OUTLIER DETECTION

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THE PROBLEM

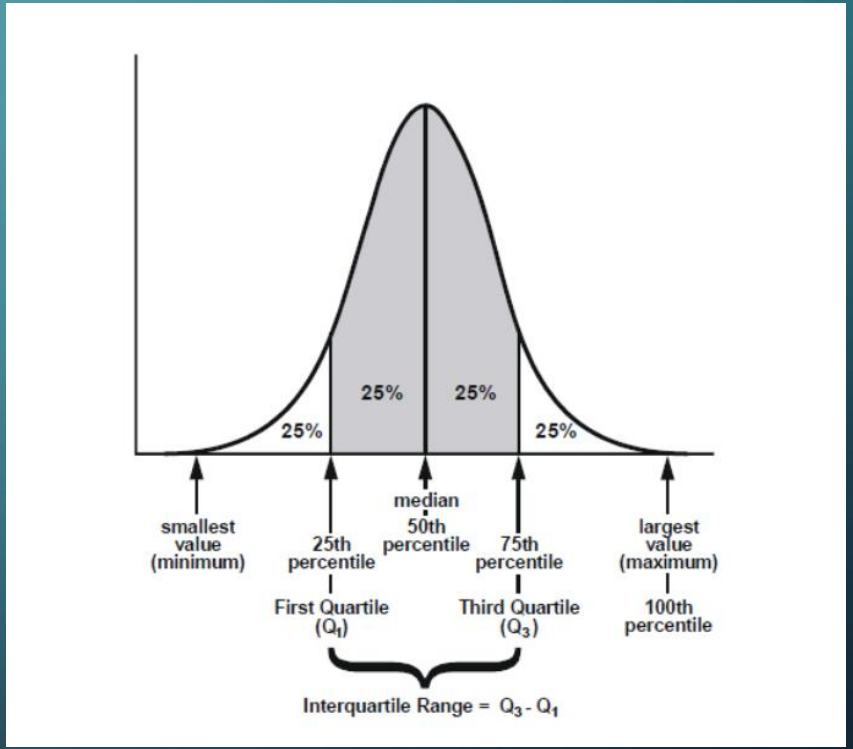
What is the problem?	• Existence of data points that deviate from the rest of the data
Why should this problem be solved?	• Can cause bias in results of data analysis • Affects the mean value of data
Causes of problem	• Errors • Genuine extreme values

PROBLEM SOLUTION

1. Detect Outliers in data
   - Exteme Value Analysis
   - Distance measures
   - Angle-based Outlier Degree
   - SmartSifter
   - AutoEncoder
2. Treat Outliers in data

EXTREME VALUE ANALYSIS

- Basic outlier detection method
- Find statistical tails in distribution of data
- Data points at extreme ends of tails are the outliers
- Use Gaussian distribution or
- Calculate inter-quantile range of data



DISTANCE MEASURES

Mahalanobis distance (MD)

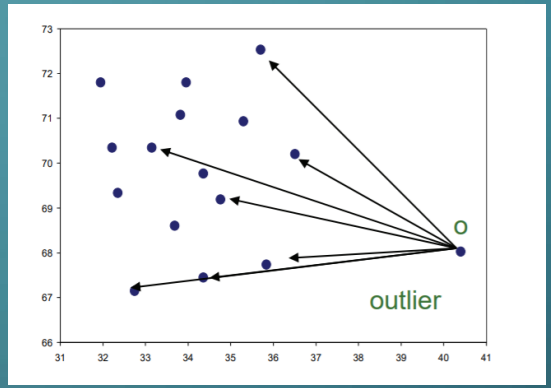
- "Distance between two points in multivariate space"
- Measures distance from central point
  - Central point – total mean of **ALL** the multivariate data
- The further away a data point is from the central point, the greater the MD

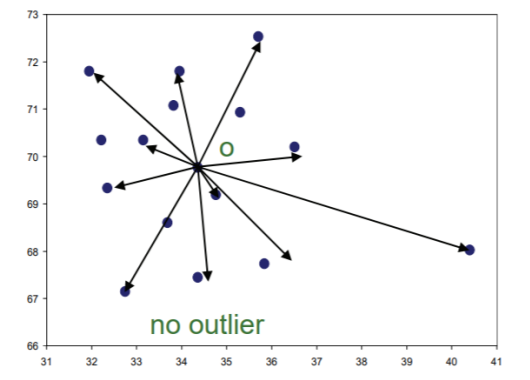
Cook's Distance (CD)

- Measures how much the expected outcome will change provided the current data point is dropped
- Common threshold value is 4 times the mean
- Therefore any change in expected outcome greater than the threshold can be considered influential

ANGLE-BASED OUTLIER DETECTION

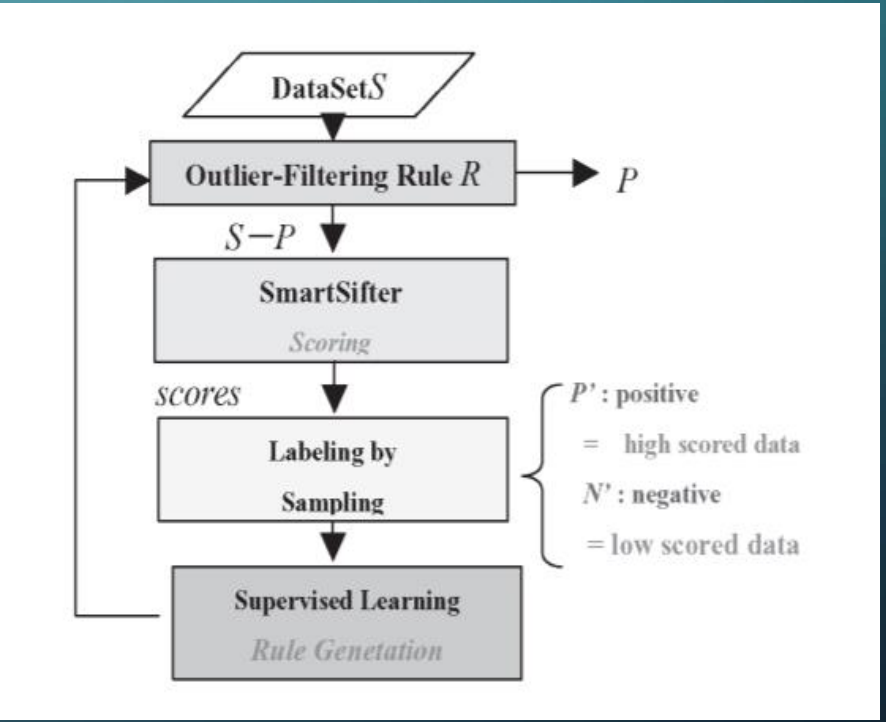
- Angles are more stable than distances when working with high-dimensional data
- Based on the variance of the angles between a point and all the other points in data set
- Outlier if majority of other data points are in similar direction
- Not outlier if other data points are in varying directions





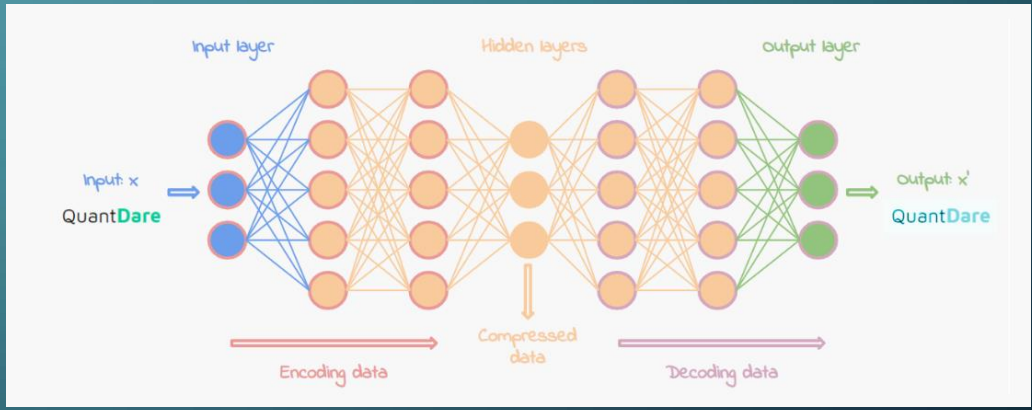
SMARTSIFTER

- Construct a model in which data is filtered through
- The model is probabilistic and it is affected by each data point passing through it
- Filter each data points successively through the model
- Data point is an outlier if the model changes significantly



AUTOENCODER

- Unsupervised artificial neural network
- Two stages: Encode & Decode
- Encode
  - Compresses data, removes noise/ unnecessary information
- Decode
  - Reconstructs data from compressed data
- Compressing data forces NN to only learn the important features (outliers are revealed when the main features are filtered out)



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