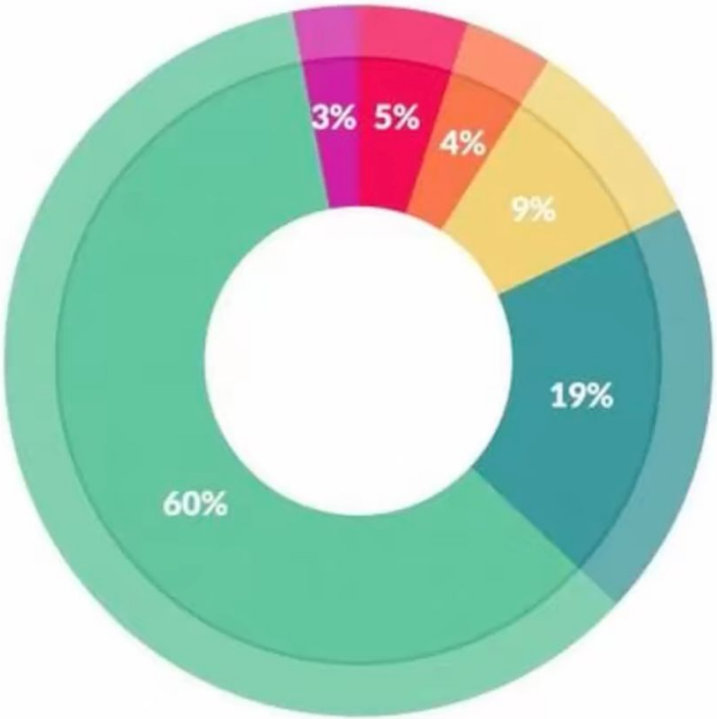
MIDS 207
Applied Machine Learning

Fall 2023

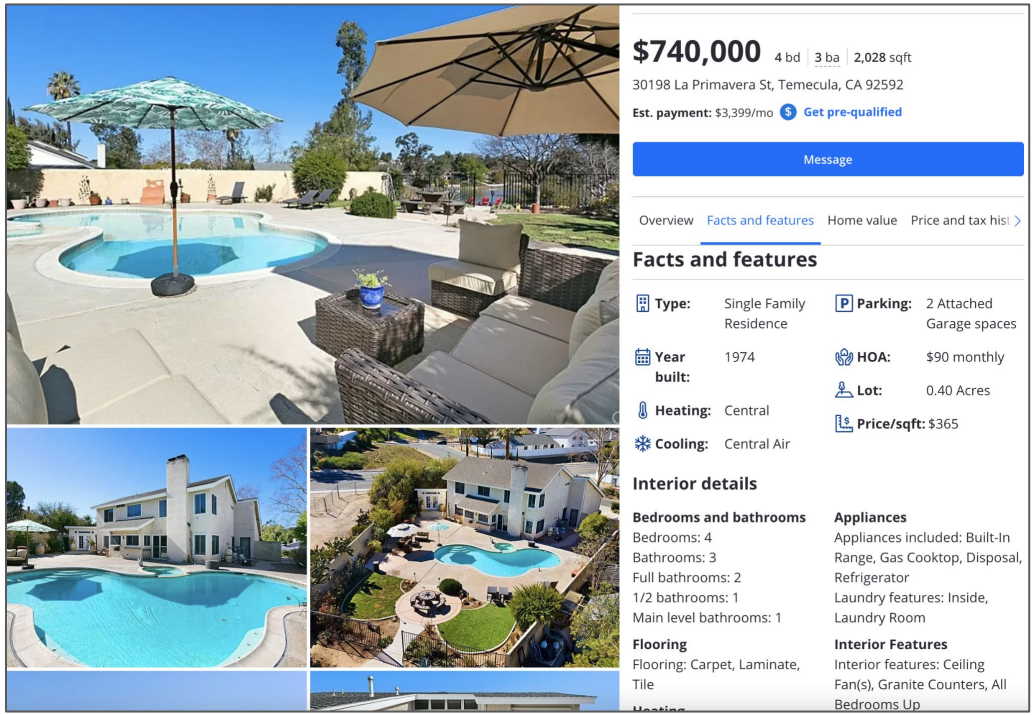
Week 3



What data scientists spend the most time doing

- *Building training sets: 3%*
- *Cleaning and organizing data: 60%*
- *Collecting data sets; 19%*
- *Mining data for patterns: 9%*
- *Refining algorithms: 4%*
- *Other: 5%*

Prediction



$740,000 4 bd | 3 ba | 2,028 sqft

30198 La Primavera St, Temecula, CA 92592

Est. payment: $3,399/mo Get pre-qualified

Message

Overview | Facts and features | Home value | Price and tax hist

Facts and features

Type: Single Family Residence

Year built: 1974

Heating: Central

Cooling: Central Air

Parking: 2 Attached Garage spaces

HOA: $90 monthly

Lot: 0.40 Acres

Price/sqft: $365

Interior details

Bedrooms and bathrooms
Bedrooms: 4
Bathrooms: 3
Full bathrooms: 2
1/2 bathrooms: 1
Main level bathrooms: 1

Flooring
Flooring: Carpet, Laminate, Tile

Appliances
Appliances included: Built-In Range, Gas Cooktop, Disposal, Refrigerator
Laundry features: Inside, Laundry Room

Interior Features
Interior features: Ceiling Fan(s), Granite Counters, All Bedrooms Up

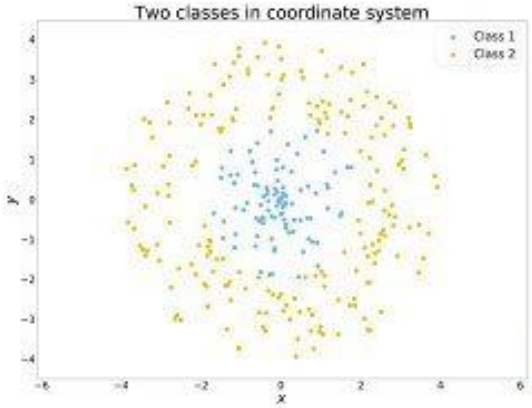
Features

Label

Rows

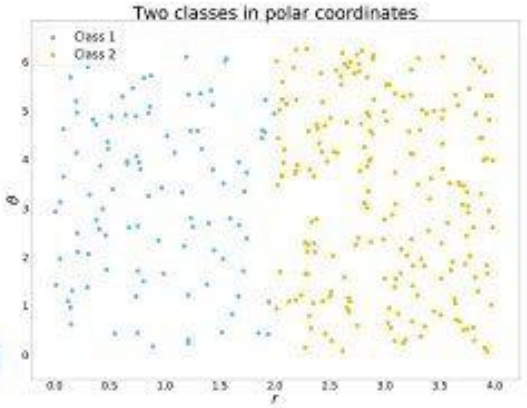
Size	Beds	Baths	Zip	Price
1100	1	1	64576	1.29
1900	3	1.5	78321	2.14
2800	3	3	98712	3.10
3400	4	3.5	25721	3.75

Columns

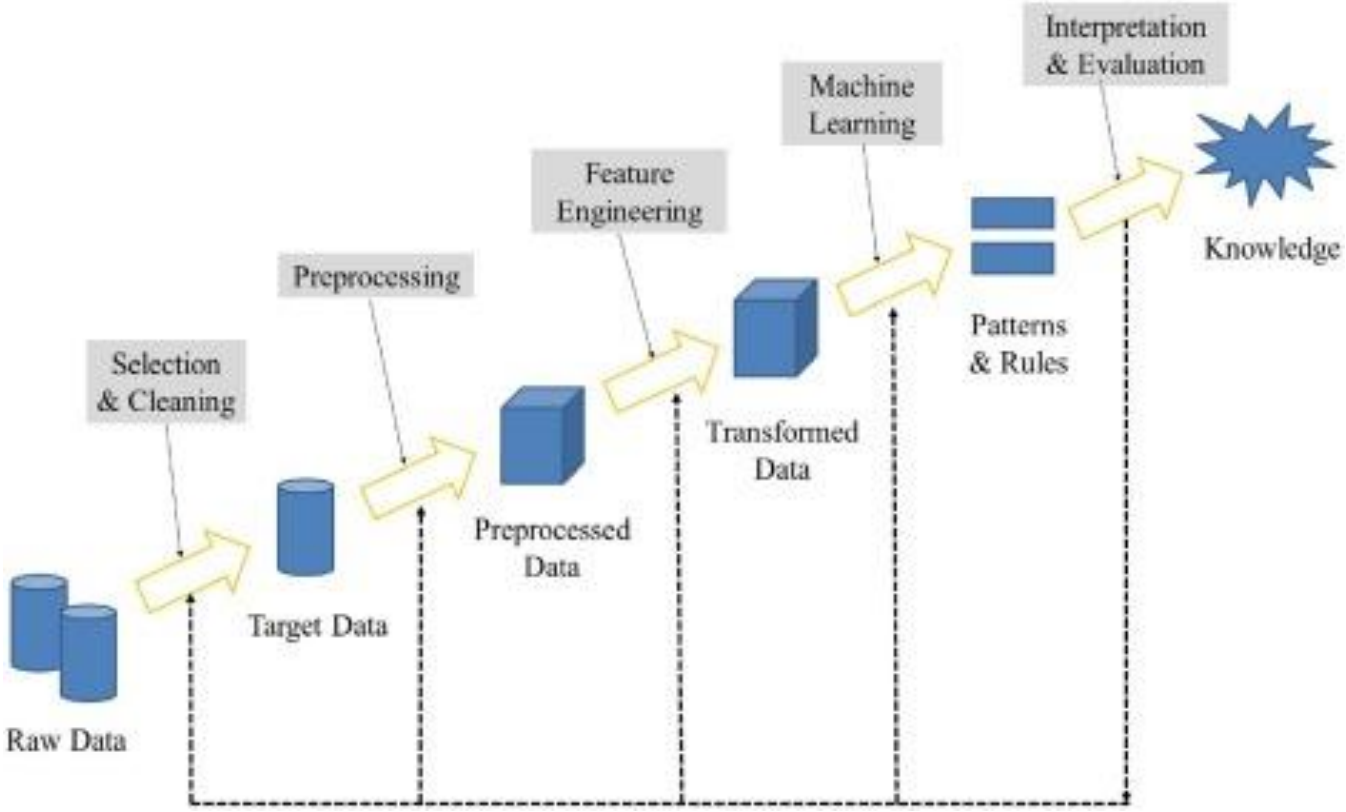


Tangled

Feature engineering



Transparent


Interpretation
& Evaluation
Machine
Learning
Feature
Engineering
Preprocessing
Selection
& Cleaning
Knowledge
Patterns
& Rules
Transformed
Data
Preprocessed
Data
Target Data
Raw Data

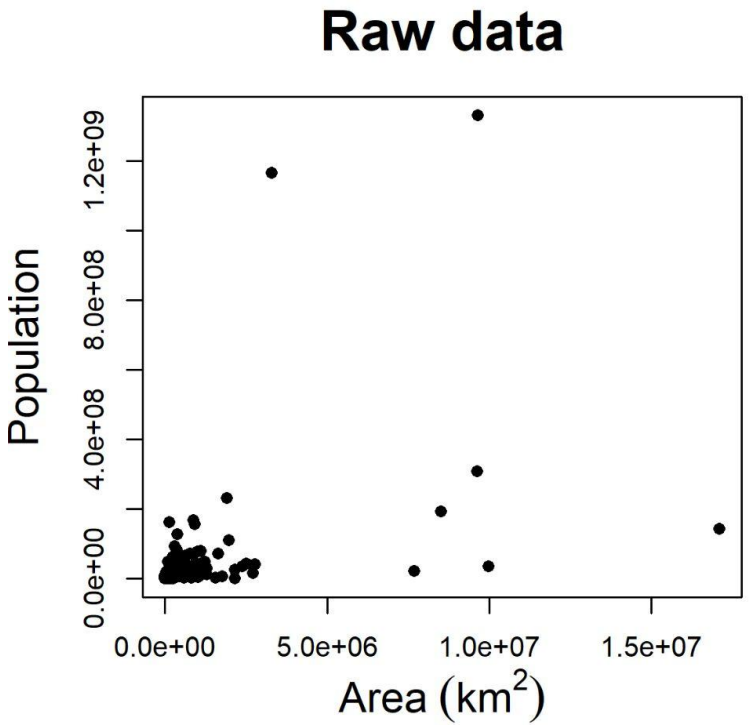
Missing Values

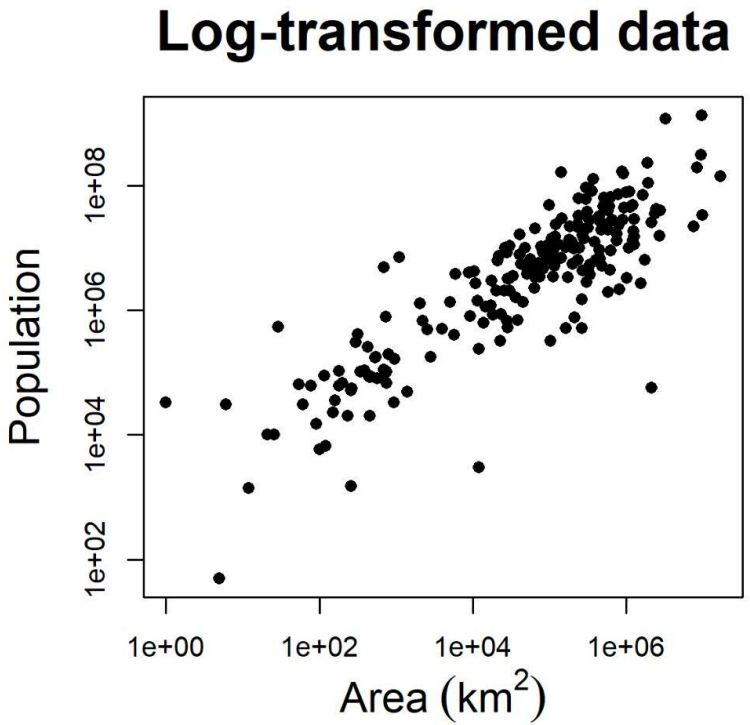
	col1	col2	col3	col4	col5
0	2	5.0	3.0	6	NaN
1	9	NaN	9.0	0	7.0
2	19	17.0	NaN	9	NaN

mean()

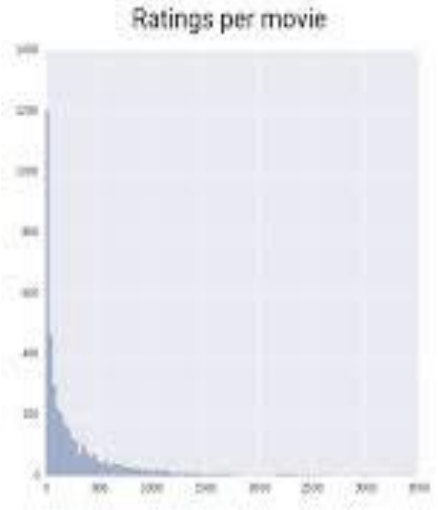
	col1	col2	col3	col4	col5
0	2.0	5.0	3.0	6.0	7.0
1	9.0	11.0	9.0	0.0	7.0
2	19.0	17.0	6.0	9.0	7.0

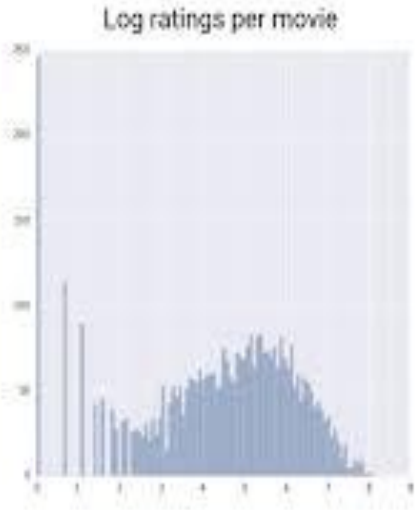
Transforming Features

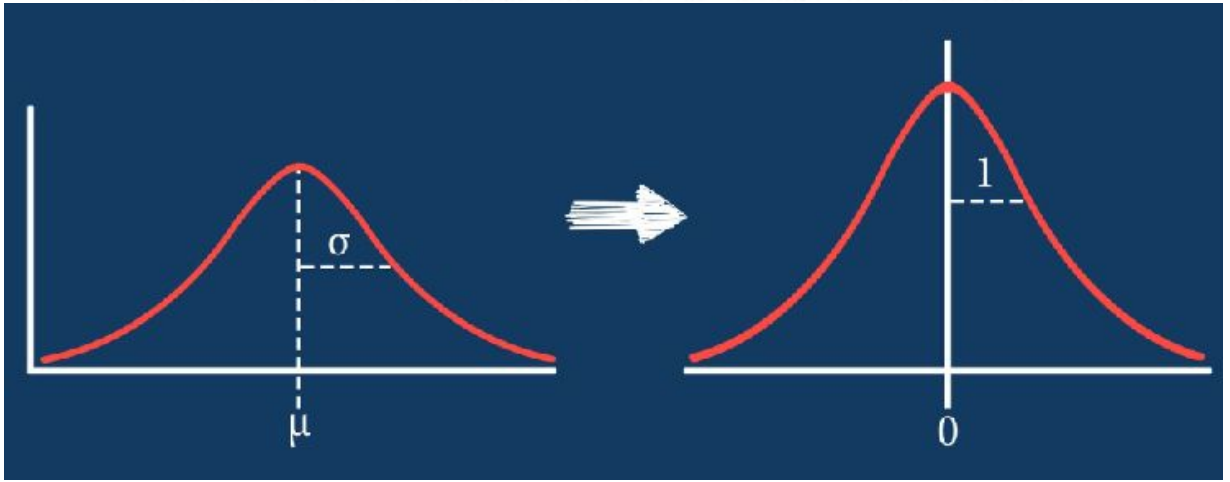




Scaling







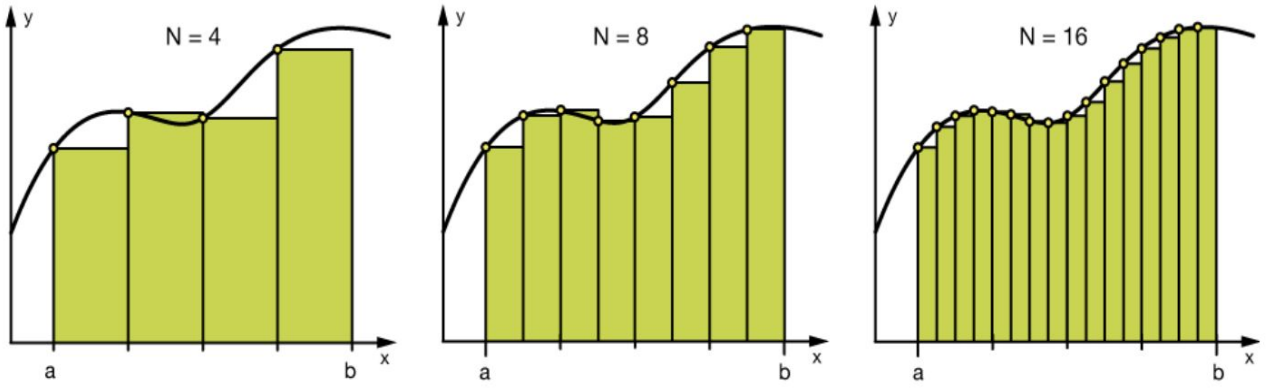
Bucketing

```
#Numerical Binning Example

Value      Bin
0–30   ->  Low
31–70  ->  Mid
71–100 ->  High

#Categorical Binning Example

Value      Bin
Spain  ->  Europe
Italy  ->  Europe
Chile  ->  South America
Brazil ->  South America
```



Encoding

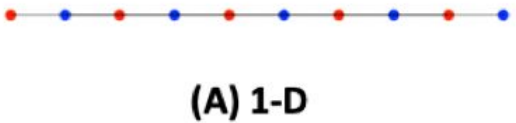
Label Encoding

Food Name	Categorical #	Calories
Apple	1	95
Chicken	2	231
Broccoli	3	50

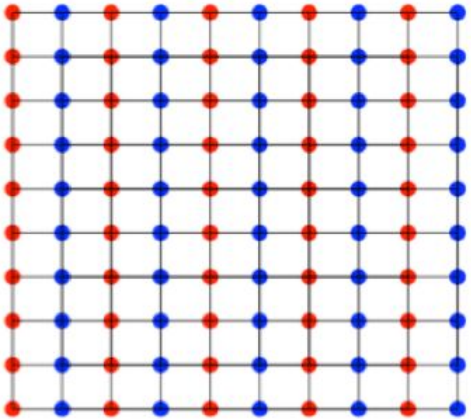
One Hot Encoding

Apple	Chicken	Broccoli	Calories
1	0	0	95
0	1	0	231
0	0	1	50

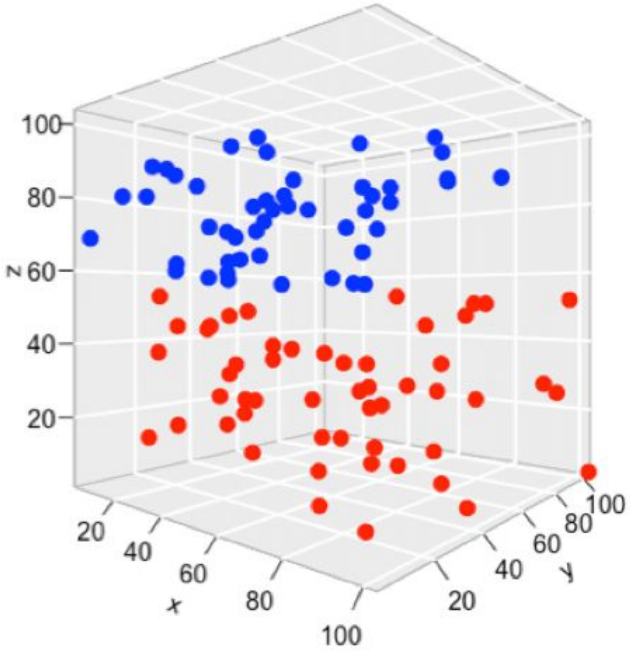
Curse of Dimensionality



(A) 1-D

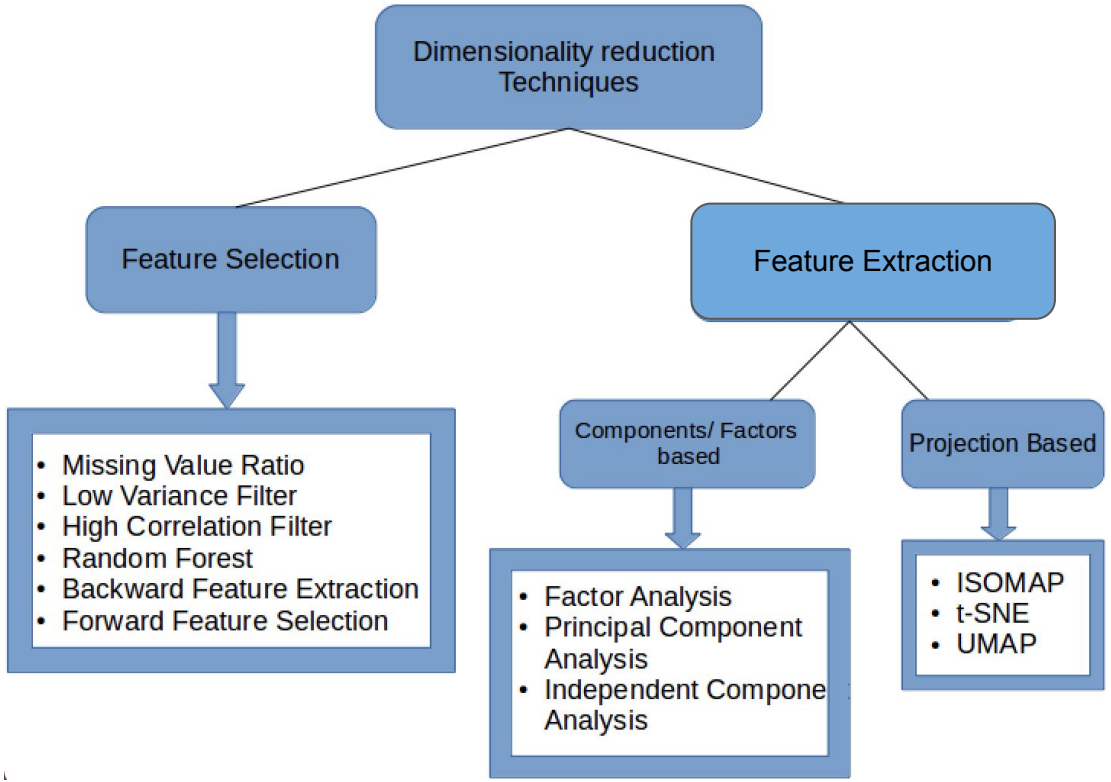


(B) 2-D



(C) 3-D

Dimensionality Reduction



Numerical

- **Standardization**

$$x_{\text{norm}} = \frac{x - \min(x)}{\max(x) - \min(x)}$$

- **Normalization**

$$X_{\text{normalized}} = \frac{(X - X_{\text{minimum}})}{(X_{\text{minimum}} - X_{\text{minimum}})}$$

- **Bucketing**

Age<18	19<=Age<30	30<=Age<40	Age>=40

Categorical

- **One-hot encoding**

Label Encoding

Food Name	Categorical #	Calories
Apple	1	95
Chicken	2	231
Broccoli	3	50

→ One Hot Encoding

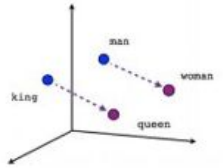
Apple	Chicken	Broccoli	Calories
1	0	0	95
0	1	0	231
0	0	1	50

- **TF-IDF**

$$w_{i,j} = tf_{i,j} \times \log\left(\frac{N}{df_i}\right)$$

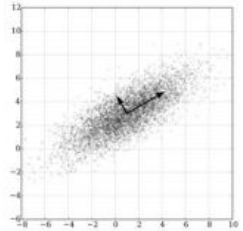
$tf_{i,j}$ = number of occurrences of i in j
df_i = number of documents containing i
N = total number of documents

- **Word embeddings**



Dimensionality Reduction

- **Principal component analysis (PCA)**



- **t-SNE**