

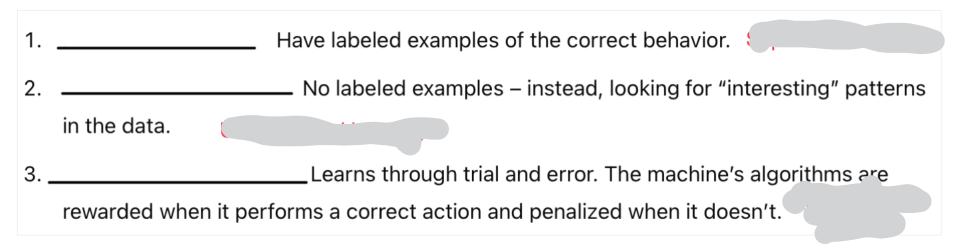
is what you want the machine to achieve. It's the primary goal of the learning process.
that the machine learns from. This data provides examples or instances for the machine to develop a model or understanding.
doing its task after being trained on the experience. It's essentially a measure of its accuracy, efficiency, and overall capability to perform its task.

_____ program an algorithm to automatically learn from data, or from experience

- Why might you want to use a learning algorithm?
- hard to code up a solution by hand (e.g. vision, speech)
- system needs to adapt to a changing environment (e.g. spam detection)
- want the system to perform better than the human programmers

What is the difference between traditional programming and machine learning

Aspect	Traditional Programming	Machine Learning
Data	Predefined and static datasets.	Dynamic, real-time, and historical.
Flexibility	Fixed and rigid.	Adaptive to changes.
Methodology	Hardcoded rules.	Data-driven predictions.
Adaptability	Limited; struggles with unforeseen cases.	Highly adaptive to new scenarios.
Efficiency	Resource-intensive for complex tasks.	Optimized for real- time problems.
Goal	Solve predefined problems.	Learn and improve over time.



Machine Learning Types and Examples

- 1. Supervised Learning
- Classification

Example: Image Classification, Identity Fraud Detection, Customer Retention, Diagnostics.

- Regression

Example: Advertising Popularity Prediction, Weather Forecasting, Market Forecasting, Estimating Life Expectancy, Population Growth Prediction.

- 2. Unsupervised Learning
- Clustering

Example: Customer Segmentation, Targeted Marketing, Recommender Systems.

- Dimensionality Reduction

Example: Big Data Visualization, Meaningful Compression, Structure Discovery, Feature Elicitation.

- 3. Reinforcement Learning
- Learning Tasks

Example: Real-Time Decisions, Game AI, Robot Navigation, Skill Acquisition.

This categorization highlights tasks and examples of each machine learning type for better understanding.

is an area of ML that focuses on unifying ML

with artificial intelligence.

Machine learning concept and terminology

- Data: forms the main source of learning in machine learning.
- + It can be structured (e.g., tables) or unstructured (e.g., images, text).
- + Features (columns) and instances (rows) are fundamental components of datasets.
- Task: is the problem that the ML algorithm is designed to solve.
- + It defines the goal, and the performance is measured based on how well the task is achieved.
- Algorithms: are the methods or processes applied to data to create models.
- + Different algorithms are suited for different tasks and datasets.

Models: are the outputs of algorithms applied to datasets.

- + They represent the learned patterns or relationships in the data.
- + Models can be logical, geometric, or probabilistic.

——— a subset of att	ributes used to describe a property of data.	
For example.		_ '
Data Types:	A data dimension consists of three attributes: day, month, year	
Attributos or fo	atures can have different data types such as:	

- Attributes or features can have different data types, such as:
 - Categorical (for example: young, old),
 - Ordinal (for example: 0, 1),
 - Numeric (for example: 1.3, 2.1, 3.2, and so on).
- Refers to the data examples that are used to learn or build a classifier.
 - Refers to the data examples that are verified against the built classifier and can help tune the accuracy of the output.
- Refers to the data examples that help assess the overall performance of the classifier.

What is the difference between testing dataset and validation dataset?

Aspect	Validation Dataset	Testing Dataset
Purpose	Tunes the model parameters.	Evaluates the final model's accuracy.
When Used	During development.	After finalizing the model.
Modifications	Model can be adjusted based on results.	No adjustments are made.
Outcome	Optimizes performance.	Confirms generalization capability.

is usually the raw form of the data.

It consists of samples of natural or human-created artifacts. For example, video streams, audio, photos, and tweets.

expensive to obtain than the unlabeled raw data.

Machine learning phases

Phase	Description	Output
Phase 1 - Training	Uses training data to pair inputs with expected outputs to build the model.	A trained learning model.
Phase 2 - Validation and Testing	Measures the model's performance using validation/testing datasets, estimating metrics like accuracy and precision.	A refined and validated model.
Phase 3 - Application	Applies the model to real-world data to derive results and predictions.	Real-world outputs and predictions.

Machine learning process

- 1. ML Problem Framing
- 2. Data Collection
- 3. Data Integration
- 4. Data Preparation and Cleaning
- 5. Data Visualization and Analysis
- 6. Feature Engineering (or Feature Augmentation if required)7. Model Training and Parameter Tuning
- 8. Model Evaluation
- Condition Are Business Goals Met?
- * Yes: Proceed to Model Deployment.
- * No: Return to Feature Augmentation, Data Augmentation
- 9. Model Deployment
- 10. Monitoring and Debugging

Examples of ML problems

Example	Description
Image Recognition	Machine learning algorithms analyze images to identify objects, people, or patterns. Applications include healthcare (diagnosing diseases), retail (categorizing products), and security (detecting threats).
Spam Detection	ML algorithms classify emails as spam or not spam based on rules derived from features of the email data.
Digit Recognition	Interprets handwritten numbers (e.g., zip codes) and groups them for faster processing.
Fraud Detection	Identifies anomalies in transactional data to detect fraud in industries like finance, healthcare, and e-commerce.
Predictive Maintenance	Analyzes sensor and maintenance data to predict equipment failures, reducing downtime and optimizing performance.
Speech Recognition	Automated systems interpret and execute user requests by mapping them to specific tasks (e.g., call center automation).
Face Detection	Tags and categorizes individuals across digital photographs; widely used in social media and photo management applications.

Real world ML applications

Application	Description
Speech Recognition	Natural language understanding in narrowly bounded domains.
Image Recognition	Identifies objects, people, or patterns in images.
Driving Assistance	Enables vehicles to drive safely along curving roads.
Real-Time Translation	Translates spoken Chinese into spoken English in real time.