

An End-to-End Deep Learning Model for Cytometry Data

Zicheng Hu Ph.D.
Research Scientist
ImmPort Team

Bakar Computational Health Sciences Institute
The University of California San Francisco

zicheng.Hu@ucsf.edu

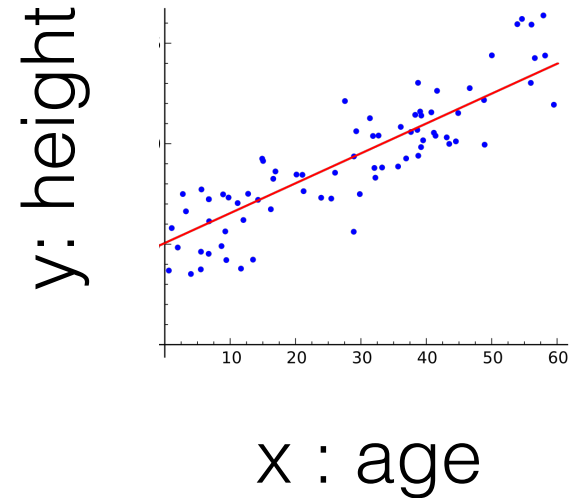
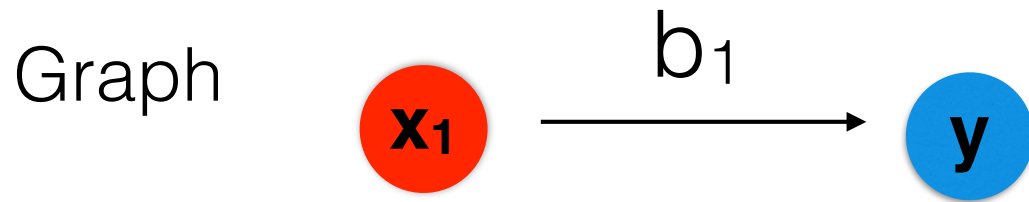


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From linear regression to deep learning

Part 1: Linear Regression

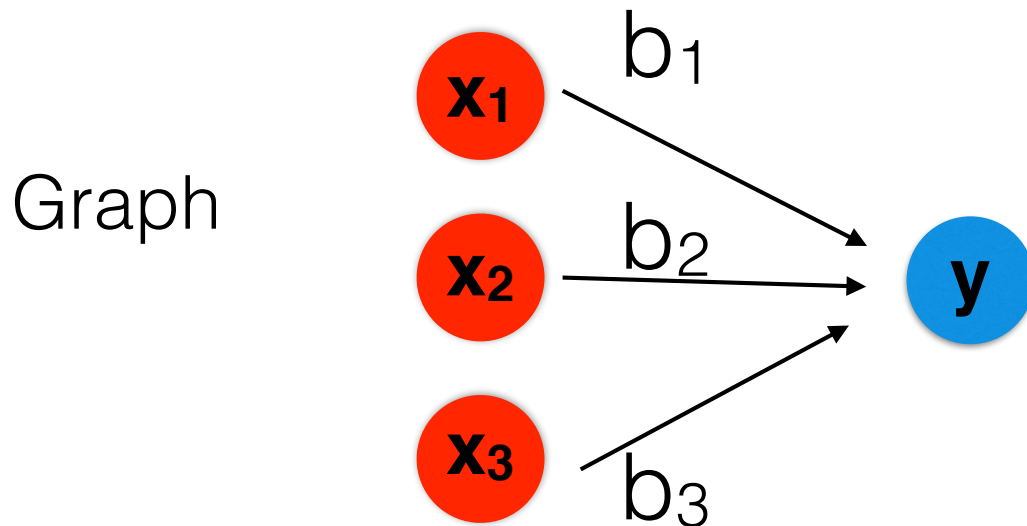
Formula $\mathbf{y} = b_0 + b_1 * \mathbf{x}_1$



From linear regression to deep learning

Part 2: Multiple Linear Regression

Formula $\mathbf{y} = b_0 + b_1 * \mathbf{x}_1 + b_2 * \mathbf{x}_2 + b_3 * \mathbf{x}_3$



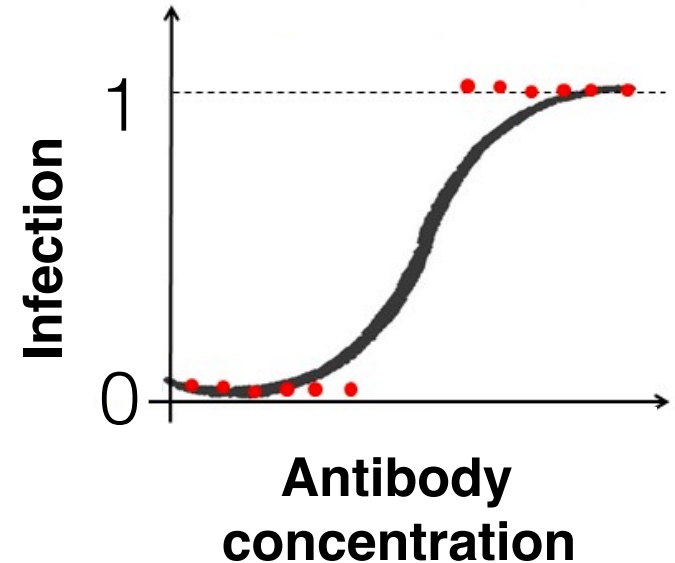
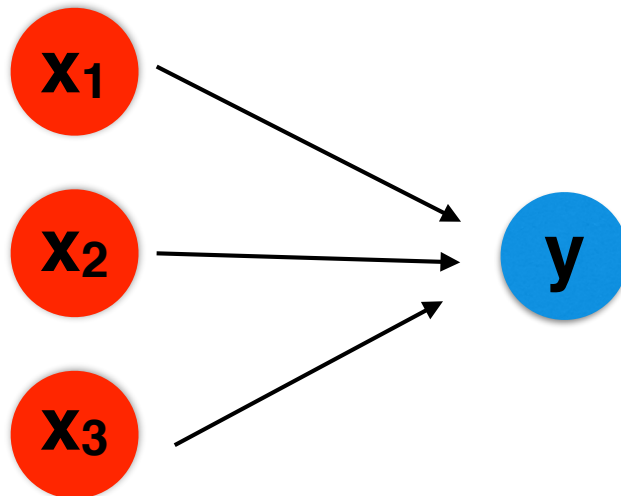
From linear regression to deep learning

Part 3: Logistic regression

Formula $\mathbf{y} = \text{sigmoid} \left(\underbrace{b_1 * \mathbf{x}_1 + b_2 * \mathbf{x}_2 + b_3 * \mathbf{x}_3}_{\text{Linear regression}} \right)$

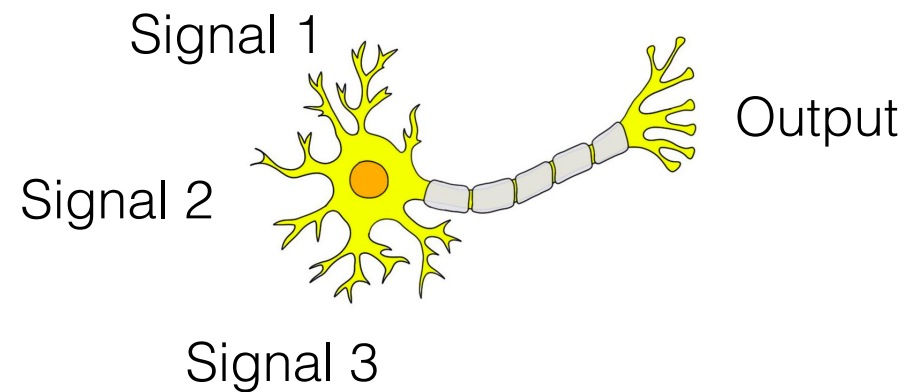
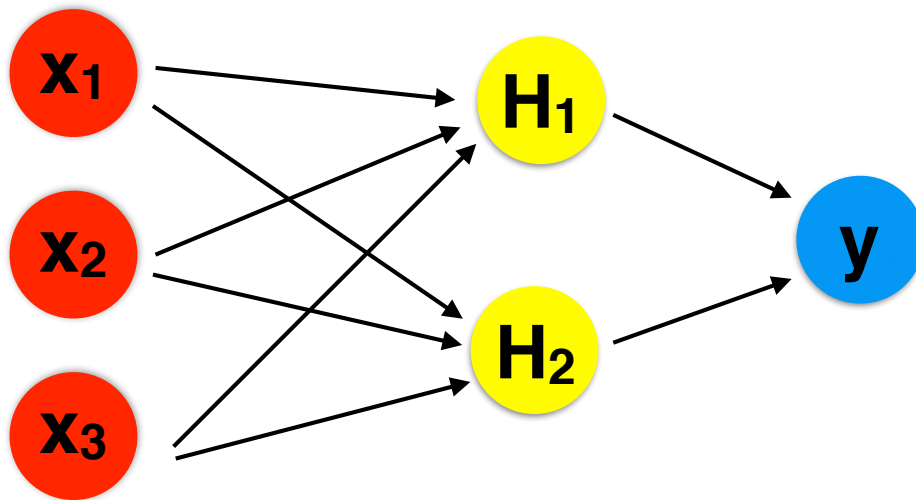
 Non-linear transformation

Graph



From linear regression to deep learning

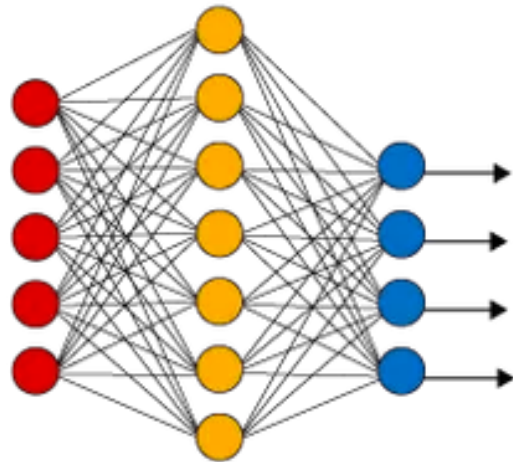
Part 4 : Neural Network



From linear regression to deep learning

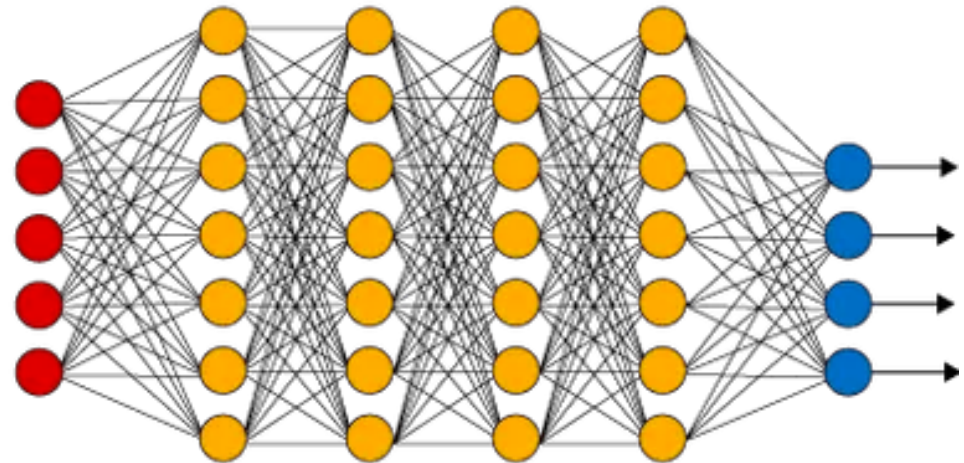
Part 5: Deep learning

Simple Neural Network



● Input Layer

Deep Learning Neural Network



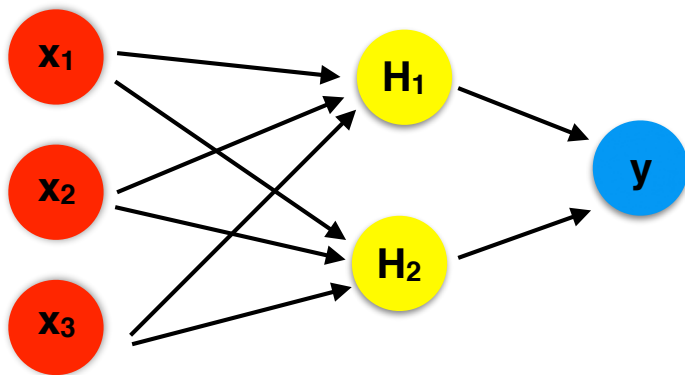
● Hidden Layer

● Output Layer

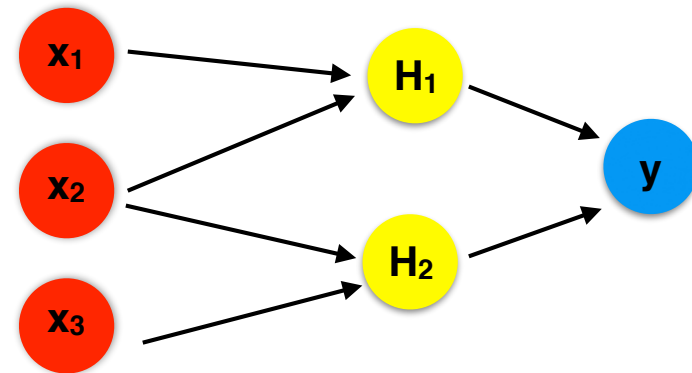
From linear regression to deep learning

Part 6: Convolutional neural network

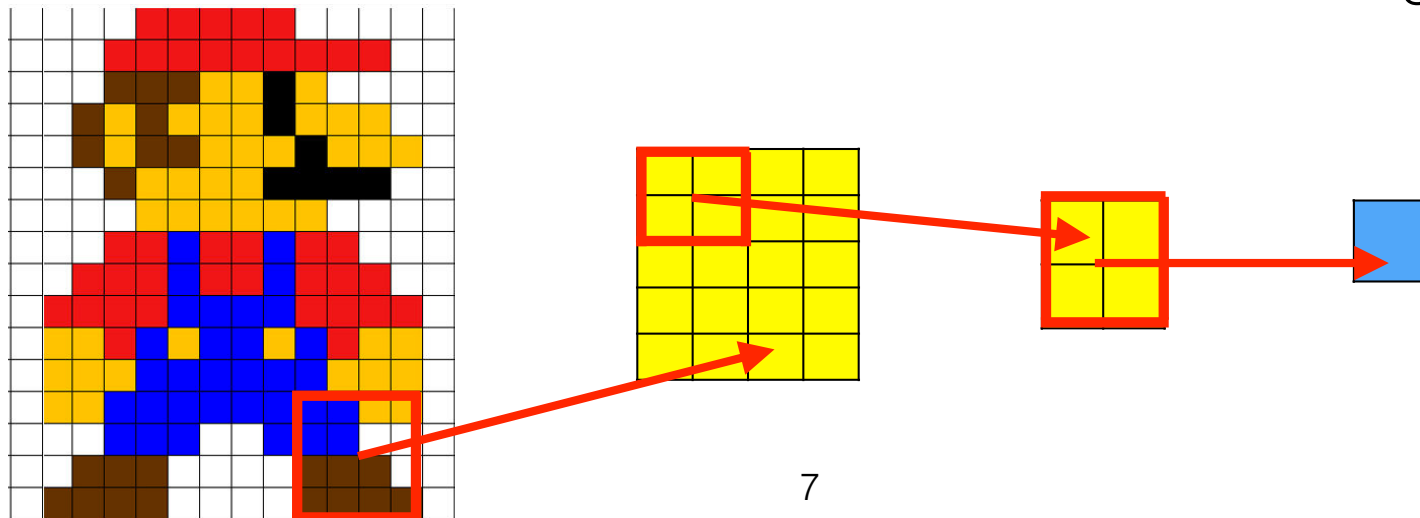
Dense neural network



Convolutional neural network



Convolutional neural network for images

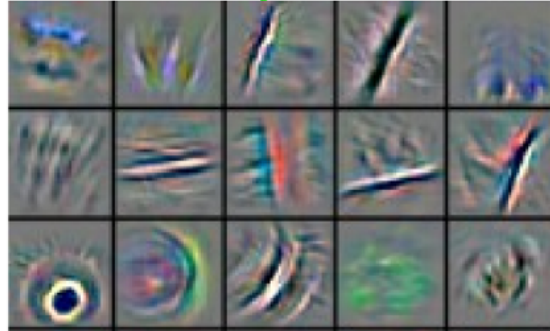


A Deep Convolutional Neural Network for Image Classification

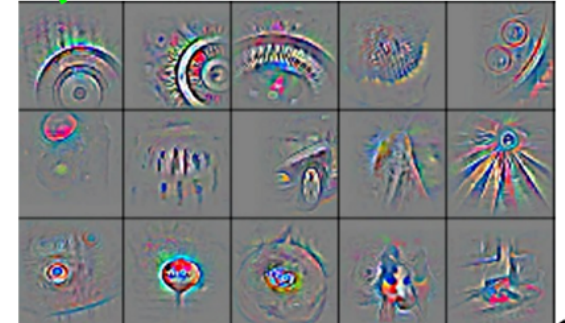
Low Level Features



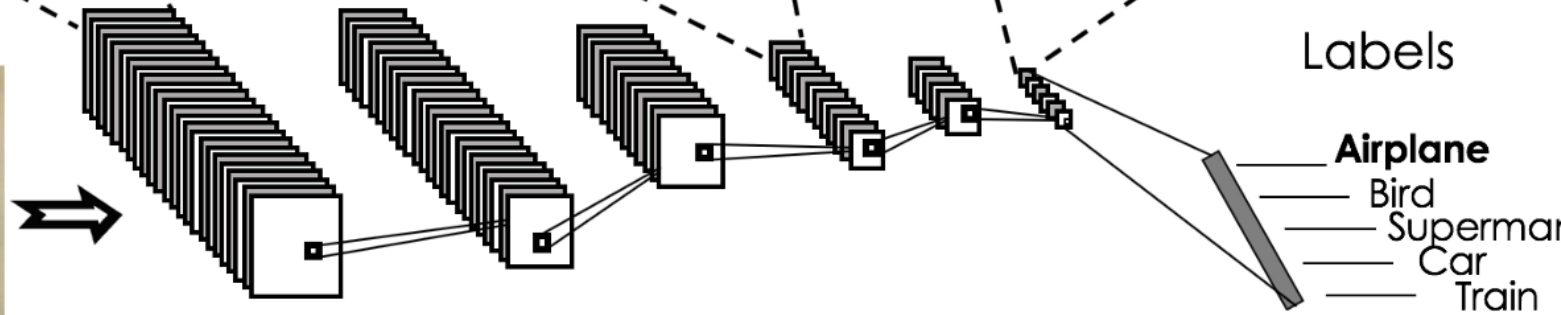
Medium Level Features



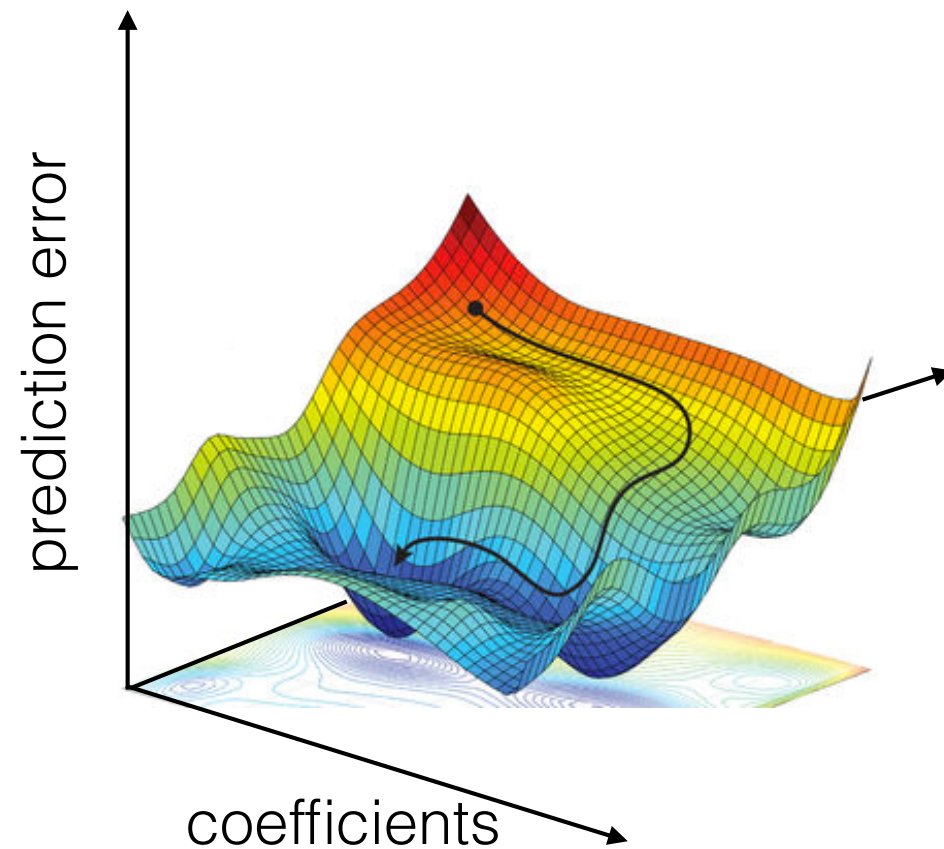
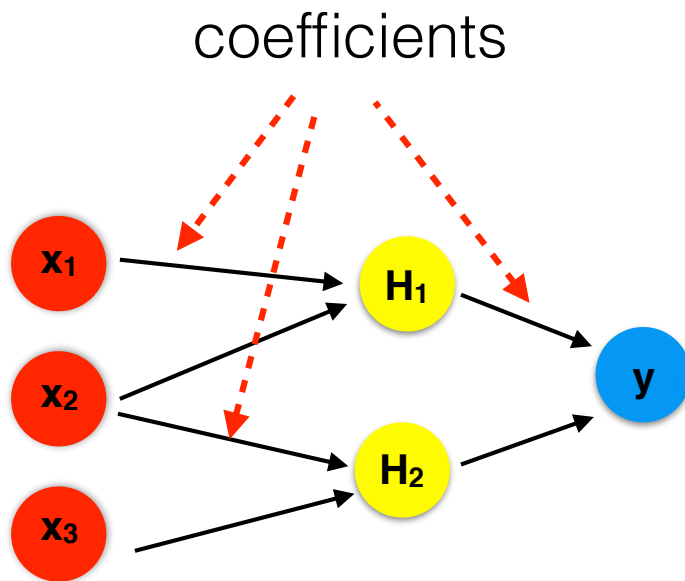
High Level Features



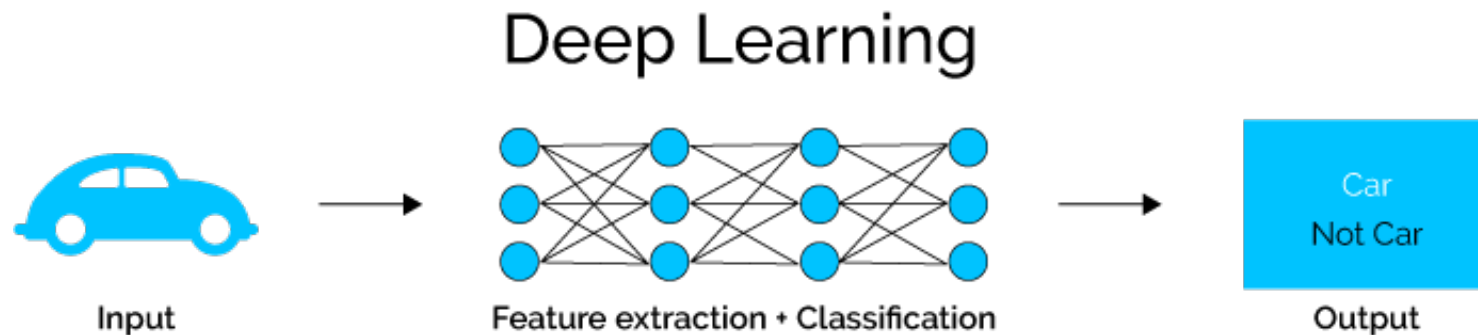
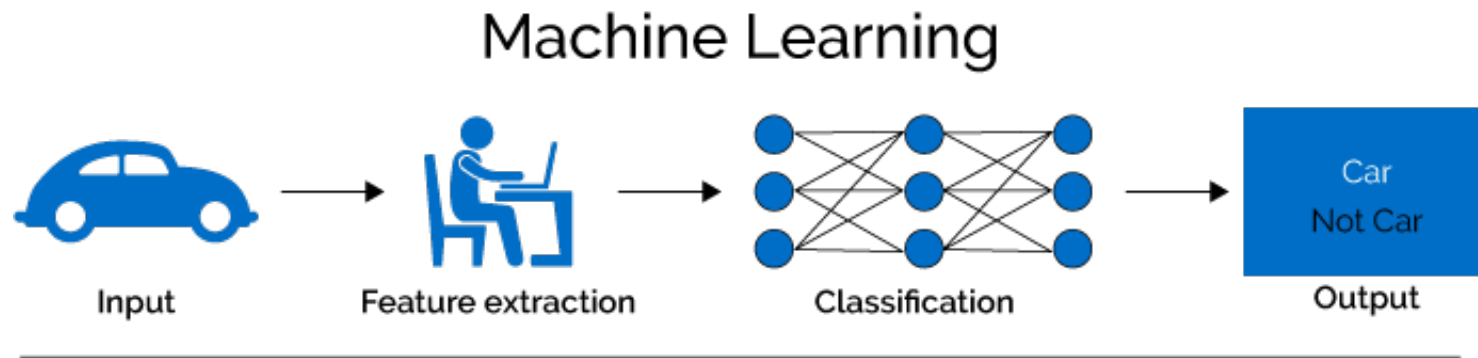
Input Image



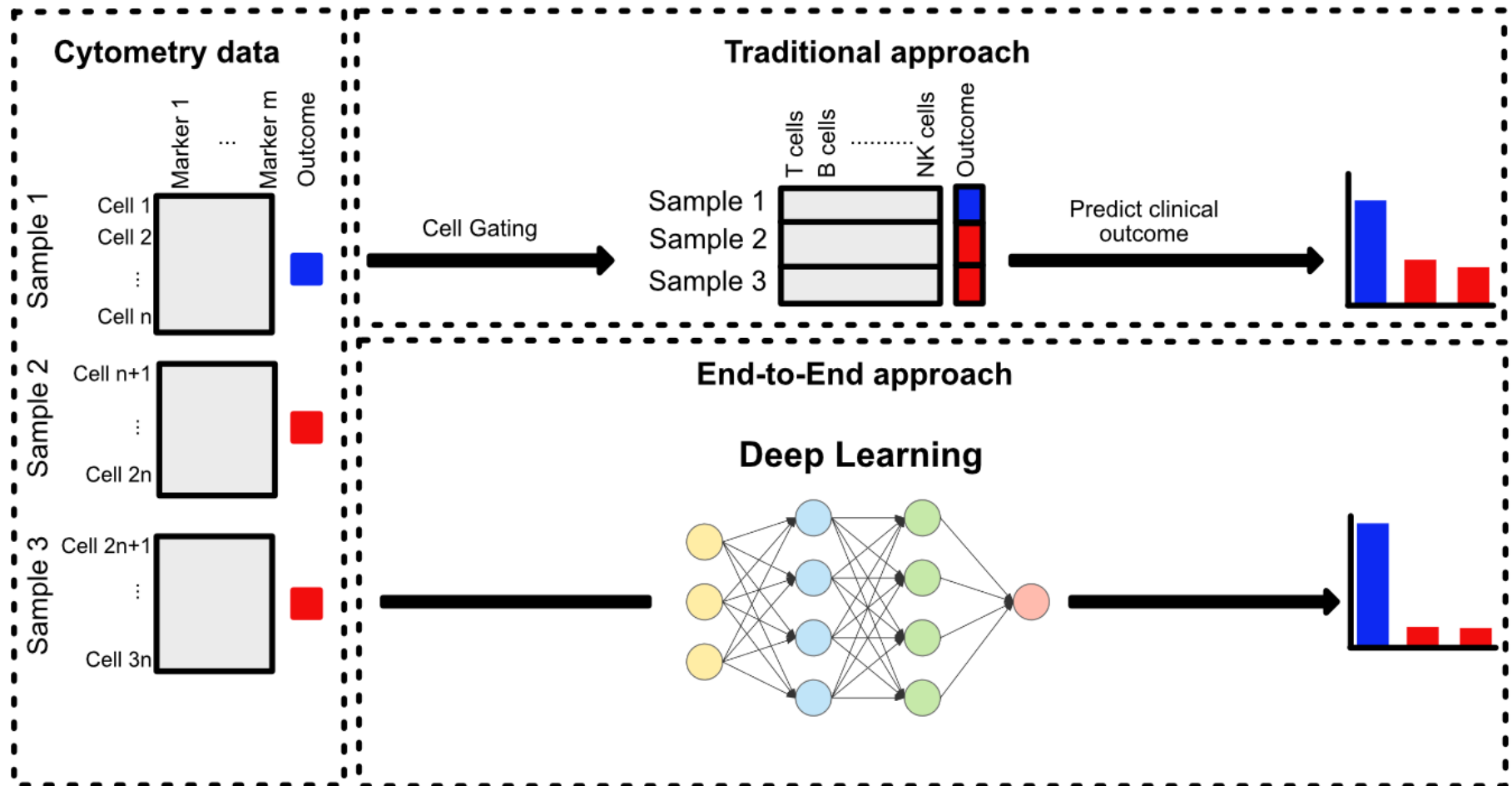
Training the neural network using gradient descent



Deep learning models allow end-to-end prediction

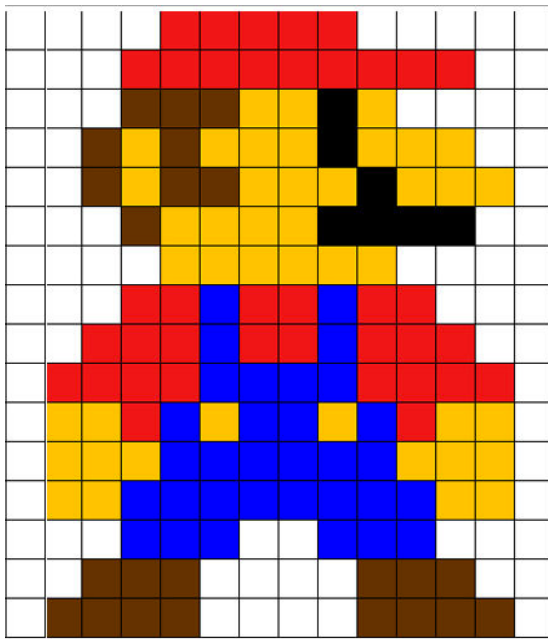


Predicting clinical features using cytometry data

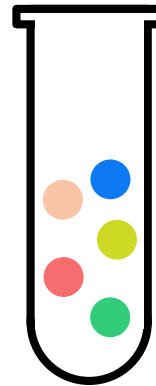


Comparing the structure of cytometry data with image

Image

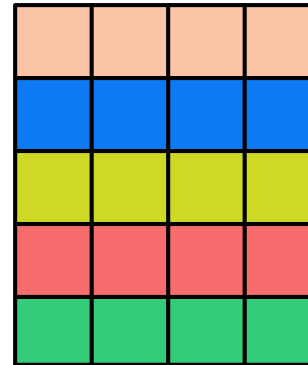


Cytometry data



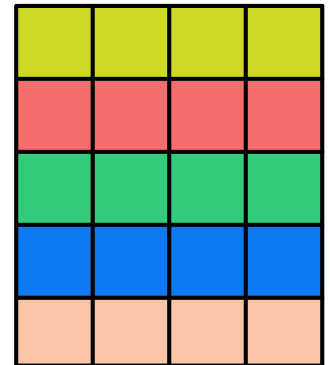
Markers

Cells



Markers

Cells



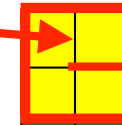
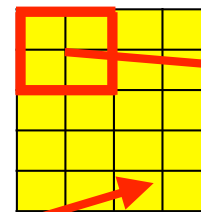
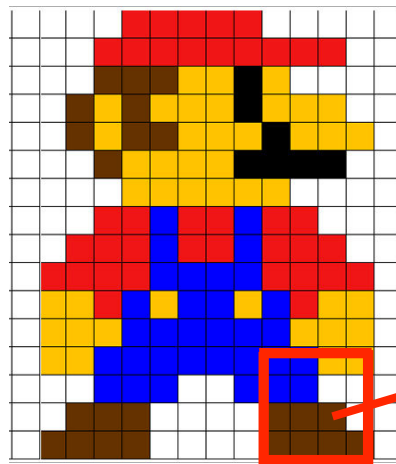
One-cell convolution for Cytometry data

Input

Hidden layers

output

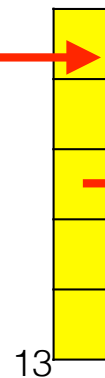
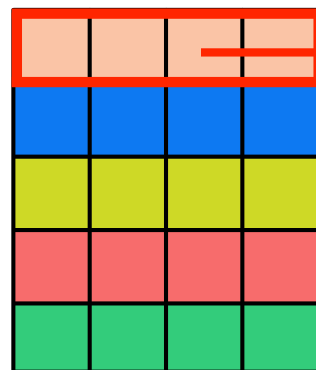
Image



Cytometry data

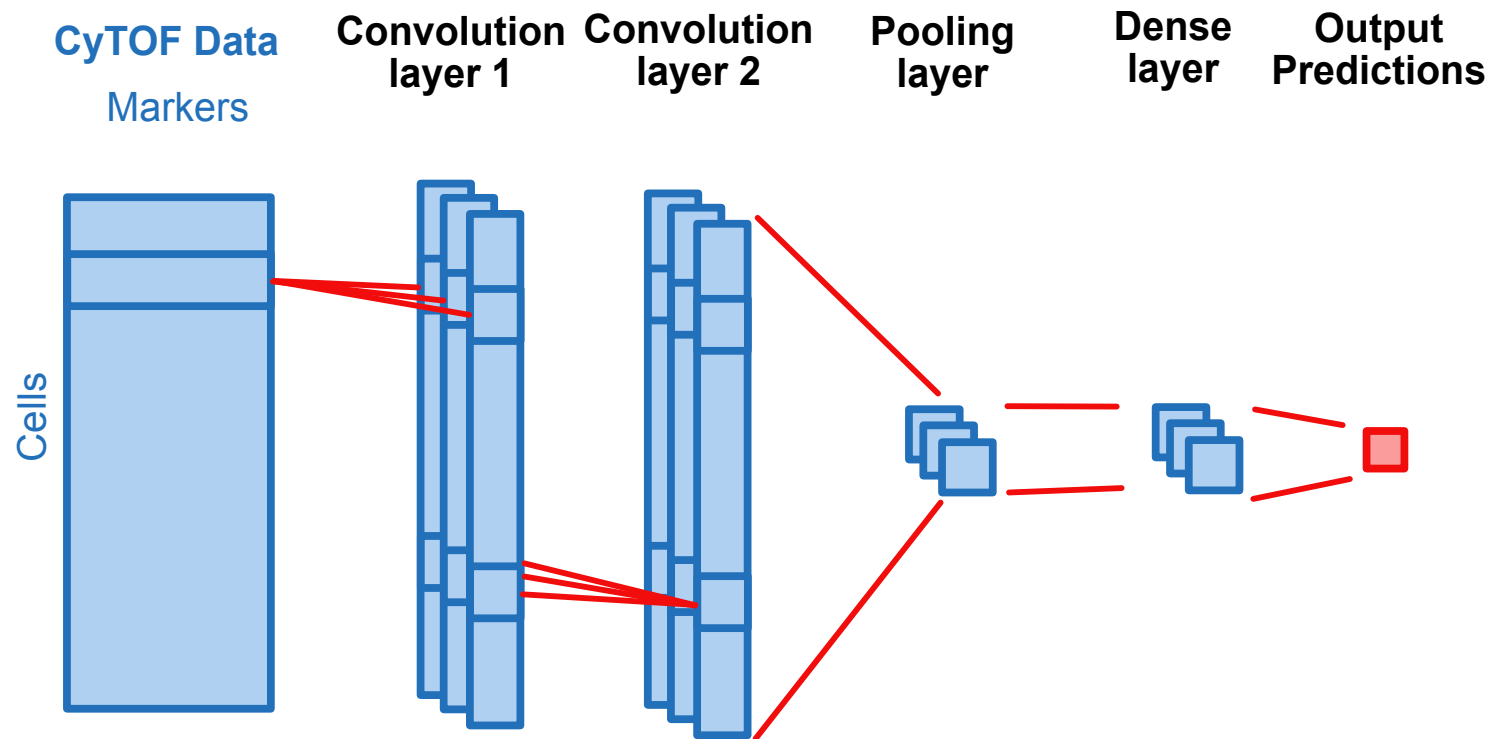
Markers

Cells

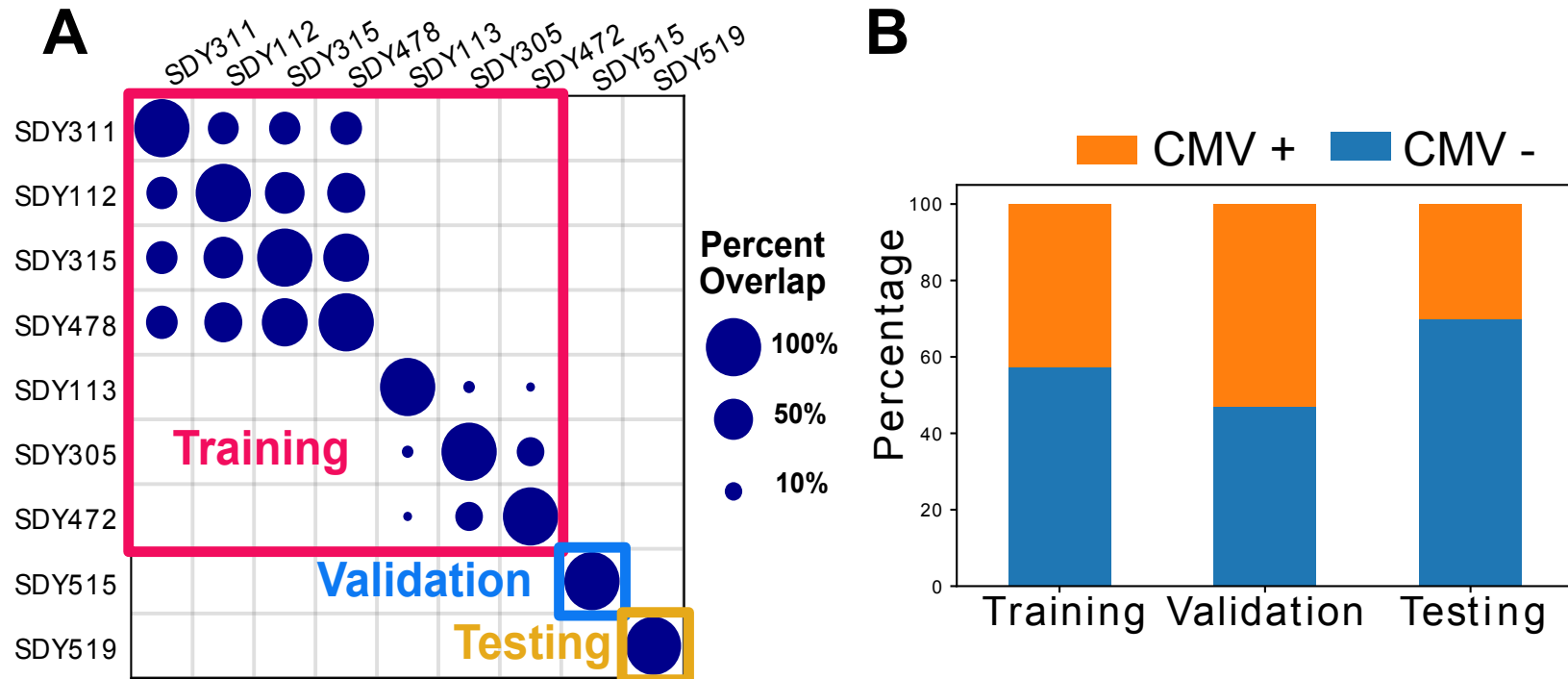


13

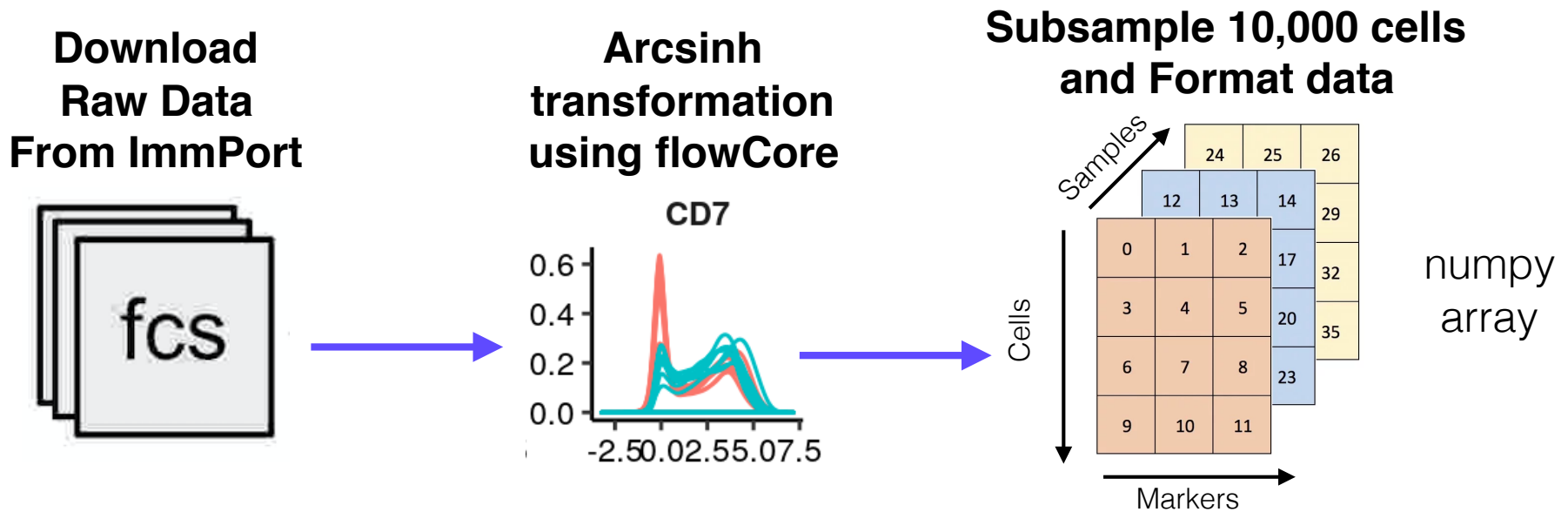
A convolutional neural network (CNN) for cytometry data



An overview of a CyTOF dataset from ImmPort



Preprocessing of the data



For more details on preprocessing the data, see:
github.com/hzc363/DeepLearningCyTOF

Deep learning using formatted data

