*Generative modeling* is a broad area of machine learning which deals with modeling a distribution $P(X)$, defined over data points $X$. Roughly speaking, we want to produce more examples that are like those already in a database $X$, but not exactly the same. We could start with a database of raw images and synthesize new, unseen images. We might take in a database of 3D models of real objects and produce more of them to fill a forest in a video game.

Generative models are one of the fastest growing areas of deep learning. In recent years a number of generative models, like Variational AutoEncoders (VAE), Wasserstein AutoEncoder (WAE), generative adversarial networks (GAN), auto-regressive models and flow-based generative models, was constructed.

AutoEncoder based generative model are theoretically elegant generative model with the drawback that they tend to generate blurry samples (especially, with relation to GAN) when applied to natural images. On the other hand, AutoEncoder based generative models have some advantages over other approach. The main advantages over adversarial model is the architecture containing latent space. It allows to fit manifold of data and approximate probability distribution simultaneously, see Fig. 1.

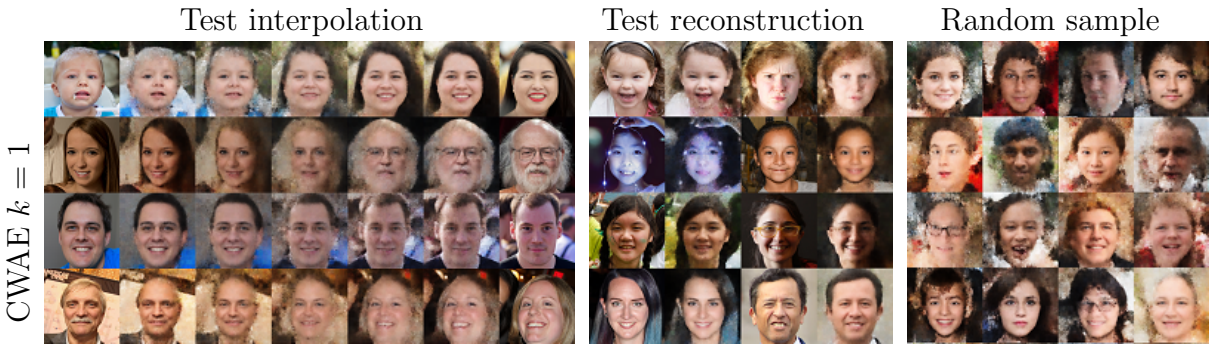


Figure 1: Result of generative models on Flickr-Faces-HQ (FFHQ) database ($1024 \times 1024$ pixels). **Left:** Interpolations between two examples from the test set. **Middle:** Reconstruction of examples from the test set; odd columns correspond to the real test points. **Right:** Random samples from the prior latent distribution.

If we force AE models to produce sharp high resolution images, then such models will become a real competition for adversarial methods in a near future. The main goal of the project is to adapt training procedure and architecture of AutoEncoder based generative models to allows training on high resolution images and generate sharp images.

In particular we aim to fix our attention on the following scientific tasks:

1. Designing a new generative model.
2. Adapt training strategy and architecture of AutoEncoder based generative to allows training on high resolution images.
3. Change geometry of latent space.