

AWS SAGEMAKER BUILT-IN ALGORITHMS

2023 EDITION

SAGEMAKER BUILT-IN ALGORITHMS

Tabular

Text

Time-series

Vision

Unsupervised

**Reinforcement
Learning**

TABULAR ALGORITHMS

AutoGluon-
Tabular

CatBoost

Factorization
Machines

K-Nearest
Neighbors (k-NN)

LightGBM

Linear Learner

TabTransformer

XGBoost

TEXT ALGORITHMS

BlazingText
Word2vec

BlazingText
Text classification

Latent Dirichlet
Allocation (LDA)

Neural Topic
Model (NTM)

Object2Vec

Sequence-to-
Sequence

Text
Classification -
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TIME-SERIES ALGORITHMS

DeepAR
Forecasting

VISION ALGORITHMS

Image
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MXNet

Image
Classification -
TensorFlow

Object Detection -
MXNet

Object Detection -
TensorFlow

Semantic
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UNSUPERVISED ALGORITHMS

IP Insights

K-Means

Principal
Component
Analysis (PCA)

Random Cut
Forest (RCF)

Supervised LINEAR LEARNER

Learns a linear function / linear threshold function, and maps a high-dimensional vector x to an approximation of the numeric label y .

- Regression
- Binary / multiclass classification

Use cases

- Predict quantitative value based on given numeric input
 - *Estimate this year's ROI, based on last 5 years ROI*
- Discrete binary classification
 - *Based on past customer response, should I mail this customer or not?*
- Discrete muticlass classification
 - *Based on past customer response, how should I reach the customer? Email, DM or a phone call?*

Supervised FACTORIZATION MACHINES

Captures interaction between features within high dimensional sparse datasets.

- Regression
- Binary classification

Use cases

- High dimensional sparse datasets
 - *Use given known information about the person viewing the page based on click-stream data to calculate which ad user will click on*
- Recommendation engine
 - *What to recommend based on user's history?*

Supervised

K-NEAREST NEIGHBORS (KNN)

Regression: finds K closest points to the sample point and returns the average of the feature values.

Classification: queries K points closest to the sample point and returns most frequently used label as the predicted label.

- Regression
- Classification

Use cases

- Credit ratings
 - *Group people together to credit risk based on attributes of known credit usage they share with others*
- Recommendation engine
 - *Find recommendations based on similar likes*

Supervised

XGBOOST

Predicts a target variable by combining an ensemble of estimates from a set of simpler and weaker models.

- Regression
- Classification
- Ranking

Use cases

- Fraud detection
 - *Map input transaction to the probability that it is fraudulent based on dataset of past transactions and information if they were fraudulent*
- Ranking
 - *Return relevance scores for searched products in an e-commerce system based on search results, clicks, and past purchases*

Supervised

AUTOGLUON

Trains highly accurate machine learning models on an unprocessed tabular dataset.

Use cases

- Automate data preparation, feature engineering, model selection, and hyperparameter tuning
- Hyperparameter optimization
- Transfer learning: leverage pre-trained models to quickly build high-performing models on new datasets
- Highly scalable: train models on large datasets using distributed computing resources

Supervised

CATBOOST

An open-source implementation of the Gradient Boosting Decision Tree (GBDT) algorithm.
Predicts a target variable by combining an ensemble of estimates from a set of simpler and weaker models.

Use cases

- Predictive modeling
- Anomaly detection
- Personalization
- Image classification

Supervised

LIGHTGBM

An implementation of the Gradient Boosting Decision Tree (GBDT) algorithm that attempts to accurately predict a target variable by combining an ensemble of estimates from a set of simpler and weaker models.

Use cases

- Predictive modeling: binary classification, multi-class classification, and regression. Particularly useful for datasets with many categorical features.
- Ranking: search engine ranking or recommendation systems
- Anomaly detection: network traffic data or financial transactions
- Image classification

Supervised

TABTRANSFORMER

A novel deep tabular data modeling architecture for supervised learning. The TabTransformer architecture is built on self-attention-based Transformers.

Use cases

- Predictive modeling: binary classification, multi-class classification, and regression. Useful for datasets with a mix of categorical and numerical features
- Time series forecasting
- Anomaly detection: fraudulent transactions or network intrusion attempts
- Personalized recommendation systems

Unsupervised

K-MEANS

Finds discrete groupings within data, where members of a group are as similar as possible to one another and as different as possible from members of other groups. Euclidean distance between these points represents similarity of observations.

- Clustering

Use cases

- Group similar objects/data together
 - *Find high-, medium-, and low-spending customers from their transaction histories*
- Handwriting recognition
- Analog audio classification

Unsupervised

RANDOM CUT FOREST

Detects anomalous data points within a data set and associates an anomaly score with each data point. Low score values indicate that the data point is considered "normal." High values indicate the presence of an anomaly in the data.

- Anomaly detection

Use cases

- Fraud detection
 - *Detect suspicious financial transaction by unusual amount / time / location and flag it for a closer look*
- Quality control
 - *Analyze an audio test pattern played by a high-end speaker system for any unusual frequencies*

Supervised

IMAGE CLASSIFICATION

Takes an image as input and outputs one or more labels assigned to that image. Uses a convolutional neural network (CNN) that can be trained from scratch or trained using transfer learning when a large number of training images are not available.

- Multi-label classification

Use cases

- Label/tag an image based on the content of the image
 - *Alert about adult content in an image*

Supervised

OBJECT DETECTION

Takes images as input and identifies all instances of objects within the image scene. The object is categorized into one of the classes in a specified collection with a confidence score that it belongs to the class. Its location and scale in the image are indicated by a rectangular bounding box.

● Object detection and classification

Use cases

- Detect people and objects in an image
 - *Police review a large photo gallery for a missing person*

Supervised

SEMANTIC SEGMENTATION

Tags every pixel in an image with a class label from a predefined set of classes.

- Computer vision

Use cases

- Computer vision
 - *Self-driving cars to identify objects in their way*
 - *Robot sensing*
- Medical imaging diagnostics

Supervised

IMAGE CLASSIFICATION - MXNET

A supervised learning algorithm that supports multi-label classification. It takes an image as input and outputs one or more labels assigned to that image.

Use cases

- Object recognition: classify images to perform image search, autonomous driving, and surveillance
- Medical image analysis: classify medical images, such as X-rays and MRIs, into diagnoses for medical diagnosis and treatment planning
- Quality control: classify images based on quality to identify defects in manufactured products
- Environmental monitoring: classify images from satellite imagery or drones to track wildlife

Supervised

IMAGE CLASSIFICATION - TENSORFLOW

A supervised learning algorithm that supports transfer learning with many pretrained models from the TensorFlow Hub. Use transfer learning to fine-tune one of the available pretrained models on your own dataset.

Use cases

- Object recognition: classify images to perform image search, autonomous driving, and surveillance
- Medical image analysis: classify medical images, such as X-rays and MRIs, into diagnoses for medical diagnosis and treatment planning
- Quality control: classify images based on quality to identify defects in manufactured products
- Environmental monitoring: classify images from satellite imagery or drones to track wildlife

Supervised

OBJECT DETECTION - MXNET

A supervised learning algorithm that detects and classifies objects in images using a single deep neural network. It takes images as input and identifies all instances of objects within the image scene.

Use cases

- Autonomous driving: detect and track objects such as cars, pedestrians, and traffic signals in autonomous vehicles and advanced driver assistance systems (ADAS)
- Surveillance: detect and track objects such as people, vehicles, and animals
- Robotics: detect and locate objects such as parts and tools in robotics applications
- Quality control: detect defects in manufactured products by detecting and localizing anomalies

Supervised

OBJECT DETECTION - TENSORFLOW

A supervised learning algorithm that supports transfer learning with many pretrained models from the TensorFlow Model Garden.

Use cases

- Security and Surveillance: detect potential threats, such as suspicious individuals or objects
- Autonomous Vehicles: detect objects, such as other vehicles, pedestrians, and obstacles
- E-commerce: automatically detect and categorize products in images
- Healthcare: analyze medical images, such as X-rays and MRI scans, to detect abnormalities and assist in diagnosis

Unsupervised LATENT DIRICHLET ALLOCATION (LDA)

Describes a set of observations as a mixture of distinct categories to discover a user-specified number of topics shared by documents within a text corpus. The topics are not specified up front, and are not guaranteed to align with how a human may naturally categorize documents.

Use cases

- Article recommendations based on similarity
 - *Recommend articles on similar topics which you read or rated in the past*
- Musical influence modelling
 - *Explore which musical artists over time were truly innovative and those who influenced from the first ones*

Unsupervised NEURAL TOPIC MODEL (NTM)

Organizes a corpus of documents into topics that contain word groupings based on their statistical distribution. The semantics of topics are usually inferred by examining the top ranking words they contain. Only the number of topics, not the topics themselves, are prespecified. The topics are not guaranteed to align with how a human might naturally categorize documents.

Use cases

- Classify or summarize documents based on the topics detected
 - *Tag a document as belonging to a medical category based on the terms used in the document*
- Retrieve information or recommend content based on topic similarities

Supervised SEQUENCE TO SEQUENCE (SEQ2SEQ)

Converts a sequence of tokens (for example, text, audio) and the output generated is another sequence of tokens.

- Machine translation
- Text summarization
- Speech-to-text

Use cases

- Machine translation
 - *Convert text from Spanish to English*
- Text summarization
 - *Summarize a long text corpus: an abstract for a research paper*
- Speech-to-text
 - *Convert audio files to text: transcribe call center conversations for further analysis*

Supervised TEXT CLASSIFICATION - TENSORFLOW

A supervised learning algorithm that supports transfer learning with many pretrained models from the TensorFlow Hub. Use transfer learning to fine-tune one of the available pretrained models on your own dataset.

Use cases

- Sentiment analysis: classify text into sentiment categories to analyze customer feedback, social media posts, and product reviews
- Topic modeling: classify text into different topics to organize large amounts of text data and extracting insights from them
- Spam detection: classify emails into spam and non-spam categories to filter unwanted messages
- Language detection: classify text into different languages

Unsupervised BLAZING TEXT (WORD2VEC)

Used for natural language processing (NLP) tasks.
Maps words to high-quality distributed vectors
and captures the semantic relationships between
words.

Use cases

- Sentiment analysis
 - *Evaluate customer comments based on positive / negative sentiment*
- Named entity recognition
- Machine translation

Supervised BLAZING TEXT (TEXT CLASSIFICATION)

Useful for web searches, information retrieval, ranking, and document classification.

Assigns a set of predefined categories to open-ended text. Can be used to organise and categorise almost all kind of text.

Use cases

- Document classification
 - *Review a large collection of documents and detect if they contain sensitive data like personal information or trade secrets*
 - *Categorize books in a library into academic disciplines*
- Web searches
- Information retrieval
- Ranking

Supervised

OBJECT2VEC

Generalizes Word2Vec embedding technique for words. Converts high-dimensional objects into low-dimensional space while preserving the semantics of the relationship between the pairs in the original embedding space.

Use cases

- Rating prediction
 - *Predict movie popularity based on rating similarity*
- Document classification
 - *What genre is the book based on its similarity to known genres?*
 - *Identify duplicate support tickets and find the correct routing based on similarity of text in the tickets*

Unsupervised

IP INSIGHTS

IP anomaly detection. Learns the usage patterns for IPv4 addresses capturing associations between IP addresses and various entities such as user id / account number.

Use cases

- Tiered authentication model
 - *Dynamically trigger 2-factor authentication routine if user logs from an anomalous IP*
- Fraud detection / prevention
 - *Permit only certain activities if the IP is unusual*

Supervised

DEEPAR

Forecasts scalar (one-dimensional) time series using recurrent neural networks (RNN) on multiple sets of historic data. Extrapolates the time series into the future.

Use cases

- Forecasting new product sales
 - *Predict sales on a new product based on previous sales data from other products*
- Predict labor needs for special events
 - *Use labor utilization rates at another distribution centre to predict the required level of staffing for a brand new center*

Unsupervised

PRINCIPAL COMPONENT ANALYSIS (PCA)

Attempts to reduce the dimensionality (number of features) within a dataset while still retaining as much information as possible. Finds a new set of features called components, which are composites of the original features that are uncorrelated with one another.

Use cases

- Feature engineering: dimensionality reduction
 - *Drop those columns from a dataset that have a weak relation with the label/target variable: the color of a car when predicting its mileage*

REINFORCEMENT LEARNING

An area of machine learning concerned with how intelligent agents ought to take actions in an environment in order to maximize the notion of cumulative reward.

Use cases

- Autonomous vehicles
 - *Model can learn through iterations of a trial and error in a simulation. Once the model is good enough, it can be tested in a real vehicle on a test track*
- Intelligent HVAC control system
 - *Model learns about impact of a sunlight and equipment efficiency to optimize temperature control for lowest energy consumption*

THANK YOU!



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