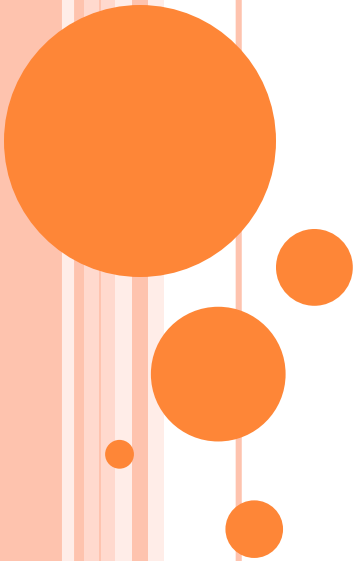
SCC.413 Applied Data Mining
Week 15 Lab Sessions



AE Tasks

- Autoencoder
- Deep AE
- Convolutional DAE
- Denoising conv DAE
- LSTM DAE
- Variationa AE
- Supervised Classification using AEs

Task01
Basic Autoencoder and Deep AE

- Code: Lab_Week15_Task01_DAE.ipynb
  - Run the code and understand AE and DAE
- Questions:
  - Check how the quality of generated images varies if you change the latent space size.
  - Check the epochs and convergence, and see how the quality of generated images improves along with the convergence process (increase/reduce epochs).
  - How to use encoders to classify the MNIST images in an supervised way?

Task02
Conv Autoencoder

- Code: Lab_Week15_Task02_convAE.ipynb
  - Run the code and understand cAE
- Questions:
  - Compare the quality of generated images from cAE against AE and DAE in Task01
  - Change parameters (epoch, number of filters,) and see what quality of images you can get?
  - Check the latent space size. Different from other Aes, the latent dimensions are not specified by users. Instead, it can be manually calculated/justified from the conv architecture. Show how the latent size is computed.

Task03
Denoising Autoencoder

- Code: Lab_Week15_Task03_dAE.ipynb
  - Run the code and understand Denoising AE
- Questions:
  - What's the difference between cAE in task 02 and dAE in this task?
  - Change parameters (epoch, number of filters, etc.) and see what denoising quality you can get?
  - Check the class based coding style, and summarize its pro and cons over the function based coding style.
- Extra reading
  - https://www.jmlr.org/papers/volume11/vincent10a/vincent10a.pdf
  - https://www.sciencedirect.com/topics/engineering/denoising-autoencoders

Task04
LSTM Autoencoder

- Code: Lab_Week15_Task01_lstmAE.ipynb
  - Run the code and understand LSTM AE
- Questions:
  - Compare the quality of generated images from lstmAE against cAE in Task02 and DAE in Task01
  - Do literature search and explain how LSTM works, and what are inside each LSTM layers?
  - How LSTM cells chained and work together?
  - What are the key parameters in LSTM AE? How will these parameters impact on the quality of generated images?
  - Use LSTM AE foe ECG classification?

Task05
Variational Autoencoder

- Code: Lab_Week15_Task05_VAE.ipynb
  - Run the code and understand VAE
- Questions:
  - What are the differences between VAE and AE/DAE?
  - In the latent space, how the latent variables are sampled or computed? Try to search online and explain.
  - What are the key parameters in VAE? How will these parameters impact on the quality of generated images?

Task06
AEs for Supervised Classification

- Code
  - Open to any solution
- Questions:
  - Given you have learned AEs, can you use them for supervised classification?
  - How can you combine a learned encoder with a softmax to do classification?
  - Taking DAE as an example, try to see if you can get a good accuracy in MNIST classification

Coursework

- AE-based ECG classification
  - AE
  - DAE
  - Conv DAE
  - LSTM DAE