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**Neural Network and deep learning course 2020/21**

**Homework 2**

**Introduction**

explain the homework goals and the main implementation strategies you choose,

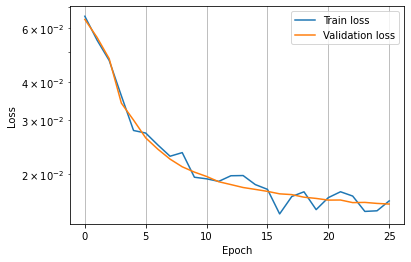
**Method**

describe your model architectures and hyperparameters

**Result**

present the simulation results.

* 1 pt: implement and test (convolutional) autoencoder, reporting the trend of reconstruction loss and some examples of image reconstruction
* 1 pt: explore advanced optimizers and regularization methods
* 1 pt: optimize hyperparameters using grid/random search and cross-validation
* 1 pt: implement and test denoising (convolutional) autoencoder
* 1 pt: fine-tune the (convolutional) autoencoder using a supervised classification task (you can compare classification accuracy and learning speed with results achieved in homework 1)
* 1 pt: explore the latent space structure (e.g., PCA, t-SNE) and generate new samples from latent codes
* 2 pt: implement variational (convolutional) autoencoder or GAN



Train Loss: 0.016

Val Loss: 0.016

Encoder(

(encoder\_cnn): Sequential(

(0): Conv2d(1, 8, kernel\_size=(3, 3), stride=(2, 2), padding=(1, 1))

(1): ReLU(inplace=True)

(2): Dropout2d(p=0, inplace=False)

(3): Conv2d(8, 16, kernel\_size=(3, 3), stride=(2, 2), padding=(1, 1))

(4): ReLU(inplace=True)

(5): Dropout2d(p=0, inplace=False)

(6): Conv2d(16, 32, kernel\_size=(3, 3), stride=(2, 2))

(7): ReLU(inplace=True)

(8): Dropout2d(p=0, inplace=False)

)

(flatten): Flatten(start\_dim=1, end\_dim=-1)

(encoder\_lin): Sequential(

(0): Linear(in\_features=288, out\_features=64, bias=True)

(1): ReLU(inplace=True)

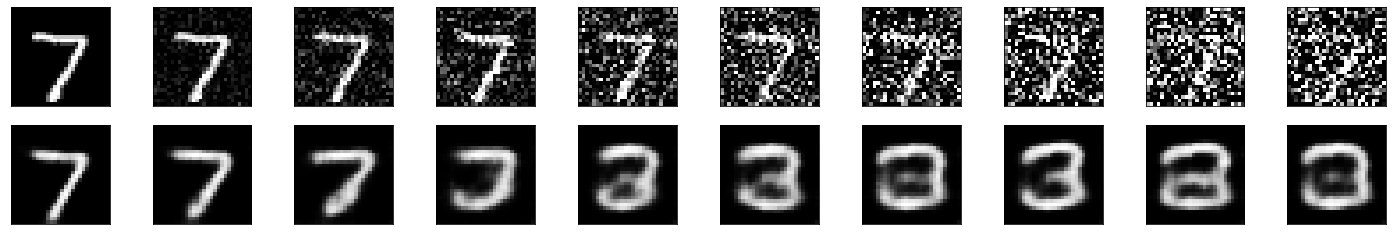
(2): Dropout(p=0, inplace=False)

(3): Linear(in\_features=64, out\_features=10, bias=True)

)

)

Normal autoencoder reconstruction:





VAE:



**Classification**

We added a fully connected layer composed of 10 neurons (one per class 0..9) on the encoder, then we freezed all layers except the last 2.

We obtained very good result without any fine tuning at the first training (96.9% test accuracy against the 98.5% of the previous homework). That means that unsupervised pre training is a powerful tool.

After some brief fine tuning we achieve the best results with learning rate =…..

Train Loss: 0.109

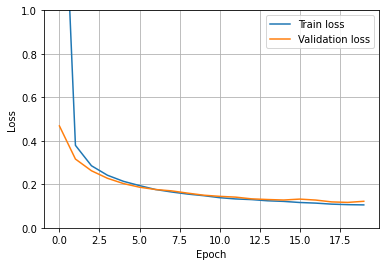
Val Loss: 0.121

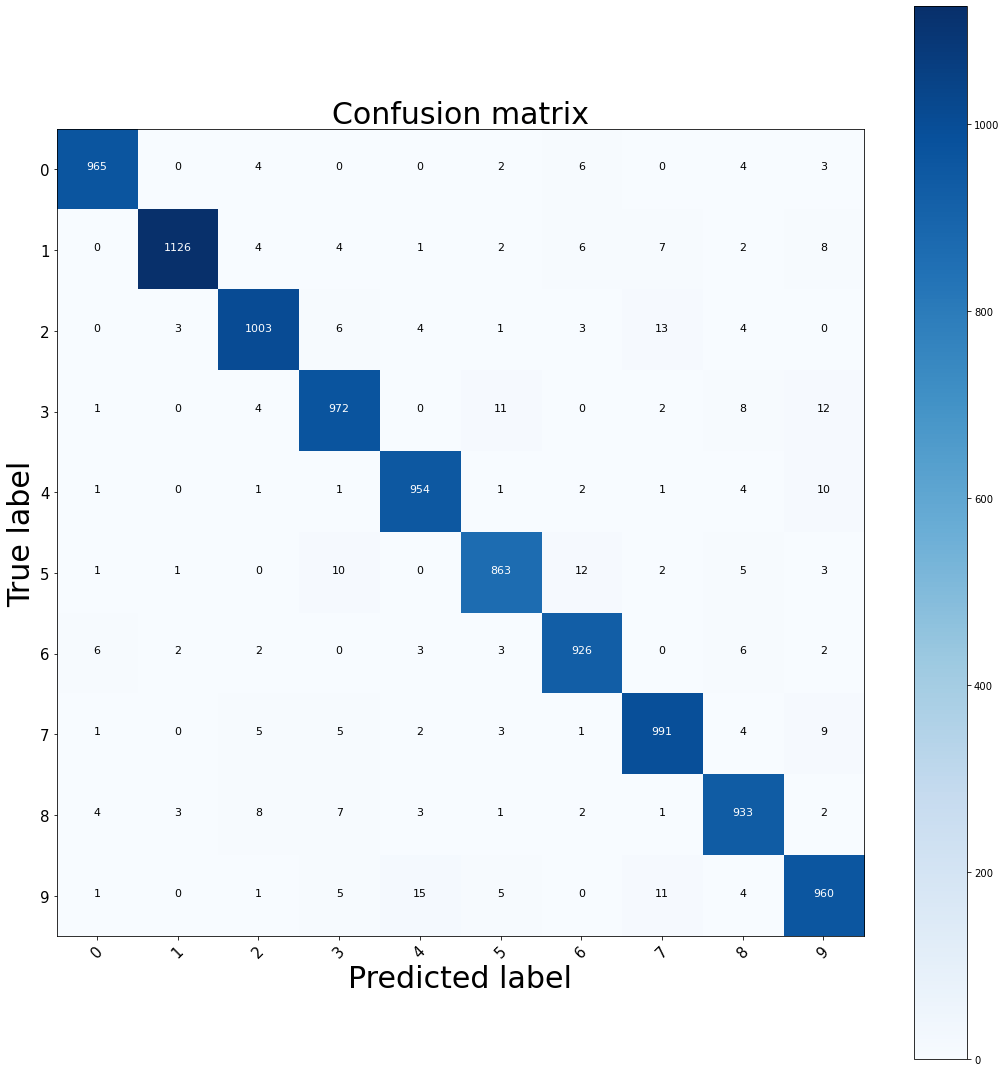
Test Loss: 0.099

Train Accuracy: 0.966

Val Accuracy: 0.966

Test Accuracy: 0.969





Possible questions:

* What is an autoencoder?