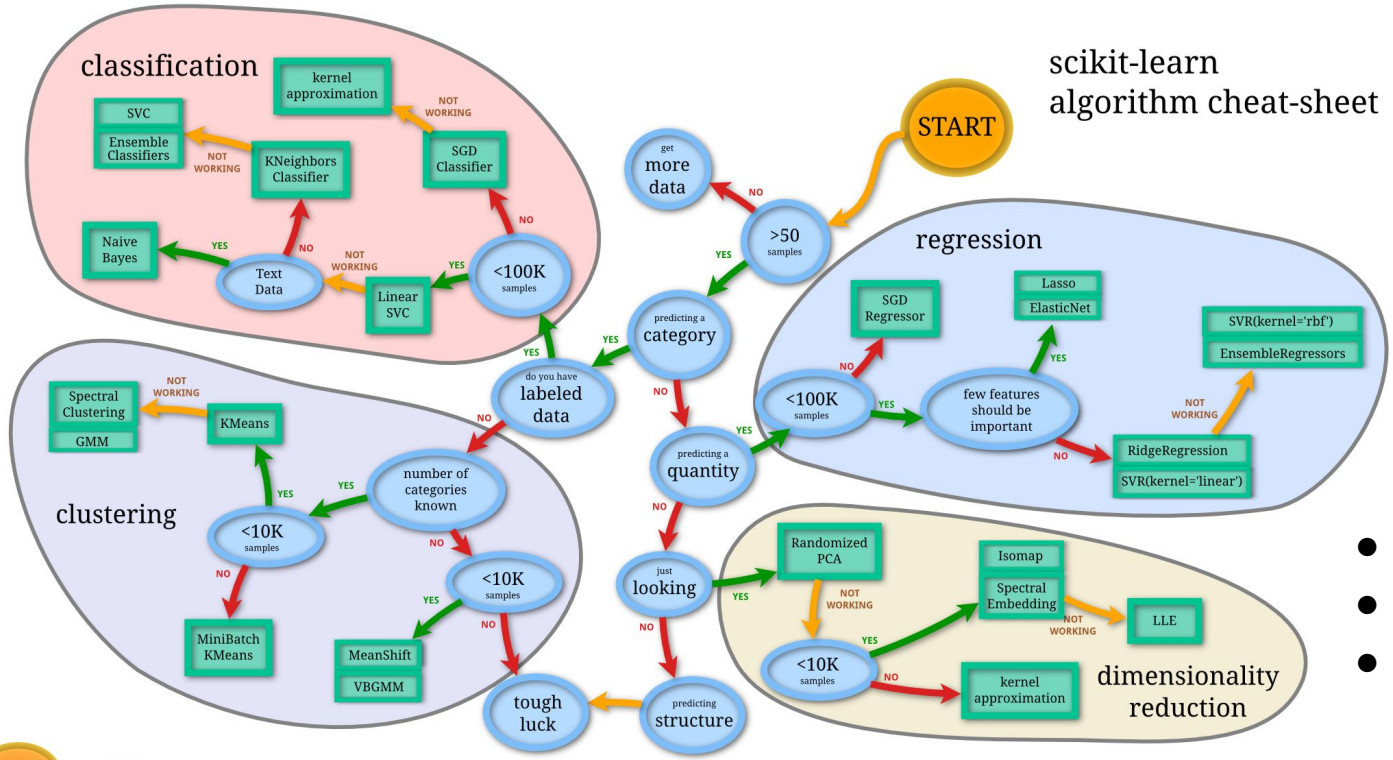
# Lecture 16-18: Machine learning

- Supervised and Unsupervised Learning
- Model validation & selection
- Evaluation metrics
- Machine learning algorithms
- Applications of ML

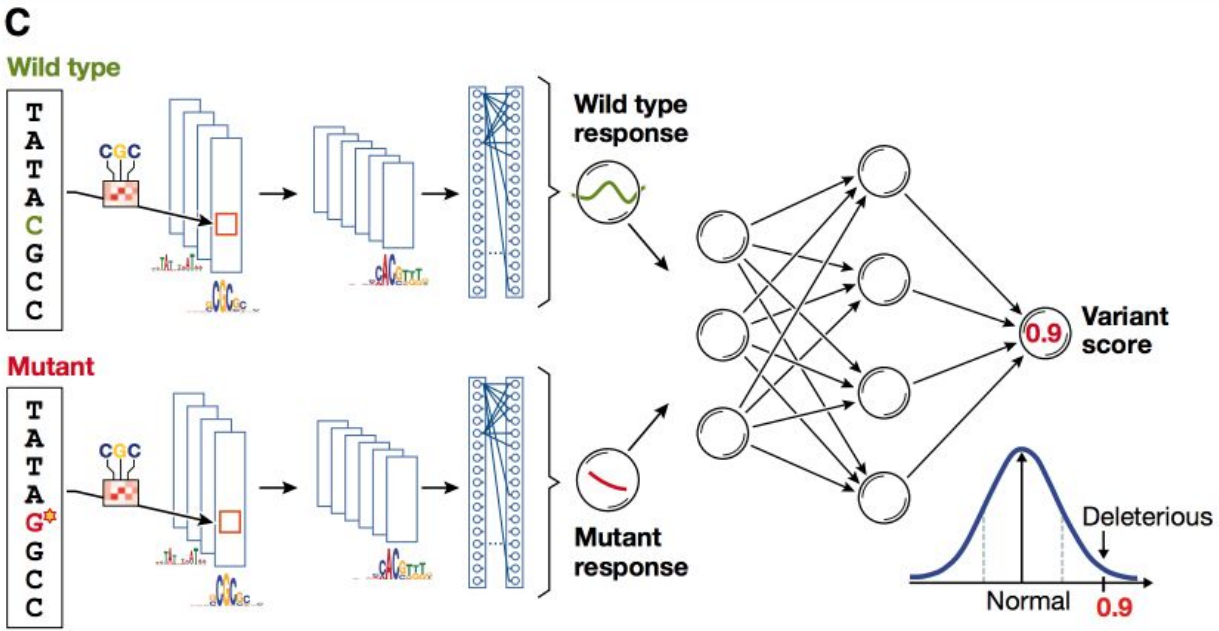
# Machine learning

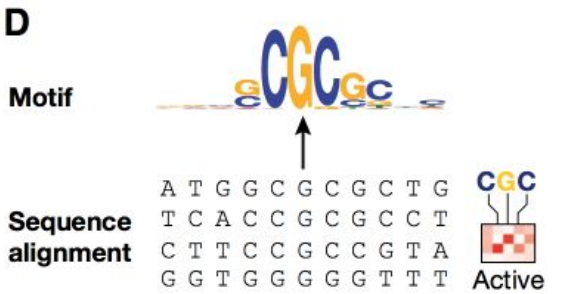


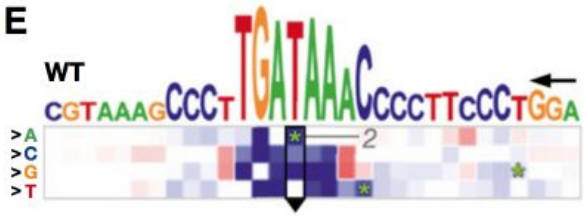

- Supervised learning
- Unsupervised learning
- Reinforcement learning

Back

# ML Applications – Effect of mutations

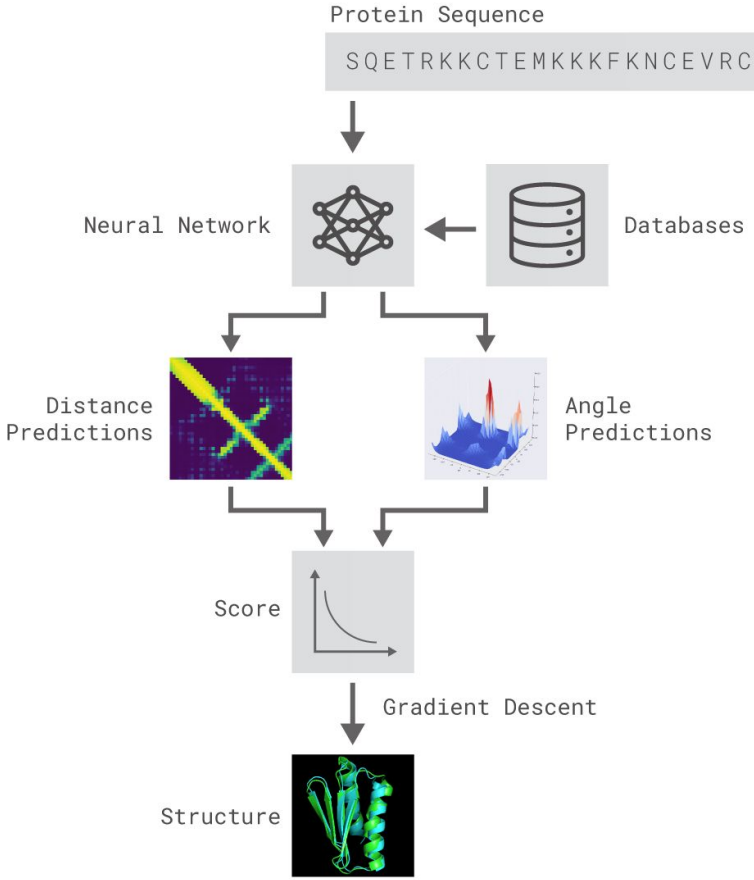


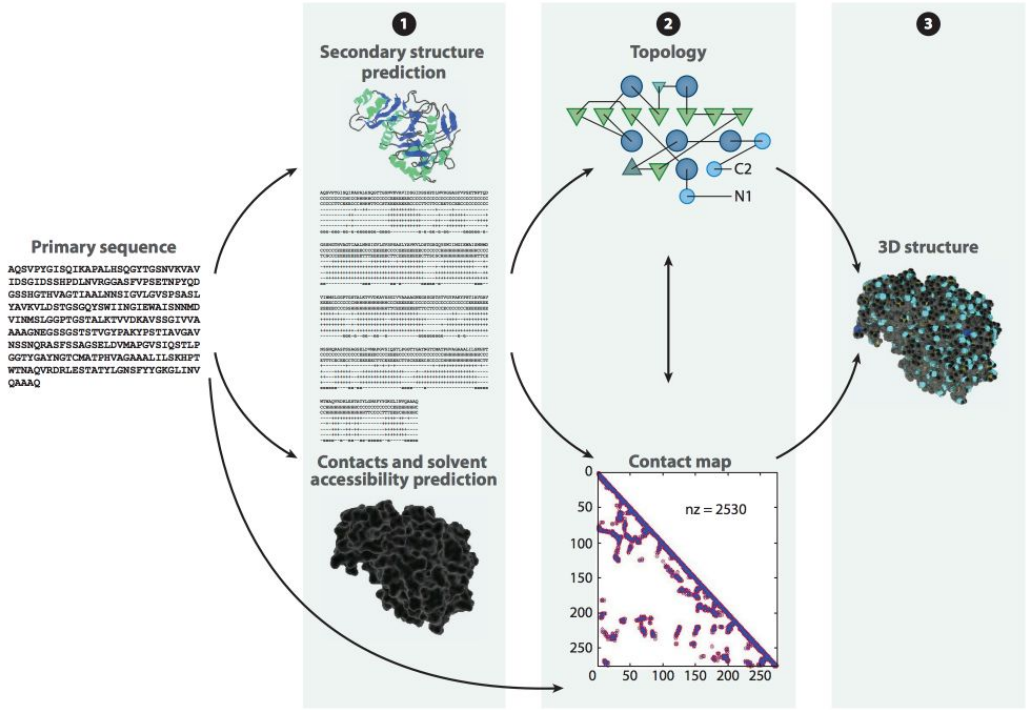




Angermueller (2016) Mol. Sys. Biol.

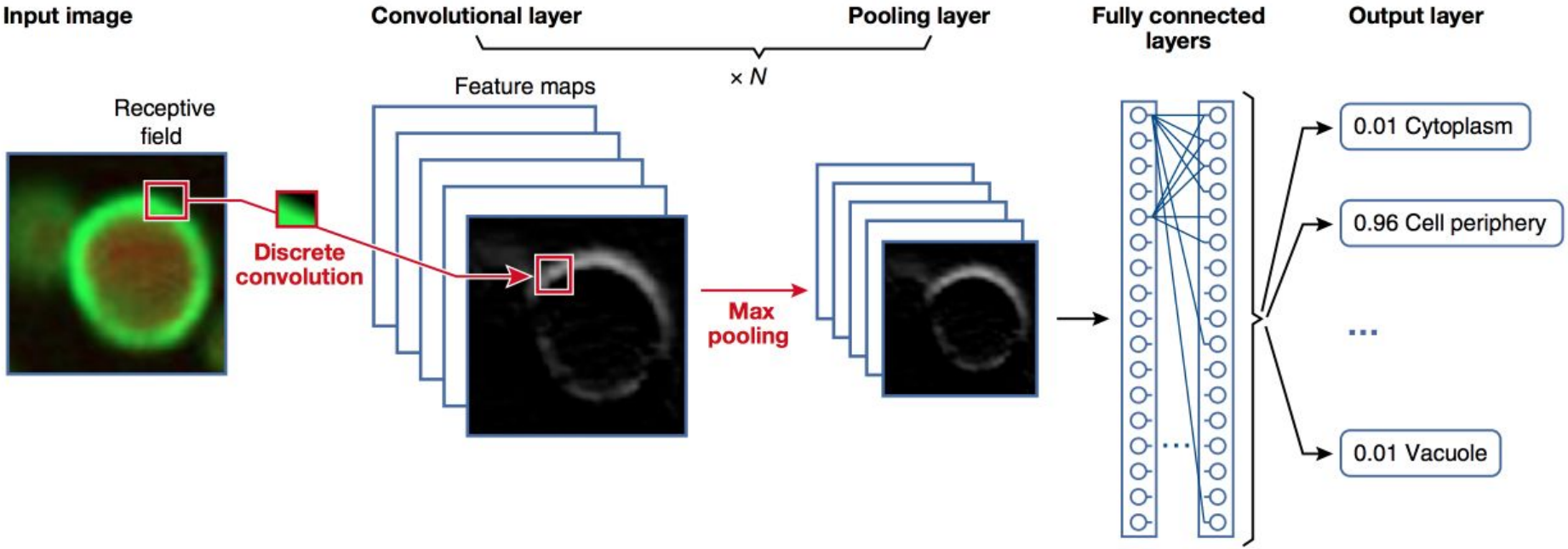
# ML Applications – Protein structure prediction



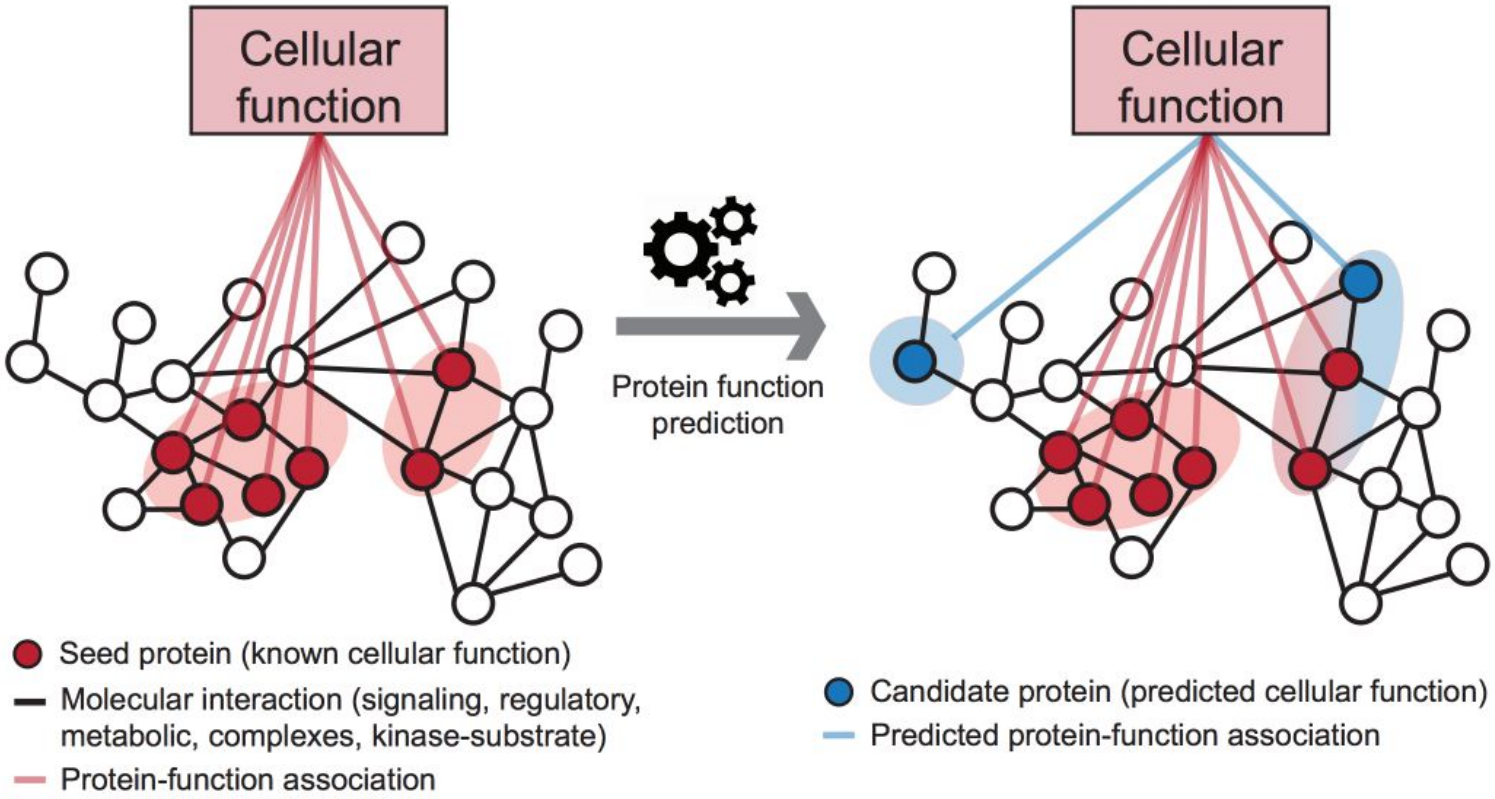

https://deepmind.com/blog/alphafold

# ML Applications – Protein subcellular localization



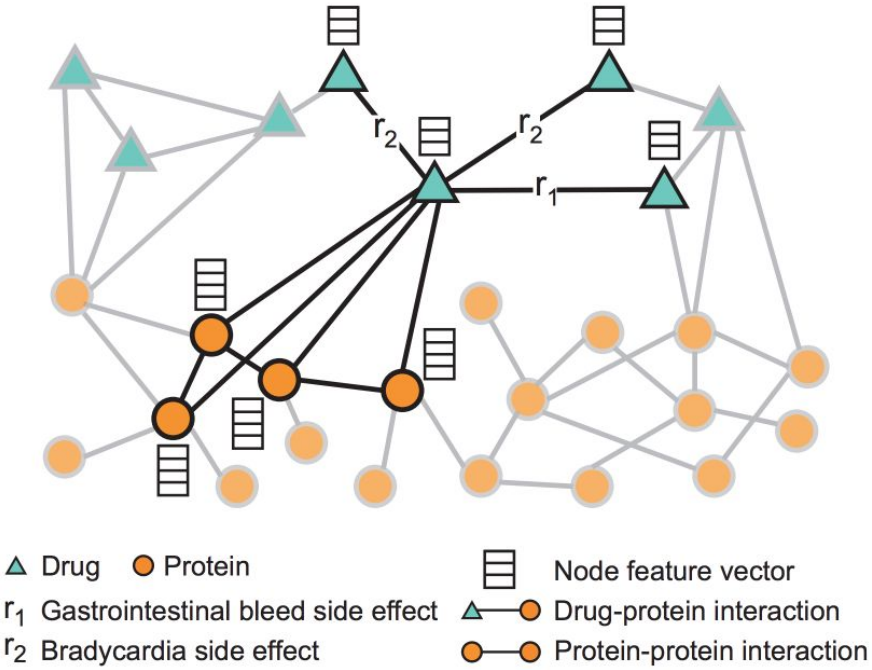

Angermueller (2016) Mol. Sys. Biol.

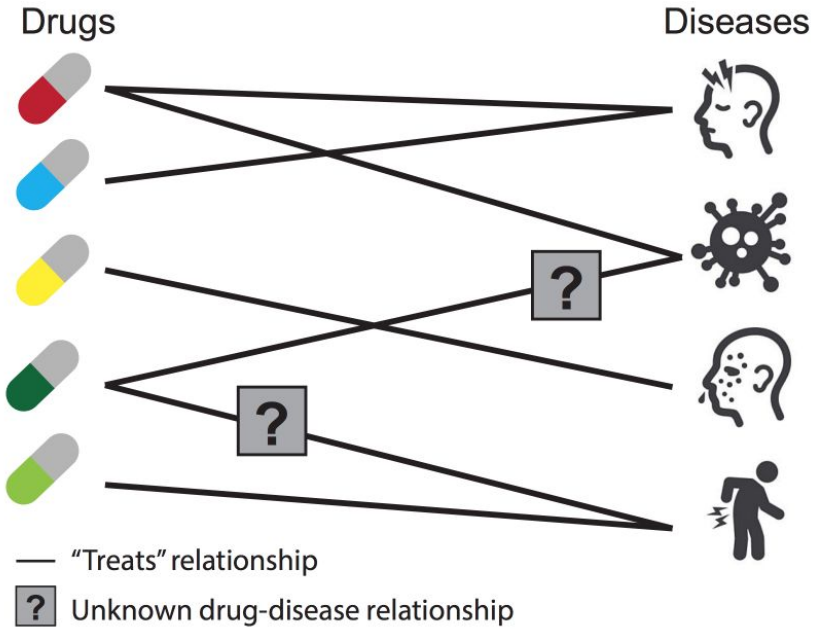
# ML Applications – Gene/protein function/phenotype prediction




Zitnik (2018) arXiv

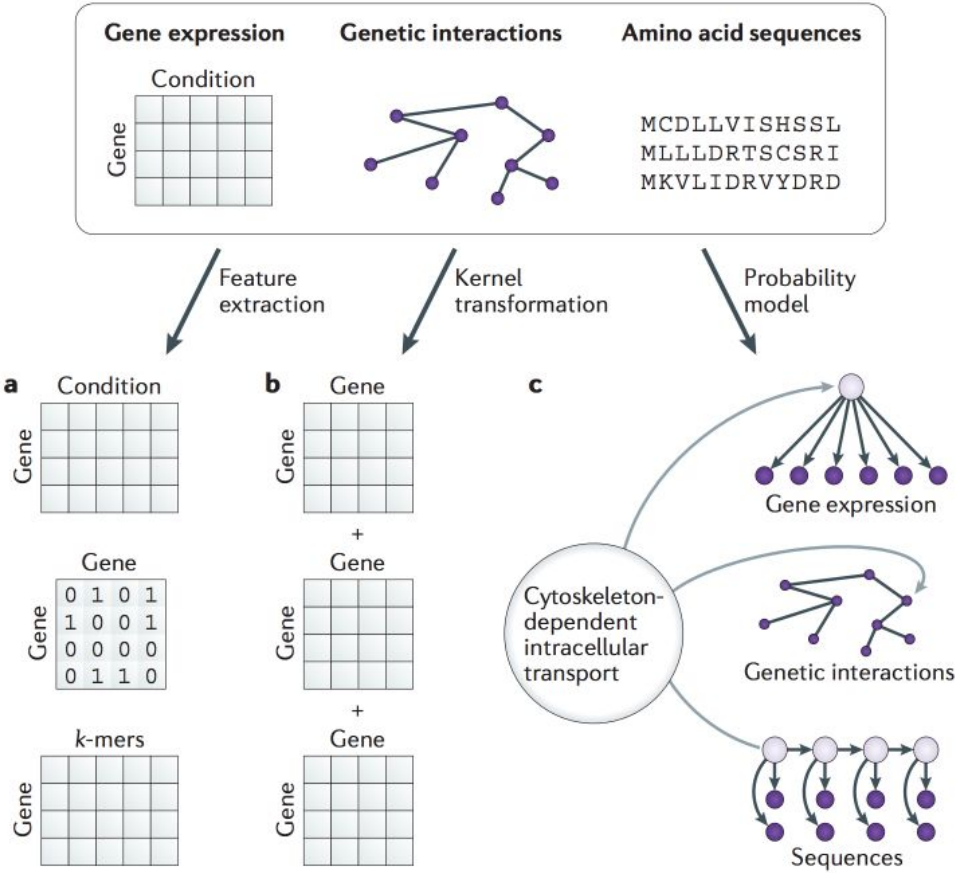
# ML Applications – Drug-target, drug-drug, drug-disease prediction



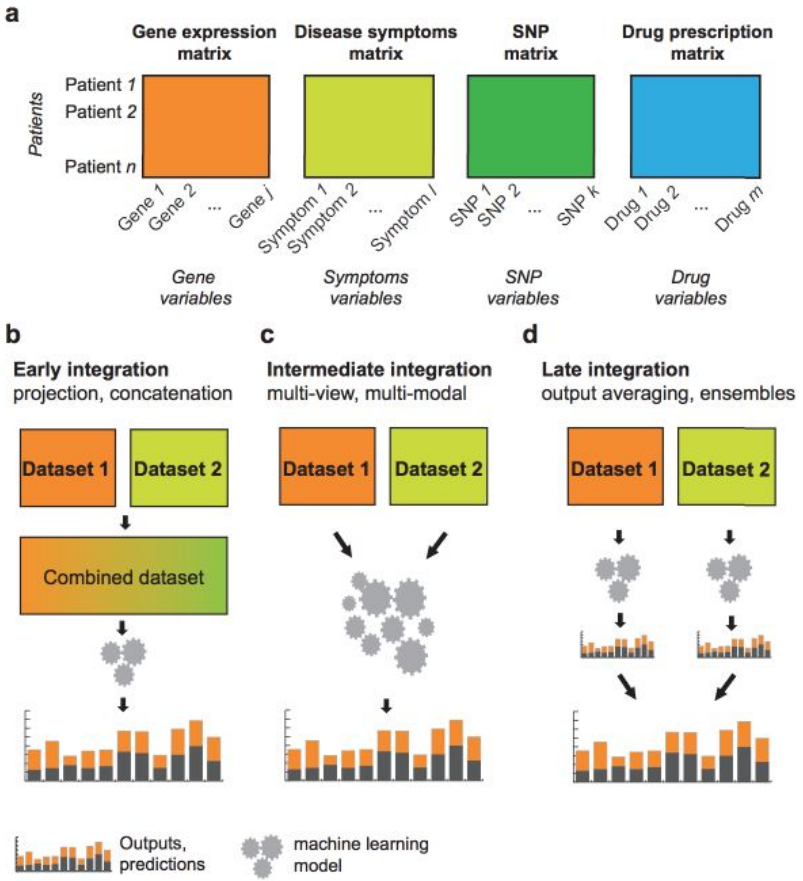

Zitnik (2018) arXiv

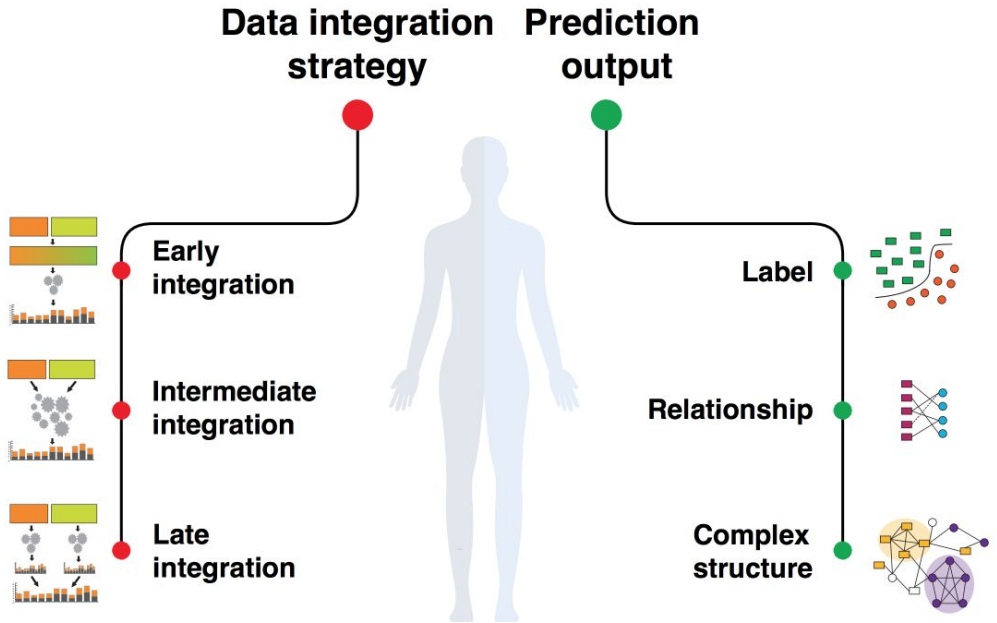
# ML Applications – Data integration




Libbrecht & Noble (2015) Nat. Rev. Genet.

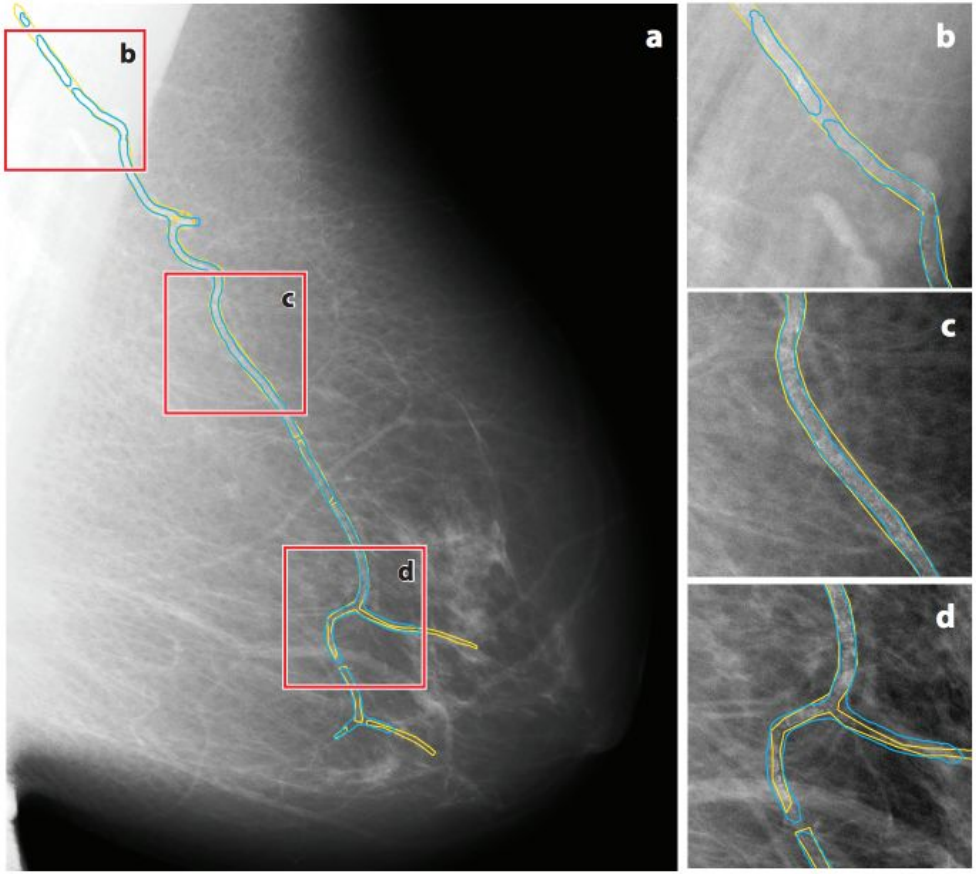
# ML Applications – Data integration

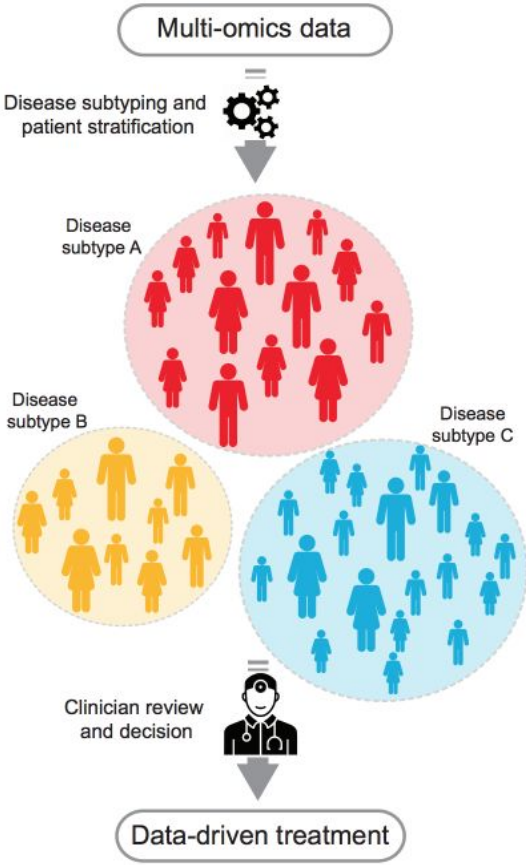



Zitnik (2018) arXiv

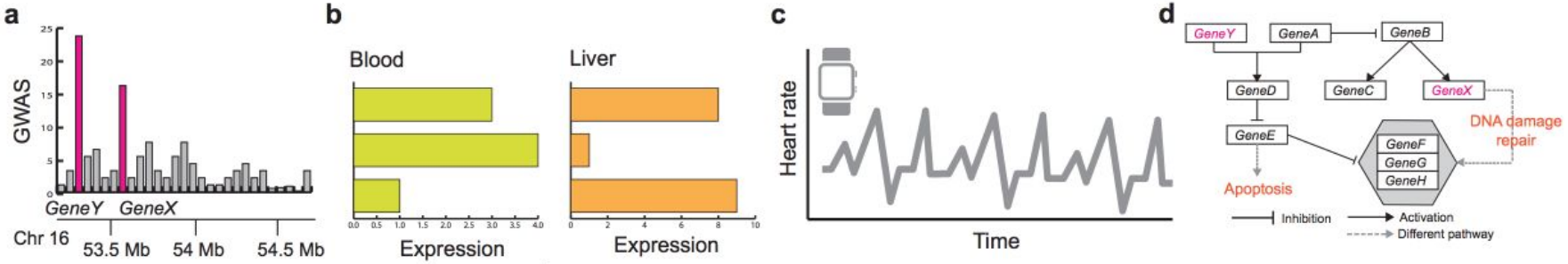
# ML Applications – Diagnosis, Personalized/precision medicine




Zitnik (2018) arXiv
Baldi (2018) Annu. Rev. Biomed. Data Sci.

# ML Applications – Data integration




**No disease**

*GeneY* region associated with disease
**AND** Low expression in Blood
**AND** High expression in Brain
**AND** Regular heartbeat

Disease probability 10% 17%

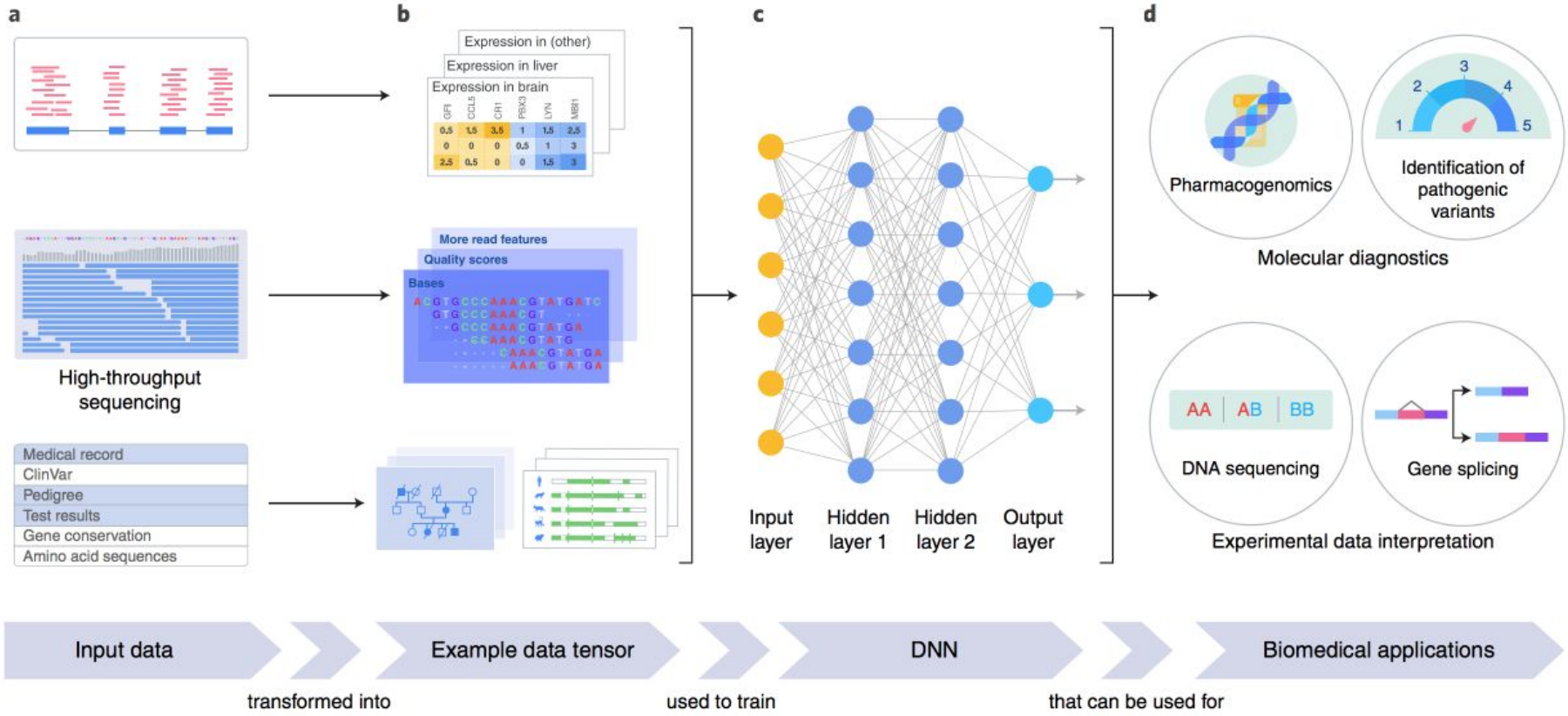
**Disease**

*GeneX* region associated with disease
**AND** High expression in Blood
**AND** Irregular heartbeat

Disease probability 59% 64% 73%

Zitnik (2018) arXiv

# ML Applications – Personalized/precision medicine




Esteva (2019) Nat. Medicine