# CUAI cs231n 스터디

2022.04.02

발표자 : 조다영

# 스터디원 소개 및 만남 인증

스터디원 1 : 김소원

스터디원 2 : 배현규

스터디원 3 : 임현오

스터디원 4:  조다영

# 목차

1. cs231n 소개
2. 스터디 계획
3. 1~3강 내용 요약

# cs231n 소개

## Deep Learning for Computer Vision (Particularly image classification)

- 총 14주차

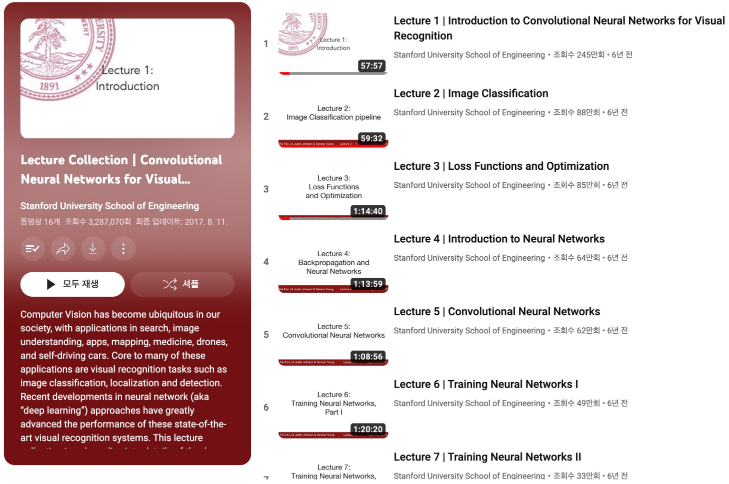
- 배우는 내용: Image classification, Loss functions, Optimization, CNN,
  RNN, Detection, Segmentation, Generative models,
  Deep reinforcement learning

- 과제 3회

| |
|---|
| Assignment #1: Image Classification, kNN, SVM, Softmax, Fully Connected Neural Network |
| Assignment #2: Fully Connected and Convolutional Nets, Batch Normalization, Dropout, Pytorch & Network Visualization |
| Assignment #3: Network Visualization, Image Captioning with RNNs and Transformers, Generative Adversarial Networks, Self-Supervised Contrastive Learning |

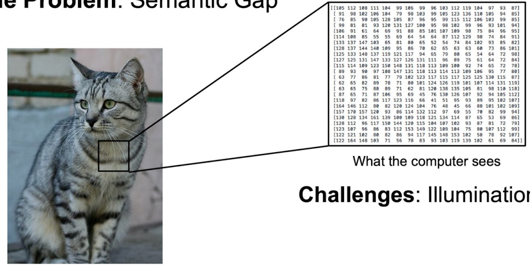
# 스터디 계획

- 시험기간 제외 매주 목요일 오후 4시 30분 대면으로 진행
- 2강씩 각자 수강해온 후 돌아가면서 내용 발표



# 1~3강 내용 요약

**The Problem**: Semantic Gap



This image by Nikita is licensed under CC-BY 2.0

What the computer sees

**Challenges**: Illumination

This image is CC0 1.0 public domain

This image is CC0 1.0 public domain

This image is CC0 1.0 public domain

**Challenges**: Deformation

This image by Umberto Salvagnin is licensed under CC-BY 2.0

This image by sare bear is licensed under CC-BY 2.0

This image by Tom Thai is licensed under CC-BY 2.0

**Challenges**: Background Clutter

This image is CC0 1.0 public domain

This image is CC0 1.0 public domain

**Challenges**: Occlusion

This image is CC0 1.0 public domain

This image is CC0 1.0 public domain

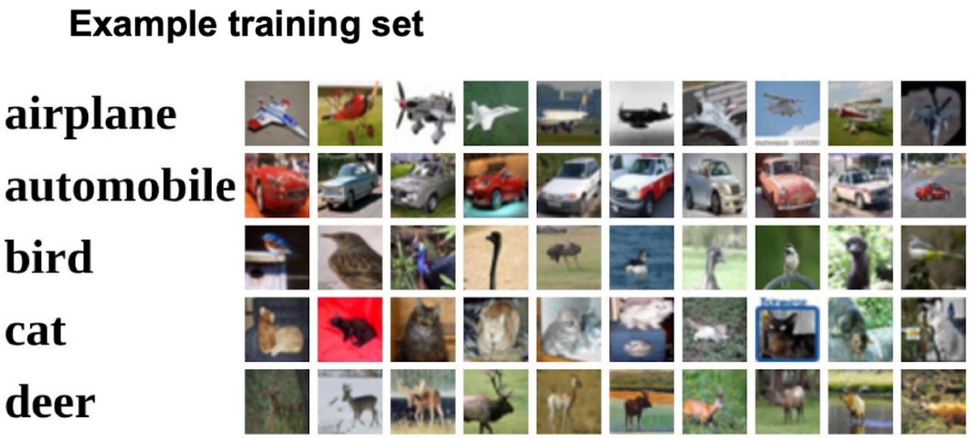
This image by jonsson is licensed under CC-BY 2.0

## Data-Driven Approach

## 1~3강 내용 요약

Data driven approach

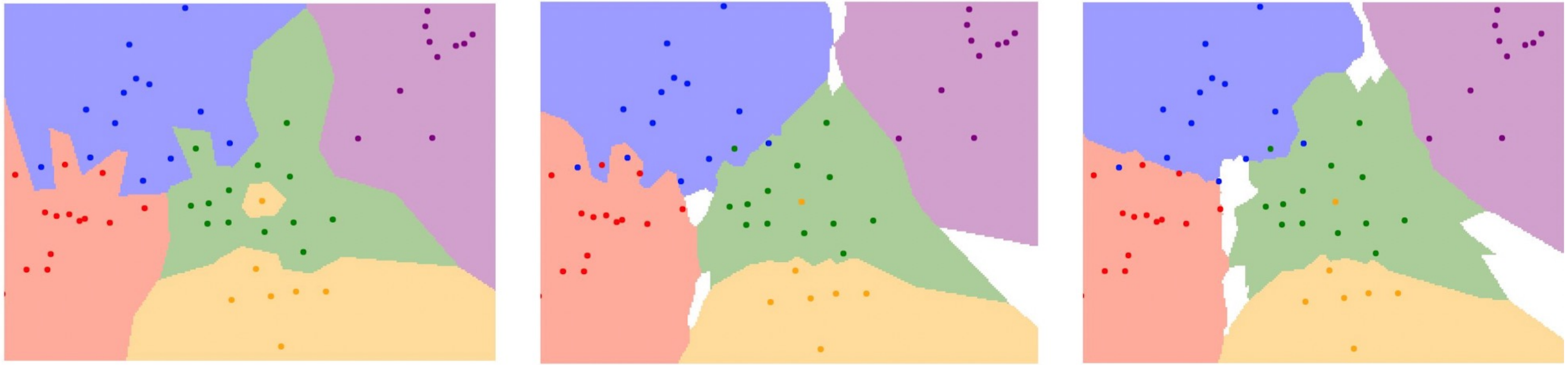
1) 라벨링된 이미지 데이터 수집
2) 머신러닝 모델 활용, 분류 학습
3) 새로운 이미지로 모델 평가



## 1~3강 내용 요약

# K-Nearest Neighbors

Instead of copying label from nearest neighbor,
take **majority vote** from K closest points



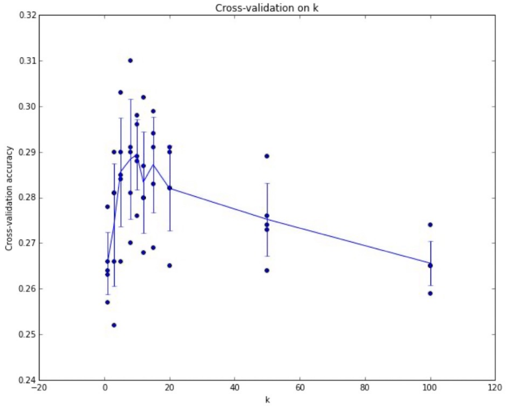
K = 1　　K = 3　　K = 5

# 1~3강 내용 요약

**Idea #4**: **Cross-Validation**: Split data into **folds**,
try each fold as validation and average the results

| | | | | | |
|---|---|---|---|---|---|
| fold 1 | fold 2 | fold 3 | fold 4 | fold 5 | test |
| fold 1 | fold 2 | fold 3 | fold 4 | fold 5 | test |
| fold 1 | fold 2 | fold 3 | fold 4 | fold 5 | test |

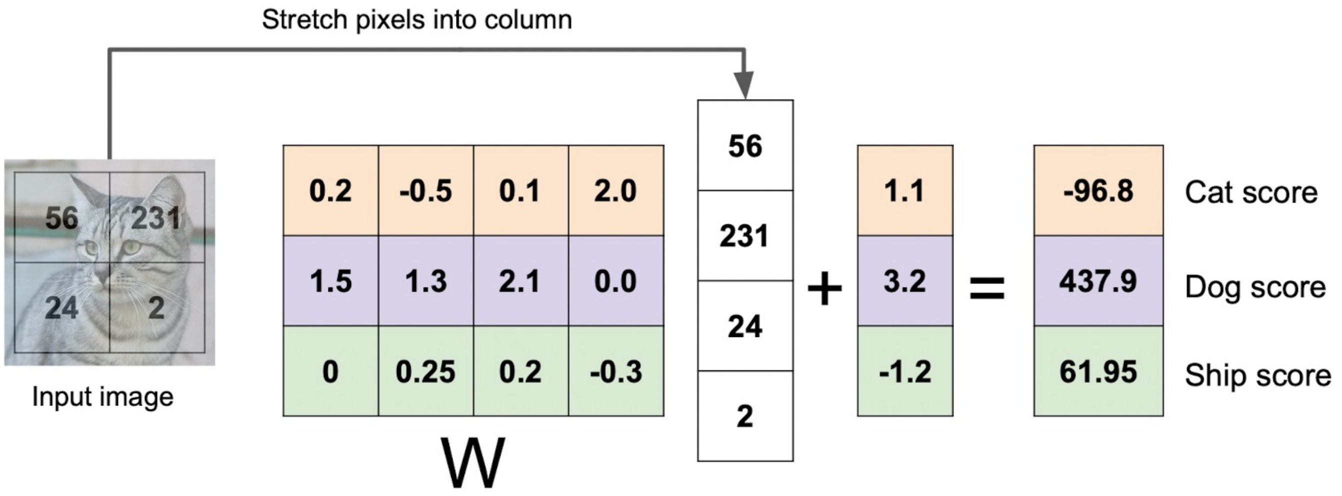
적잘한 파라미터 선택이 중요



## 1~3강 내용 요약

# Linear classification

Example with an image with 4 pixels, and 3 classes (cat/dog/ship)



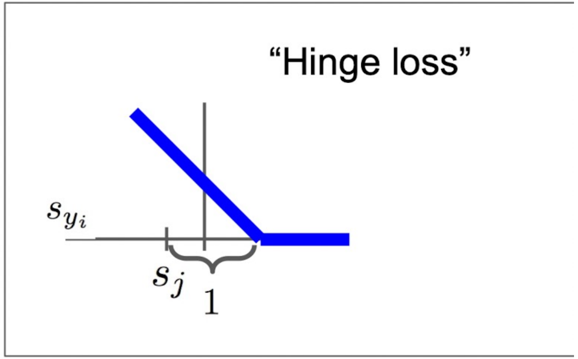
# 1~3강 내용 요약

## Loss function - SVM loss

Suppose: 3 training examples, 3 classes.
With some W the scores $f(x, W) = Wx$ are:

| | | | |
|---|---|---|---|
| cat | **3.2** | 1.3 | 2.2 |
| car | 5.1 | **4.9** | 2.5 |
| frog | -1.7 | 2.0 | **-3.1** |

**Multiclass SVM loss:**




$$L_i = \sum_{j \neq y_i} \begin{cases} 0 & \text{if } s_{y_i} \geq s_j + 1 \\ s_j - s_{y_i} + 1 & \text{otherwise} \end{cases}$$

$$= \sum_{j \neq y_i} \max(0, s_j - s_{y_i} + 1)$$

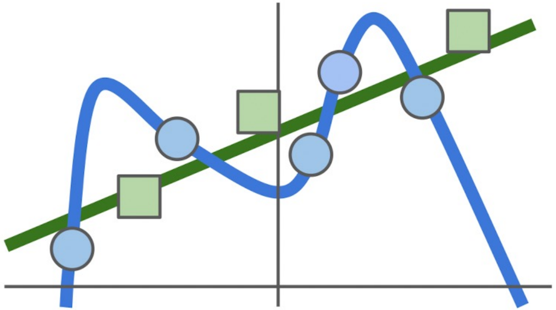
# 1~3강 내용 요약

## Regularization

$$L(W) = \underbrace{\frac{1}{N}\sum_{i=1}^{N} L_i(f(x_i, W), y_i)}_{\text{Data loss}} + \underbrace{\lambda R(W)}_{\text{Regularization}}$$

**Data loss**: Model predictions should match training data

**Regularization**: Model should be "simple", so it works on test data



# 1~3강 내용 요약

**Softmax Classifier** (Multinomial Logistic Regression)

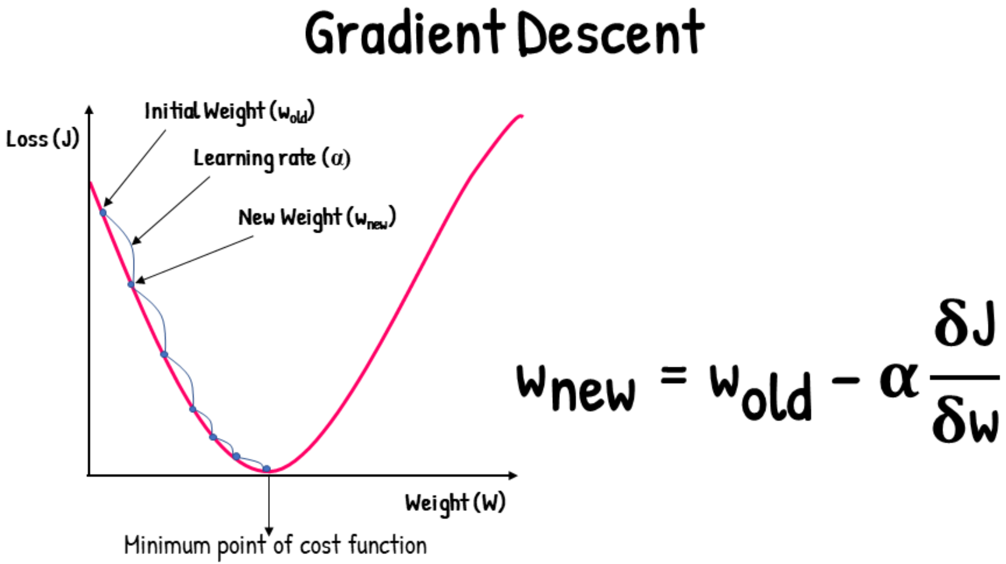
$$L_i = -\log\left(\frac{e^{s_{y_i}}}{\sum_j e^{s_j}}\right)$$

| | unnormalized log probabilities | $\xrightarrow{\text{exp}}$ unnormalized probabilities | $\xrightarrow{\text{normalize}}$ probabilities |
|---|---|---|---|
| cat | **3.2** | **24.5** | **0.13** |
| car | 5.1 | 164.0 | 0.87 |
| frog | -1.7 | 0.18 | 0.00 |

→ L_i = -log(0.13)
= **0.89**

# 1~3강 내용 요약

## Optimization - Gradient Descent



# 1~3강 내용 요약

## Optimization - Stochastic Gradient Descent

### Stochastic Gradient Descent (SGD)

$$L(W) = \frac{1}{N} \sum_{i=1}^{N} L_i(x_i, y_i, W) + \lambda R(W)$$

$$\nabla_W L(W) = \frac{1}{N} \sum_{i=1}^{N} \nabla_W L_i(x_i, y_i, W) + \lambda \nabla_W R(W)$$

Full sum expensive
when N is large!

Approximate sum
using a **minibatch** of
examples
32 / 64 / 128 common