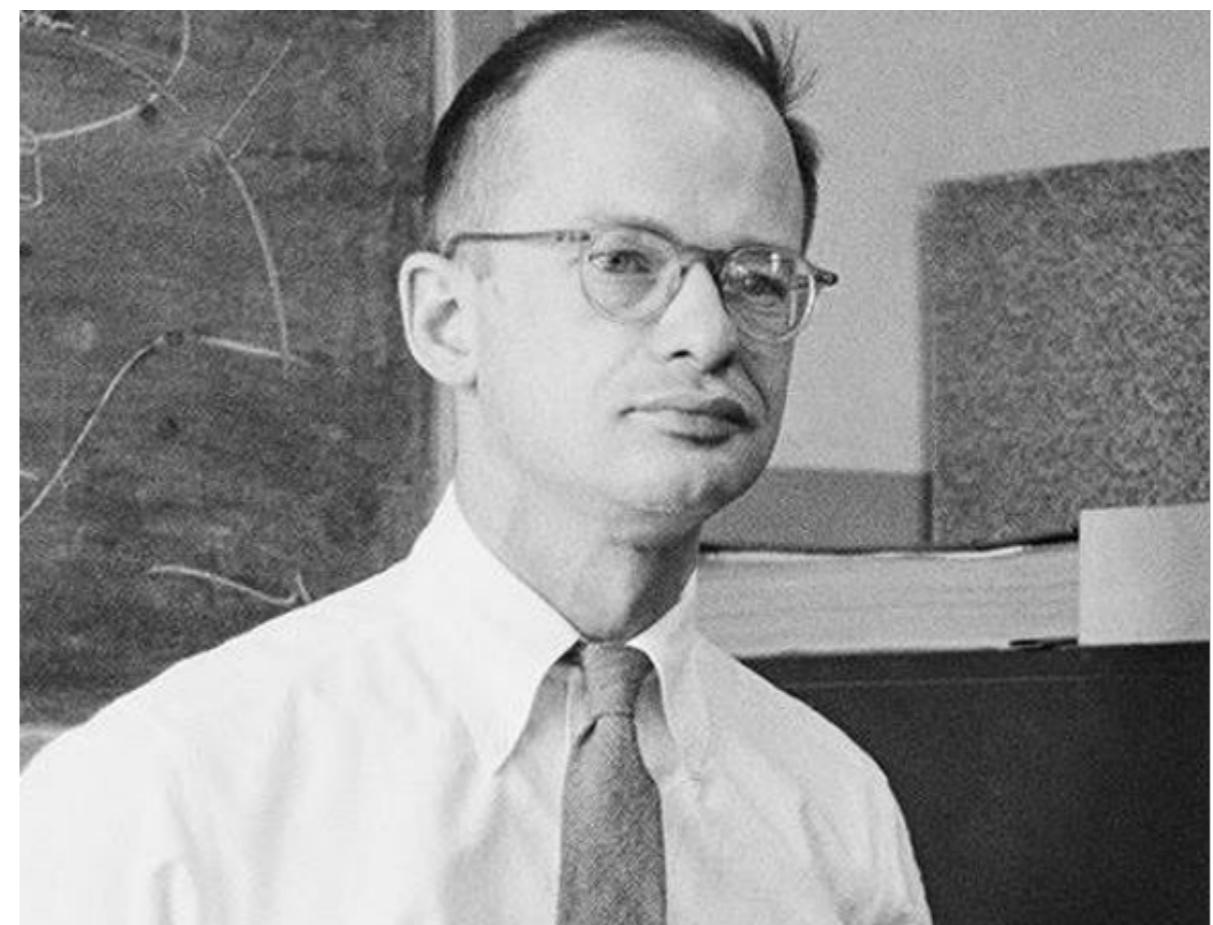
机器自学

神经网络 (1943)

- Warren McCulloch与Walter Pitts首先提出神经网络。



Warren McCulloch



Walter Pitts

神经网络 (1943)

- Warren McCulloch与Walter Pitts首先提出神经网络。

BULLETIN OF
MATHEMATICAL BIOPHYSICS
VOLUME 5, 1943

A LOGICAL CALCULUS OF THE
IDEAS IMMANENT IN NERVOUS ACTIVITY

WARREN S. MCCULLOCH AND WALTER PITTS

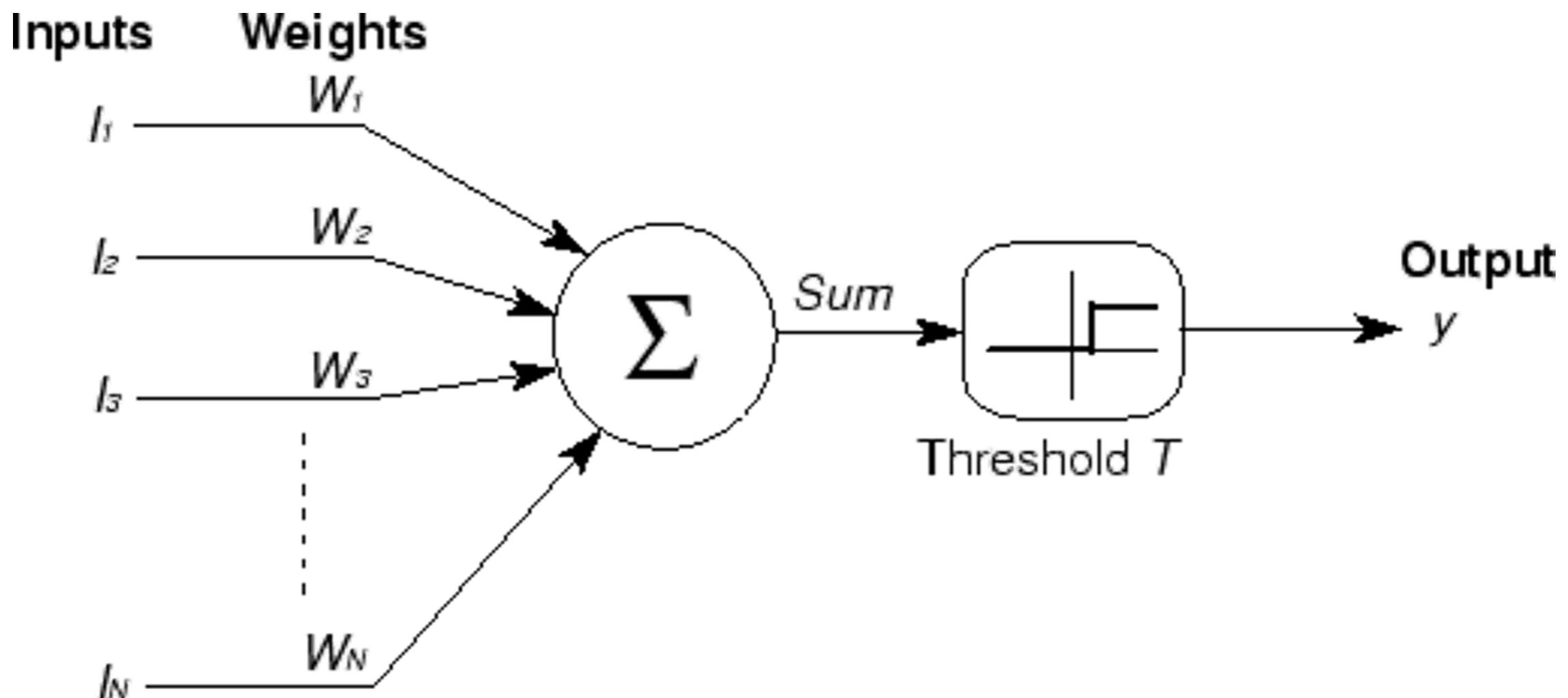
FROM THE UNIVERSITY OF ILLINOIS, COLLEGE OF MEDICINE,
DEPARTMENT OF PSYCHIATRY AT THE ILLINOIS NEUROPSYCHIATRIC INSTITUTE,
AND THE UNIVERSITY OF CHICAGO

Because of the "all-or-none" character of nervous activity, neural events and the relations among them can be treated by means of propositional logic. It is found that the behavior of every net can be described in these terms, with the addition of more complicated logical means for nets containing circles; and that for any logical expression satisfying certain conditions, one can find a net behaving in the fashion it describes. It is shown that many particular choices among possible neurophysiological assumptions are equivalent, in the sense that for every net behaving under one assumption, there exists another net which behaves under the other and gives the same results, although perhaps not in the same time. Various applications of the calculus are discussed.

a b c d e f g h

神经网络 (1943)

- Warren McCulloch与Walter Pitts首先提出神经网络。



图片来源: <http://wwwold.ece.utep.edu/>

机器翻译（1949）

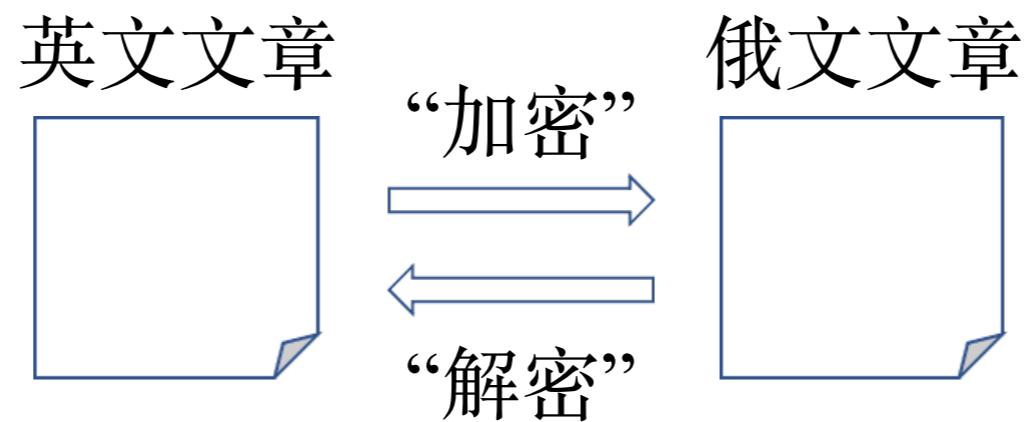
- Warren Weaver提出用计算机自动翻译人类语言。



Warren Weaver

机器翻译（1949）

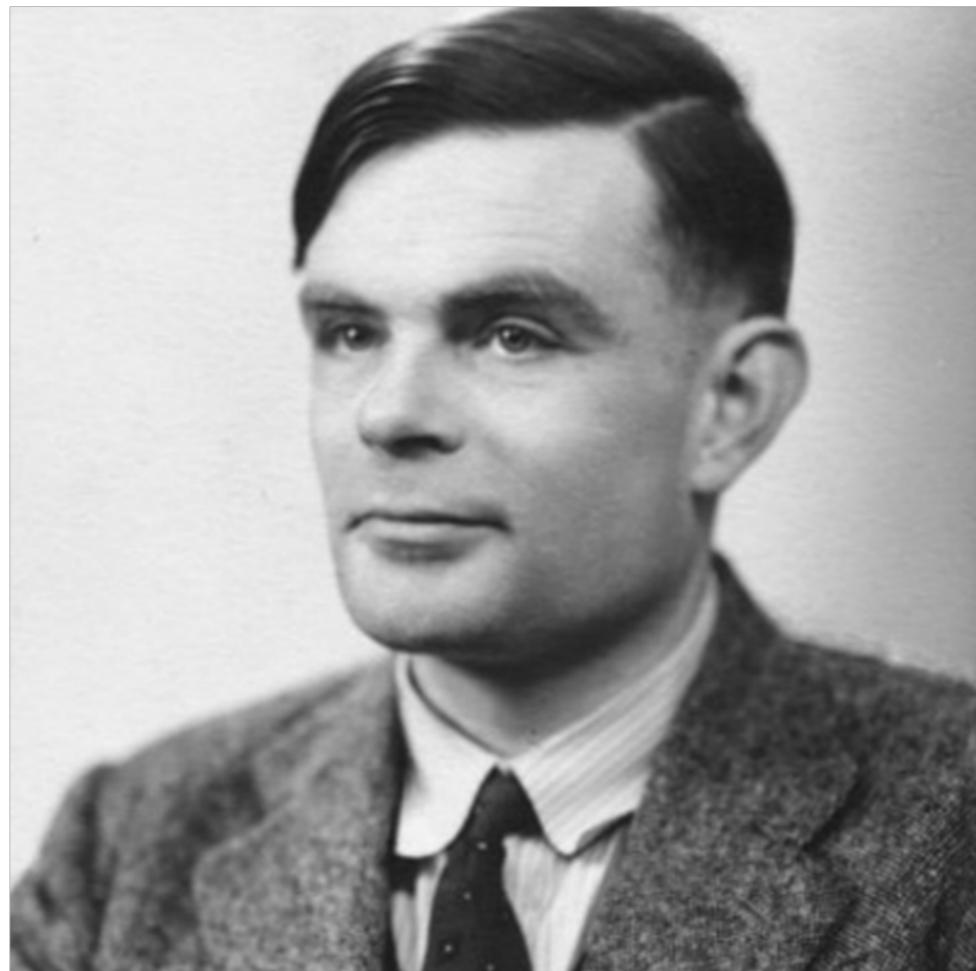
- Warren Weaver提出用计算机自动翻译人类语言。



"Also knowing nothing official about, but having guessed and inferred considerable about, powerful new mechanized methods in cryptography - methods which I believe succeed even when one does not know what language has been coded - one naturally wonders if the problem of translation could conceivably be treated as a problem in cryptography. When I look at an article in Russian, I say "This is really written in English, but it has been coded in some strange symbols. I will now proceed to decode."

图灵测试（1950）

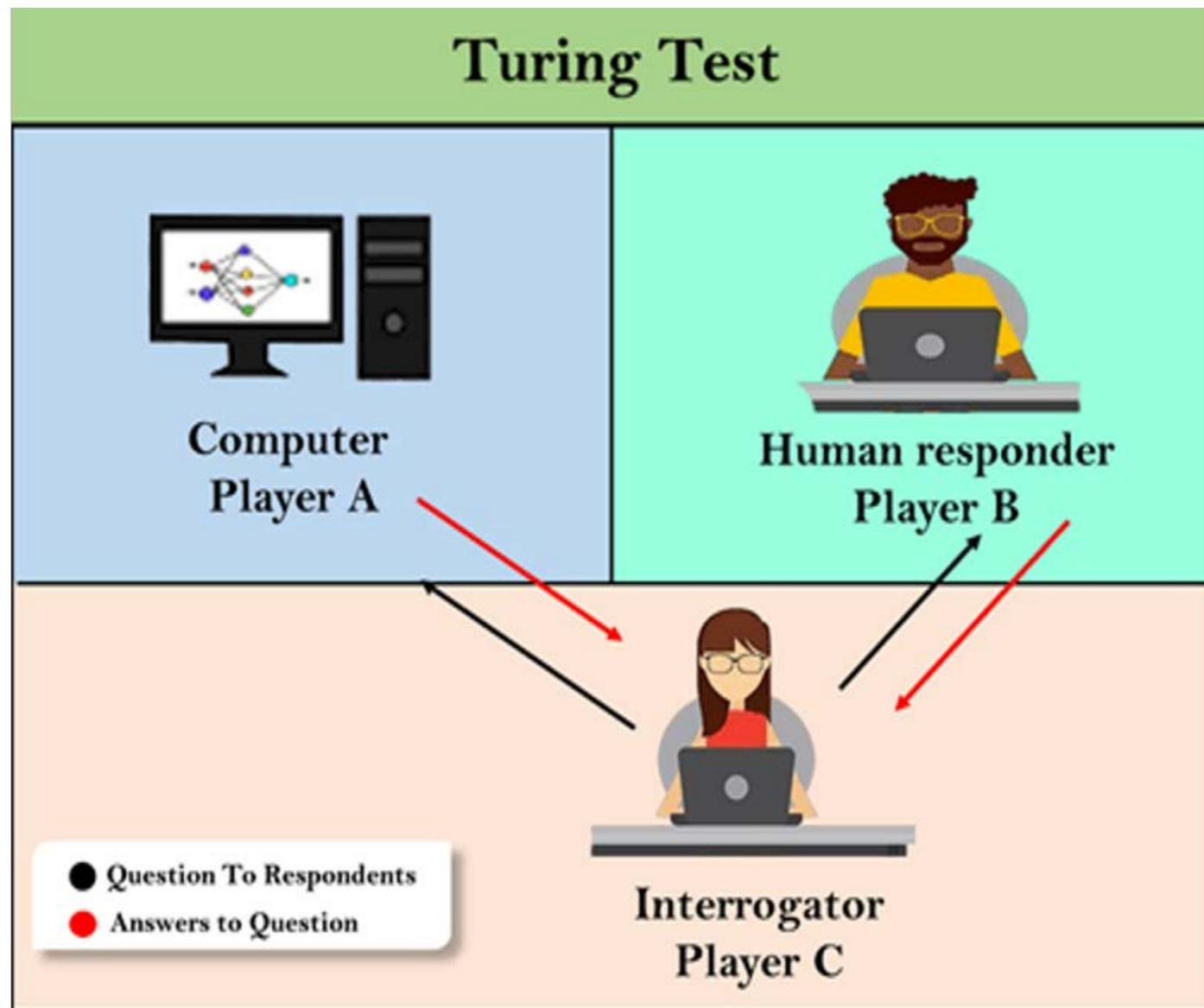
- Alan Turing提出“图灵测试”检验机器是否具备智能。



Alan Turing

图灵测试（1950）

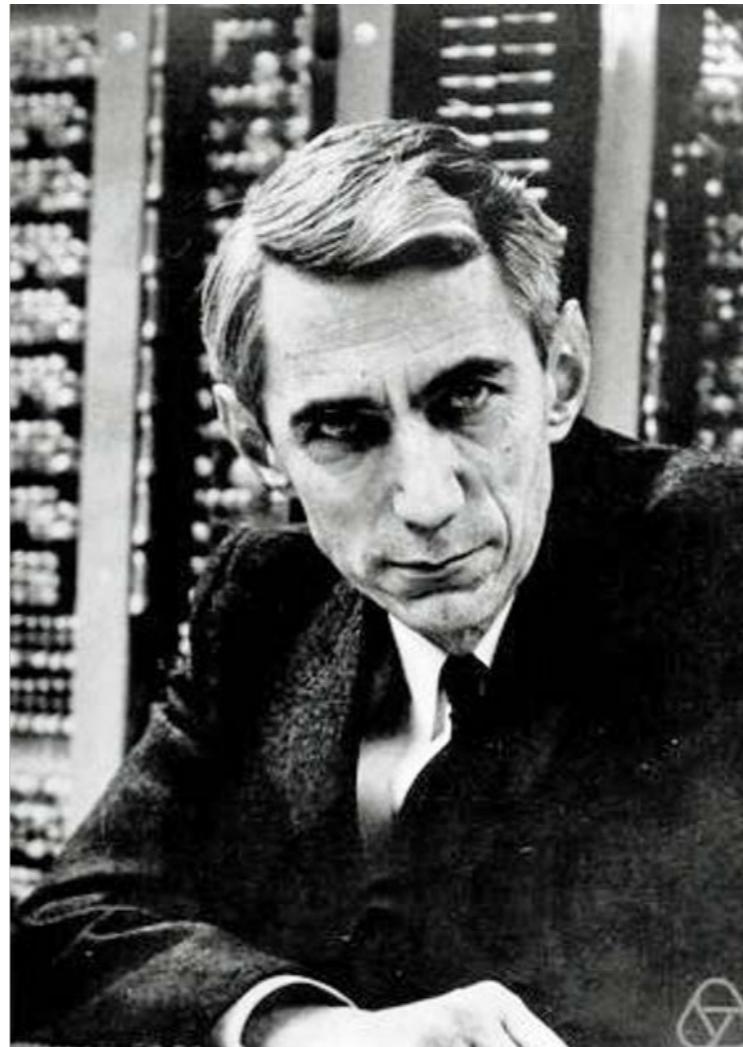
- Alan Turing提出“图灵测试”检验机器是否具备智能。



图片来源：<https://www.javatpoint.com/turing-test-in-ai>

计算机下棋（1950）

- Claude Shannon提出利用计算机实现下国际象棋。



Claude Shannon

计算机下棋（1950）

- Claude Shannon提出利用计算机实现下国际象棋。

Philosophical Magazine, Ser.7, Vol. 41, No. 314 - March 1950.

XXII. Programming a Computer for Playing Chess¹

By CLAUDE E. SHANNON

Bell Telephone Laboratories, Inc., Murray Hill, N.J.²

[Received November 8, 1949]

1. INTRODUCTION

This paper is concerned with the problem of constructing a computing routine or "program" for a modern general purpose computer which will enable it to play chess. Although perhaps of no practical importance, the question is of theoretical interest, and it is hoped that a satisfactory solution of this problem will act as a wedge in attacking other problems of a similar nature and of greater significance. Some possibilities in this direction are: -

形式语言 (1950)

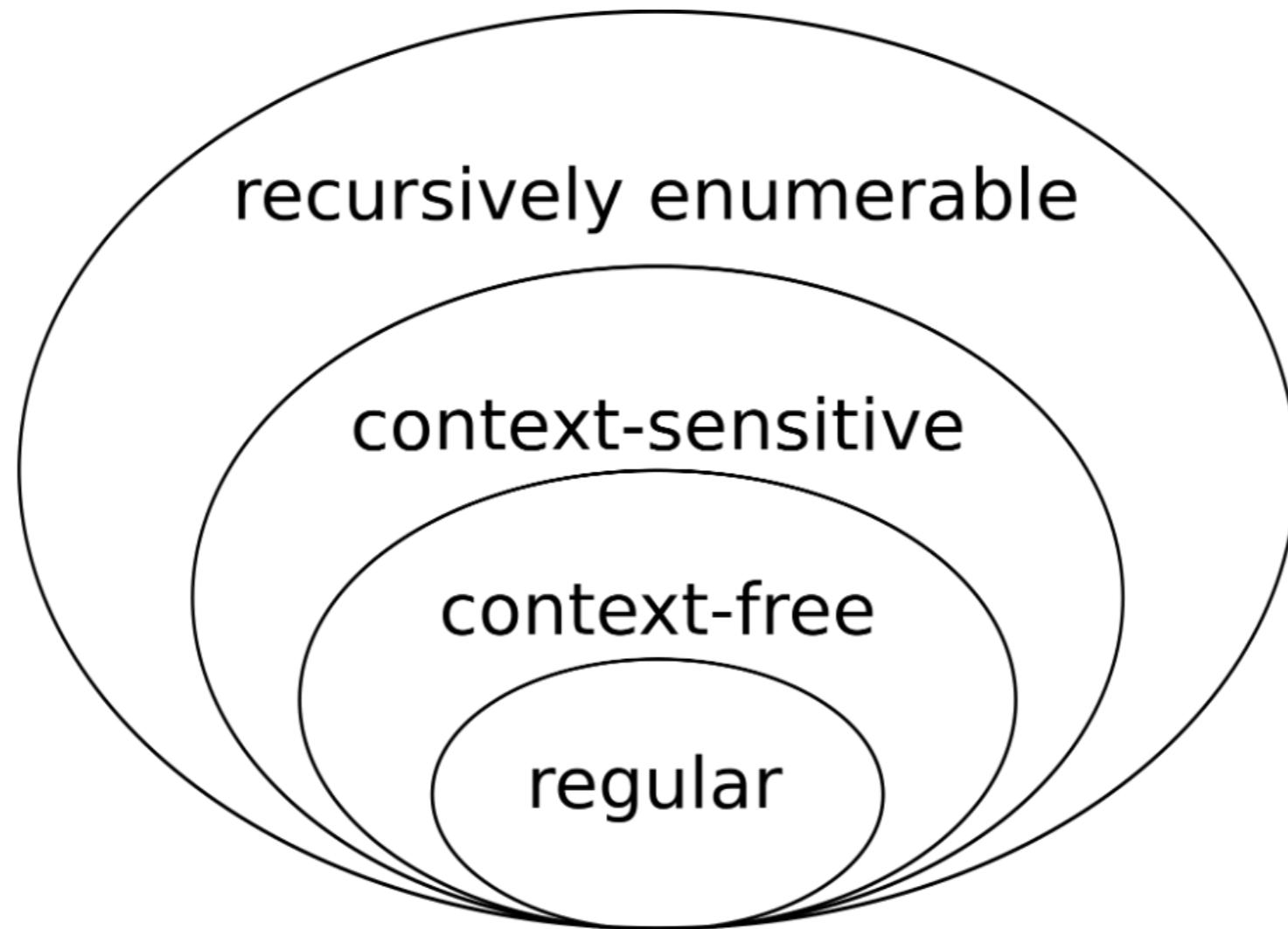
- Noam Chomsky提出形式语言体系，用数学描述语言。



Noam Chomsky

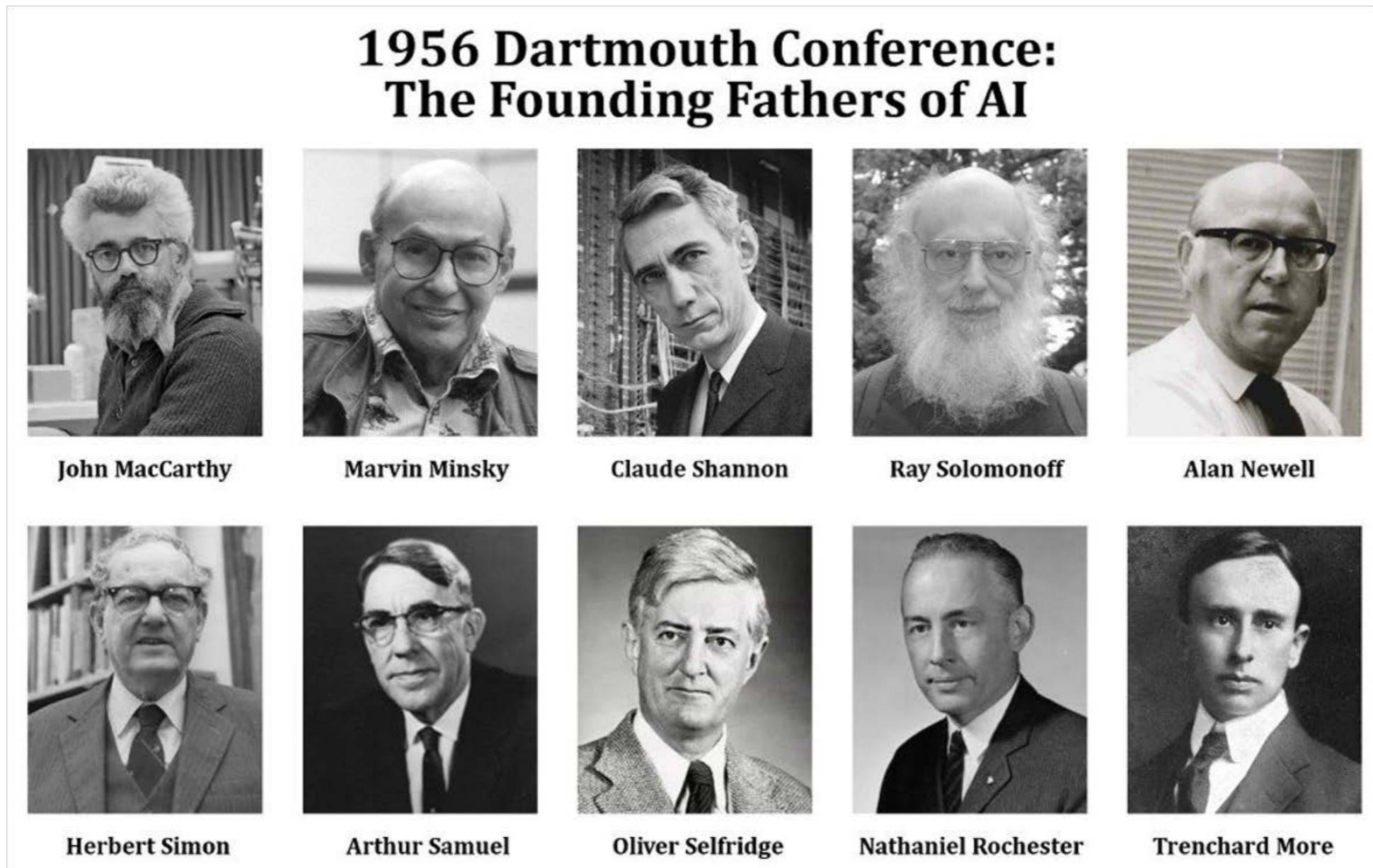
形式语言 (1950)

- Noam Chomsky提出形式语言体系，用数学描述语言。



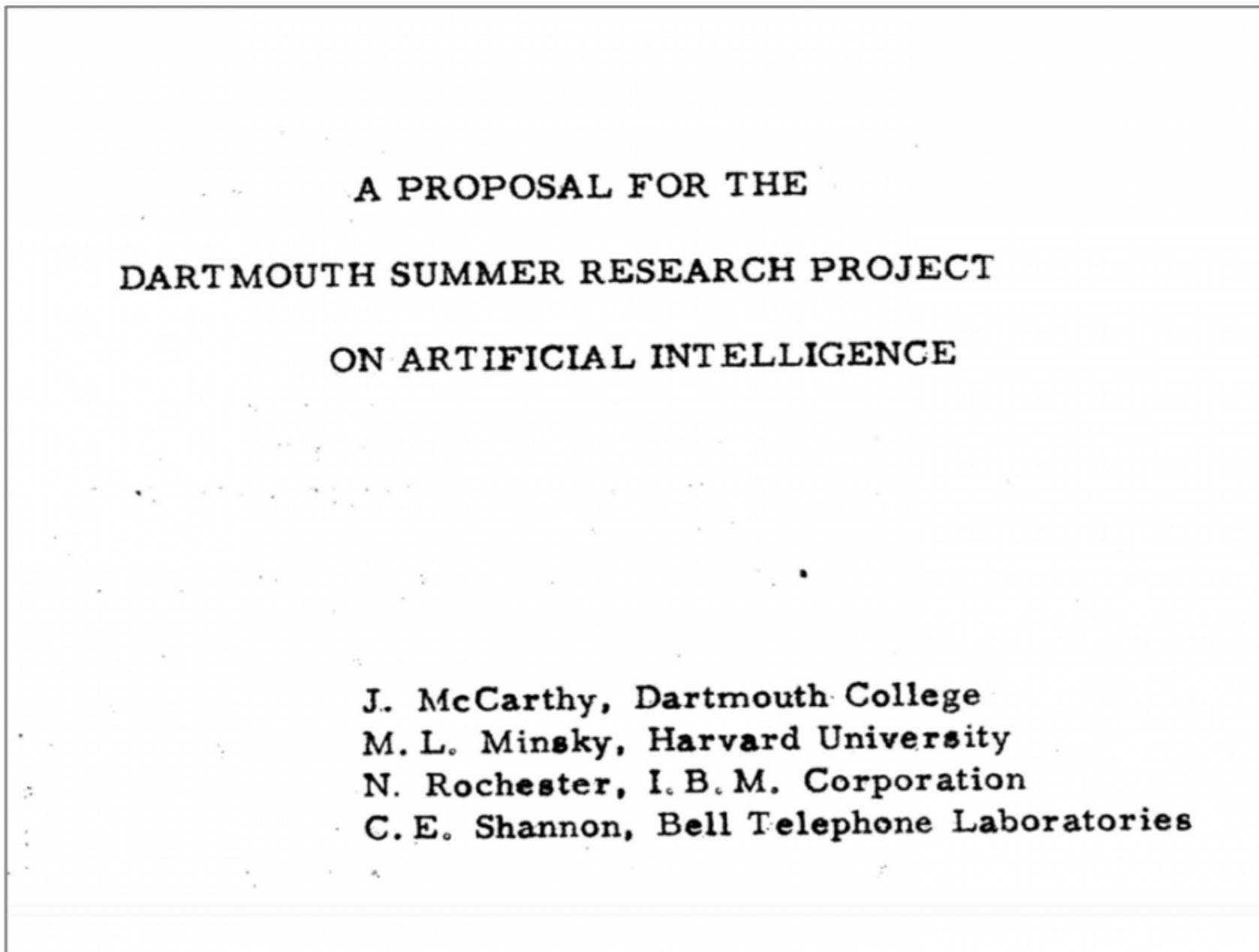
达特茅斯会议 (1956)

- 达特茅斯会议的召开标志着人工智能正式诞生。



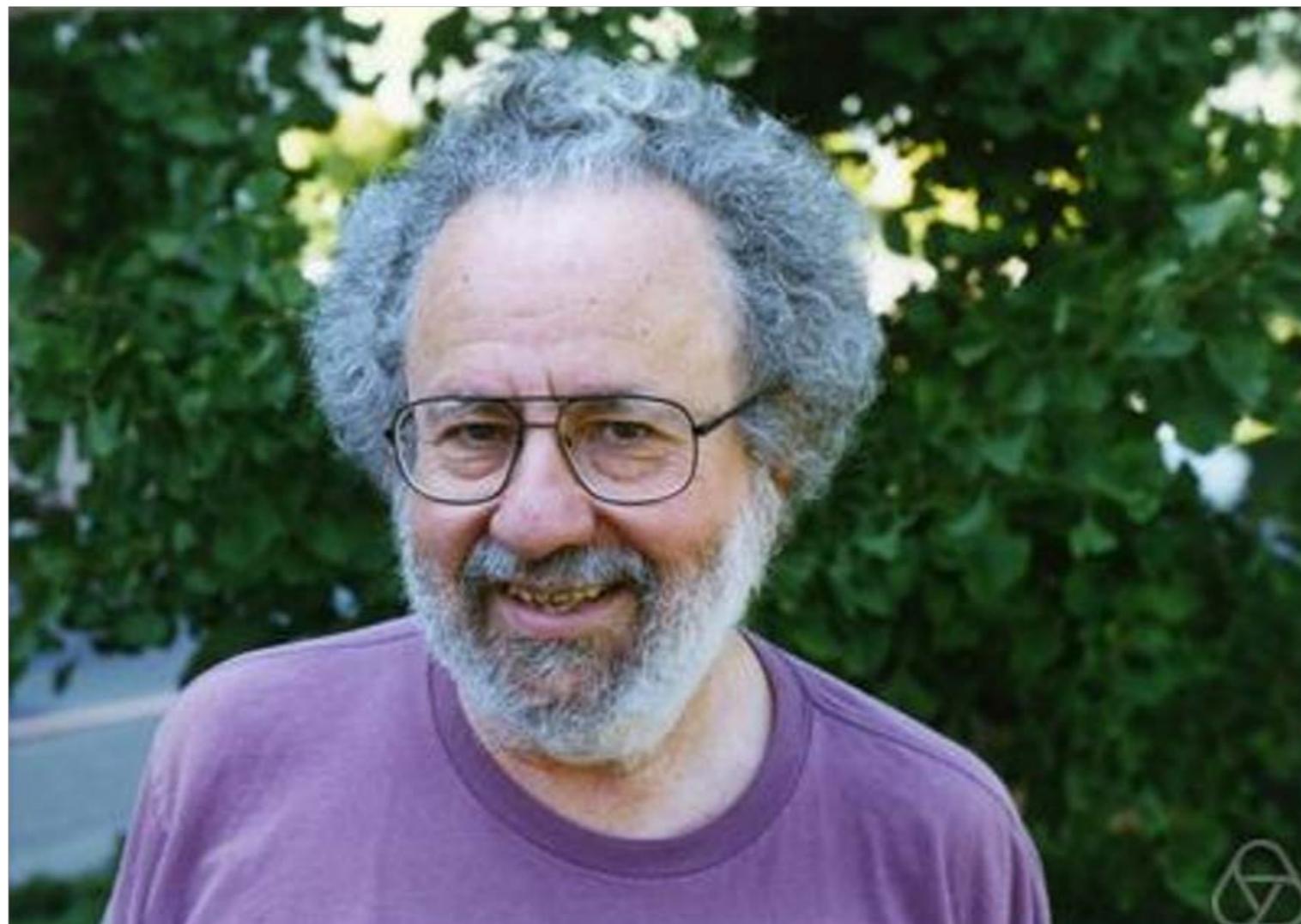
达特茅斯会议 (1956)

- 达特茅斯会议的召开标志着人工智能正式诞生。



自动定理证明 (1956)

- Martin Davis率先对自动定理证明开展研究。



Martin Davis

自动定理证明 (1956)

- Martin Davis率先对自动定理证明开展研究。

(1)	$\neg(P \vee Q), \neg Q \vee \neg R \rightarrow \neg P \vee \neg R$	Given
(2)	$\neg Q \vee \neg R \rightarrow \neg P \vee \neg R, P \vee Q$	(1)[1b]
(3)	$\neg Q \rightarrow \neg P \vee \neg R, P \vee Q$	(2)[2b], branch 1
(4)	$\rightarrow \neg P \vee \neg R, P \vee Q, Q$	(3)[1b]
(5)	$\rightarrow \neg P, \neg R, P \vee Q, Q$	(4)[2a]
(6)	$P \rightarrow \neg R, P \vee Q, Q$	(5)[1a]
(7)	$R, P \rightarrow P \vee Q, Q$	(6)[1a]
(8)	$R, P \rightarrow P, Q, Q$	(7)[2a]
Axiom		
(9)	$\neg R \rightarrow \neg P \vee \neg R, P \vee Q$	(2)[2b], branch 2
(10)	$\rightarrow \neg P \vee \neg R, P \vee Q, R$	(9)[1b]
(11)	$\rightarrow \neg P, \neg R, P \vee Q, R$	(10)[2a]
(12)	$P \rightarrow \neg R, P \vee Q, R$	(11)[1a]
(13)	$R, P \rightarrow P \vee Q, R$	(12)[1a]
(14)	$R, P \rightarrow P, Q, R$	(13)[2a]
Axiom		

感知机 (1957)

- Frank Rosenblatt提出了感知机，推动了神经网络发展。

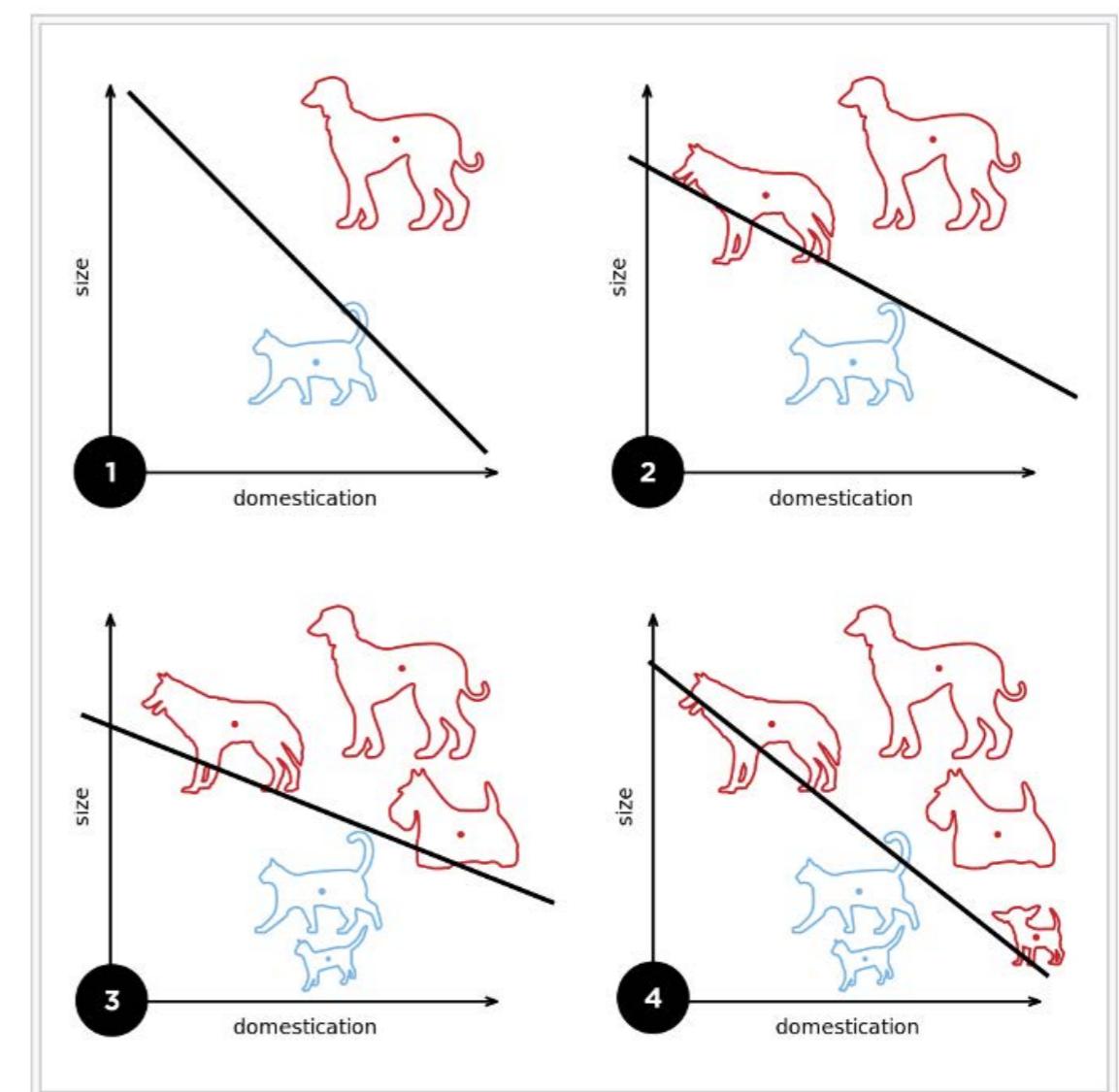


Frank Rosenblatt

感知机 (1957)

- Frank Rosenblatt提出了感知机，推动了神经网络发展。

$$f(\mathbf{x}) = \begin{cases} 1 & \text{if } \mathbf{w} \cdot \mathbf{x} + b > 0, \\ 0 & \text{otherwise} \end{cases}$$



图片来源：<https://en.wikipedia.org/wiki/Perceptron>

聊天机器人（1964）

- Joseph Weizenbaum研制聊天机器人ELIZA。



Joseph Weizenbaum

聊天机器人（1964）

- Joseph Weizenbaum研制聊天机器人ELIZA。

```
Welcome to
      EEEEEE  LL    IIII   ZZZZZZ  AAAAAA
      EE      LL    II     ZZ    AA    AA
      EEEEEE  LL    II     ZZZ   AAAAAAAA
      EE      LL    II     ZZ    AA    AA
      EEEEEE  LLLLLL IIII   ZZZZZZ  AA    AA

Eliza is a mock Rogerian psychotherapist.
The original program was described by Joseph Weizenbaum in 1966.
This implementation by Norbert Landsteiner 2005.

ELIZA: Is something troubling you ?
YOU: Men are all alike.
ELIZA: What is the connection, do you suppose ?
YOU: They're always bugging us about something or other.
ELIZA: Can you think of a specific example ?
YOU: Well, my boyfriend made me come here.
ELIZA: Is it important to you that your boyfriend made you come here ?
YOU: He says I'm depressed much of the time.
ELIZA: I am sorry to hear that you are depressed.
YOU: It's true. I am unhappy.
ELIZA: Can you explain what made you unhappy ?
YOU: ■
```

图片来源：<https://en.wikipedia.org/wiki/ELIZA>

专家系统（1965）

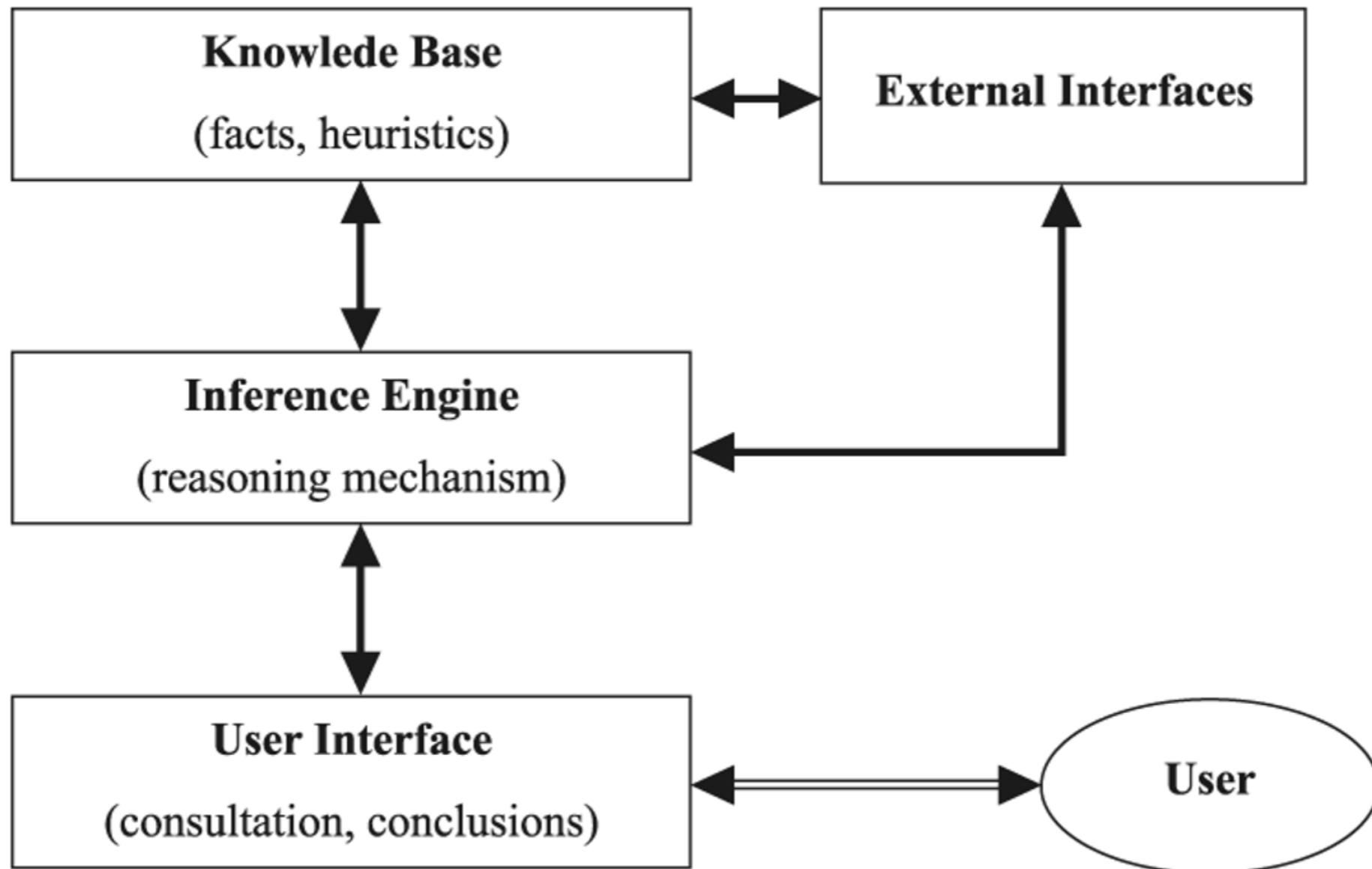
- Edward Feigenbaum提出专家系统DENDRAL。



Edward Feigenbaum

专家系统 (1965)

- Edward Feigenbaum提出专家系统DENDRAL。



图片来源: <https://expertsystem101.weebly.com/dendral.html>

隐马尔科夫模型 (1966)

- Leonard Baum和Lloyd Welch提出了隐马尔科夫模型。



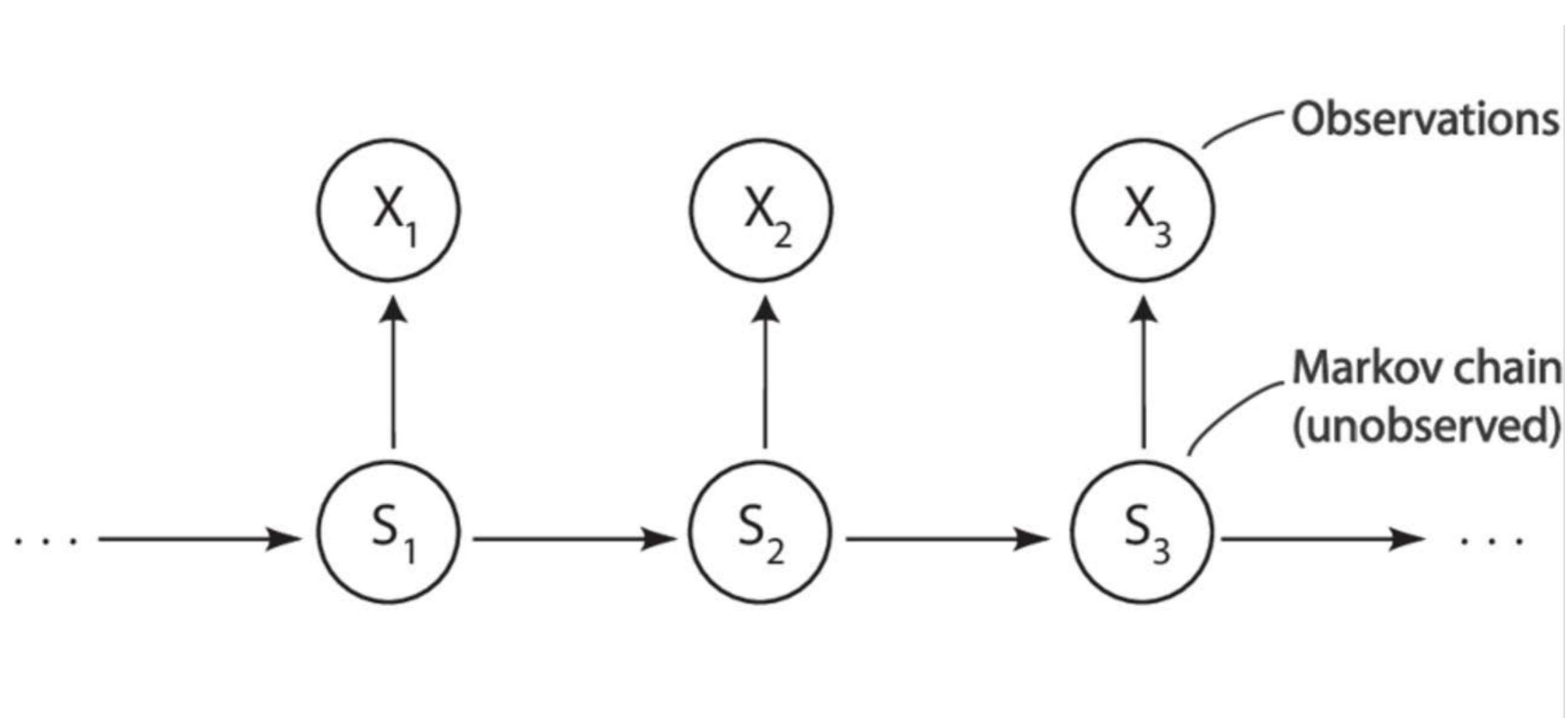
Leonard Baum



Lloyd Welch

隐马尔科夫模型 (1966)

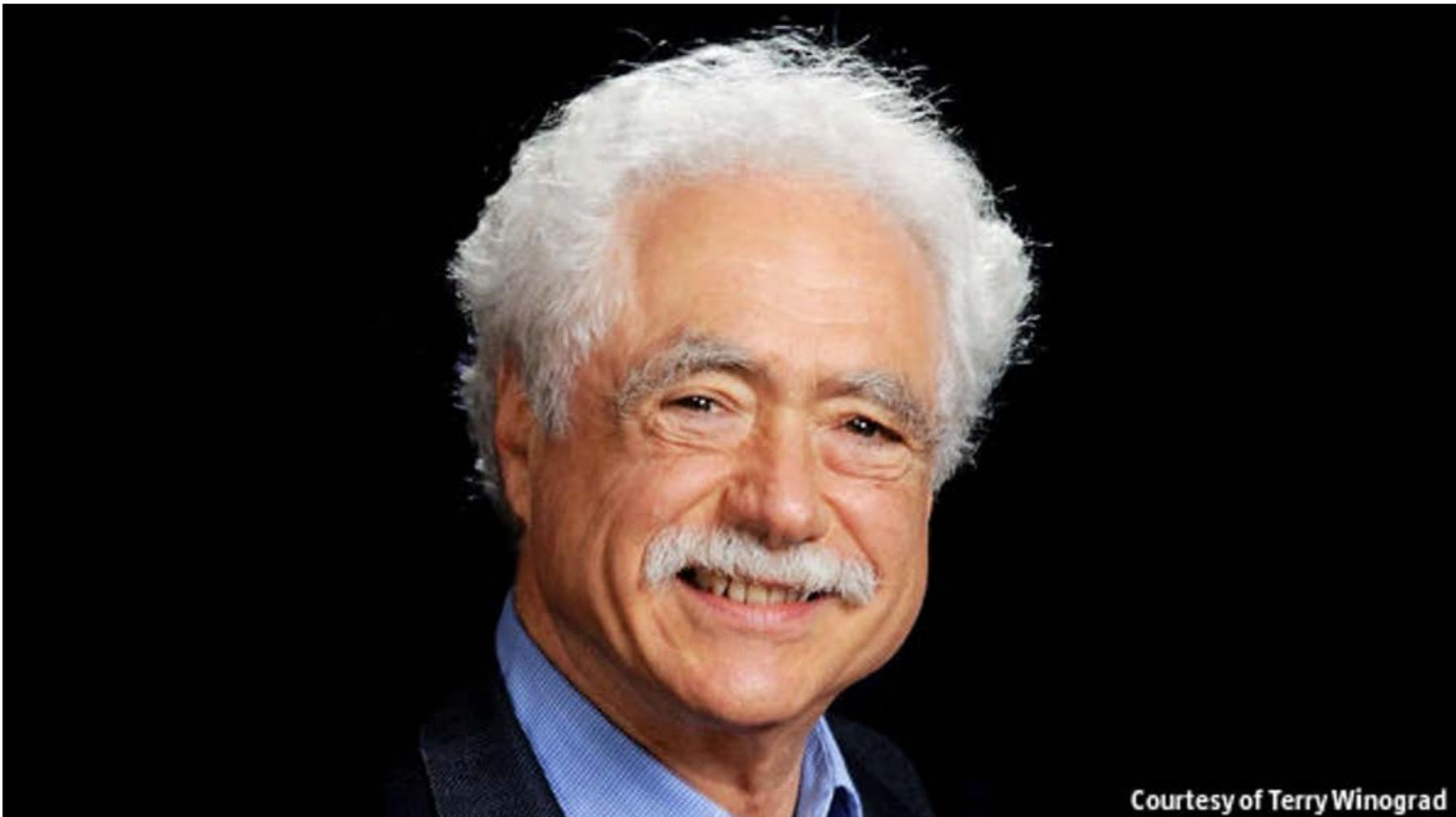
- Leonard Baum和Lloyd Welch提出了隐马尔科夫模型。



图片来源: <https://www.researchgate.net/>

积木世界 (1968)

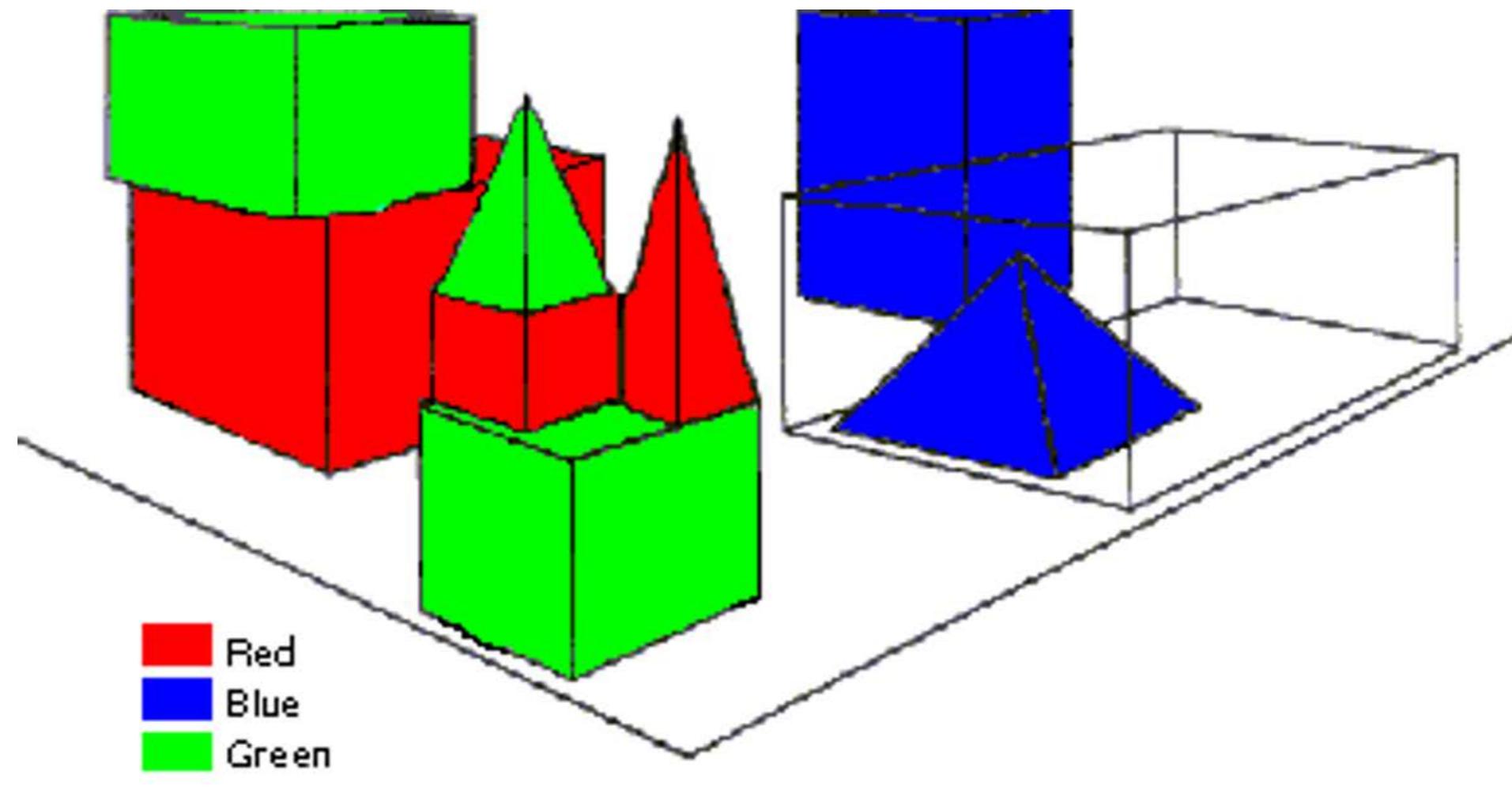
- Terry Winograd提出积木世界系统SHRDLU。



Terry Winograd

积木世界 (1968)

- Terry Winograd提出积木世界系统SHRDLU。



图片来源：<http://science.slc.edu/~jmarshall/>

积木世界 (1968)

- Terry Winograd提出积木世界系统SHRDLU。

Person: Pick up a big red block.
Computer: OK.
Person: Grasp the pyramid.
Computer: I DON'T UNDERSTAND WHICH PYRAMID YOU MEAN.
Person (changing their mind): Find a block which is taller than the one you are holding and put it into the box.
Computer: BY "IT", I ASSUME YOU MEAN THE BLOCK WHICH IS TALLER THAN THE ONE I AM HOLDING.
Computer: OK.
Person: What does the box contain?
Computer: THE BLUE PYRAMID AND THE BLUE BLOCK.
Person: What is the pyramid supported by?
Computer: THE BOX.
Person: How many blocks are not in the box?
Computer: FOUR OF THEM.
Person: Is at least one of them narrower than the one which i told you to pick up?
Computer: YES, THE RED CUBE.
Person: Is it supported?
Computer: YES, BY THE TABLE.
Person: Can the table pick up blocks?
Computer: NO.

图片来源: <https://en.wikipedia.org/wiki/SHRDLU>

后向传播算法 (1974)

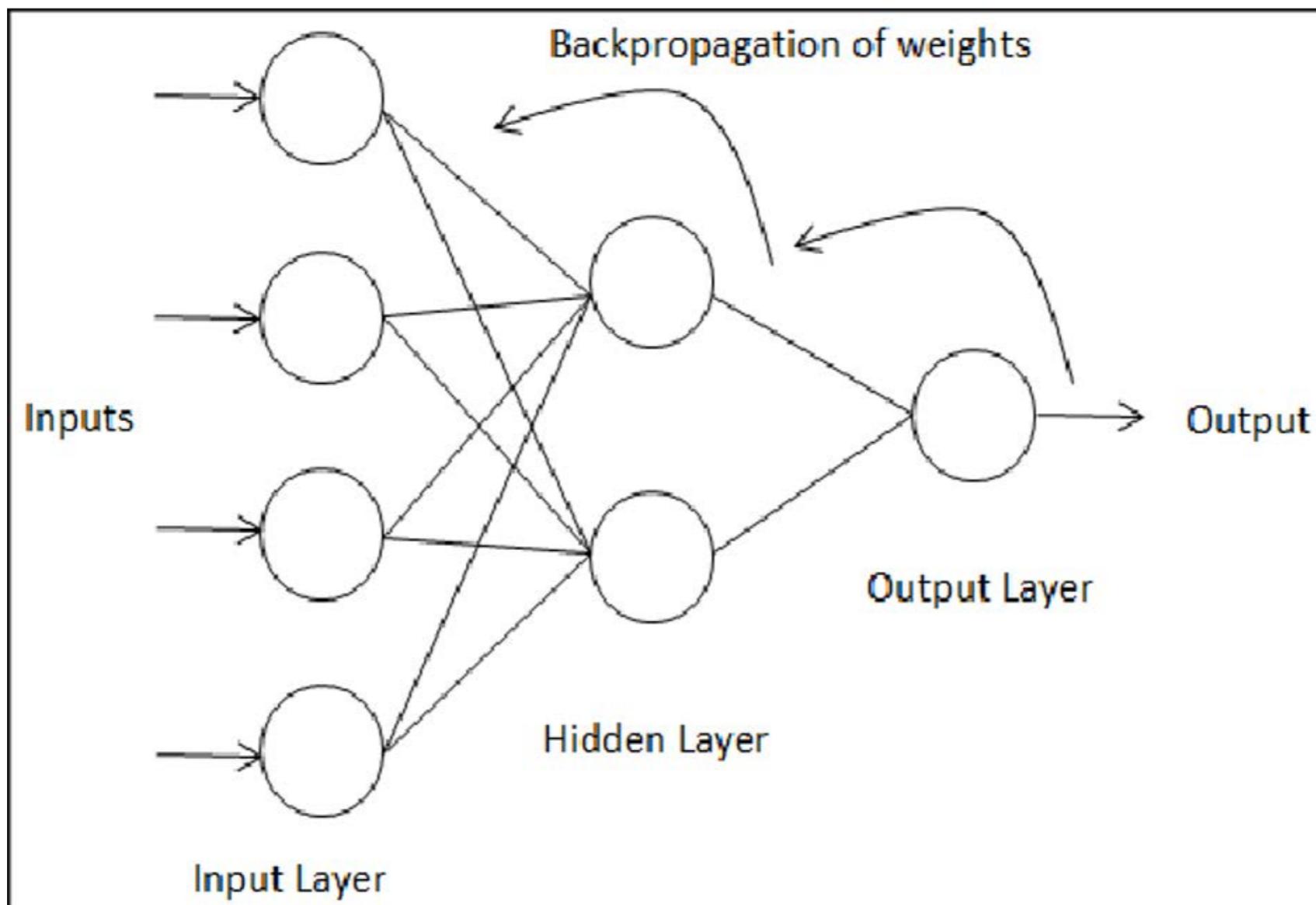
- Paul Werbos为神经网络提出后向传播算法。



Paul Werbos

后向传播算法 (1974)

- Paul Werbos为神经网络提出后向传播算法。



图片来源: <https://www.researchgate.net/>

遗传算法（1975）

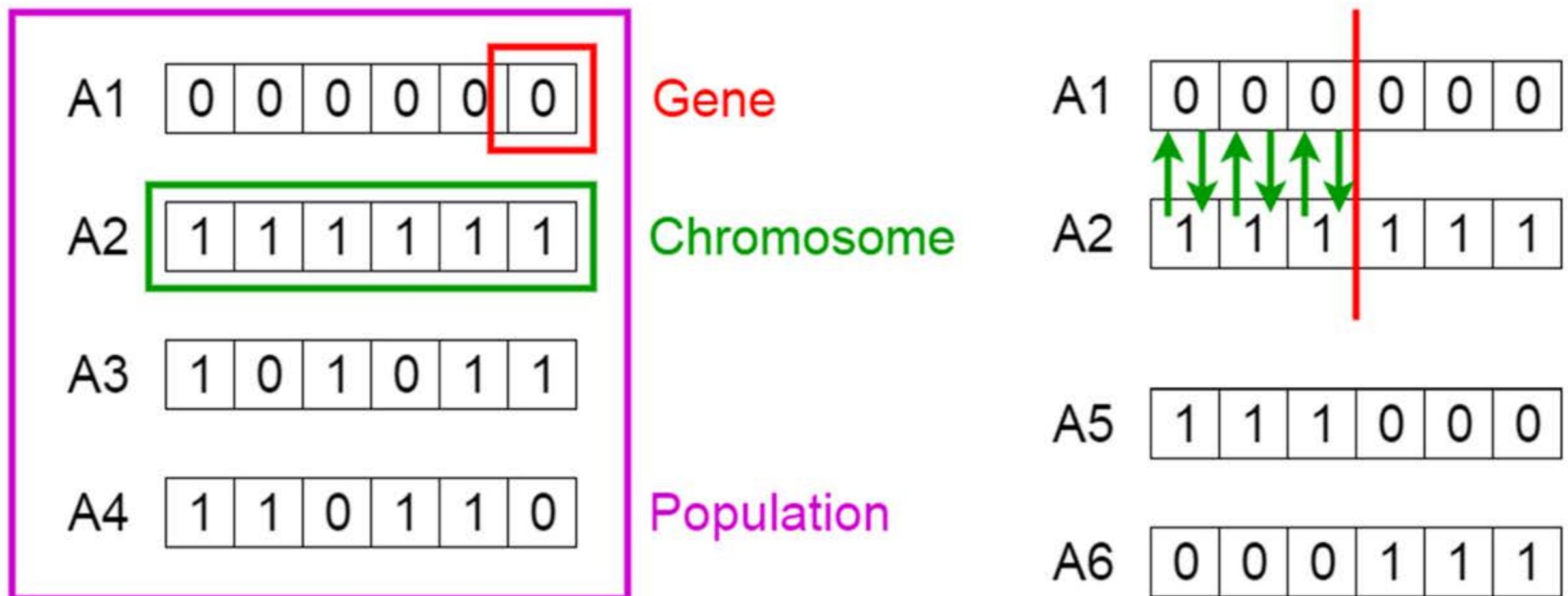
- John Holland模拟达尔文生物进化论提出遗传算法。



John Holland

遗传算法 (1975)

- John Holland模拟达尔文生物进化论提出遗传算法。



图片来源: <https://towardsdatascience.com/>

知识库（1984）

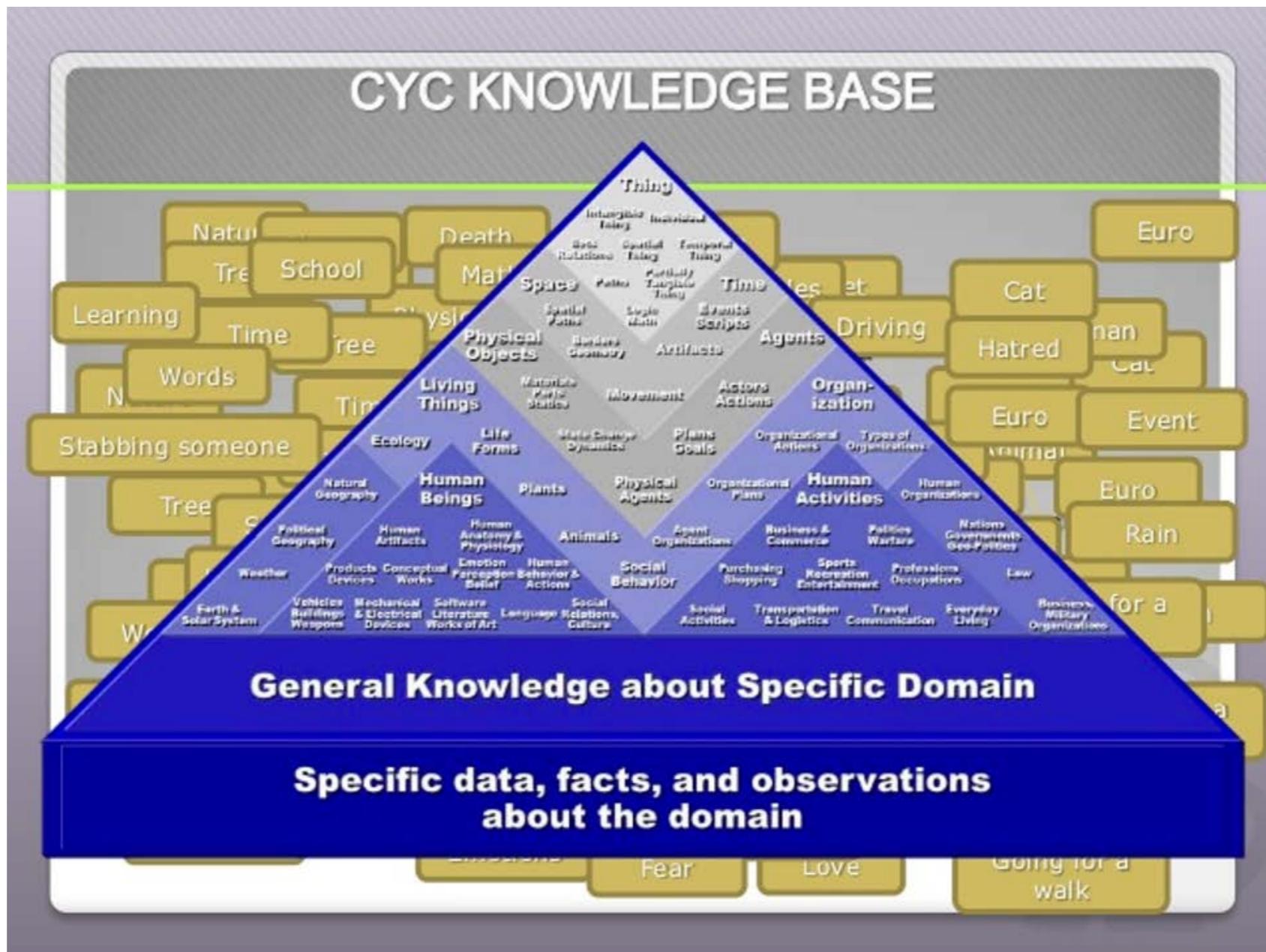
- Douglas Lenat提出了常识知识库Cyc。



Douglas Lenat

知识库（1984）

- Douglas Lenat提出了常识知识库Cyc。



支持向量机 (1995)

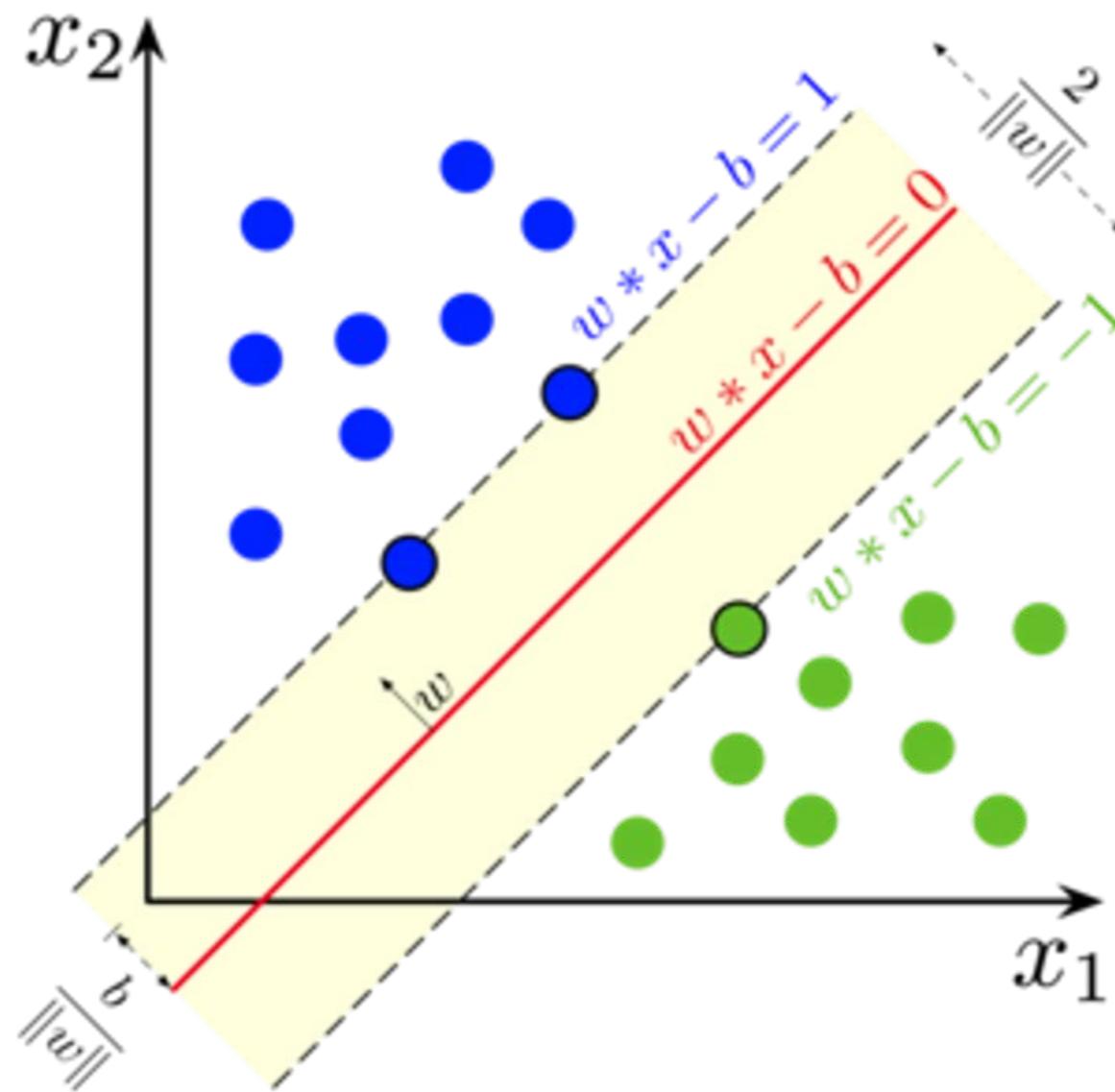
- Vladimir Vapnik提出支持向量机。



Vladimir Vapnik

支持向量机 (1995)

- Vladimir Vapnik提出了支持向量机。



图片来源: https://en.wikipedia.org/wiki/Support-vector_machine

IBM“深蓝” (1997)

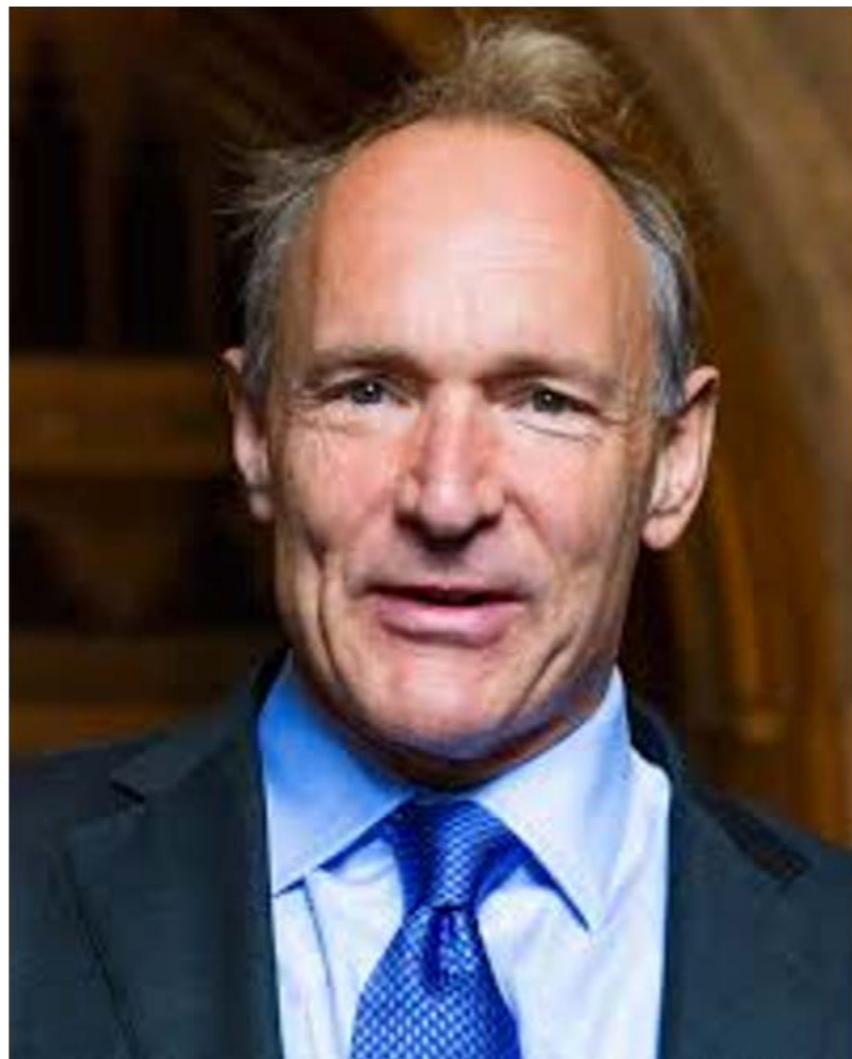
- IBM研制“深蓝”系统，击败人类国际象棋冠军。



图片来源：<http://raunorasanen.blogspot.com/>

语义网 (2001)

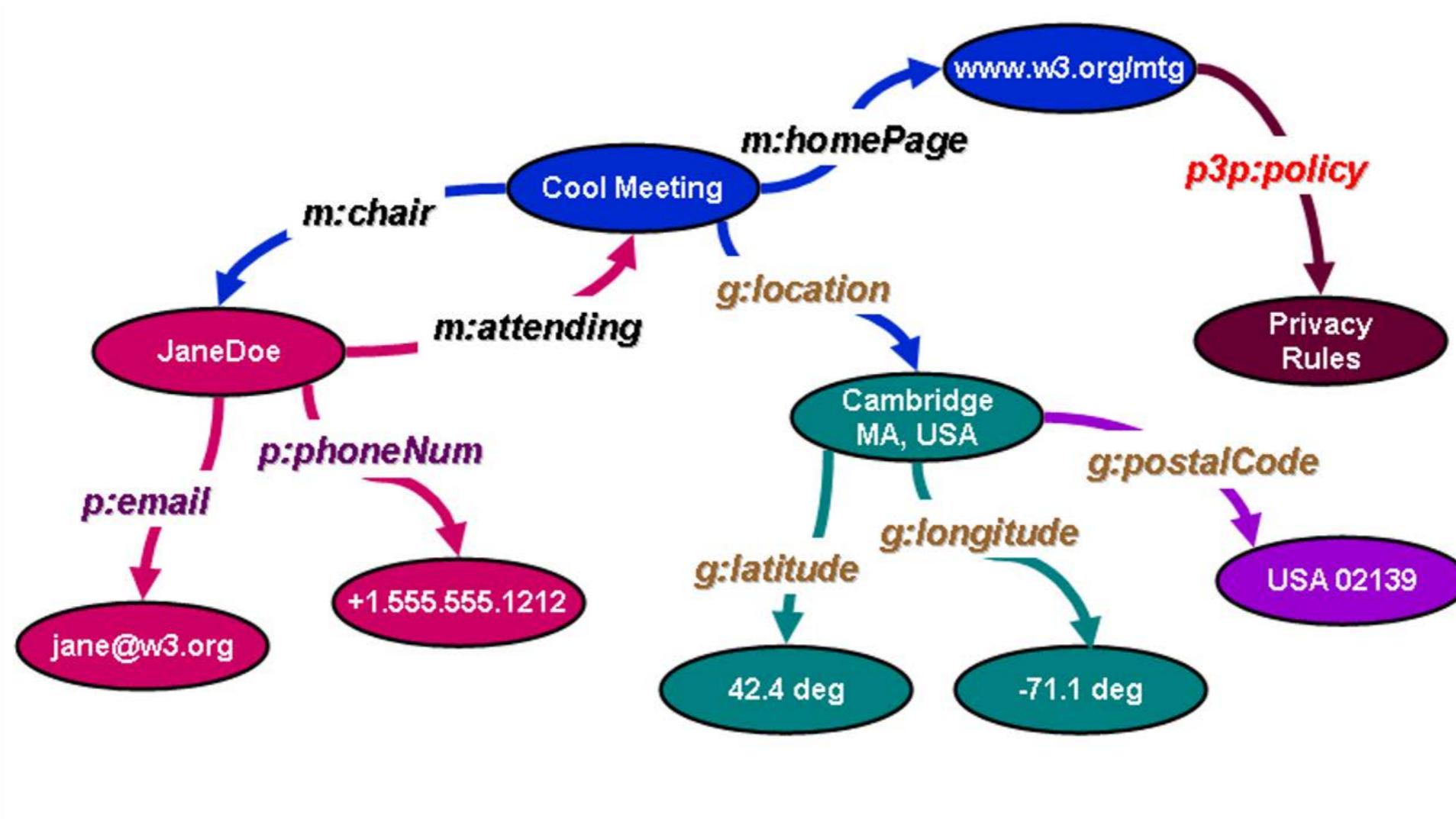
- Tim Berners-Lee提出语义网的概念。



Tim Berners-Lee

语义网 (2001)

- Tim Berners-Lee提出语义网的概念。



图片来源: <https://www.w3.org/>

深度学习 (2006)

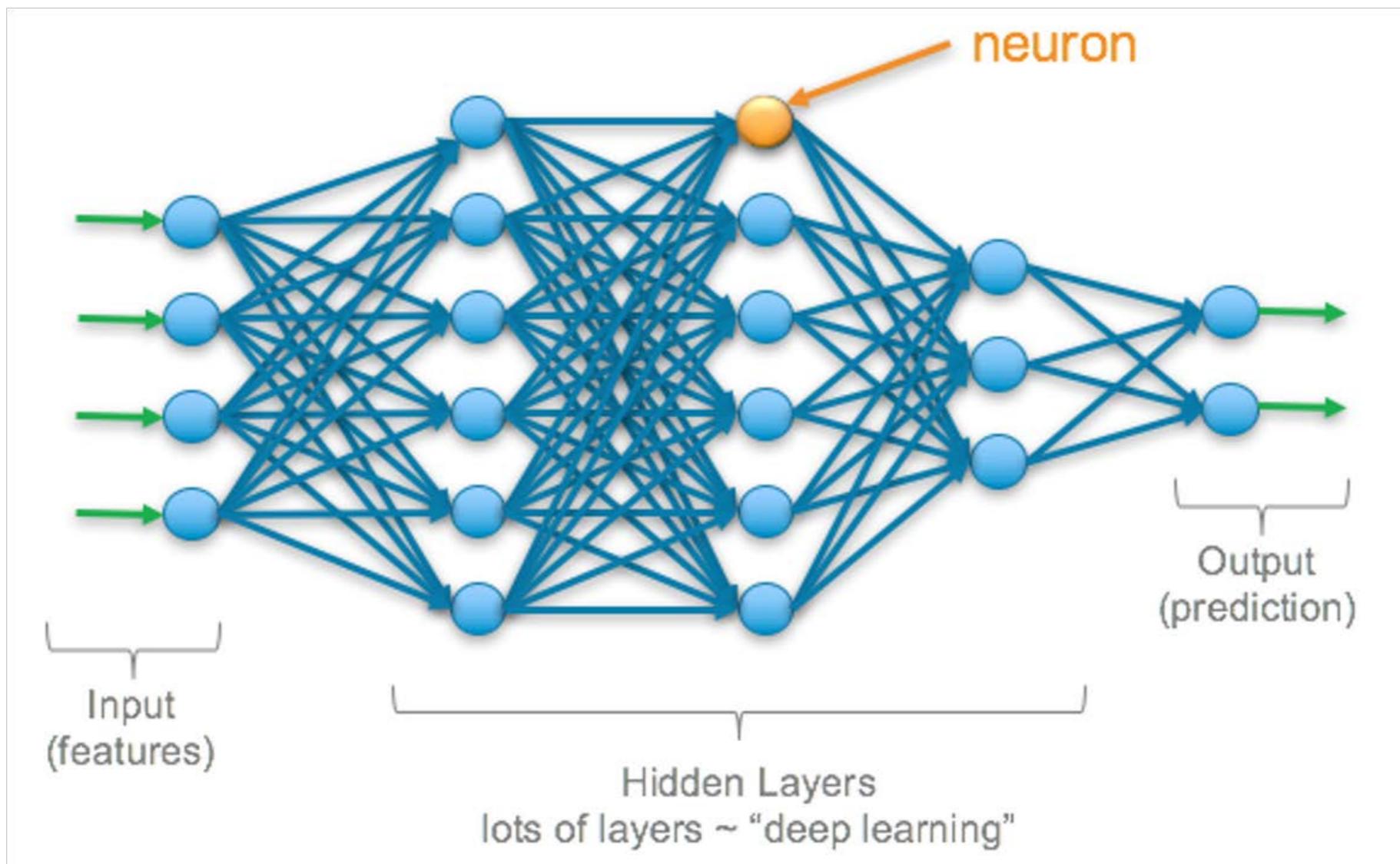
- Geoffrey Hinton引领了深度学习的兴起。



Geoffrey Hinton

深度学习 (2006)

- Geoffrey Hinton引领了深度学习的兴起。



图片来源: <https://mc.ai/deep-learning-common-architectures/>

IBM“沃森”（2011）

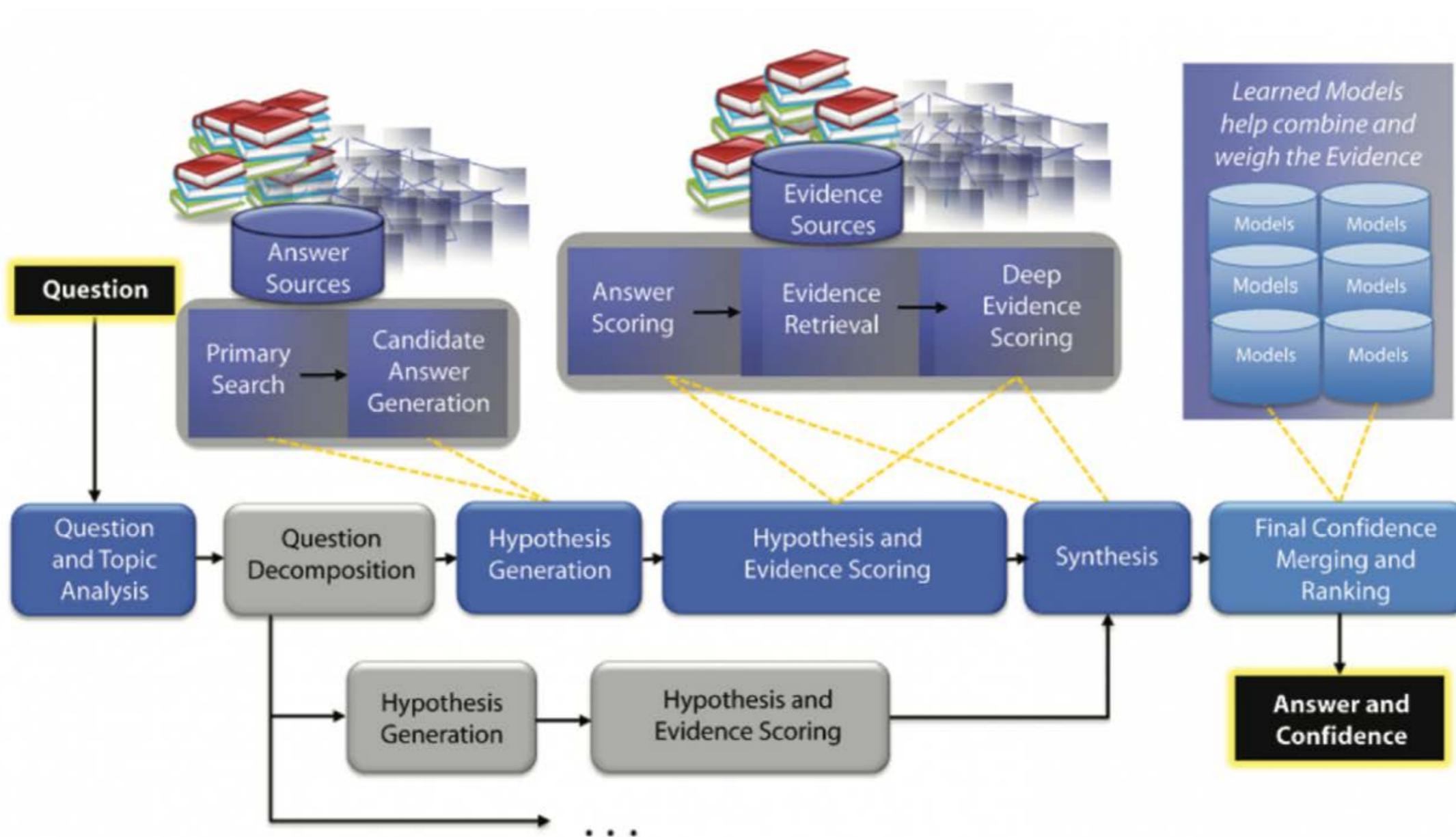
- IBM研制的“沃森”系统在知识问答任务中超过人类冠军。



图片来源：<https://www.youtube.com/>

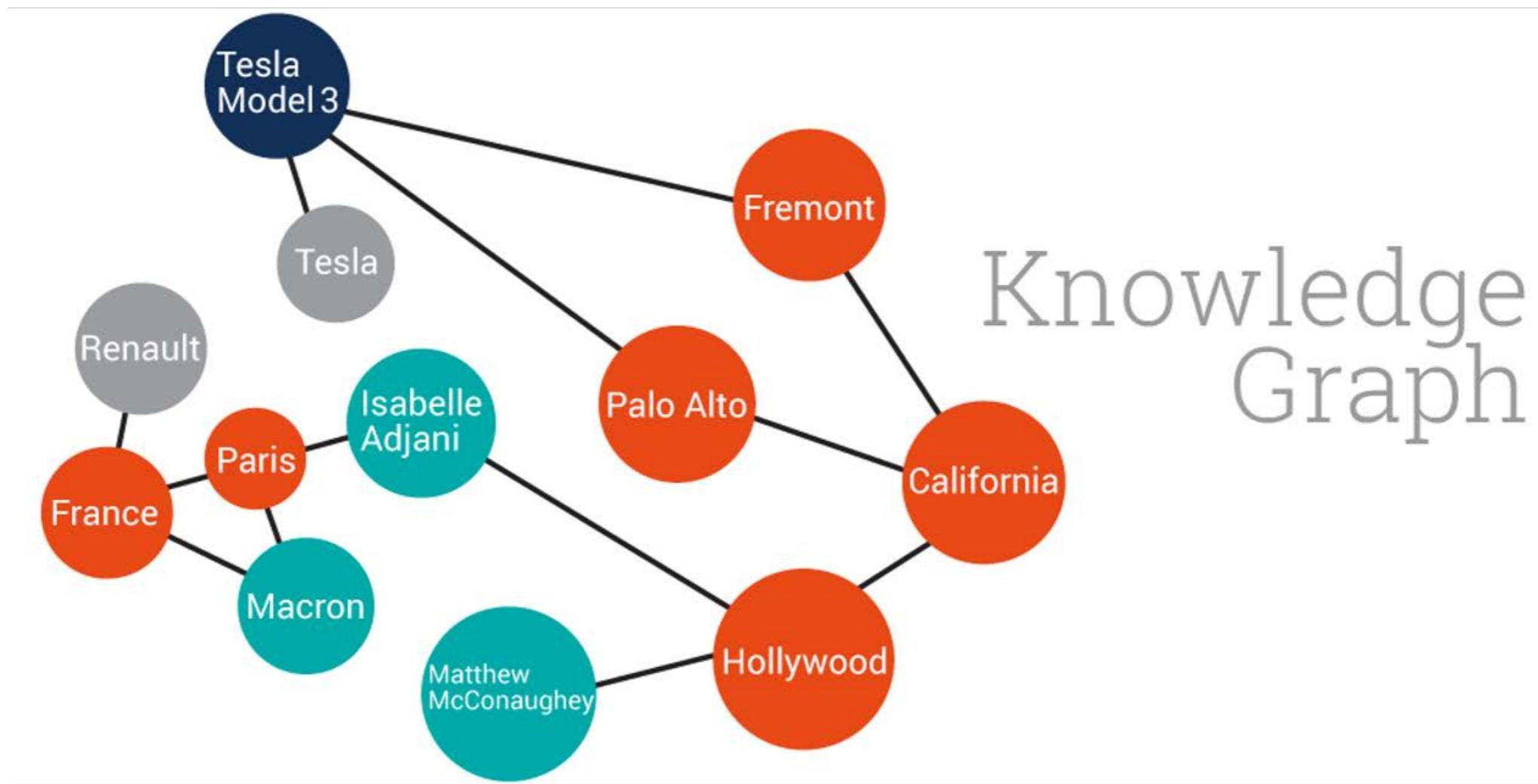
IBM“沃森” (2011)

- IBM研制的“沃森”系统在知识问答任务中超过人类冠军。



知识图谱 (2012)

- Google推出知识图谱并在搜索引擎中使用。



图片来源：<https://www.ontotext.com/>

谷歌AlphaGo (2016)

- 谷歌研制的AlphaGo系统击败人类围棋冠军。



图片来源：<http://www.bbc.com/>

谷歌AlphaGo (2016)

- 谷歌研制的AlphaGo系统击败人类围棋冠军。



图片来源：<http://nature.com/>

谷歌Transformer (2017)

- 谷歌研制的Transformer是大模型时代重要基石。

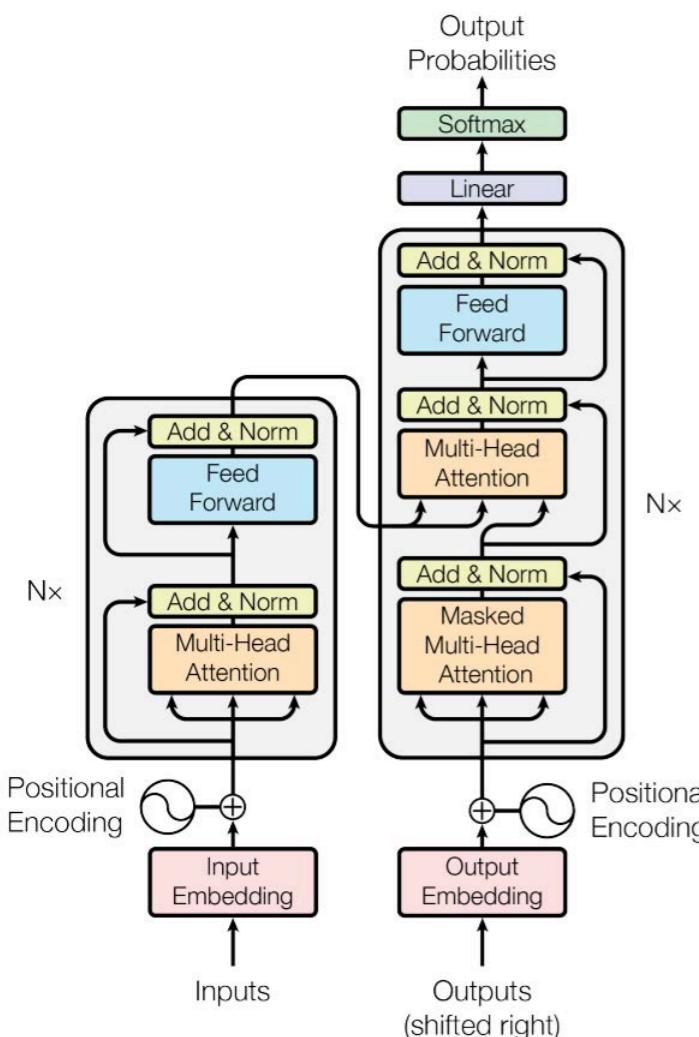


Figure 1: The Transformer - model architecture.

Provided proper attribution is provided, Google hereby grants permission to reproduce the tables and figures in this paper solely for use in journalistic or scholarly works.

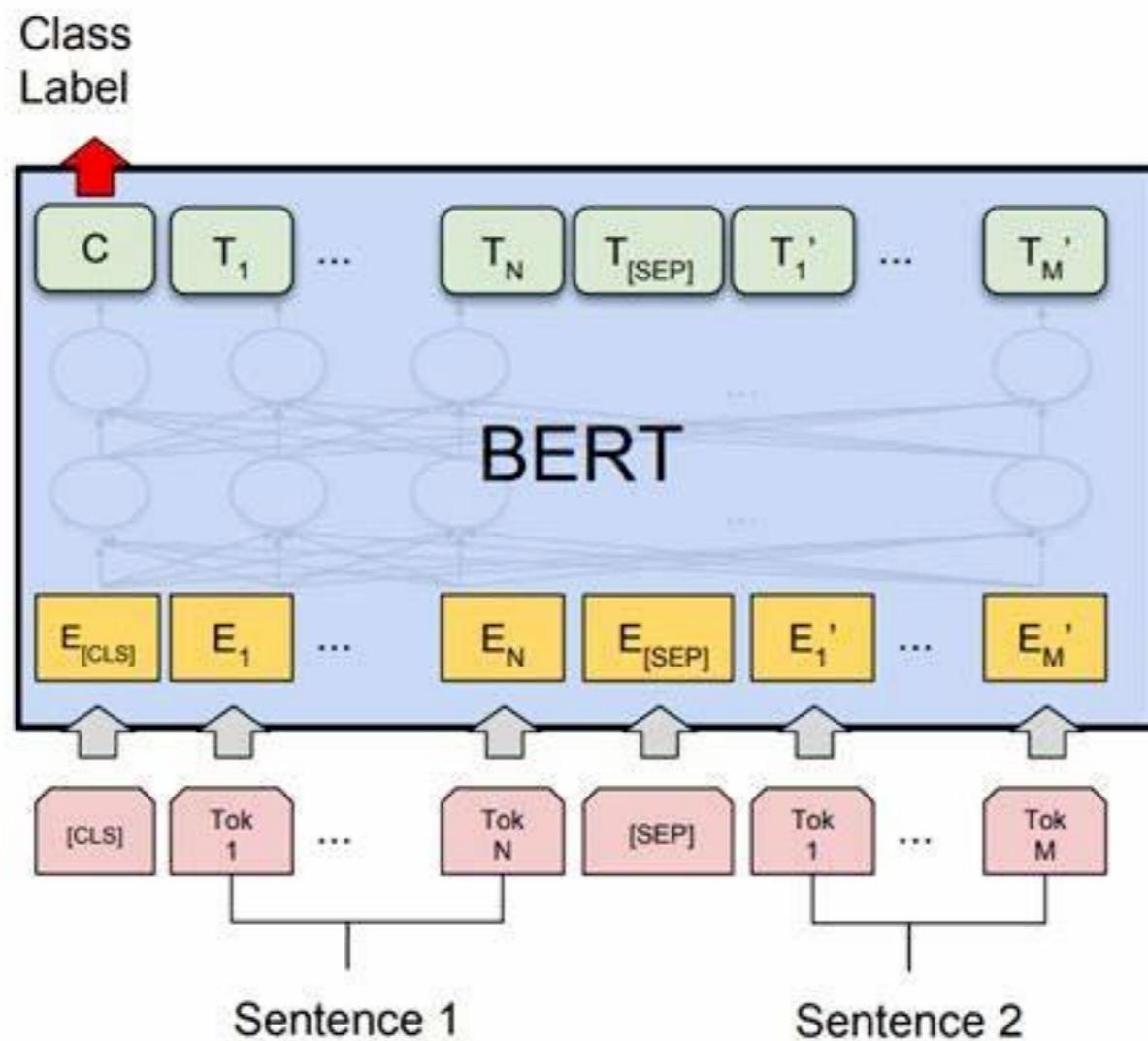
Attention Is All You Need

Ashish Vaswani* Google Brain avaswani@google.com	Noam Shazeer* Google Brain noam@google.com	Niki Parmar* Google Research nikip@google.com	Jakob Uszkoreit* Google Research usz@google.com
Llion Jones* Google Research llion@google.com	Aidan N. Gomez* † University of Toronto aidan@cs.toronto.edu	Lukasz Kaiser* Google Brain lukaszkaiser@google.com	
Illia Polosukhin* ‡ illia.polosukhin@gmail.com			

图片来源: <https://arxiv.org/abs/1706.03762>

谷歌BERT (2018)

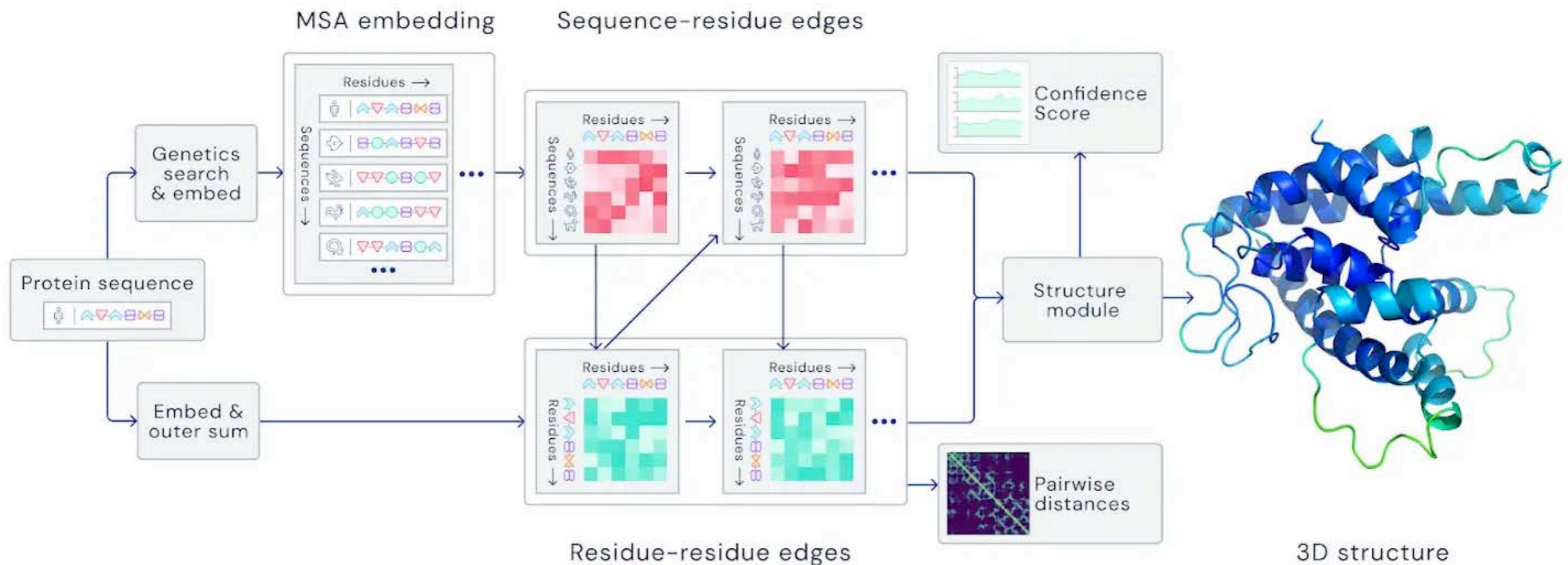
- 谷歌研制的BERT引领了超大规模预训练模型的蓬勃发展。



图片来源：<http://nlp.gluon.ai/>

谷歌AlphaFold2 (2020)

- 谷歌研制的AlphaFold2的成功预示着人工智能向科学领域挺进。



图片来源：<https://en.wikipedia.org/>

ChatGPT (2022)

- OpenAI研制的ChatGPT取得了巨大成功，很可能是一个颠覆性重大突破。

User help me write a short note to introduce myself to my neighbor

ChatGPT Hi there,

My name is [Your Name] and I just moved in next door. I wanted to reach out and introduce myself. I'm looking forward to getting to know you and the neighborhood. If you ever need anything or just want to chat, please don't hesitate to stop by or give me a call.

Best,
[Your Name]

图片来源：<https://openai.com/blog/chatgpt/>

ChatGPT (2022)

- OpenAI研制的ChatGPT取得了巨大成功，很可能是一个颠覆性重大突破。

User can you make it more formal?

ChatGPT Dear Neighbor,

I am writing to introduce myself. My name is [Your Name] and I have recently moved in next door. I wanted to take a moment to reach out and say hello. I am looking forward to getting to know you and the neighborhood.

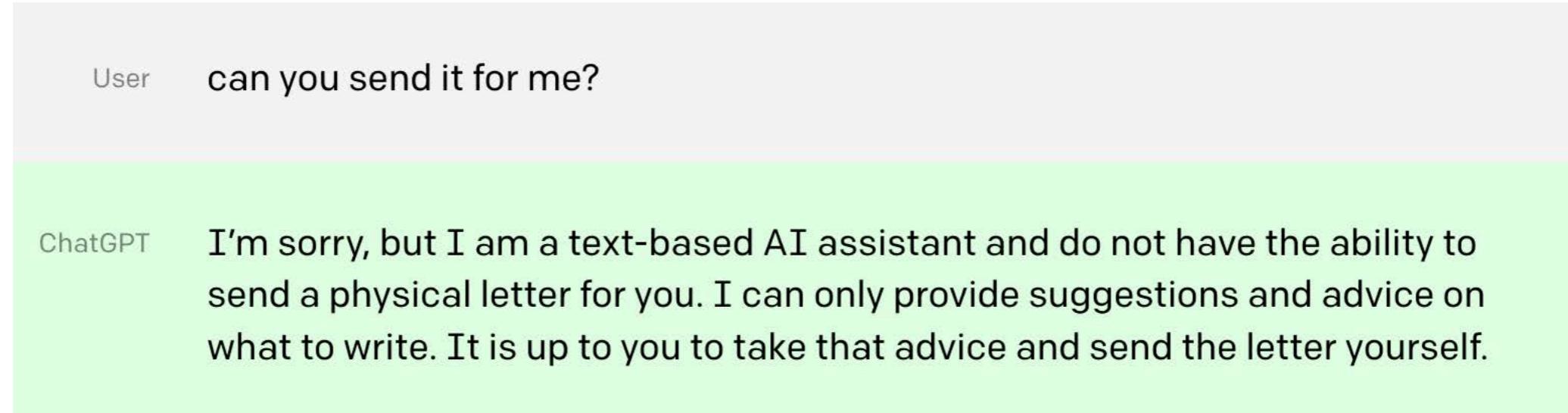
If there is anything I can do to be a good neighbor, or if you ever need anything, please do not hesitate to let me know. I am happy to help in any way that I can.

Sincerely,
[Your Name]

图片来源：<https://openai.com/blog/chatgpt/>

ChatGPT (2022)

- OpenAI研制的ChatGPT取得了巨大成功，很可能是一个颠覆性重大突破。



图片来源：<https://openai.com/blog/chatgpt/>

智能体 (2023)

- 斯坦福大学和Google建立基于自主智能体的虚拟小镇。



图片来源: <https://arxiv.org/pdf/2304.03442.pdf>

Sora (2024)

- OpenAI发布文本到视频生成系统Sora，支持1分钟长度的视频生成。



Prompt: A stylish woman walks down a Tokyo street filled with warm glowing neon and animated city signage. She wears a black leather jacket, a long red dress, and black boots, and carries a black purse. She wears sunglasses and red lipstick. She walks confidently and casually. The street is damp and reflective, creating a mirror effect of the colorful lights. Many pedestrians walk about.

图片来源: <https://openai.com/sora>

DeepSeek (2025)

- DeepSeek在2025年春节期间火爆全球，中国在AI领域的力量开始凸显。

一位74岁的男性，患糖尿病，有慢性肾病，左耳耳鸣且听力下降。他每天的食谱如下，请分析一下是否合理。如果不合理，请给出推荐的食谱。

每天早餐一个煮鸡蛋，一根黄瓜，一盘包菜，一小碗杂粮饭（20来样品种，一样一点）。午餐杂菜（8种以上有冬瓜油菜大白菜苦瓜白萝卜西兰花黑木耳等），一两杂面条（干面条），一点瘦肉或鱼。晚餐二个鹌鹑蛋一盘青菜一个西红柿一个全麦馒头或窝头或紫薯。上午加餐一袋无糖酸奶一点饼干，下午加餐一个苹果或两片面包）。但每天必吃一个水煮鸡蛋一袋牛奶二个核桃5粒杏仁。基本上是这样。



⊗ 已深度思考（用时 65 秒） ^

好的，我现在需要分析这位74岁糖尿病合并慢性肾病患者的每日食谱是否合理，如果不合理的话，还要给出推荐食谱。首先，我需要回顾一下用户提供的饮食内容，然后结合糖尿病和慢性肾病的饮食原则来评估。

首先，用户的基本情况是74岁男性，患有糖尿病和慢性肾病，主诉左耳耳鸣和听力下降。这可能与糖尿病引起的微血管病变有关，但饮食方面主要关注点还是糖尿病和肾病的营养管理。

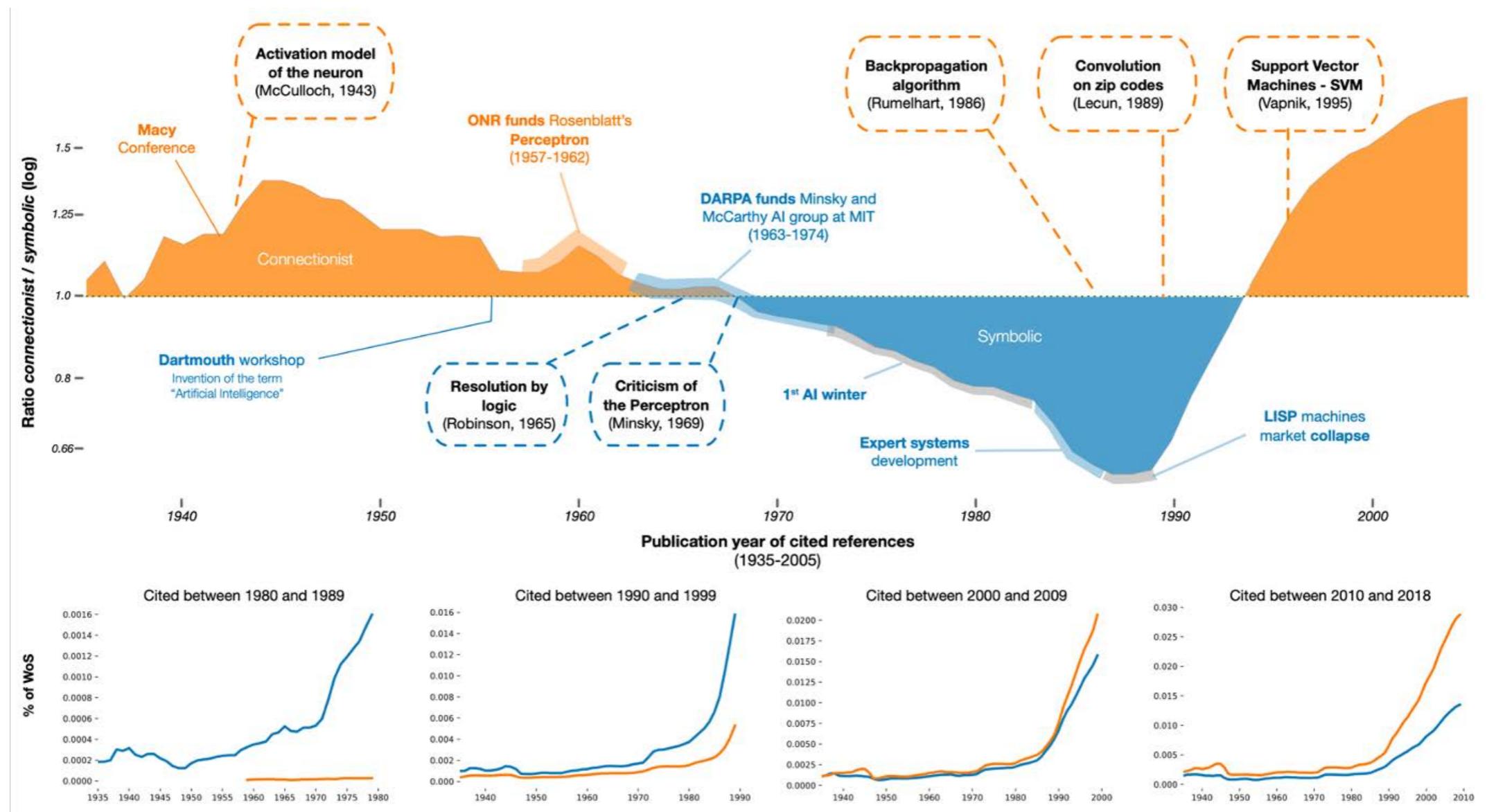
现在来看他的每日食谱：



图片来源：<https://chat.deepseek.com/>

人工智能发展历史

- 联结主义方法与符号主义方法交替占据主流地位。



图片来源：<https://neurovenge.antonomase.fr/>

现有人工智能的局限性

- 张钹院士认为当前人工智能的成功有五个限制条件

- 具备丰富的数据或知识
- 确定信息
- 完全信息
- 简单静态环境
- 单任务和有限领域



张钹，清华大学

绝大多数应用场景都不完全满足这五个条件！

未来发展趋势

当前场景	未来场景
具备丰富的数据或知识	缺乏丰富的数据或知识
确定信息	不确定信息
完全信息	不完全信息
简单静态环境	复杂动态环境
单任务和有限领域	多任务和开放领域

总结

- 人工智能是新一轮科技革命和产业变革的重要驱动力量，是我国赢得全球科技竞争主动权的重要战略抓手。
- 人工智能的发展历史是联结主义和符号主义不断交替占据主导地位的历程。
- 当前的主流方法深度学习取得了巨大的成功，但也面临着很多挑战。

谢谢