

## Q2:

---

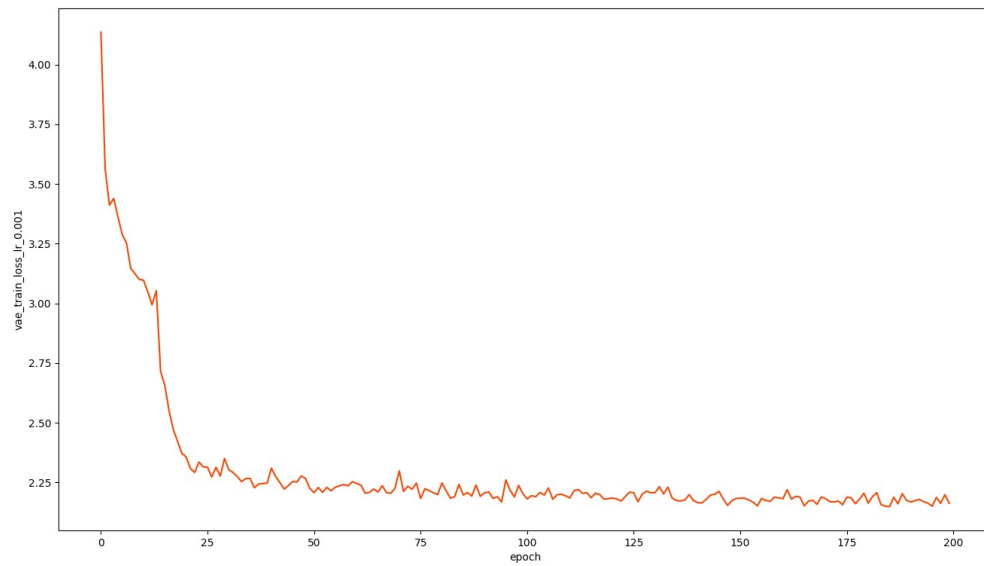
## VAE:

---

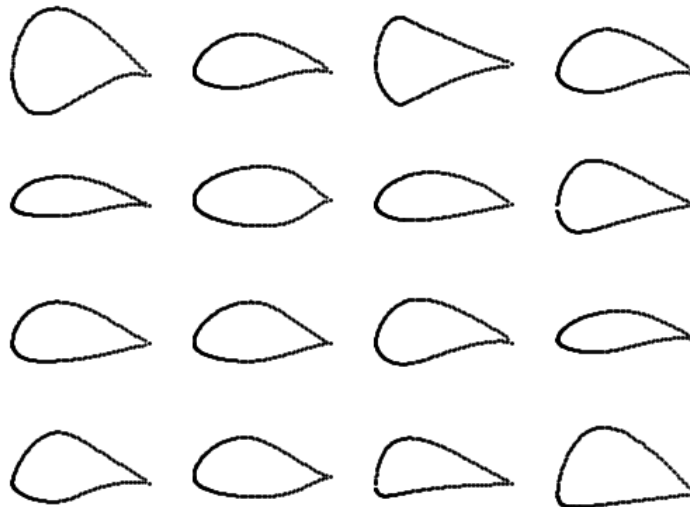
### Network architecture

---

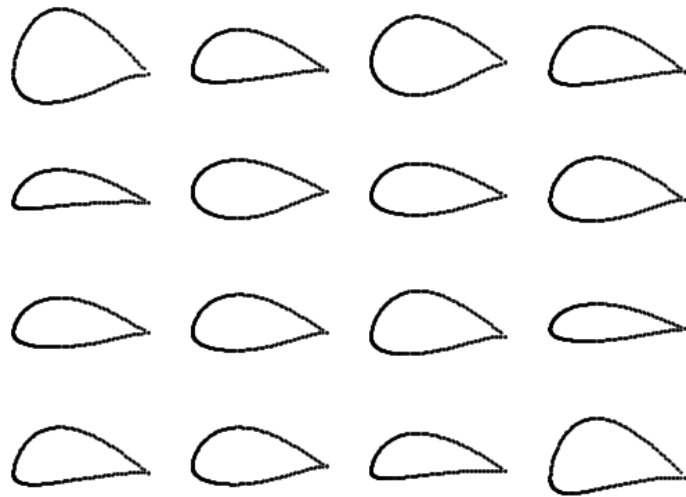
- Encoder: (The encoder predicts the mean and the log of variance)
  1. Linear(input\_dim=200, output\_dim=684, activation=ReLU)
  2. Linear(input\_dim=684, output\_dim=512, activation=ReLU)
  3. Linear(input\_dim=512, output\_dim=256, activation=ReLU)
  4. output = Linear(input\_dim=256, output\_dim=32, activation=ReLU)
  5. mean = output[batch\_size, 0:16], logvar = output[batch\_size, 16:32]
- Decoder:
  1. Linear(input\_dim=16, output\_dim=684, activation=ReLU)
  2. Linear(input\_dim=684, output\_dim=512, activation=ReLU)
  3. Linear(input\_dim=512, output\_dim=256, activation=ReLU)
  4. Linear(input\_dim=256, output\_dim=200, activation=tanh)
- Optimizer: Adam(learning\_rate=1e-3)
- Train loss vs Epochs:



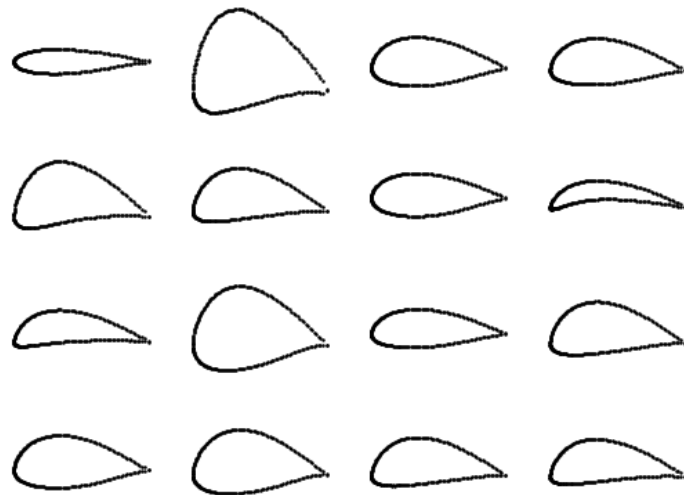
○ Real airfoils:



○ Reconstructed airfoils:



- Generated airfoils:

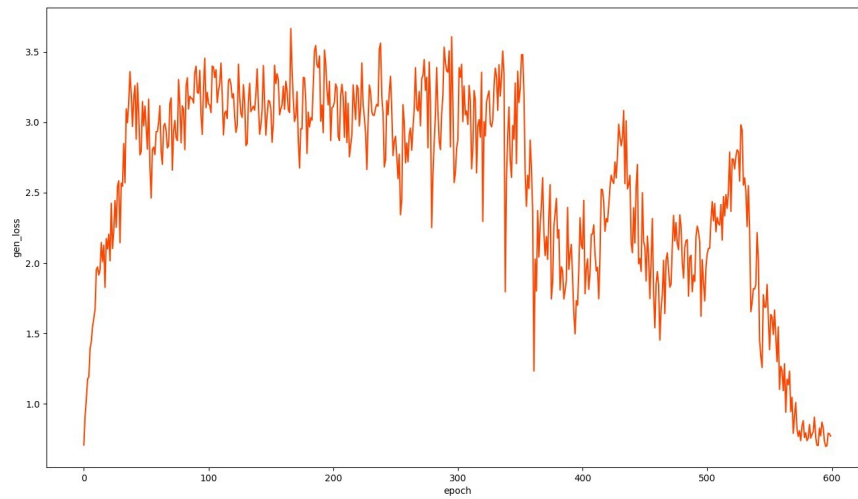


## GAN:

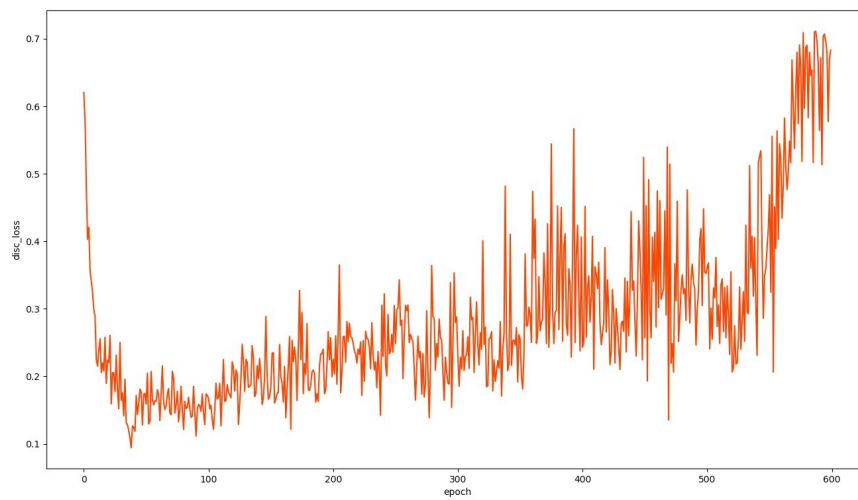
---

- Discriminator:
  1. Linear(input\_dim=200, output\_dim=50, activation=ReLU)
  2. Linear(input\_dim=50, output\_dim=512, activation=ReLU)
  3. Linear(input\_dim=512, output\_dim=256, activation=ReLU)
  4. output = Linear(input\_dim=256, output\_dim=1, activation=sigmoid)
  5. Optimizer: Adam(learning\_rate = 5e-5)
- Generator:
  1. Linear(input\_dim=16, output\_dim=50, activation=ReLU)
  2. Linear(input\_dim=684, output\_dim=512, activation=ReLU)

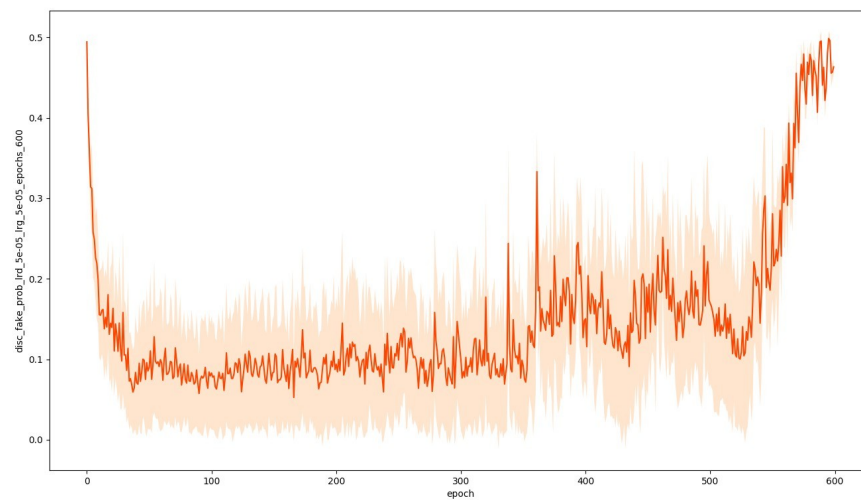
3. Linear(input\_dim=512, output\_dim=256, activation=ReLU)
  4. Linear(input\_dim=256, output\_dim=200, activation=tanh)
  5. Optimizer: Adam(learning\_rate=5e-5)
- Train loss vs Epochs (trained for 600 epochs):
    - Generator loss:



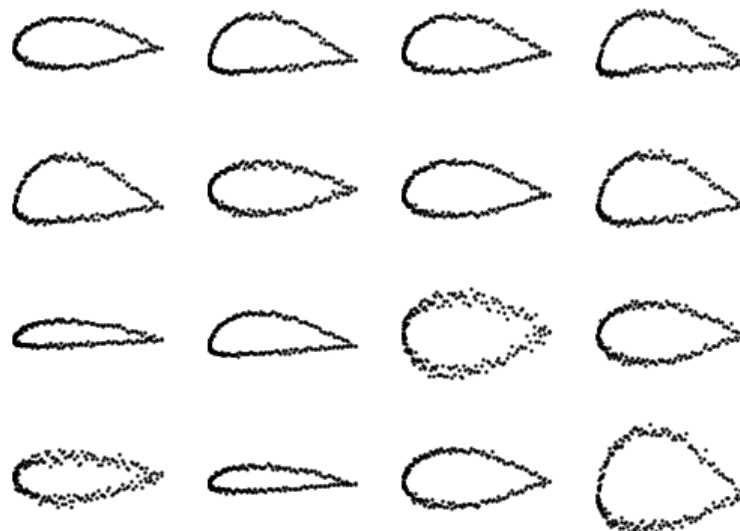
- Discriminator loss:



- Discriminator's probability of classifying fake(generated) data as real vs training epochs (shaded part shows the variance within the batch):



- Generated airfoils:



### Comparison of airfoils generated by VAE and GAN:

The airfoils generated by VAE look more similar to the real ones, and seems like it is able to generate realistic looking data given random noise. On the other hand GAN is able to generate airfoils which do look similar to actual ones in shape though not to the same extent as VAE, also the data points look staggered. Maybe more training or denser real data could have helped in this case.