

# **Pix2Pix: Colorization**

**Image-to-Image Translation with Conditional Adversarial Nets**

**Week 1**

# Schedule

## Pix2Pix: Colorization

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
시험문제 풀이	Image Data	DataLoader Implementation	Pix2Pix Generator Implementation	Pix2Pix Discriminator Implementation	Pix2Pix Initialization Implementation	Pix2Pix Loss Implementation	Pix2Pix Training Implementation
인공지능개론	Input Data	Pix2Pix Network	GAN Descriminator	Model Initialization Methods	GAN Loss Function	Assembling Everything Together	Improving Pix2Pix
GAN이란?	DataLoader	GAN Generator	Pix2Pix Discriminator	Pix2Pix Model Initialization	Pix2Pix Loss Function	Train Validation Test	Other Deep Learning Networks
Color Channel		Pix2Pix Generator					인공지능 면접질문

# 시험문제 풀이

## def & class

- def
  - 함수 - 매개변수를 받아서 연산 후 결과를 리턴
- class
  - 객체를 생성하는 설계도
- ...Why use class?

# 시험문제 풀이

## 엑셀 파일이 주어졌을 시, 읽어오는 시나리오

- pandas 라이브러리로 읽어오기

```
import pandas as pd

df = pd.read_excel('엑셀 파일 경로')
data = df.iloc[:, :-1]
label = df.iloc[-1]
```

# 시험문제 풀이

## 엑셀 파일이 주어졌을 시, 읽어오는 시나리오

- pytorch에 맞게 변환

```
import pandas as pd
from torch.utils.data import DataLoader, TensorDataset
import torch

df = pd.read_excel('엑셀 파일 경로')
data = df.iloc[:, :-1]
label = df.iloc[-1]

torch_data = torch.Tensor(data.to_numpy())
torch_label = torch.Tensor(label.to_numpy())
torch_whole_data = TensorDataset(torch_data, torch_label)

train_loader = DataLoader(torch_data, batch_size=16)
```

# 시험문제 풀이

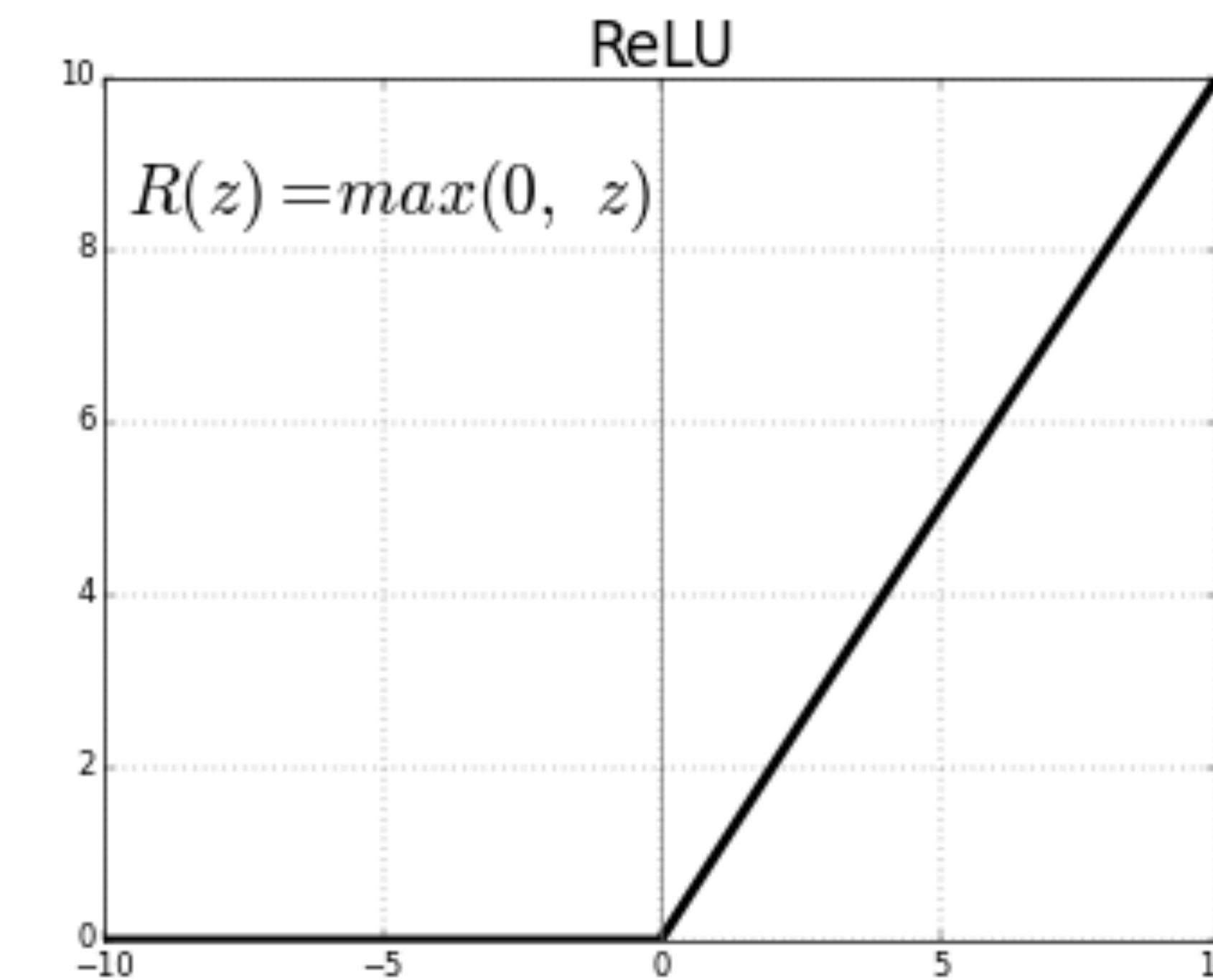
## 인공지능에 필요한 학문 분야들

- 개발자
  - 알고리즘
  - 데이터 구조 ....
- 인공지능 리서처
  - English
  - 확률과 통계
  - 수학
  - Calculus & Linear Algebra

# 시험문제 풀이

## 로스 함수가 미분이 가능해야하는 이유, 대처 방법

- Backpropagation
- 대처 방법
  - Reinforcement Learning
  - Derivate-free optimization
  - SPSA Algorithm
- ... ReLU???



# 시험문제 풀이

## Linear Regression / Logistic Regression

- Linear Regression

- $H(x) = Wx + b$

- Logistic Regression

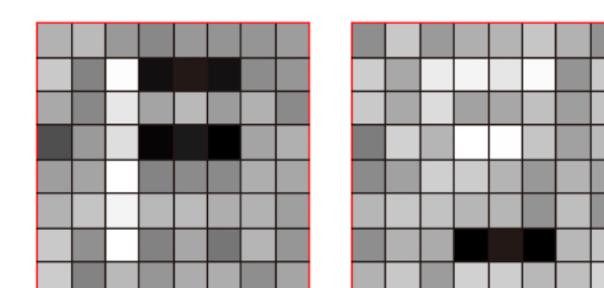
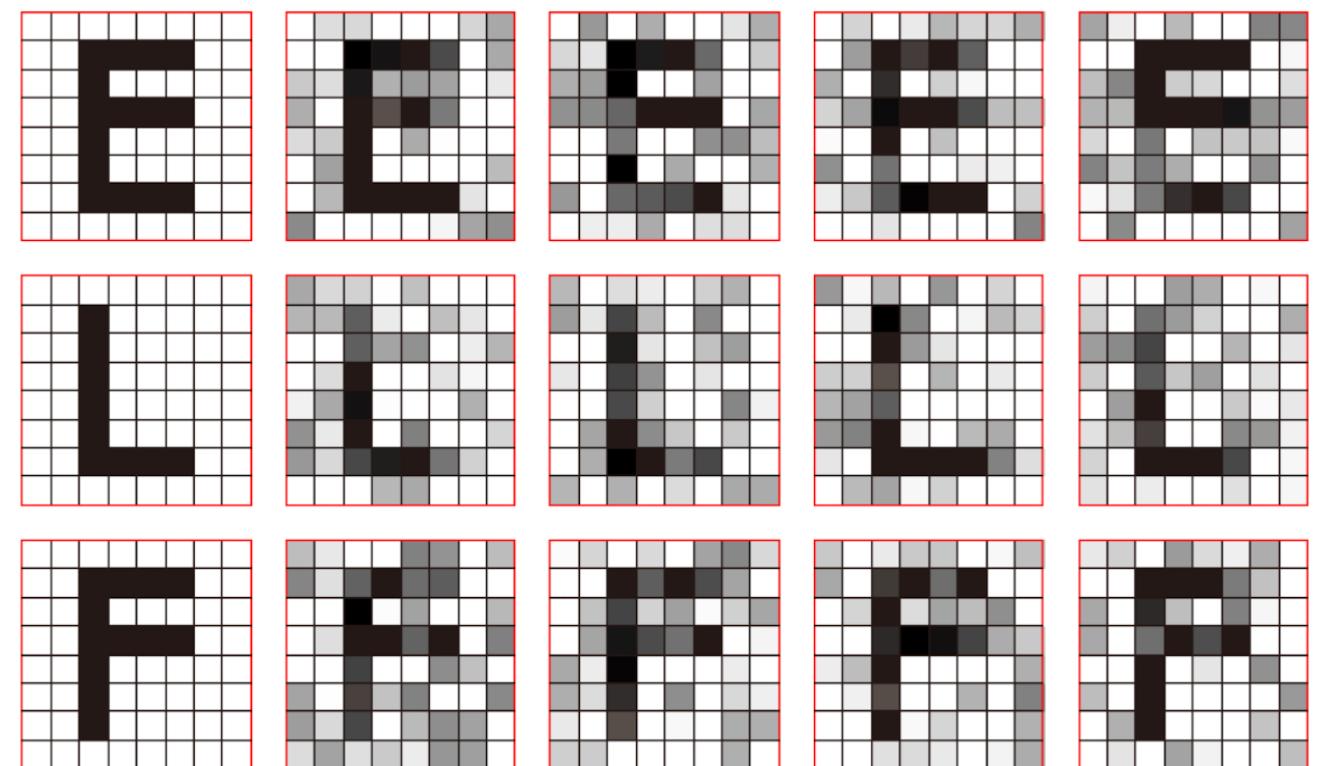
- $H(x) = \sigma(Wx + b)$

# 시험문제 풀이

## MLP, CNN, RNN의 Inductive Bias

- MLP

(a) sample training patterns



(b) learned input-to-hidden weights

- CNN

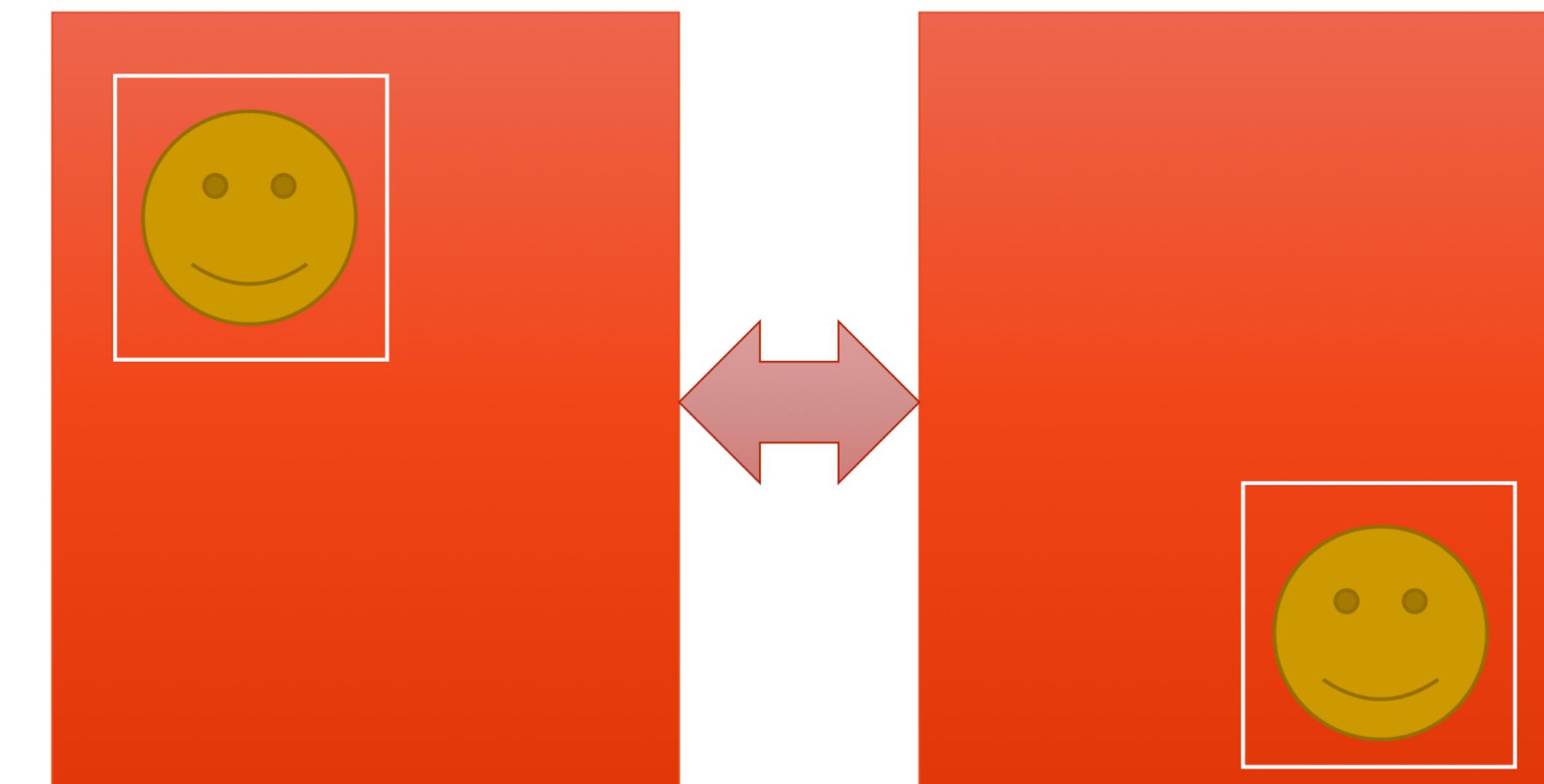


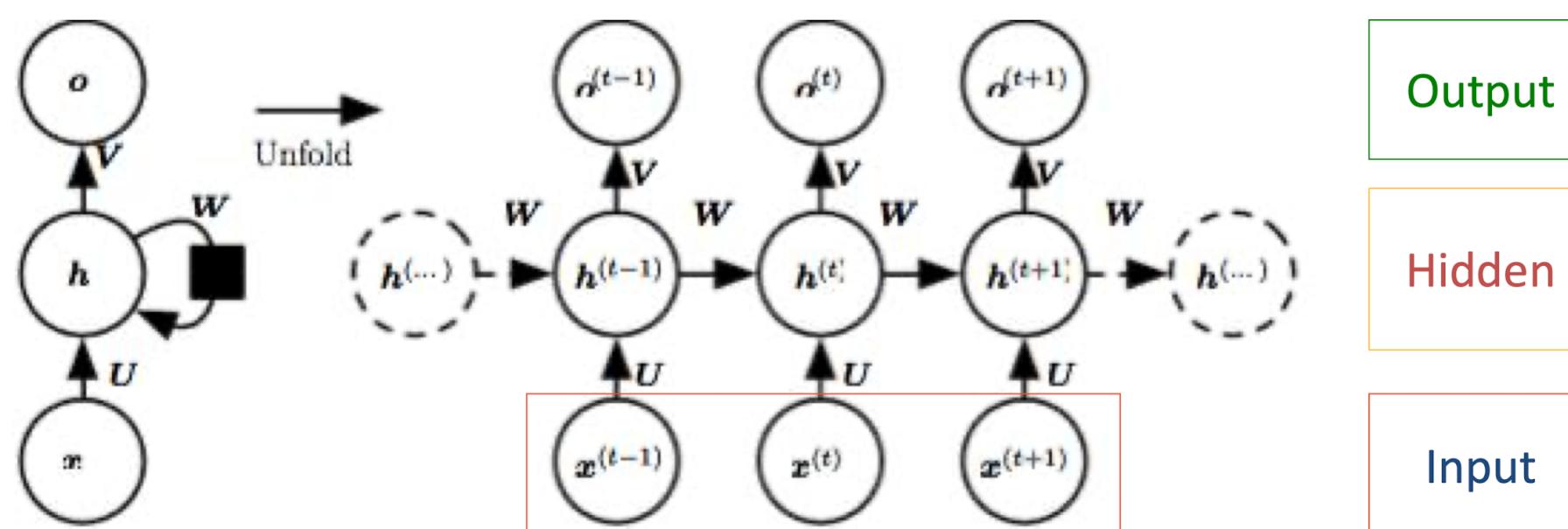
Image 1

Image 2

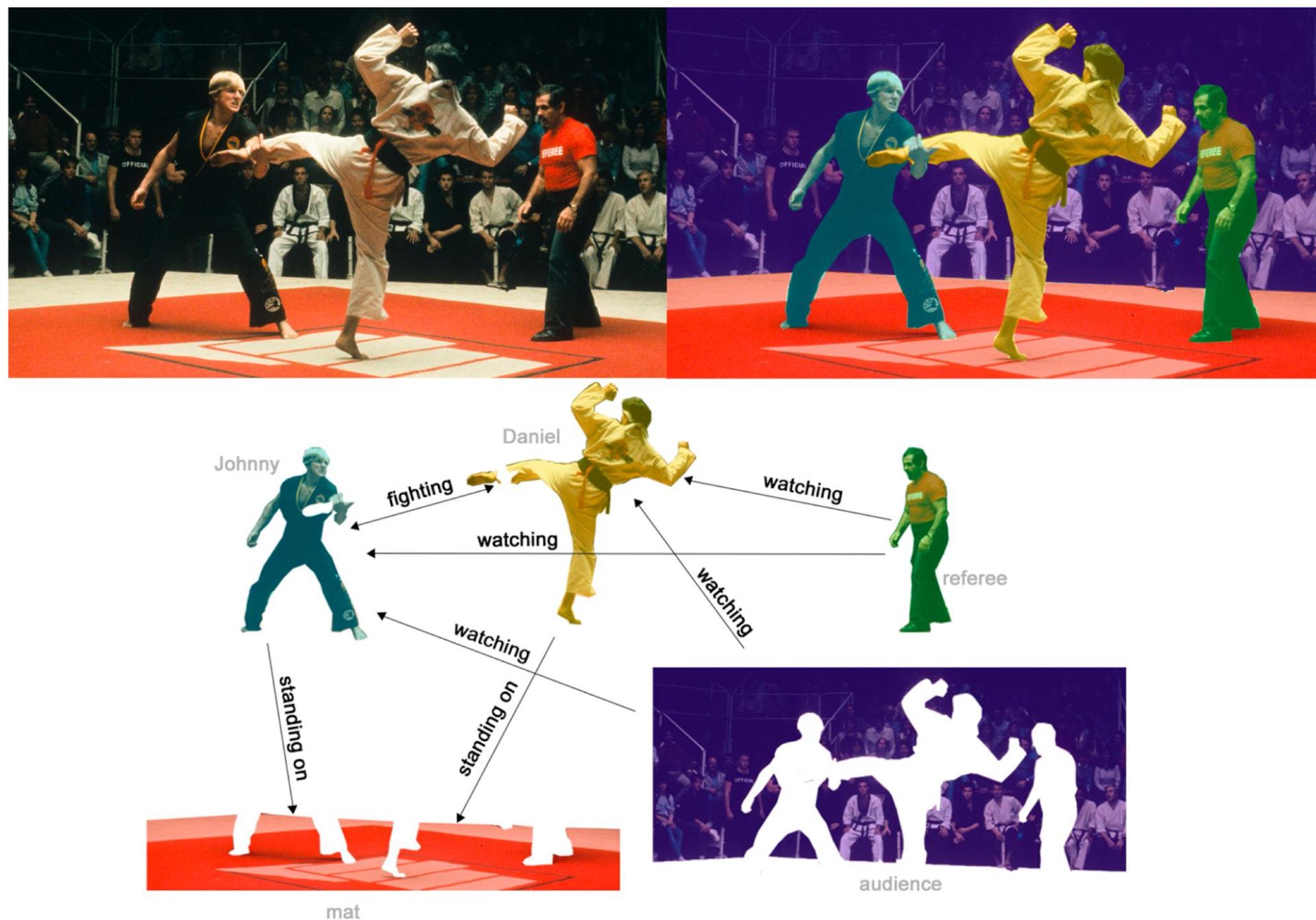
# 시험문제 풀이

## MLP, CNN, RNN의 Inductive Bias

- RNN



- GNN



# 시험문제 풀이

## 두 확률분포의 차이를 계산할 때 사용되는 함수

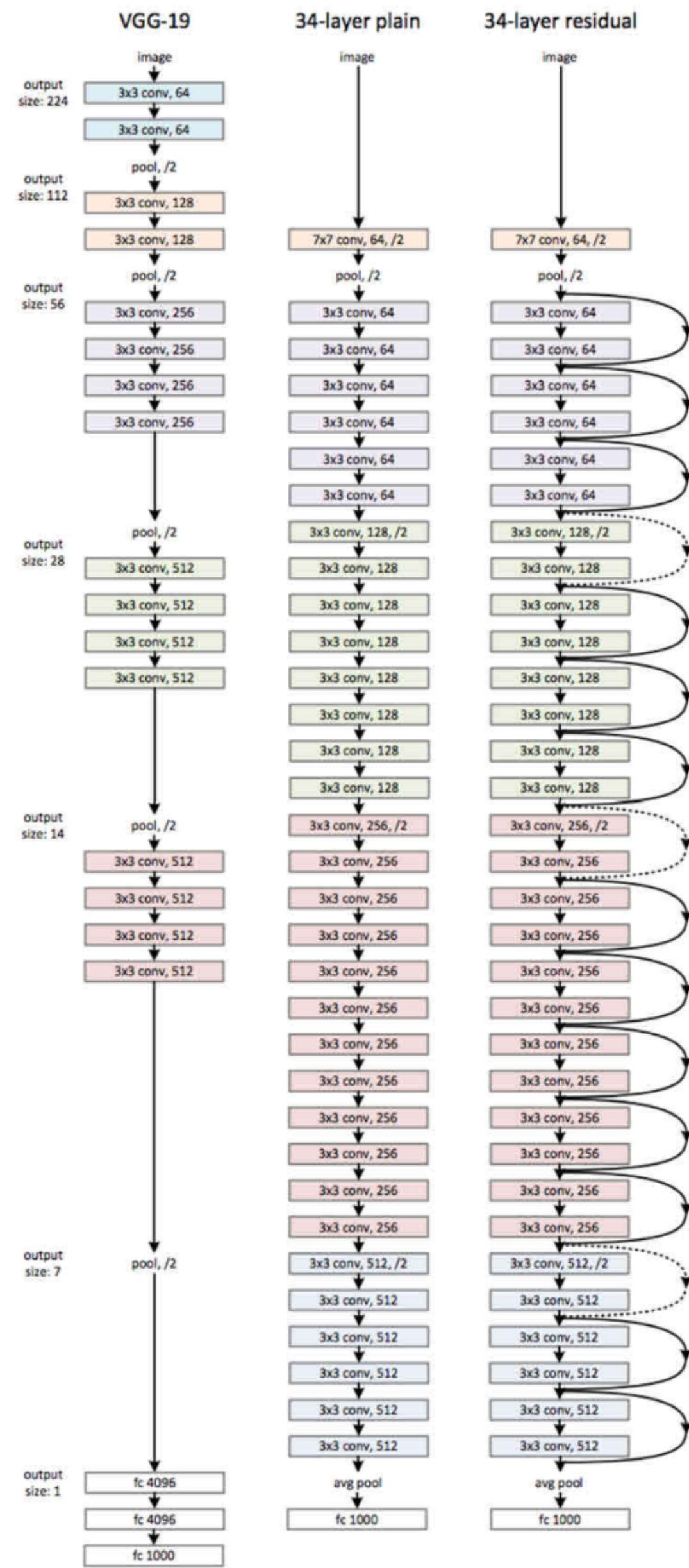
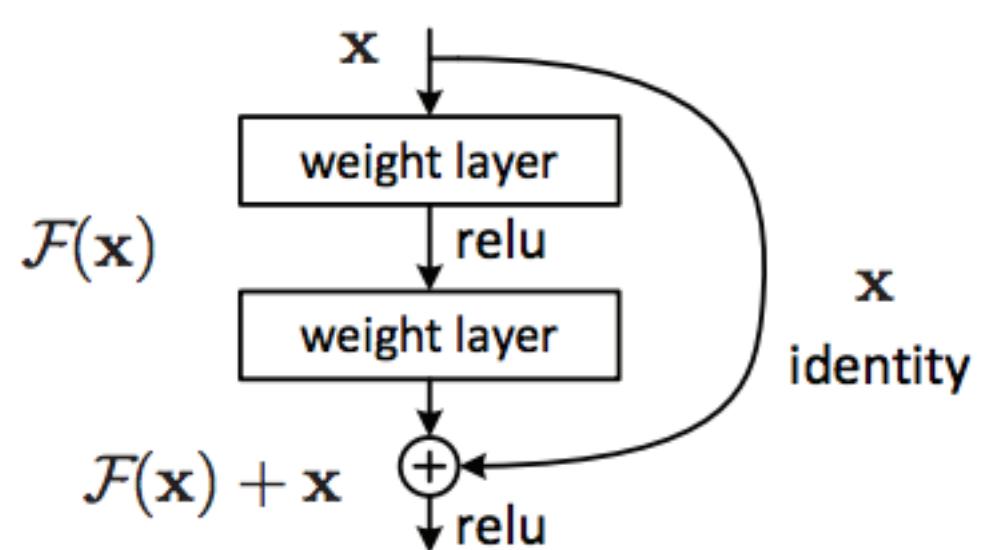
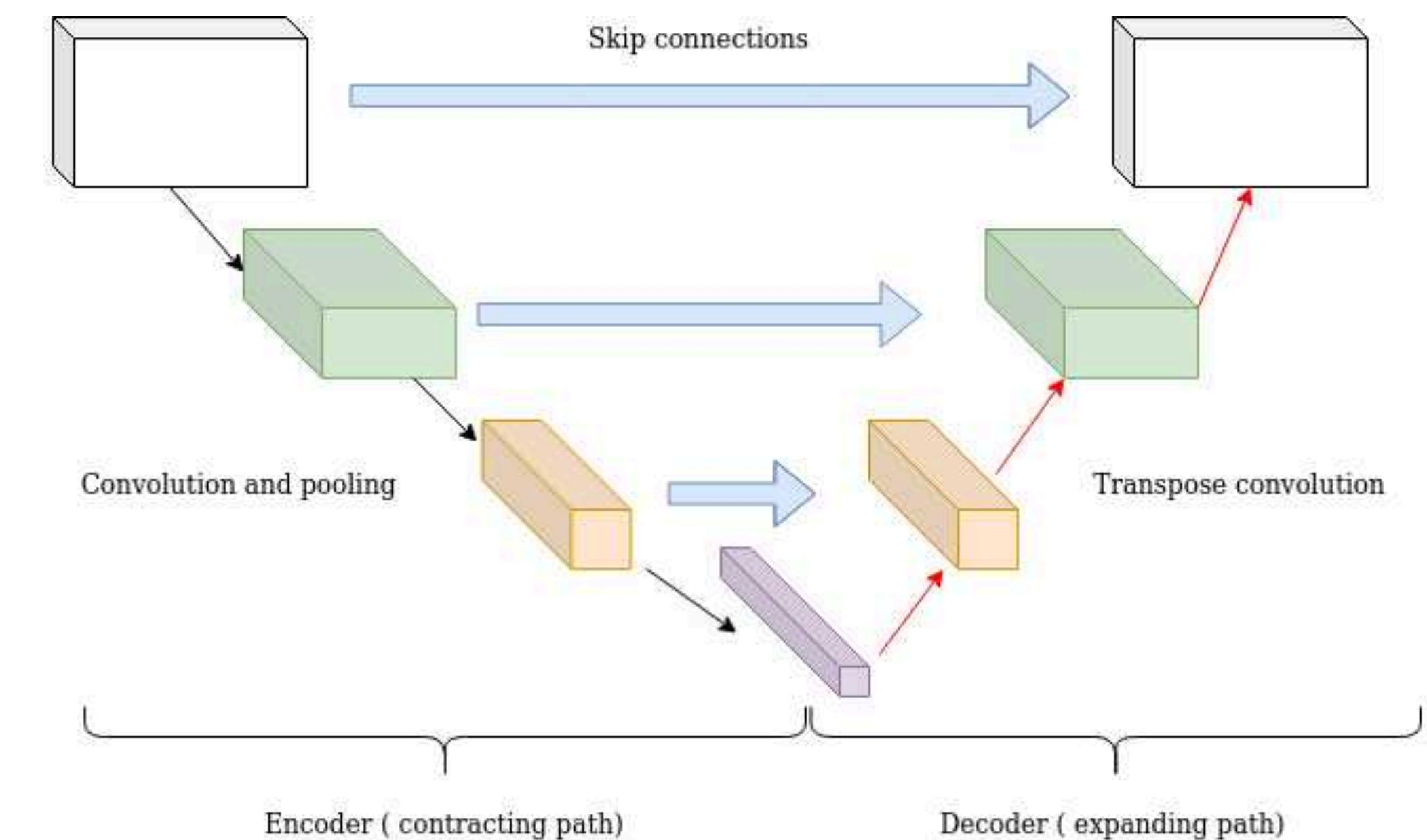
- KL Divergence

$$KL(p||q) = \begin{cases} \sum_i p_i \log \frac{p_i}{q_i}, & \text{if discrete} \\ \int p(x) \log \frac{p(x)}{q(x)} dx, & \text{if continuous} \end{cases}$$

- 두 확률분포의 차이를 계산하는데 사용되는 함수
- $KL(p||q) \geq 0$ 
  - 쉽게 생각하면, 두 분포의 차이가 없을 때는 0이니!
  - 정확하게는, cross entropy에서 entropy를 뺀 값이기 때문
- $KL(p||q) \neq KL(q||p)$ 
  - KL Divergence는 거리 개념이 아니다!

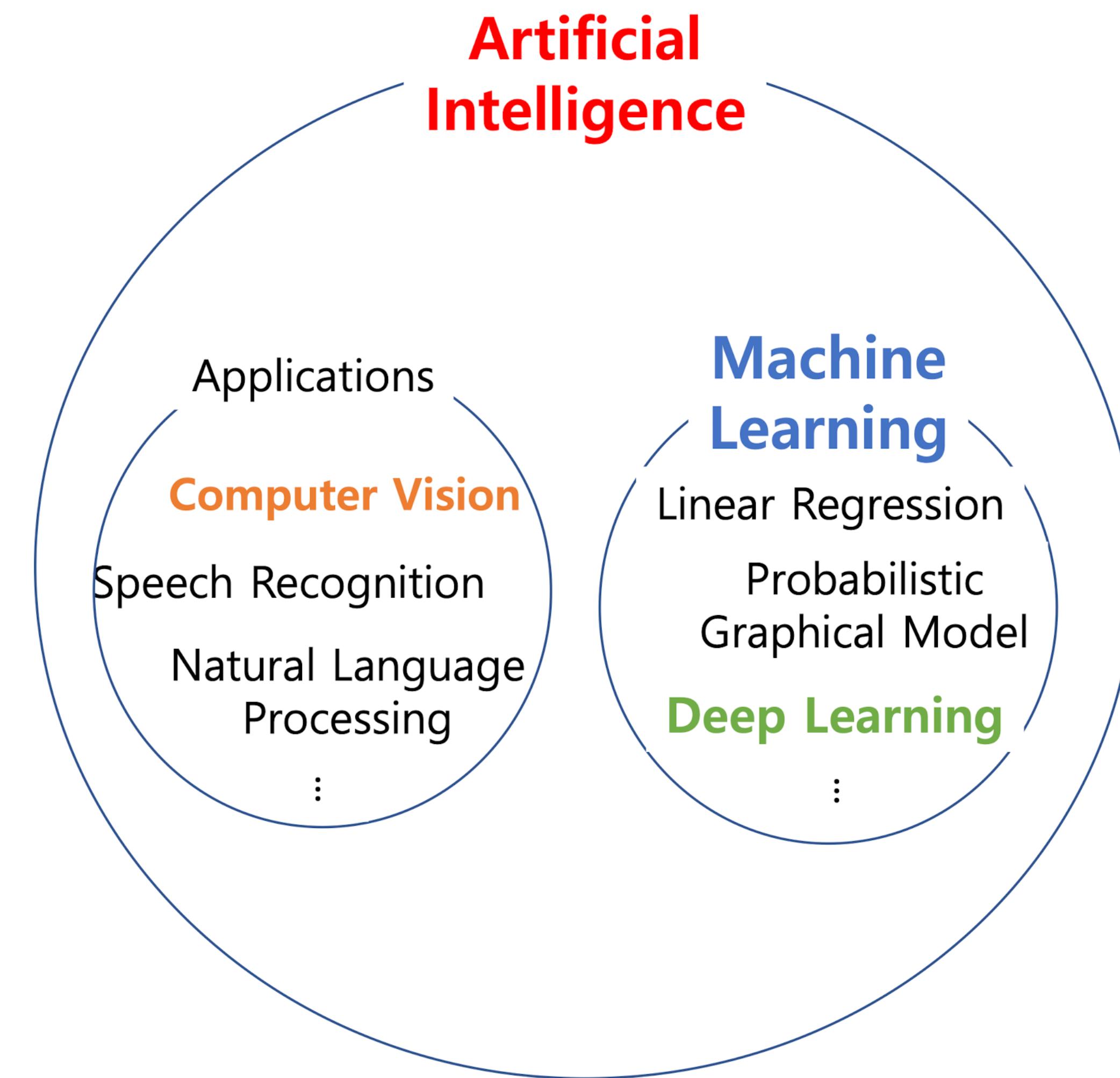
# 시험문제 풀이

## Skip Connection?



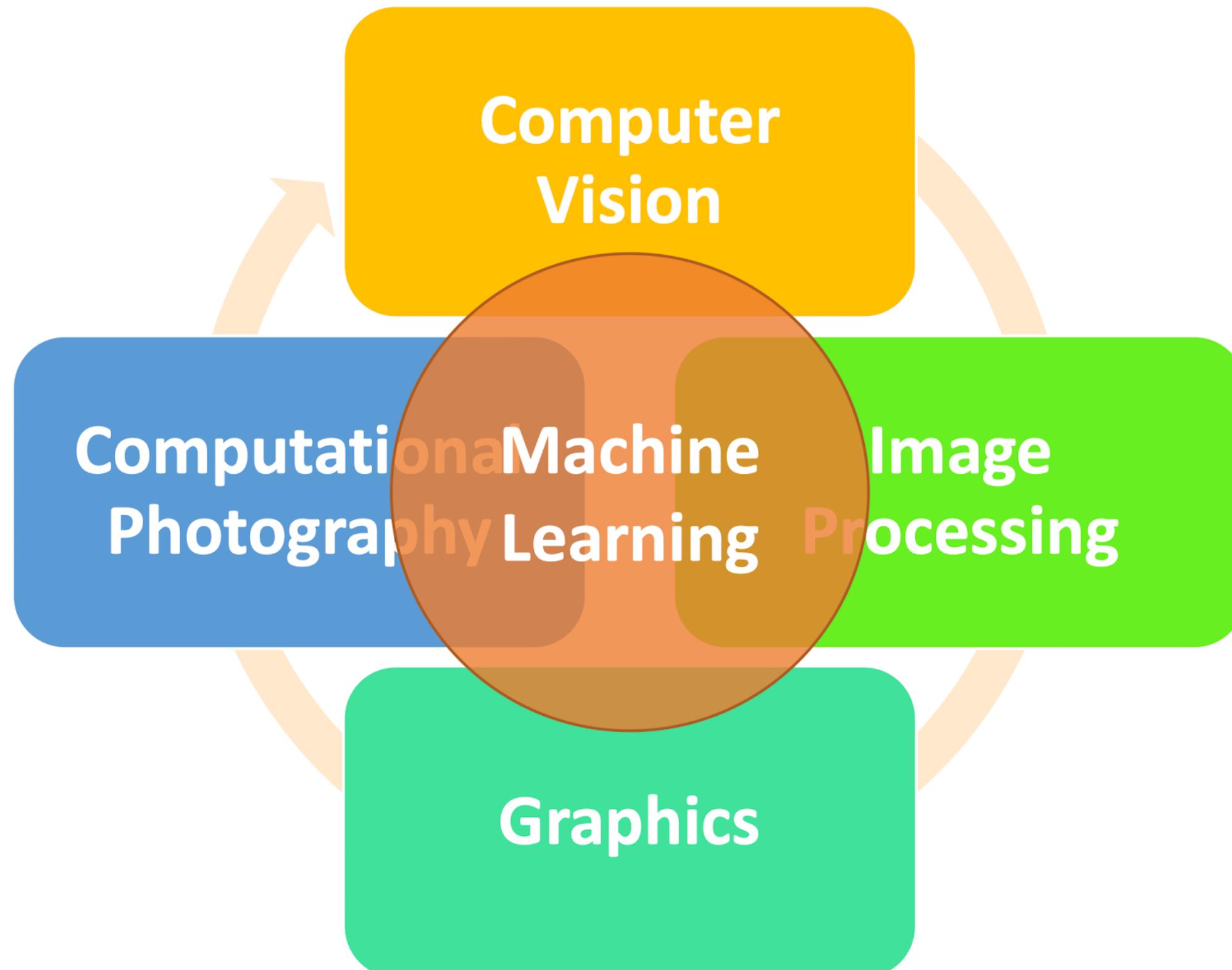
# AI intro.

## AI / Machine Learning / Deep Learning



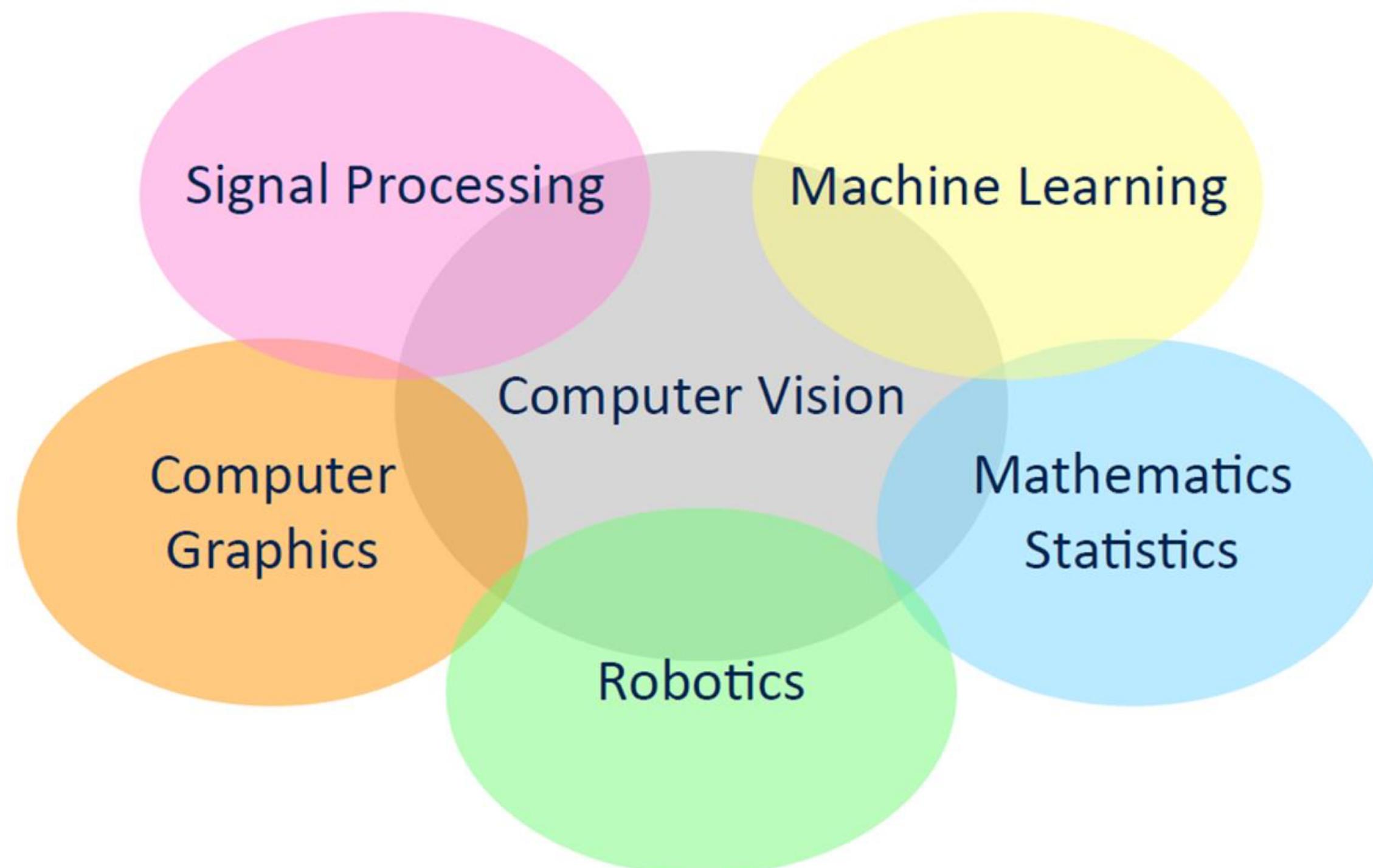
# AI intro.

## Computer Vision



# AI intro.

## Computer Vision



# AI intro.

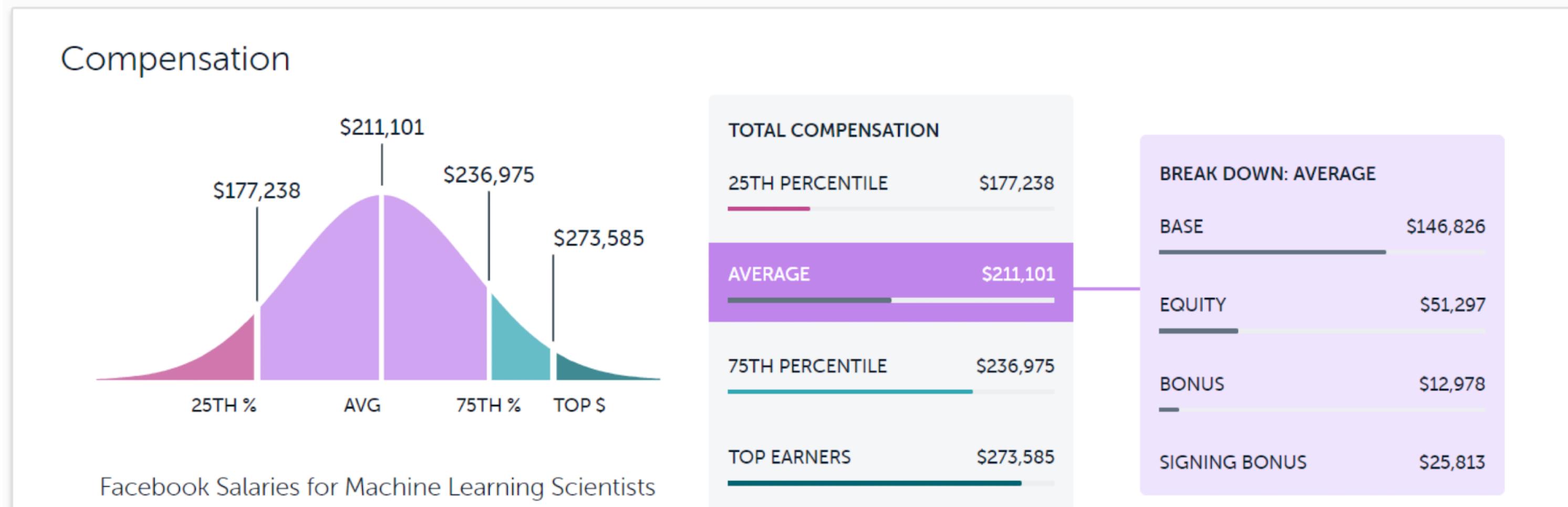
## Computer Vision

**Facebook Machine Learning Scientist Salaries**  
Data based on fewer than 20 profiles  
[f](#) [t](#) [in](#)

How much does a Facebook Machine Learning Scientist make?

A Machine Learning Scientist at Facebook earns an average of \$211,101, ranging from \$177,238 at the 25th percentile to \$236,975 at the 75th percentile, with top earners (the top 10%) earning more than \$273,585. Compensation is derived from fewer than 20 profiles, including base salary, equity and bonus.

COMPENSATION | COMPANIES | LOCATIONS | TALENT | JOBS | DIVERSITY

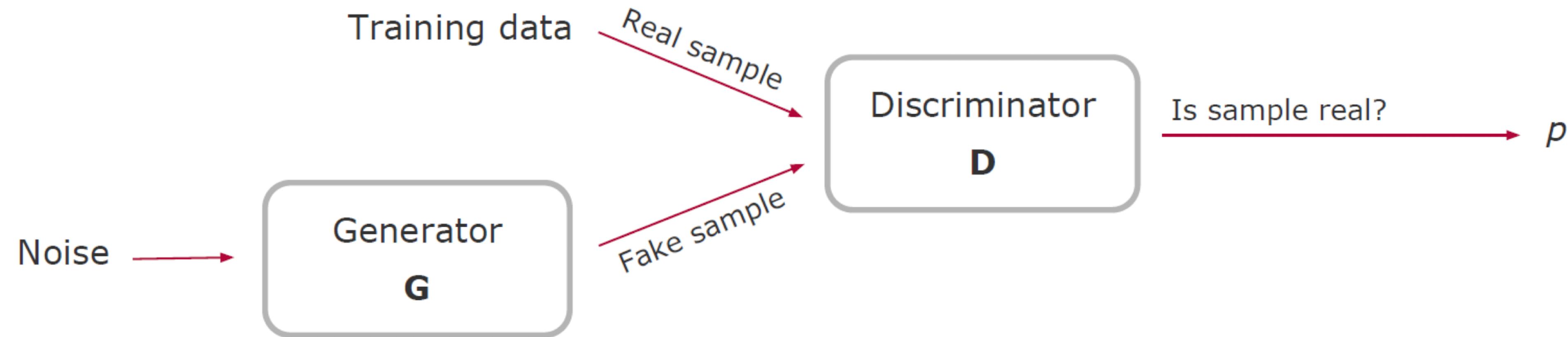


# GAN Outputs



# GAN

## Overview



# GAN

## Loss Function

- Discriminator

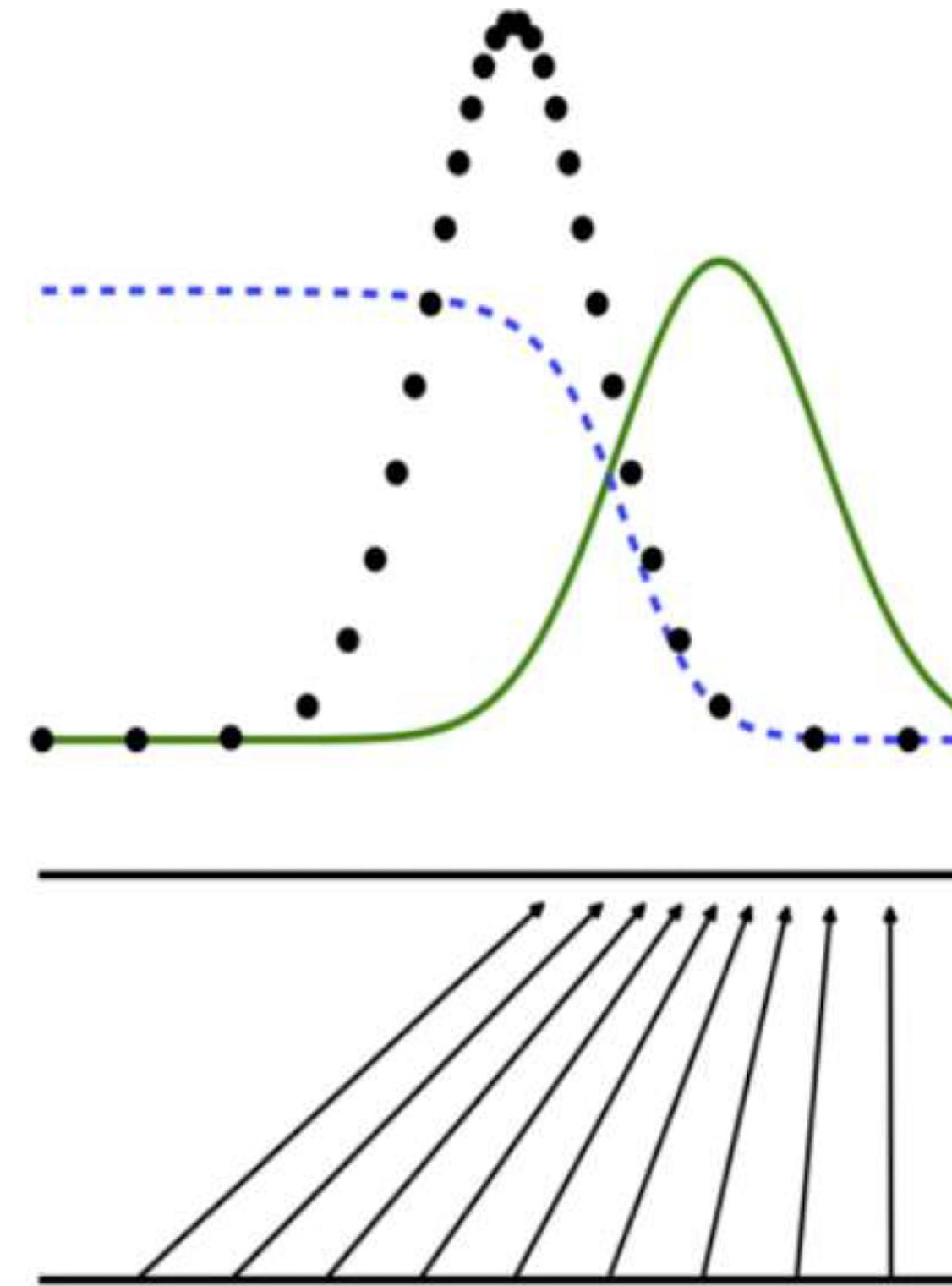
$$\max_D V(G, D) = E_{x \sim p_{data}}[\log D(x)] + E_{x \sim p_G}[\log(1 - D(x))]$$

- Generator

$$\min_G V(G, D) = E_{x \sim p_{data}}[\log D(x)] + E_{x \sim p_G}[\log(1 - D(x))]$$

# GAN

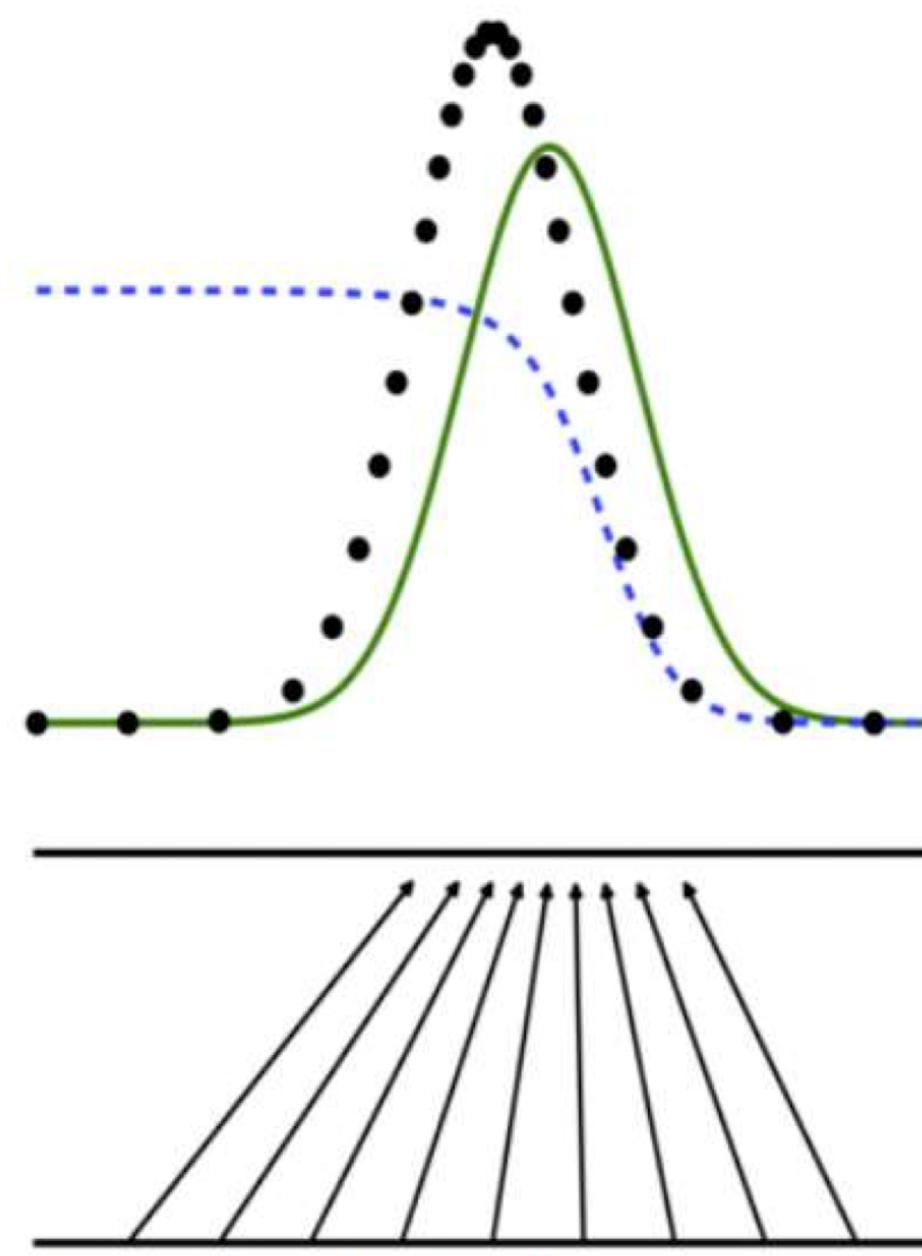
## Loss Function



D is trained to discriminate samples from data.

# GAN

## Loss Function

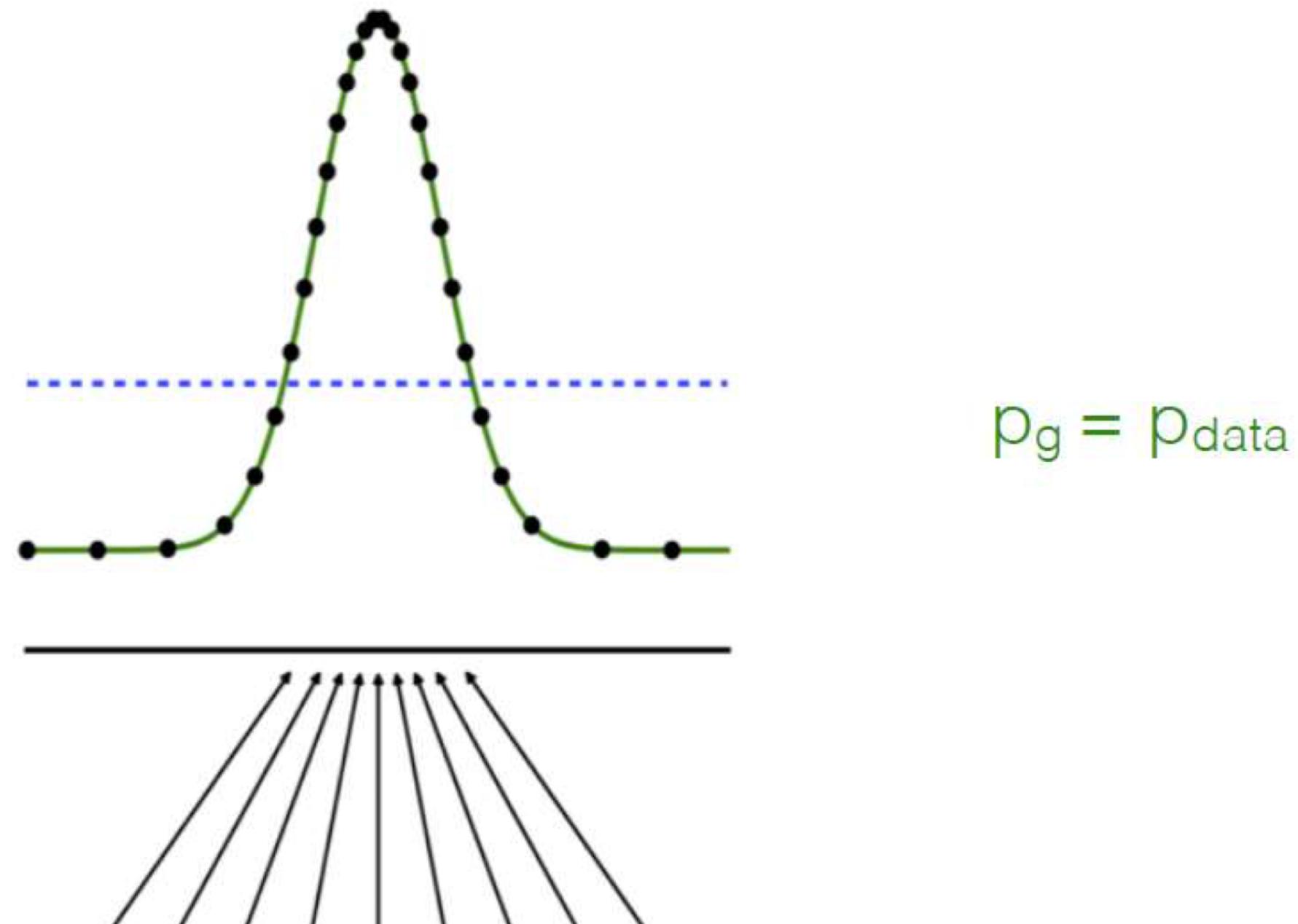


Gradients of  $\mathbf{D}$  guides  $\mathbf{G}(\mathbf{z})$  to flow to regions more likely to be classified as data.

# GAN

## Loss Function

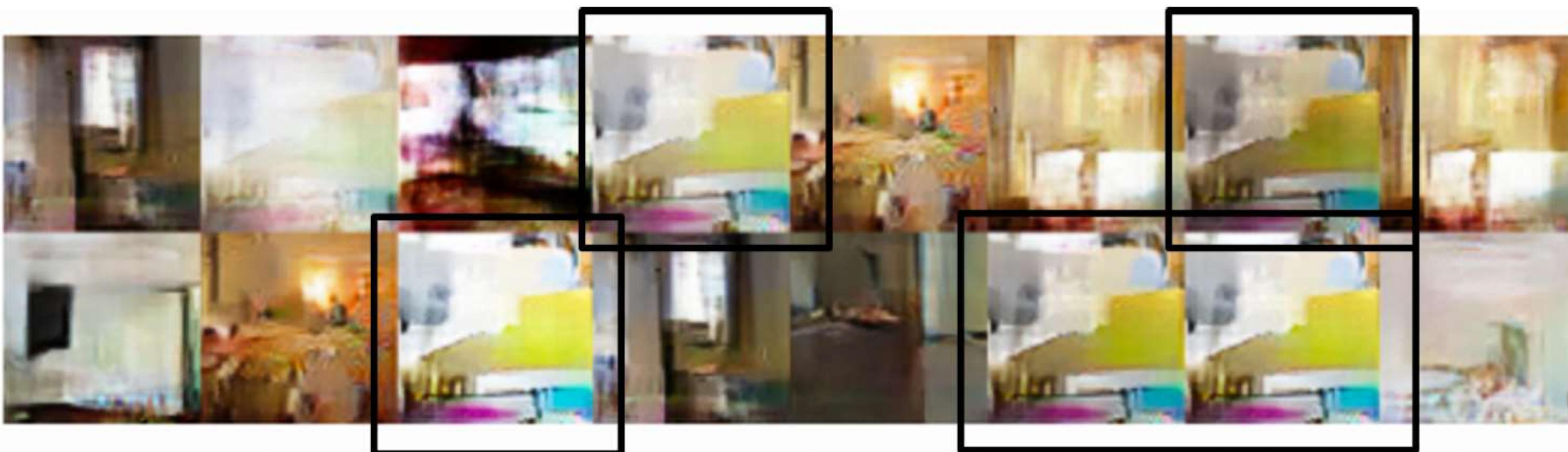
$$D(x) = 1/2$$



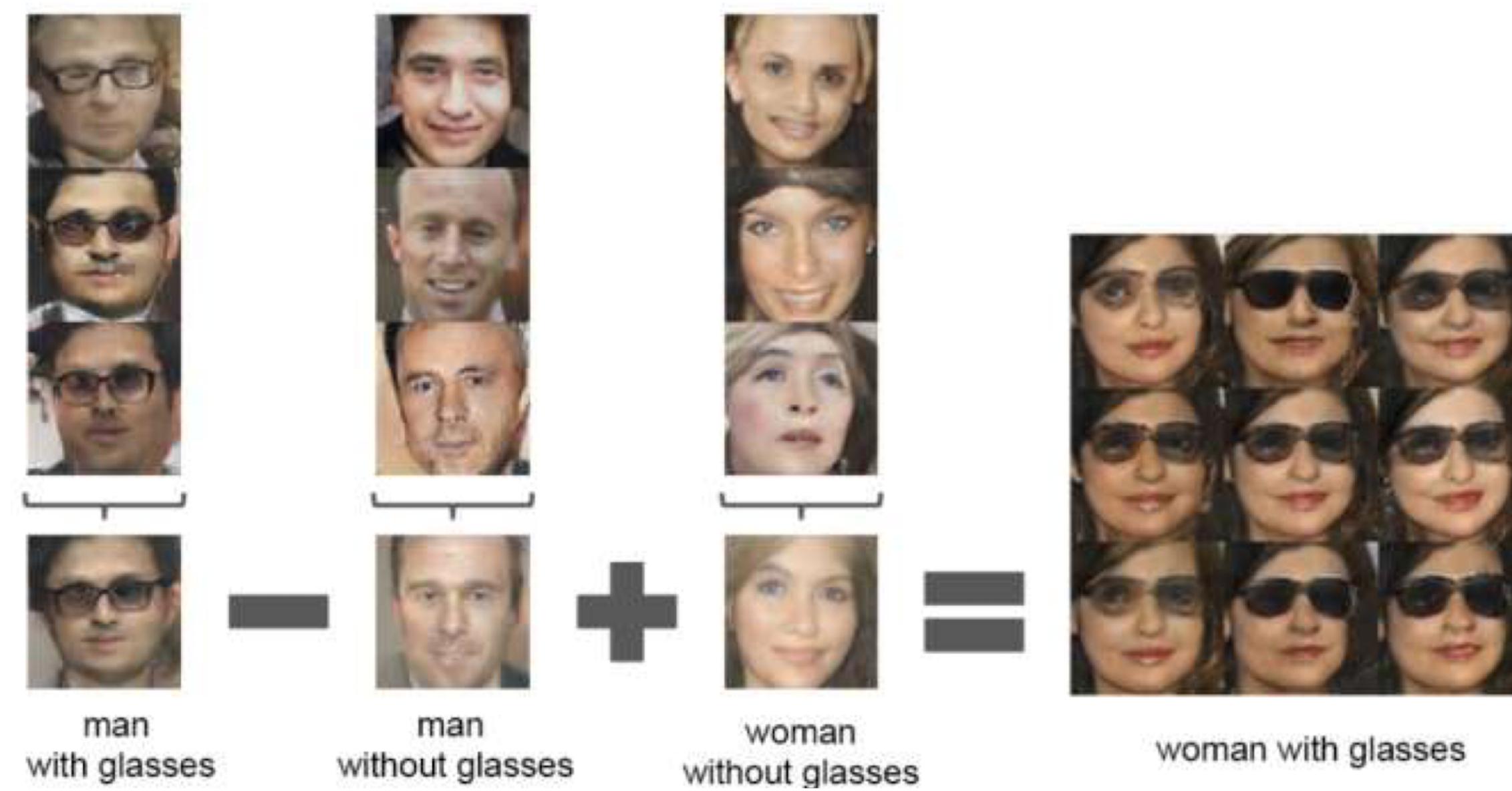
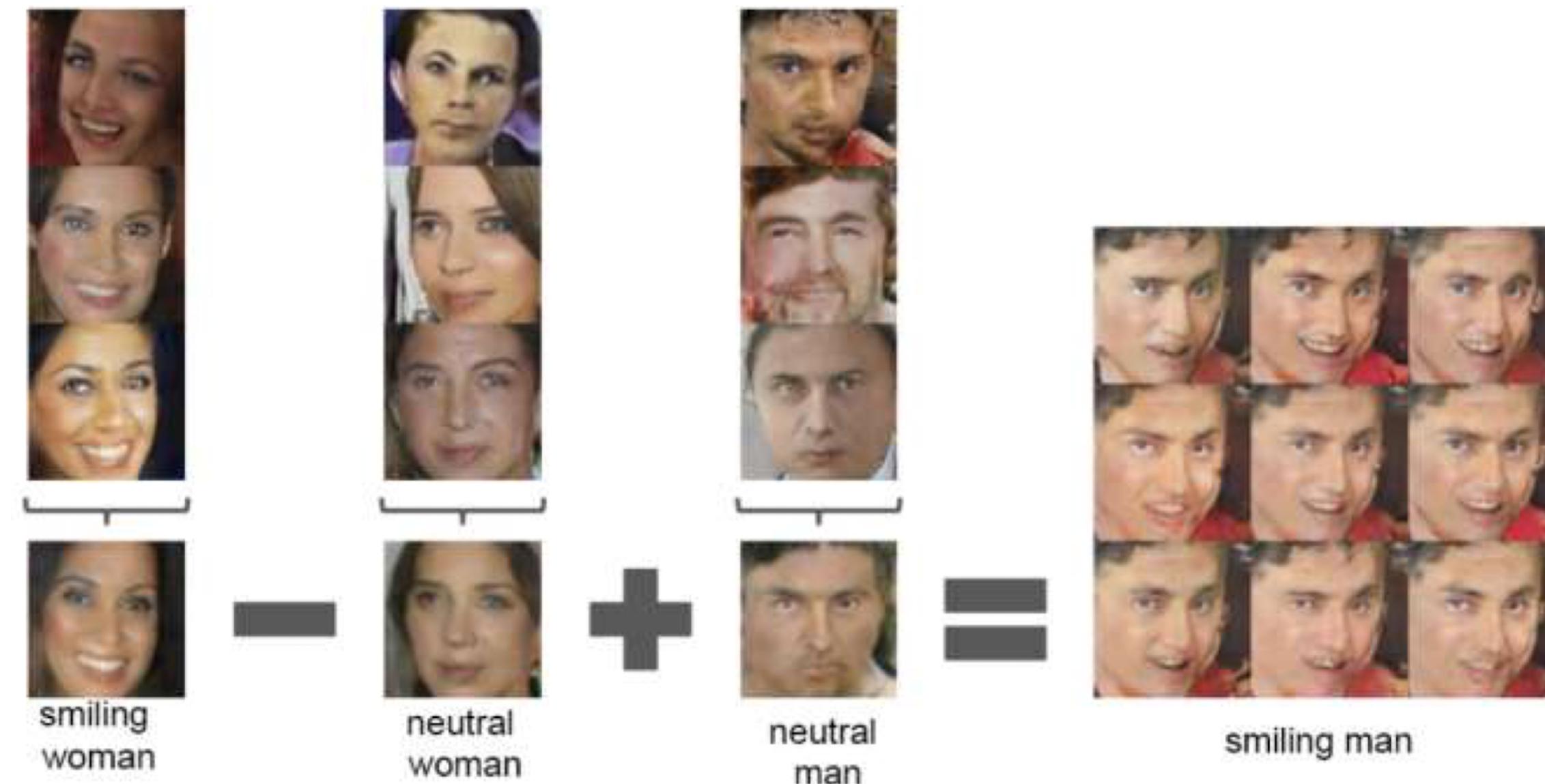
Goodfellow et al. 2014

# GAN

## Mode Collapse



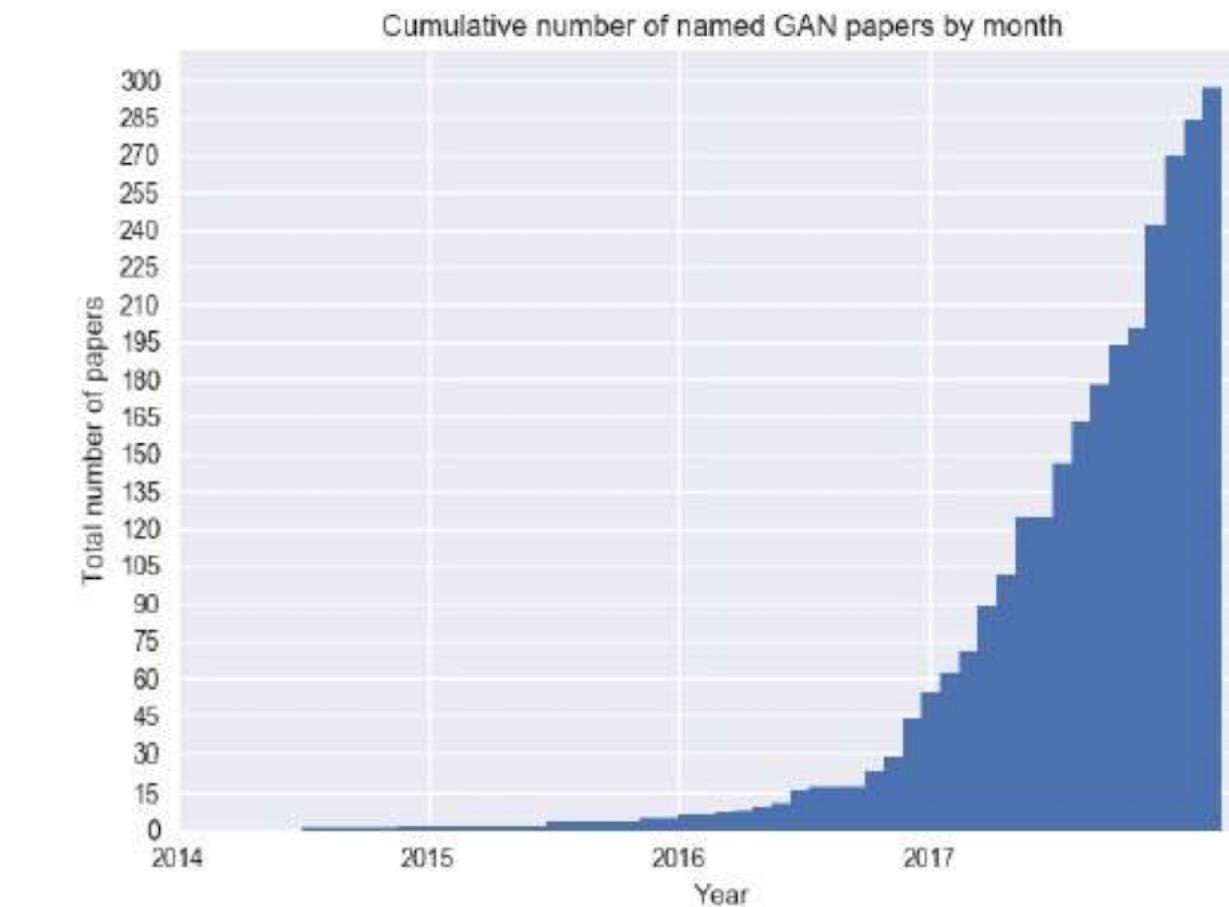
# GAN



# GAN



# GAN



# Color Space

## RGB vs Lab

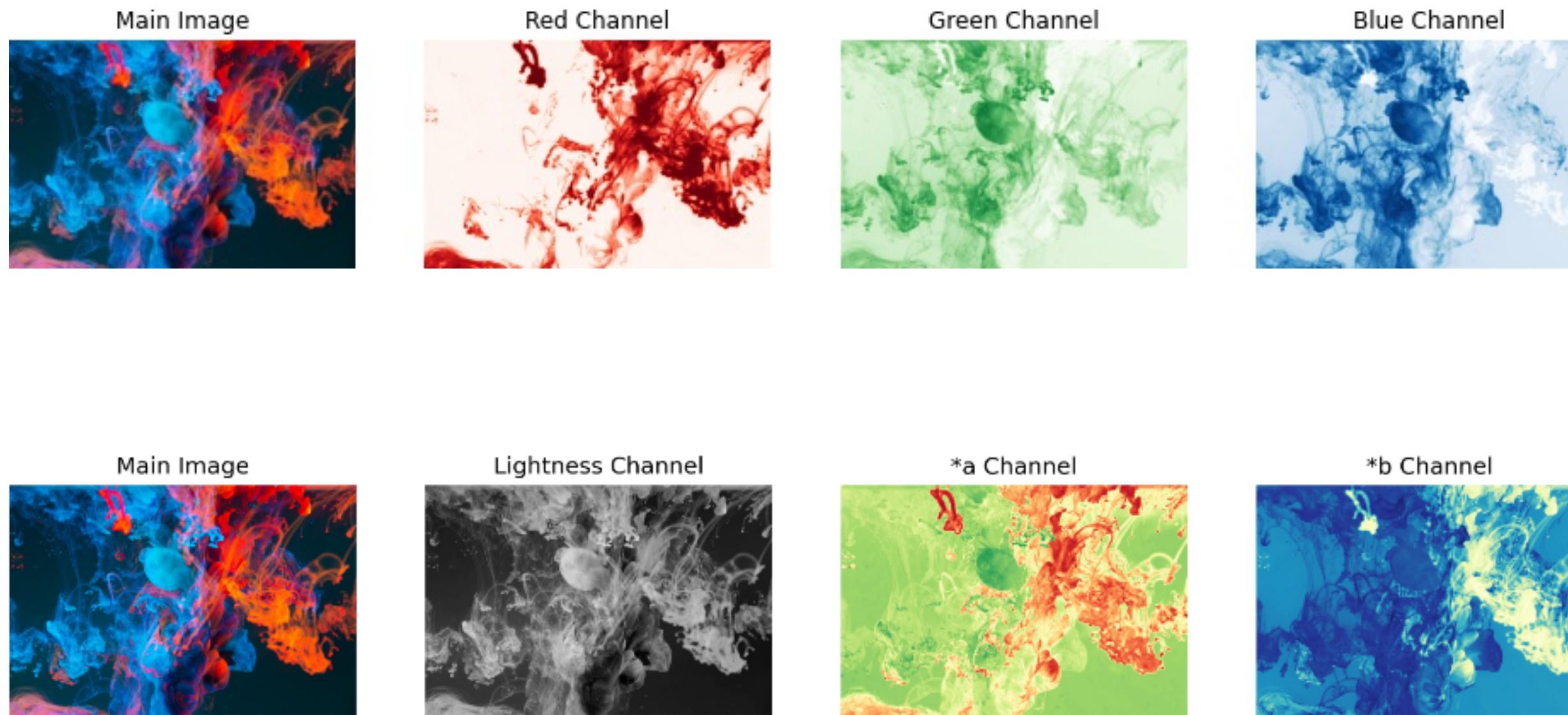


Figure 17. CIELAB color chart

