Data-driven techniques for learning nonlinear dynamics of physical systems

Simon Olesen (s162695)
Andreas Gleerup (s164383)

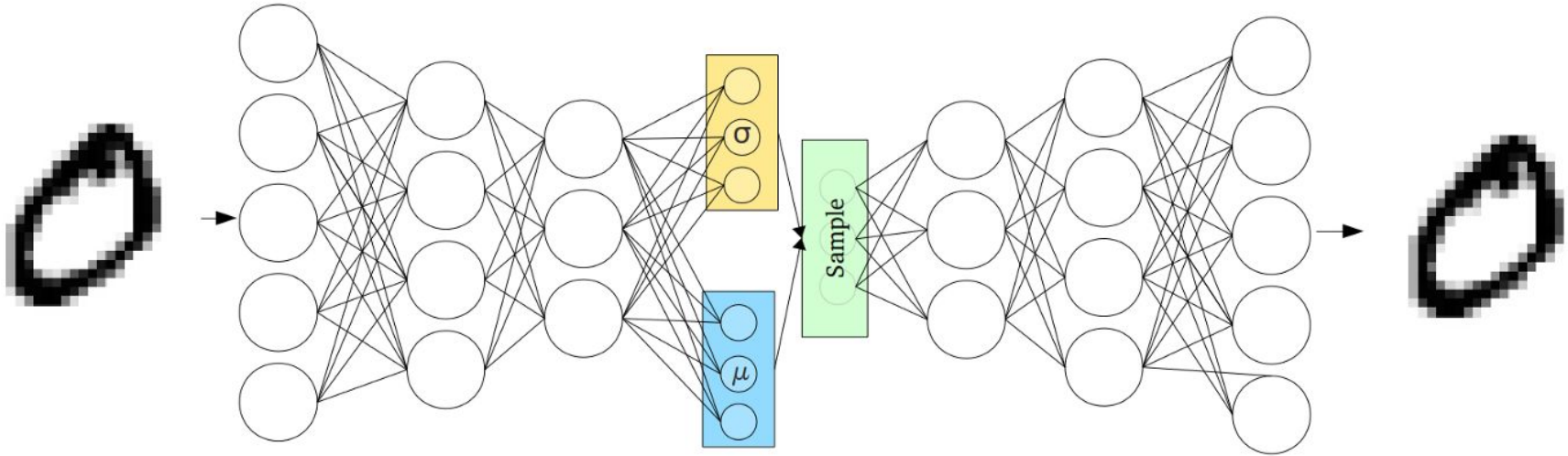
Research questions

Investigate data-driven variational autoencoder’s (VAE) and generative adversarial network’s (GAN) ability to learn from time-series of observation.

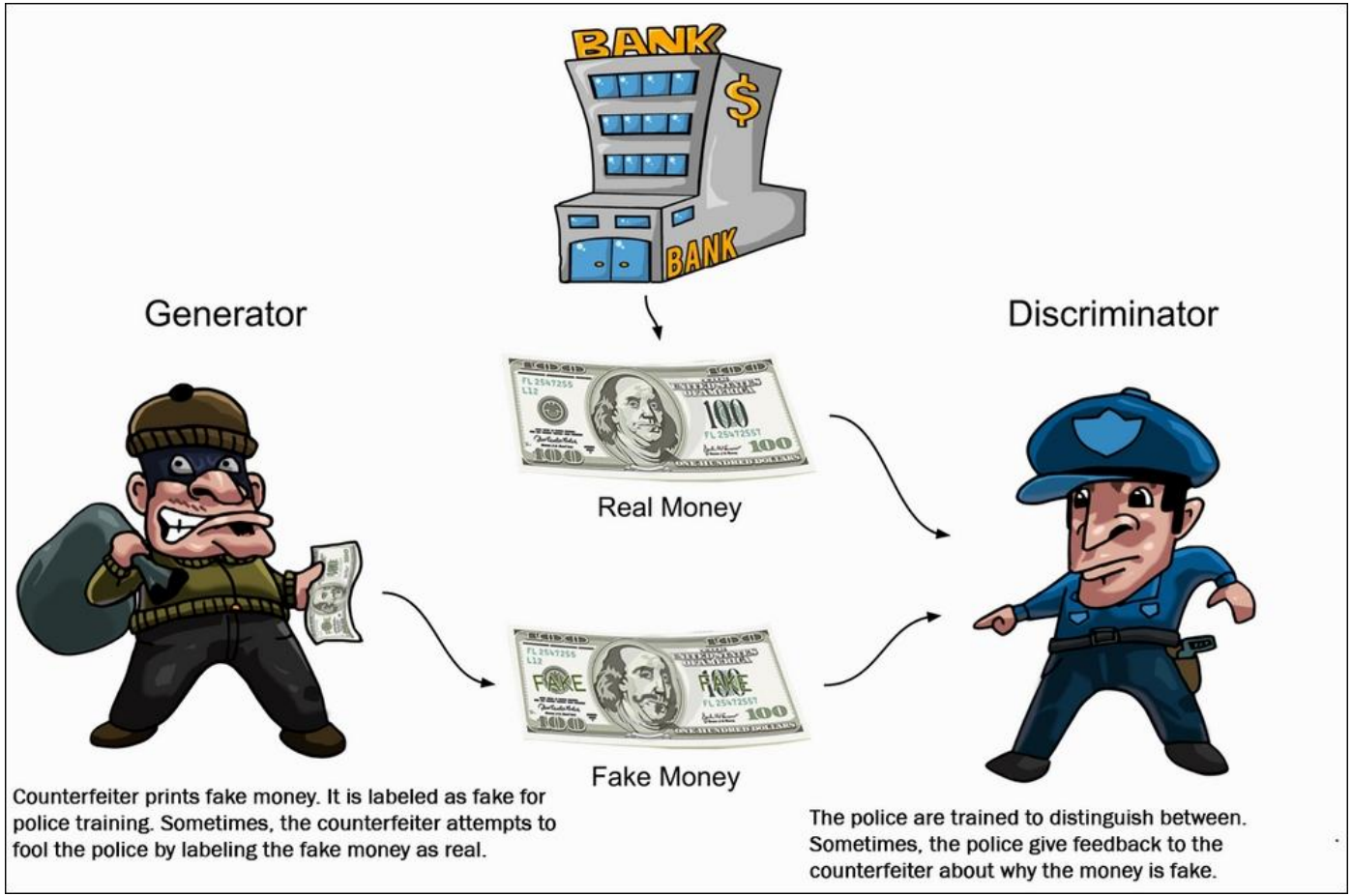
Learn to generate useful representation of differential equations and/or generate synthetic data representations to these.

Investigate current litteratur and state-of-the-art use cases.

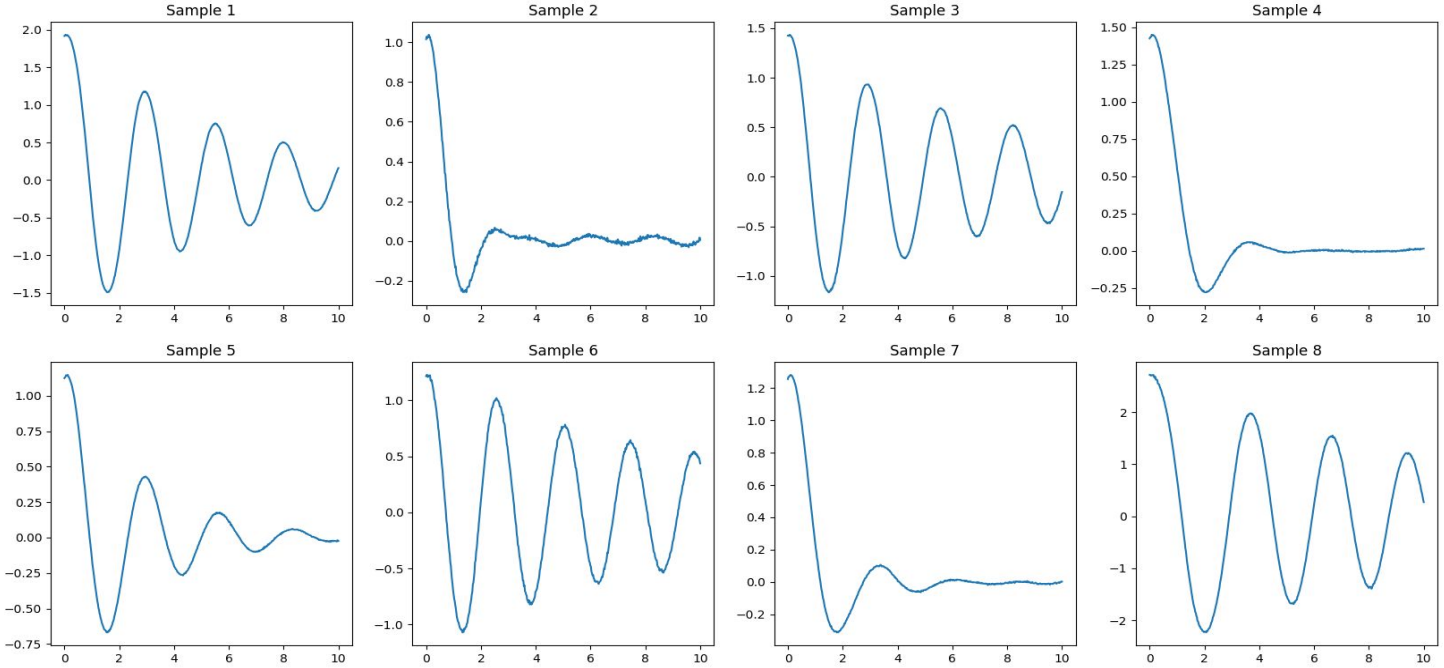
Variational autoencoder (VAE)



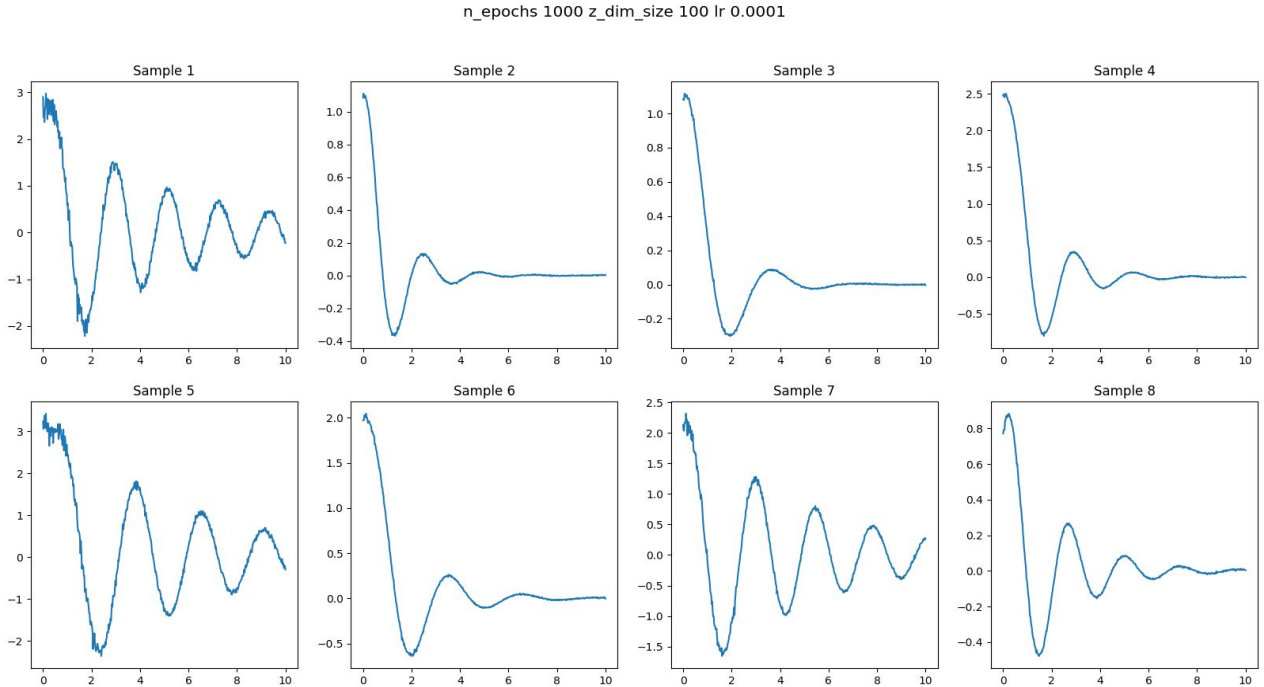
Generative adversarial network (GAN)



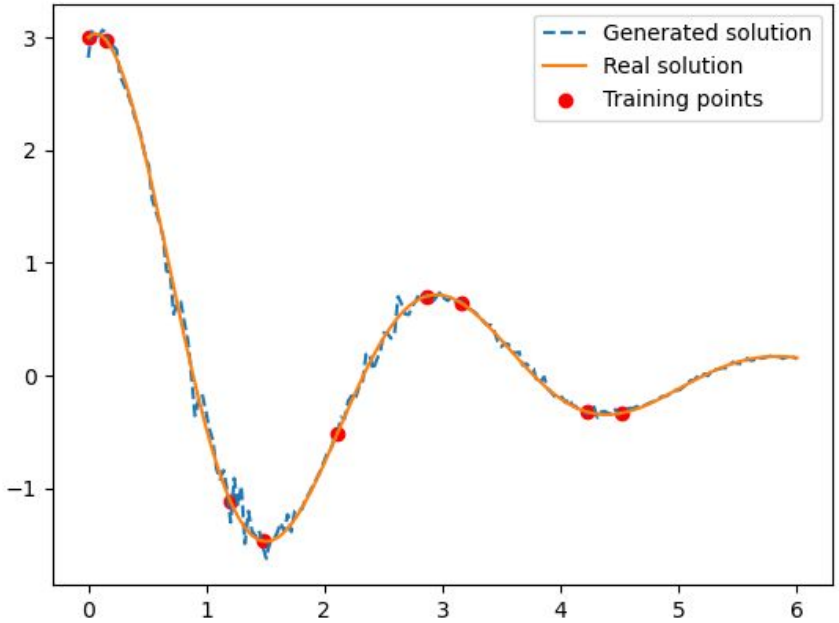
VAE results

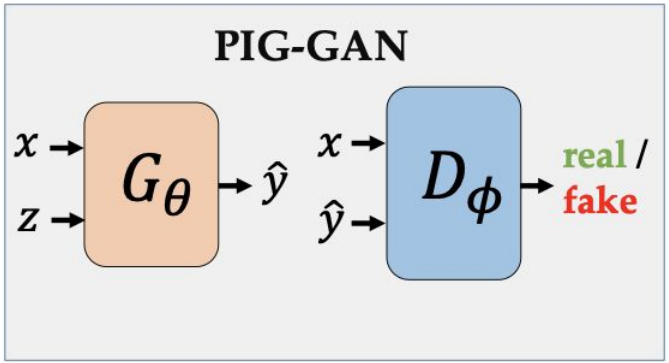

Sample 1
Sample 2
Sample 3
Sample 4
Sample 5
Sample 6
Sample 7
Sample 8

GAN result

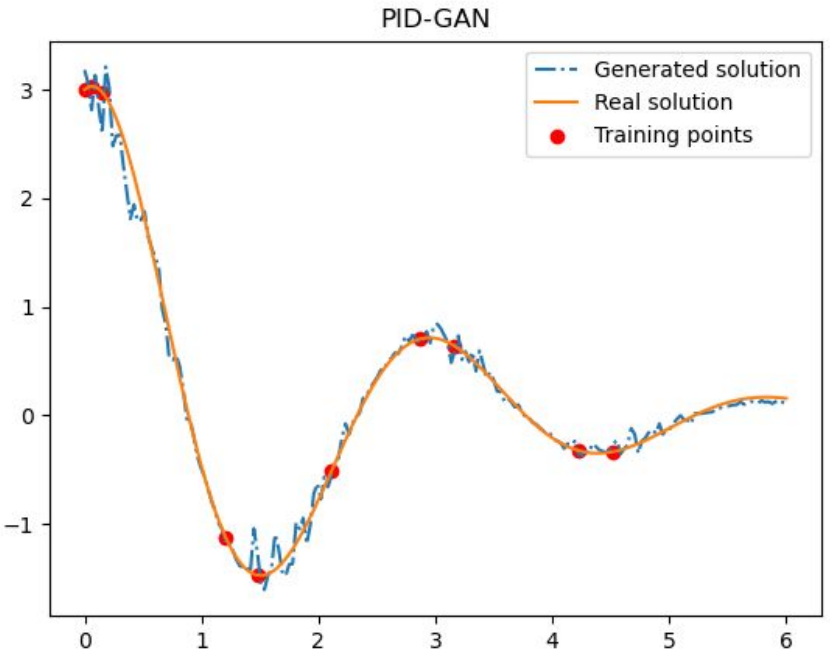

n_epochs 1000 z_dim_size 100 lr 0.0001
Sample 1
Sample 2
Sample 3
Sample 4
Sample 5
Sample 6
Sample 7
Sample 8

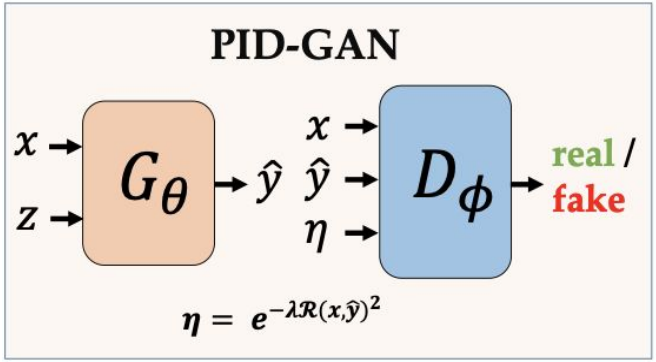
Physics-informed generator GAN





Physics-informed discriminator GAN





Current status

PI-GANs are good at solving inverse problems with physics and few data points

PI-GANs will not generate multiple solutions

Started work on PINN litteratur review and implementation