

# The Effect of Different Initialization Methods on VAEs for Modeling Cancer using RNA Genome Expressions

## 1 Background

- Cancer hard to treat, need for personalized treatment plans
- Success with **Variational Auto-Encoders (VAE)**
- VAEs perform dimension reduction to find disentangled representations
- Initialization techniques set the weights of the nodes in the layers
- Initialization methods can **increase performance** of VAEs
- RNA genome expressions from **The Cancer Genome Atlas (TCGA)** [1]
- Samples include different cancer types

## 2 Research Question

**Quantify** the impact of different initialization methods

**Compare** different VAE models to conclude if some models are **more sensitive** to initialization methods

## 3 Method

### VAE models:

- VAE [2]
- IWEA [3]
- InfoVAE [4]
- LogCoshVAE [5]

### Initialization methods:

- Default PyTorch implementation:

- Normal: 
$$\mathcal{U}\left(-\sqrt{\frac{1}{fan\_in}}, \sqrt{\frac{1}{fan\_in}}\right)$$

- Uniform:

$$\mathcal{U}(0, 1)$$

- Glorot Normal (Xavier normal):

$$\mathcal{N}(0, \sigma^2)$$

$$\sigma = gain \cdot \sqrt{\frac{2}{fan\_in + fan\_out}}$$

- Glorot Uniform (Xavier uniform):

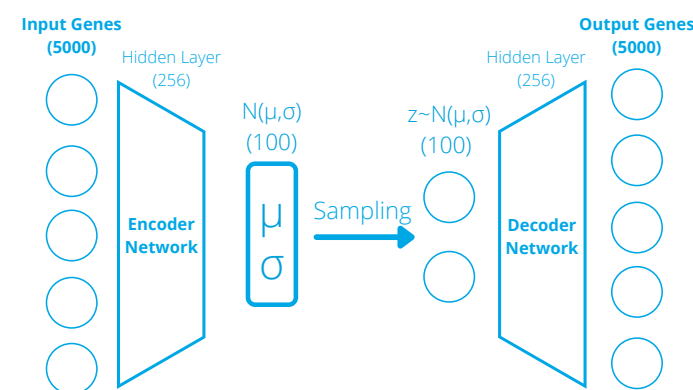
$$\mathcal{U}(-a, a)$$

$$a = gain \cdot \sqrt{\frac{6}{fan\_in + fan\_out}}$$

**Empirical analysis** on the loss function of the validation set

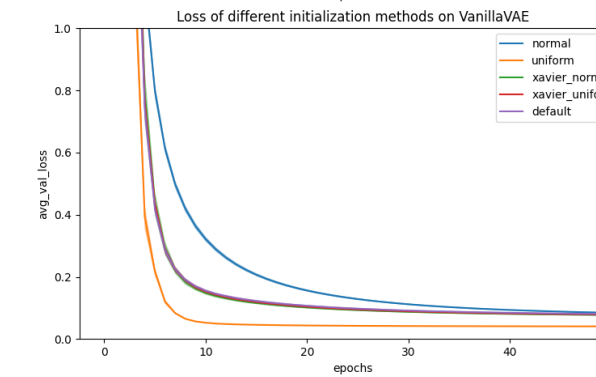
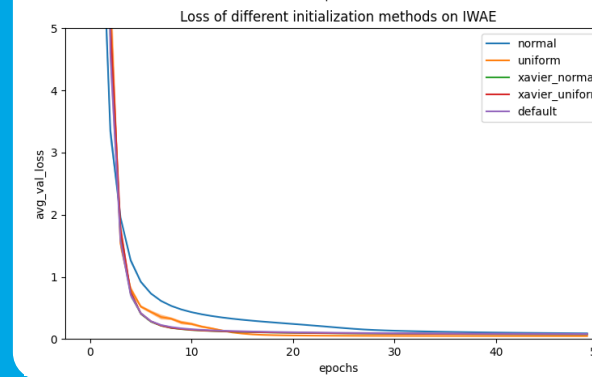
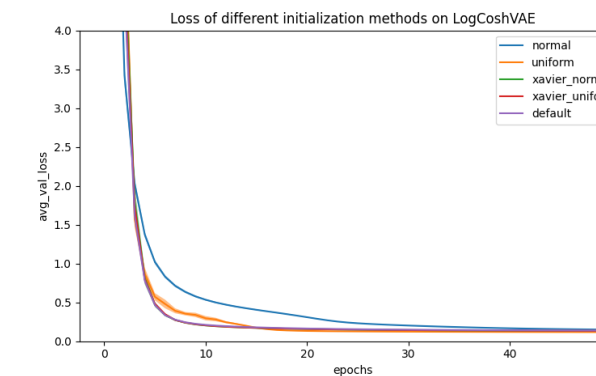
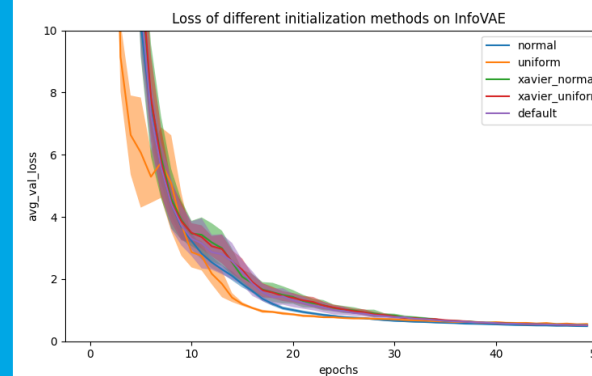
Using a **80% 20%** split for training and validation

**Normalize** the data and use only the **5000** most variable genes

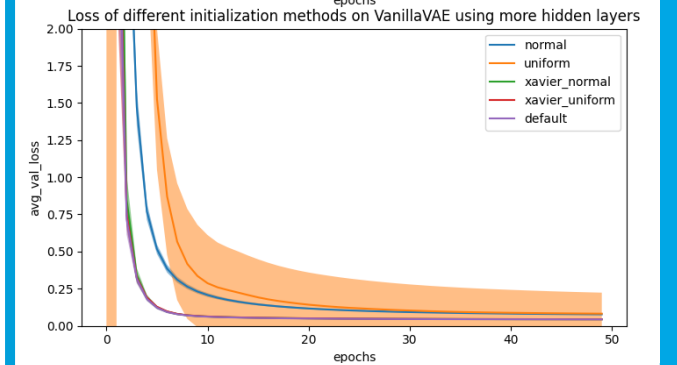
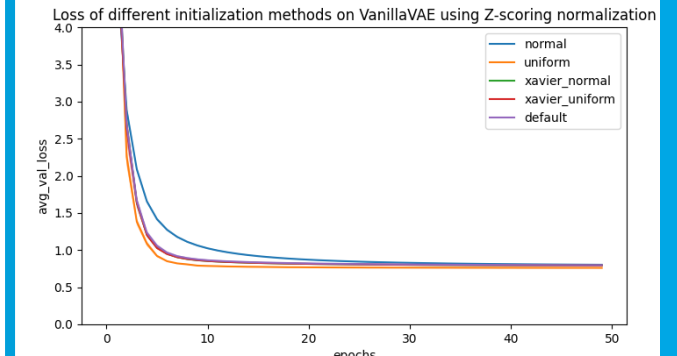


## 4 Results

### All four models using 0-1 normalization



### VanillaVAE using z-scoring normalization or more hidden layers



## 5 Conclusion

Using different normalization techniques does not influence results

VanillaVAE **most sensitive** to initialization methods

When using **one hidden layer**:

- Uniform performs best for VanillaVAE and InfoVAE
- Xavier Normal, Xavier Uniform & Default performs best for IWAE and LogCoshVAE

When using **more hidden layers**:

- Use Xavier Normal, Xavier Uniform & Default