



# Making Machines Learn

Introduction to Deep Learning

By: Deepak Anand



# Outline

1. Learning problem formulation
2. Types of learning tasks
3. Learning techniques and their variants
4. Deep learning architectures for different domains

# The Learning Problem

Questions ?

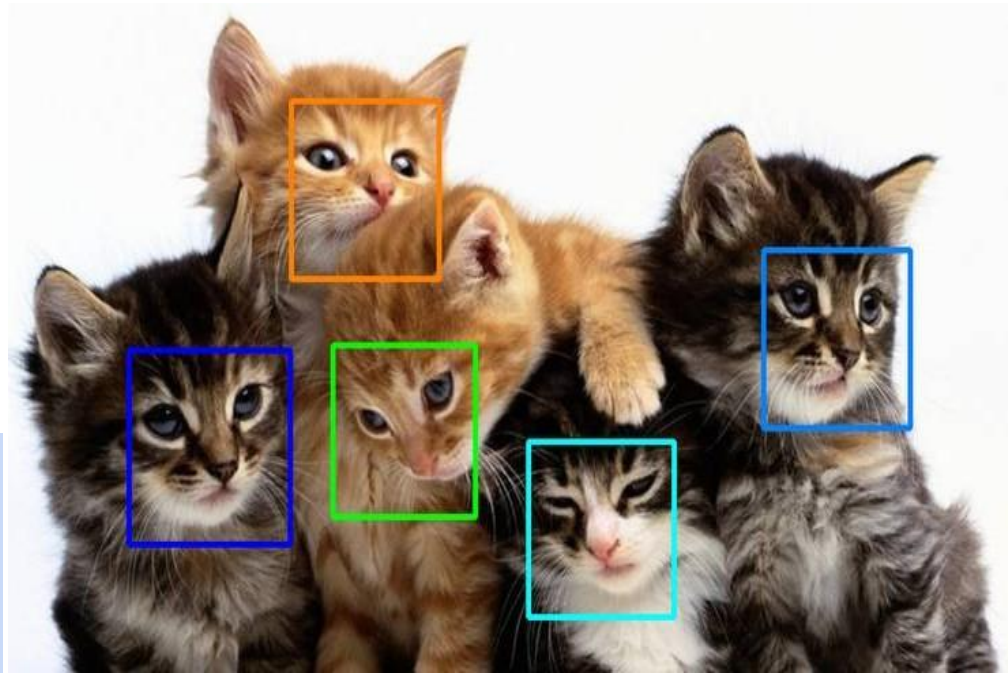
1. What ? "Cats"
2. How many ? "5"
3. Where ? "Bounding Boxes"

Given some data  $\mathbf{X}$ , can we infer something  $\mathbf{y}$  about it ?

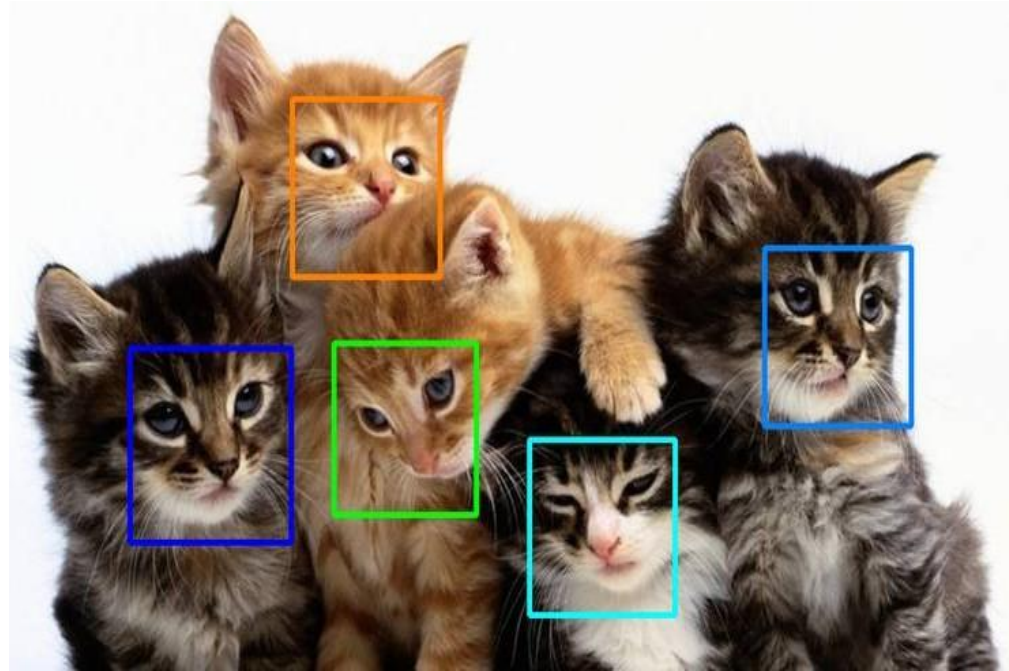
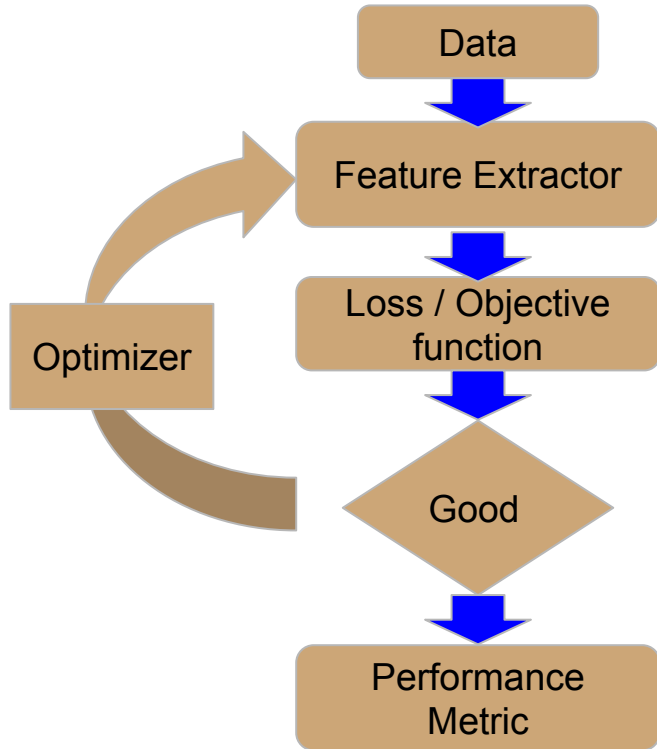
$\mathbf{X}$  := Input features or data representation

$\mathbf{y}$  := Desired inference

$$h: \mathbf{X} \rightarrow \mathbf{y}$$



# How do we learn ?



# Types of Tasks

1. What ? "Cat"

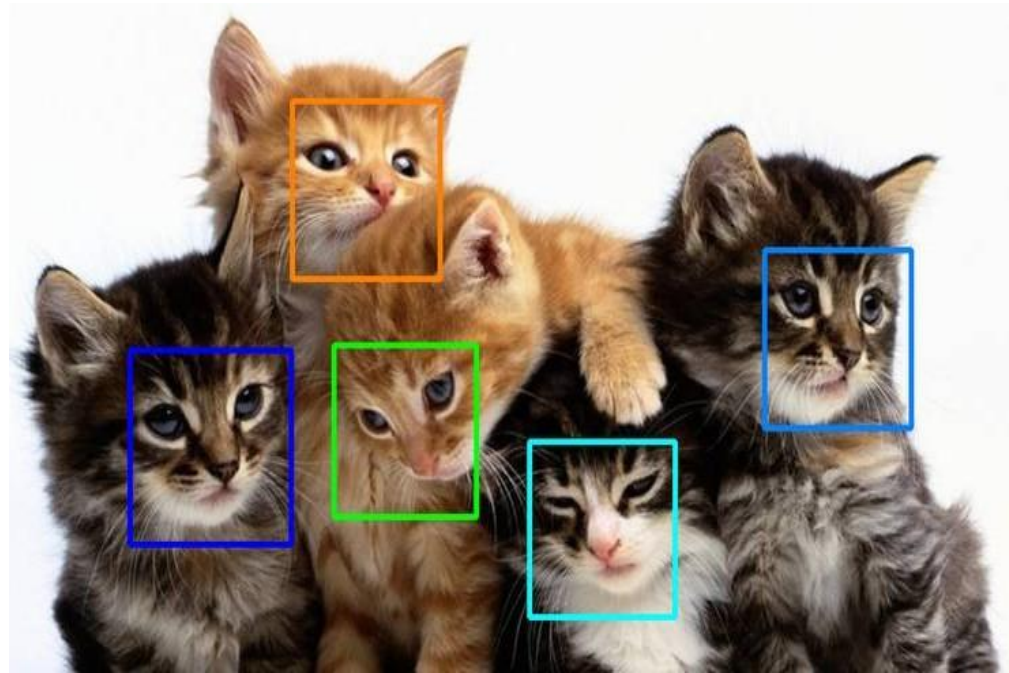
**Classification**

2. How many or How much ? "5"

**Regression**

3. Where ? "Bounding Boxes"

**Segmentation**



# Types of learning

## Supervised Learning

Given a paired dataset  $D := \{(X_1, y_1), (X_2, y_2), \dots, (X_N, y_N)\}$

Train a  $h: X \rightarrow y$  to predict the  $y$  from a given  $X$

## Unsupervised Learning

Given a dataset  $D := \{X_1, X_2, \dots, X_N\}$

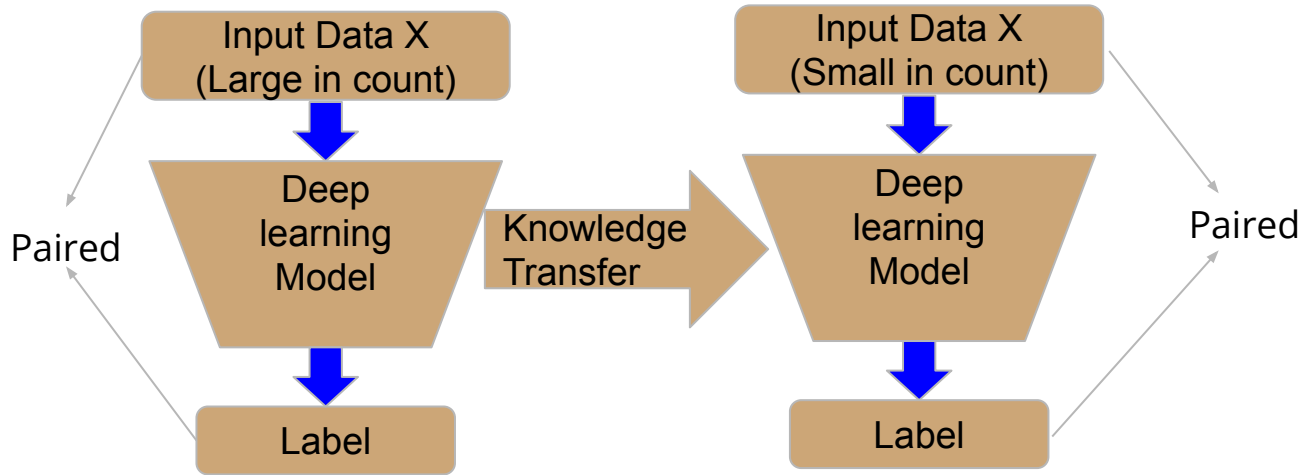
Group **similar** data points as a category

## Reinforcement Learning

Given an **environment**, **action-space** and **states**;  
an **agent** interacts or trains to maximize a **reward function**.

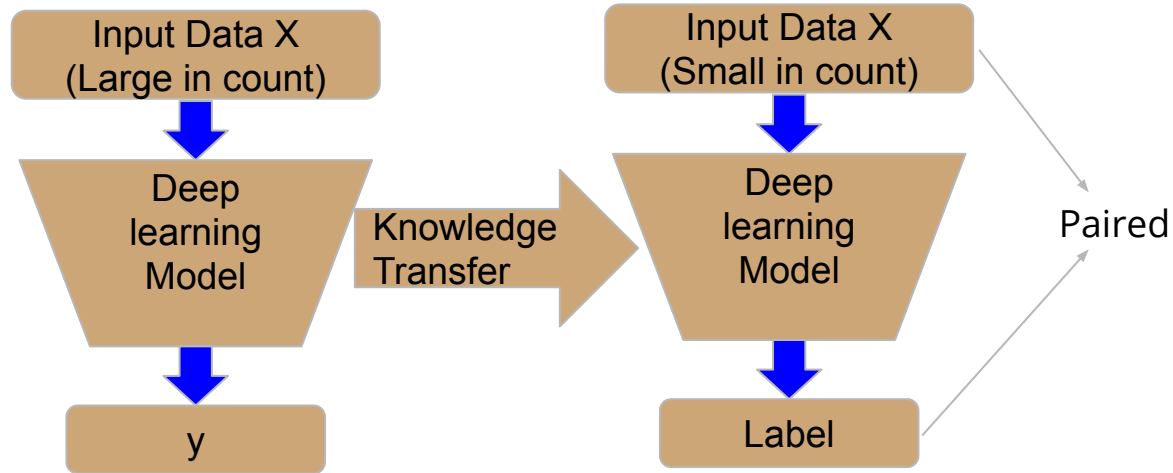
# Transfer Learning

- Use already learnt features from a **different** task but from a **related domain**



# Self-supervised learning

- Use already learnt features from a **different** task but from a **related domain**





# Self-supervision tasks

1. Embedding learning
2. Colorization
3. In-painting
4. Jigsaw
5. Orientation prediction
6. Compression
7. Temporal consistency in adjacent frames

# Colorization

Ex. 3: **Colorization** (predict color given intensity)



# Inpainting



(a) Input context



(b) Human artist

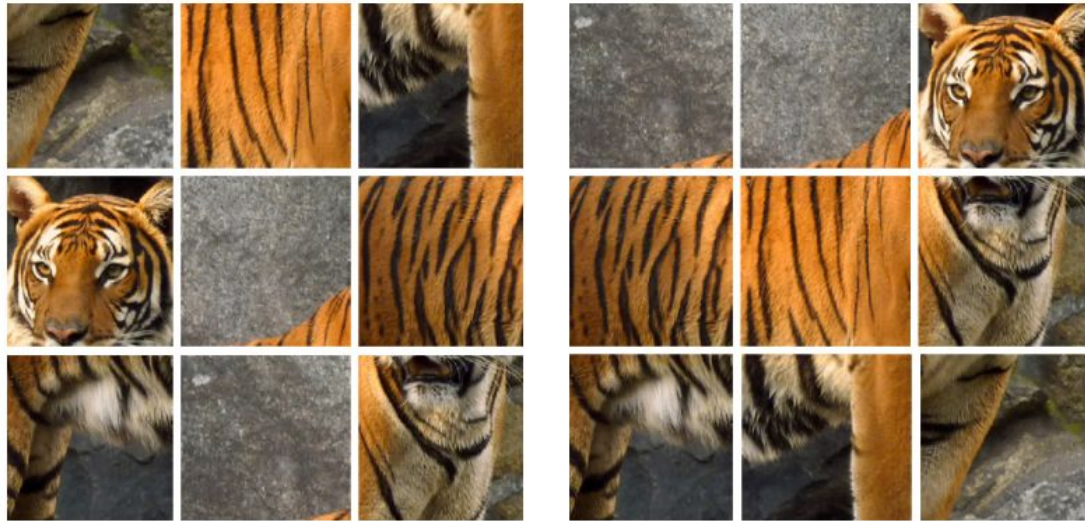
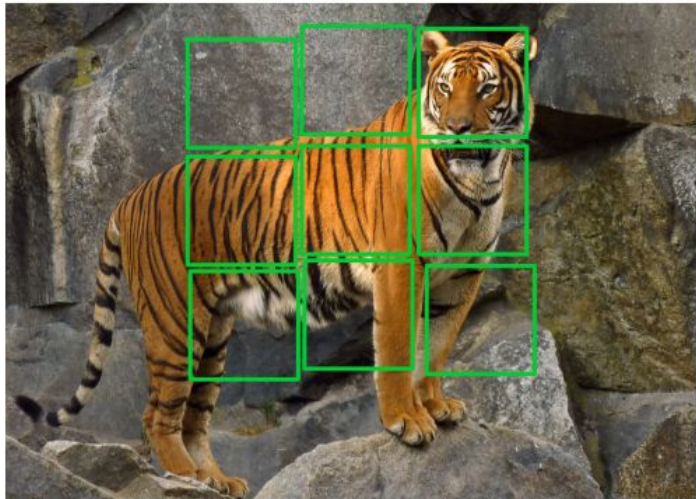


(c) Context Encoder  
( $L_2$  loss)

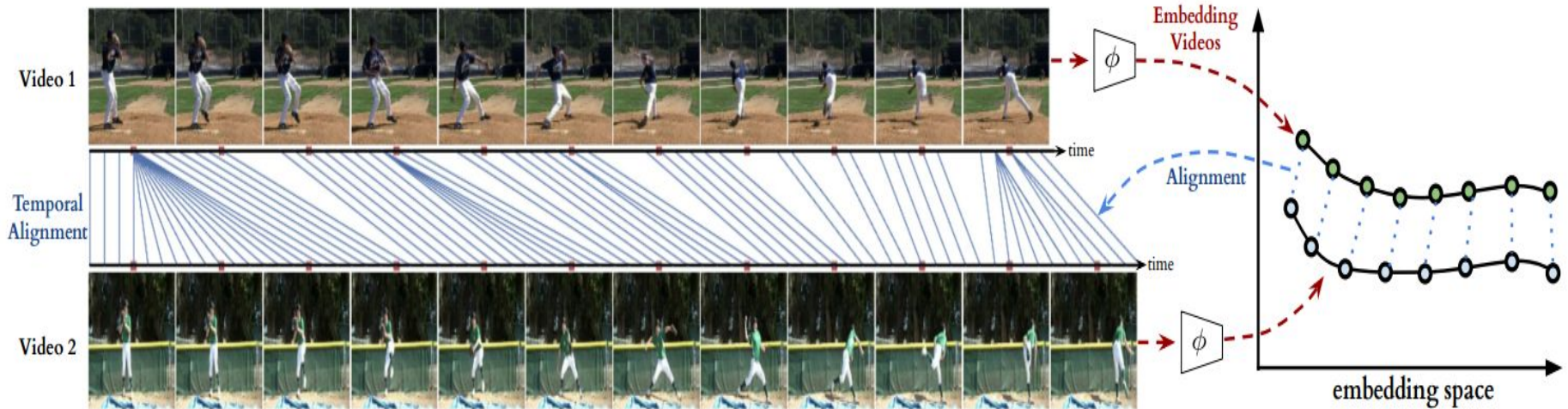


(d) Context Encoder  
( $L_2 + \text{Adversarial loss}$ )

# Jigsaw



# Temporal alignment in video frames

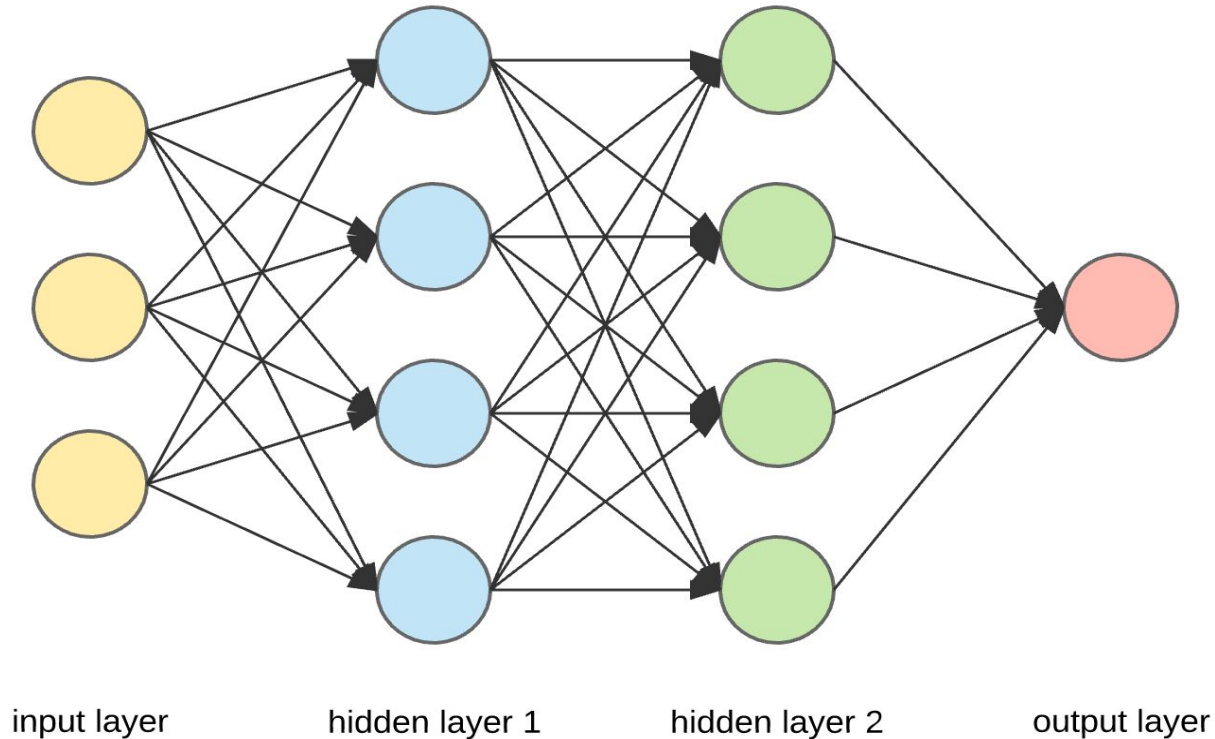


# Types of Deep Networks

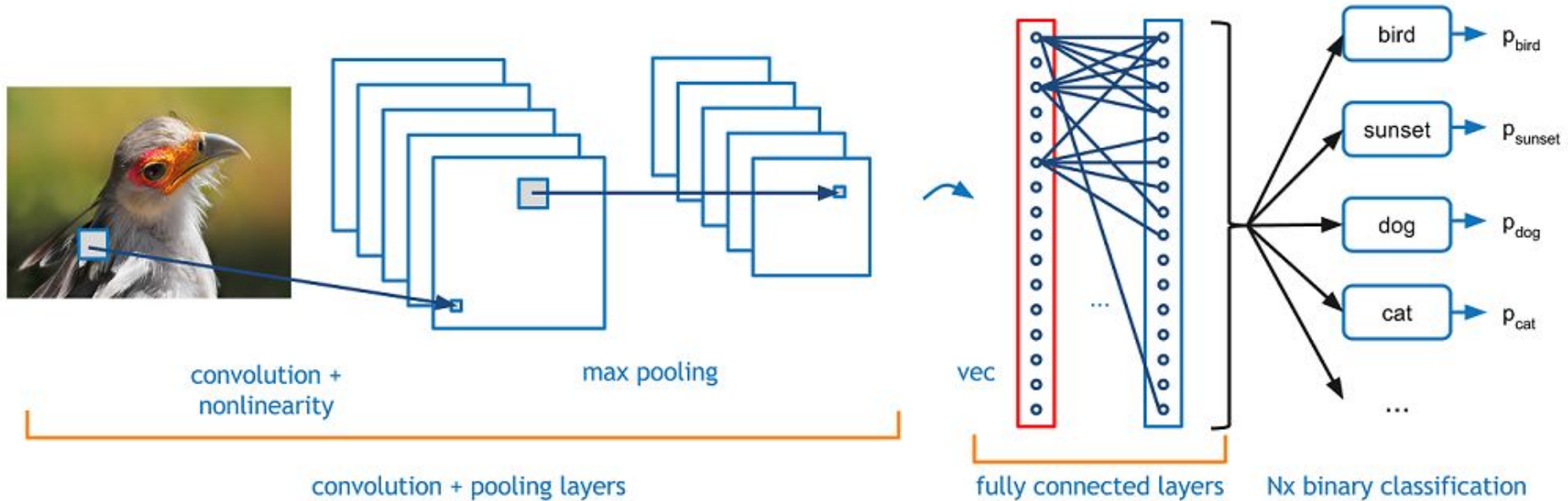
1. Neural Networks
2. Convolutional Neural Networks
3. Recurrent Neural Networks
4. Graph Convolutional Neural Networks
5. Generative Adversarial Networks



# Neural Networks

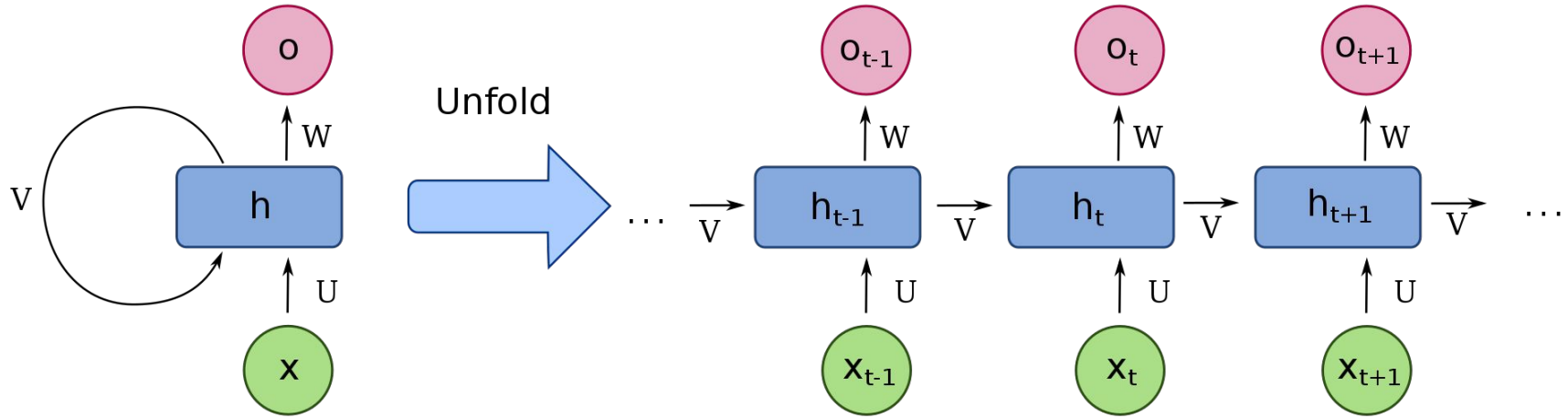


# Convolutional Neural Networks

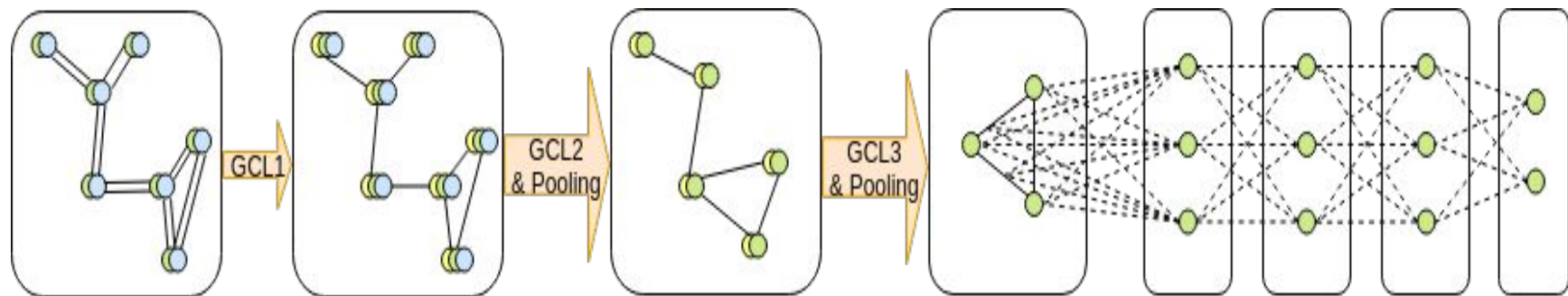




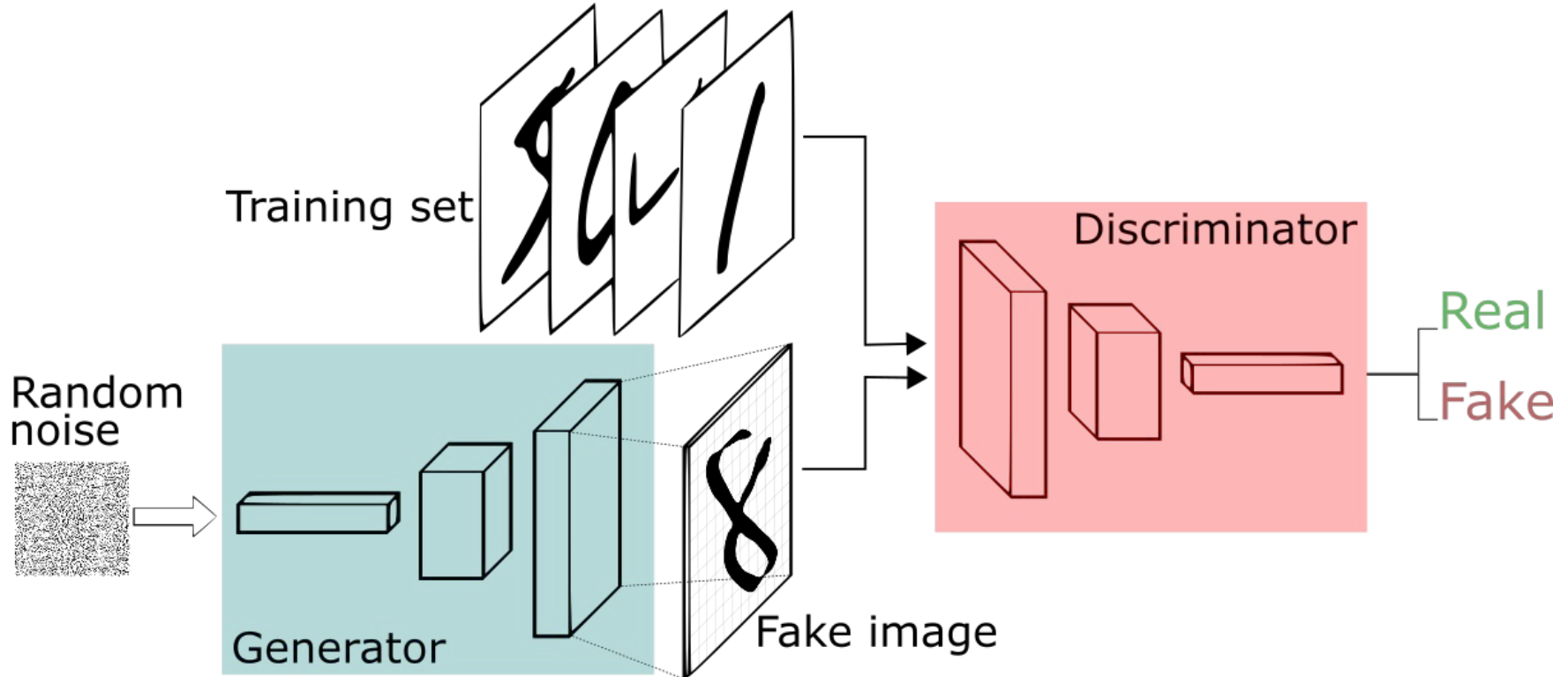
# Recurrent Neural Networks



# Graph-Convolutional Neural Networks



# Generative Adversarial Networks



Thank you

Questions?