

Image Classification and Segmentation



Sarah Binta Alam Shoilee

*Faculty of Engineering Science
Department of Computer Science
Master in Artificial Intelligence*

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Outline

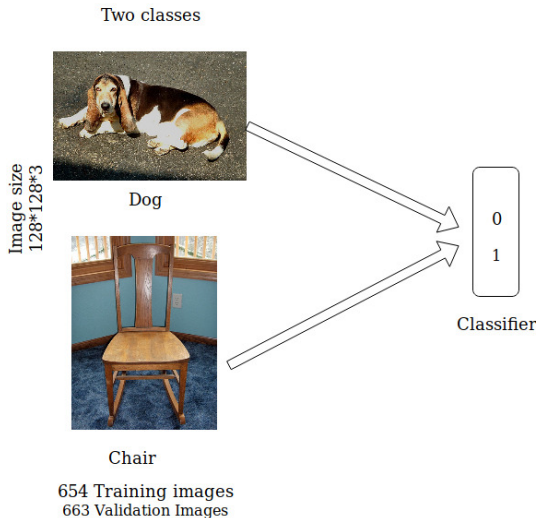
Introduction

AutoEncoder

Classifier

Segmentation

Data Set



AutoEncoder: Linear PCA

- Consider $x \in R^n$ and $z \in R^m$ with $m < n$ (dimensionality reduction)
- Encoder: $z = G(x)$
- Decoder: $x_{new} = F(z)$

Reconstruction Error

$$(\min)E = \frac{1}{N} * \sum_{i=0}^N (x_i - x_{newi})^2 \quad (1)$$

Principal component analysis: dimensionality reduction

- Decreasing the dimensionality of the given input space by mapping vectors $x \in R^n$ to $z \in R^m$ with $m < n$.
- A point x is mapped to z in the lower dimensional space by
$$z_j = u_j^T * x$$
- where u_j are the eigenvectors corresponding to the m largest eigenvalues and $z = [z_1, z_2, \dots, z_m]^T$

Principal component analysis: dimensionality reduction

- Given data x_i^N $i = 1$ with $x_i \in R^n$ (assumed zero mean)
- Find projected variables $w^T x_i$ with maximal variance

$$(max) E\{(w^T x)^2\} = w^T E\{xx^T\} w = w^T C w \quad (2)$$

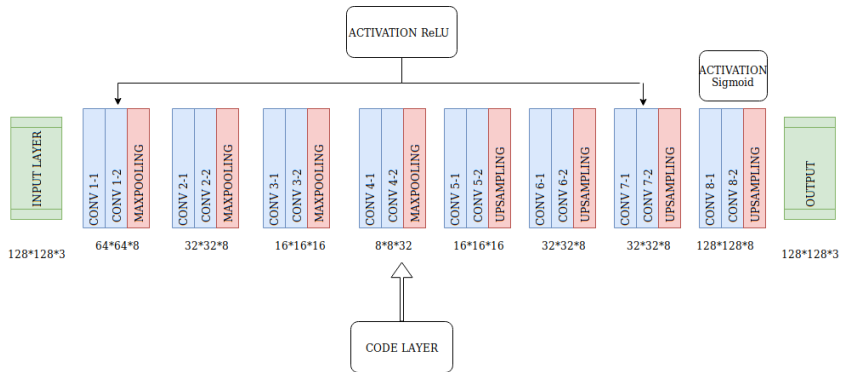
- where C is the covariance matrix

$$C \simeq \frac{1}{N} \sum_{i=1}^N x_i x_i^T \quad (3)$$

Encoder: Hyper Parameters

1. Approach 01:
 - 3 Blocks
 - one convolution layer and one Pooling layer;
 - # of Kernels: 16, 8, 8
2. Approach 02:
 - 2 Blocks
 - one convolution layer with batch normalization and one Pooling layer;
 - # of Kernels: 32, 32
3. Approach 03(Inspired from VGG-16):
 - 5 Blocks
 - more than one convolution layer with batch normalization and one Pooling layer;
 - # of Kernels: 64, 32, 16, 8, 8

The Architecture



- Loss Function: Mean Squared Error
- Optimizer: Adadelata
- Training: Epochs: 200
- Training Batch: 64
- Validation accuracy: 60.94%

Auto-encoder: Performance

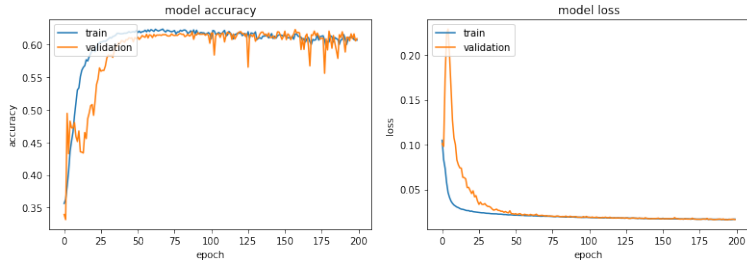
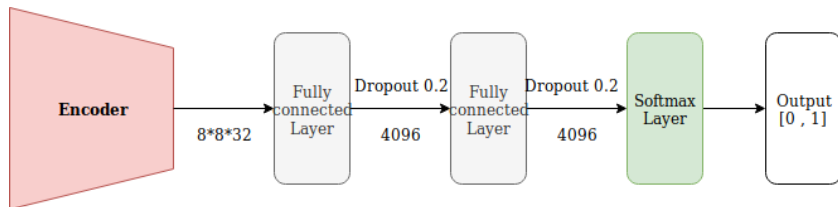


Figure: Performance measure of auto-encoder model



Classifier



- Loss Function: Catagorical Cross-entropy
- Optimizer: Adam
- Epoch: 100
- Batch size: 64

Performance

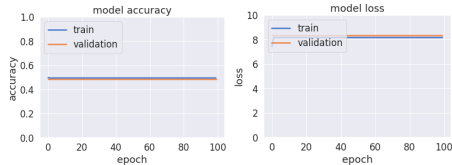


Figure: Performance measure of classifier using the trained weight of auto-encoder(acc 48.27%)

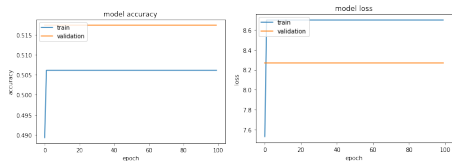
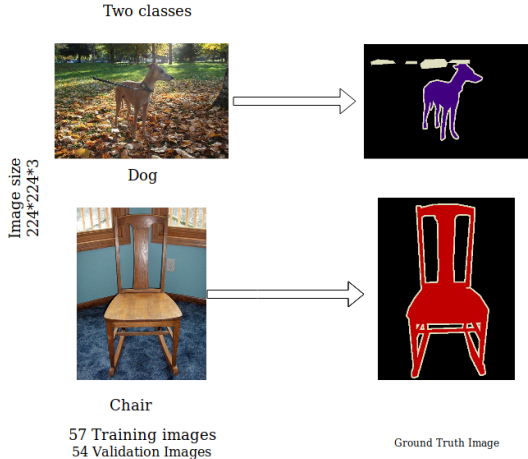
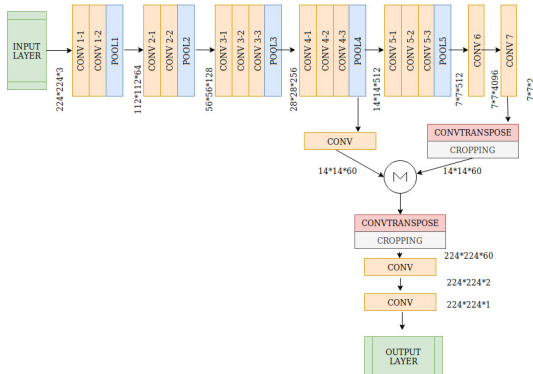


Figure: Performance measure of classifier from independent training(acc

Segmentation: Data Set



Segmentation



Performance

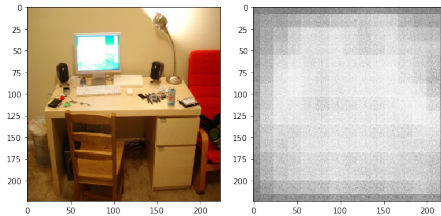


Figure: Original image and predicted segmentation



Figure: Validation dataset corresponding to it's mask

Computer Vision

Performance

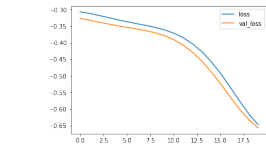


Figure: Performance plot of Segmentation model

C	TP	FP	FN	IoU
0	393661	52851	1992056	1.61
1	8114	237973	77779	0.025
2	176579	1840326	61315	0.085

Table: Performance Matrix

Questions.....