PHY 835: Exercise 7
Released March 31, 2021;Target Due Date: April 15, 2021

1. Clustering

The aim of this exercise is to familiarize yourself with the analysis of clustering hyperparameters. For this purpose, let us consider the AgglomerativeClustering algorithm in sklearn. Using **`make_circles`**, **`make_moons`**, **`make_blobs`** visualize the different performance of different linkages (ward, complete, average, single).

Perform a little bit of hyperparameter tuning and show for the different linkage models the best model you have found. You are not required to perform extensive parameter scanning but do not just use default parameters.

2. AutoEncoder

The aim of this exercise is to implement simple autoencoders.

1) Generate 2-d images (1-channel) showing polynomials up to a maximum degree (e.g. 40x40) in two variables.
2) Build two autoencoder architectures (e.g. similar to the ones presented in the lecture) which involve a single hidden dense layer and several hidden dense layers.
3) For quadratic polynomials and two latent dimensions, visualize the results of your latent dimensions. Is an interpretation of your latent parameters easily visible?
4) (Optional) Add a custom loss function which de-correlates the latent parameters. Is it possible to find an interpretation for the latent parameters in this case?

3. KL – divergence

Show by example that $D_{KL}(Q||P) \neq D_{KL}(P||Q)$ in general.