

Study Jam Machine Learning 4: Introduction to Machine Learning

```
lookup.KeyValue  
f.constant(['em  
=tf.constant([G  
.lookup.StaticV  
_buckets=5)
```



Google Developer Groups

On Campus Widyatama University

- **Co-Lead GDGoC Widyatama University**
- **Informatics student at Widyatama University**
- **Bangkit Alumni 2024 batch 1**



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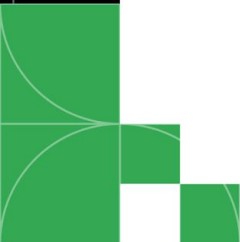
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M Syahrindra
Core Team





Menurut anda gambar
disamping itu
laki-laki atau
perempuan?

What is learning?

"The activity or process of gaining knowledge or skill by studying, practicing, being taught, or experiencing something."

Merriam Webster dictionary

"A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P , if its performance at tasks in T , as measured by P , improves with experience E ."

Tom Mitchell

Apa itu Machine Learning (ML) ?

“Field of study that gives computers the ability to learn without being explicitly programmed.”

Arthur Samuel (1959)

Traditional Programming



Machine Learning

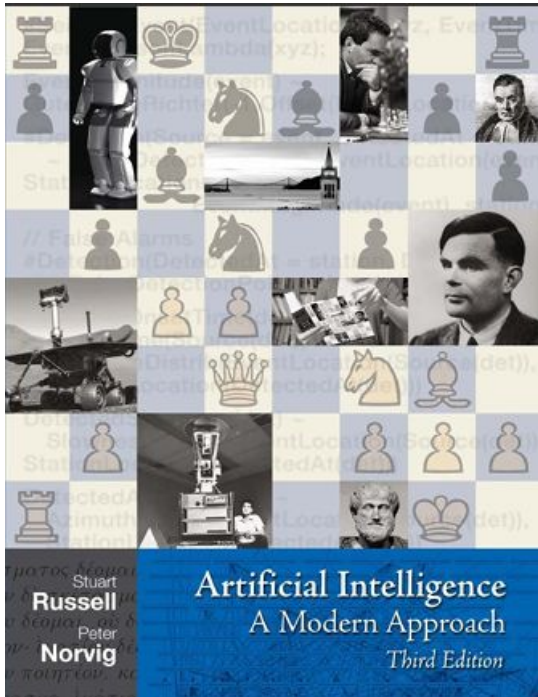


Apa itu Machine Learning (ML) ?

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
- privacy/fairness (e.g. ranking search results)

Apa itu Artificial Intelligence (AI) ?



Thinking Humanly

"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985)

"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning ..." (Bellman, 1978)

Thinking Rationally

"The study of mental faculties through the use of computational models."
(Charniak and McDermott, 1985)

"The study of the computations that make it possible to perceive, reason, and act."
(Winston, 1992)

Acting Humanly

"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)

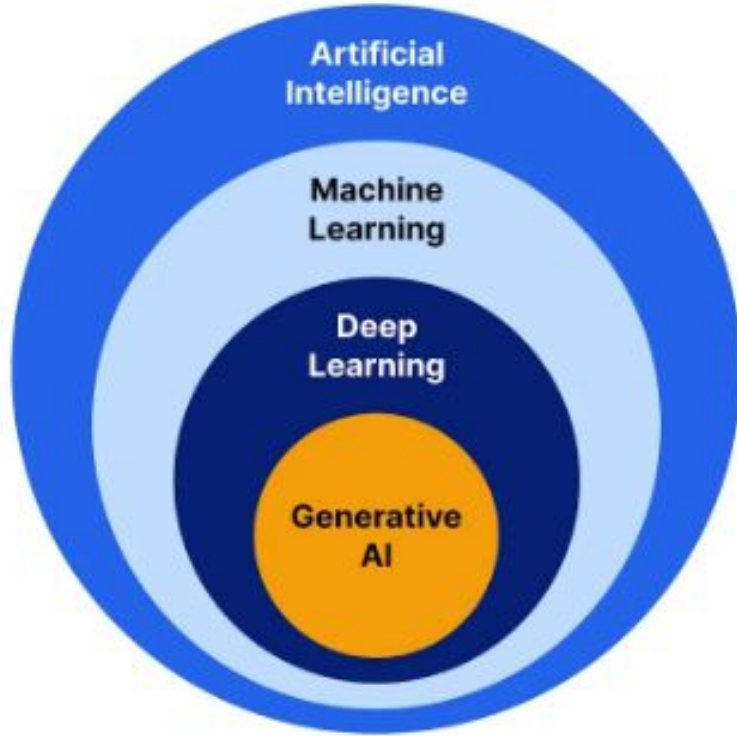
"The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)

Acting Rationally

"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998)

"AI ...is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Taksonomi Artificial Intelligence

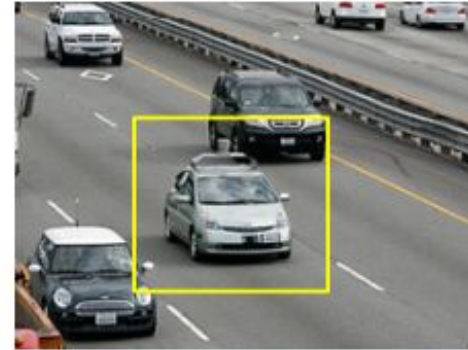


AI does not always imply a learning based system

- Rule based system
- Tree Search
- Symbolic Reasoning
- etc.

Contoh penerapan Machine Learning, bang

Autonomous Cars

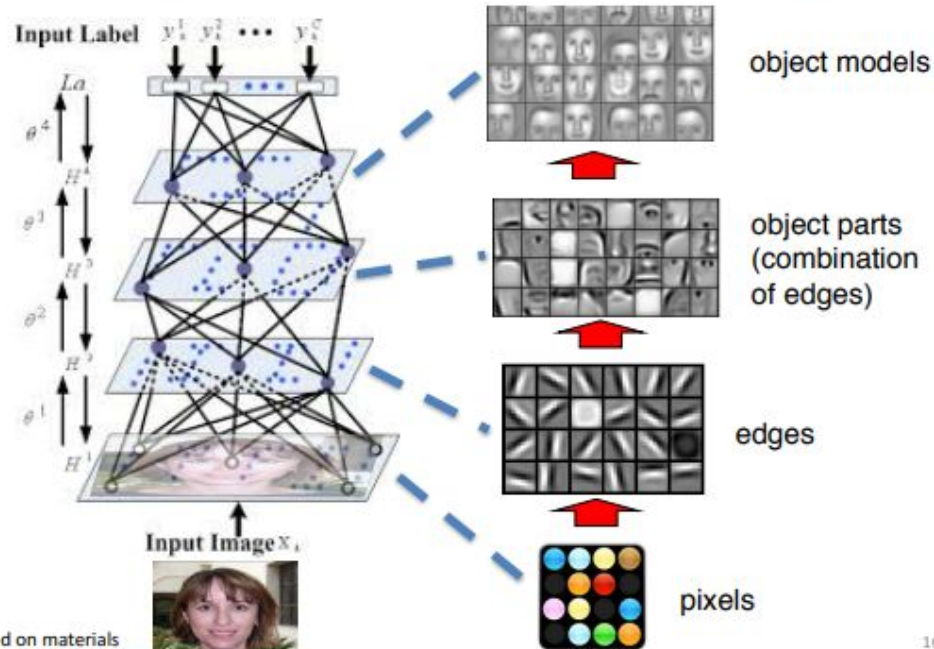


- Nevada made it legal for autonomous cars to drive on roads in June 2011
- As of 2013, four states (Nevada, Florida, California, and Michigan) have legalized autonomous cars



Contoh penerapan Machine Learning, bang

Deep Belief Net on Face Images

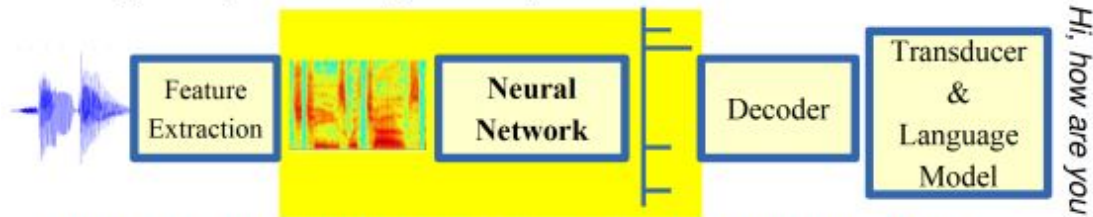


Based on materials
by Andrew Ng

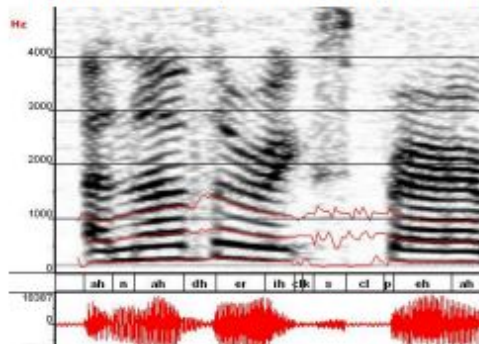
Contoh penerapan Machine Learning, bang

Machine Learning in Automatic Speech Recognition

A Typical Speech Recognition System



ML used to predict of phone states from the sound spectrogram



Deep learning has state-of-the-art results

# Hidden Layers	1	2	4	8	10	12
Word Error Rate %	16.0	12.8	11.4	10.9	11.0	11.1

Baseline GMM performance = 15.4%

[Zeiler et al. "On rectified linear units for speech recognition" ICASSP 2013]

Types of Learning

Types of learning

- **Supervised Learning:** Have labeled examples of the correct behaviour
 - – Given: training data + desired outputs(labels)
- **Unsupervised Learning:** no labeled examples – instead, looking for “interesting” patterns in the data
 - – Given: training data (without desired outputs)
- **Reinforcement Learning:** learning system (agent) interacts with the world and learns to maximize a scalar reward signal
 - – Rewards from sequence of actions

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Supervised Learning

Data	Sky	AirTemp	Humidity	Wind	Water	Forecast	EnjoySport
1	Sunny	Warm	Normal	Strong	Warm	Same	Yes
2	Sunny	Warm	High	Strong	Warm	Same	Yes
3	Rainy	Cold	High	Strong	Warm	Change	No
4	Sunny	Warm	High	Strong	Cool	Change	Yes

Supervised Learning: Regression

- Regression is used to predict continuous values.
- It finds relationships between input feature (independent variables) and output (dependent variable).
- Contoh:
 - Predicting house price based on square footage.
 - Estimating the number of sales based on advertising budget.
 - Forecasting temperature based on historical weather data.

Supervised Learning: Classification

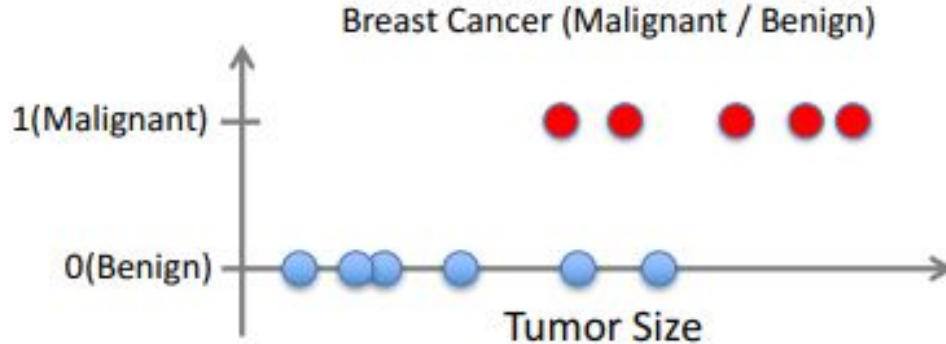
Classification is a **supervised learning** technique where the goal is to assign a category (or class) to given input data based on patterns learned from labeled training data. Unlike regression, where the output is continuous, classification deals with **discrete categories**.

Key concept in classification:

- **Label (Target Variable):** The category we want to predict (e.g., "Spam" or "Not Spam").
- **Features (Independent Variables):** The input attributes used for prediction.
- **Binary Classification:** Two possible output classes (e.g., "Yes" or "No").
- **Multiclass Classification:** More than two possible output classes (e.g., classifying different animal species).

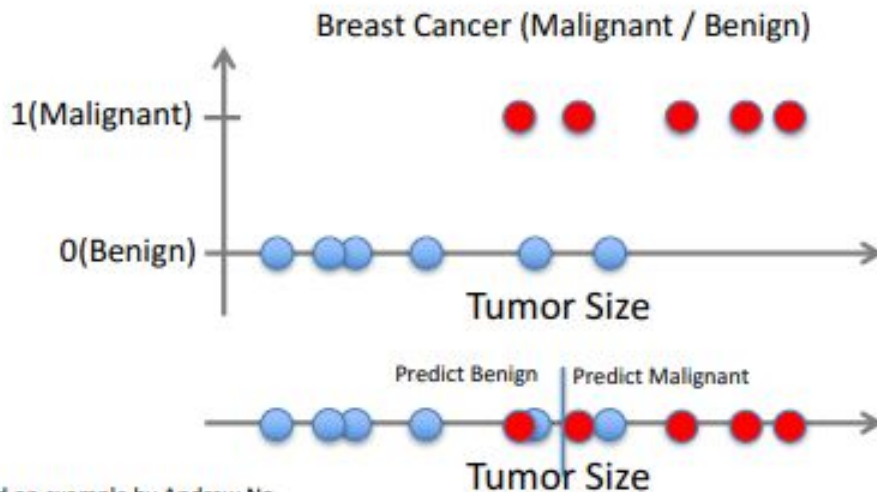
Supervised Learning: Classification

- Given $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$
- Learn a function $f(x)$ to predict y given x
 - y is categorical == classification



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used as example by Andrew Ng



Supervised Learning: Classification

Some commonly used classification algorithms include:

1. **Logistic Regression** – Simple linear model for binary classification.
2. **Decision Tree** – Splits data based on feature importance.
3. **Random Forest** – Multiple decision trees combined (ensemble method).
4. **Support Vector Machine (SVM)** – Finds the optimal boundary (hyperplane) between classes.
5. **K-Nearest Neighbors (KNN)** – Classifies based on the majority of nearest neighbors.
6. **Naïve Bayes** – Based on probability and Bayes' theorem.
7. **Neural Networks (Deep Learning)** – Used for complex problems like image and speech recognition.

Unsupervised learning

Unsupervised Learning is a type of **machine learning** where the algorithm learns patterns from **unlabeled data** without explicit supervision. The goal is to **discover hidden structures** or **group similar data points**.

feature	Supervised Learning	Unsupervised Learning
Labels (Target)	Yes (labeled data)	No (Unlabeled data)
Goal	Predict outcomes	Discover hidden patterns
Examples	Classification, Regression	Clustering, Anomaly detection
Common Algorithms	Decision Tree, SVM, Neural Networks	K-means, PCA, Autoencoders

Types of Unsupervised Learning

A. Clustering (Grouping Similar Data)

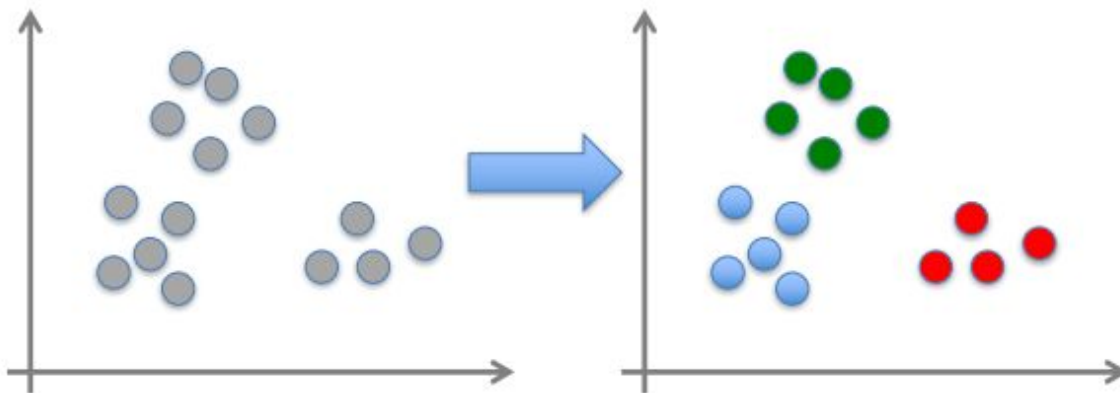
- Groups similar data points together based on their features.
- Used for customer segmentation, anomaly detection, document categorization.

B. Dimensionality Reduction (Feature Compression)

- Reduces the number of input variables while preserving important information.
- Used for visualization, speeding up computation, and noise reduction.

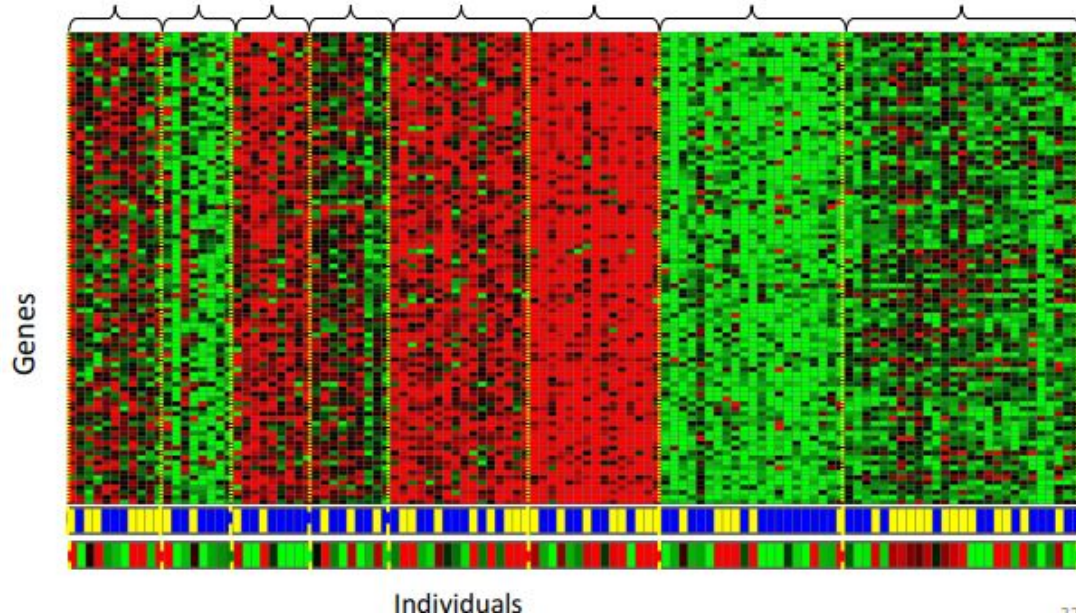
Unsupervised learning

- Given x_1, x_2, \dots, x_n (without labels)
- Output hidden structure behind the x 's
 - E.g., clustering



Unsupervised learning

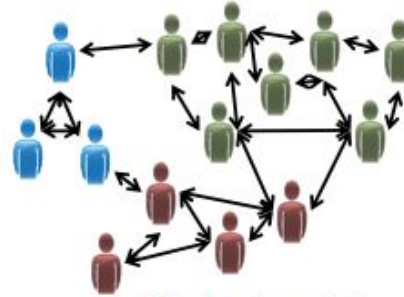
Genomics application: group individuals by genetic similarity



Unsupervised learning



Organize computing clusters



Social network analysis



Market segmentation



Astronomical data analysis

Reinforcement Learning

Reinforcement Learning (RL) is a **type of machine learning** where an **agent learns by interacting with an environment** to maximize rewards over time. It is inspired by how humans and animals learn through trial and error.

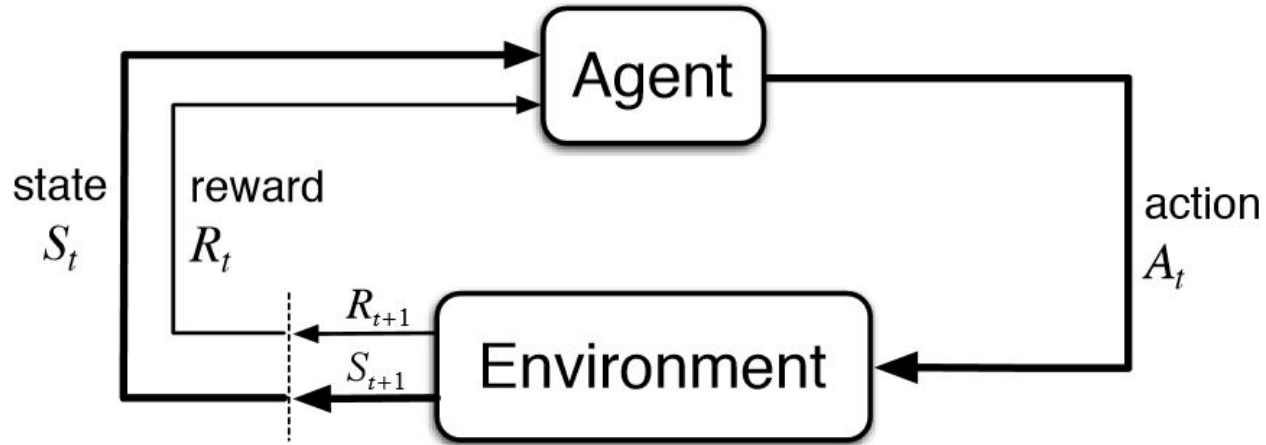
RL is based on the **Markov Decision Process (MDP)** and follows these steps:

1. **Agent**: The learner (e.g., a robot, AI system).
2. **Environment**: Where the agent operates (e.g., a game, traffic system).
3. **State (S)**: The current situation of the agent.
4. **Action (A)** : The decisions the agent can take.
5. **Reward (R)** : Feedback given after an action (positive or negative).
6. **Policy (π)** : The agent's strategy for choosing actions.

Goal: The agent **learns to maximize total rewards** over time by trial and error.



Reinforcement Learning



Reinforcement Learning



AI Learns to Walk (deep reinforcement learning)

https://youtu.be/L_4BPjLBF4E?si=Aa-3yCDZBgxCvPcG

Feedback Form

