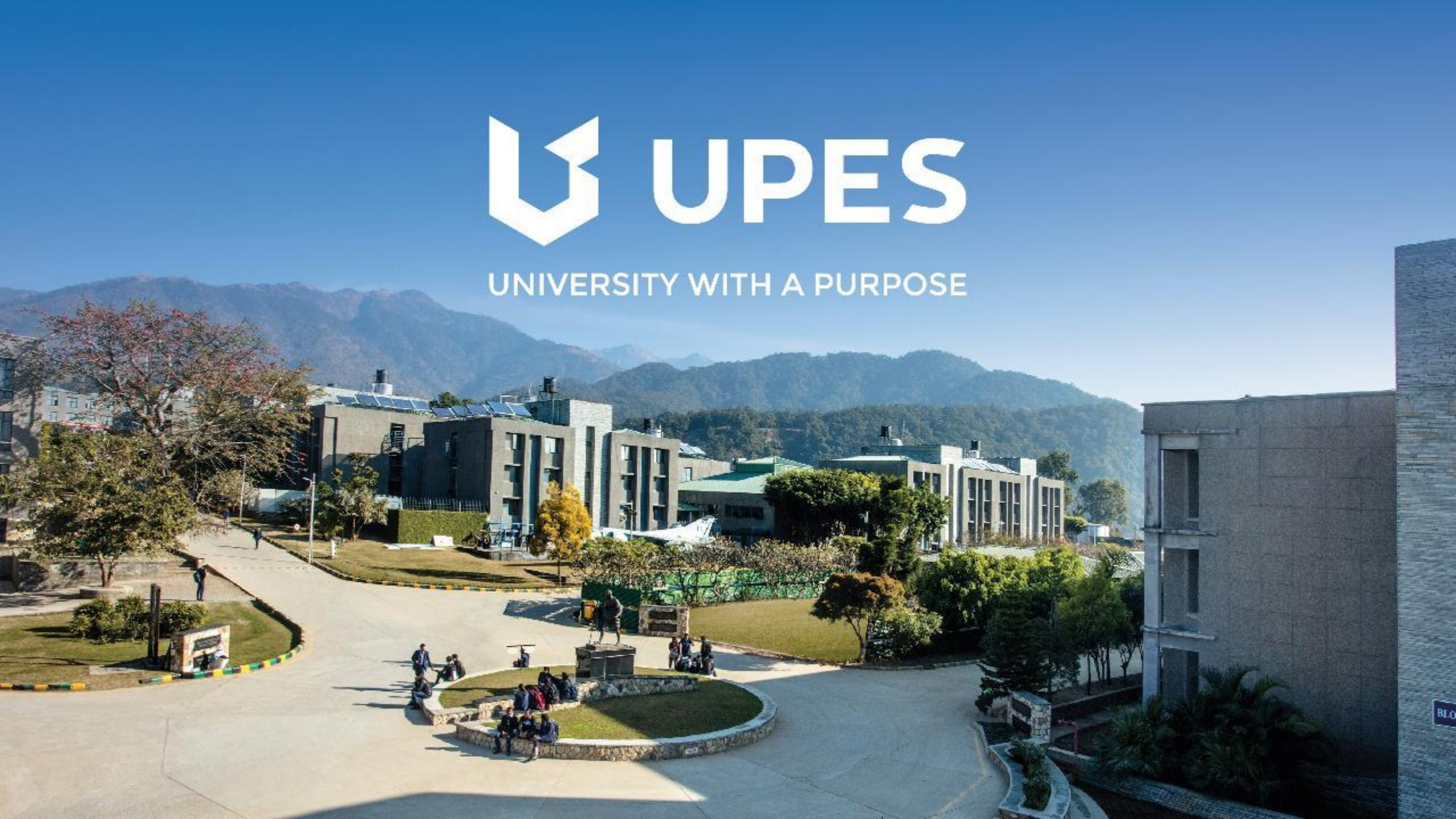
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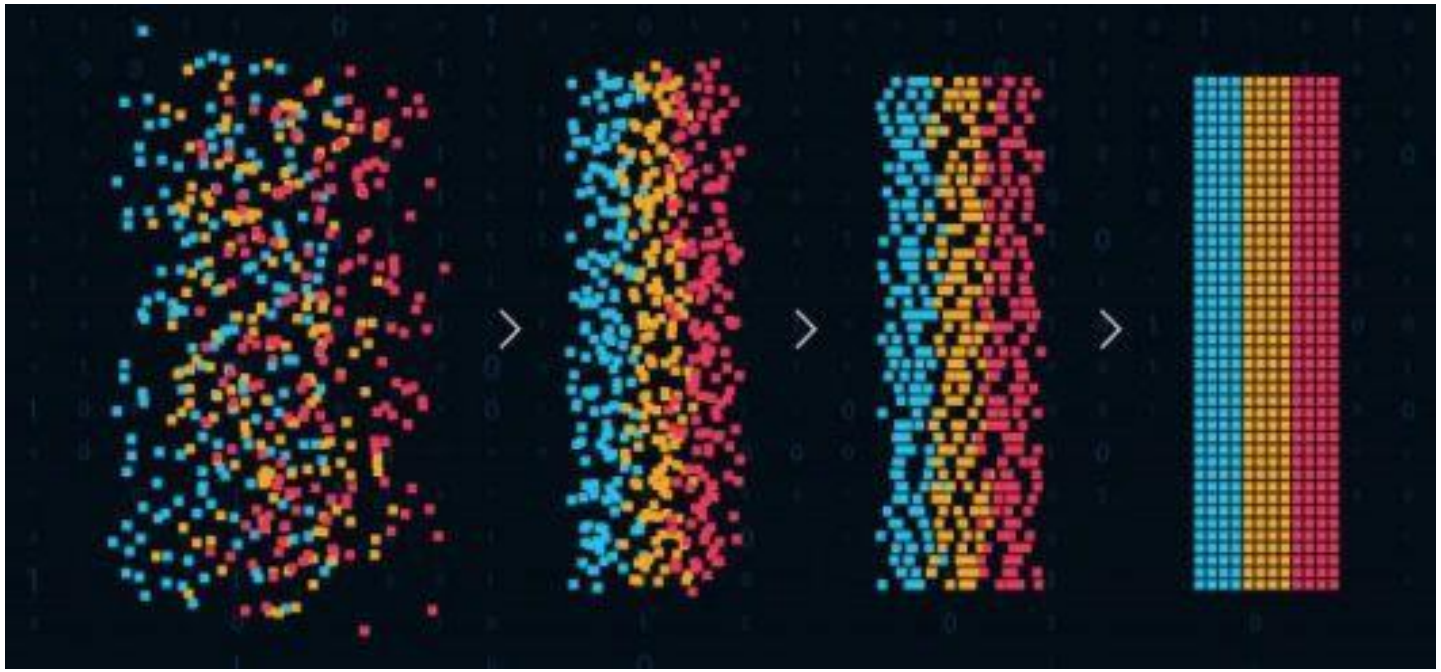
# Pattern and Anomaly Detection



Source: Edureka

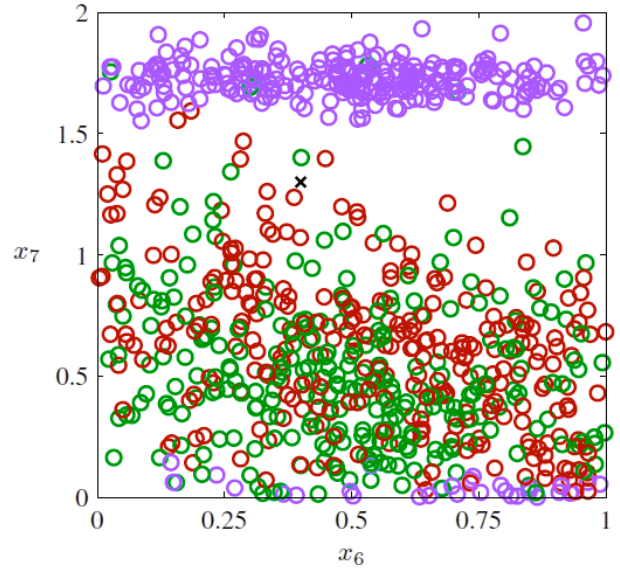
**B. Tech., CSE + AI/ML**

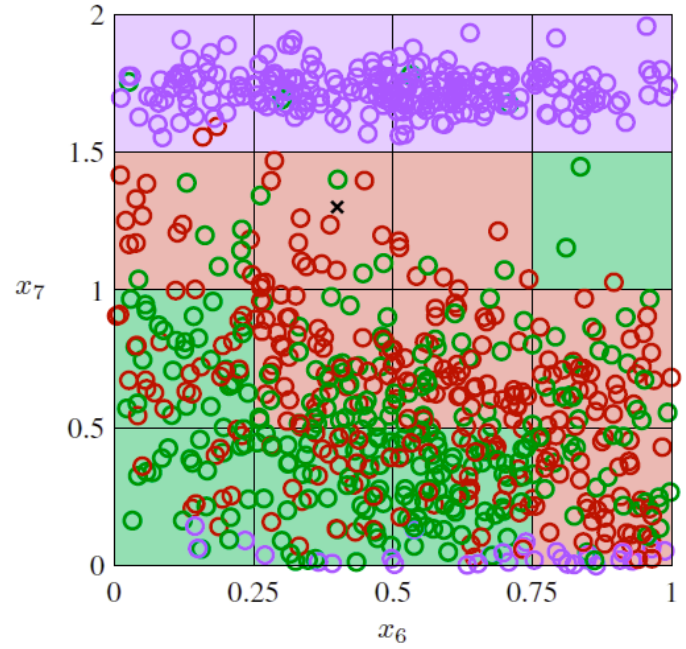
Dr Gopal Singh Phartiyal

26/08/2021

# Curse of Dimensionality

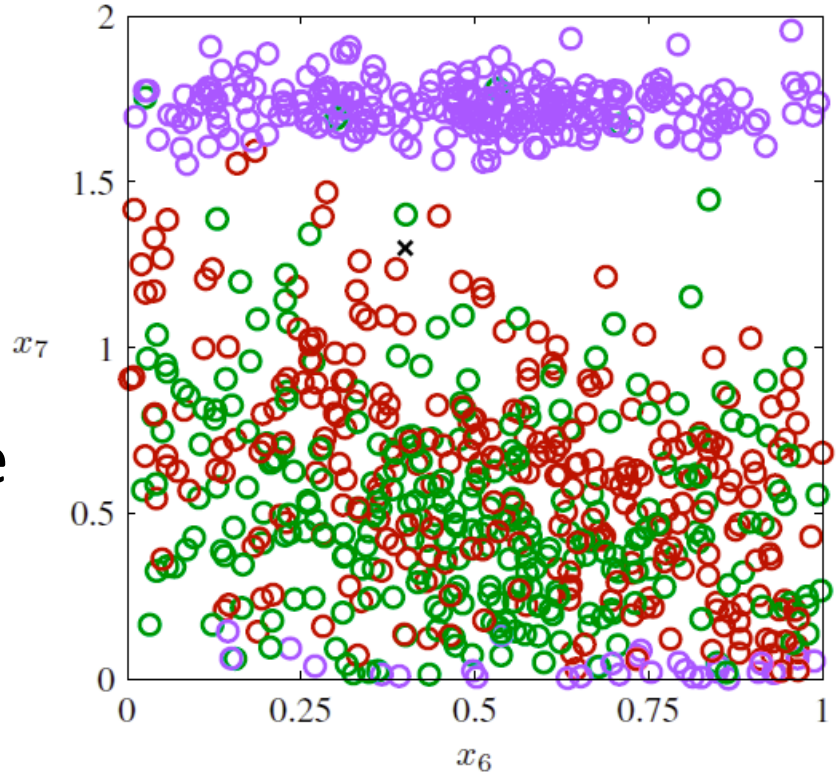
- So far we have considered input with 1-dimension space or scalar or one variable.
  - X was 1- dimensional
- But in practical applications today, x is a high-dimensional input.
- The challenges with high-dimensional data in PR applications?

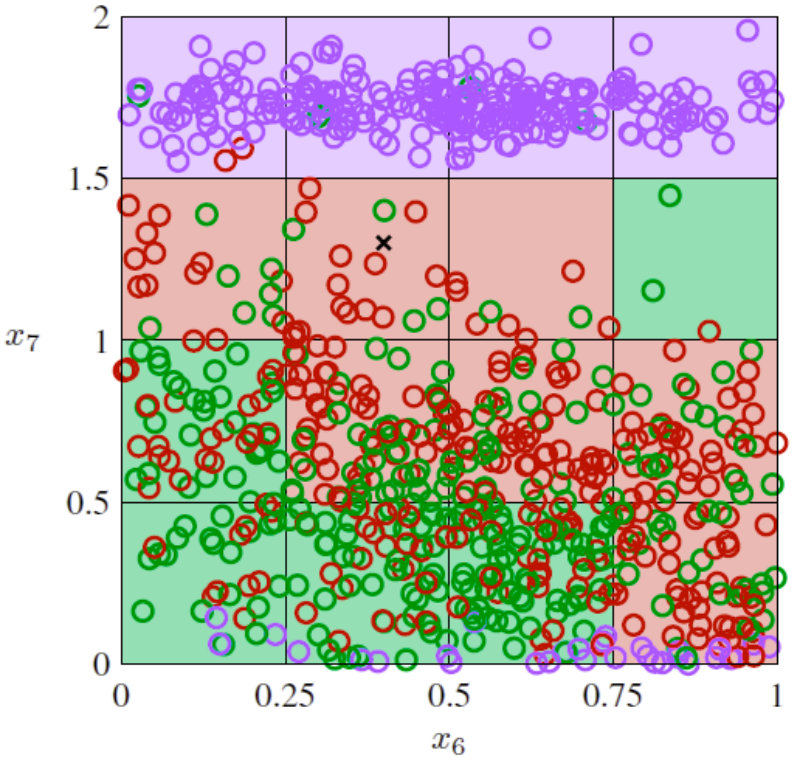


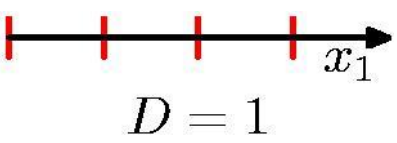
# High-dimension data: Example

- Input dimension = 12
- Output = labels or classes
- Goal= To predict the label of test point (marked with x)
- Demo: Classification problem



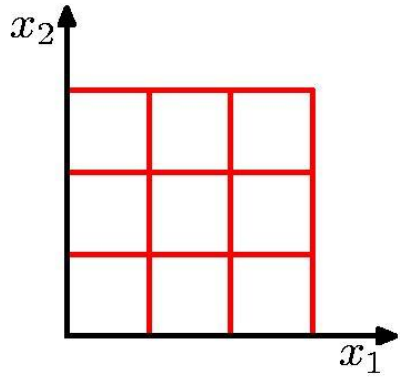



# Curse of Dimensionality



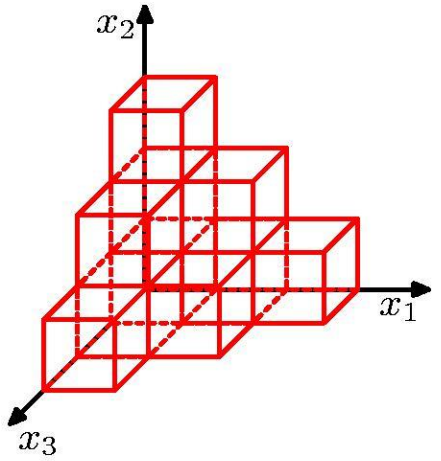

$D = 1$

- Problem with the before mentioned example:




$D = 2$

- As input dimension increases, the number of cells increases exponentially.




$D = 3$

- In turn requires large amounts of training data.

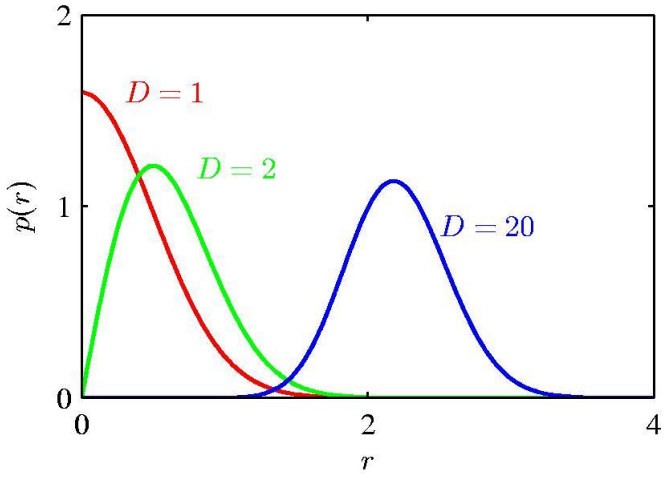
# Curse of Dimensionality

- Impact of increased input-dimensionality on polynomial curve fitting
  - M = 3

$$y(\mathbf{x}, \mathbf{w}) = w_0 + \sum_{i=1}^{D} w_i x_i + \sum_{i=1}^{D}\sum_{j=1}^{D} w_{ij} x_i x_j + \sum_{i=1}^{D}\sum_{j=1}^{D}\sum_{k=1}^{D} w_{ijk} x_i x_j x_k$$

- Number of Coefficients are proportional to **$D^M$** **(power law function)**

- Gaussian Densities in higher dimensions



# Next time: Decision Theory

- Probability theory provides
  - A consistent mathematical framework for quantifying and manipulating uncertainty
- **Inference**
  - Determination of $p(x, t)$ from a set of training data is an example of *inference* and
- **Decision theory**
  - The subject of decision theory to tell us how to make optimal decisions given the appropriate probabilities.
- Decision theory **plus** Probability theory
  - Help us To make optimal decisions

Next time: Curse of Dimensionality

# Thank You