Deep learning
-- Beyond Supervised Learning

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Spring 2018

Outline

Unsupervised Learning

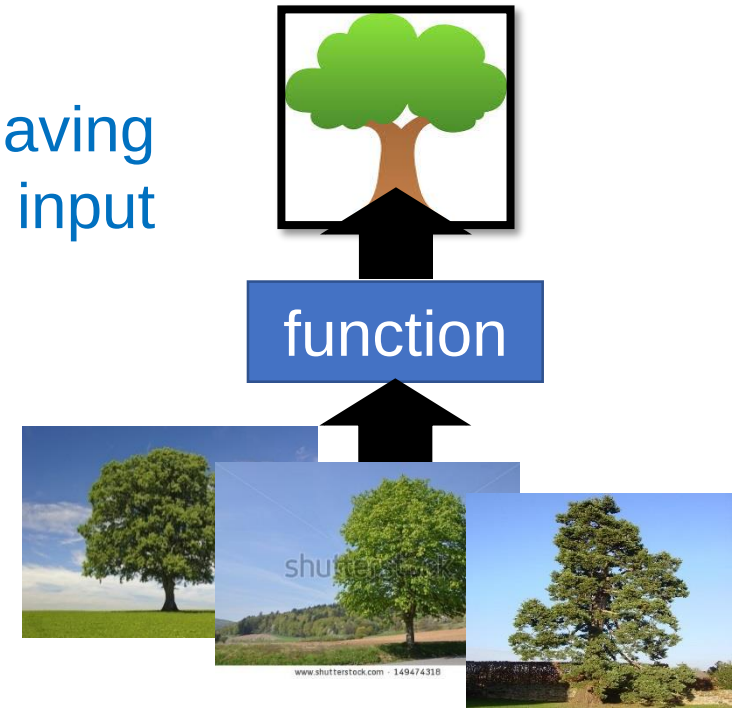
- 化繁為簡
  - Auto-encoder
- 無中生有

Reinforcement Learning

Unsupervised Learning

- 化繁為簡

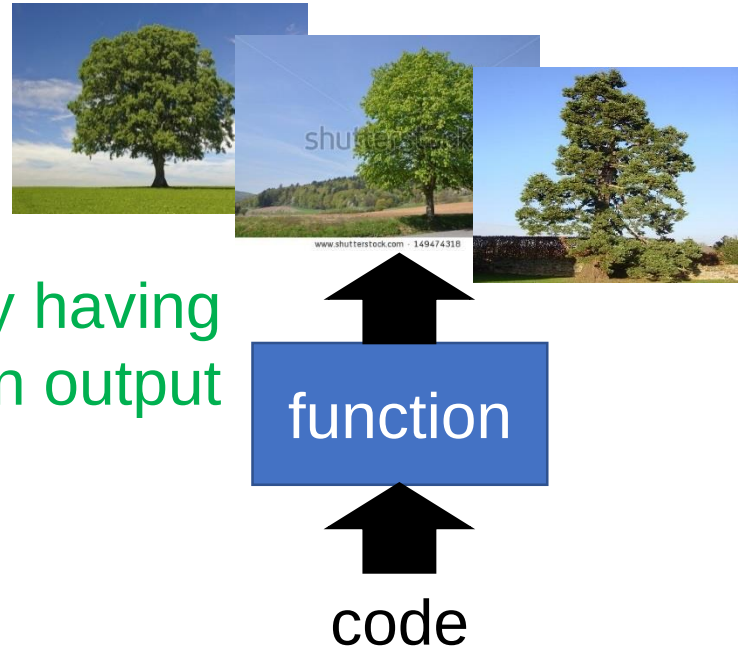
only having function input



Learn a low dimensional feature from many input images without supervision

- 無中生有

only having function output



Generate images similar with a set of images from code

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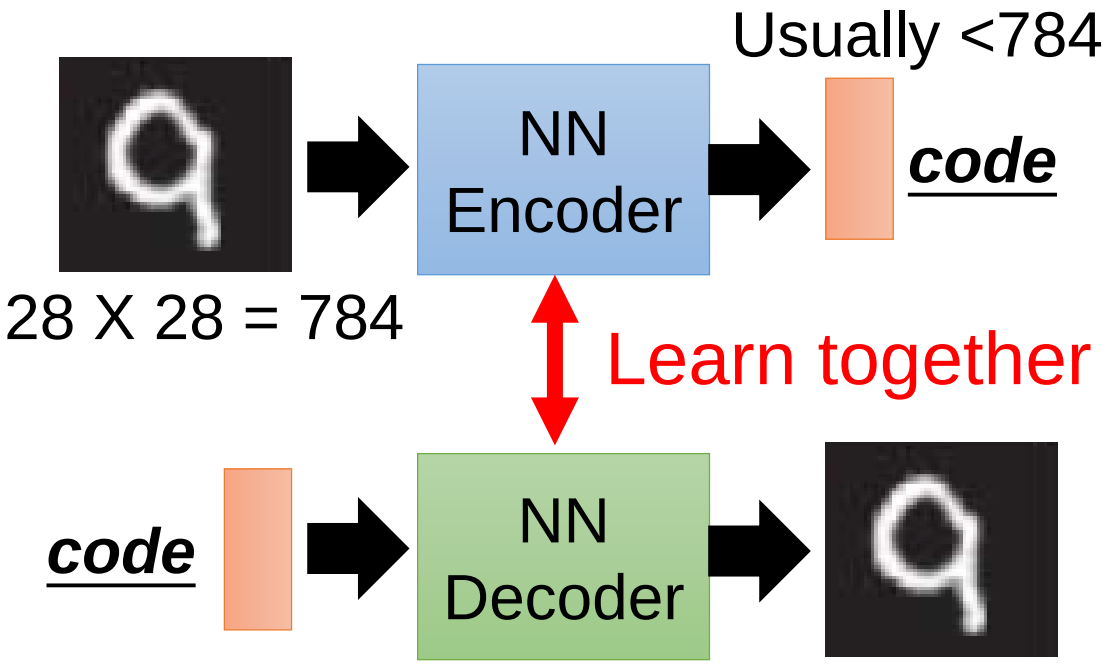
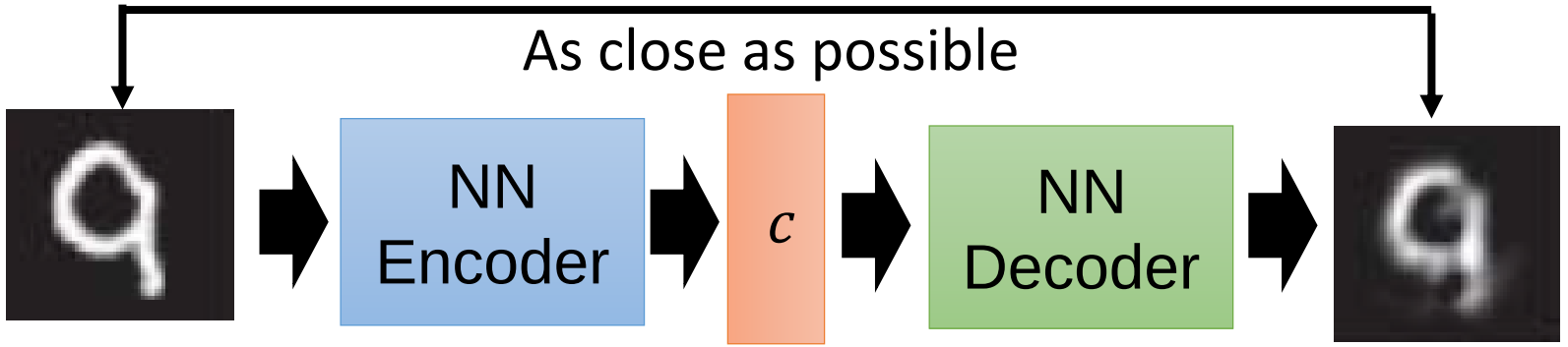
Auto-encoder



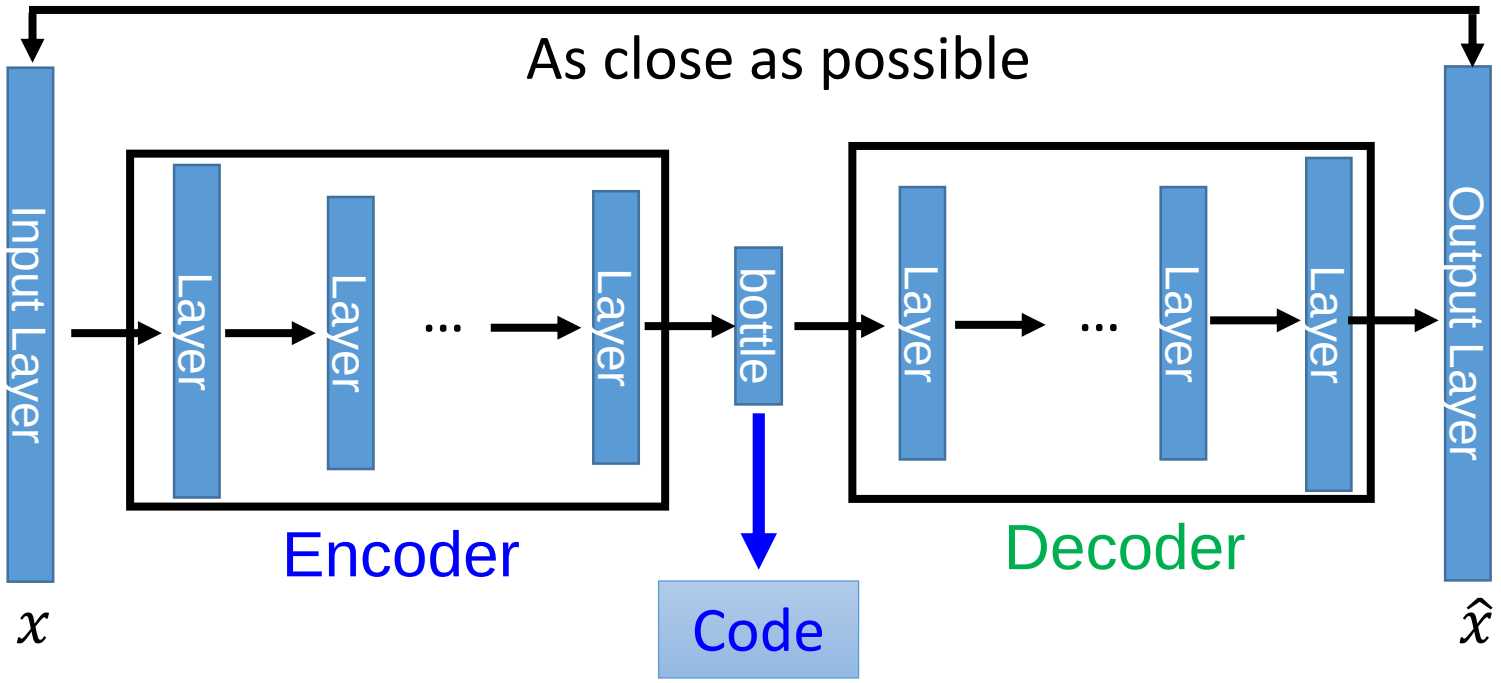
Compact representation of the input object

Can reconstruct the original object



Deep Auto-encoder

- NN encoder + NN decoder = a deep network



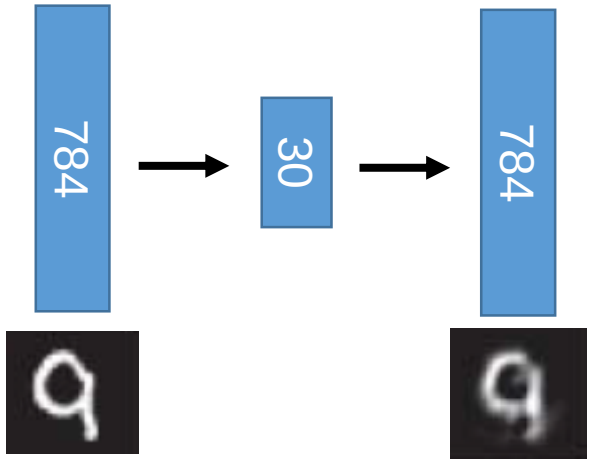
Reference: Hinton, Geoffrey E., and Ruslan R. Salakhutdinov. "Reducing the dimensionality of data with neural networks." *Science* 313.5786 (2006): 504-507

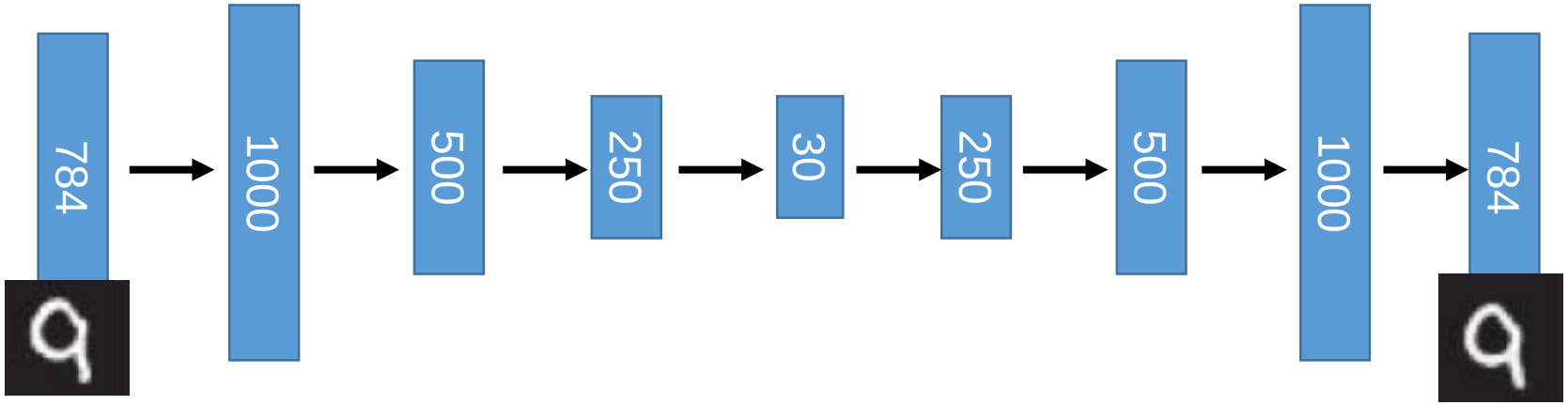
Deep Auto-encoder

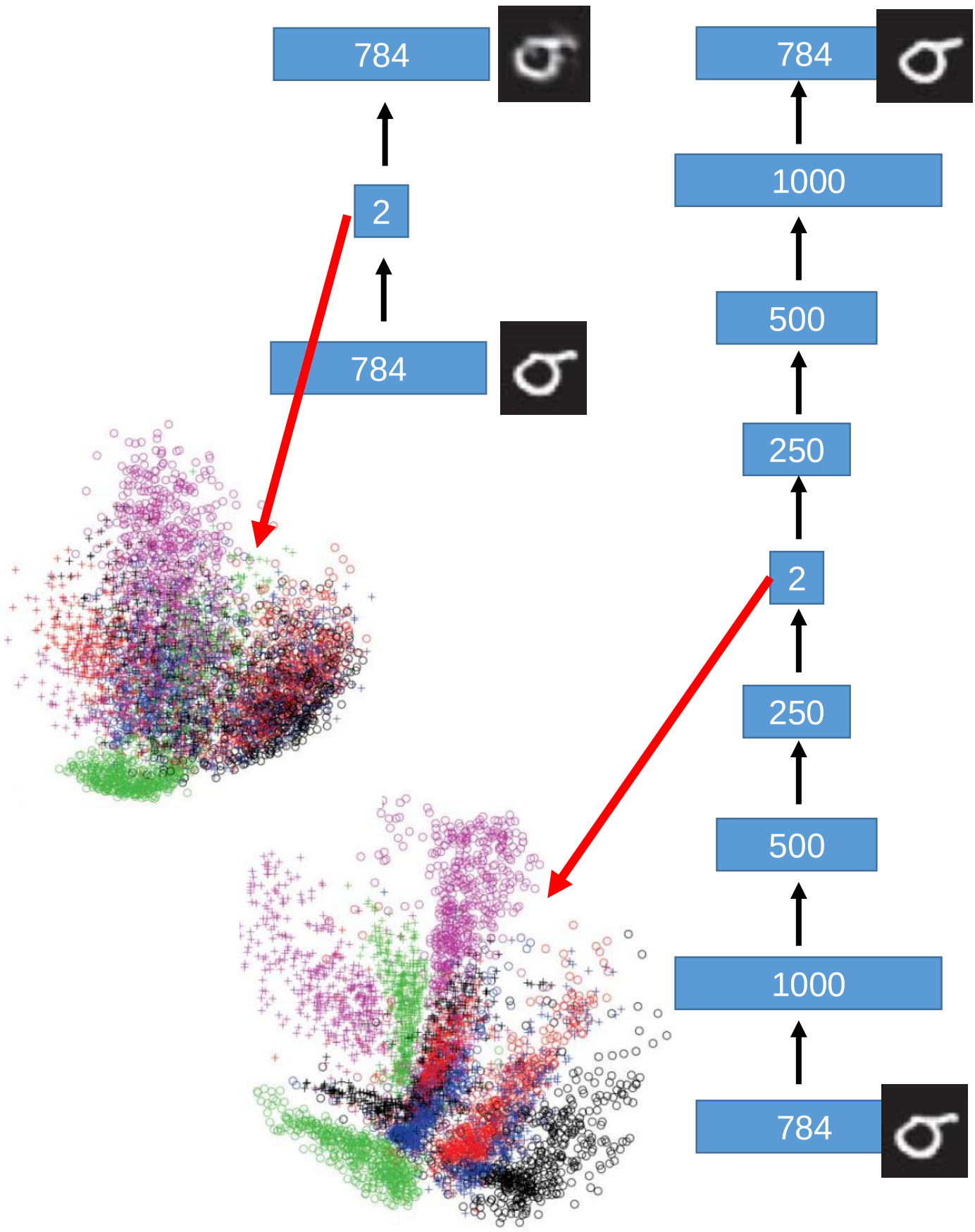
Original Image

PCA

Deep Auto-encoder





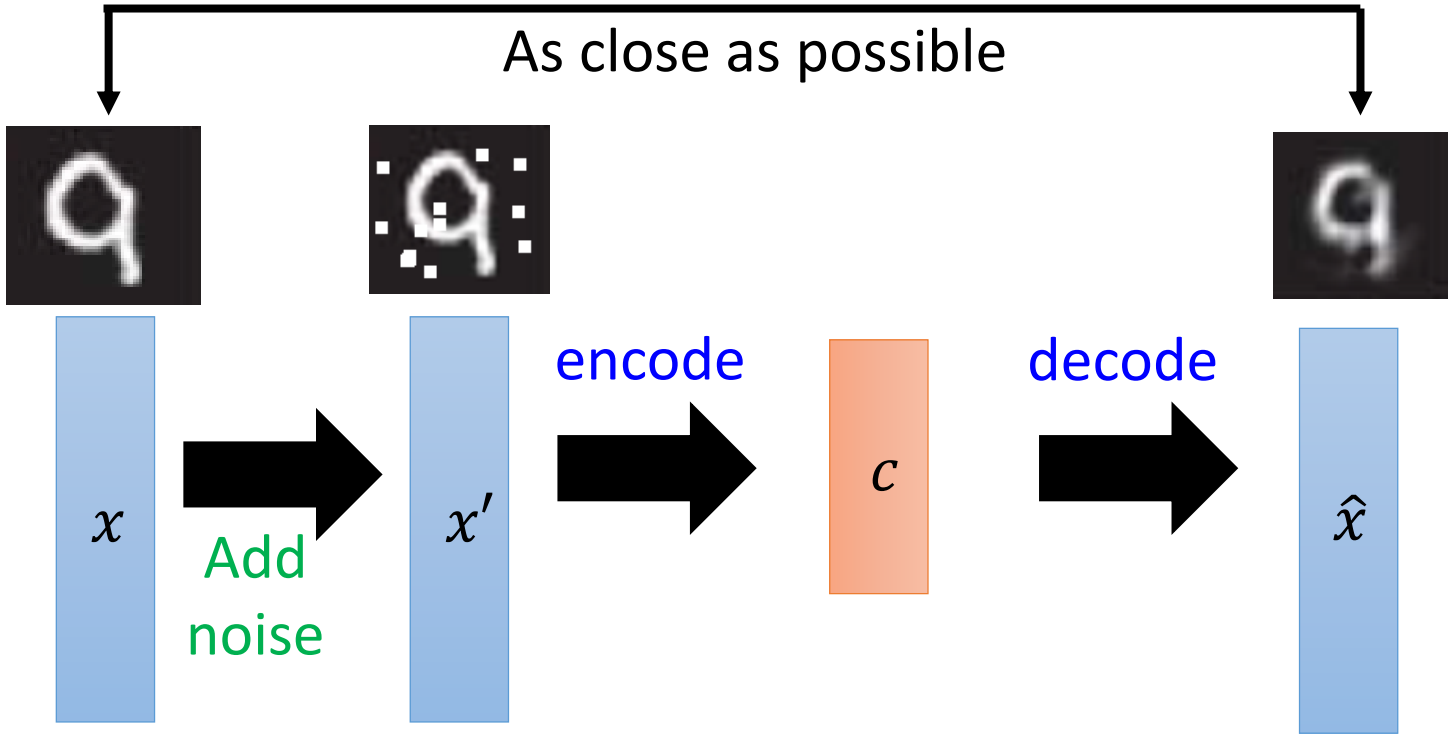

784
2
784
784
1000
500
250
2
250
500
1000
784

Auto-encoder

- De-noising auto-encoder

More: Contractive auto-encoder

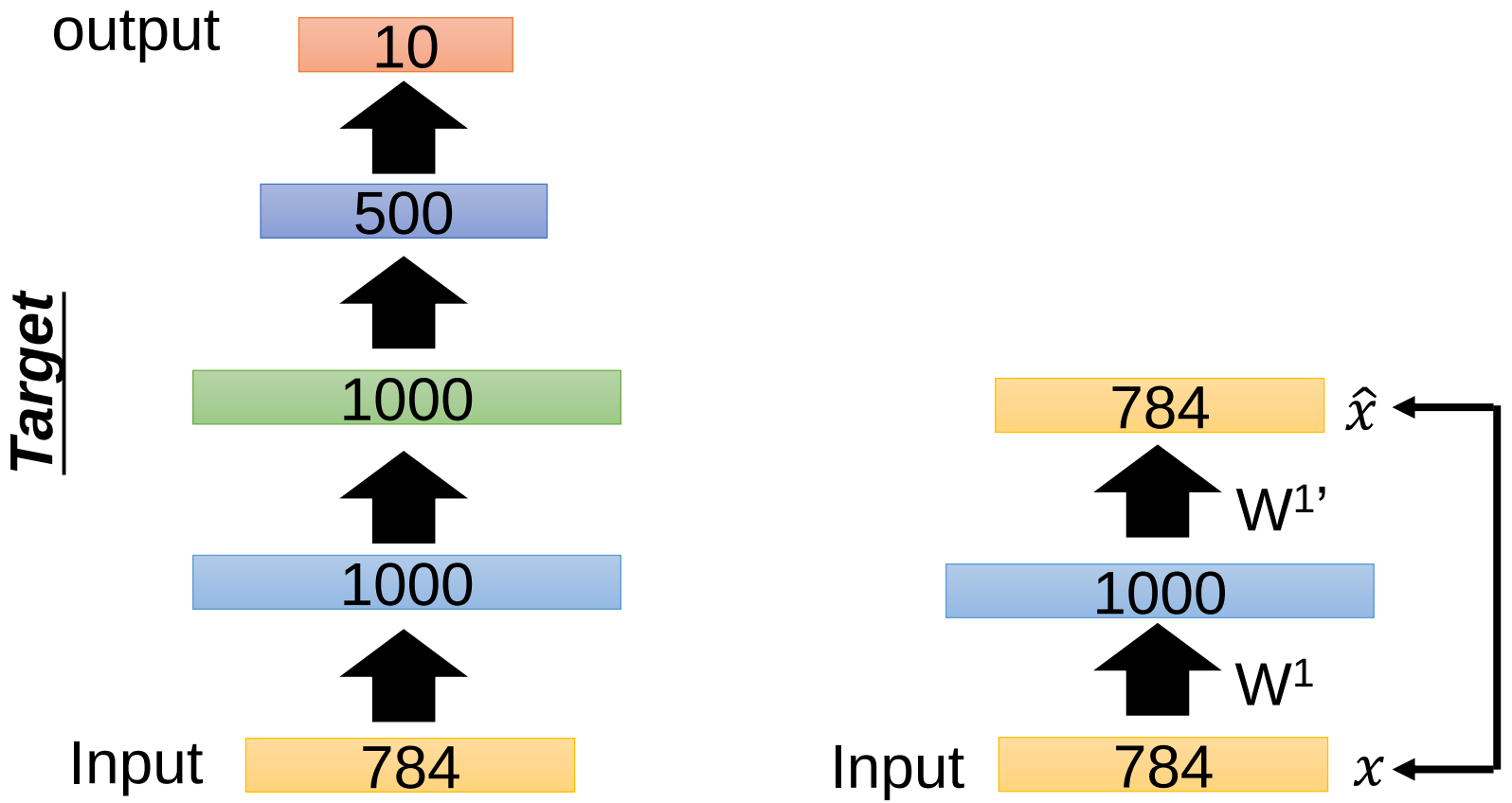
Ref: Rifai, Salah, et al. "Contractive auto-encoders: Explicit invariance during feature extraction." *Proceedings of the 28th International Conference on Machine Learning (ICML-11)*. 2011.



Vincent, Pascal, et al. "Extracting and composing robust features with denoising autoencoders." *ICML*, 2008.

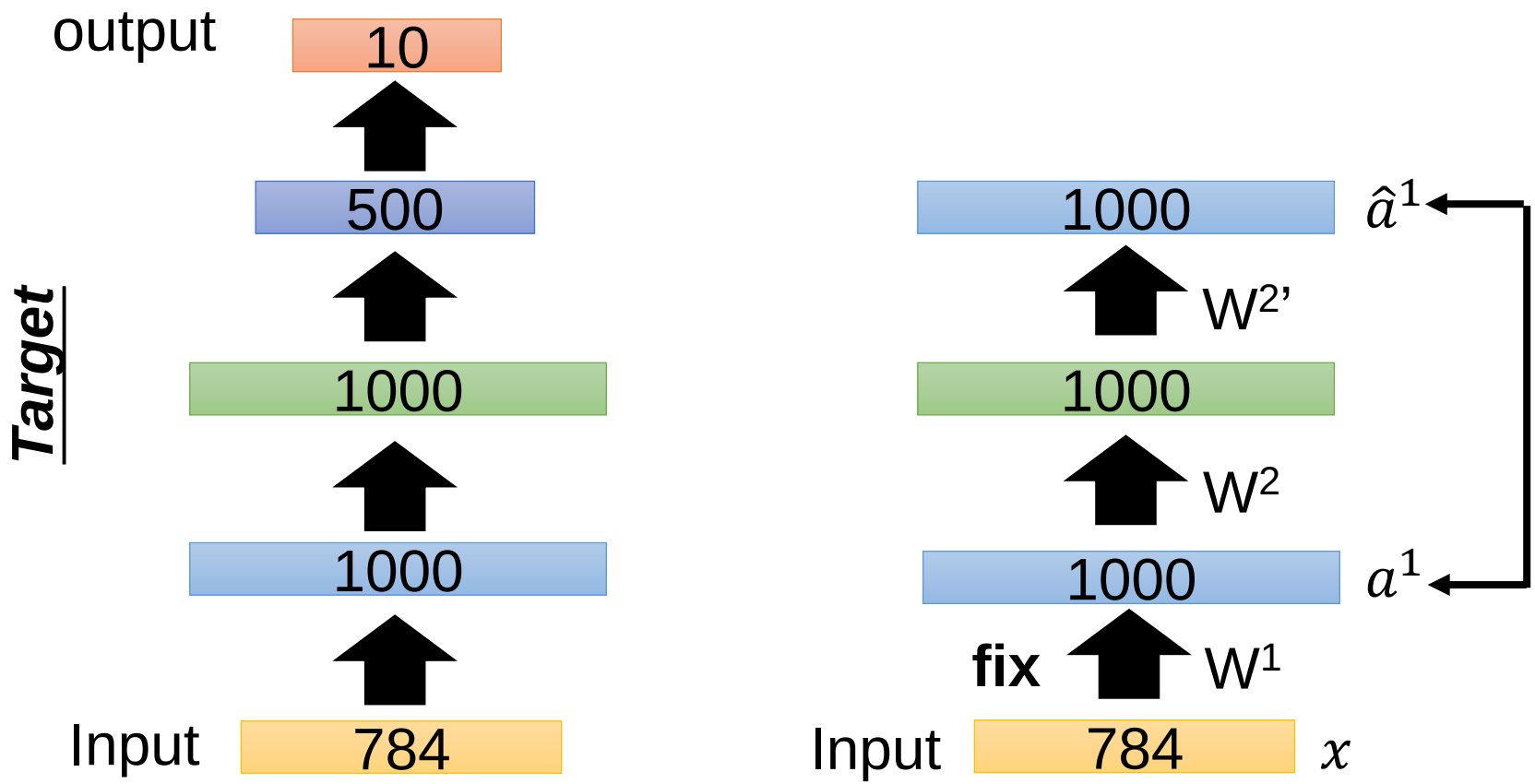
Auto-encoder – Pre-training DNN

- Greedy Layer-wise Pre-training *again*



Auto-encoder – Pre-training DNN

- Greedy Layer-wise Pre-training *again*



Auto-encoder – Pre-training DNN

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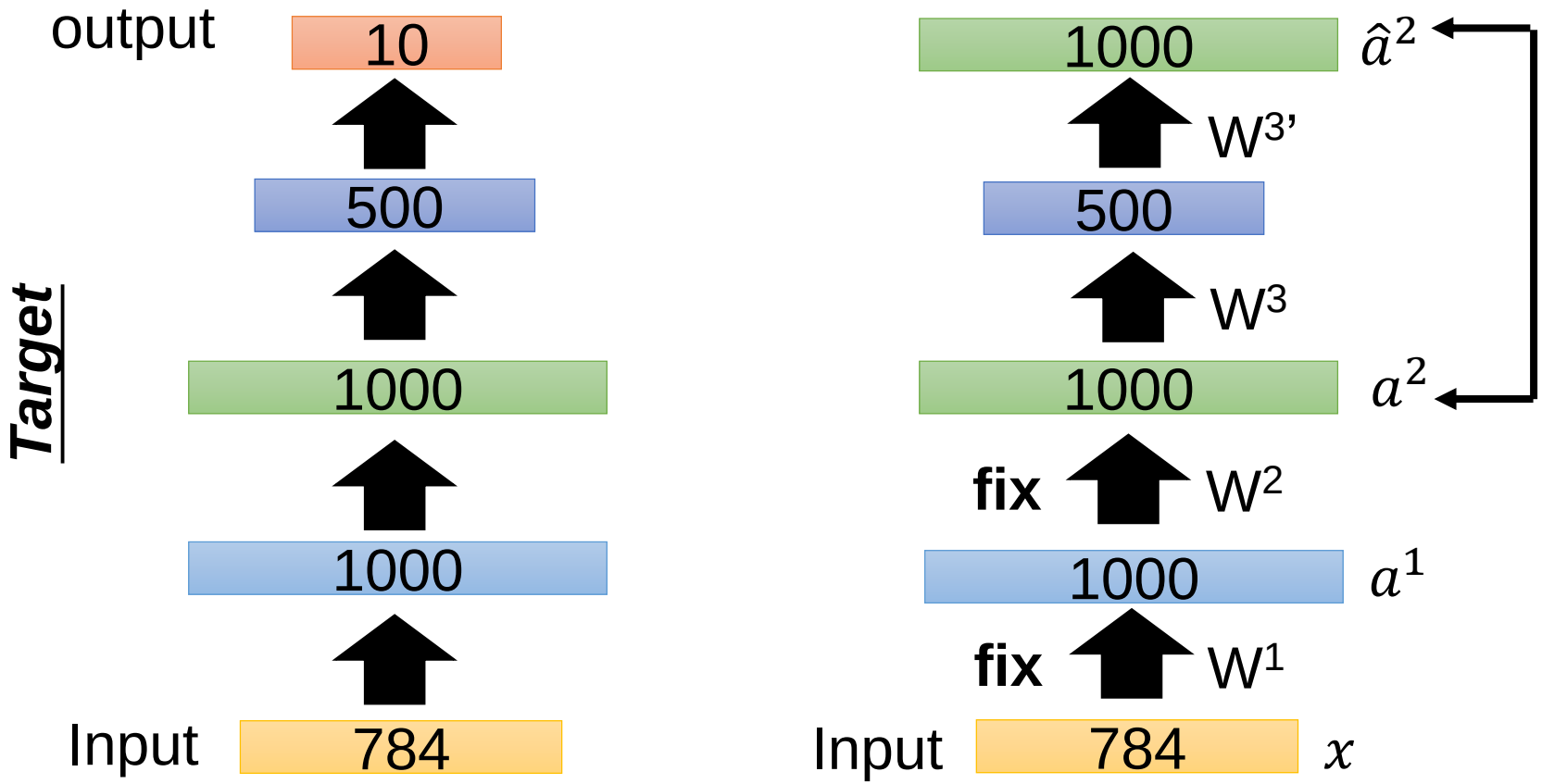

Auto-encoder – Pre-training DNN

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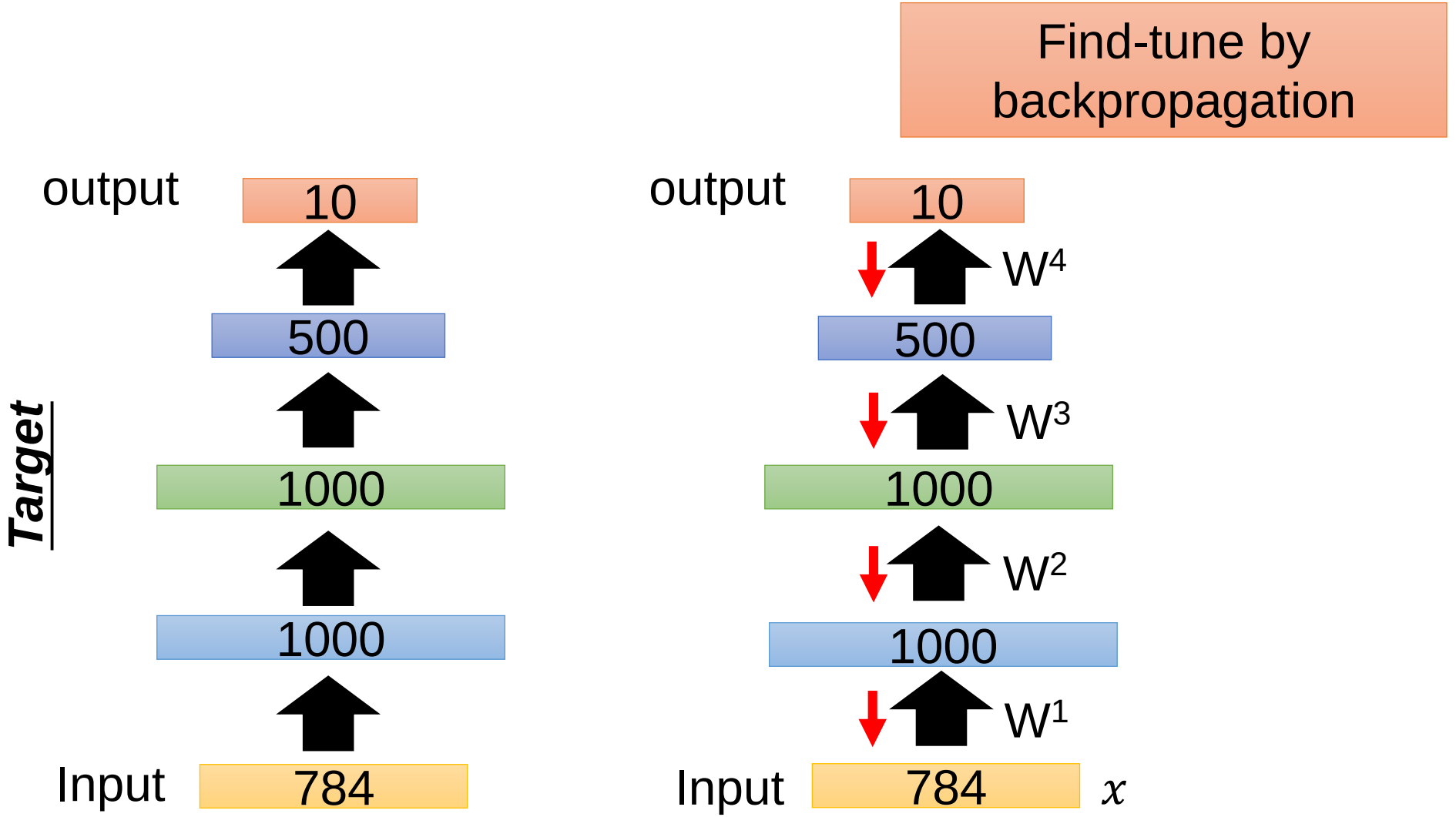

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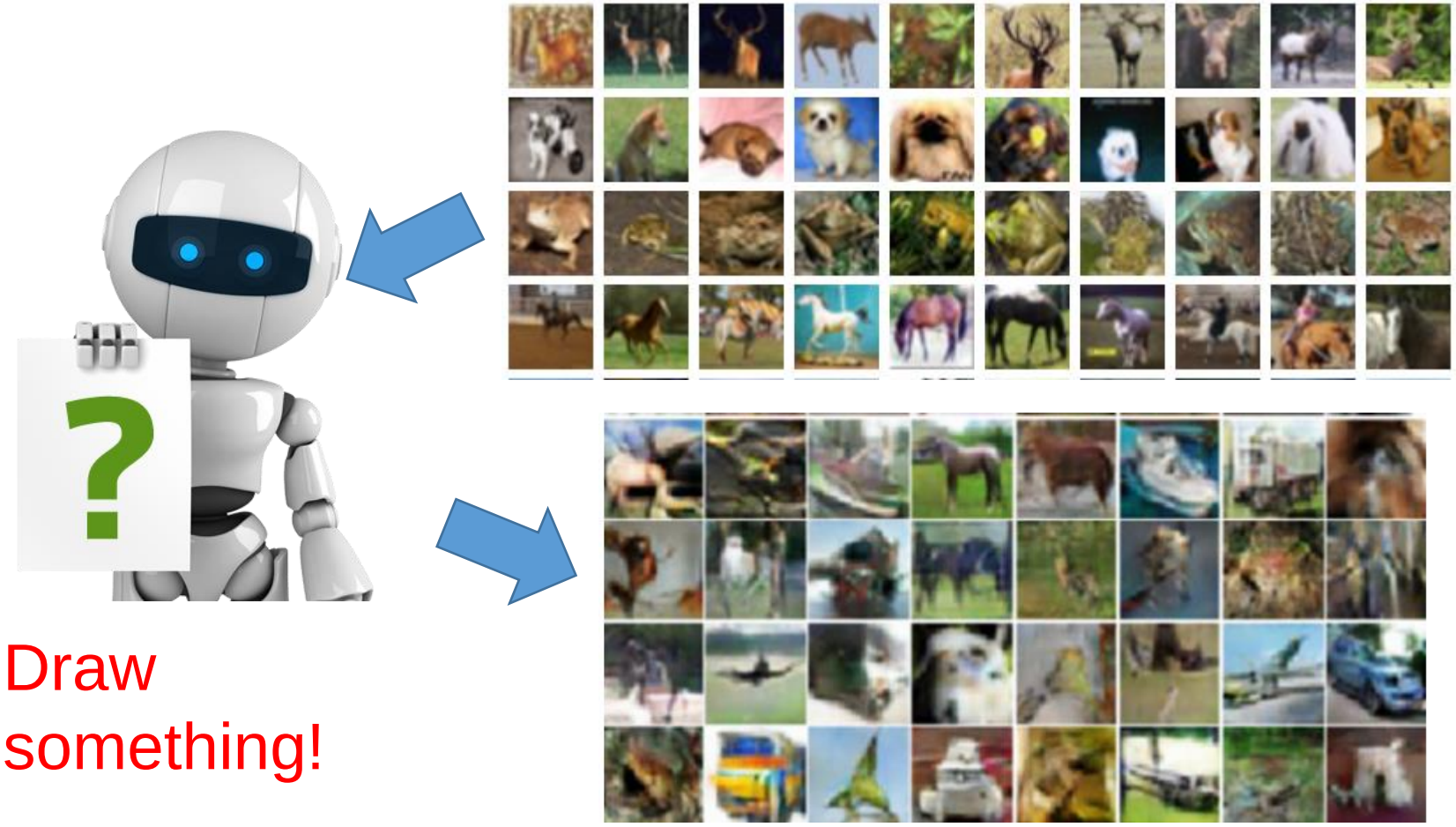
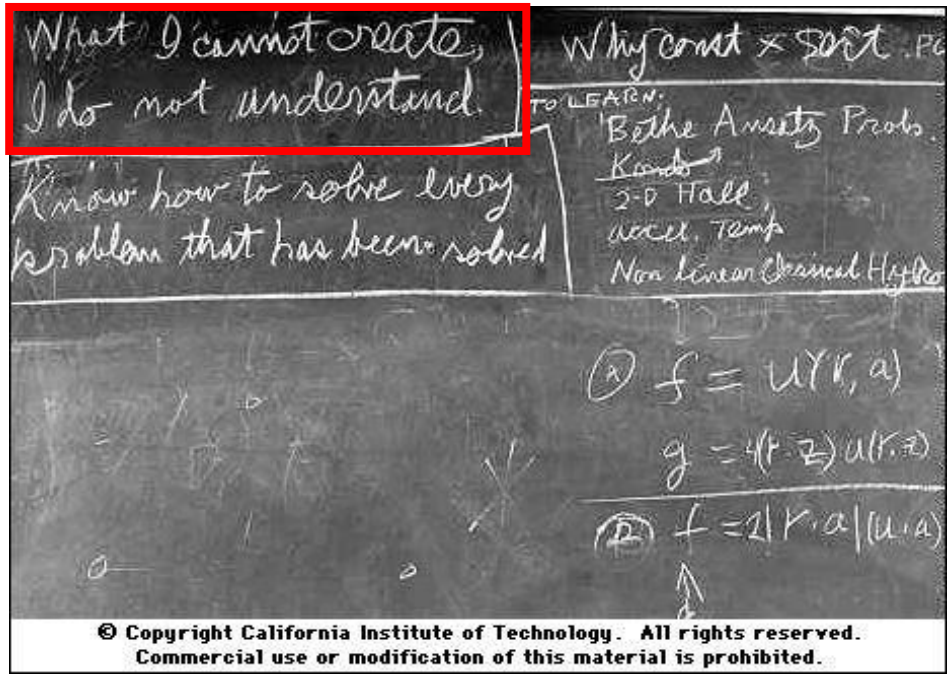
Creation



Creation

- Generative Models: https://openai.com/blog/generative-models/

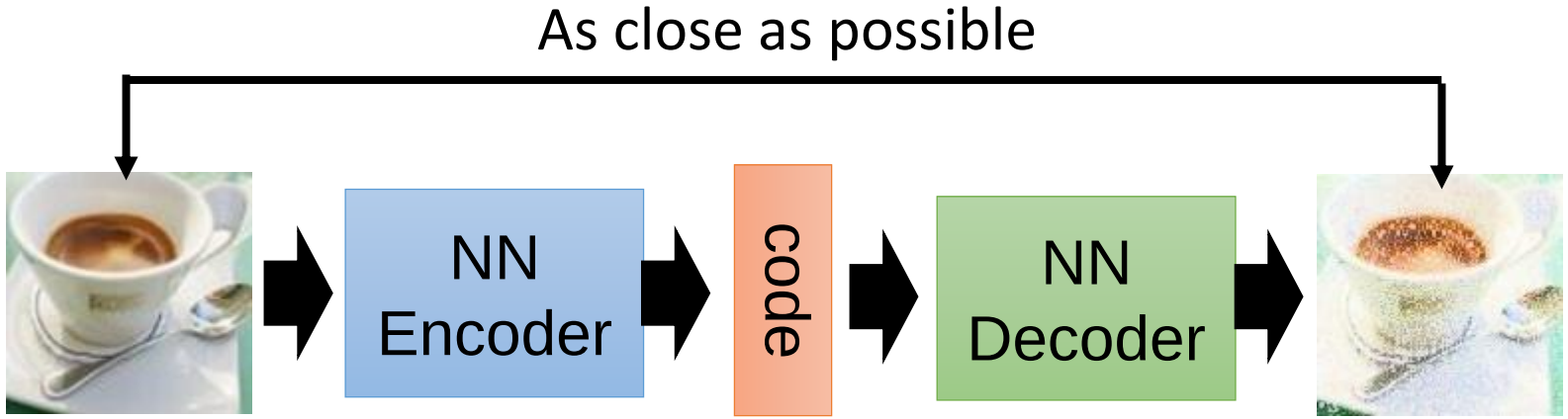


What I cannot create, I do not understand.

Richard Feynman

https://www.quora.com/What-did-Richard-Feynman-mean-when-he-said-What-I-cannot-create-I-do-not-understand

Auto-encoder



Randomly generate a vector as code

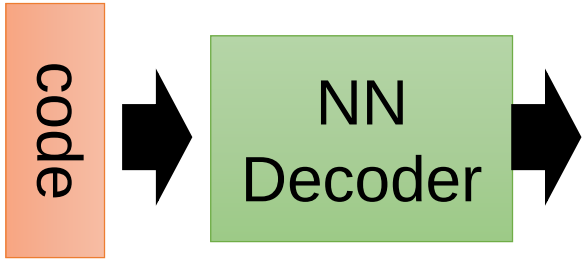
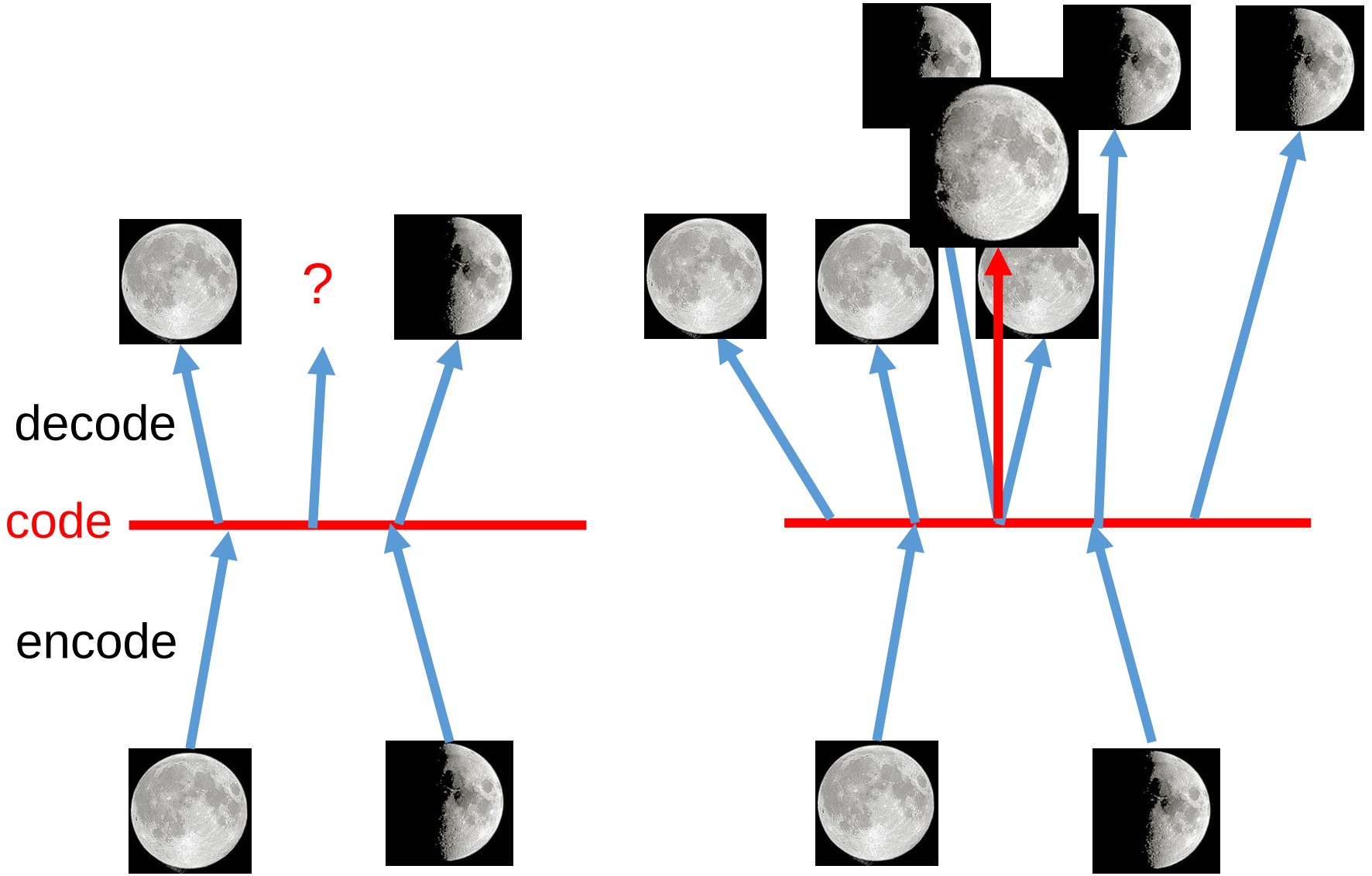


Image ?

Variation Auto-encoder (VAE)

Ref: Auto-Encoding Variational Bayes, https://arxiv.org/abs/1312.6114

Why VAE?



VAE

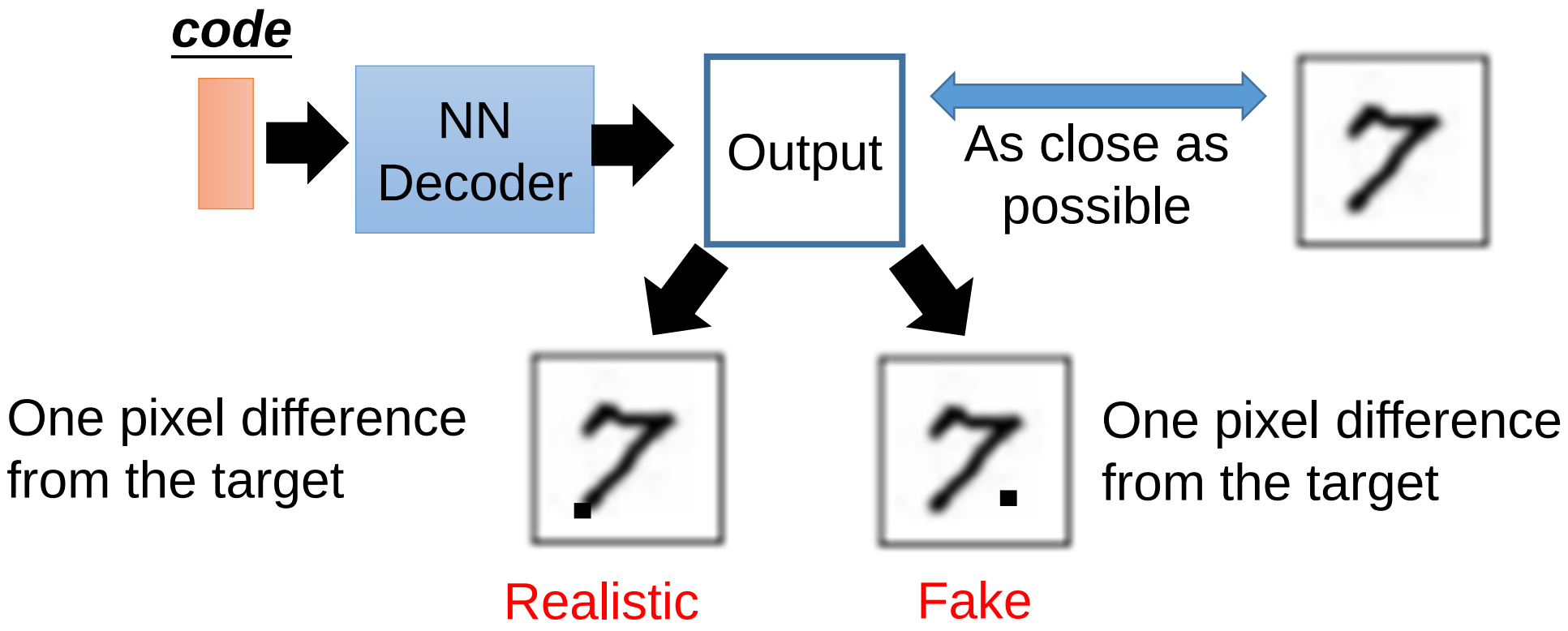
Cifar-10

https://github.com/openai/iaf

Source of image: https://arxiv.org/pdf/1606.04934v1.pdf

Problems of VAE

- It does not really try to simulate real images



Generative Adversarial Network (GAN)

What are some recent and potentially upcoming breakthroughs in unsupervised learning?

Yann LeCun, Director of AI Research at Facebook and Professor at NYU
Written Jul 29 · Upvoted by Joaquin Quiñonero Candela, Director Applied Machine Learning at Facebook and Huang Xiao

Adversarial training is the coolest thing since sliced bread.

I've listed a bunch of relevant papers in a previous answer.

Expect more impressive results with this technique in the coming years.

What's missing at the moment is a good understanding of it so we can make it work reliably. It's very finicky. Sort of like ConvNet were in the 1990s, when I had the reputation of being the only person who could make them work (which wasn't true).

Ref: Generative Adversarial Networks, http://arxiv.org/abs/1406.2661

擬態的演化

棕色

葉脈

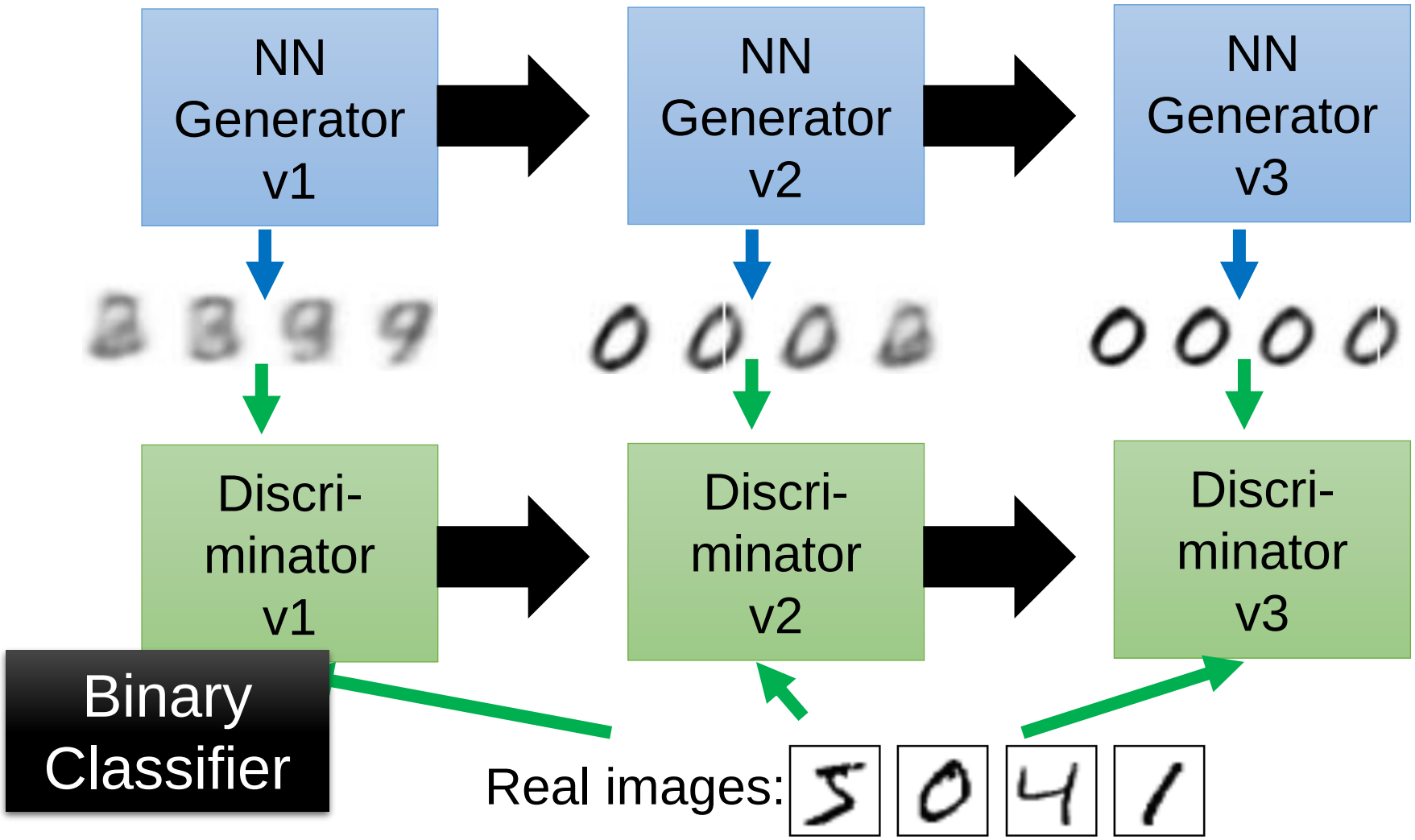
蝴蝶不是棕色

蝴蝶沒有葉脈

……..

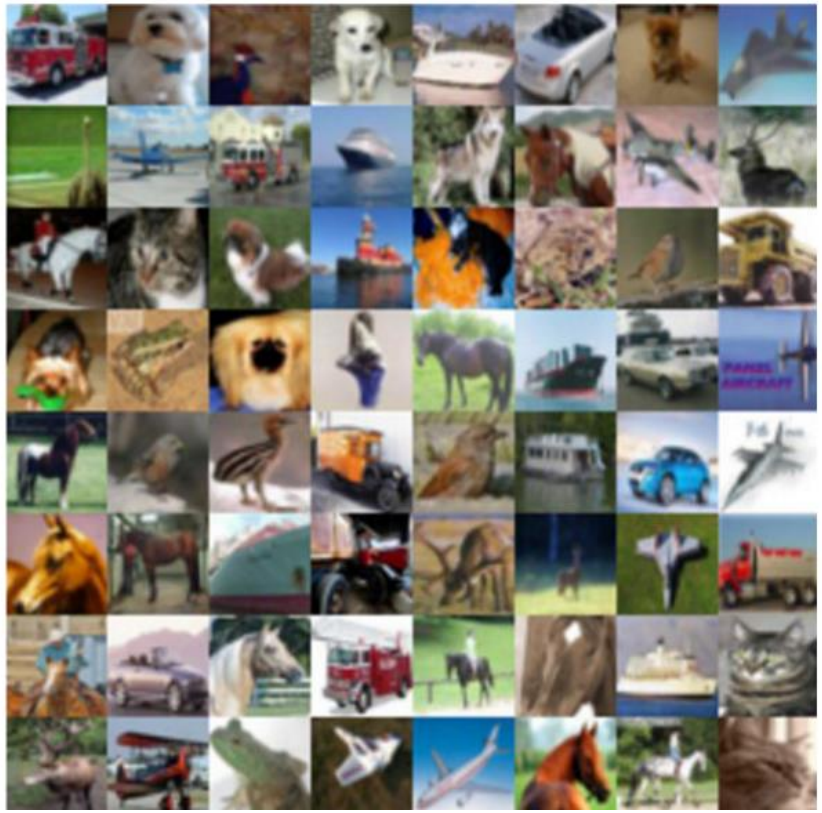
http://peellden.pixnet.net/blog/post/40406899-2013-%E7%AC%AC%E5%9B%9B%E5%AD%A3%EF%BC%8C%E5%86%AC%E8%9D%B6%E5%AF%82%E5%AF%A5

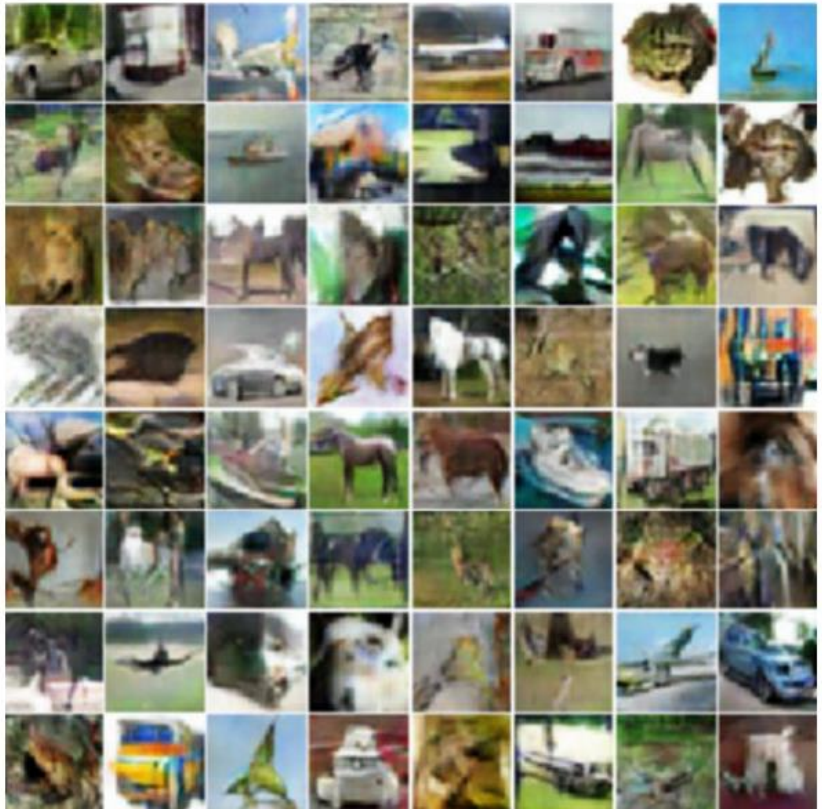
The evolution of generation



Cifar-10

- Which one is machine-generated?

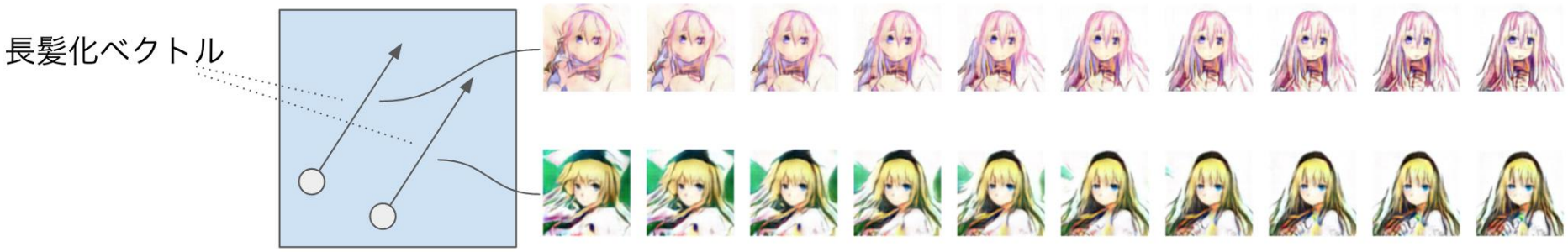




Ref: https://openai.com/blog/generative-models/

畫漫畫

- Ref: https://github.com/mattya/chainer-DCGAN
- Ref: http://qiita.com/mattya/items/e5bfe5e04b9d2f0bbd47



一番左のキャラクターが元画像で、
右に行くほど長髪化ベクトルを強く足している

Image-to-Image Translation with Conditional Adversarial Networks – cvpr16

https://phillipi.github.io/pix2pix/

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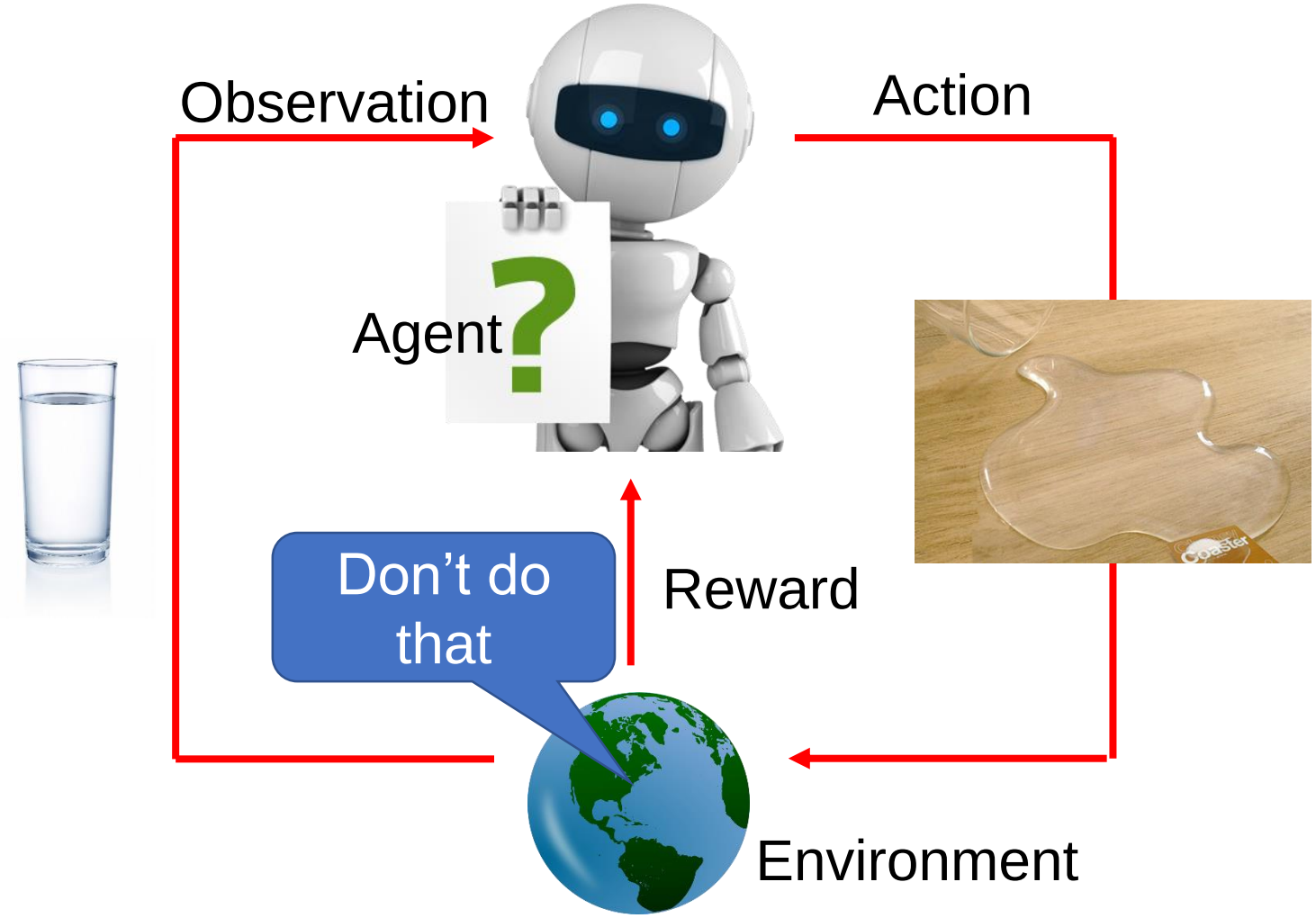
Scenario of Reinforcement Learning



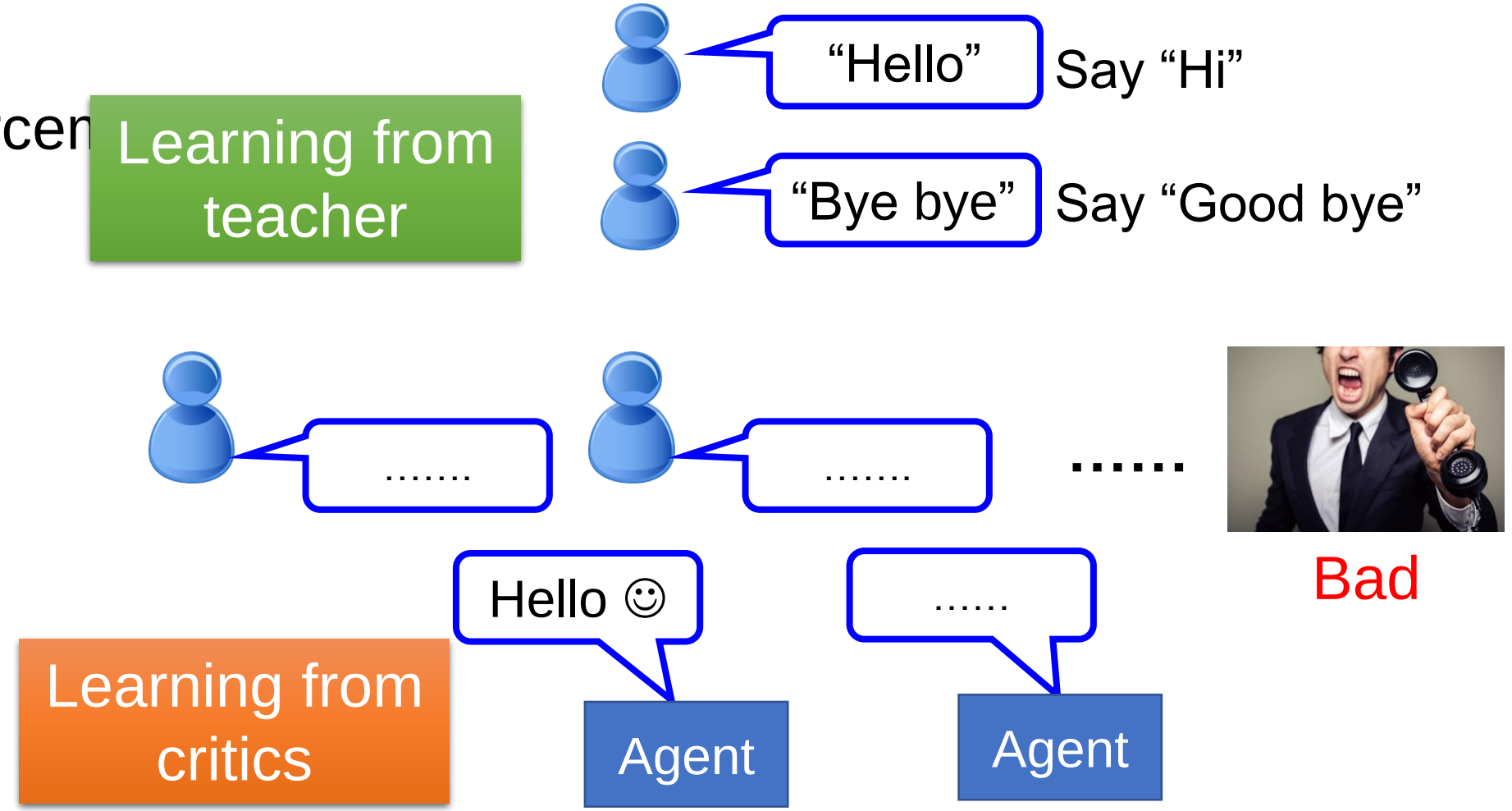
Scenario of Reinforcement Learning

http://www.sznews.com/news/content/2013-11/26/content_8800180.htm

Supervised v.s. Reinforcement

- Supervised

- Reinforcement

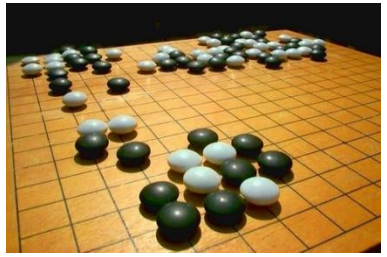


Scenario of Reinforcement Learning

Supervised v.s. Reinforcement

- Supervised:

Next move: “5-5”



Next move: “3-3”

- Reinforcement Learning

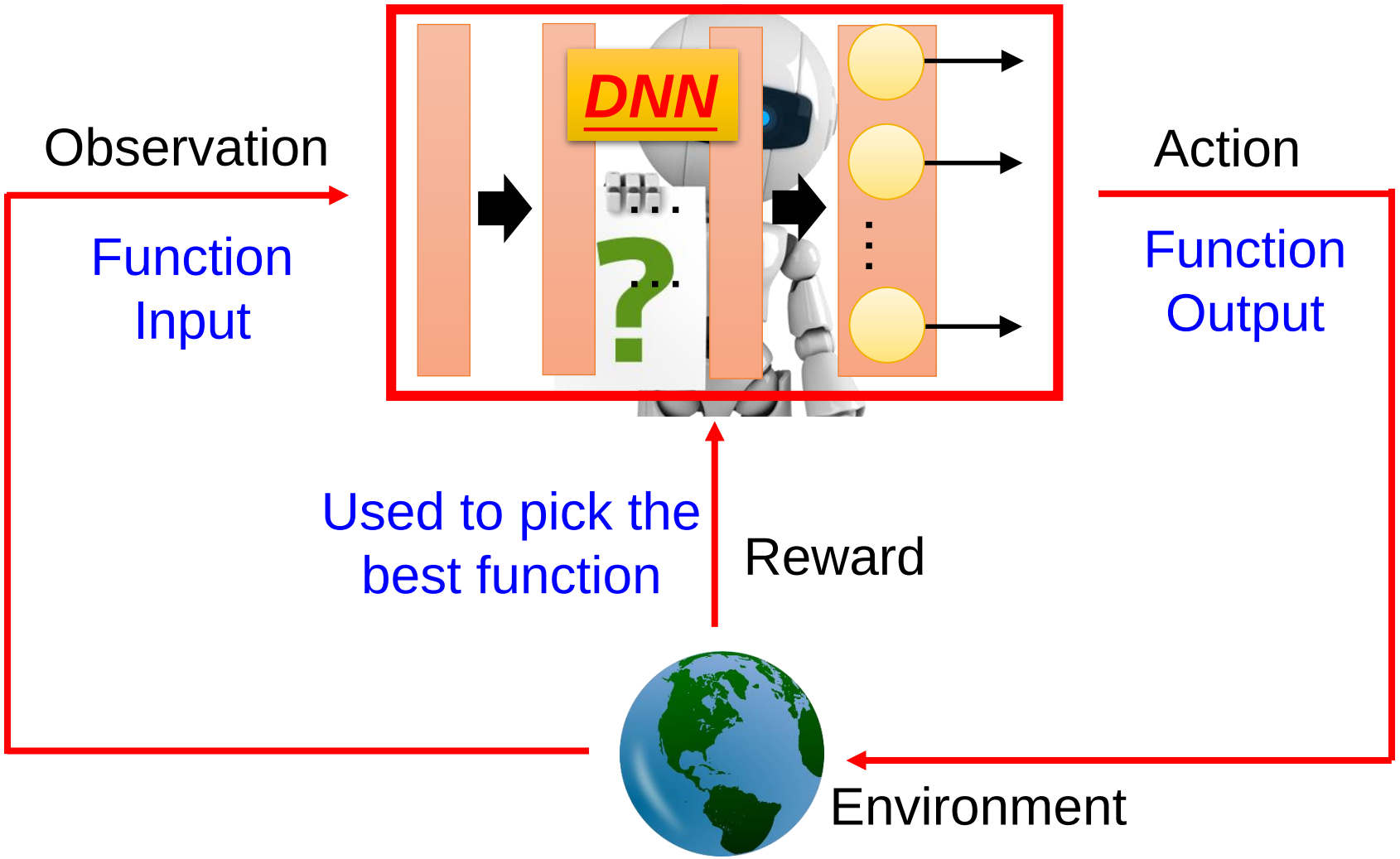
First move → …… many moves …… → Win!

Alpha Go is supervised learning + reinforcement learning.

Difficulties of Reinforcement Learning

- It may be better to sacrifice immediate reward to gain more long-term reward
  - E.g. Playing Go
- Agent's actions affect the subsequent data it receives
  - E.g. Exploration

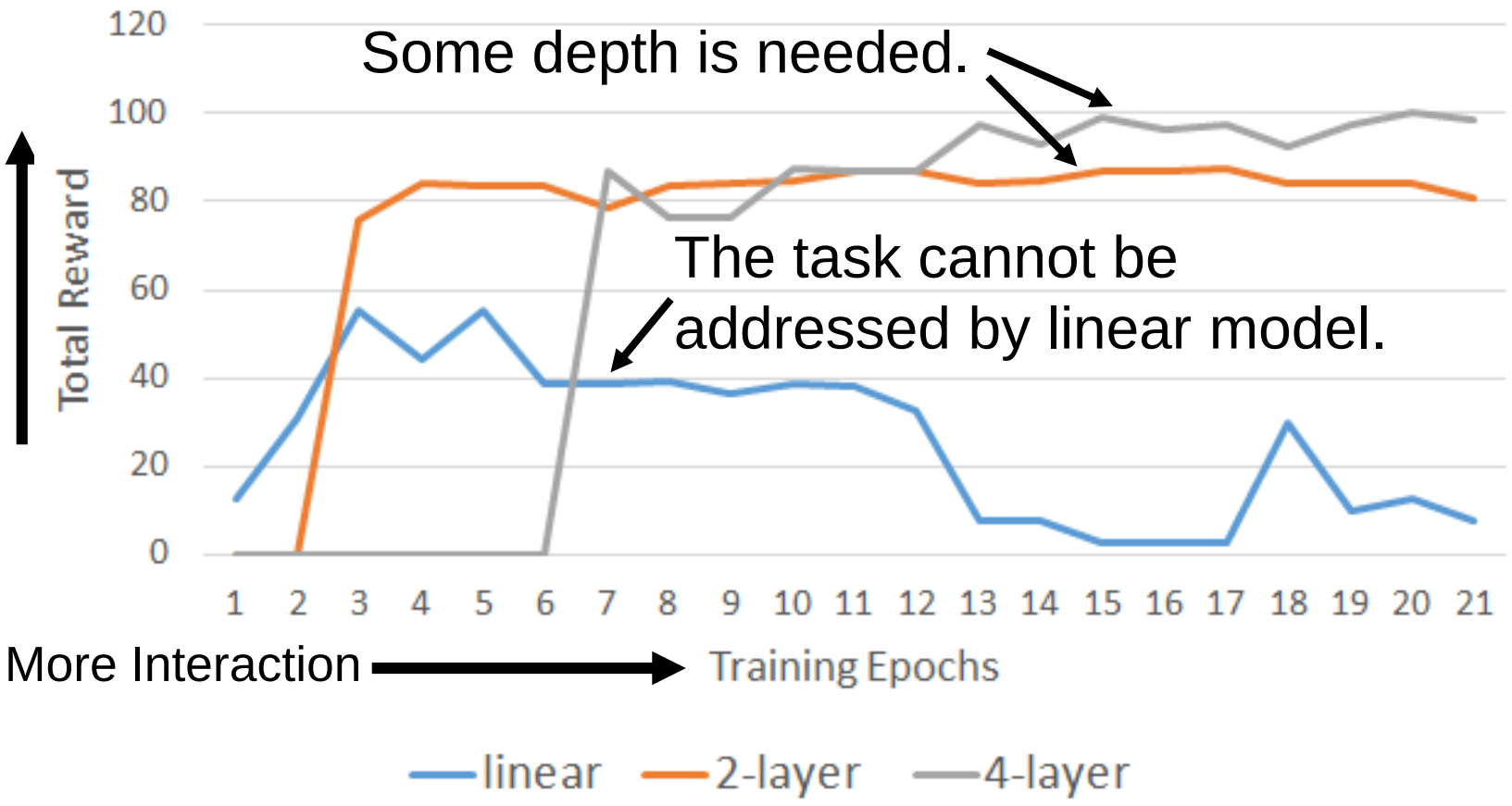
Deep Reinforcement Learning



Deep Reinforcement Learning

- Different network depth

Better retrieval performance, Less user labor



More applications

- Alpha Go, Playing Video Games, Dialogue
- Flying Helicopter
  - https://www.youtube.com/watch?v=0JL04JJjocc
- Driving
  - https://www.youtube.com/watch?v=0xo1Ldx3L5Q
- Google Cuts Its Giant Electricity Bill With DeepMind-Powered AI
  - http://www.bloomberg.com/news/articles/2016-07-19/google-cuts-its-giant-electricity-bill-with-deepmind-powered-ai

To learn deep reinforcement learning ……

- Lectures of David Silver
  - http://www0.cs.ucl.ac.uk/staff/D.Silver/web/Teaching.html
  - 10 lectures (1:30 each)
- Deep Reinforcement Learning
  - http://videolectures.net/rldm2015_silver_reinforcement_learning/

Conclusion

如何成為武林高手

- 內外兼修
  - 內功充沛，恃強克弱
  - 招數精妙，以快打慢
- *Deep Learning* 也需要內外兼修
  - 內力：運算資源
  - 招數：各種技巧
- 內力充沛,平常的招式也有可能發會巨大的威力
- 只有內力、沒有招數
  - *WavNet* 並不是只憑蠻力

希望大家都可以成為內外兼修的高手

Thanks