

# Non-Linear Transformations

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In linear models, hypothesis modeled by:

$$\underline{w}^T \underline{x}$$

$\underline{x}$  represents features

Ⓠ can we adjust this to represent features more appropriately?

⇒ Yes: FEATURE TRANSFORM

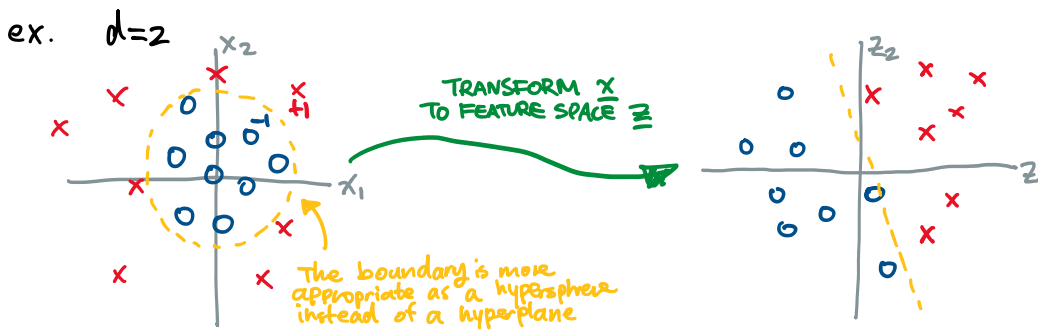
$$\underline{z} = \phi(\underline{x}) \in \mathbb{Z}$$

FEATURE SPACE

we can then use the transformed input features to get HYPERHESIS:

$$h(\underline{x}) = \text{sign}(\underline{w}^T \underline{z})$$

$$= \text{sign}(\underline{w}^T \phi(\underline{x}))$$



⚠ ONLY PERFORM TRANSFORM BASED ON UNDERSTANDING OF THE PROBLEM, NOT OBSERVATIONS.

Polynomial Transform:

$$\phi_2([1, x_1, x_2]) = [1, x_1, x_2, x_1^2, x_1 x_2, x_2^2]$$

note that this transformation CHANGES the input vector dimensions

IN GENERAL:

$$\phi_Q(\underline{x}) \leftarrow Q^{\text{th}} \text{ order polynomial transform}$$

the output dimension is:

$$\hat{d} = \binom{d+Q}{Q} - 1$$

FEATURE SELECTION