



UNIVERSITY *of*
WEST FLORIDA

Lecture 1:Introduction to Deep Learning

Shusen Pu

What is deep learning?

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Deep learning is part of a broader family of machine learning methods, which is based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised.[2]

Deep-learning architectures such as deep neural networks, deep belief networks, deep reinforcement learning, recurrent neural networks, convolutional neural networks and transformers have been applied to fields including computer vision, speech recognition, natural language processing, machine translation, bioinformatics, drug design, medical image analysis, climate science, material inspection and board game programs, where they have produced results comparable to and in some cases surpassing human expert performance.[3][4][5]

深度学习是更广泛的机器学习方法家族的一部分，它基于具有表示学习的人工神经网络。学习可以是监督的、半监督的或无监督的。[2] 

深度神经网络、深度信念网络、深度强化学习、递归神经网络、卷积神经网络和Transformer等深度学习架构已应用于计算机视觉、语音识别、自然语言处理、机器翻译、生物信息学、药物设计等领域、医学图像分析、气候科学、材料检验和棋盘游戏程序，它们在这些方面产生的结果可与人类专家的表现相媲美，在某些情况下甚至超过人类专家的表现。[3][4][5]

Shēndù xuéxí shì gèng guǎngfàn de jīqì xuéxí fāngfǎ jiāzú de yībùfèn, tā jīyú jùyǒu biǎoshí xuéxí de réngōng shénjīng wǎngluò. Xuéxí kěyǐ shì jiāndū de, bàn jiāndū de huò wú jiāndū de. [2]

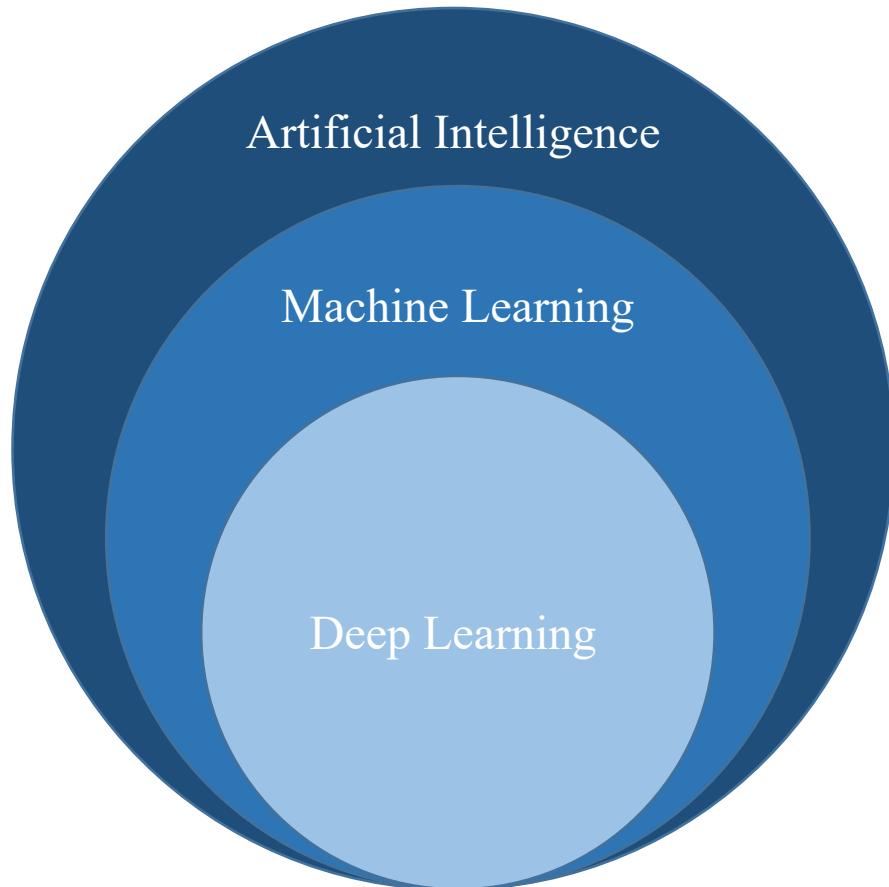
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Google translate entire web page to a different language

The image shows the iOS Photos app interface. At the top, there's a navigation bar with a '+' button, the word 'Albums', and tabs for 'Albums' (selected), 'Map', and 'Grid'. Below this is a section titled 'People & Places' with two grid thumbnails: one for 'People' (11 items) and one for 'Places' (21,108 items, highlighted with a red box). The 'Places' thumbnail is a map of North America with several photo overlays and blue callout bubbles indicating the count of photos taken at specific locations. Below this is a section titled 'Media Types' listing five categories with their counts: Videos (1,023), Selfies (1,573), Live Photos (6,162), Portrait (1,004), Panoramas (30), and Time-lapse (8). At the bottom are navigation icons for Library, For You, Albums (selected), and Search.

Iphone groups images based on their locations.

What **exactly** is deep learning?



Artificial
Intelligence

- A science devoted to making machines think and act like humans.

Machine
Learning

- Focuses on enabling computers to perform tasks without explicit programming.

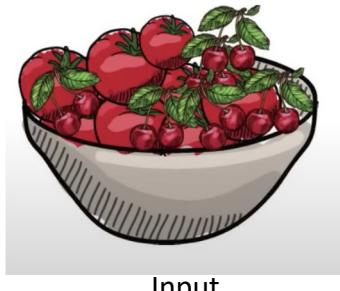
Deep
Learning

- A subset of machine learning based on artificial neural networks.

What is the **difference** between
machine learning and deep learning?

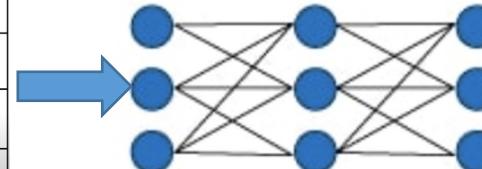


Machine Learning



Features		
	Tomato	Cherry
Size		
Type of Stem		

Feature extraction



Classification

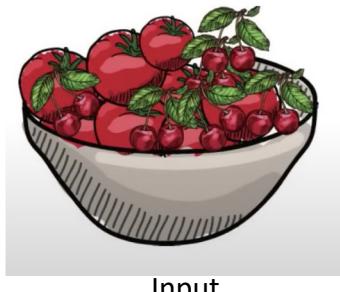


Feature extraction + Classification
picked up by machine without human input

Deep Learning

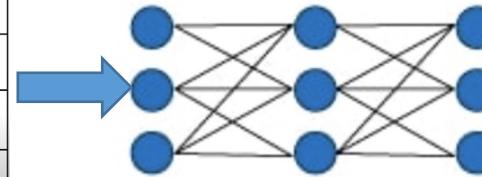


Machine Learning



Features		
	Tomato	Cherry
Size		
Type of Stem		

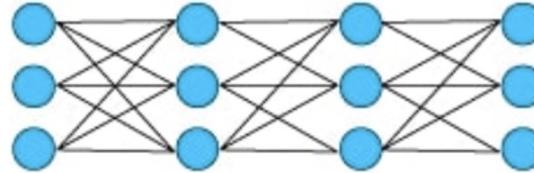
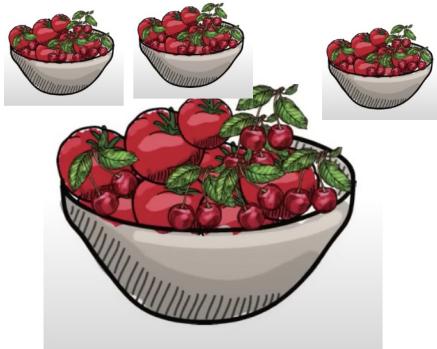
Feature extraction



Classification



Output



Feature extraction + Classification



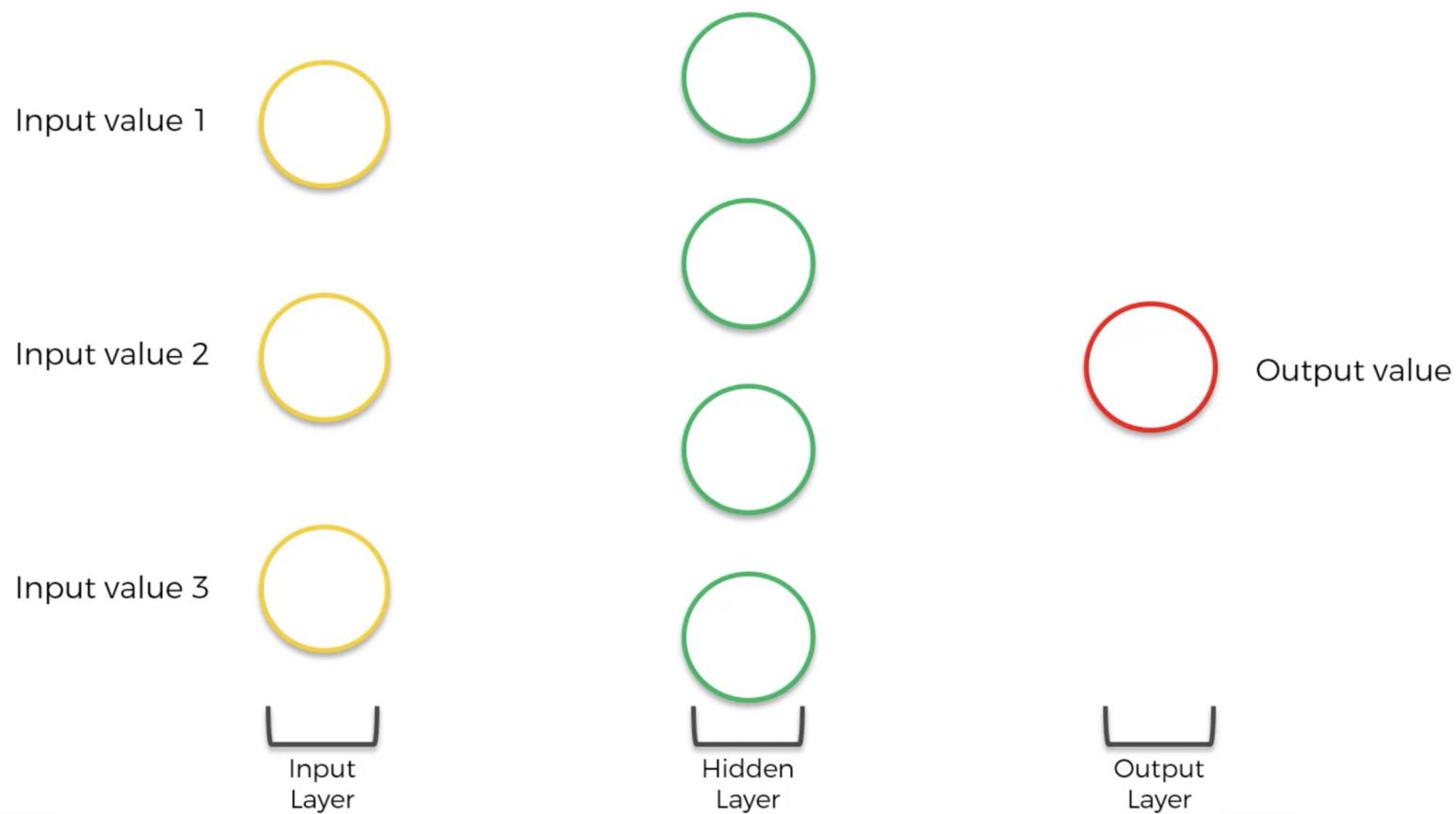
Output

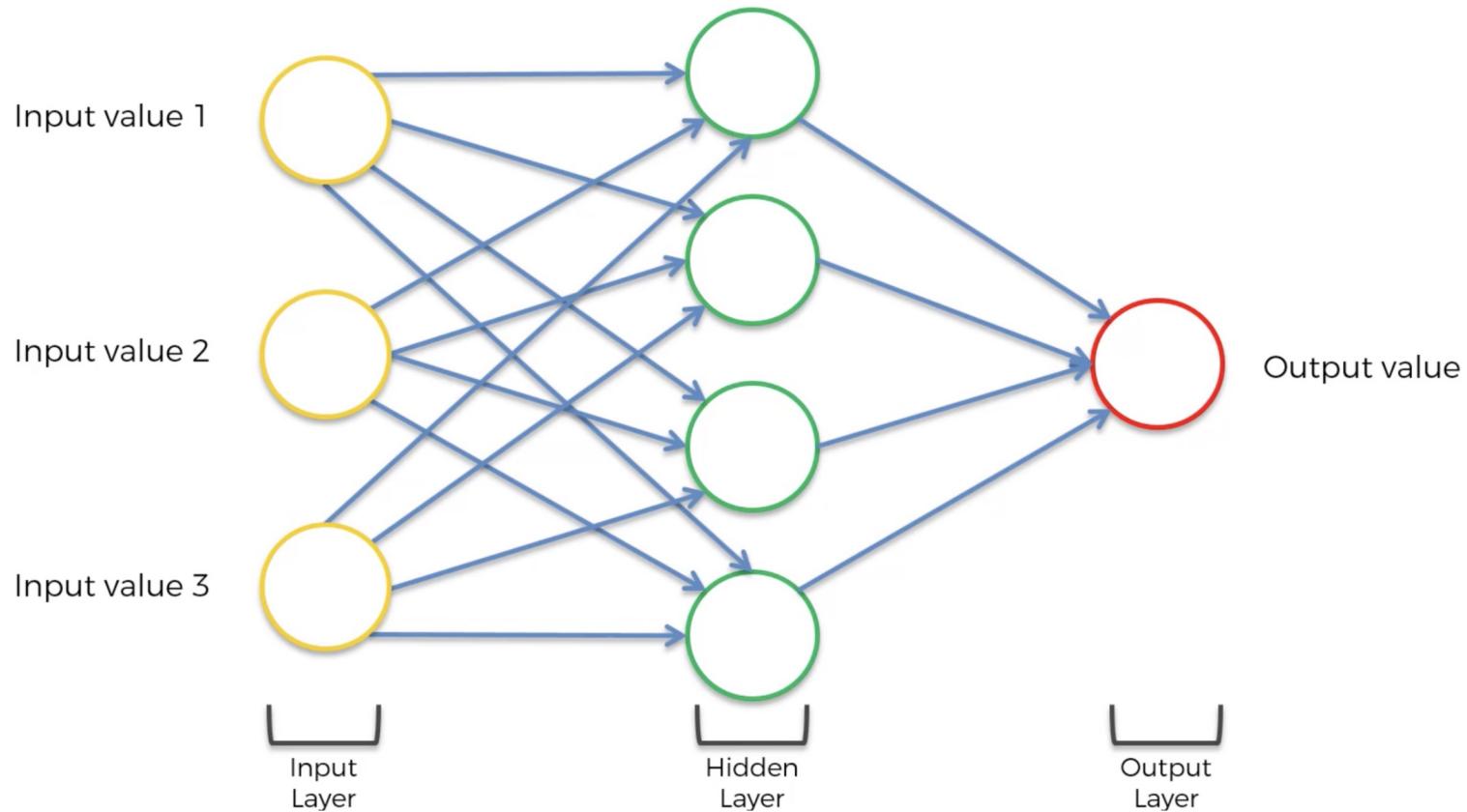
Deep Learning

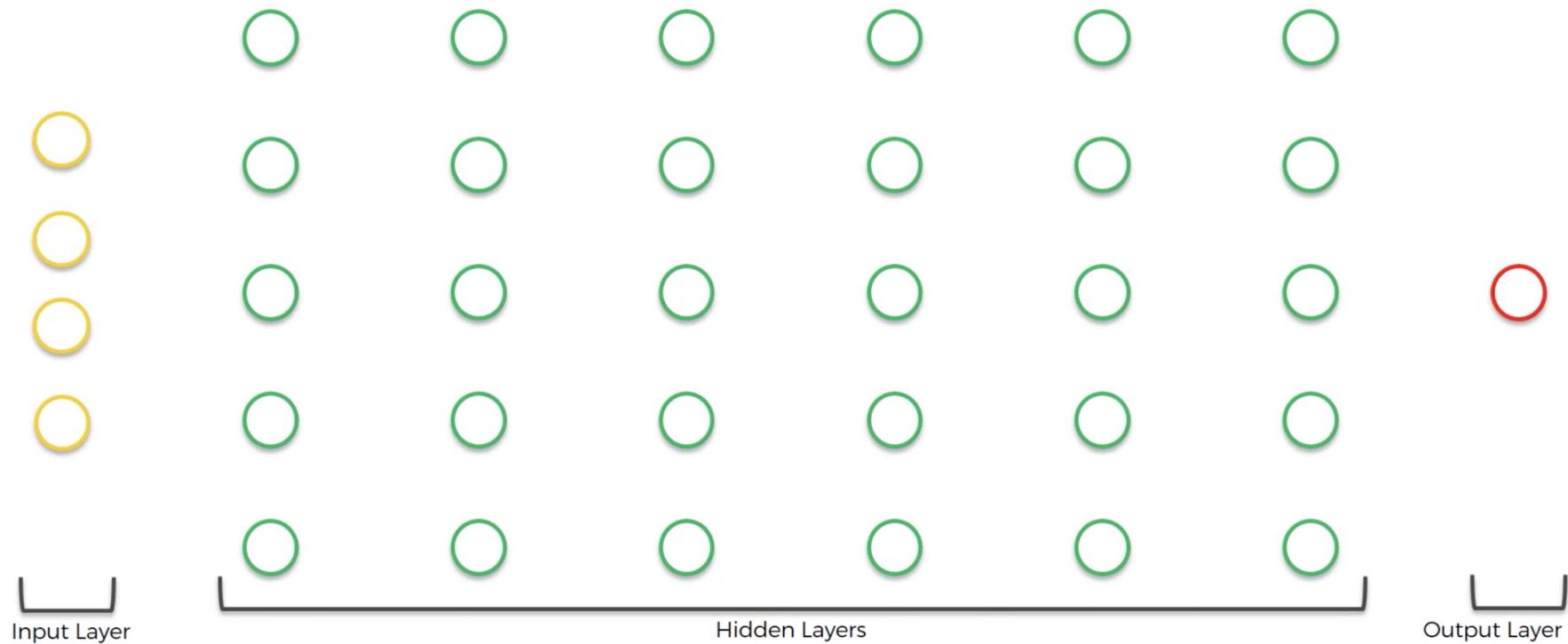
Deep Learning Vs Machine Learning

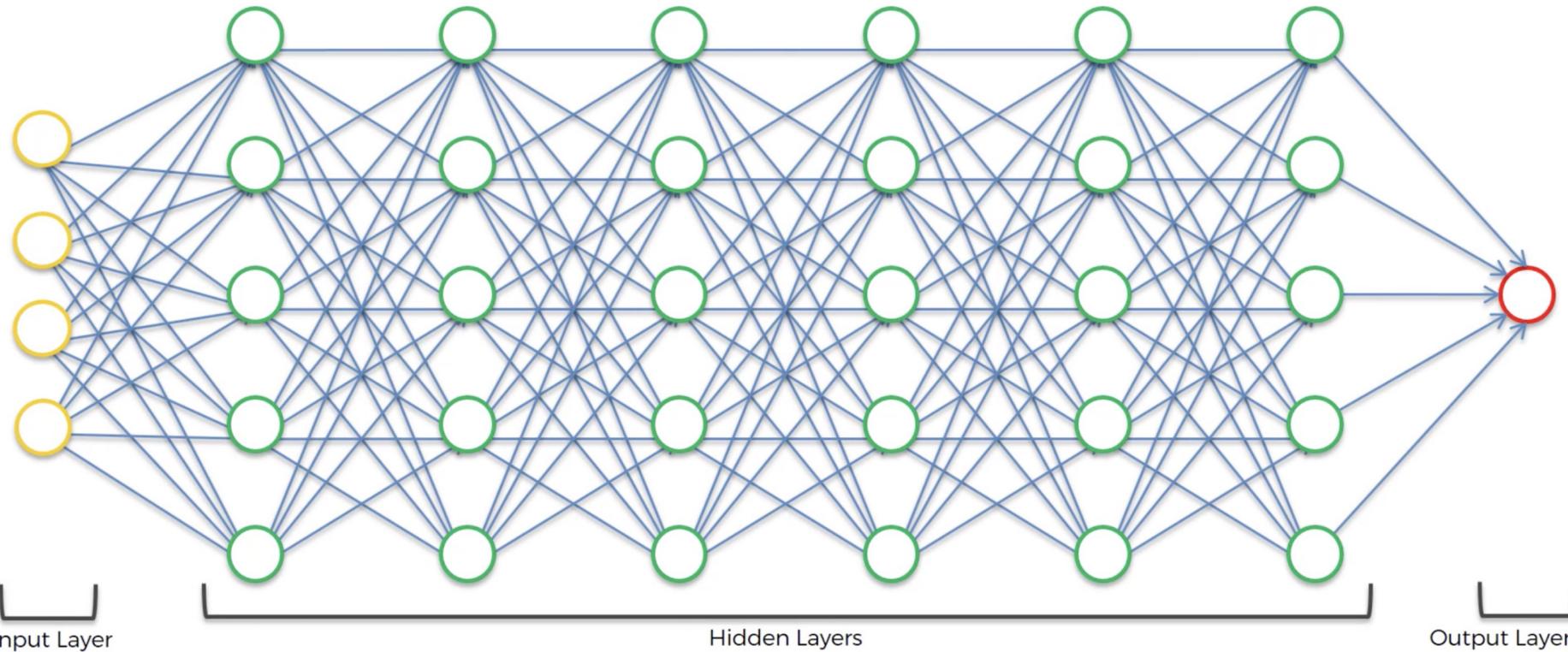
Factors	Deep Learning	Machine Learning
Data Requirements	Requires large data	Can train on lesser data
Accuracy	Provides high accuracy	Gives lesser accuracy
Training Time	Takes longer to train	Takes less time to train
Hardware Dependency	Requires GPU to train properly	Trains on CPU
Hyperparameter Tuning	Can be tuned in various different ways	Limited tuning capabilities

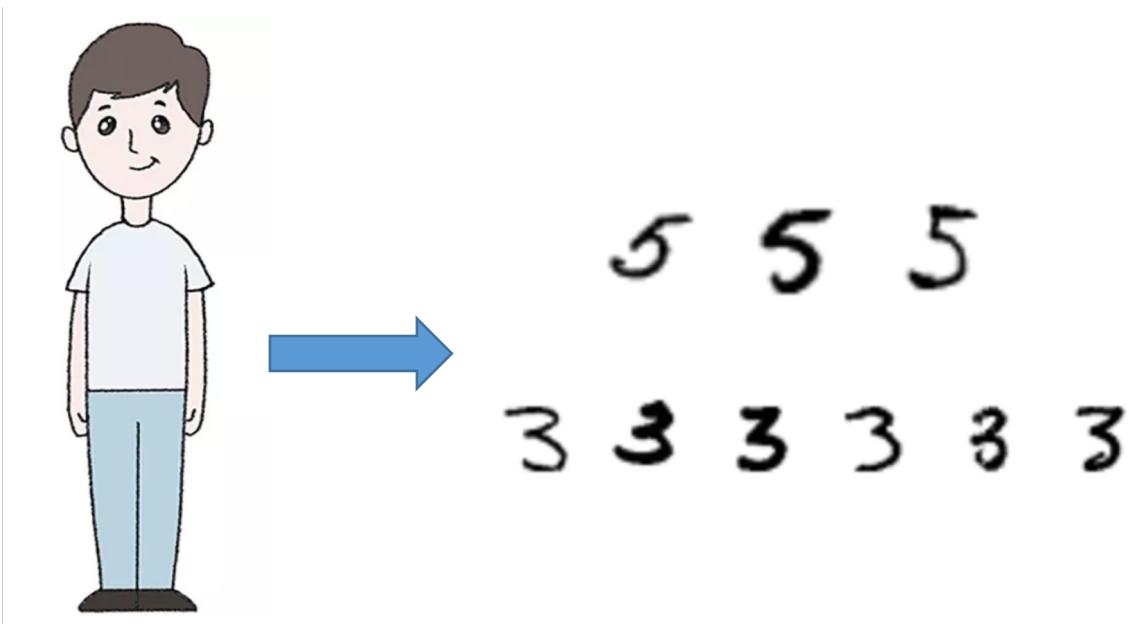
Working of Neural Networks

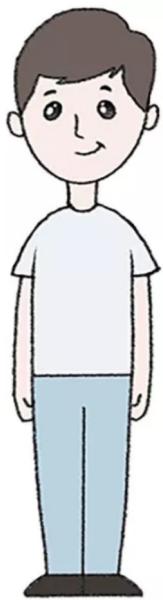


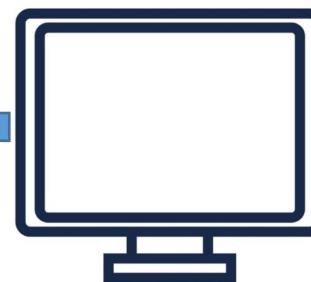
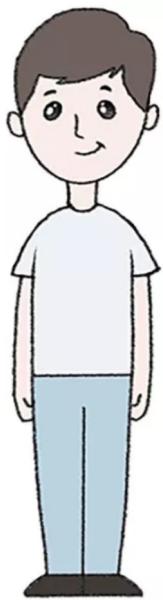


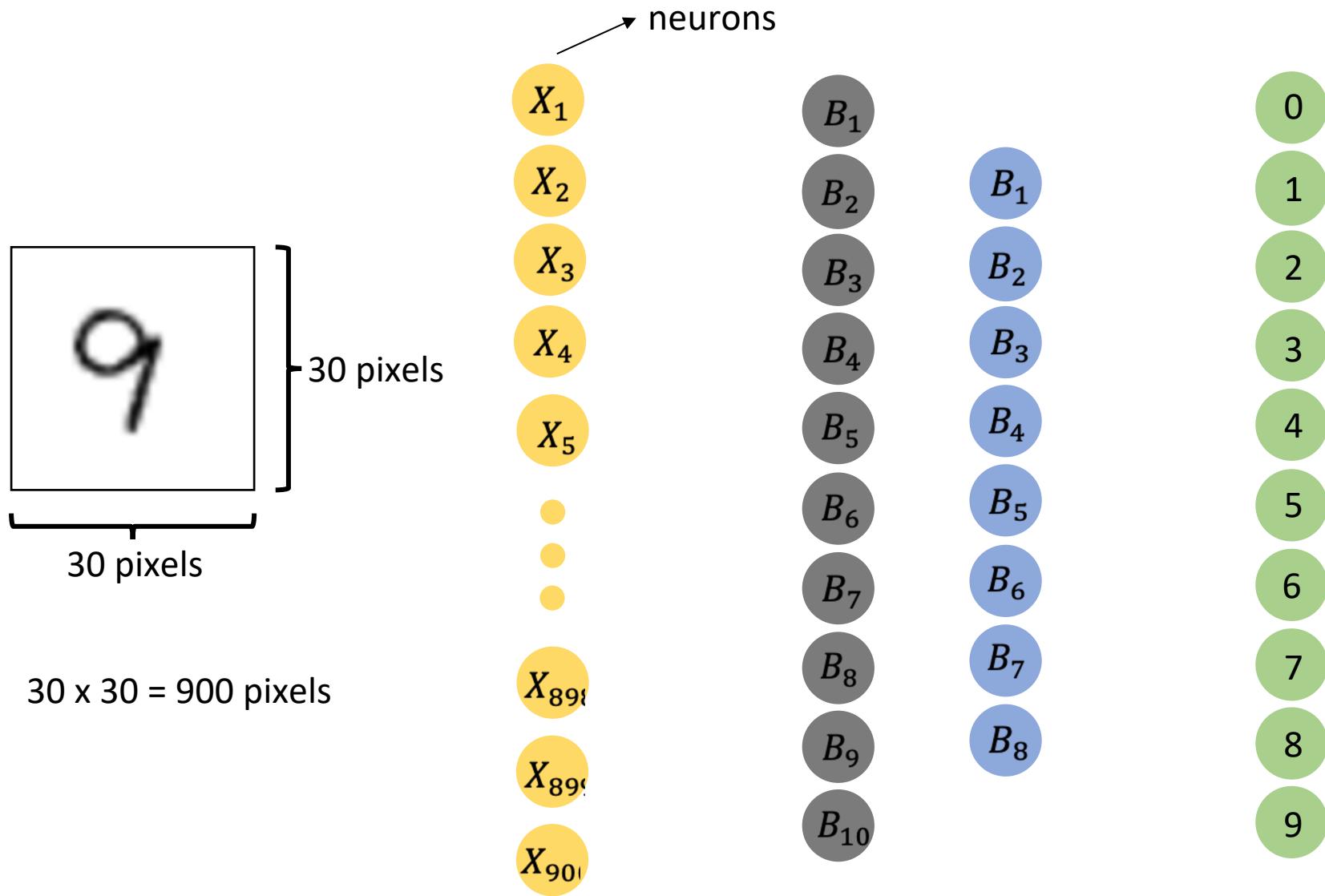


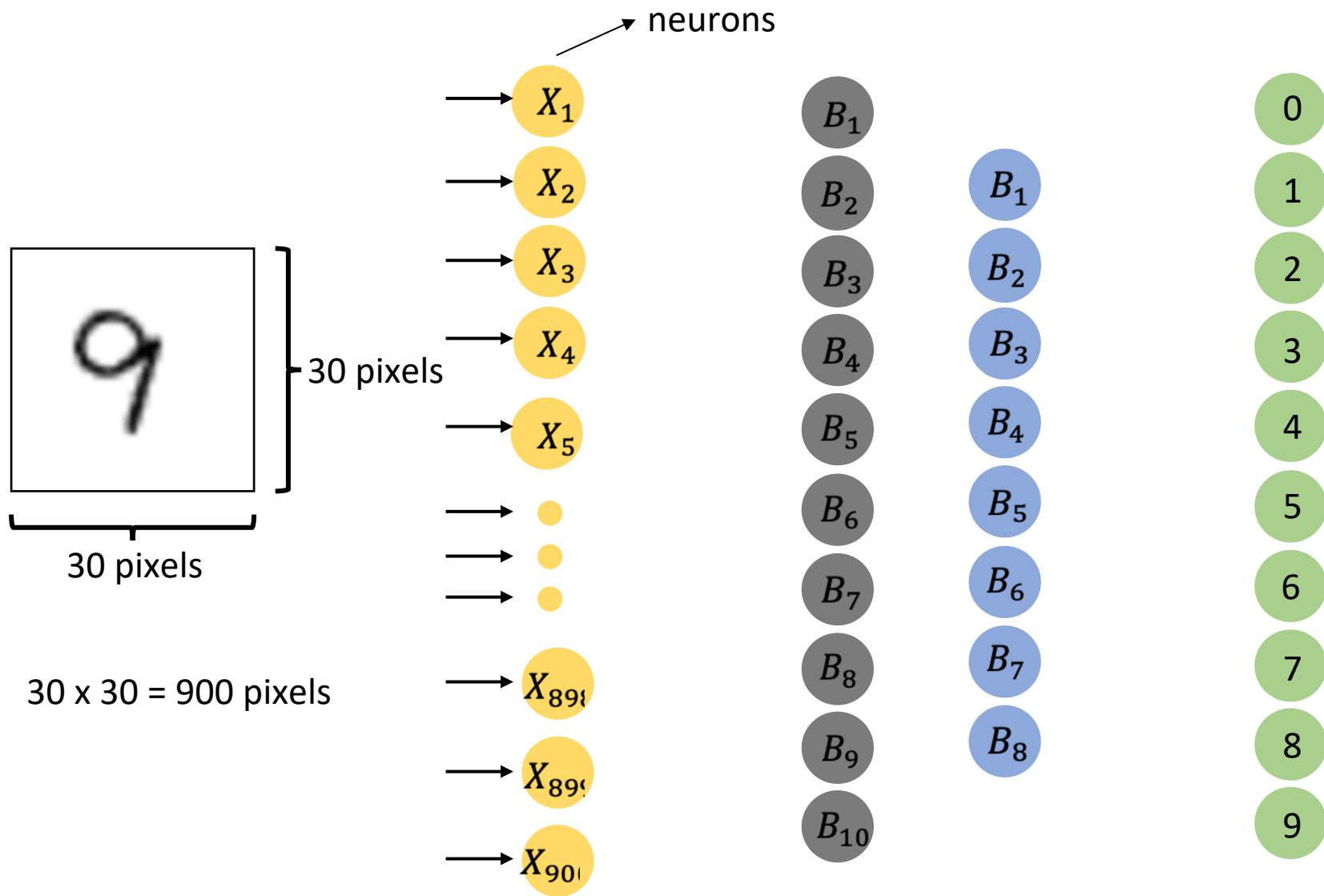


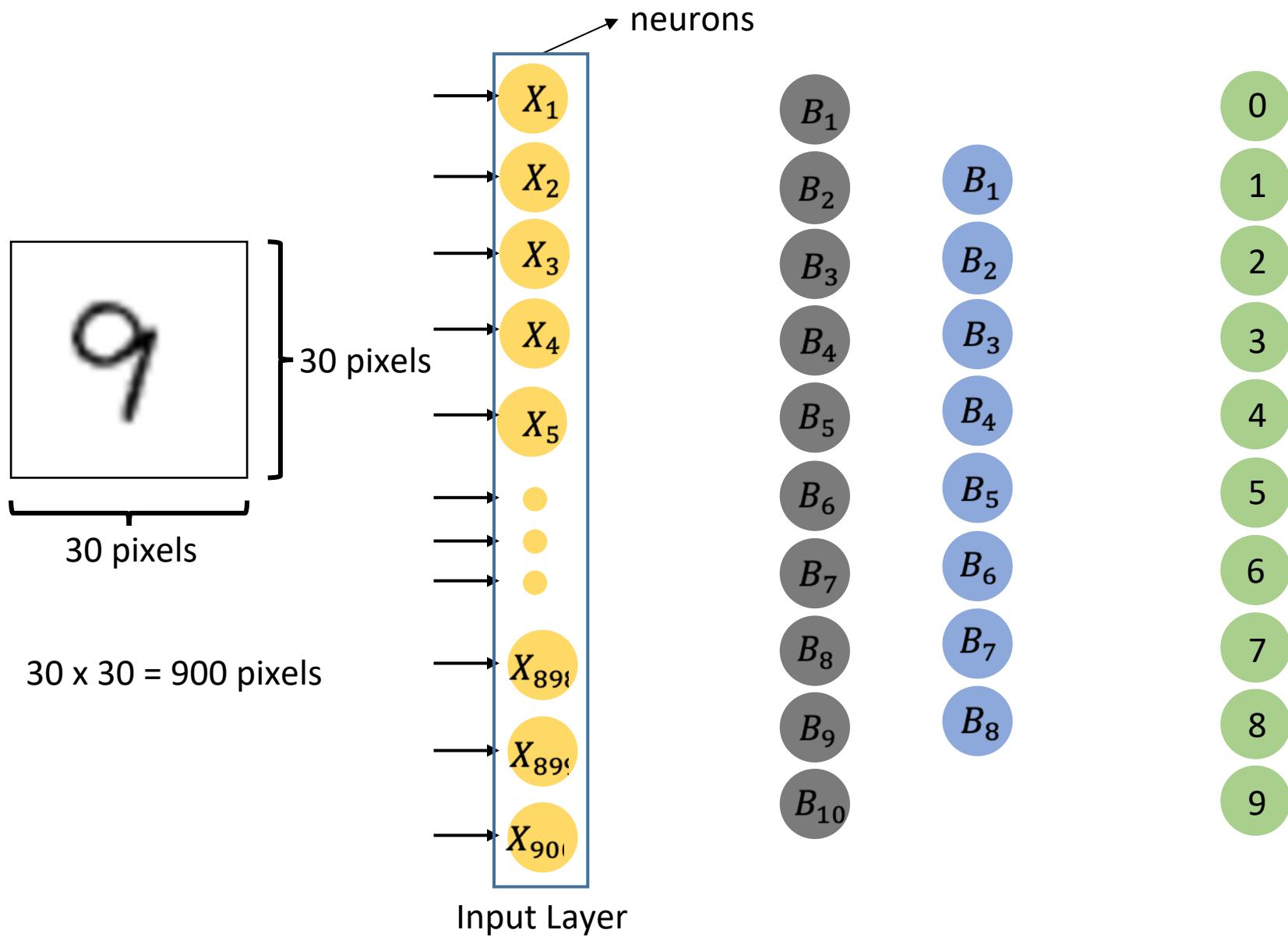


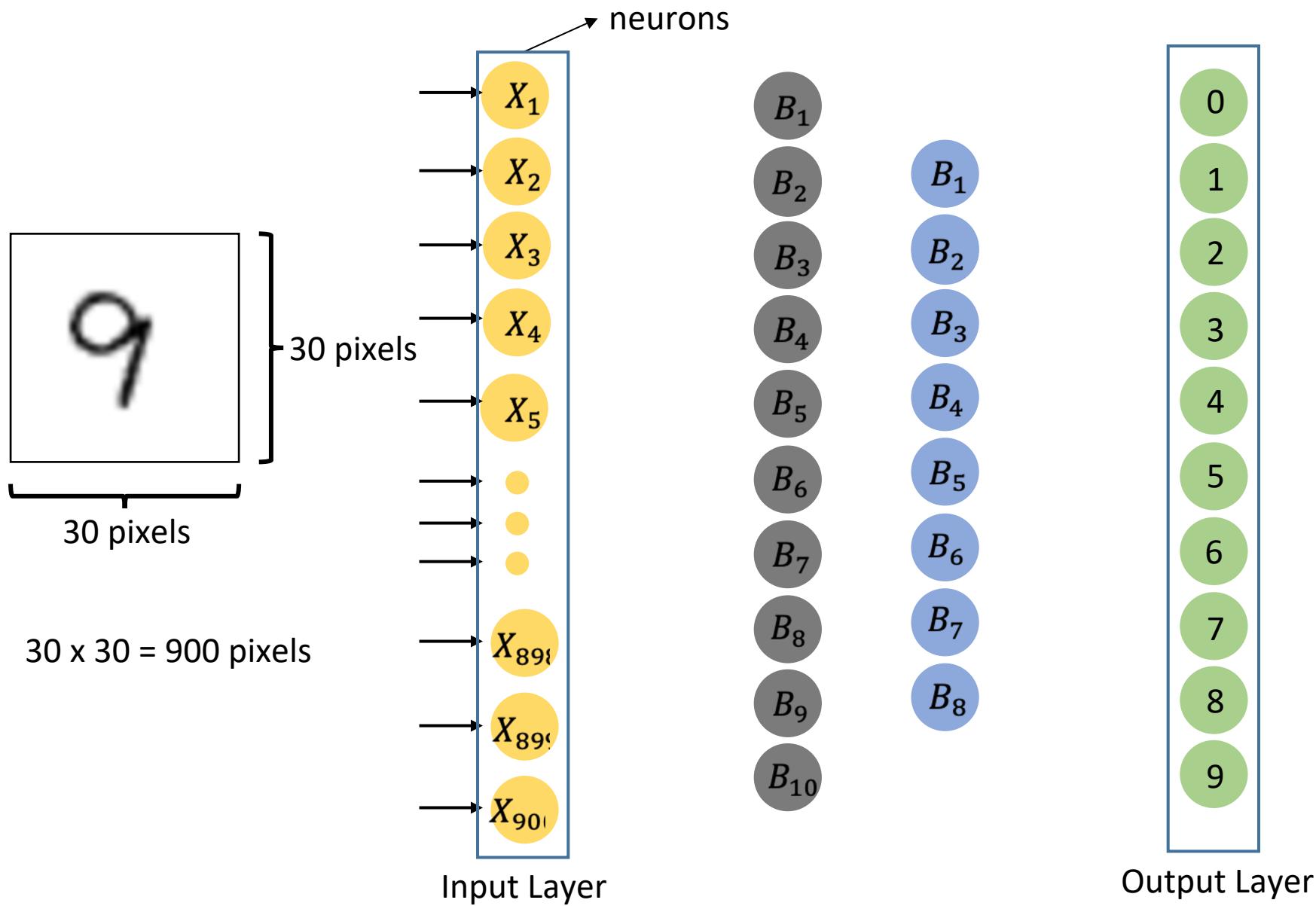


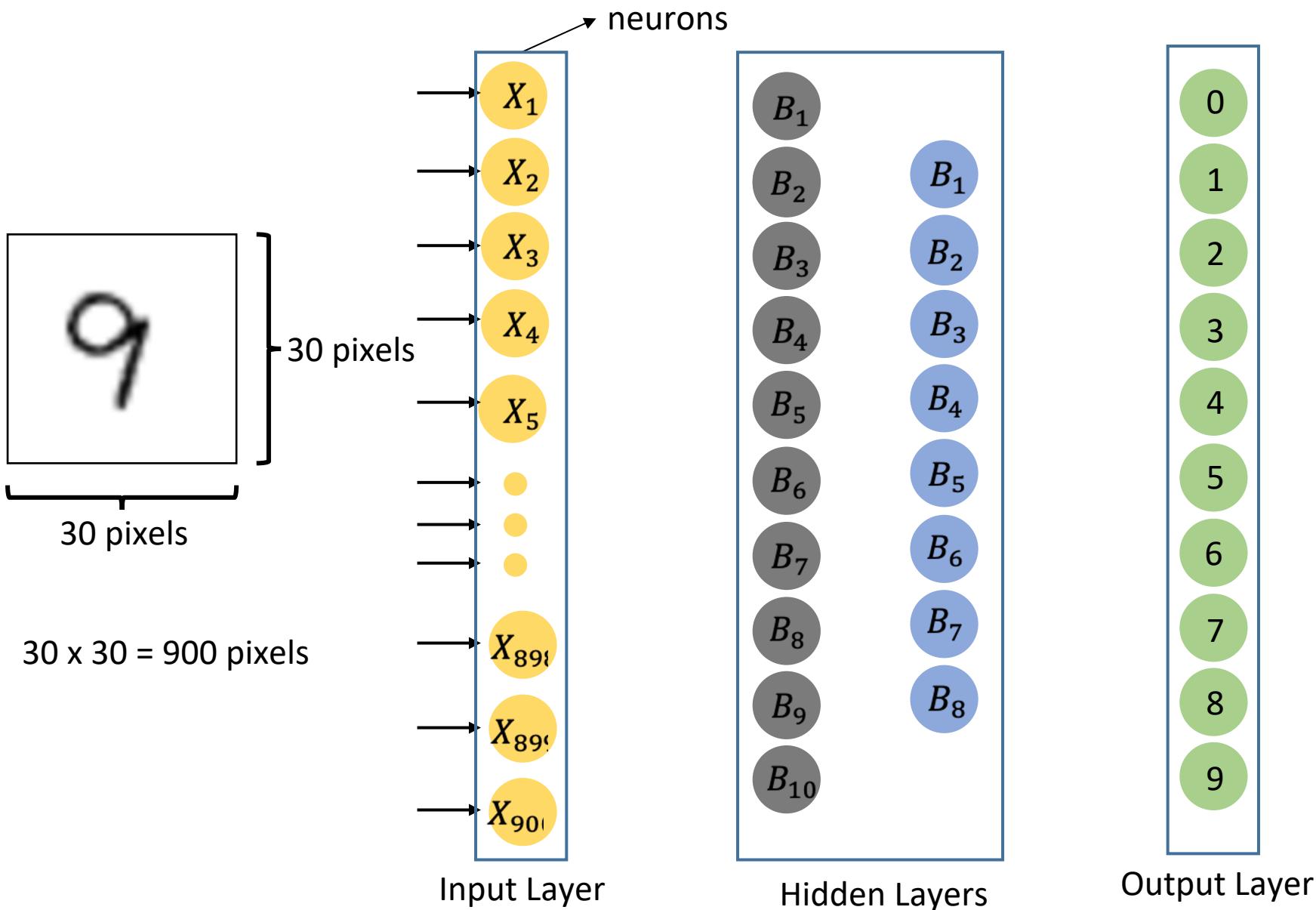












Types of Neural Networks

Types of Neural Networks

Feedforward Neural Networks (FNNs)

- the simplest type of ANN, with **a linear flow of** information through the network
- image classification, speech recognition, and natural language processing

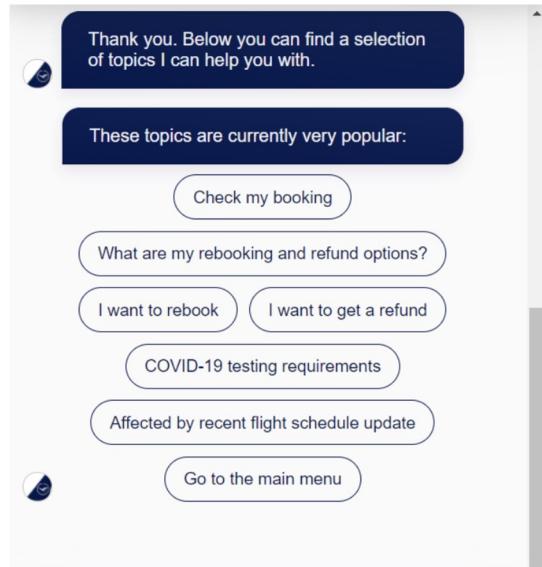
Convolutional Neural Networks (CNNs)

- specifically, for image and video recognition tasks
- automatically learn features from the images, which makes them well-suited for tasks such as image classification, object detection, and image segmentation

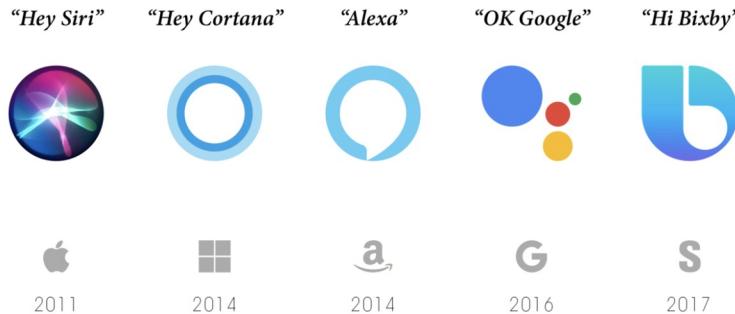
Recurrent Neural Networks (RNNs)

- a type of neural network that can process sequential data, such as time series and natural language
- maintain an internal state that captures information about the previous inputs, which makes them well-suited for tasks such as speech recognition, natural language processing, and language translation.

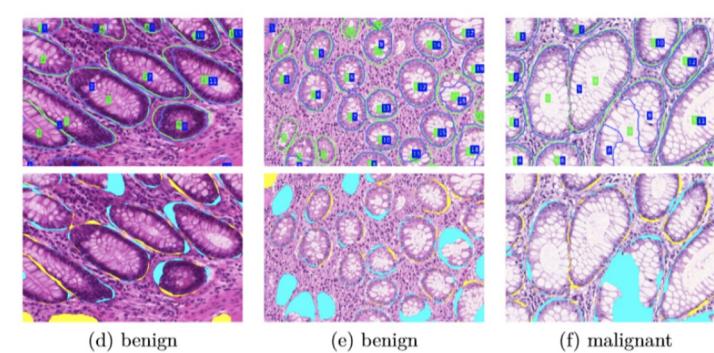
Where is deep learning applied?



Customer support (chatbots or live agents)



Virtual assistants



[Nvidia Dev Blog 2017]



Self-driving cars



Spam emails detection

Applications of Deep Learning

Computer Vision

- Object detection and recognition
- Image classification
- Image segmentation

Natural Language Processing (NLP)

- Automatic text generation
- Language translation
- Sentiment analysis
- Speech recognition

Reinforcement Learning

- Game playing
- Robotics
- Control systems

Challenges in Deep Learning

1. **Data availability:** It requires large amounts of data to learn from. For using deep learning it's a big concern to gather as much data for training.
2. **Computational Resources:** For training the deep learning model, it is computationally expensive because it requires specialized hardware like GPUs and TPUs.
3. **Time-consuming:** While working on sequential data depending on the computational resource it can take very large even in days or months.
4. **Interpretability:** Deep learning models are complex; it works like a black box. it is very difficult to interpret the result.
5. **Overfitting:** when the model is trained again and again, it becomes too specialized for the training data, leading to overfitting and poor performance on new data.

Advantages of Deep Learning

1. **High accuracy:** Deep Learning algorithms can achieve state-of-the-art performance in various tasks, such as image recognition and natural language processing.
2. **Automated feature engineering:** Deep Learning algorithms can automatically discover and learn relevant features from data without the need for manual feature engineering.
3. **Scalability:** Deep Learning models can scale to handle large and complex datasets, and can learn from massive amounts of data.
4. **Flexibility:** Deep Learning models can be applied to a wide range of tasks and can handle various types of data, such as images, text, and speech.
5. **Continual improvement:** Deep Learning models can continually improve their performance as more data becomes available.

Popular deep learning frameworks & libraries include:



gensim

spaCy

theano