DATA 3464: Fundamentals of Data Processing

Numeric Data Transformations

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Topic overview

- Why transformations are necessary
- Common transformations
- Dimensionality reduction

Resources used:

- Feature Engineering Chapter 6
- Hands on Machine Learning with Scikit-Learn and Tensorflow/PyTorch, Chapter 4. Available at MRU Library
- Scikit-learn user guide: Chapter 7

A brief intro to gradient descent

- Many linear models minimize some cost function through **gradient descent**
- The **gradient** is a vector of partial derivatives

$$\nabla f = \begin{bmatrix} \frac{\partial f}{\partial x_1} \\ \frac{\partial f}{\partial x_2} \\ \vdots \\ \frac{\partial f}{\partial x_n} \end{bmatrix}$$

for some scalar-valued $f(\mathbf{x})$

Descending the gradient

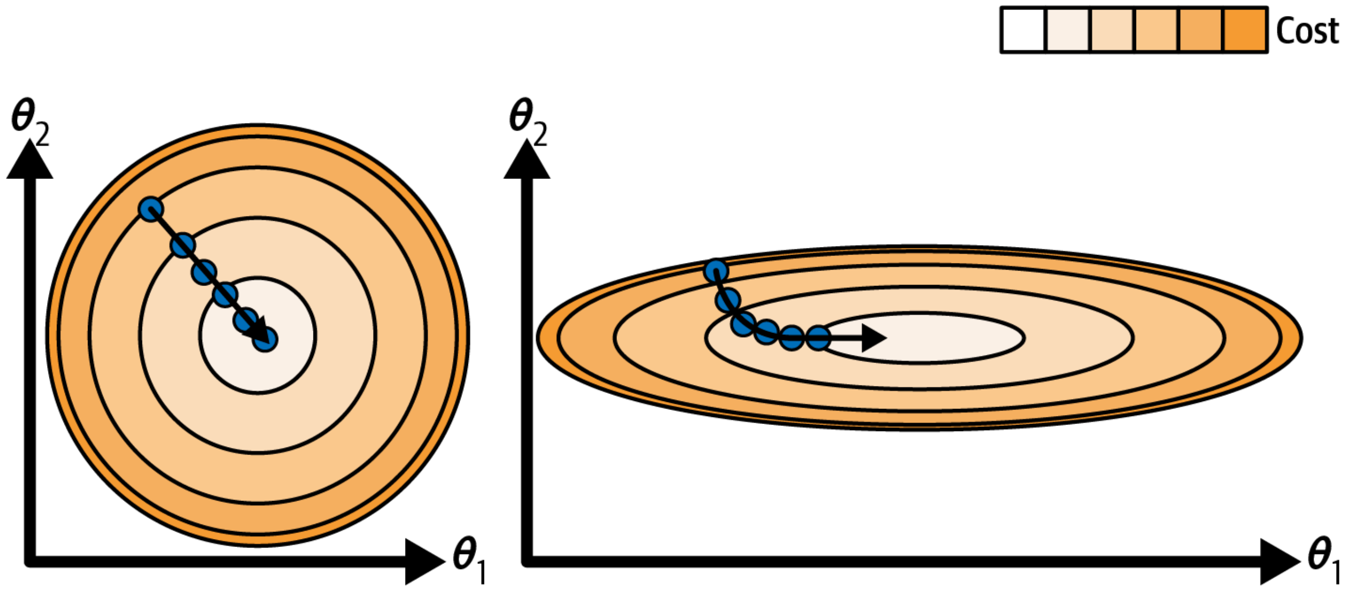
For a loss (or cost) function such as $MSE(\theta) = \frac{1}{m}(\mathbf{X}\theta - \mathbf{y})^T(\mathbf{X}\theta - \mathbf{y})$

1. Start with a random θ
2. Calculate the gradient ∇_θ for the current θ
3. Update θ as $\theta = \theta - \eta\nabla_\theta$
4. Repeat 2-3 until some stopping criterion is met

   where η is the **learning rate**, or the size of step to take in the direction opposite the gradient.

Visualizing in 2D

- The gradient has $m + 1$ dimensions, where m is the number of features
- step size η is a scalar parameter



> *Main takeaway: feature should be more or less on the same scale*

Figure 4-7 from Hands-on Machine Learning

Approaches to scaling