H2O.ai Algorithms

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Algorithms on H2O

Supervised Learning

Statistical Analysis

- **Penalized Linear Models**: Super-fast, super-scalable, and interpretable
- **Naïve Bayes:** Straightforward linear classifier

Decision Tree Ensembles

- **Distributed Random Forest**: Easy-to-use tree-bagging ensembles
- **Gradient Boosting Machine**: Highly tunable tree-boosting ensembles

Stacking

- **Stacked Ensemble**: Combine multiple types of models for better predictions

Unsupervised Learning

Clustering

- **K-means**: Partitions observations into similar groups; automatically detects number of groups

Dimensionality Reduction

- **Principal Component Analysis**: Transforms correlated variables to independent components
- **Generalized Low Rank Models:** Extends the idea of PCA to handle arbitrary data consisting of numerical, Boolean, categorical, and missing data

Aggregator

- **Aggregator:** Efficient, advanced sampling that creates smaller data sets from larger data sets

Neural Networks

Multilayer Perceptron

Deep Learning

- **Deep neural networks**: Multi-layer feed-forward neural networks for standard data mining tasks
- **Convolutional neural networks:** Sophisticated architectures for pattern recognition in images, sound, and text

Anomaly Detection

- **Autoencoders**: Find outliers using a nonlinear dimensionality reduction technique

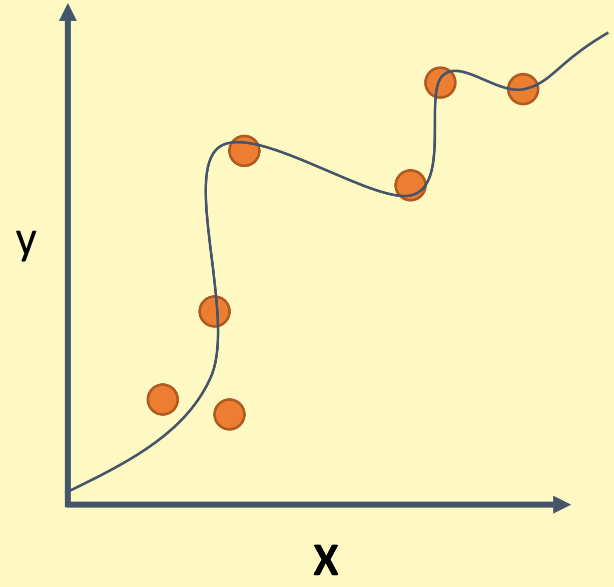
Term Embeddings

- **Word2vec:** Generate context-sensitive numerical representations of a large text corpus

Supervised Learning

Regression:

How much will a customers spend?

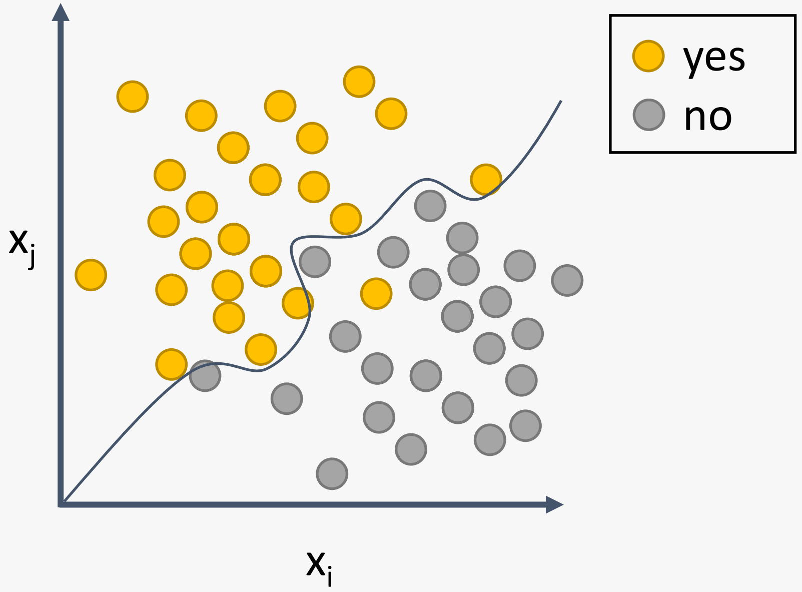


H_2O algos:

- Penalized Linear Models
- Random Forest
- Gradient Boosting
- Neural Networks
- Stacked Ensembles

Classification:

Will a customer make a purchase? Yes or No



H_2O algos:

- Penalized Linear Models
- Naïve Bayes
- Random Forest
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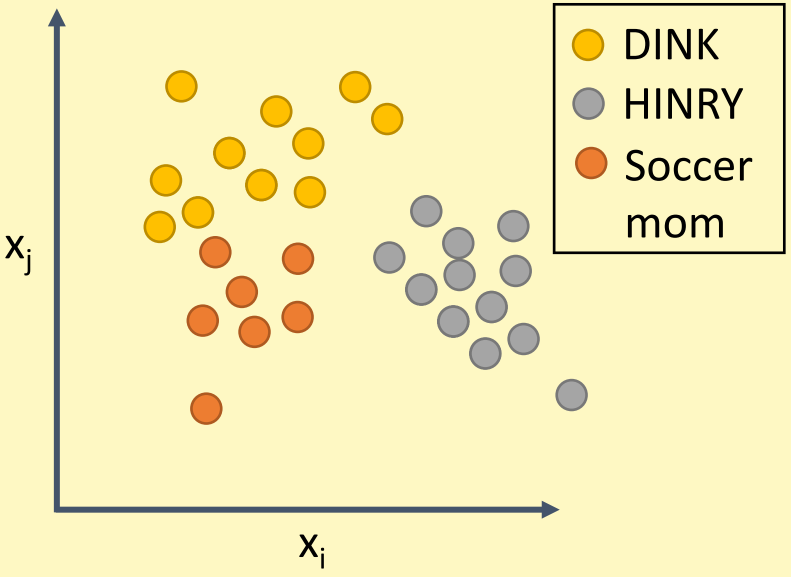
Unsupervised Learning

Clustering:

Grouping rows – e.g. creating groups of similar customers

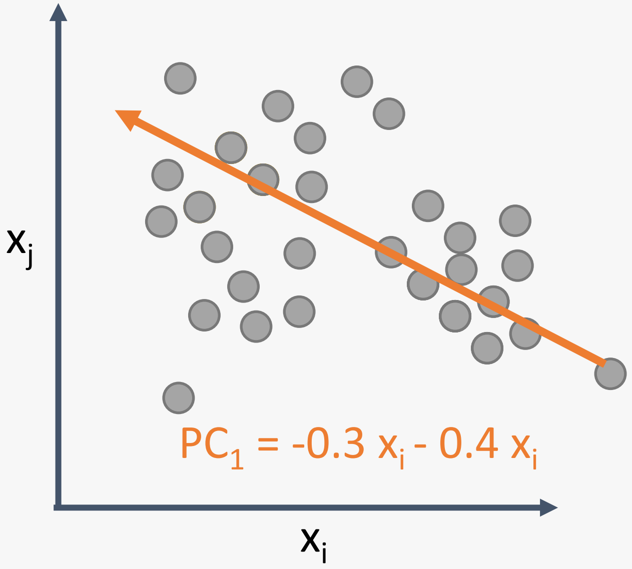


H_2O algos:

k – means

Feature extraction:

Grouping columns – Create a small number of new representative dimensions



H_2O algos:

Principal components

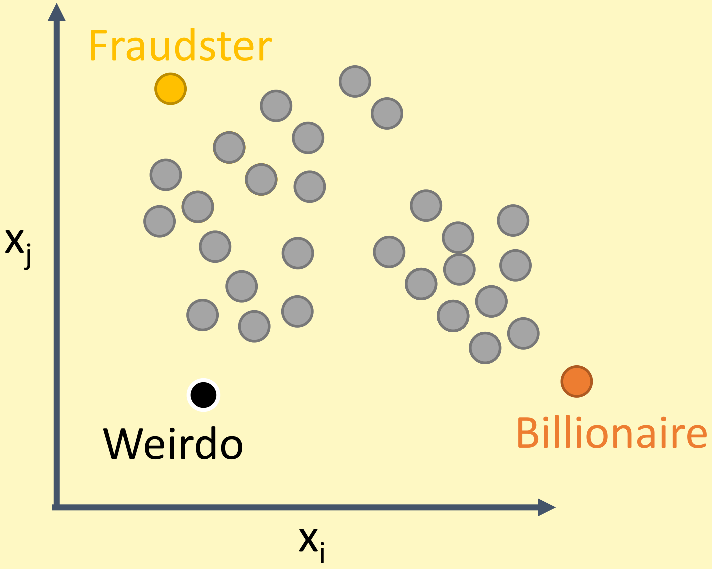
Generalized low rank models

Autoencoders

Word2Vec

Anomaly detection:

Detecting outlying rows - Finding high-value, fraudulent, or weird customers



H_2O algos:

Principal components

Generalized low rank models

Autoencoders

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	Usage	Recommendations	Problems
Penalized Linear Models	• Regression • Classification	• Creates interpretable models with super-fast training time • Nonlinear and interaction terms to be specified manually • Can extrapolate beyond training data domain • Select the correct target distribution • Few hyperparameters to tune	• NAs • Outliers/influential points • Strongly correlated inputs • Rare categorical levels in new data
Naïve Bayes	• Classification	• Nonlinear and interaction terms should be specified by users	• Linear independence assumption • Often less accurate than more sophisticated classifiers • Rare categorical levels in new data
Random Forest	• Regression • Classification	• Builds accurate models without overfitting • Few hyperparameters to tune • Requires less data prep • Great for implicitly modeling interactions	• Difficulty extrapolating beyond training data domain • Can be difficult to interpret • Rare categorical levels in new data
Gradient Boosting Machines	• Regression • Classification	• Builds accurate models without overfitting (often more accurate than random forest) • Requires less data prep • Great for implicitly modeling interactions	• Many hyperparameters • Difficulty extrapolating beyond training data domain • Can be difficult to interpret • Rare categorical levels in new data
Neural Networks (Deep learning & MLP)	• Regression • Classification	• Great for modeling interactions in fully connected topologies • Can extrapolate beyond training data domain • Deep learning architectures best-suited for pattern recognition in images, videos, and sound	• NAs • Overfitting • Outliers/influential points • Long training times • Difficult to interpret • Many hyperparameters • Strongly correlated inputs • Rare categorical levels in new data

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	Usage	Recommendations	Problems
k **- means**	• Clustering	• Great for creating Gaussian, non-overlapping, roughly equally sized clusters • The number of clusters can be unknown	• NAs • Outliers/influential points • Strongly correlated inputs • Cluster labels sensitive to initialization • Curse of dimensionality
Principal Components Analysis	• Feature extraction • Dimension reduction • Anomaly detection	• Great for extracting a number <= ***N*** of linear, orthogonal features from i.i.d. numeric data • Great for plotting extracted features in a reduced-dimensional space to analyze data structure, e.g. clusters, hierarchy, sparsity, outliers	• NAs • Outliers/influential points • Categorical inputs
Generalized Low Rank Models	• Feature extraction • Dimension reduction • Anomaly detection • Matrix completion • Recommender Systems	• Great for extracting linear features from mixed data • Great for plotting extracted features in a reduced-dimensional space to analyze data structure, e.g. clusters, hierarchy, sparsity, outliers • Great for imputing NAs • Great for creating recommendations	• Outliers/influential points
Autoencoders (Neural Networks)	• Feature extraction • Dimension reduction • Anomaly detection	• Great for extracting a number of nonlinear features from mixed data • Great for plotting extracted features in a reduced dimensional space to analyze structure, e.g. clusters, hierarchy, sparsity, outliers	• NAs • Overtraining • Outliers/influential points • Long training times • Many hyperparameters • Strongly correlated inputs • Rare categorical levels in new data
Word2Vec	• Highly representative feature extraction from text	• Great for extracting highly representative, context sensitive term embeddings (e.g. numerical vectors) from text • Great for text preprocessing prior to further supervised or unsupervised analysis	• Many Hyperparameters • Overtraining • Specifying term weightings prior to training • Long training times