会思考的通用智能机器还有多远？

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Toutiao Lab
头条实验室

- 人工智能是什么？
- 人工智能发展到什么程度？
- 面临的挑战

什么是人工智能？ -- 类人智能

- 思维

  研究如何让计算机具备人的感知、决策、解决问题、学习能力

- 动作

  研究如何让计算机具备人的行为能力

Artificial Intelligence: a Modern Approach
[Russell & Norvig]

图灵测试

Can Computers Think?

A question raised by Alan Turing in “Computing Machinery and Intelligence”, 1950

什么是人工智能？ -- 理性智能

- 思维

  研究如何通过计算方法达到合理的感知、决策、解决问题、学习能力

- 动作

  研究如何通过计算方法形成合理的行为能力

Artificial Intelligence: a Modern Approach
[Russell & Norvig]

人工智能的研究范畴

- 知识表示、形式化推理
- 规划与决策
- 机器学习
- 理解文字、自然语言（人类语言）
- 语音识别与合成
- 理解图像、视觉感知
- 机器人控制

人工智能现状

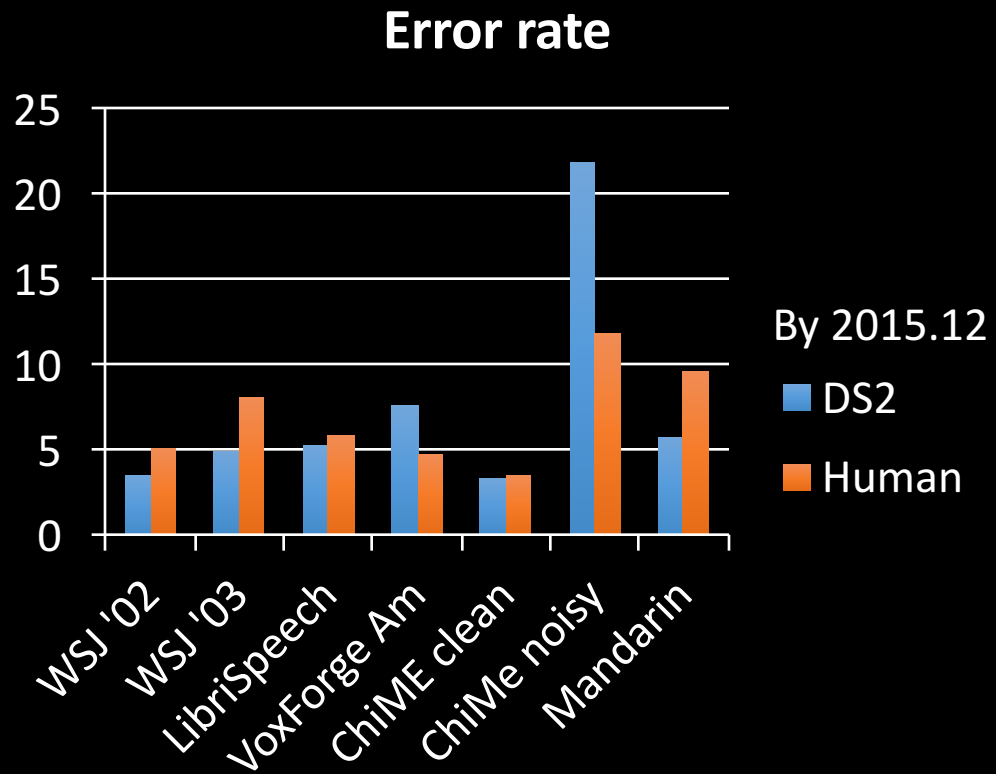
- 在某些具体任务上达到或超过人类能力
- 通用型智能还有漫漫长路

Better than human in GO playing

Via deep reinforcement learning and Monte-Carlo tree search

Towards human level in Speech recognition

Via end-to-end deep learning models

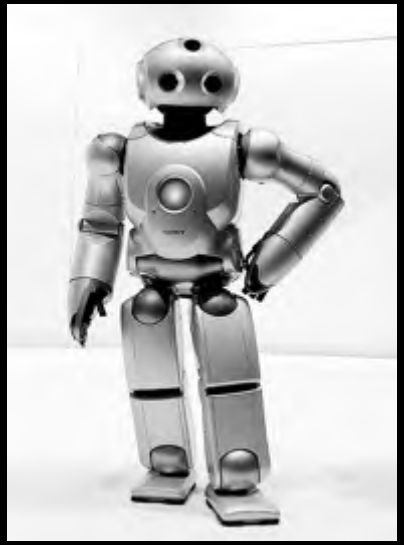


Deep Speech 2 [Amodei et. al. 2015]

Speech Is 3x Faster than Typing for English and Mandarin Text Entry on Mobile Devices, with 20% - 50% lower error rates. [Ruan et al, 2016]

Telling stories in images

A giraffe standing next to forest.



[Mao et al 2015]
[Karpathy et al, 2015]
[Kiros et al 2015]
[Vinyals et al 2015]
[Chen & Zitnick, 2015]

Toutiao Xiaomingbot: Automatic Olympic News Writing

16 days
450 articles
1million readers

奥运会羽毛球男子单打金牌赛 名宿谌龙(中国)完胜李宗伟(马来西亚) 成就冠军荣耀

奥运AI小记者Xiaomingbot 2016-08-20 22:15

简讯：北京时间8月20日20:20时，奥运会羽毛球男子单打金牌赛在里约会议中心-4号馆展开较量。现世界排名第2的谌龙迎战现世界排名第1的李宗伟，双方你来我往展开了激烈的较量。最后，耗时1时14分钟，谌龙率先在3局2胜制比赛中获得制胜分，以2:0拿下比赛，加冕桂冠，为中国夺得宝贵一金。双方各局小分分别为: 21:18，21:18。

DL algorithms work well for

Supervised learning

data

label

X

$f(\cdot)$

Y

Cat/dog/…

“今天天气不错！”

“Today is a nice day”

A giraffe standing next to forest

”打车去故宫”

Neural networks: massively connected simple units

Inspired by a biological neuron

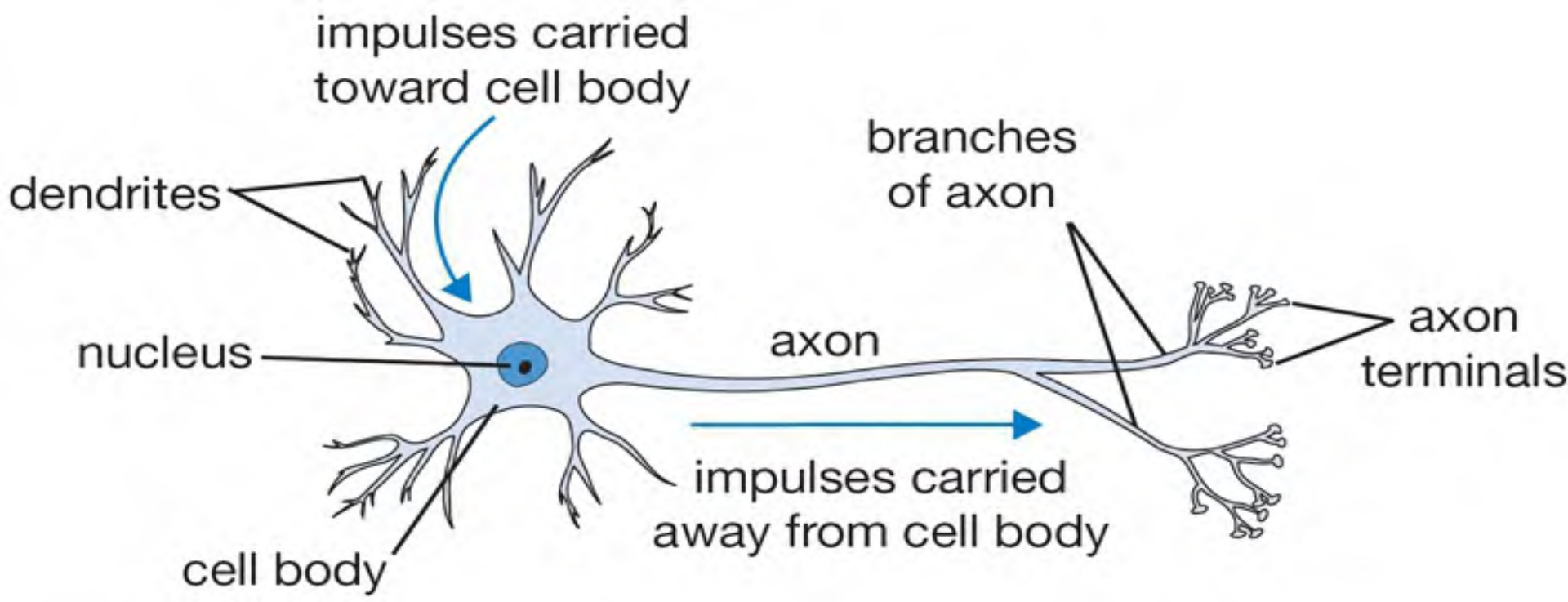
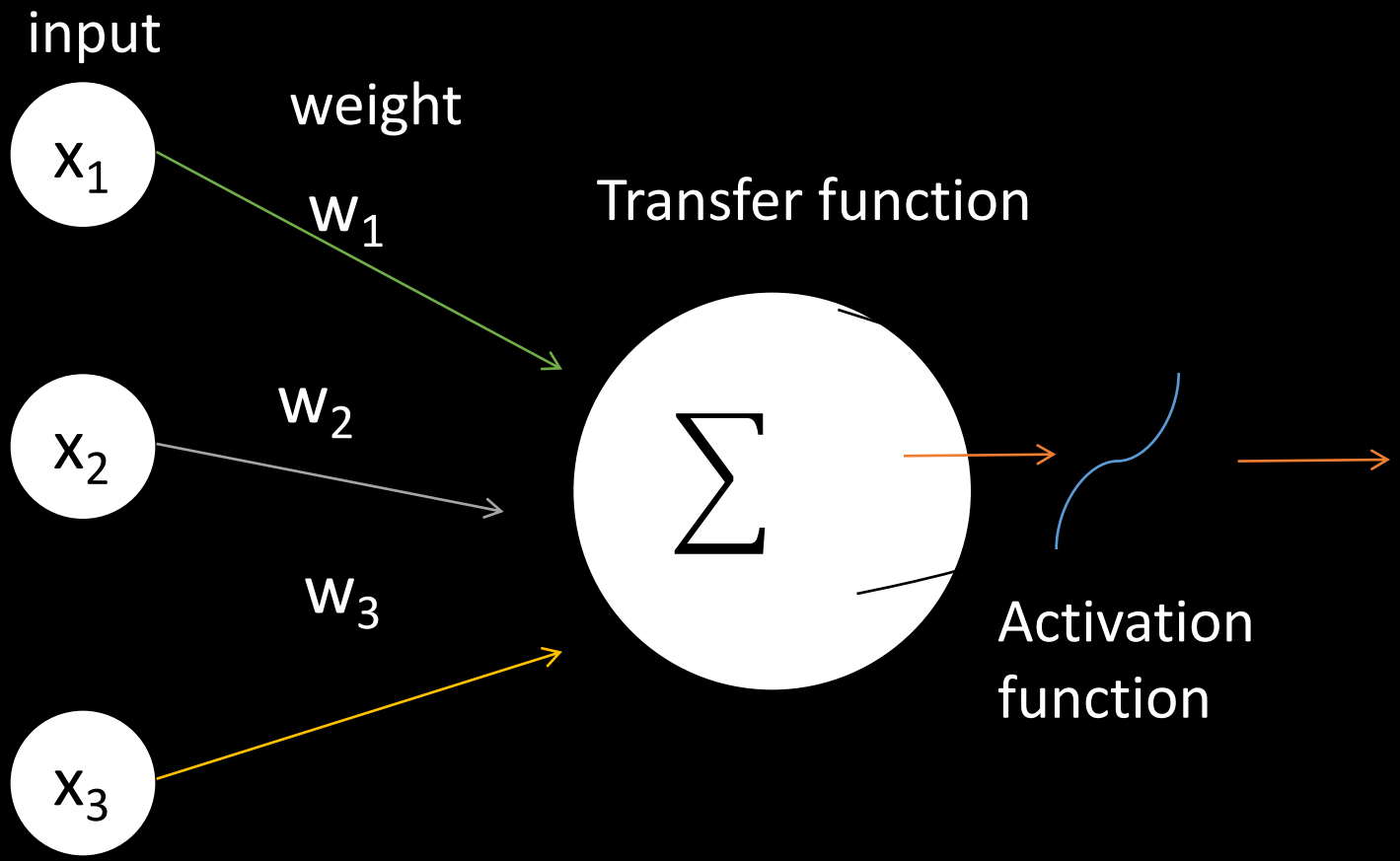


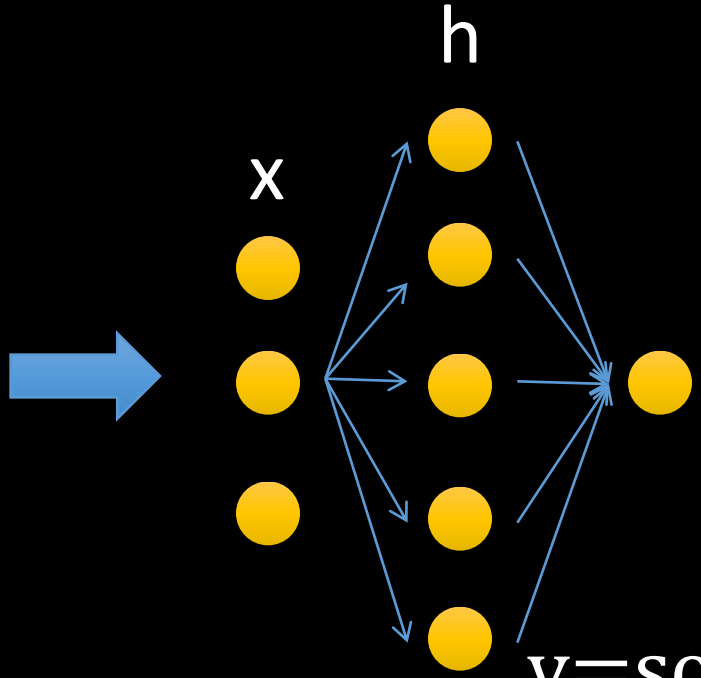
Image credit:
http://cs231n.github.io/neural-networks-1/

How to model a single artificial neuron?



Supervised Learning with Neural Nets

Input



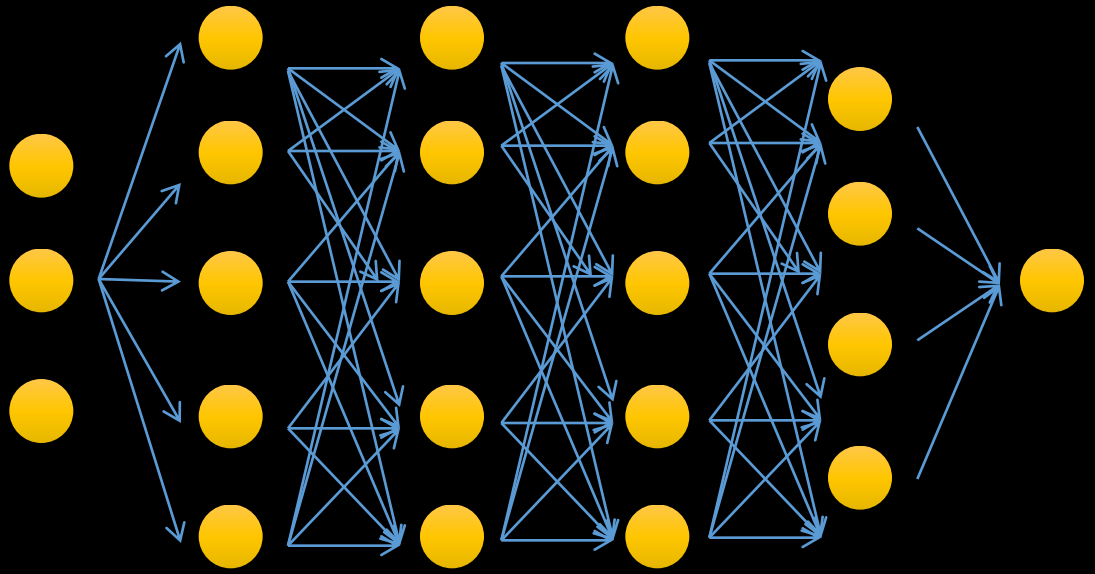
4

$$y = \mathrm{softmax}(w_2 \cdot h_1 + b_2)$$

$$h_1 = \tanh(w_1 \cdot x + b_1)$$

Deep Neural Nets

Input



$$h_1=\sigma_1(w_1 \bullet x+b_1)$$

$$h_2=\sigma_2(w_2 \bullet h_1+b_2)$$

Casual chat generated by neural networks

今天午饭好好吃好开心！

So happy to have delicious lunch today!

我也要吃!

I want to eat too!

土豪我们做朋友吧

Let us befriend, rich guy

我不是土豪!

I am not rich !

你喜欢一见钟情还是日久生情？

Would you prefer falling in love at first sight or developing love over time?

一见钟情吧……

Falling in love at first sight probably

星球大战好看吗？

Is Star Wars worth watching?

不是很好看

Not very much

[Fei Jiang & Lei Li 2015]

What about longer utterance?

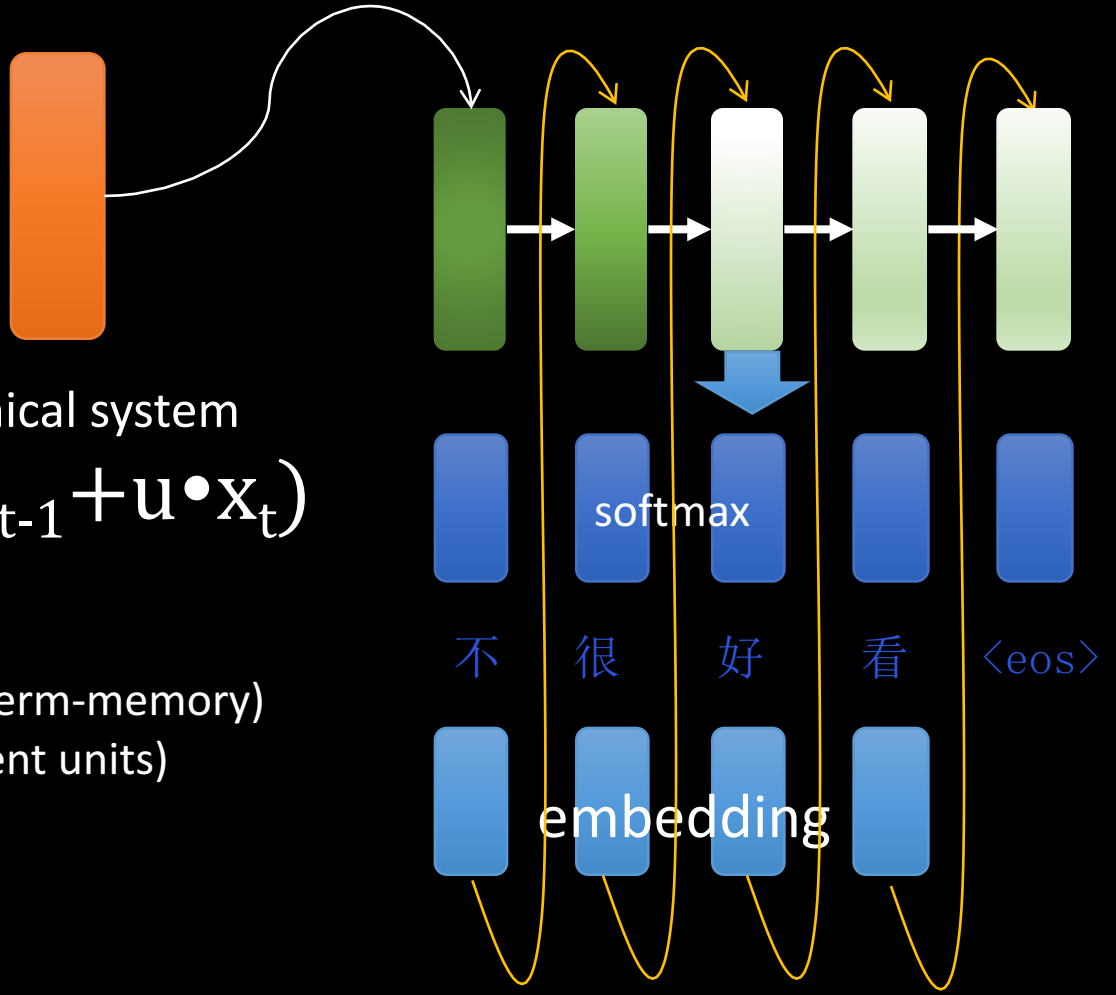
曾经有一段真挚的爱情摆在我眼前，
我没有去珍惜，等到失去了才后悔莫及，
尘世间最痛苦的事莫过于此，
如果上天能给我一个再来一次的机会，
我希望能对那个女孩说我爱你，
如果非要给这爱加一个期限的话，
我希望是一万年。

I once let the truest love slip away from before my eyes,
Only to find myself regretting when it was too late,
No pain in the world comes near to this,
If only God would give me another chance,
I would say to the girl, I love you!
If there had to be a limit of time,
I pray it's ten thousand years.

愿你安好.

Bless you.

Generating sentence with RNN

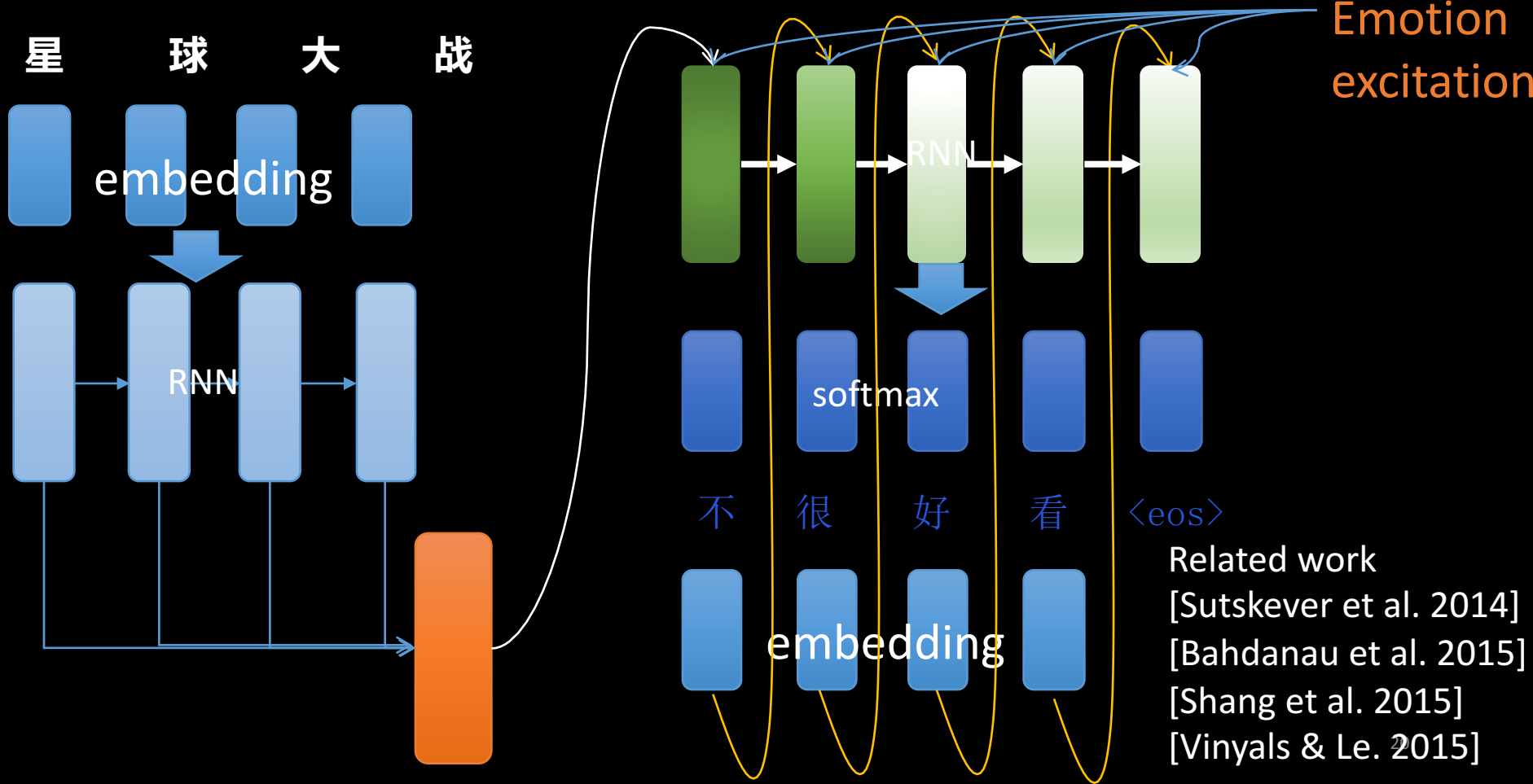


Nonlinear dynamical system

$$h_t = \sigma(w \cdot h_{t-1} + u \cdot x_t)$$

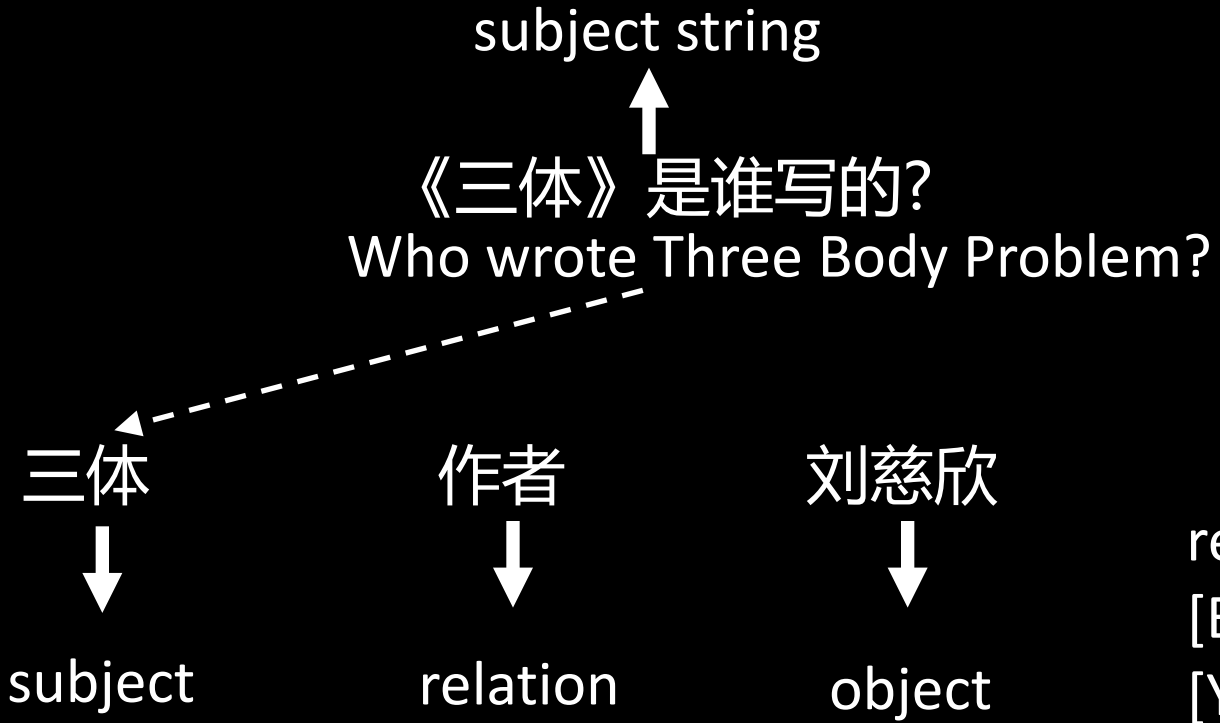
Alternatives:
LSTM (long-short-term-memory)
GRU (gated recurrent units)

Generating Emotional Responses



Related work
[Sutskever et al. 2014]
[Bahdanau et al. 2015]
[Shang et al. 2015]
[Vinyals & Le. 2015]

Answering Knowledge Questions



related work
[Berant 2013]
[Yih 2014]
[Bordes 2015]

Why difficult for machines?

Language complexity

- 奥巴马总统在哪儿生的?
- 奥巴马总统出生地在哪里?

Ambiguity

- 麦克乔丹是谁?

Sparse Label

- 2千万事实，十万标注问答对

Deep learning based system: CFO

哈利波特在哪儿上的学？

霍格沃兹魔法学校

格罗格里小学

哈利波特是谁写的？

罗琳女士

罗琳的写作风格受谁影响？

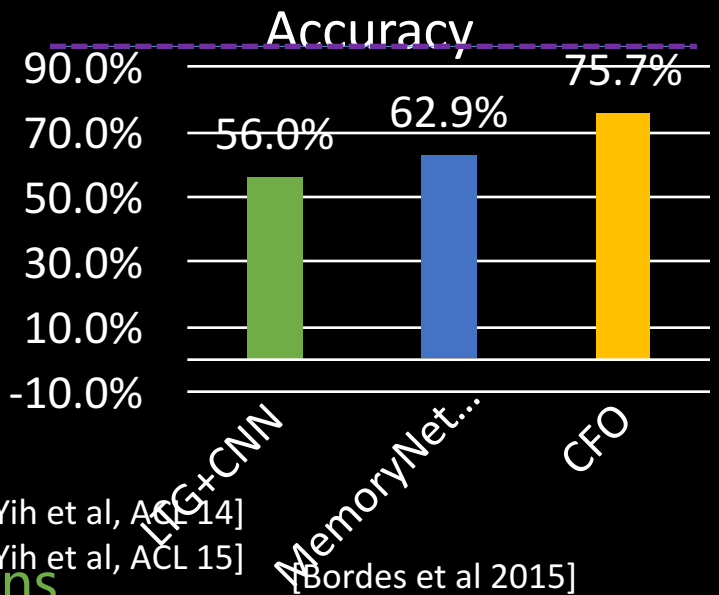
乔治艾略特

史蒂文金

史蒂文金写了什么小说?

Las cuatro estaciones/different seasons

肖生克的救赎



[Yih et al, ACL 14]
[Yih et al, ACL 15]
[Bordes et al 2015]

CFO: Conditional Focused Neural Question Answering with Large-scale Knowledge Bases
[Zihang Dai, Lei Li, Wei Xu, ACL 2016]



AI(ML) is more than supervised learning, and more than deep learning

AI replies on Knowledge Representation

Probabilistic Graphical Models

Deep Learning

Kernel Methods

Sparse Representation

Trees

Limitations of exiting DL algorithms

- Relying on huge labeled data
- Generalizability / adaptability

实现通用人工智能需要解决的问题：

- (self-) interpretability
  - knowing why succeed/fail
- Reasoning about objects in the world
- Intelligence power density (per joule)

Thanks!

Contact

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