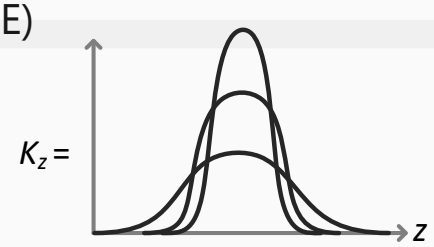
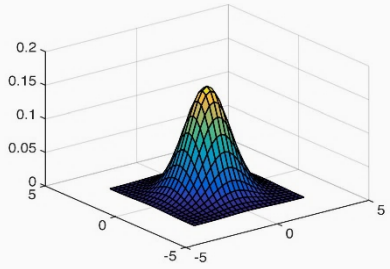
## Kernel Density Estimation (KDE)

$$\hat{f}_h(x) - \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x-x_i}{h}\right)$$




KDE is the most commonly used method of **Density Estimation**.

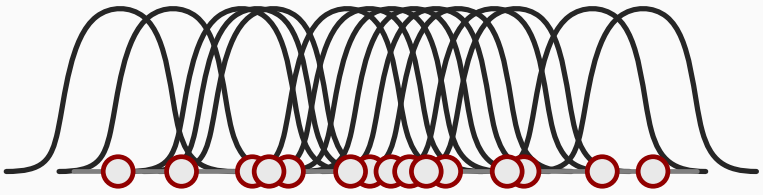
KDE can be applied to both **single** and **multivariate** dimensional density estimation.

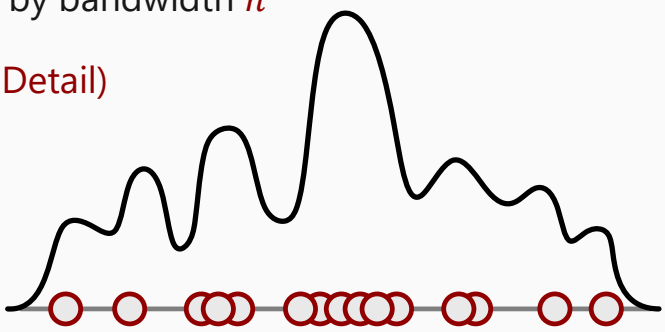
KDE is **Nonparametric** meaning each data point possesses a characteristic distribution

KDE commonly uses the **Gaussian Kernel** that expects a rounded distribution, making it difficult to apply anything other than physical (Euclidean) distance.

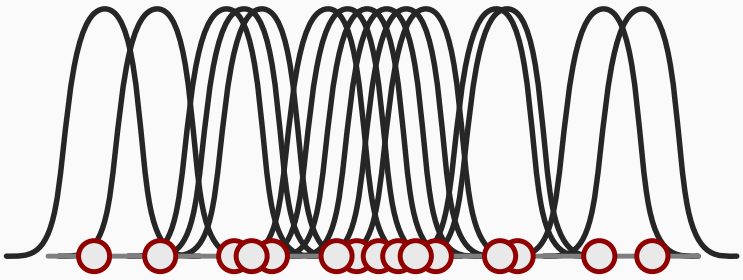
Kernels are centered at the points $x_i$ and scaled by bandwidth $h$

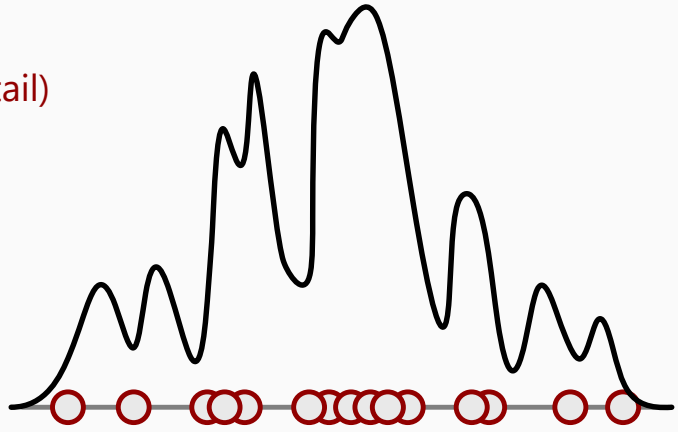
### Adequate KDE Bandwidth (Appropriate Density Detail)





### Narrow KDE Bandwidth (Overfitted Density Detail)





### Excessive KDE Bandwidth (Underfitted Density Detail)