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Artificial Intelligence in Medical Technology

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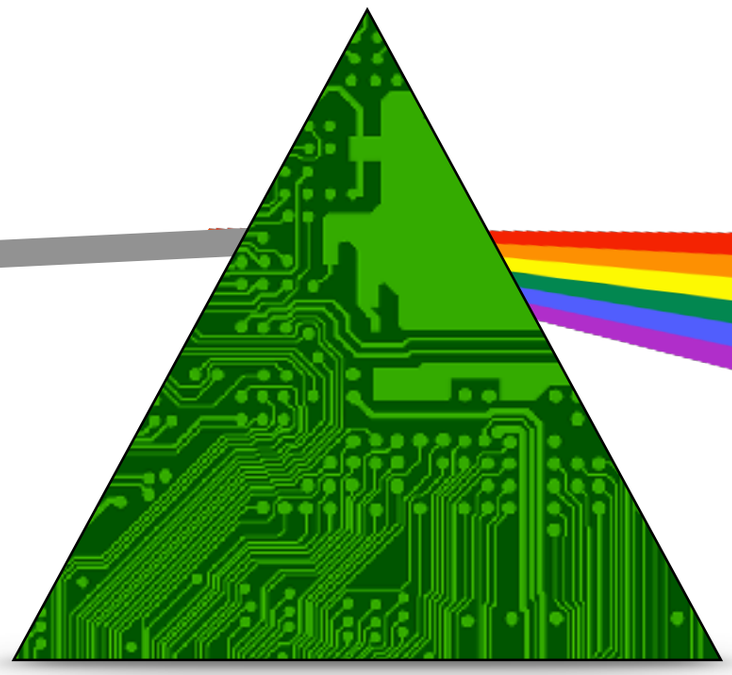
S3martmed Workshop

September 20, 2019

what is artificial intelligence?



data

AI

decisions

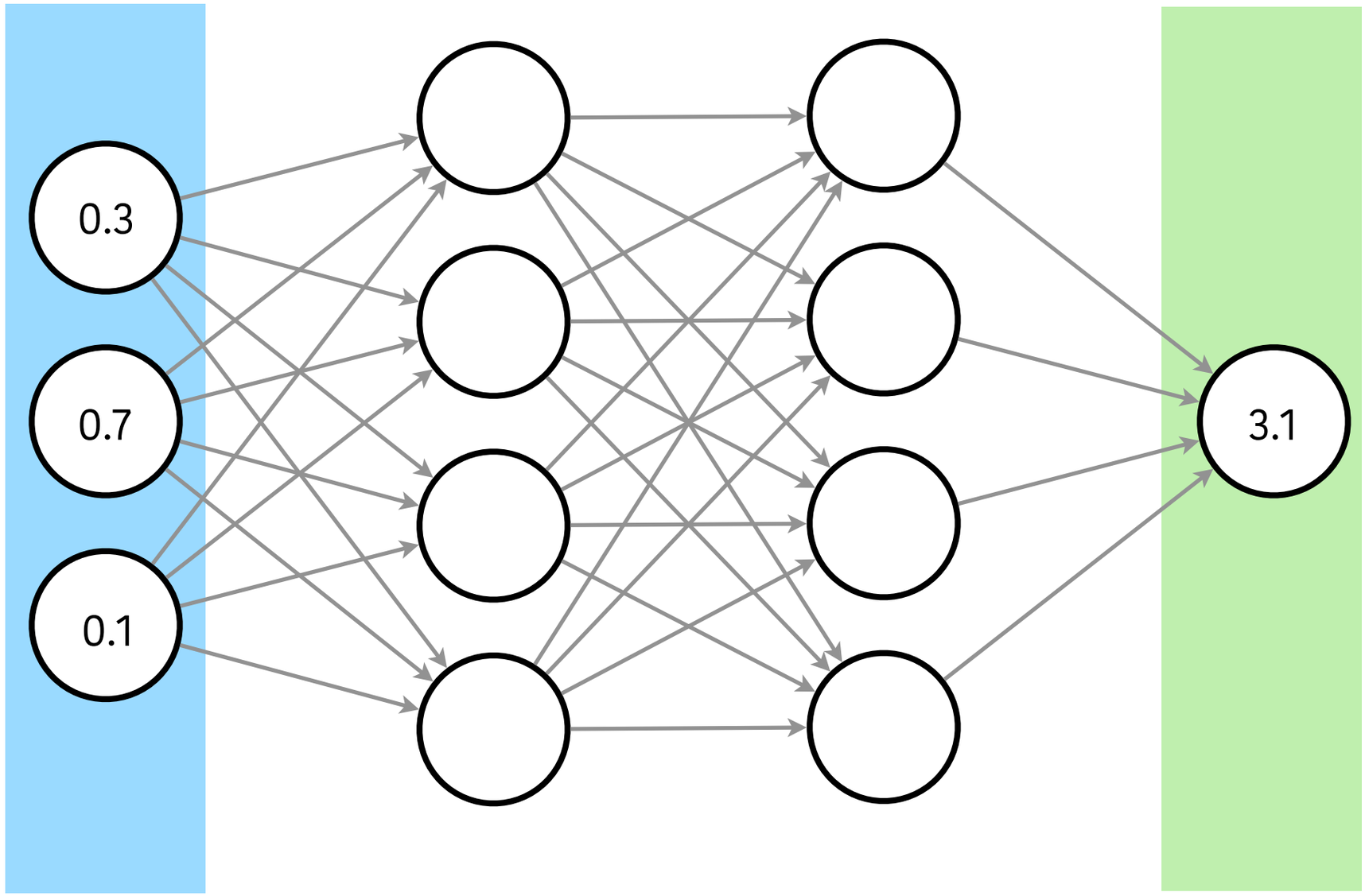
Phase I
Training

- learning phase
- requires large compute resources
- adequate choice of network architecture
- carefully prepared input data

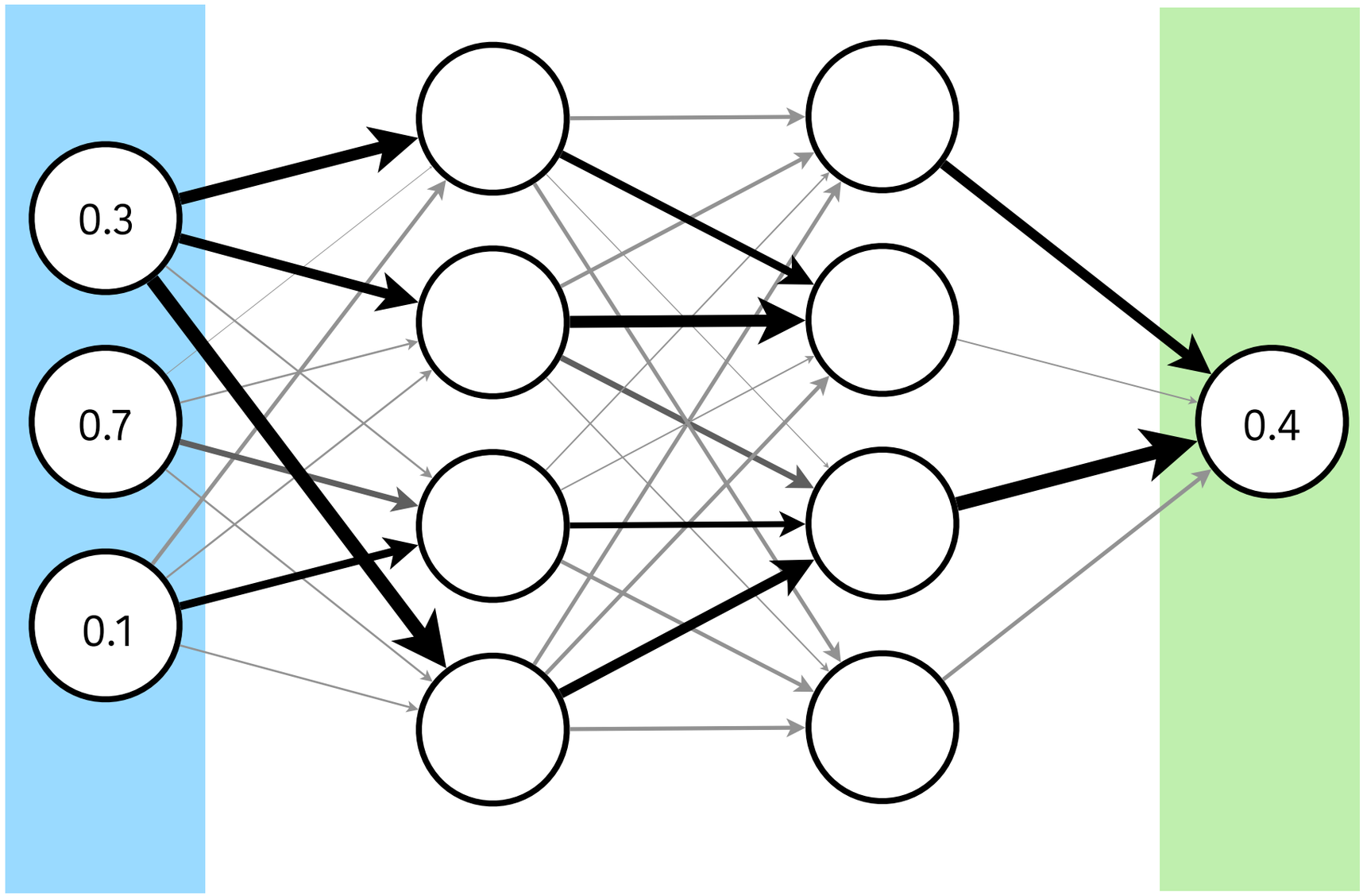
Phase II
Inference

- forward-pass = derive decision
- usually very fast
- requires lower compute resources
- input data should conform

How to train a deep neural network



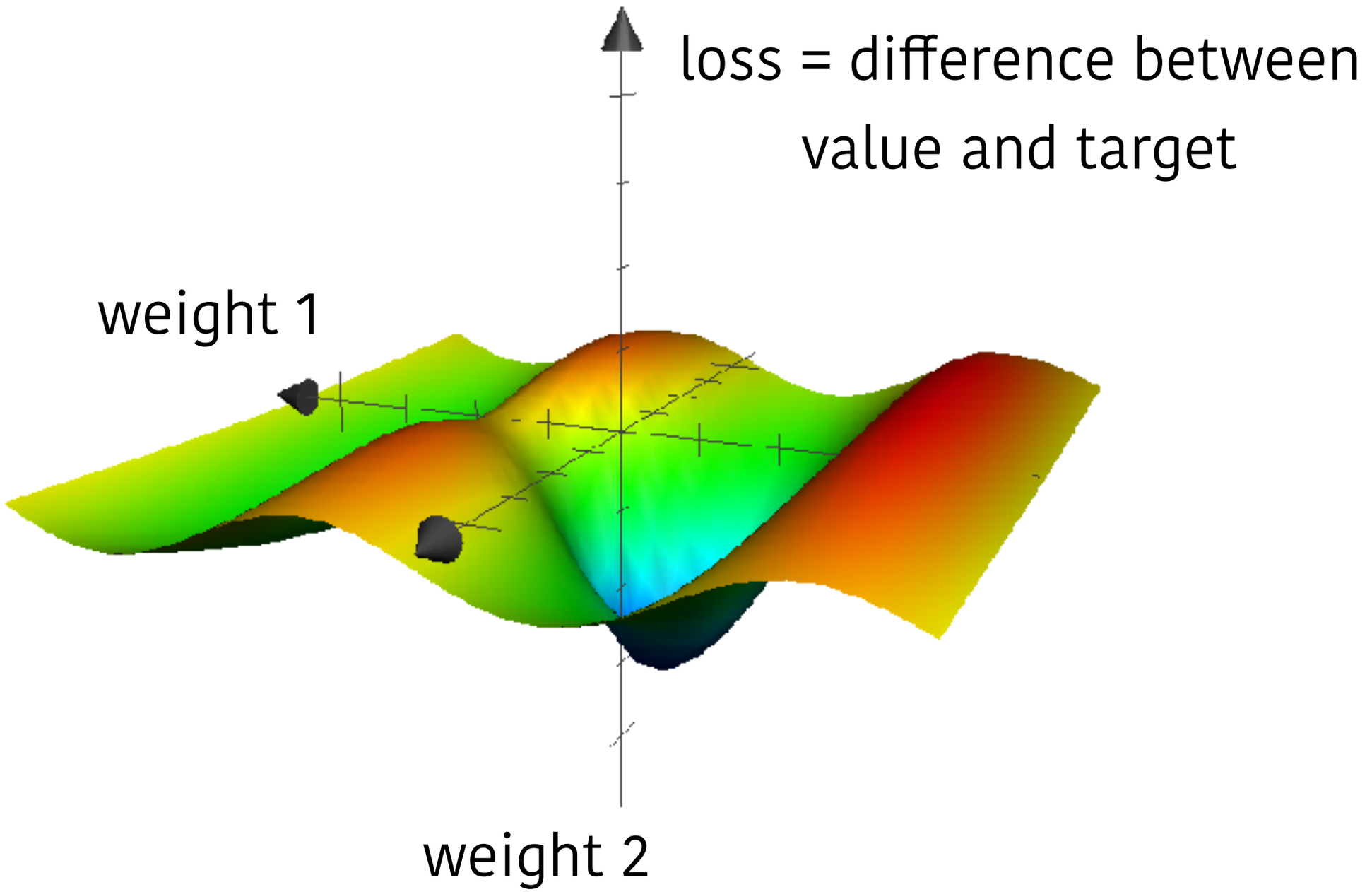
How to train a deep neural network



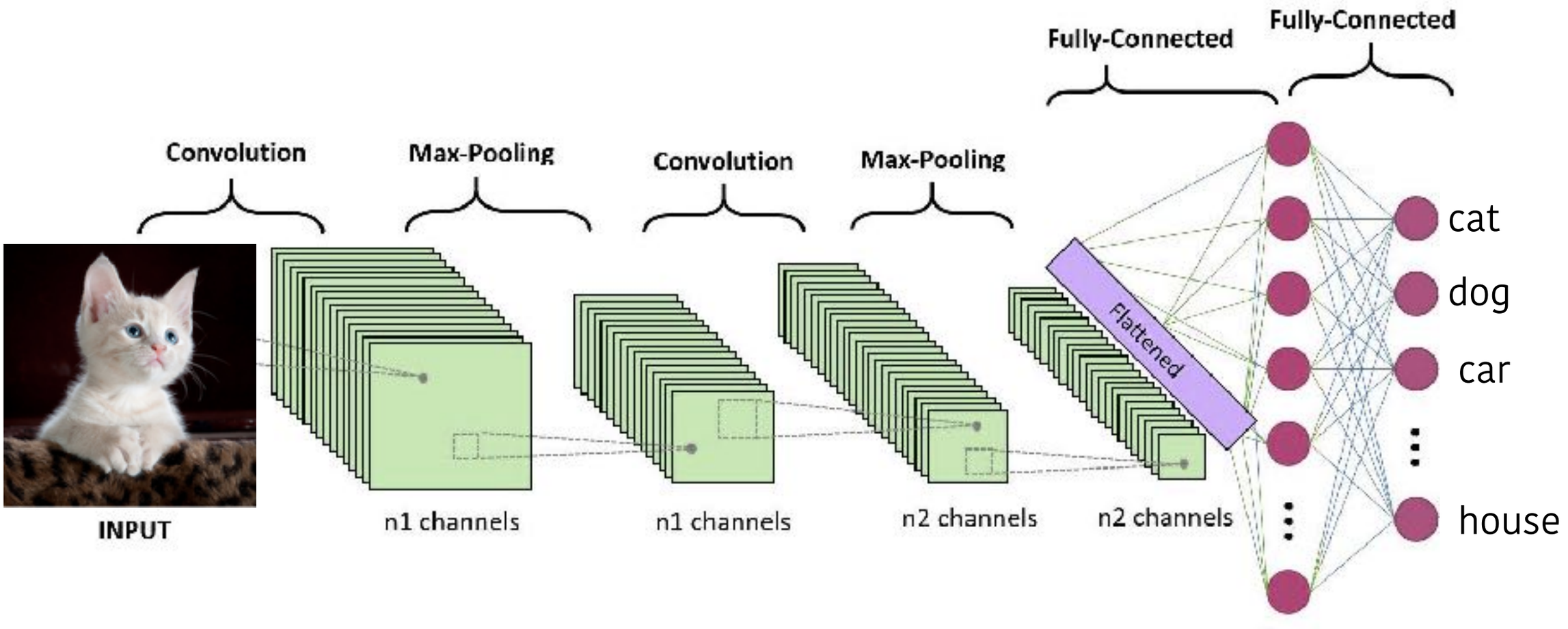
target: 0.4

input **hidden layers** **output**

optimization

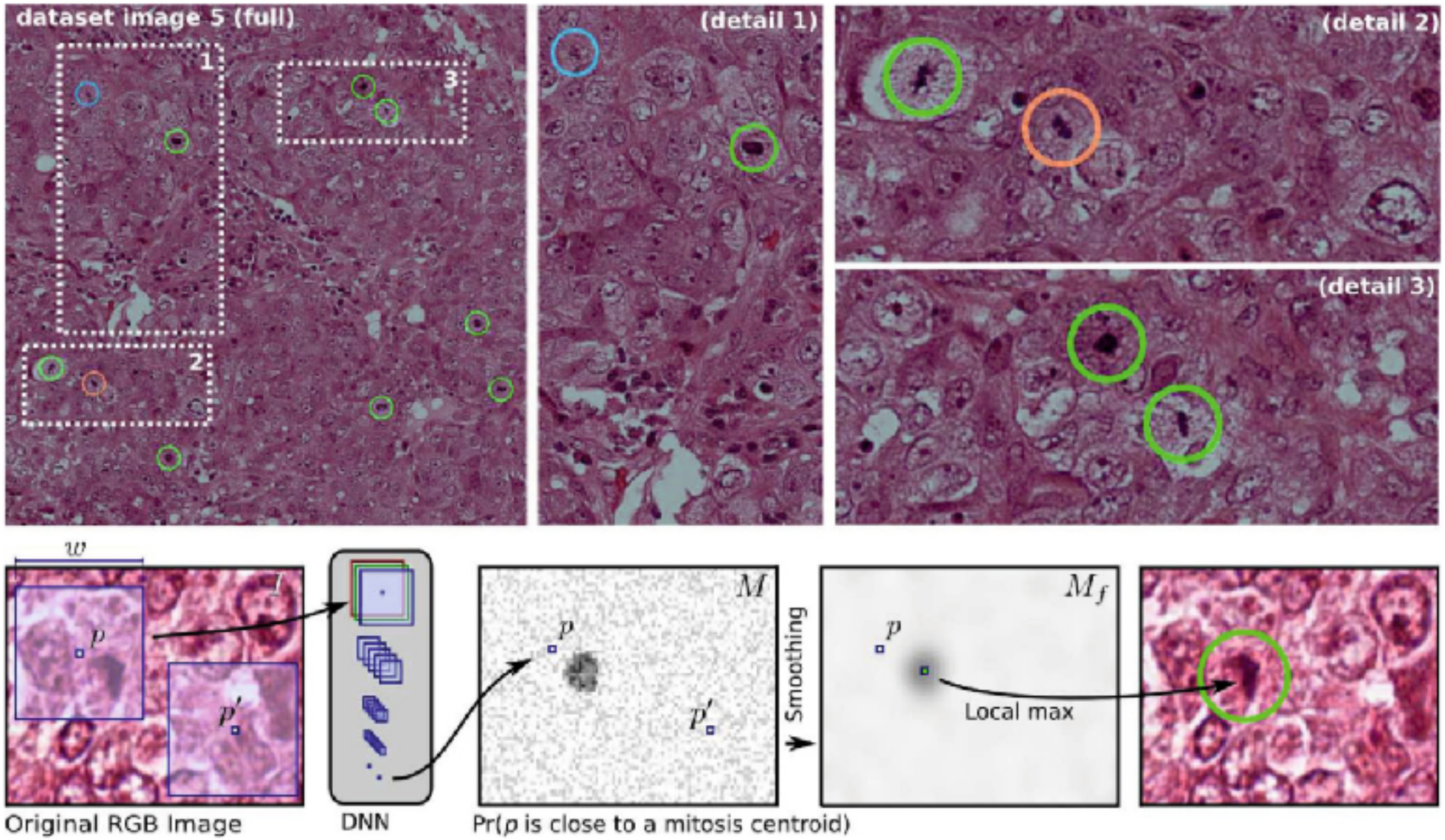


Convolutional Neuronal Networks



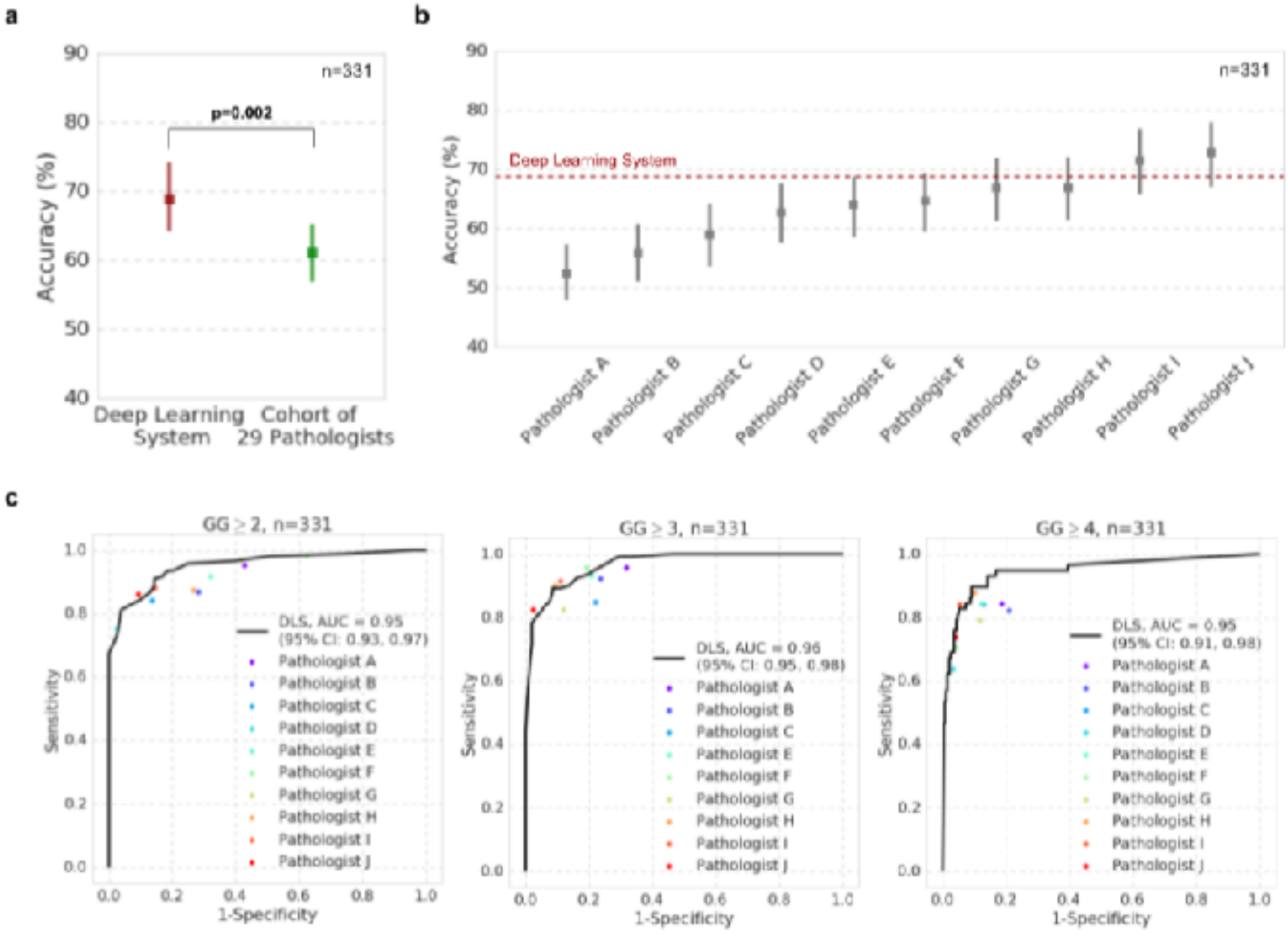
fast parallel computing:
graphical processing units (GPUs)

Deep Learning breakthrough 2013



Cireșan, D. C., Giusti, A., Gambardella, L. M., and Schmidhuber, J. (2013). Mitosis detection in breast cancer histology images with deep neural networks. Med Image Comput Comput Assist Interv 16, 411–418.

super-human performance scoring prostate cancer



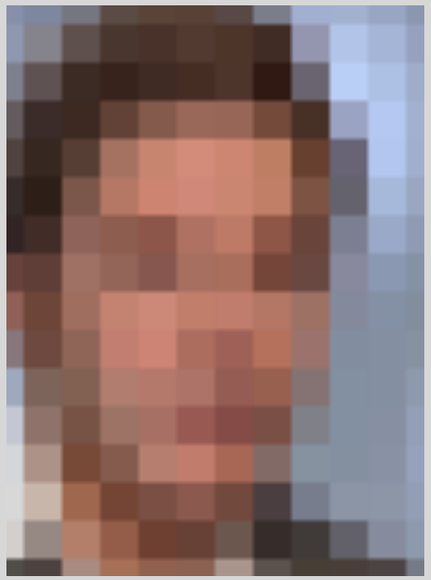
Nagpal, K., Foote, D., Liu, Y., Po-Hsuan, Chen, Wulczyn, E., et al. (2018). Development and Validation of a Deep Learning Algorithm for Improving Gleason Scoring of Prostate Cancer. arXiv cs.CV.

super-resolution

inpainting

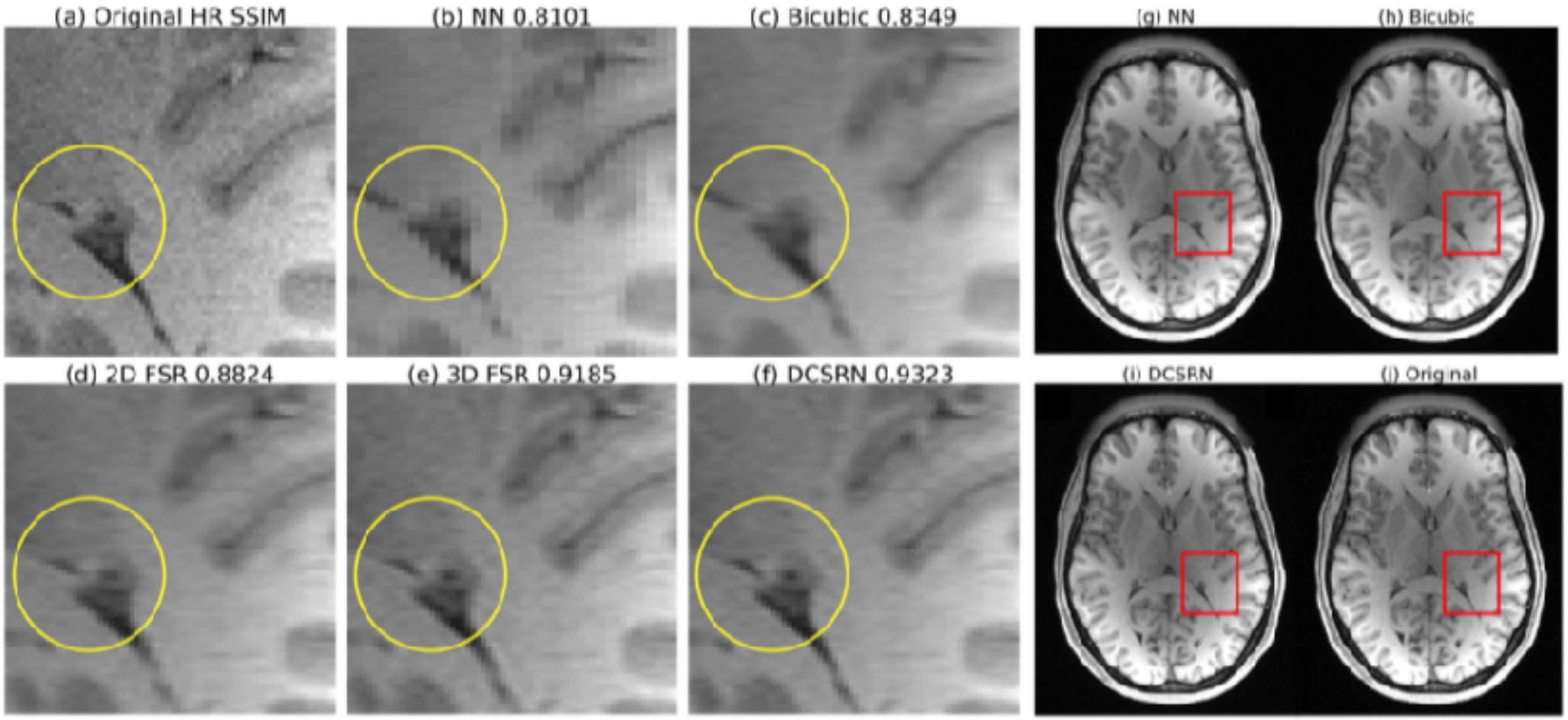
black/white -> color

in



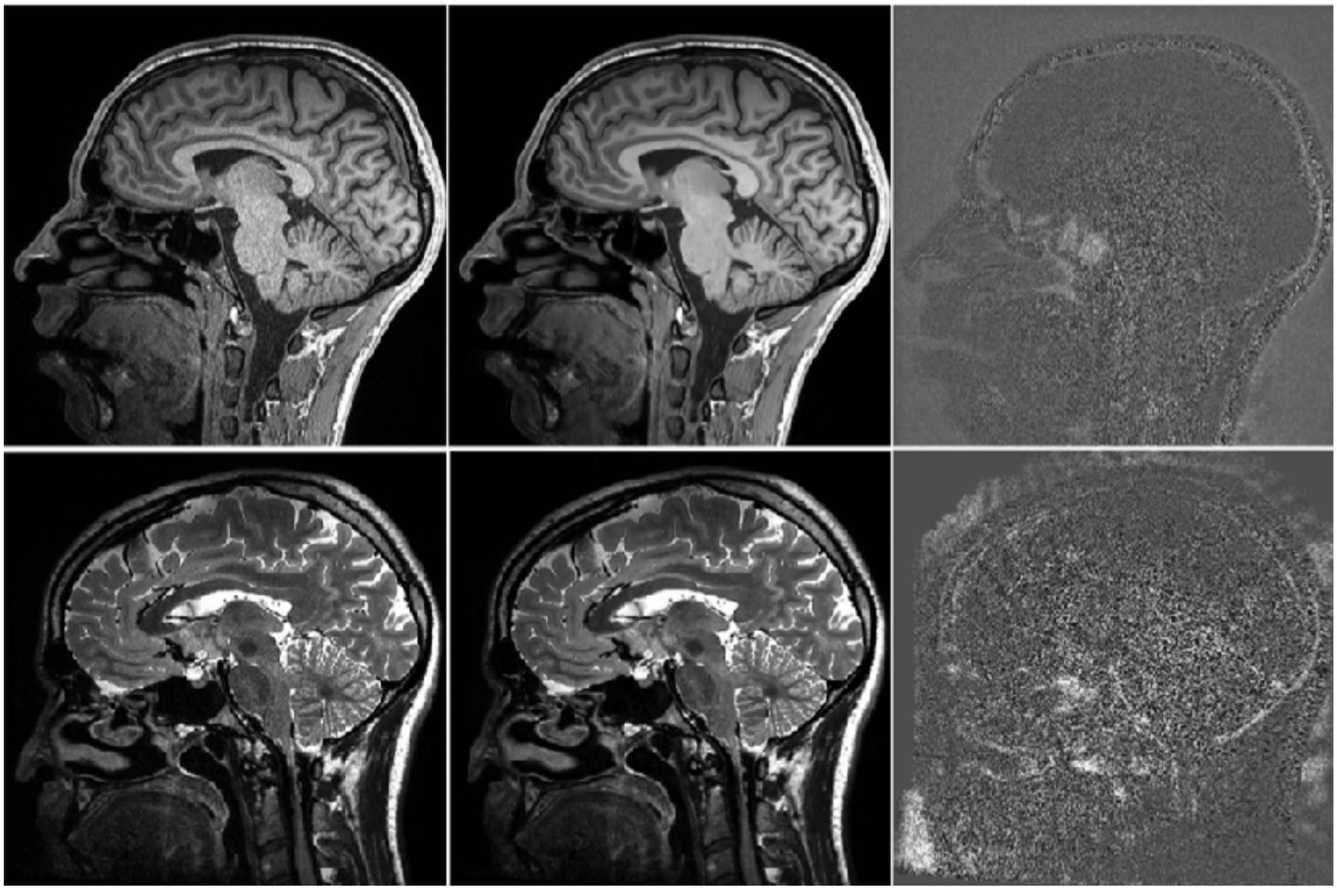
out

Super resolution using deep neural networks



Chen, Y., Xie, Y., Zhou, Z., Shi, F., Christodoulou, A. G., and Li, D. (2018). Brain MRI Super Resolution Using 3D Deep Densely Connected Neural Networks. arXiv cs.CV, 739–742. doi:10.1109/ISBI.2018.8363679.

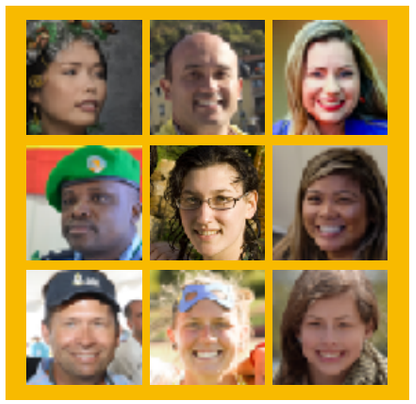
Image denoising using deep learning



Manjón, J. V., and Coupe, P. (2018). MRI Denoising Using Deep Learning. Springer International Publishing doi:10.1007/978-3-030-00500-9_2.

Generative Adverserial Networks (GANs)

Image Database



Discriminator

? data base or generator

Generator

Goodfellow, Ian, et al. (2014) "Generative adversarial nets." Advances in neural information processing systems.

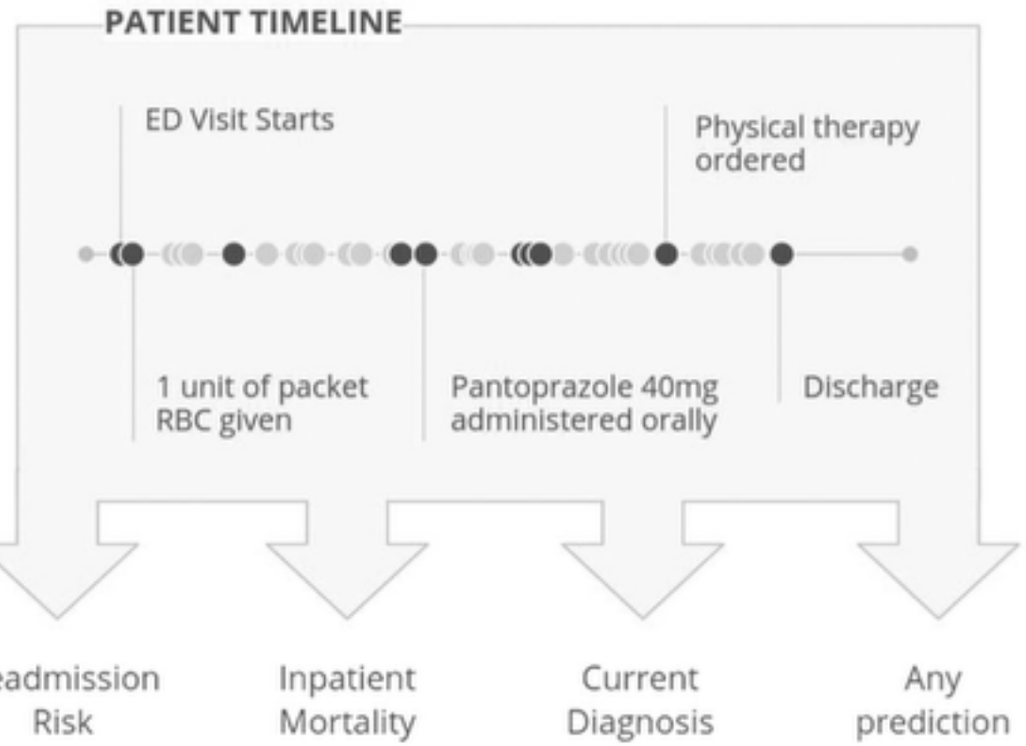
GANs 2015

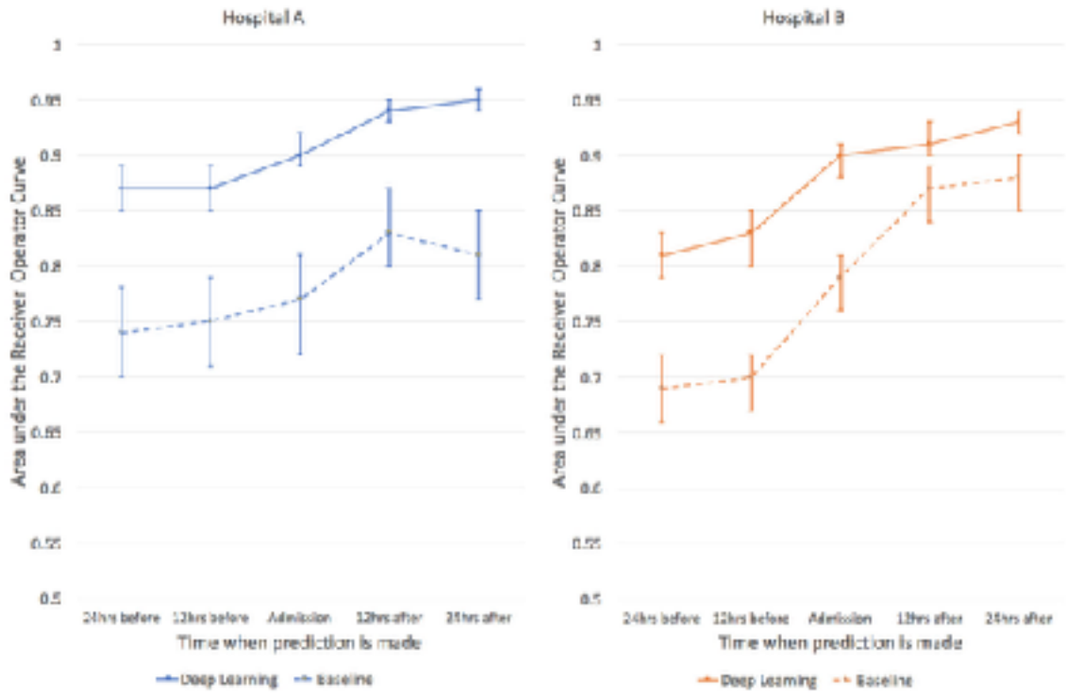
Radford, Alec, Luke Metz, and Soumith Chintala. "Unsupervised representation learning with deep convolutional generative adversarial networks." arXiv preprint arXiv:1511.06434 (2015).

GANs 2019

Karras, T., Laine, S., and Aila, T. (2019). A Style-Based Generator Architecture for Generative Adversarial Networks. arXiv.org cs arXiv., 1–12.

Google health:
modeling with electronic health records



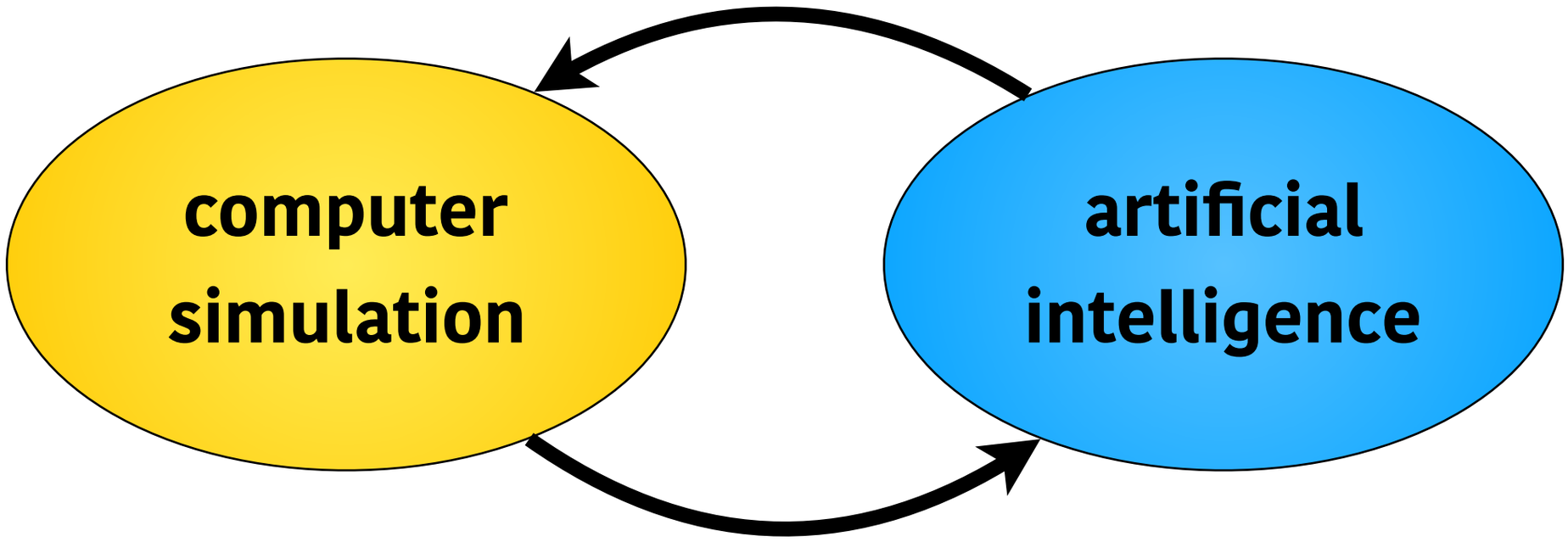


Rajkomar, A., Oren, E., Chen, K., Dai, A. M., Hajaj, N., Hardt, M., et al. (2018). Scalable and accurate deep learning with electronic health records. npj Digital Medicine, 1–10. doi:10.1038/s41746-018-0029-1.

Deepmind: super-human performance in go-game

Silver, D., Hubert, T., Schrittwieser, J., Antonoglou, I., Lai, M., Guez, A., et al. (2018). A general reinforcement learning algorithm that masters chess, shogi, and Go through self-play. Science 362, 1140–1144. doi:10.1126/science.aar6404.

simulation-driven AI optimization



- identify AI potentials
- implement AI solutions
- AI & data science support

thanks for your attention!