EECS 598-12 Deep Learning

HW3

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Q1. Text Classification using CNNs

1.

$Y_{n,f} = b_f + \sum_c X_{n,c} *_{filt} W_{f,c}^{conv}$

2.

The size of $\mathrm{Y_{n,f}}$ is $(1,1,\mathrm{H}-\mathrm{H}'+1)$.

3.

The size of the output of the pooling layer is $(\mathrm{N},\mathrm{F},1)$

4.

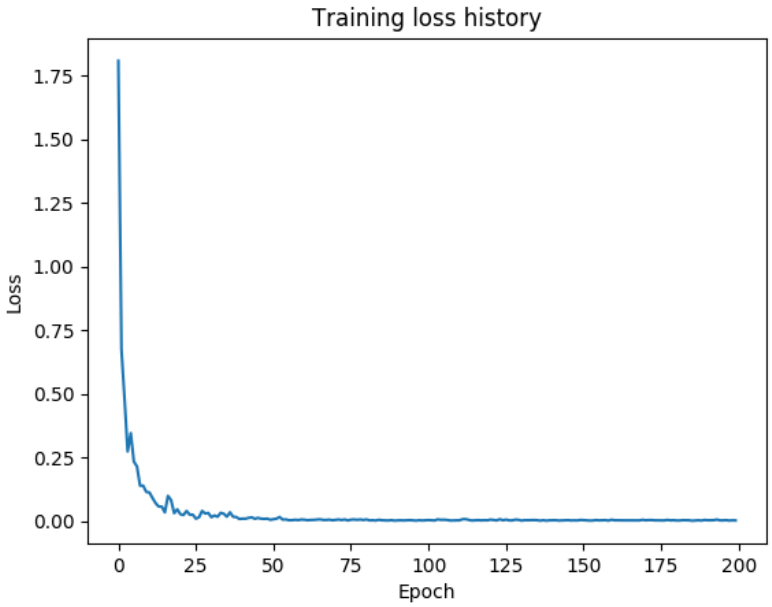
Use GloVe pre-trained embedding with "update_embedding" option opened during training, the accuracies under different settings are:

	Global average-pooling	Global max-pooling
Kernel size: 5	93.92%	95.87%
Kernel size: 7	91.82%	95.28%

Q2. Siamese Networks for Learning Embeddings

2.

1) Learning curve:



2) Results on training set:


train, dissimilarity:3.10


train, dissimilarity:2.80


train, dissimilarity:1.90


train, dissimilarity:1.84


train, dissimilarity:5.65


train, dissimilarity:3.93


train, dissimilarity:4.42


train, dissimilarity:4.05


train, dissimilarity:3.25


train, dissimilarity:1.99


train, dissimilarity:1.76


train, dissimilarity:2.45


train, dissimilarity:2.78


train, dissimilarity:3.85


train, dissimilarity:3.63


train, dissimilarity:2.46

3) Results on Testset

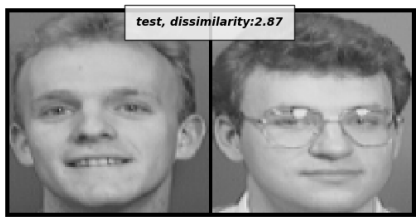

test, dissimilarity:2.68


test, dissimilarity:2.43


test, dissimilarity:2.88

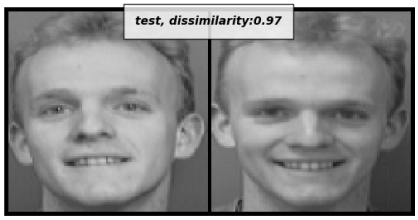

test, dissimilarity:0.00

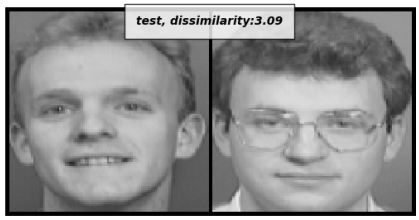

test, dissimilarity:1.01

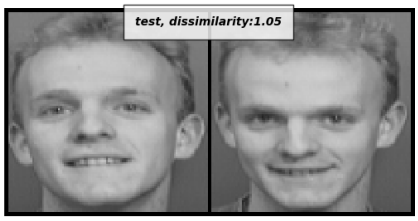

test, dissimilarity:2.87

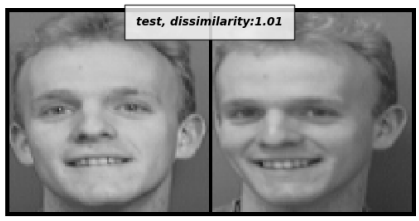

test, dissimilarity:2.09


test, dissimilarity:3.17


test, dissimilarity:0.97


test, dissimilarity:3.09


test, dissimilarity:1.05


test, dissimilarity:1.01


test, dissimilarity:2.10


test, dissimilarity:3.22

Q3. Conditional Variational Autoencoders

1.

$$\log p_\theta(x|y) = \int q_\phi(z|x,y) \log p_\theta(x|y)\, dz$$

$$= \int q_\phi(z|x,y) \log \frac{p_\theta(x,z|y)}{p_\theta(z|x,y)} dz$$

$$= \int q_\phi(z|x,y) \log \frac{p_\theta(x|y,z)p_\theta(z|y)}{p_\theta(z|x,y)} dz$$

$$= \int q_\phi(z|x,y)(-\log p_\theta(z|x,y) + \log p_\theta(x|y,z) + \log p_\theta(z|y))dz$$

$$= \int q_\phi(z|x,y)\big(-\log p_\theta(z|x,y) + \log q_\phi(z|x,y) + \log p_\theta(x|y,z) - \log q_\phi(z|x,y) + \log p_\theta(z|y)\big)dz$$

$$= KL(q_\phi(z|x,y)\|p_\theta(z|x,y)\big) - KL(q_\phi(z|x,y)\|p_\theta(z|y)\big) + \int q_\phi(z|x,y) \log p_\theta(x|y,z)\, dz$$

$$= KL(q_\phi(z|x,y)\|p_\theta(z|x,y)\big) - KL(q_\phi(z|x,y)\|p_\theta(z|y)\big) + \mathbb{E}_{q_\phi(z|x,y)}[\log p_\theta(x|y,z)]dz$$

$$\geq -KL(q_\phi(z|x,y)\|p_\theta(z|y)\big) + \mathbb{E}_{q_\phi(z|x,y)}[\log p_\theta(x|y,z)]dz$$

2.

Let J be the dimensionality of z. Let μ and σ denote the variational mean and s.d. evaluated at datapoint i, and let μ_j and σ_j simply denote the j-th element of these vectors. Then:

$$KL(q_\phi(z|x,y)\|p_\theta(z|y)\big) = \int q_\phi(z|x,y)\big(\log p_\theta(z|x,y) - \log q_\phi(z|x,y)\big)dz$$

$$= \int q_\phi(z|x,y) \log p_\theta(z|x,y) - \int q_\phi(z|x,y) \log q_\phi(z|x,y)$$

$$= \int \mathcal{N}(z;\mu,\sigma^2) \log \mathcal{N}(z;0,I)\, dz - \int \mathcal{N}(z;\mu,\sigma^2) \log \mathcal{N}(z;\mu,\sigma^2)\, dz$$

$$= -\frac{J}{2}\log(2\pi) - \frac{1}{2}\sum_{j=1}^{J}\big(\mu_j^2 + \sigma_j^2\big) + \frac{J}{2}\log(2\pi) + \frac{1}{2}\sum_{j=1}^{J}\big(1 + \log \sigma_j^2\big)$$

$$= \frac{1}{2}\sum_{j=1}^{J}\big(1 + \log \sigma_j^2 - \mu_j^2 - \sigma_j^2\big)$$

3. Generated images by CVAE.

Q4. Generative Adversarial Networks

Generated images by DCGAN: