

POLYNOMIAL EMBEDDINGS

Why

A simple example of an embedding.¹

Definition

Fix $d \in \mathbb{N}$. A polynomial feature map of degree d is a function $\phi : \mathbb{R} \to \mathbb{R}^d$ with

$$\phi(x) = \begin{pmatrix} 1 & x^2 & \cdots & x^d \end{pmatrix}^\top.$$

For $x \in \mathbb{R}$, we call $\phi(x)$ the polynomial embedding of x.

A polynomial regressor is a least squares linear predictor using a polynomial feature embedding (of any degree, but to be precise one must specify the degree). The task of consructing a linear predictor is often referred to as polynomial regression.

Given a dataset of paired records $(x^1, y^1), \ldots, (x^2, y^2) \in \mathbb{R}^2$, one can construct a predictor $g : \mathbb{R} \to \mathbb{R}$ for y by embedding the dataset $(\phi(x^1), \ldots, \phi(x^n))$ and finding the least squares linear regressor $f : \mathbb{R}^d \to \mathbb{R}$ for y. One defines the predictor $g : \mathbb{R} \to \mathbb{R}$ by $g(\phi(x))$.

¹Future editions will expand, or perhaps collapse this sheet.

