

Neural Patient

A neural approach to multimodal patient data representation

Francesco Sansone

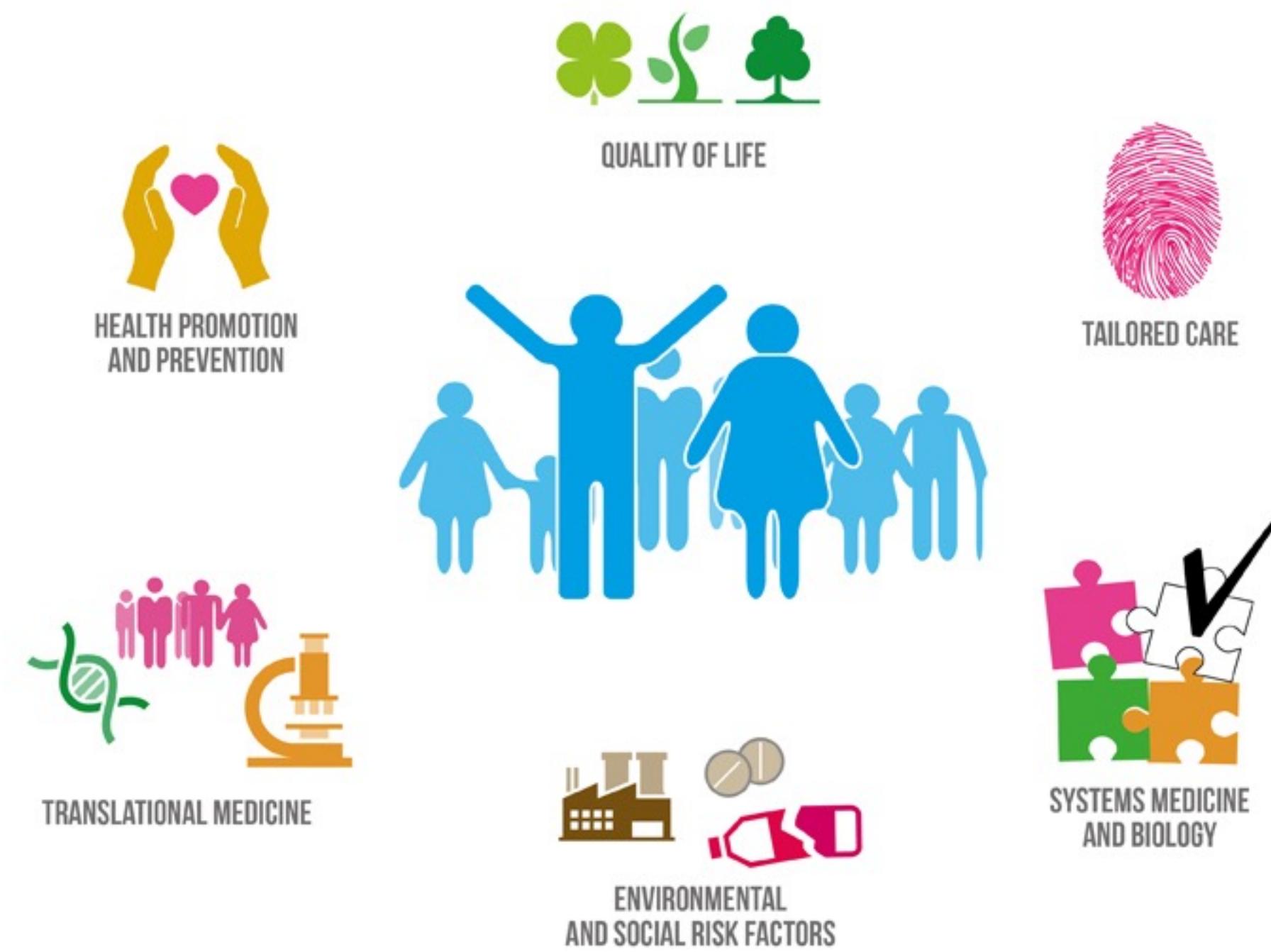
Mauriana Pesaresi Seminar Series - 5th Feb 2021

Outline

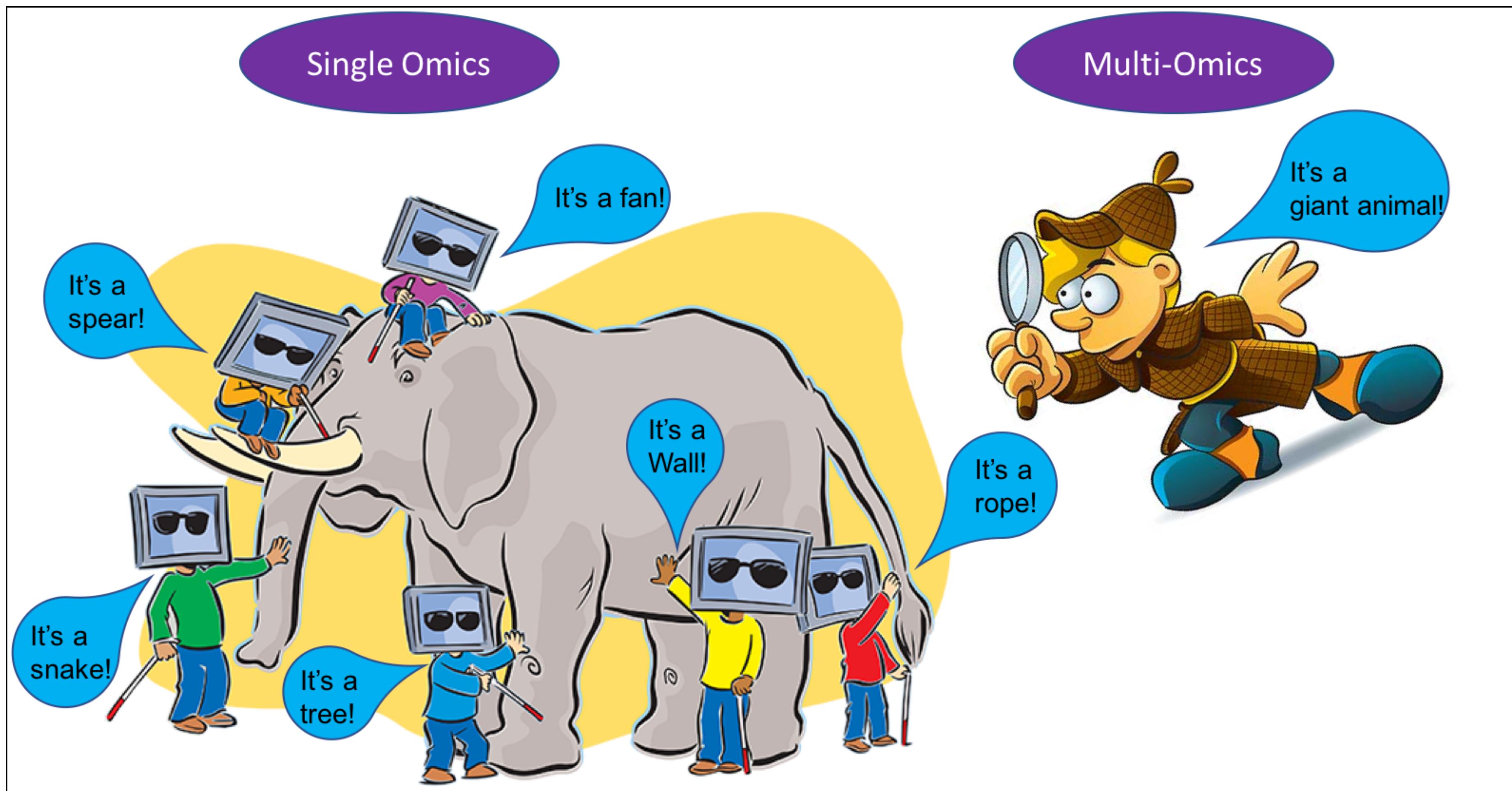
- Motivations & Background
- State-of-art
- My proposal
- Conclusions



Motivations



Background



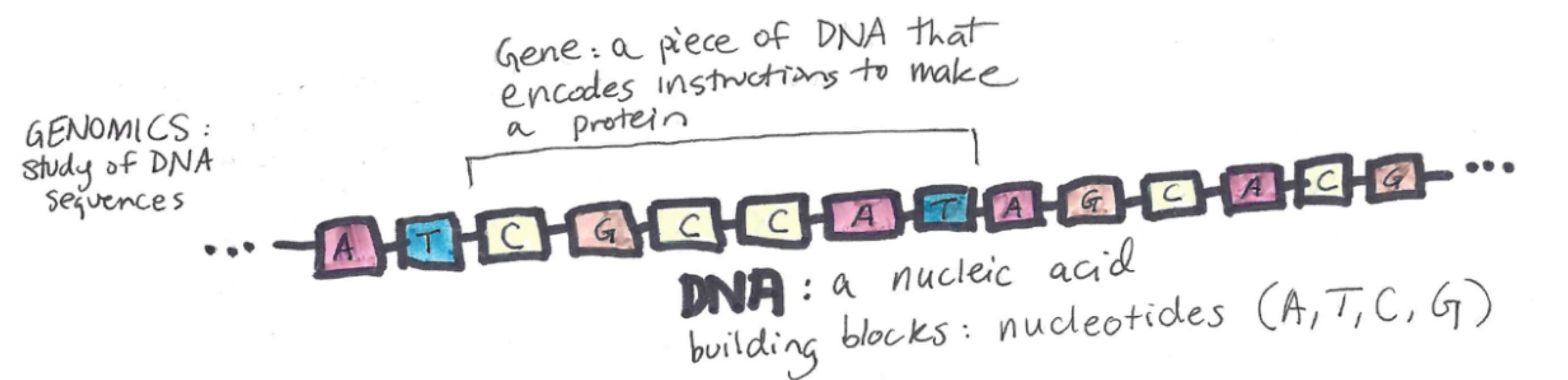
Background

- Omic Science is the part of biotechnology which analyzes the structure and features of a given biological function
- the objective of omic science is to identify, characterize, and quantify all biological molecules that are involved in the structure, function, and dynamics of a cell, tissue, or organism



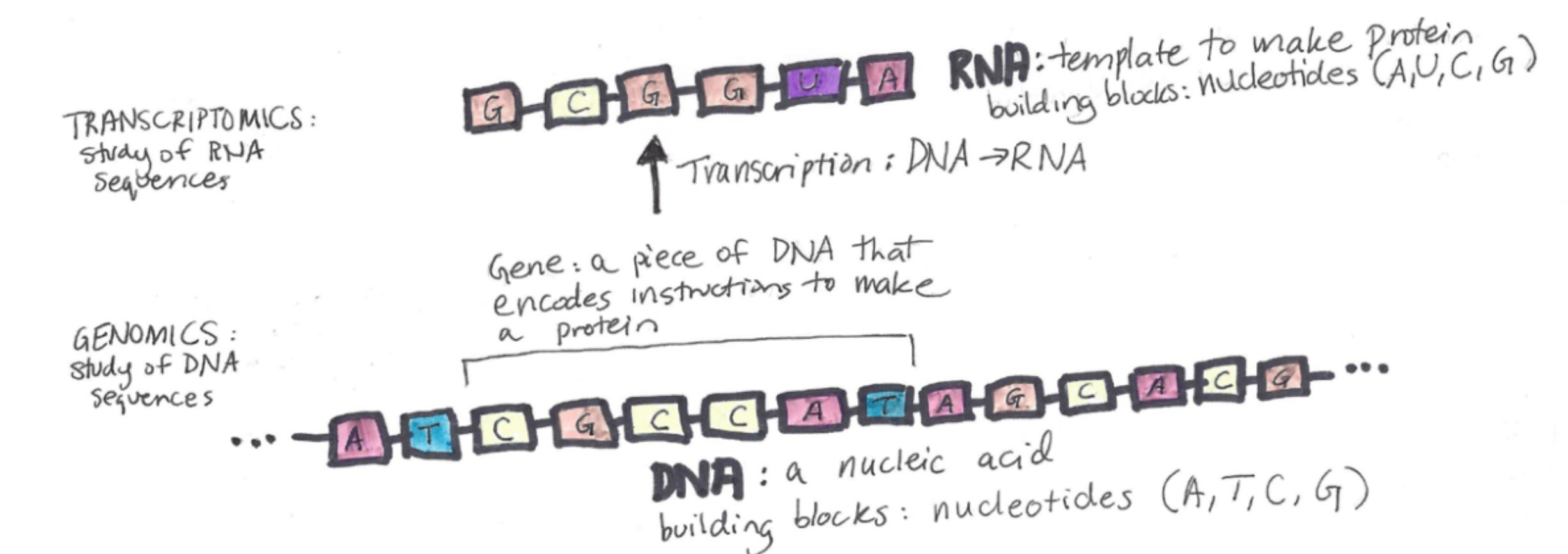
Genomics

- genomics: study of DNA sequences
- GWAS is a gold standard method



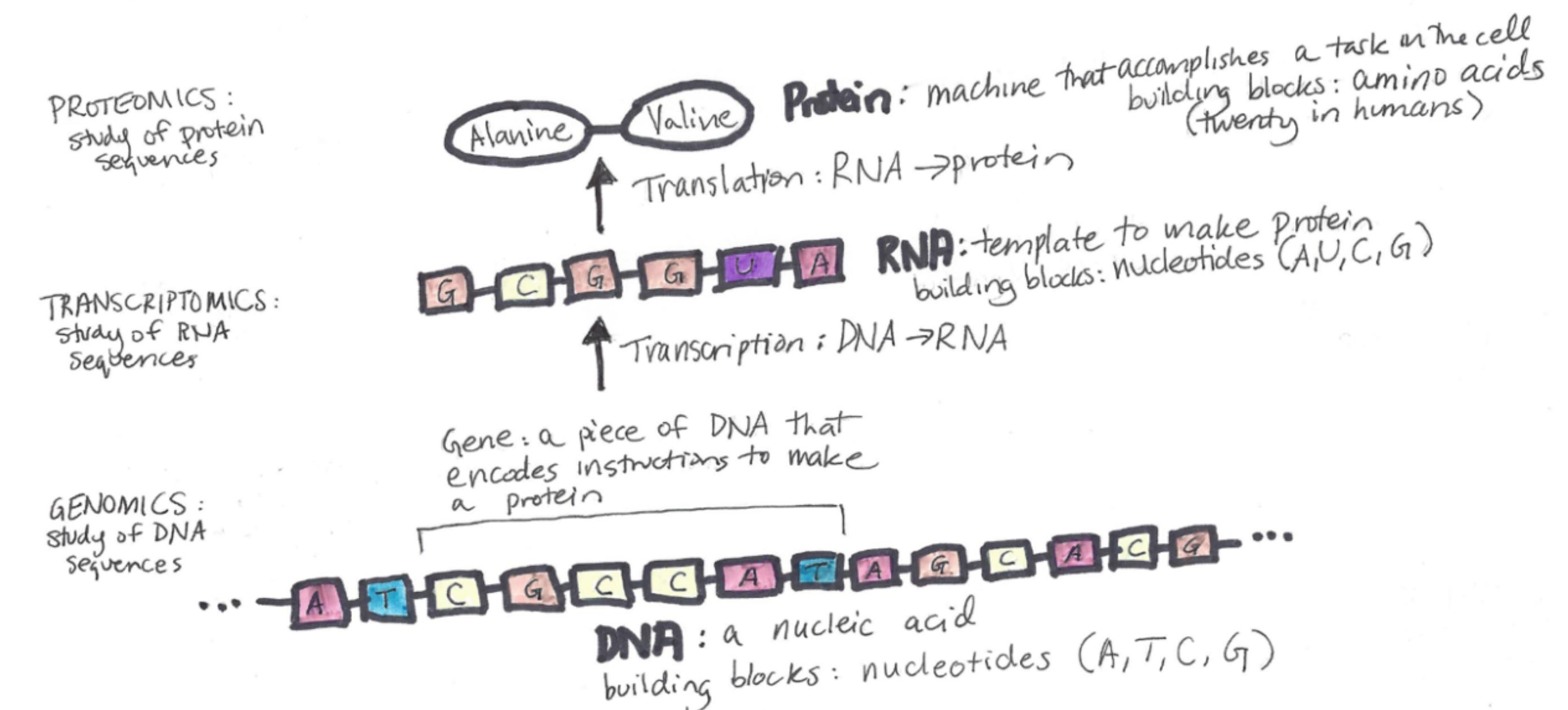
Transcriptomics

- RNA is build by a copy of DNA
- Transcription process
- Study of the RNA sequences



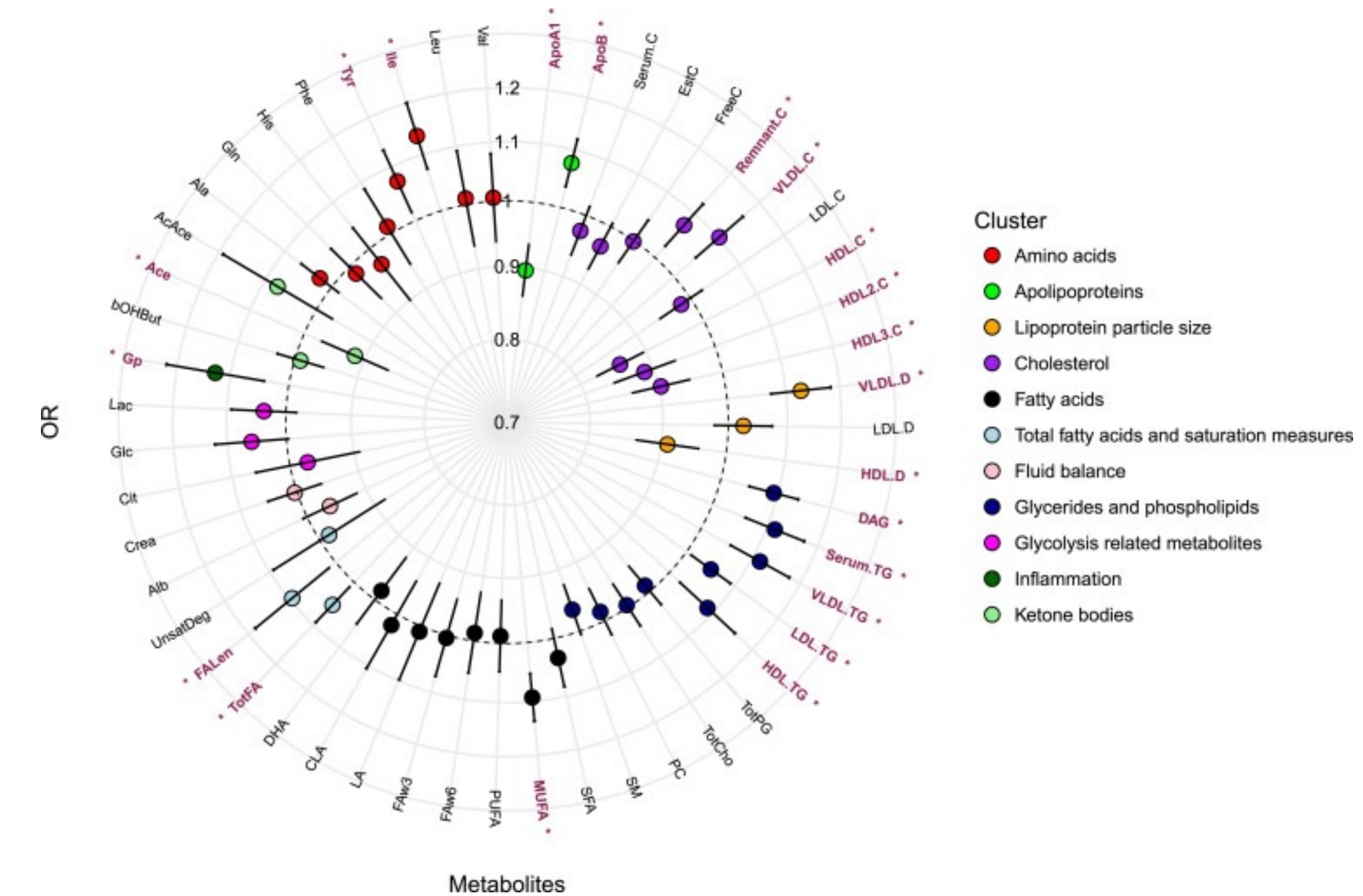
Proteomics

- Study of the protein sequences
- mass spectrometry is the instrument
- provide protein inventory of a cell or of a tissue

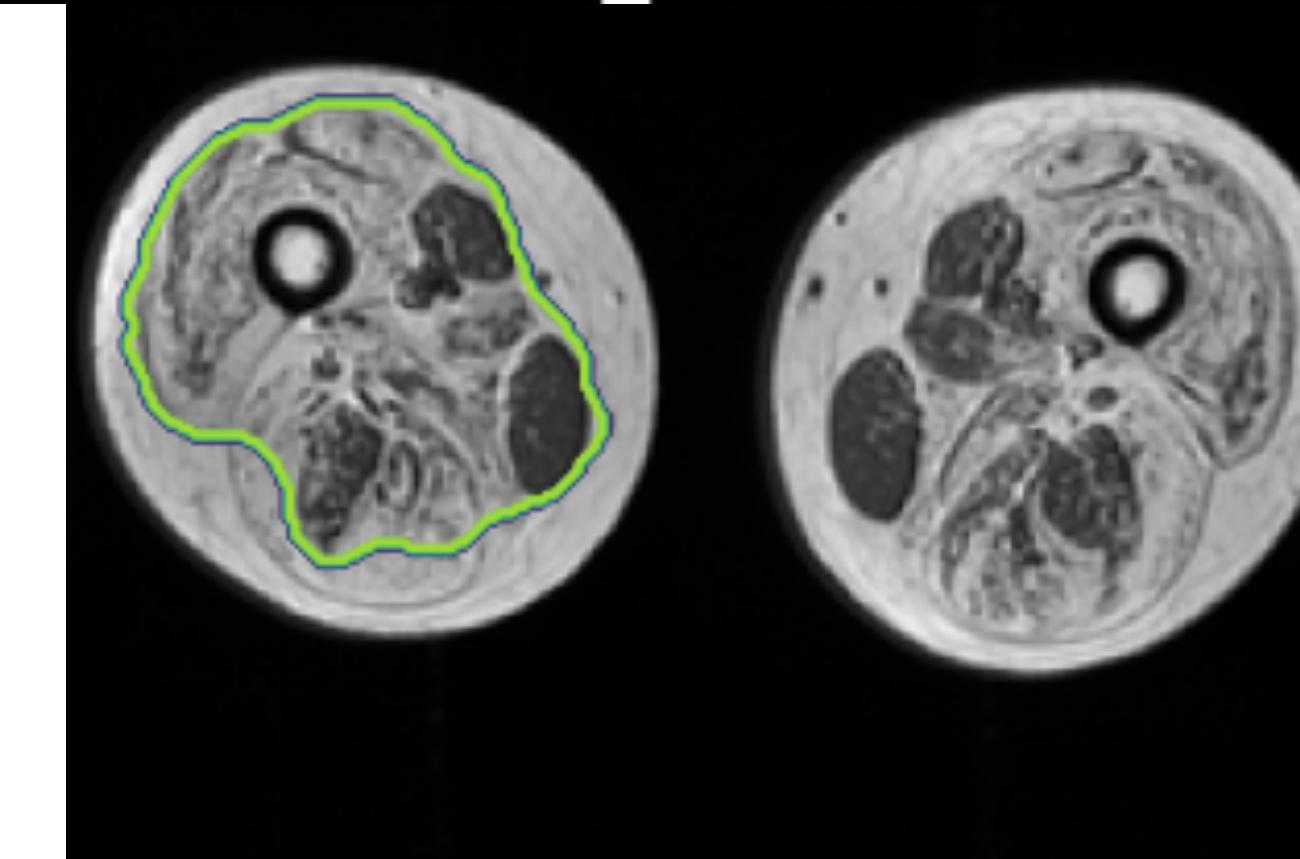
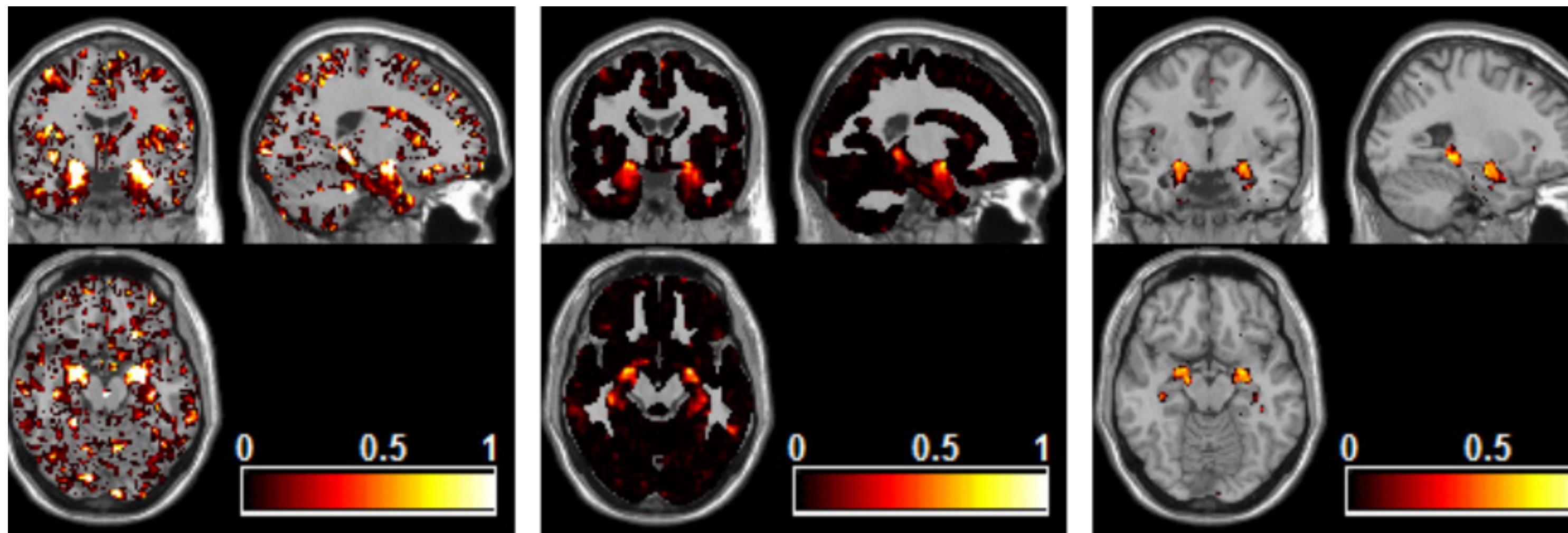


Metabolomics

- study the global profile of metabolites
- PCA can be a instrument
- can be conducted on different tissues or biological fluids



Other sources



Precision Medicine

The target is to design and optimize pathway for:

- diagnosis,
- therapeutic intervention,
- prognosis

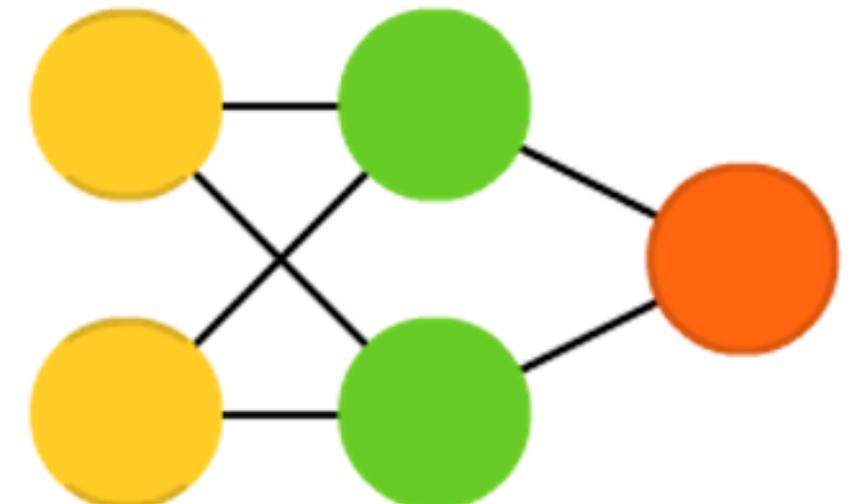
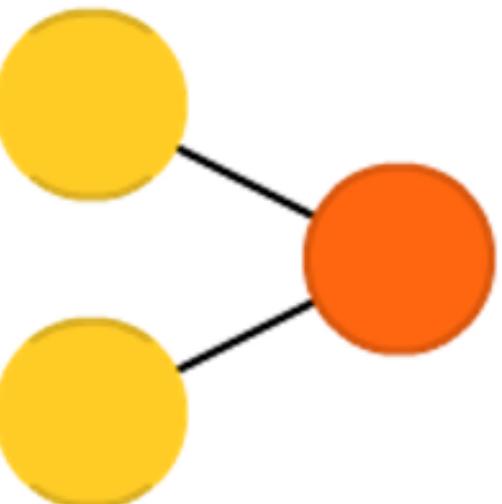
by using a large multidimensional biological dataset that capture individual variability in genes, function and environment.

e.g. Blood typing leads doctors to guide transfusions



MultiLayer Perceptron

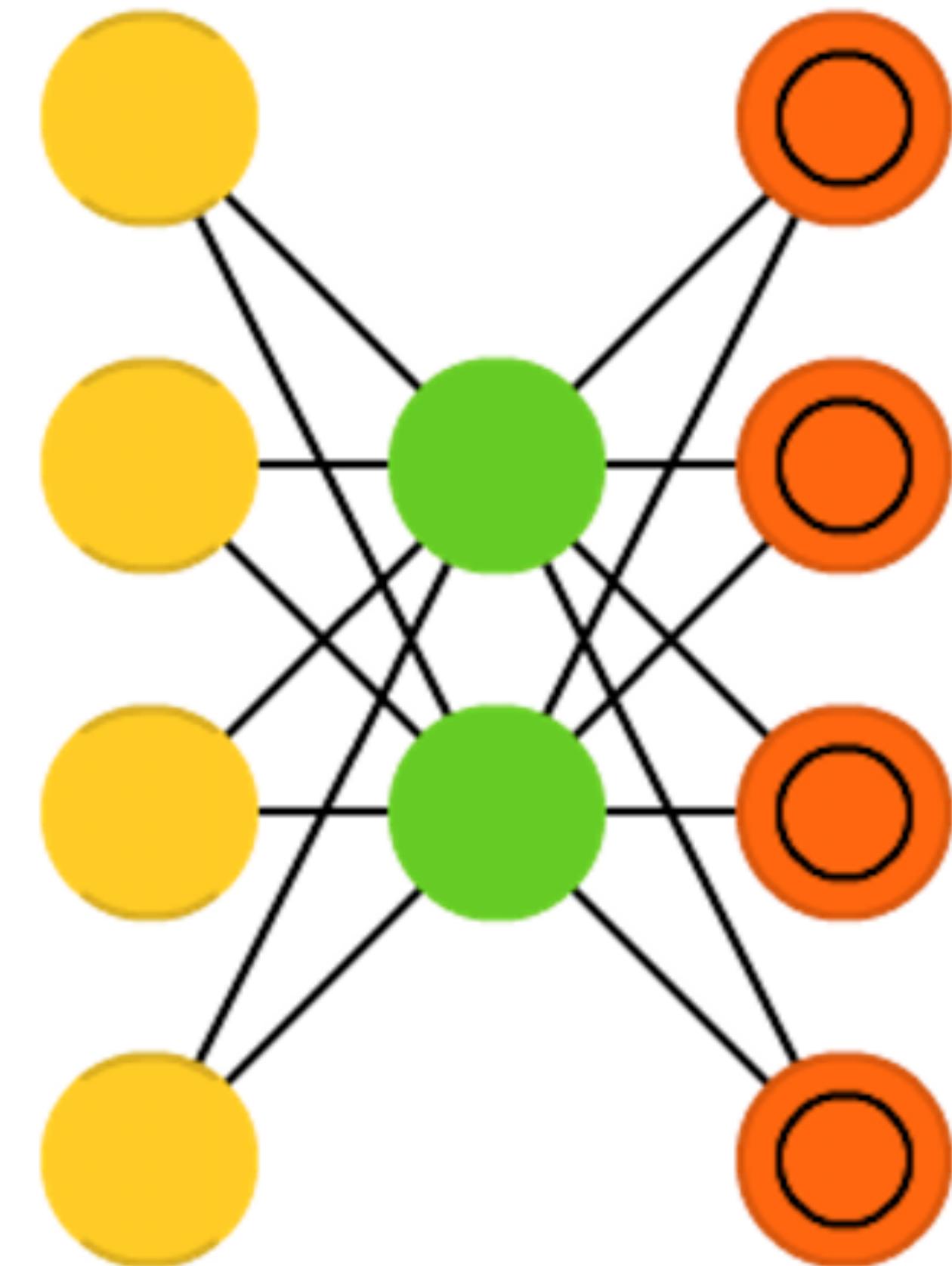
features not related in time or
space in omics research



Neural Auto-Encoder

econder -> hidden representation
-> decoder

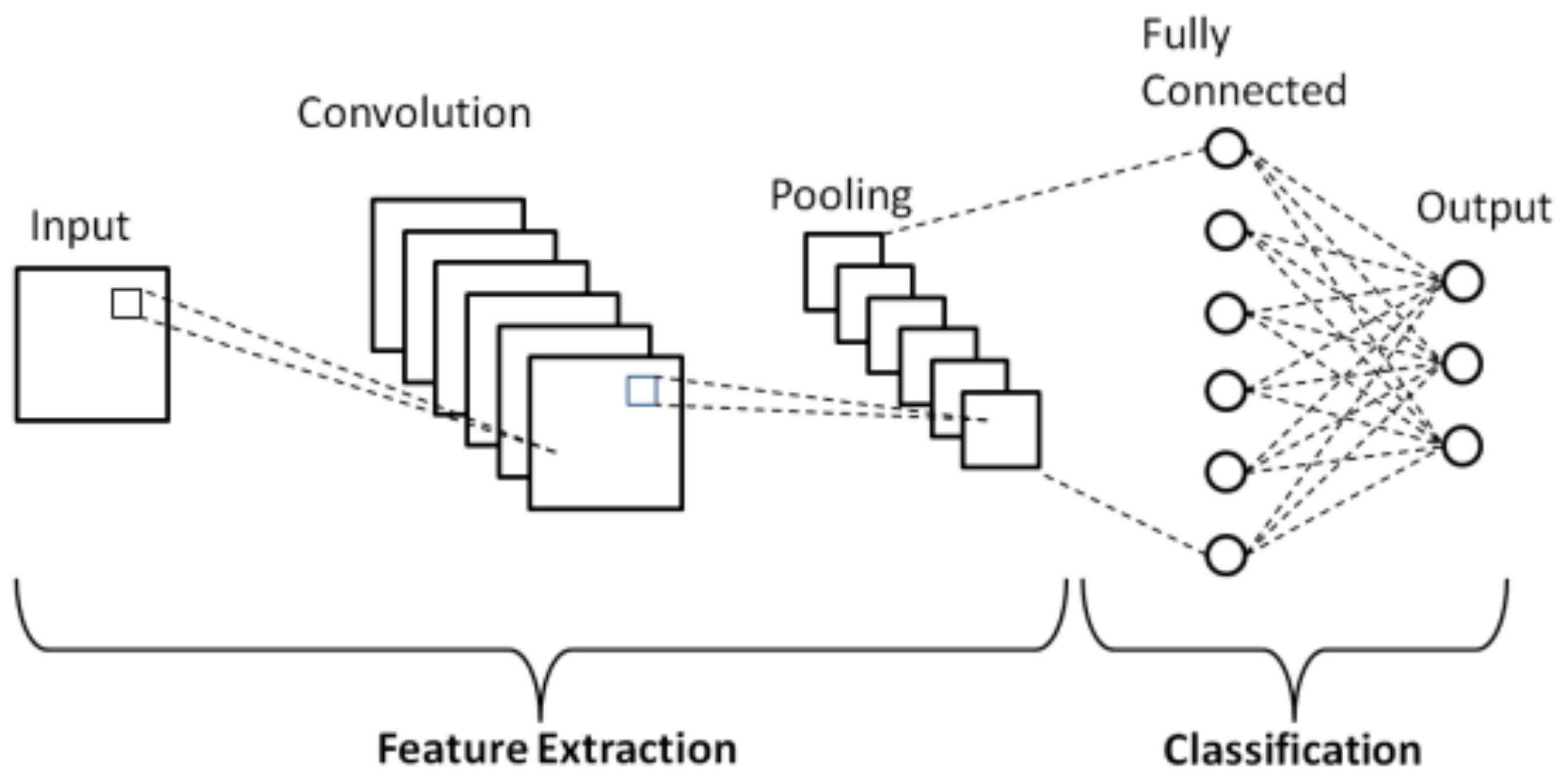
used for data reduction or feature extraction



Convolutional Neural Networks

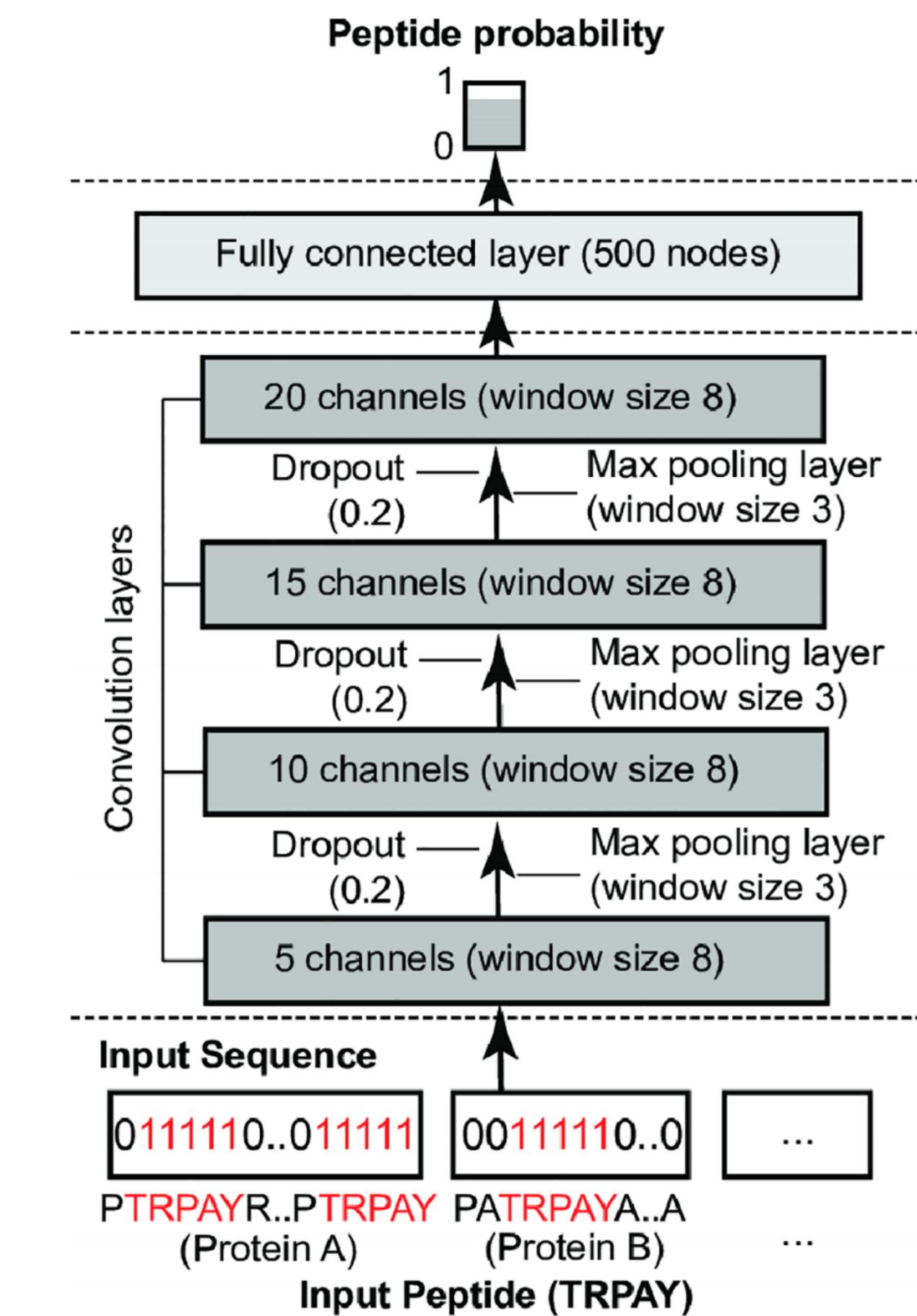
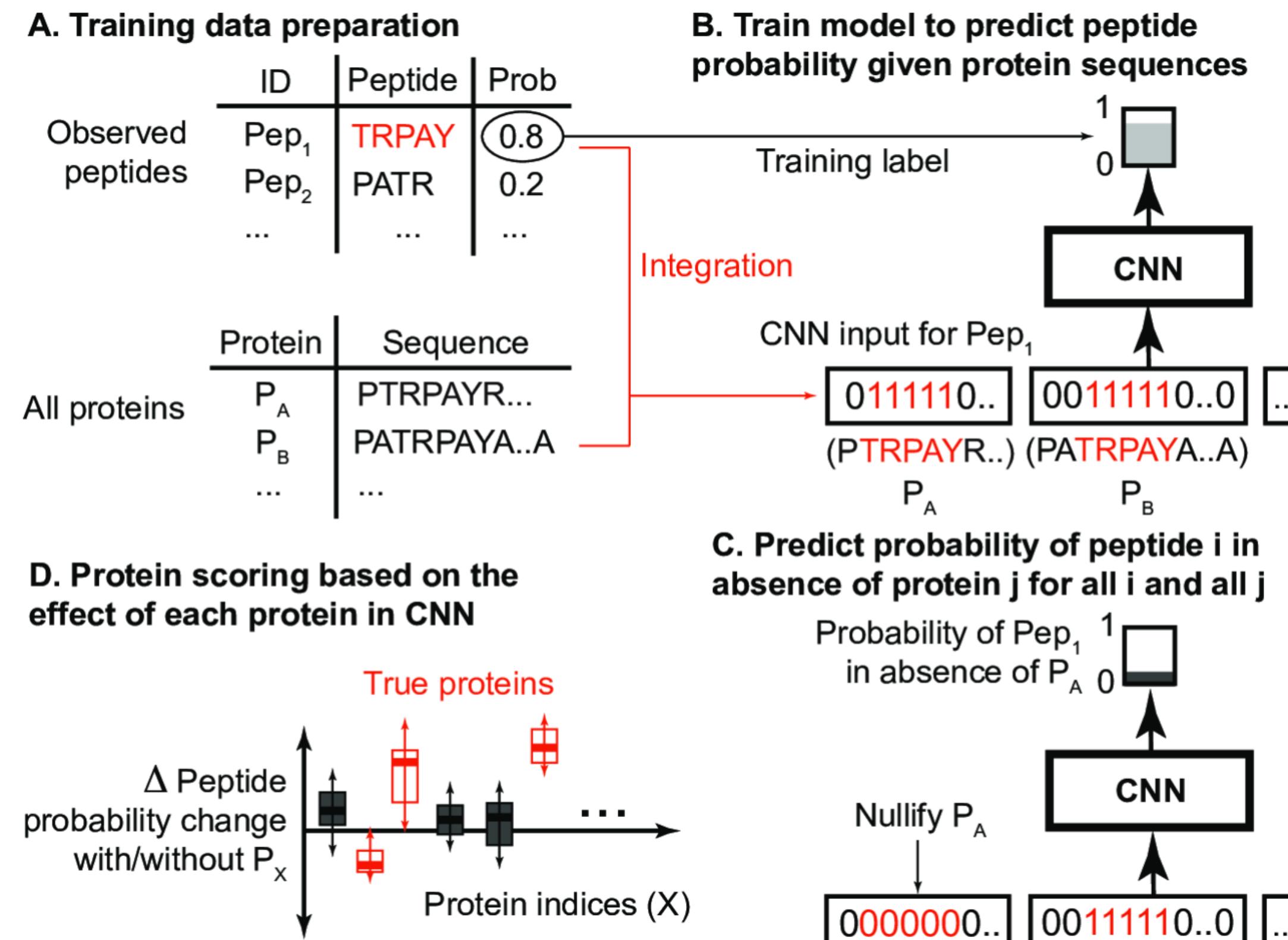
Building block:

- convolutional layer
- pooling layer
- fully connected layer



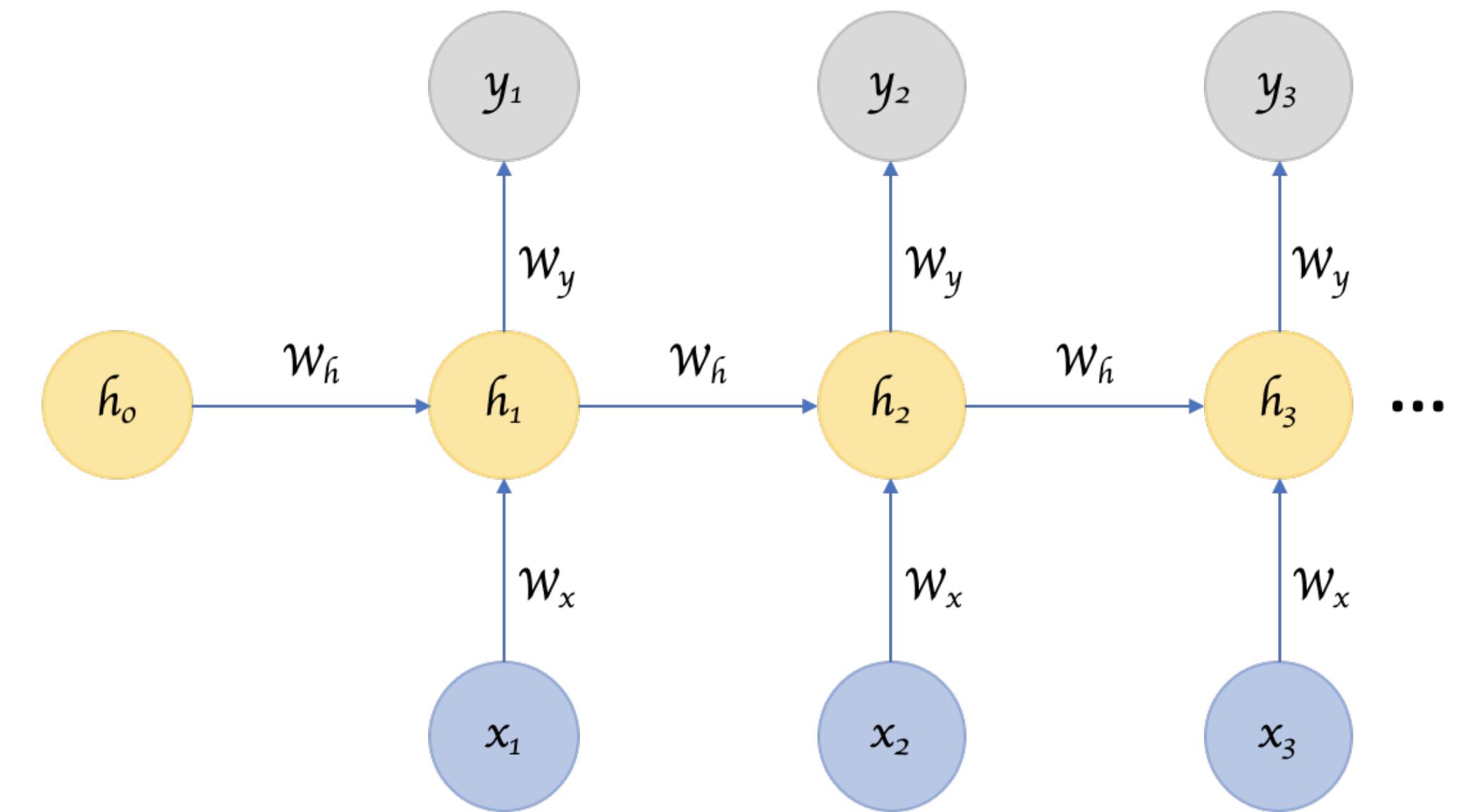
LeNet, alexNet GoogLeNet, ResNet
are famous examples

DeepPep



Recurrent Neural Network

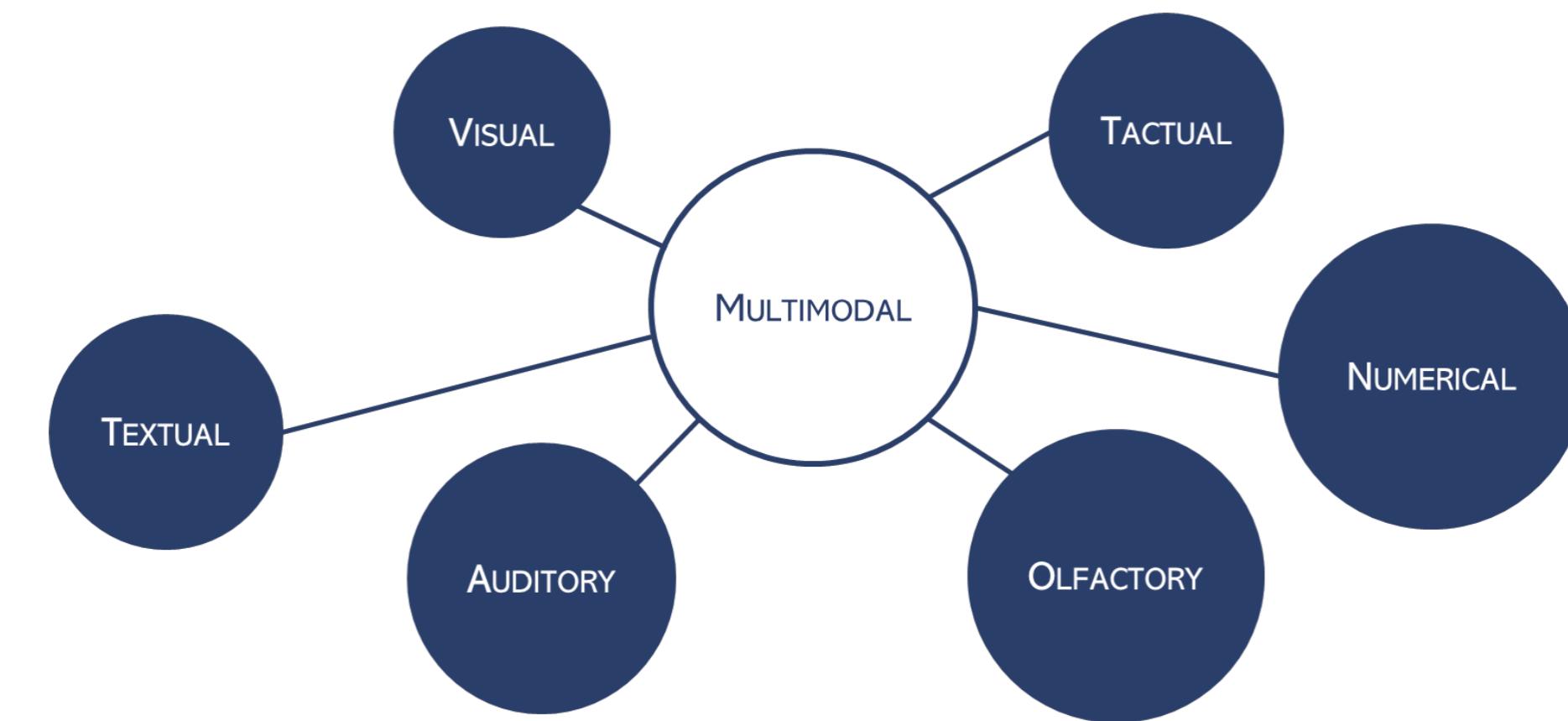
- normally used to process sequential data
- the output at time $t-1$ affects the decision at time t
- very promising for biomedical signals and comics data



Multimodal deep learning



our brain process
multimodal messages

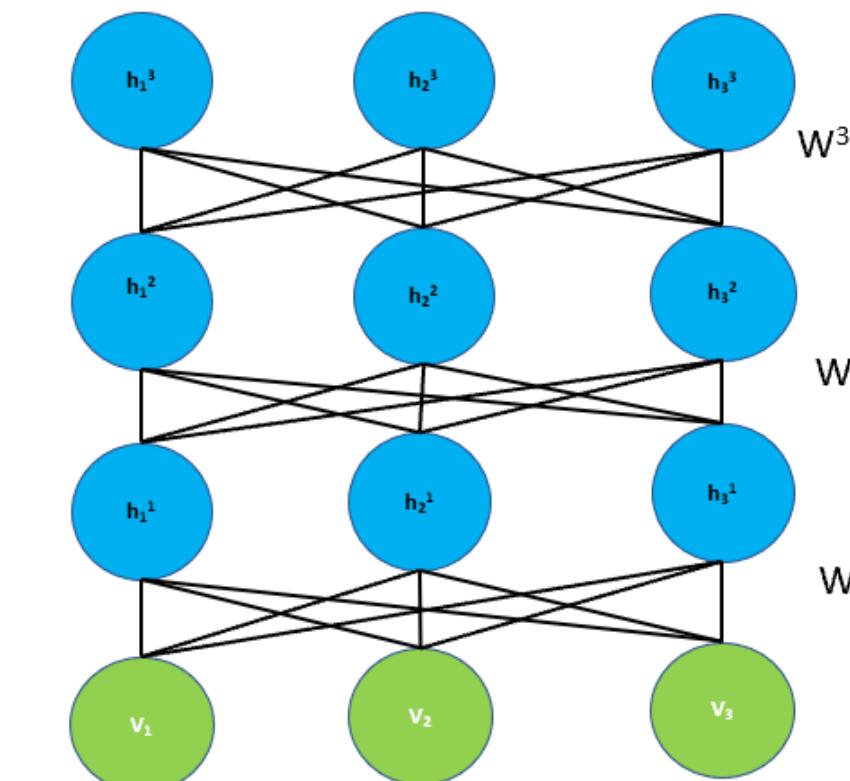


...and our artificial
neurons?

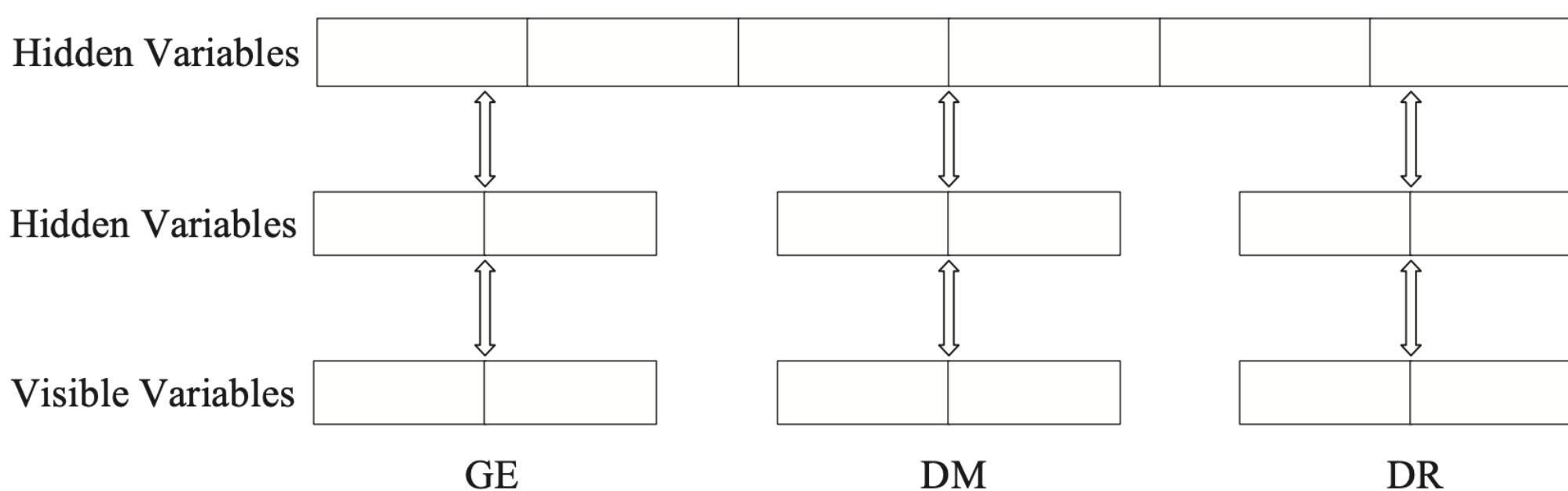
Multimodal: Representation

Represent the information from multiple entities (images, audio samples, sentences...)

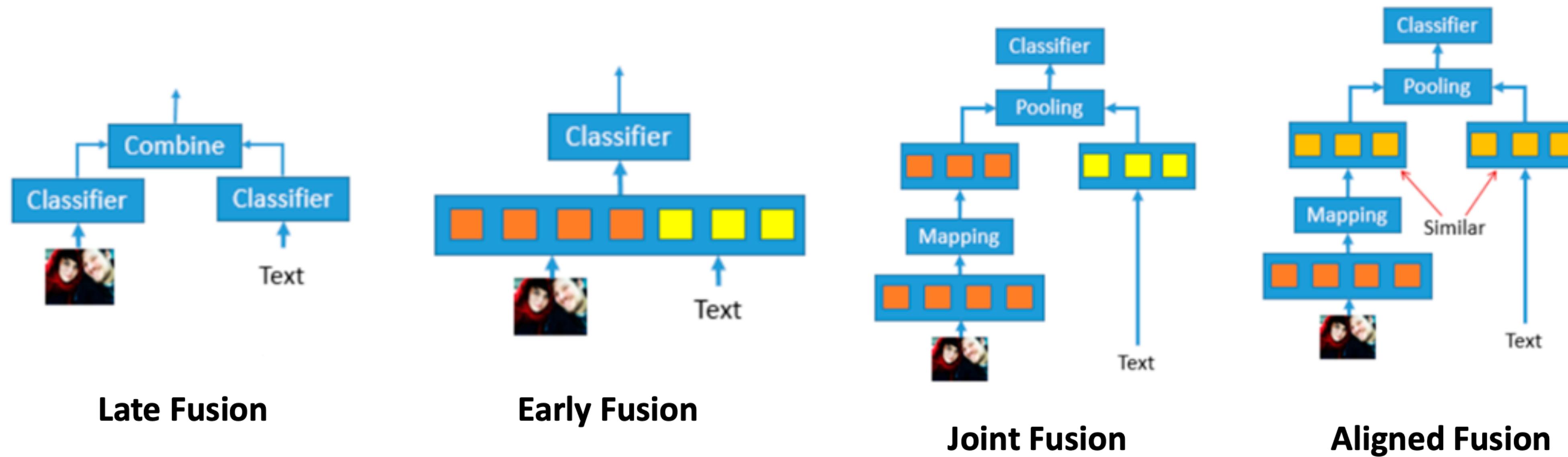
joint vs coordinated are two different types of multimodal representation



Deep Boltzmann Machine is an example



Multimodal: Fusion



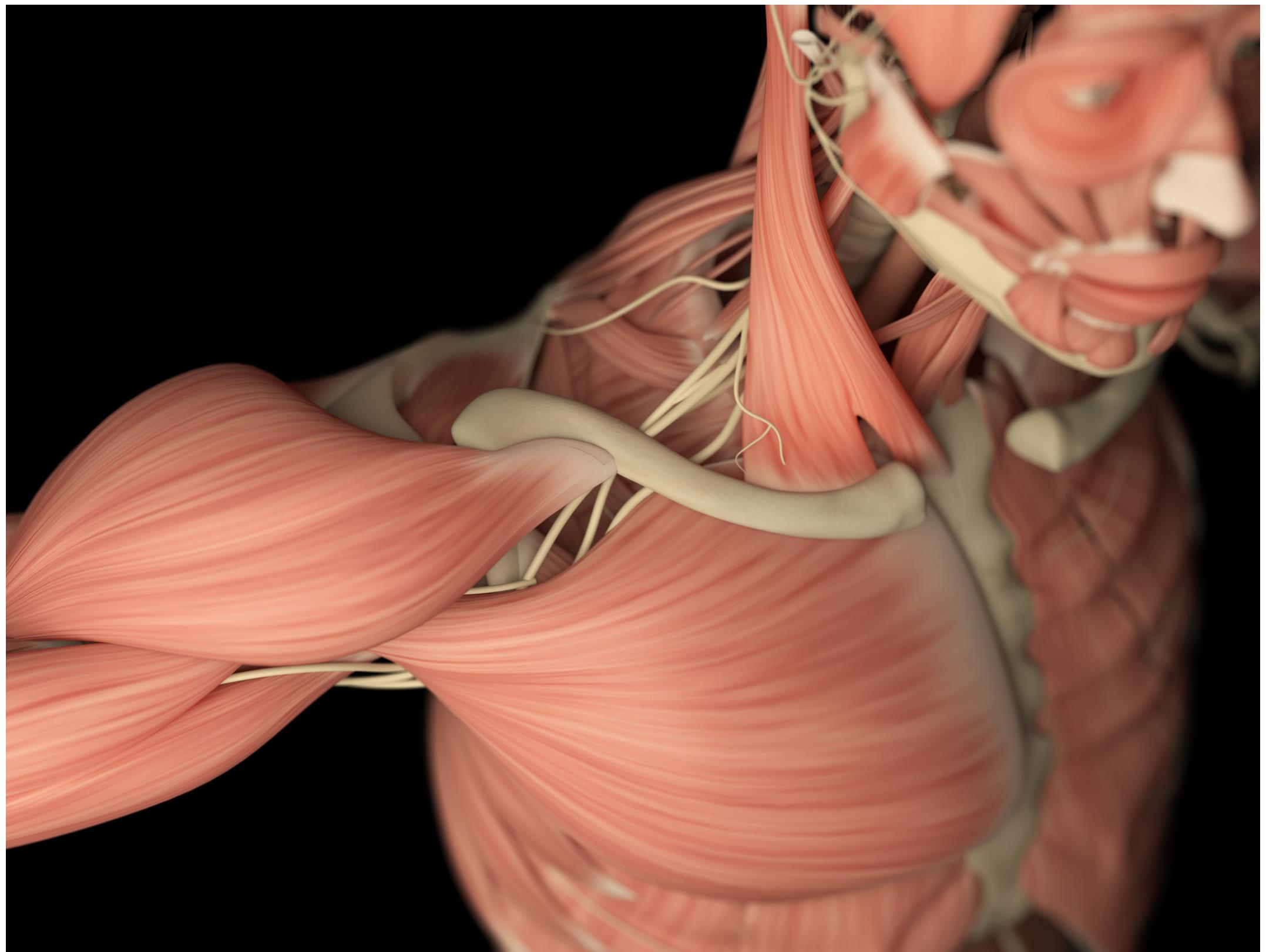
My Project

Neural Patient:
a neural approach to multimodal patient data
representation



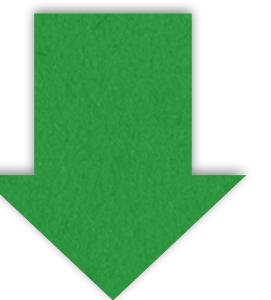
Main Objectives

- Neural encoding of a patient
- Integrative approach to multimodal data



Neural Encoding of a patient

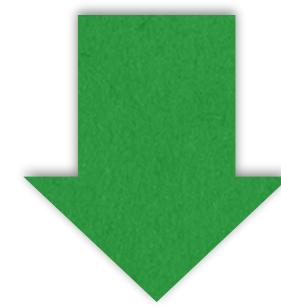
- quantitative models employed for health status prediction
- sparse, noisy, structured and unstructured data
- inclusion of the patient data



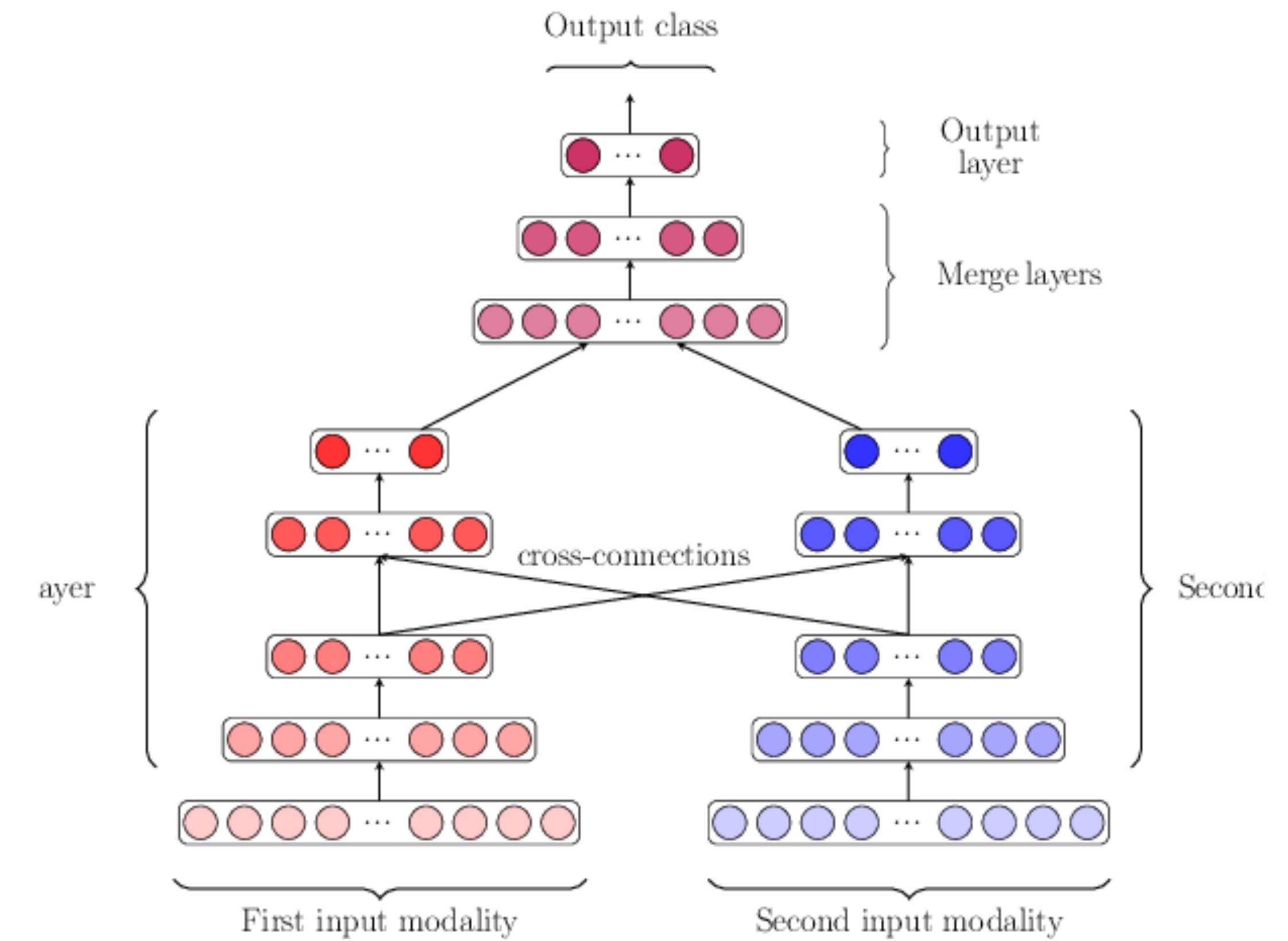
disentangled data representation of a patient in order to learn latent factors that can describe what we see in the data

Integrative approach to a multimodal data

find an approach to integrate different modalities and data coming from different sources



multimodal fusion approach



Wrap up

- Multi omics approach to diseases
- Use of new methodologies
- My objective - make something that can be used



Thank you

Francesco Sansone

PhD Student in Computer Science

francesco.sansone@phd.unipi.it

