# Assignment: Estimating manifolds using auto-encoders

*Submit Assignment by May 18th.*

The python script “MakeManifold.py” creates data on a manifold in 6D which has a lower intrinsic dimension.

Set your student ID number as the value for “student\_id” at the top of the file, to generate a unique set of data for yourself.

Extend the script in order to apply an auto encoder to this data so that you can try different numbers of nodes in the hidden layer (n\_hidden) and different different dimensions for the latent space (n\_latent).

The full auto-encoder network should thus have the following sequence of modules

1. Linear layer (6D to n\_hidden)
2. Sigmoid layer
3. Linear layer (n\_hidden to n\_latent)
4. Linear layer (n\_latent to n\_hidden)
5. Sigmoid layer
6. Linear layer (n\_hidden to 6D)

The first three modules act as the encoder, the last three the decoder.

(*Hint: See the example scripts accompanying the lecture*)

Perform a series of experiments in order to generate the following graphs:

1. For a 1-D latent space, plot the reconstruction error (Mean Square Error) against the number of hidden layers
2. For a 2-D latent space, plot
   1. the reconstruction error (Mean Square Error) against the number of hidden nodes
   2. The projection of the data into 2D as a scatter plot (when using 20 hidden nodes)
3. For a 3-D latent space, plot
   1. the reconstruction error (Mean Square Error) against the number of hidden nodes
   2. The projection of the data into 3D as a scatter plot (when using 20 hidden nodes)
4. A plot of the reconstruction error (Mean Square Error) against the number of hidden layers when the latent space is four dimensional.

In each case use n\_hidden= 5, 10, 15, 20.

Given these results, indicate what you think the intrinsic dimensionality of the manifold is, and explain your decision.

Please supply the solution as a PDF containing

1. The python script (or scripts) that you used
2. The graphs
3. Some text explaining what you think the intrinsic dimensionality is and why.