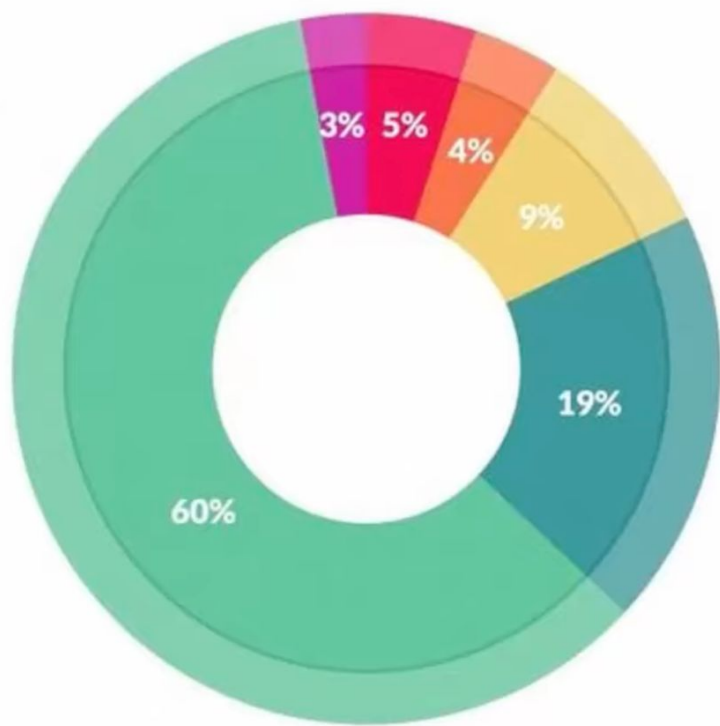


MICS 207

Applied Machine Learning For Cybersecurity

Summer 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 history](#)

Facts and features

Type: Single Family Residence
Parking: 2 Attached Garage spaces
Year built: 1974
HOA: \$90 monthly
Heating: Central
Lot: 0.40 Acres
Cooling: Central Air
Price/sqft: \$365

Interior details

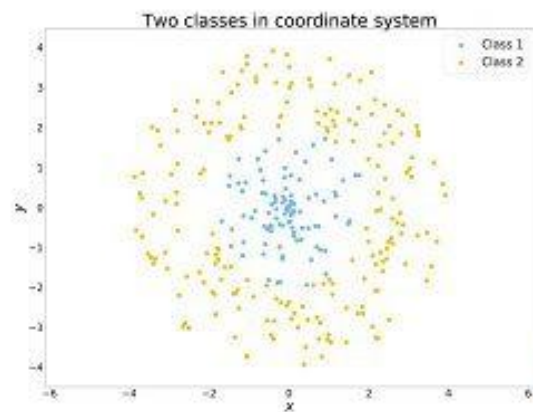
Bedrooms and bathrooms
Bedrooms: 4
Bathrooms: 3
Full bathrooms: 2
1/2 bathrooms: 1
Main level bathrooms: 1

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

Flooring
Flooring: Carpet, Laminate, Tile

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

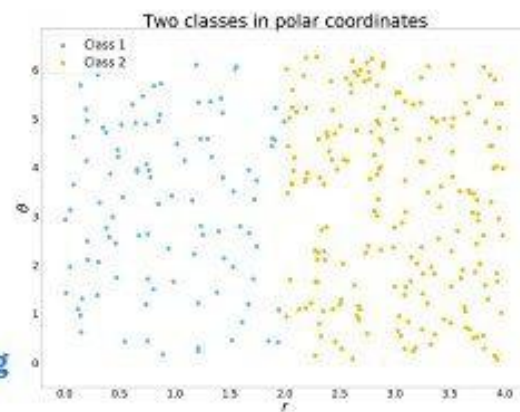
Features				Label
Size	Beds	Baths	Zip	Price
1100	1	1	64576	1.29
1900	3	1.5	78321	2.14
2800	3	3	98712	3.10
3400	4	3.5	25721	3.75



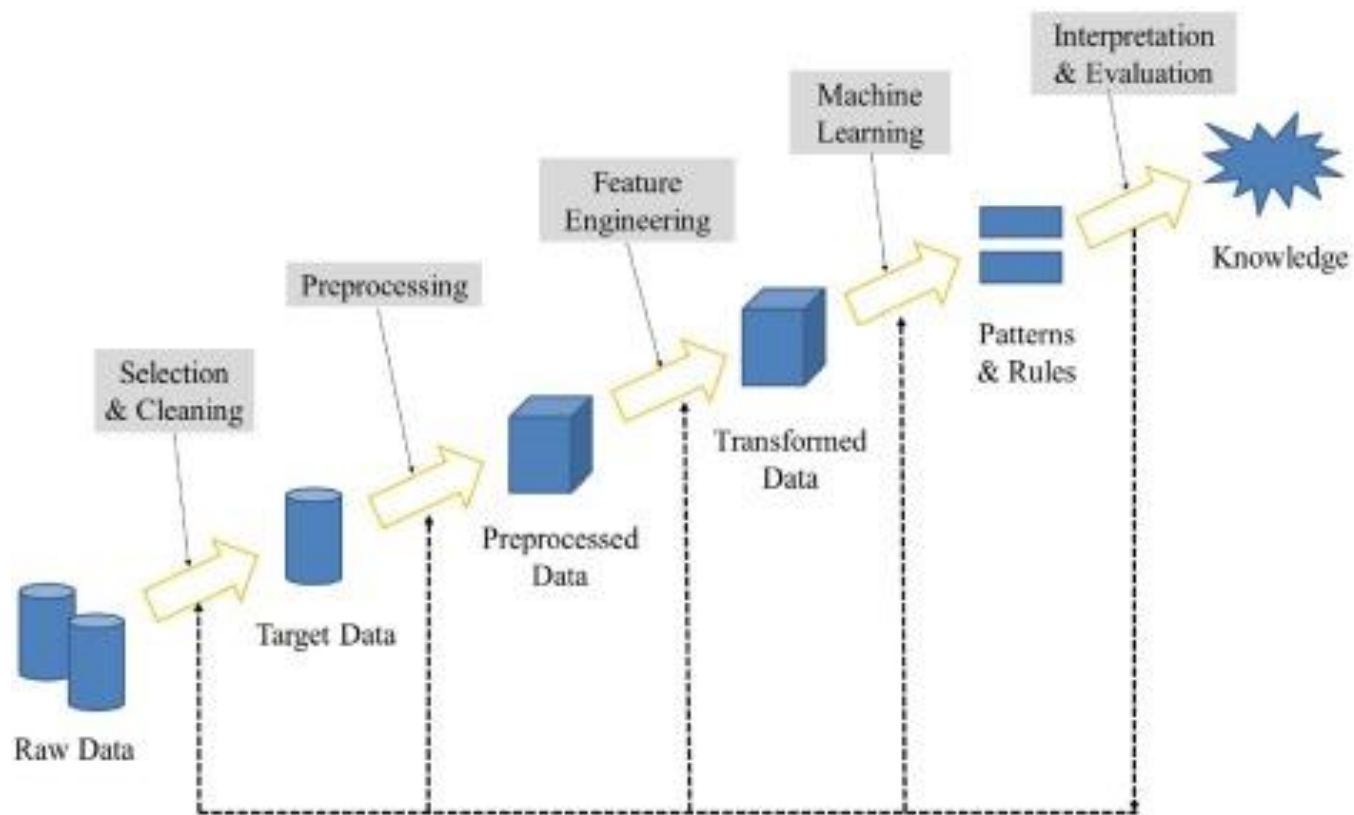
Tangled



Feature engineering



Transparent



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

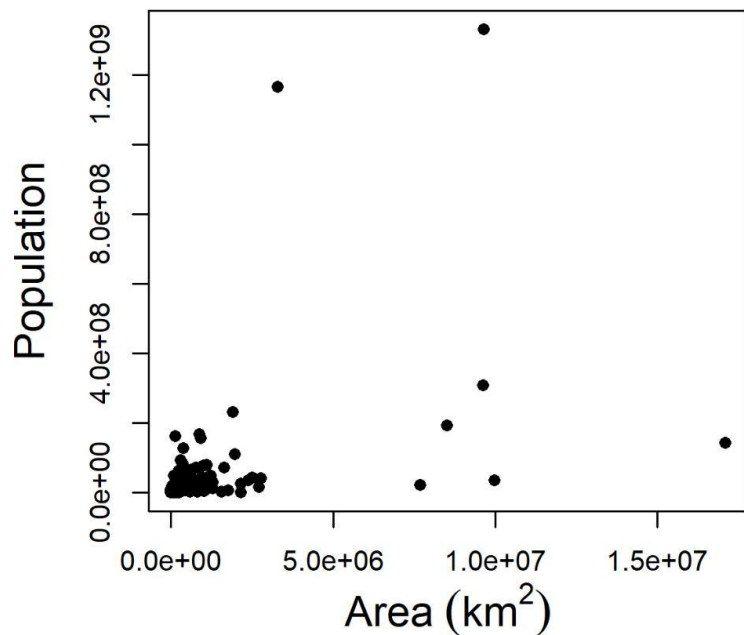
`mean()`



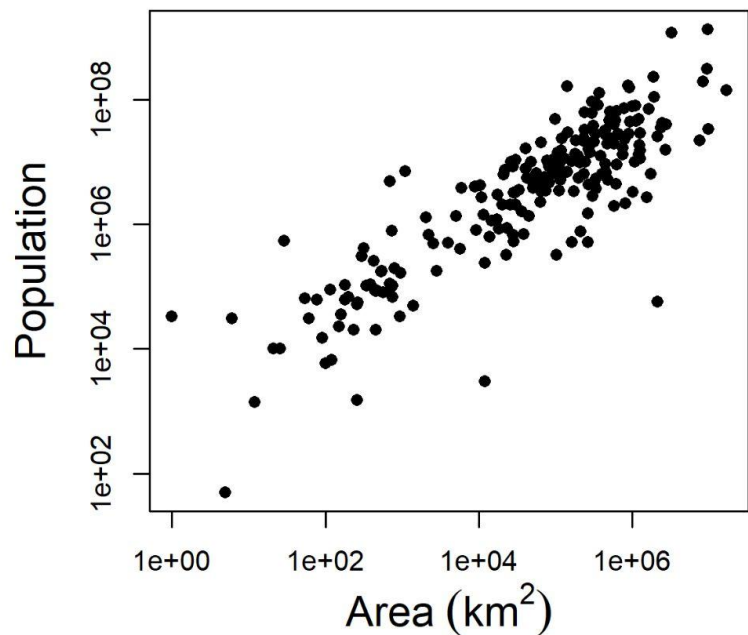
	col1	col2	col3	col4	col5
0	2.0	5.0	3.0	6.0	7.0
1	9.0	11.0	9.0	0.0	7.0
2	19.0	17.0	6.0	9.0	7.0

Transforming Features

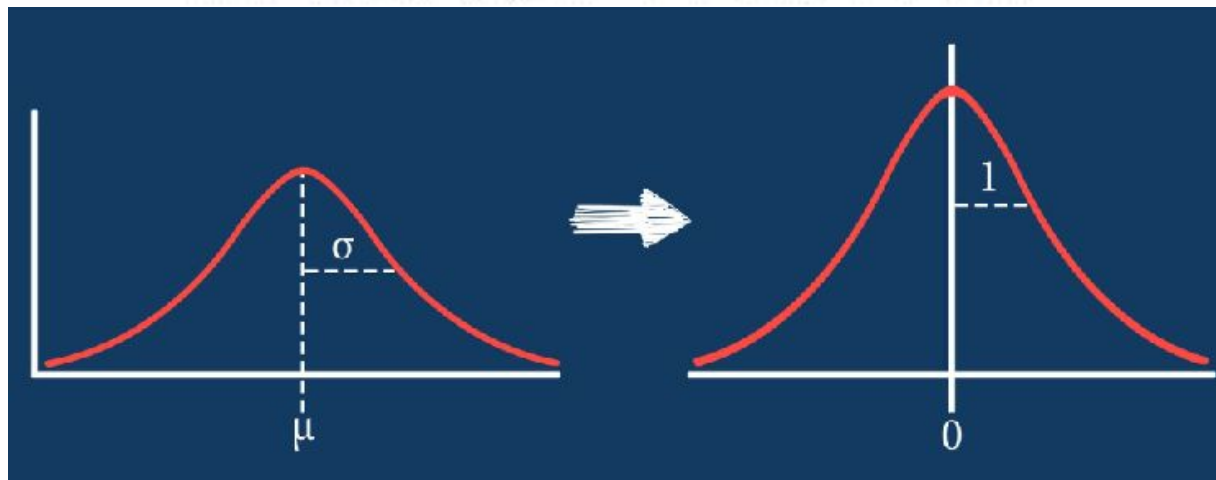
Raw data



Log-transformed data



Scaling



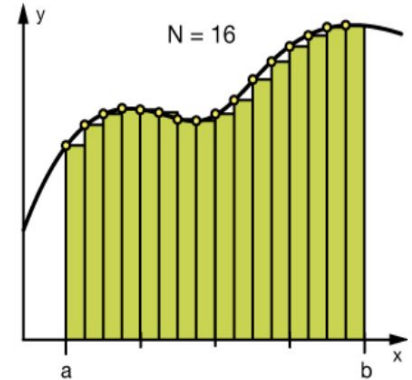
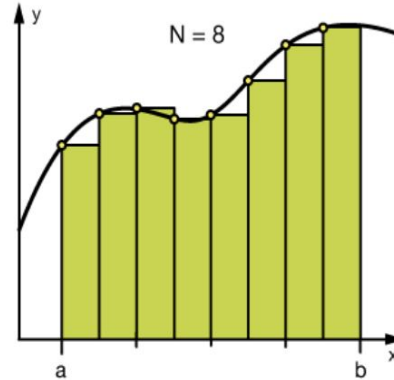
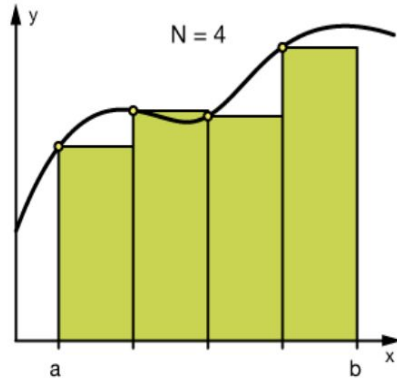
Bucketing

#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



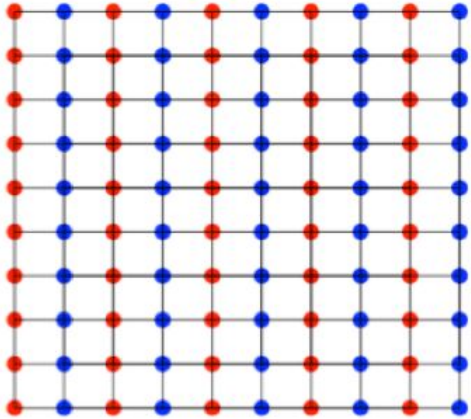
One Hot Encoding

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

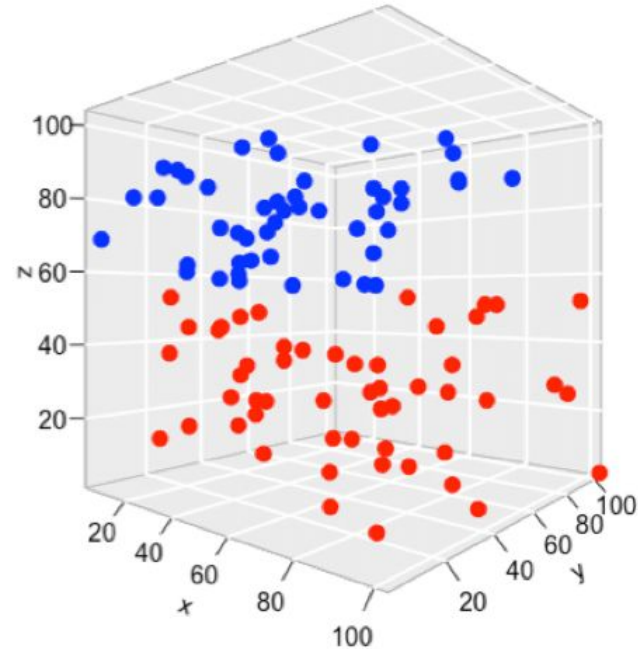
Curse of Dimensionality



(A) 1-D

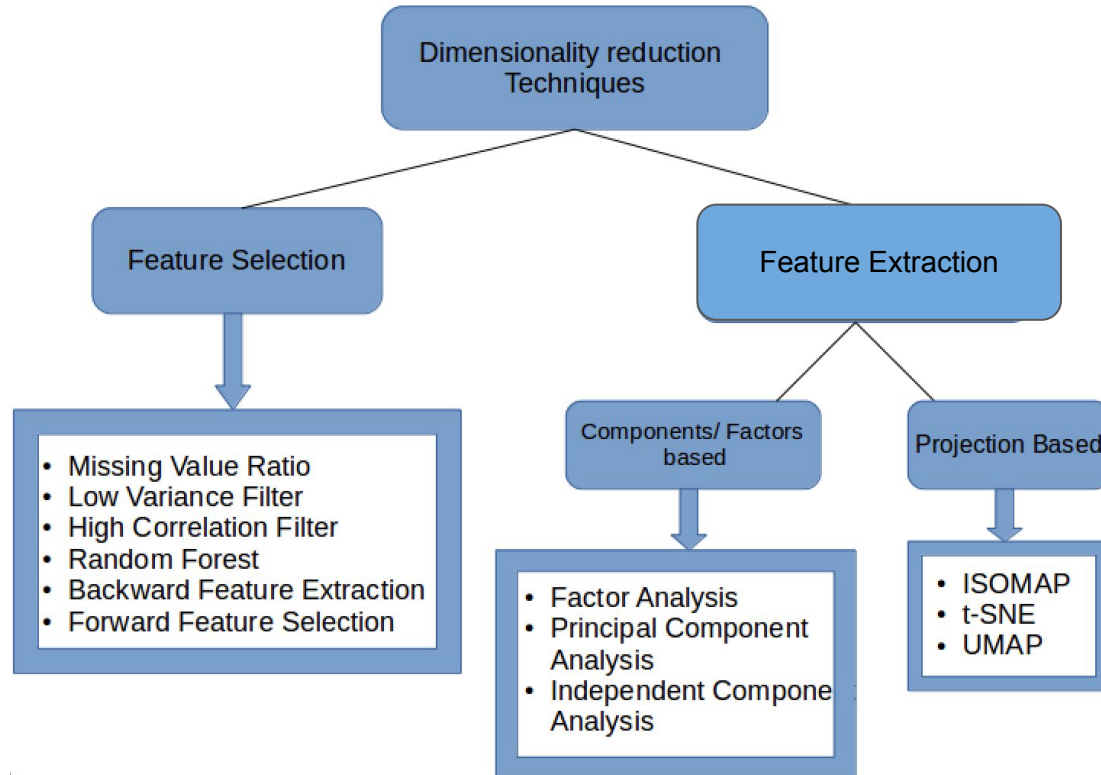


(B) 2-D



(C) 3-D

Dimensionality Reduction



Numerical

- Standardization

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

- Normalization

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

- Bucketing

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

- One-hot encoding

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

→

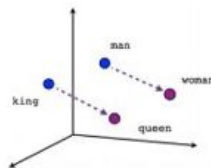
One Hot Encoding					
Apple	Chicken	Broccoli	Calories		
1	0	0	95		
0	1	0	231		
0	0	1	50		

- TF-IDF

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

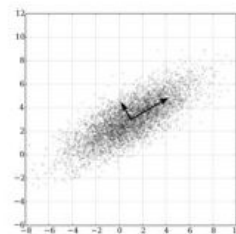
$tf_{i,j}$ = number of occurrences of i in j
 df_i = number of documents containing i
 N = total number of documents

- Word embeddings



Dimensionality Reduction

- Principal component analysis (PCA)



- t-SNE

