- Sources:
  - CS229 notes (17-19)
  - https://towardsdatascience.com/locally-weighted-linear-regression-in-python-3d324108efbf
  - https://aman.ai/cs229/locally-weighted-linear-regression/
- Used when data is non-linear, since it can fit non-linear data
- Assuming there is sufficient training data, makes the choice of features less critical

In the original linear regression algorithm, to make a prediction at a query point x (i.e., to evaluate $h(x)$), we would:

1. Fit θ to minimize $\sum_i (y^{(i)} - \theta^T x^{(i)})^2$.
2. Output $\theta^T x$.

In contrast, the locally weighted linear regression algorithm does the following:

1. Fit θ to minimize $\sum_i w^{(i)} (y^{(i)} - \theta^T x^{(i)})^2$.
2. Output $\theta^T x$.

A fairly standard choice for the weights is[4]

$$w^{(i)} = \exp\left(-\frac{(x^{(i)} - x)^2}{2\tau^2}\right)$$

$$\theta = \left(X^\top W X\right)^{-1} \left(X^\top W Y\right)$$

- w (i) are not random variables
- tau (bandwidth parameter) controls how quickly the weight the weight of a training example falls off with distance of its x (i) from the query point x
- Non-parametric learning algorithm - because we need to keep the entire training set to make predictions. Non-parametric refers to the fact that the amount of stuff we need to keep in order to represent the hypothesis (h) grows linearly with the size of the training set.
  - Linear regression is a parametric learning algorithm because it has a fixed, finite number of parameters (thetas), which are fit to the data. Once we have the thetas, we no longer need the training data to make predictions.
- **Assumptions**
  - w (i) are non-negative valued weights
- **Advantages**
  - Don't need to think about which features to use
  - Useful when number of data points is small
  - Useful when number of dimensions are less

- **Disadvantages**
  - Not ideal if dataset is massive since high memory and computation cost
  - Can get affected by outliers (applies to all least square methods in ML)
  - In high dimensions, possible that not many points are near a particular query