



Park Kibum (Polar)

AlexNet (2012)

ImageNet Classification with Deep Convolution Neural Networks



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AlexNet

Background

논문 선정 배경 및 간단한 모델 소개



01 Background

ImageNet Classification with Deep Convolutional Neural Networks

Alex Krizhevsky
University of Toronto
kriz@cs.utoronto.ca

Ilya Sutskever
University of Toronto
ilya@cs.utoronto.ca

Geoffrey E. Hinton
University of Toronto
hinton@cs.utoronto.ca

Abstract

We trained a large, deep convolutional neural network to classify the 1.2 million high-resolution images in the ImageNet ILSVRC-2010 contest into the 1000 different classes. On the test data, we achieved top-1 and top-5 error rates of 37.5% and 17.0% which is considerably better than the previous state-of-the-art. The neural network, which has 60 million parameters and 650,000 neurons, consists of five convolutional layers, some of which are followed by max-pooling layers, and three fully-connected layers with a final 1000-way softmax. To make training faster, we used non-saturating neurons and a very efficient GPU implementation of the convolution operation. To reduce overfitting in the fully-connected layers we employed a recently-developed regularization method called “dropout” that proved to be very effective. We also entered a variant of this model in the ILSVRC-2012 competition and achieved a winning top-5 test error rate of 15.3%, compared to 26.2% achieved by the second-best entry.

01 Background

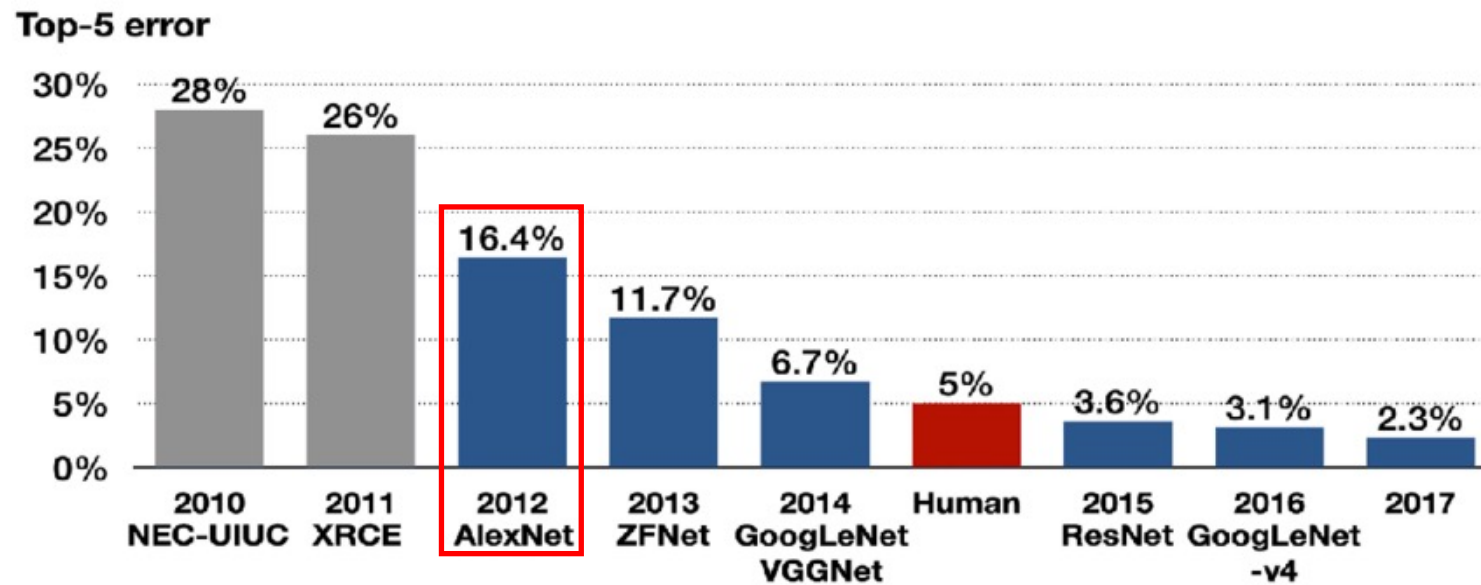


사진: Application of Deep Learning in Dentistry and Implantology



AlexNet

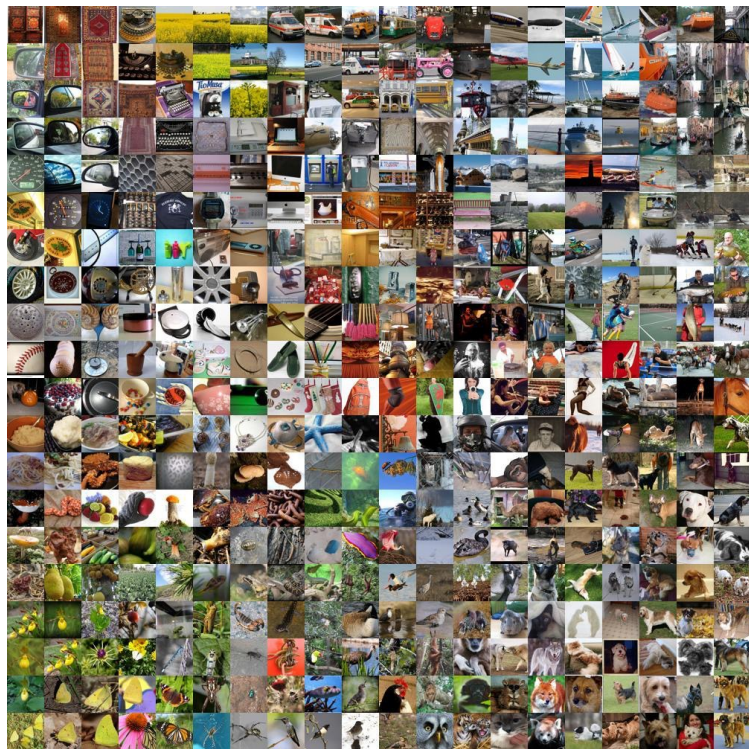
Introduction

논문의 문제제기와 핵심 포인트



02 Introduction

Problems



출처 : <https://cs.stanford.edu/people/karpathy/cnnembed/>

224 x 224 High resolution

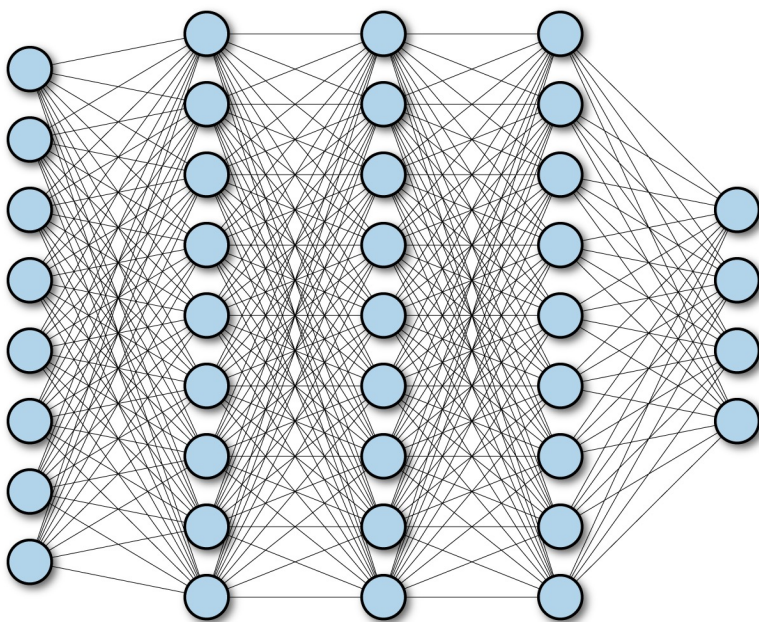
120만개 Train set

5만개 Valid set

15만개 Test set

02 Introduction

Problems



출처 : TensorFlow for Deep Learning by Bharath Ramsundar, Reza Bosagh Zadeh

Large Dataset

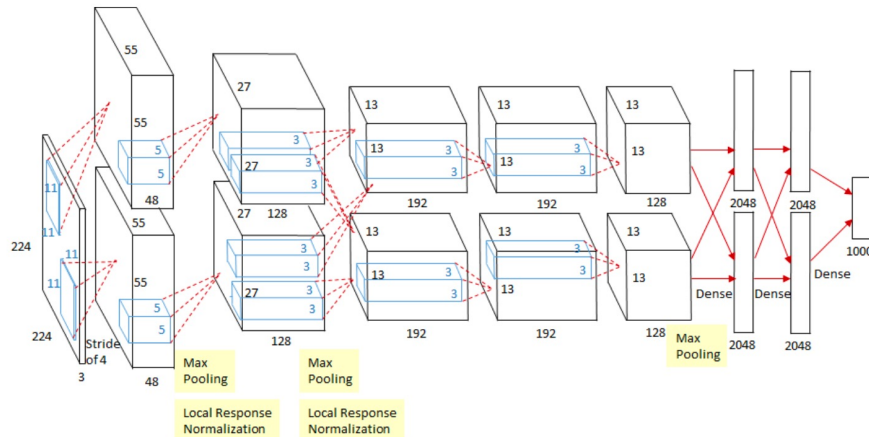


Large Model



Complexity ↑

02 Introduction

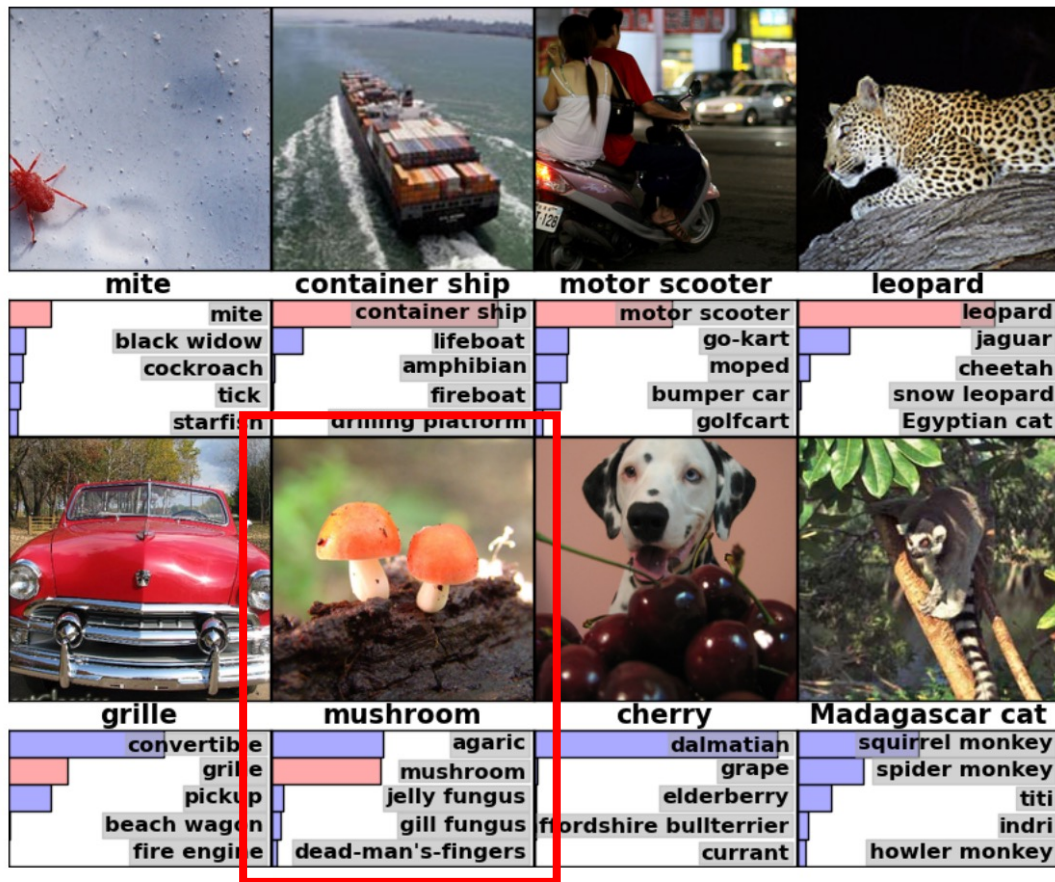


Points

1. 2012 ILSVRC Winner (16.4% Top-5 error)
2. 5 Conv Layers + 3 FC Layers
3. Training Faster
4. Reducing Overfitting

02 Introduction

Metrics (평가지표) : Top-n error rate (top-1, top-5 error)



모델의 카테고리 분류 결과 중
상위 n개에 정답 class가 있는지를 측정



AlexNet

AlexNet 구조

Faster Training / Reducing Overfitting



03 AlexNet 구조

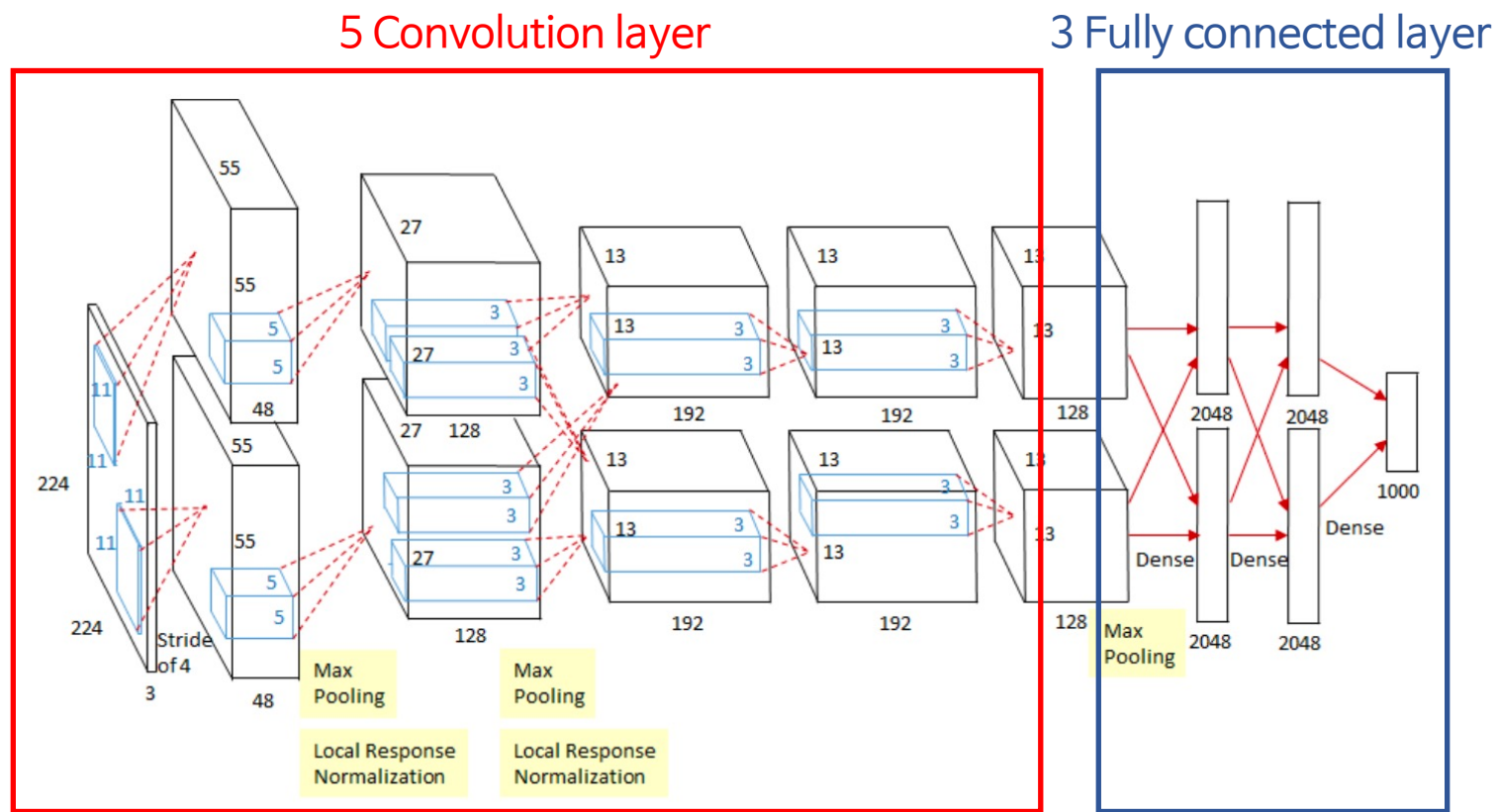
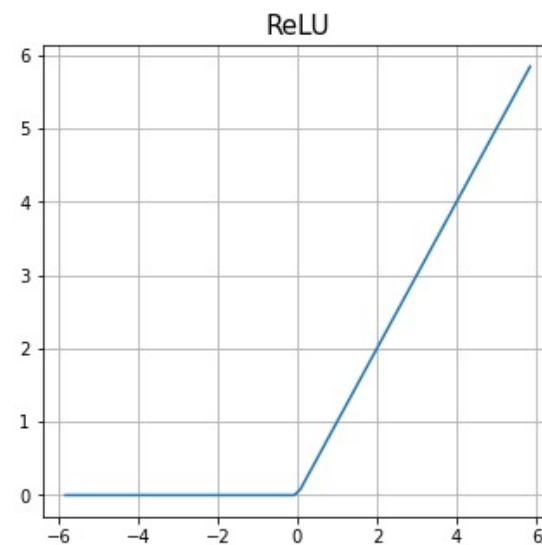
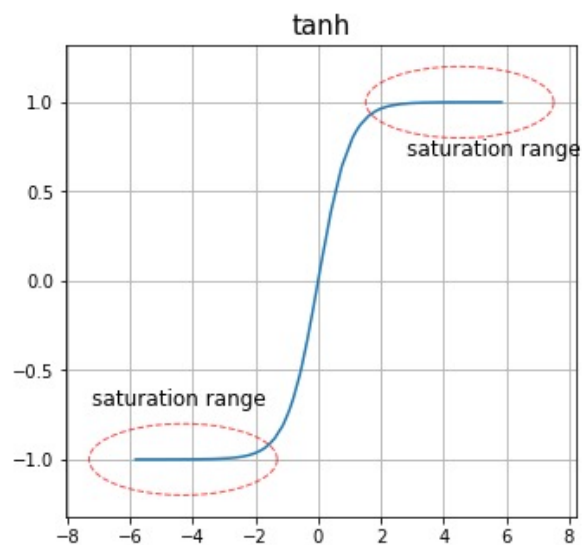
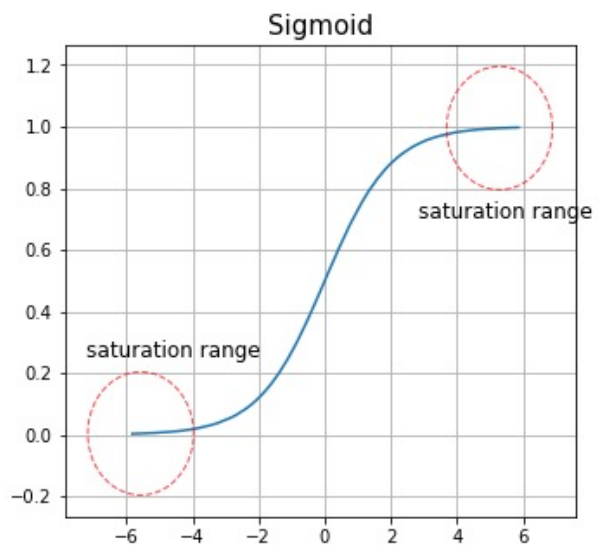


사진: Deep Learning's Most Important Ideas - A Brief Historical Review

03 AlexNet 구조

Training Faster : ReLU



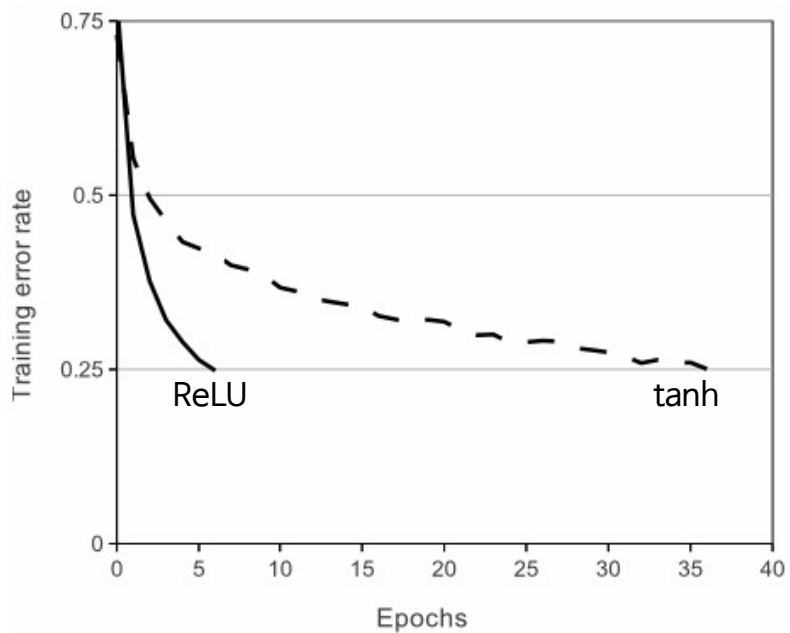
Saturated neuron Problem (포화 뉴런 문제)



ReLU

03 AlexNet 구조

Training Faster : ReLU

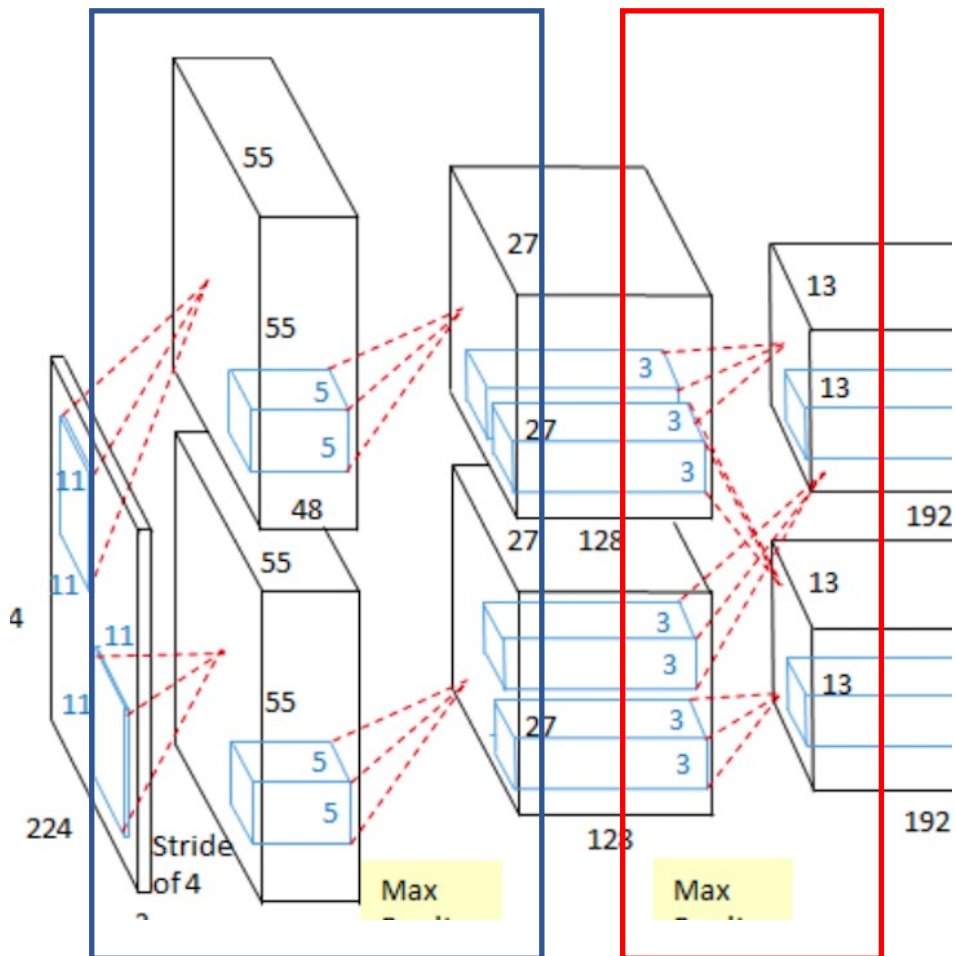


Rectified Linear Unit (ReLU) 사용

1. 그레이언트 소멸 문제의 부분적 해결책
2. $\tanh(x)$ 보다 더 빠른 loss 수렴속도

03 AlexNet 구조

Training Faster : GPU parallelization



당시 GPU 한계로 Multi GPU 학습

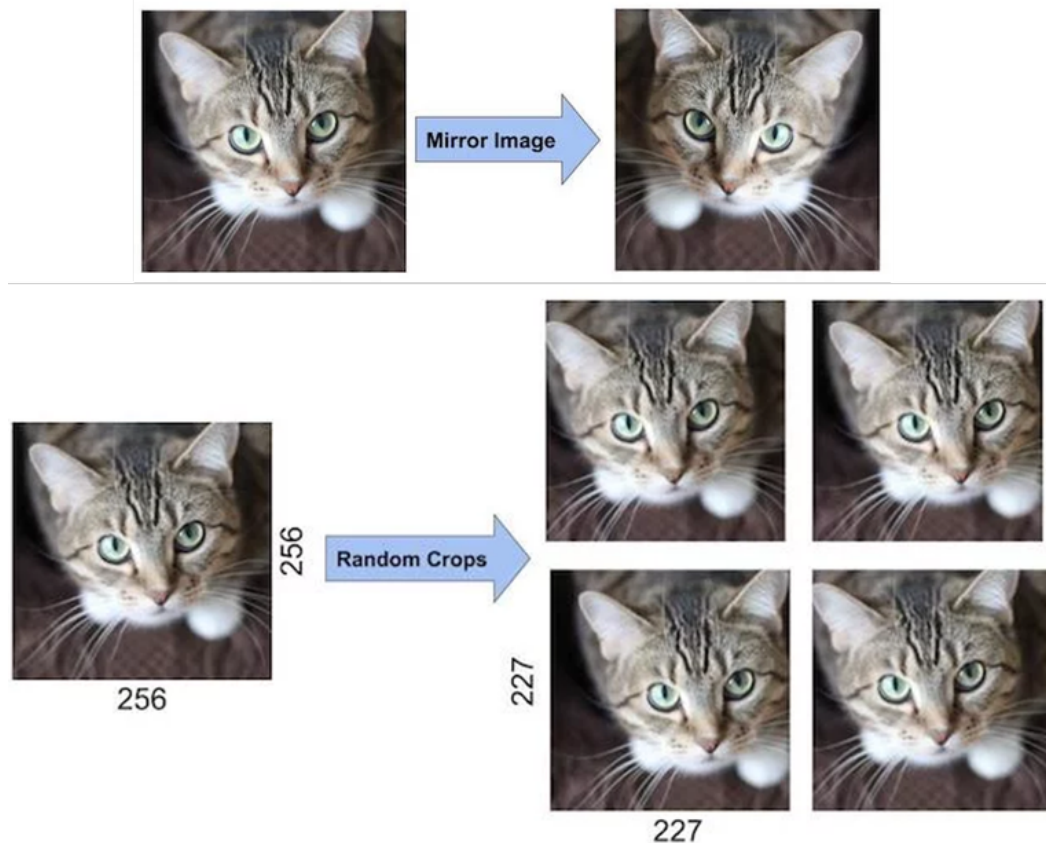
1. 전체 커널을 절반씩 나눠 각각 GPU에 할당
2. 3번째 Convolution layer에서 GPU 통합

Top-1 error 1.7% 감소

Top-5 error 1.2% 감소

03 AlexNet 구조

Reducing Overfitting : Data Augmentation



Overfitting 해결의 전통적인 방식

1. 256 x 256 이미지를 224 x 224로 crop
 1. 중앙, 좌상, 좌하, 우상, 우하 기준으로 총 5 종류의 crop
2. 모든 이미지를 horizontal reflection 수행

03 AlexNet 구조

Reducing Overfitting : Data Augmentation



출처 : <https://aparico.github.io>

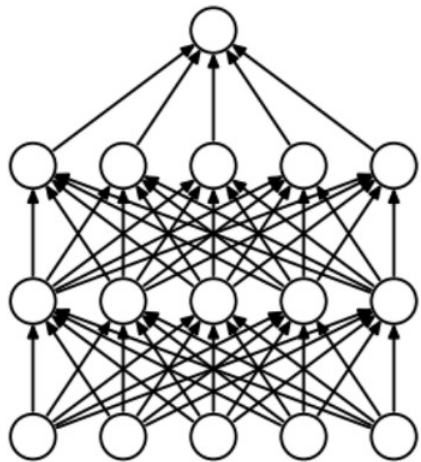
PCA color augmentation (Fancy PCA)

1. PCA로 RGB pixel의 eigen value 계산
2. $N(0, 0.1)$ 에서 추출한 변수와 eigen value의 곱을 RGB에 더해줌

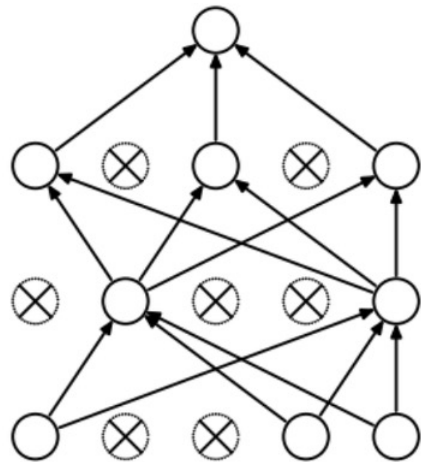
조명의 영향과 색의 intensity 변화에 대한 불변성

03 AlexNet 구조

Reducing Overfitting : Dropout



(a) Standard Neural Net



(b) After applying dropout.

앙상블 모델은 test error를 감소시키는 효과

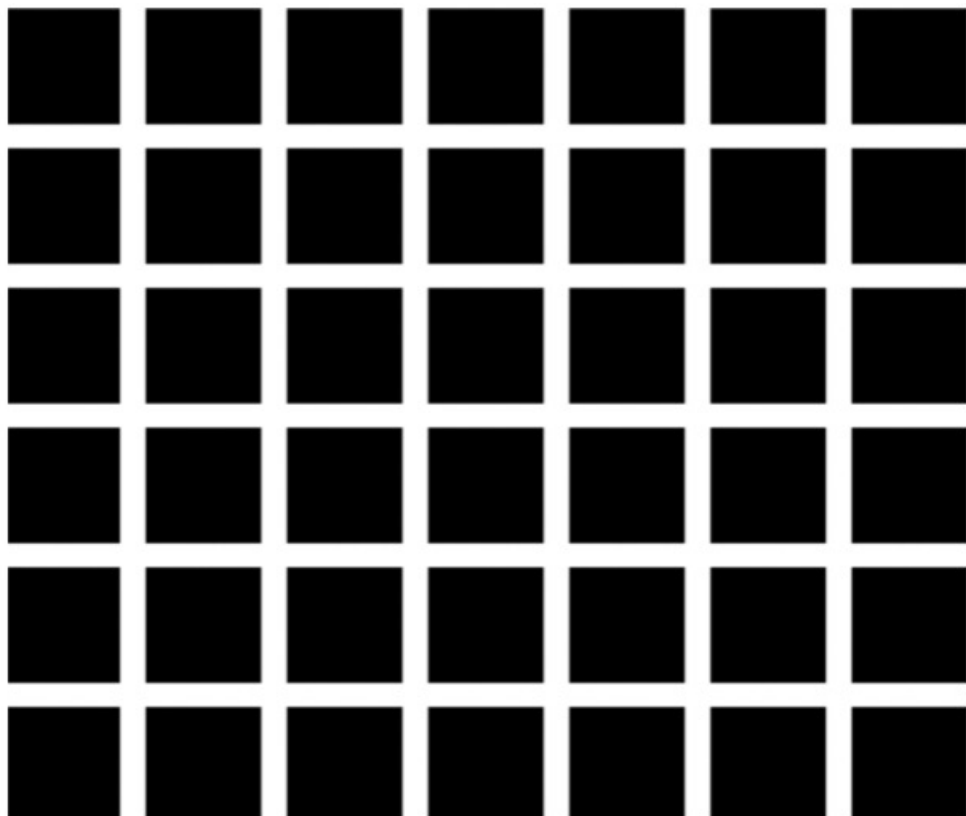
가중치는 공유, 신경망 구조는 변화

Neuron은 다른 neuron의 존재성에
영향을 받지 않음

Train에서만 사용, Test에서는 모든 뉴런 사용

03 AlexNet 구조

Local Response Normalization



Generalization을 위한 정규화

ReLU의 성질로 큰 값에 의해 주변 수 낮은 값의 정보를 방해하는 later inhibition 발생

LRN은 later inhibition을 방지하는 역할

Batch Normalization이 나오며 최근에는 잘 쓰지 않음



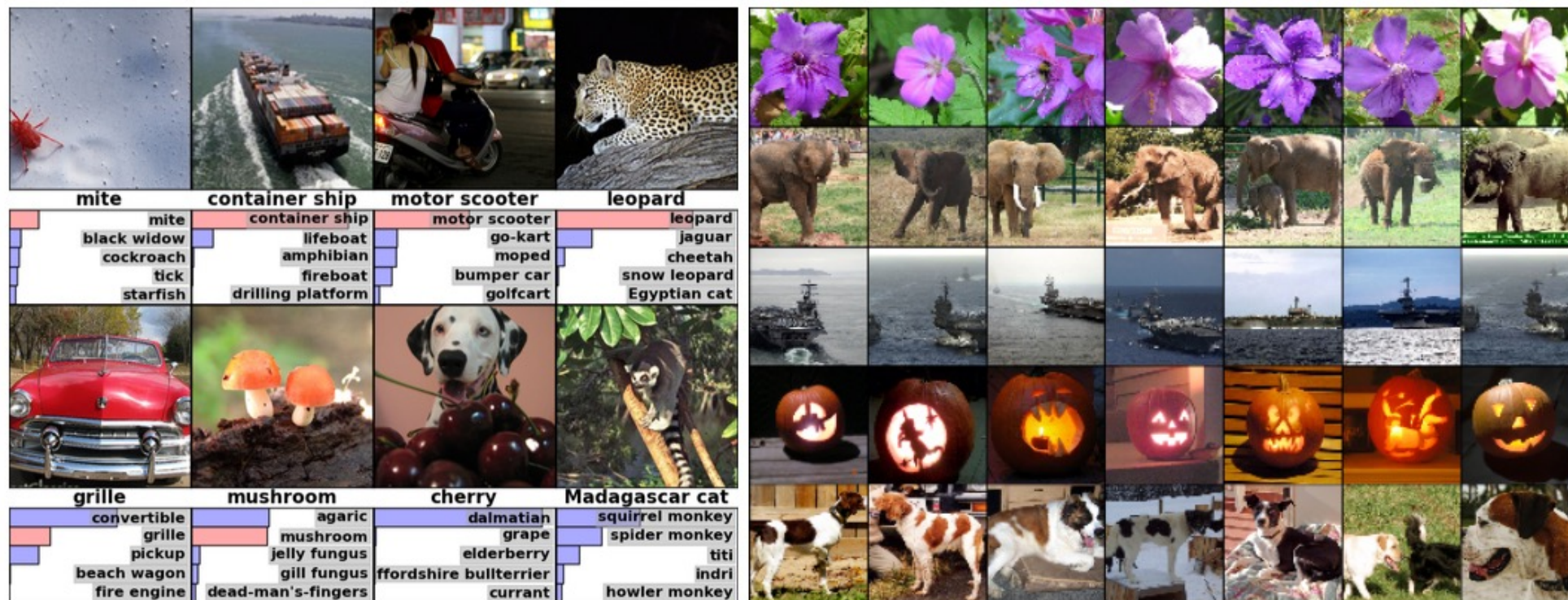
AlexNet

모델 결과 및 총평

결과분석 및 discussion



04 모델 결과 및 총평



1. ILSVRC-2012 top-5 error의 test error 16.4%로 우승
2. Top-5 class에 실제 답과 유사한 클래스들을 제시
3. Euclidean distance를 통해 거리가 짧을수록 유사하다고 판단
4. CNN 발전의 초석과 같은 역할



AlexNet

Reference



05 Reference

1. AlexNet 구조, <https://bskyvision.com/421>
2. LRN이란?, <https://taeguu.tistory.com/29>



AlexNet

THANK YOU





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Questions?

