Introduction to Artificial Intelligence

SUMMER 2023

Jiwoon Lee

PROCESS

Session 0

I ntroduce

- STUDY GOALS
- STUDY KEYPOINTS

P lan & Details

- STUDY DETAILS
- WEEKLY TASKS
- STUDY PLANS

Q &A

- Q&A & NETWORKING TIME

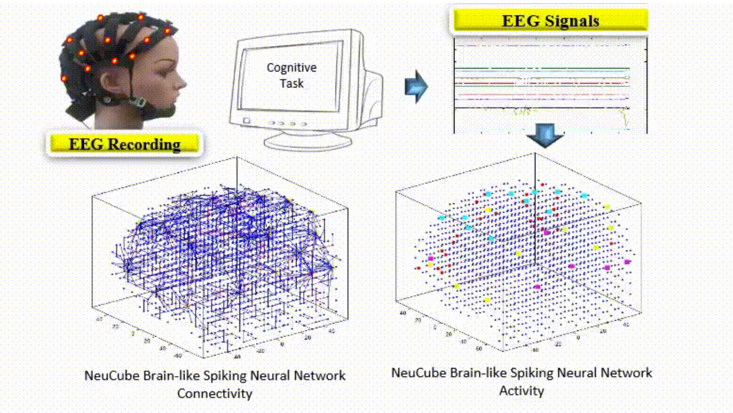
Jiwoon Lee 이 지 운

Kwangwoon University
Department of Computer Engineering

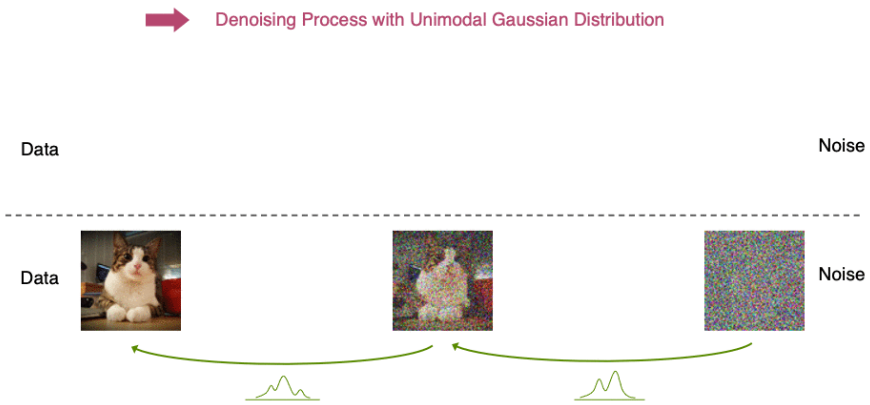
Affiliation

- Student researcher at Bio Computing and Machine Learning Lab
- (Former) Research intern at Qualcomm Institute – University of California, San Diego
- IEEE Seoul Section, CT Society Student Member
- Organizer of Machine Learning Community 'DeepUser'
- Organizer of Kwangwoon Univ. Machine Learning Community 'MI:RU'
- Organizer of Facebook Group '코딩이랑 무관합니다만,'

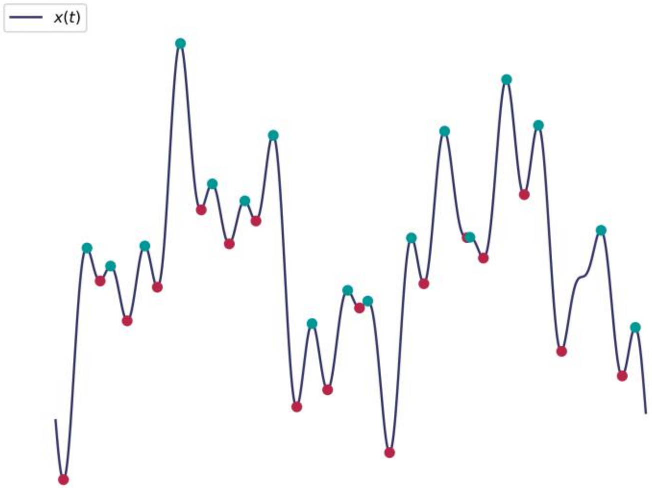
Research area



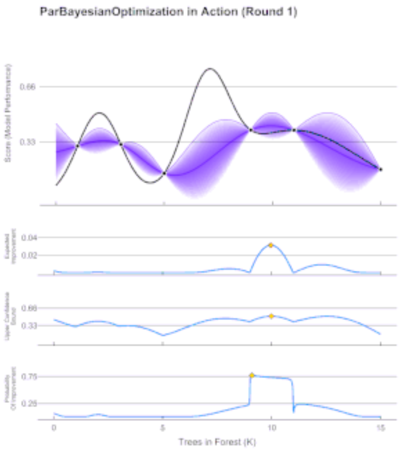
Computational neuroscience



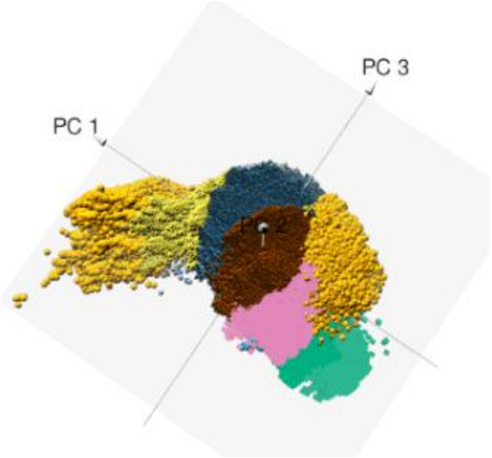
Generative AI



Signal processing



Information theory



Machine Learning

INTRODUCE

STUDY GOALS

INTERMEDIATE

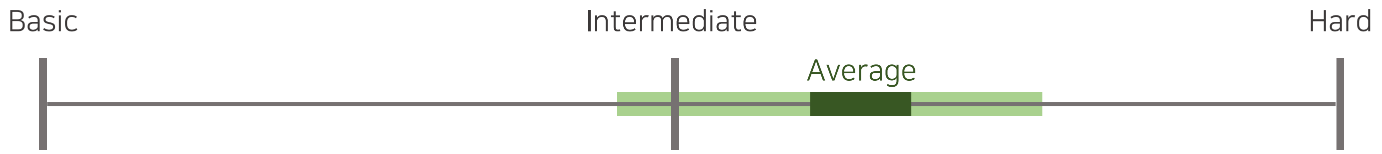
Introduction to Artificial Intelligence (Summer 2023)

Journey through the fascinating world of AI

Learn about the basic algorithms of Machine Learning and Artificial Intelligence

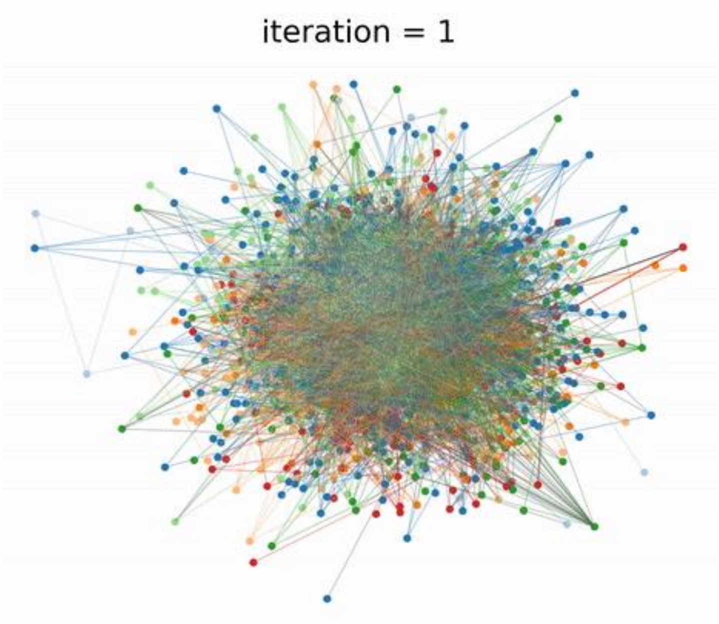
Explore the core concepts, techniques, and applications of AI and ML
Preparing you for a deep dive into advanced topics

Overall Level



INTRODUCE

LECTURE KEYPOINTS



Intuitive understanding

With visualization

PLAN

WEEKLY TASKS

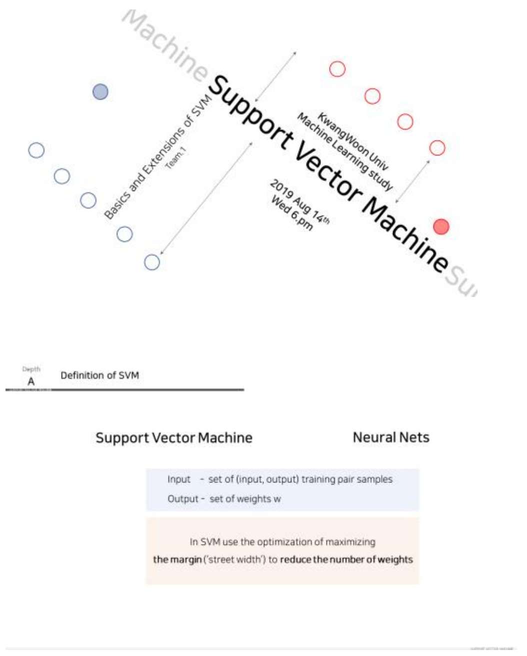
PERSONAL TASK

Submit Preliminary research about topic of the next presentation

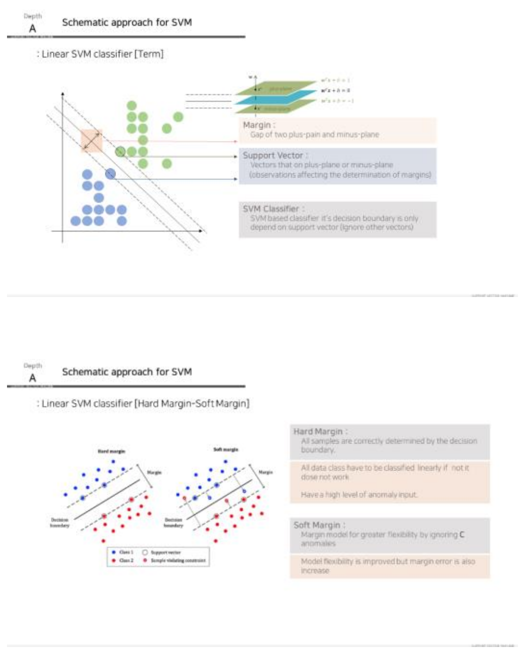
'Warning'
If task is not prepared
3 warnings == expulsion

EXAMPLE

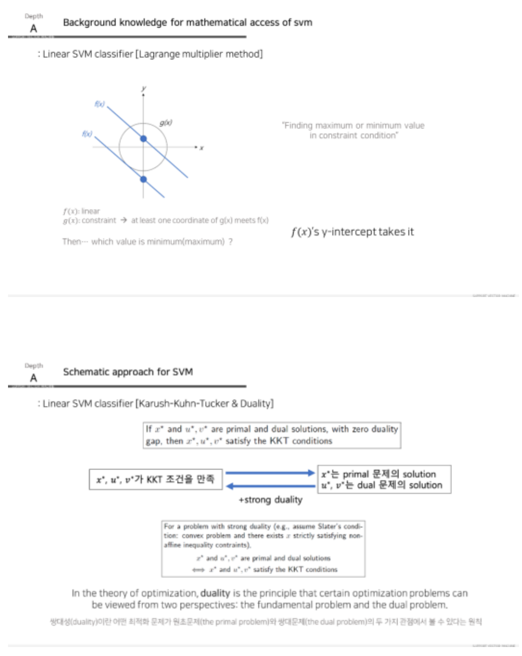
Section PPT



< Intro >



< Graphical Inst >



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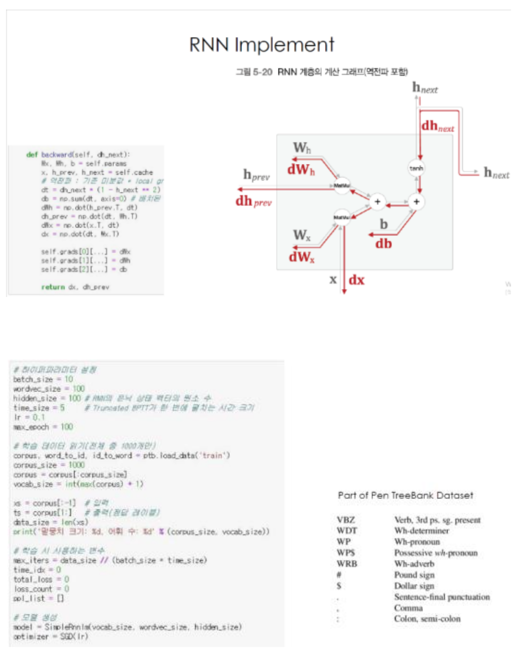


< Implement >

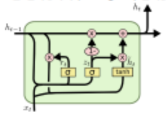
EXAMPLE

Weekly Assignment

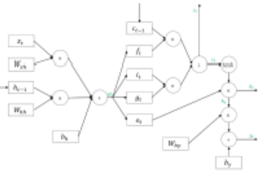
KW ML STUDY #3, #4 | 제출자 주혜경 | 2019.08.01

Topic #4 Long Short-Term Memory (LSTM)

LSTM은 RNN의 긴 의존 기간의 vanishing gradient 문제를 극복하기 위해 설계되었다. 기본적인 RNN은 NN 모듈을 반복하는 체인 형태를 갖는다. LSTM은 각 반복 모듈에 cell-state를 추가한 체인 형태이다. 직전 시점의 그래디언트 값에 영향을 받아 cell state와 히든 state가 재귀적으로 구해진다. Cell-state는 gate (sigmoid, dot) 를 통해서 정보를 더하거나(기억) 제거하는(잊음) 기능을 수행한다. 세 게이트는 새로운 정보를 잊을지 결정하고, 새로운 정보를 기억할 지 결정하여 다음 cell-state를 갱신하고, 이 새 cell-state를 필터링하여 (tanh, sigmoid) 출력값을 결정한다. RNN보다 좋은 성능을 보인다.



$$z_t = \sigma\left(W_z \cdot [h_{t-1}, x_t]\right)$$
$$r_t = \sigma\left(W_r \cdot [h_{t-1}, x_t]\right)$$
$$\tilde{h}_t = \tanh\left(W \cdot [r_t * h_{t-1}, x_t]\right)$$
$$h_t = (1 - z_t) * h_{t-1} + z_t * \tilde{h}_t$$



Jiwoon Lee

Stanford CS230: Deep Learning

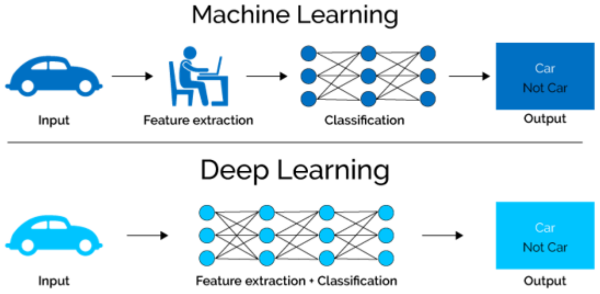
Lecture 5 - AI + Healthcare

Lecture 6 - Deep Learning Project Strategy

Healthcare questions -- levels

1. What happened? (Descriptive)
2. Why did it happen? (Diagnostic)
3. What will happen? (Predictive)
4. What should we do? (Prescriptive)

Paradigm shift of deep learning



BCL Machine Learning Study 2019 Winter 소프트웨어학부 2018203067 이원빈

CS230 Lecture #1 > Class Introduction and Logistics
CS230 Lecture #2 > Deep Learning Intuition

[Lecture Summary]

CS230 Lecture #1 > Class Introduction and Logistics

Machine Learning과 Deep Learning의 발전이 두드러진 이유는 모든 산업에서의 데이터가 아날로그에서 디지털 데이터의 기록으로 바뀌고 현재 그러한 상황이 확립되고 있기 때문이다.
데이터의 양이 많아지면 많아질수록 Logistic Regression, Decision Tree, SVM과 같은 전통적은 기계학습보다는 Neural Network에서 효율을 더 높이 보이는데 그중에서도 Small보단 Medium이, Medium보단 Large Neural Network에서 더 큰 효율을 보인다. 특히 방대한 규모의 데이터를 다루는 현재 상황에서 PGM(Probabilistic Graphic Model), Planning Algorithms, Searching Algorithms, Knowledge Representation, Game Theory 등도 시간에 대해 성능이 점차 상승하고 있지만, Deep Learning과 Machine Learning은 급진적인 성능 향상을 보인다. 규모 면에서도, 계산적 측면에서도 뛰어난 측면을 나타낸다.

CS230 Lecture #2 > Deep Learning Intuition

특정 이미지 데이터는 색깔 정보를 담고 있는 숫자로 구성된 3D 행렬로 구성되어 있는데 이러한 데이터를 학습하기 위해선 학습 모델(Architecture)과 Parameter들을 찾아야 한다. 여기서, Parameter란 입력값에서 CNN을 거쳐 추출되는 출력값으로 변환해주는 함수에 사용되는 인자인데 이는 수많은 수로 이루어졌기 때문에 이를 찾는 것이 학습에 있어 가장 궁극적인 목표라 할 수 있다. 또한, 실제 데이터와 출력값 간의 오차를 줄이는 것도 중요한 쟁점이다.
해당 데이터가 동물이라 할 때, 데이터마다 다른 동물을 대표할 것이고 이를 위해 각 동물에 해당하는 Neron을 따로 구성하여 따로 학습 후 분류해야 한다. (Multi-Logistic-Regression) 어떤 Neron이 어떤 동물을 대표하는지 알기 위해서는 One-hot-Encoding을 통해 추출된 벡터를 통한 Labelling 작업이 매우 중요하다. 이미지 데이터 행렬값을 함

<Preliminary research>

LECTURES

List of Topic

- Lecture #1 - Probability Theorems and Metrics for Data Analysis
- Lecture #2 - Introduction to Neural Network
- Lecture #3 - Curse of Dimensionality and Dimensionality Reduction
- Lecture #4 - Introduction to Time Series Analysis
- Lecture #5 - Markov Chains and Value-Based Reinforcement Learning
- Lecture #6 - Policy-Based Reinforcement Learning

Easy Hard

LECTURES

List of Topic

Lecture #1 - Probability Theorems and Metrics for Data Analysis

Part 1: Introduction to Metrics for Data Analysis
Part 2: Data Scaling
Part 3: Probability Theorems
Part 4: Bayes Theorem
Part 5: Practice: Calculating Loss
Part 6: Normalization and the Normal Distribution
Part 7: Probability Theorems and Metrics Practices

LECTURES

List of Topic

Lecture #2 - Introduction to Neural Network

Part 1: Perceptron and Artificial Neurons
Part 2: Quick Review of Partial Derivatives
Part 3: Activation Functions
Part 4: Backpropagation Algorithm
Part 5: Convolutional Neural Networks (CNN)
Part 6: Recurrent Neural Networks (RNN)

LECTURES

List of Topic

Lecture #3 - Curse of Dimensionality and Dimensionality Reduction

Part 1: Introduction to Curse of Dimensionality
Part 2: Norm in Linear Algebra
Part 3: Projection and Dimensionality Reduction
Part 4: Visualization Techniques
Part 5: Curse of Dimensionality in Machine Learning
Part 6: Dimensionality Reduction Practices
Part 7: Visualization Practices

LECTURES

List of Topic

Lecture #4 - Introduction to Time Series Analysis

Part 1: Introduction to Time Series Analysis
Part 2: Time Series Components and Patterns
Part 3: Time Series Modeling: ARIMA
Part 4: Time Series Modeling: Seasonal ARIMA
Part 5: Time Series Modeling: Exponential Smoothing
Part 6: Time Series Modeling: ARIMA vs. Exponential Smoothing
Part 7: Time Series Analysis Practices

LECTURES

List of Topic

Lecture #5 - Markov Chains and Value-Based Reinforcement Learning

Part 1: Markov Chains
Part 2: Introduction to Reinforcement Learning
Part 3: Value-Based Reinforcement Learning
Part 4: Deep Q-Networks (DQN)

LECTURES

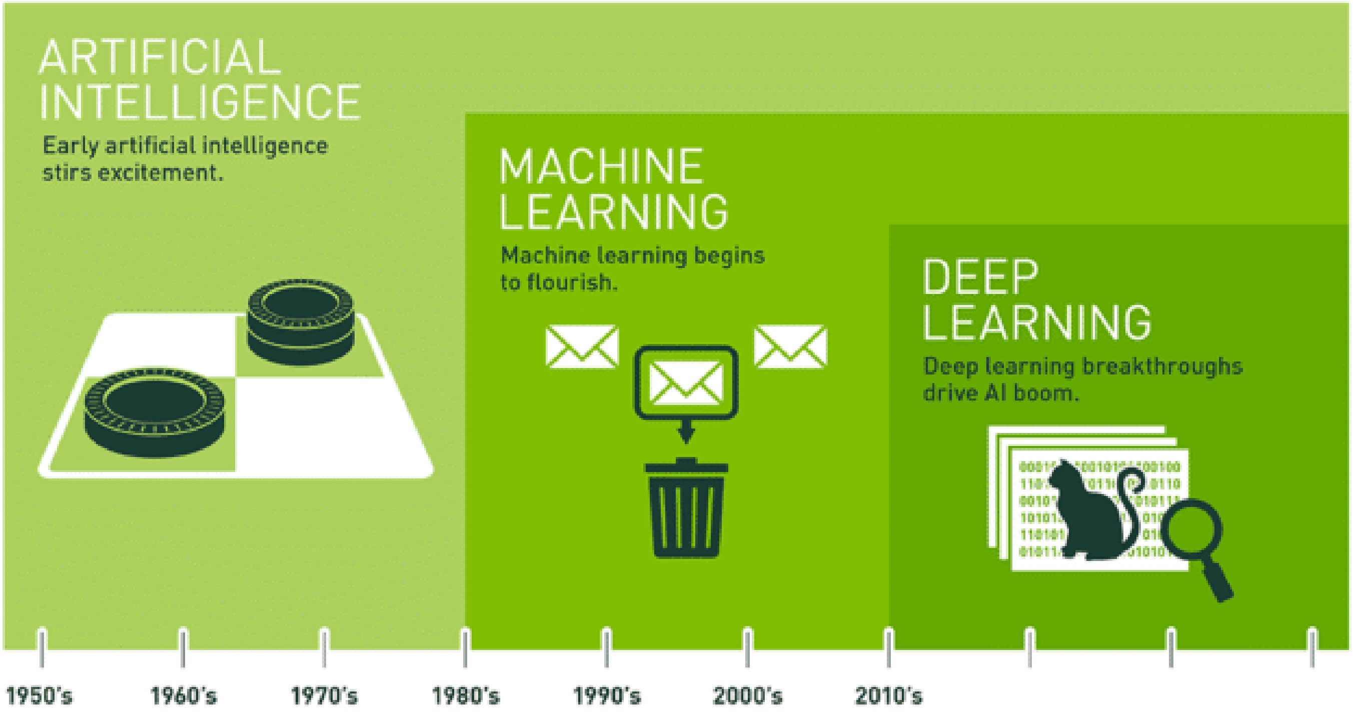
List of Topic

Lecture #6 - Policy-Based Reinforcement Learning

Part 1: Introduction to Policy-Based Reinforcement Learning
Part 2: Policy Parameterization and Policy Gradients
Part 3: Actor-Critic Methods
Part 4: Proximal Policy Optimization (PPO)

Part 1: What is AI?

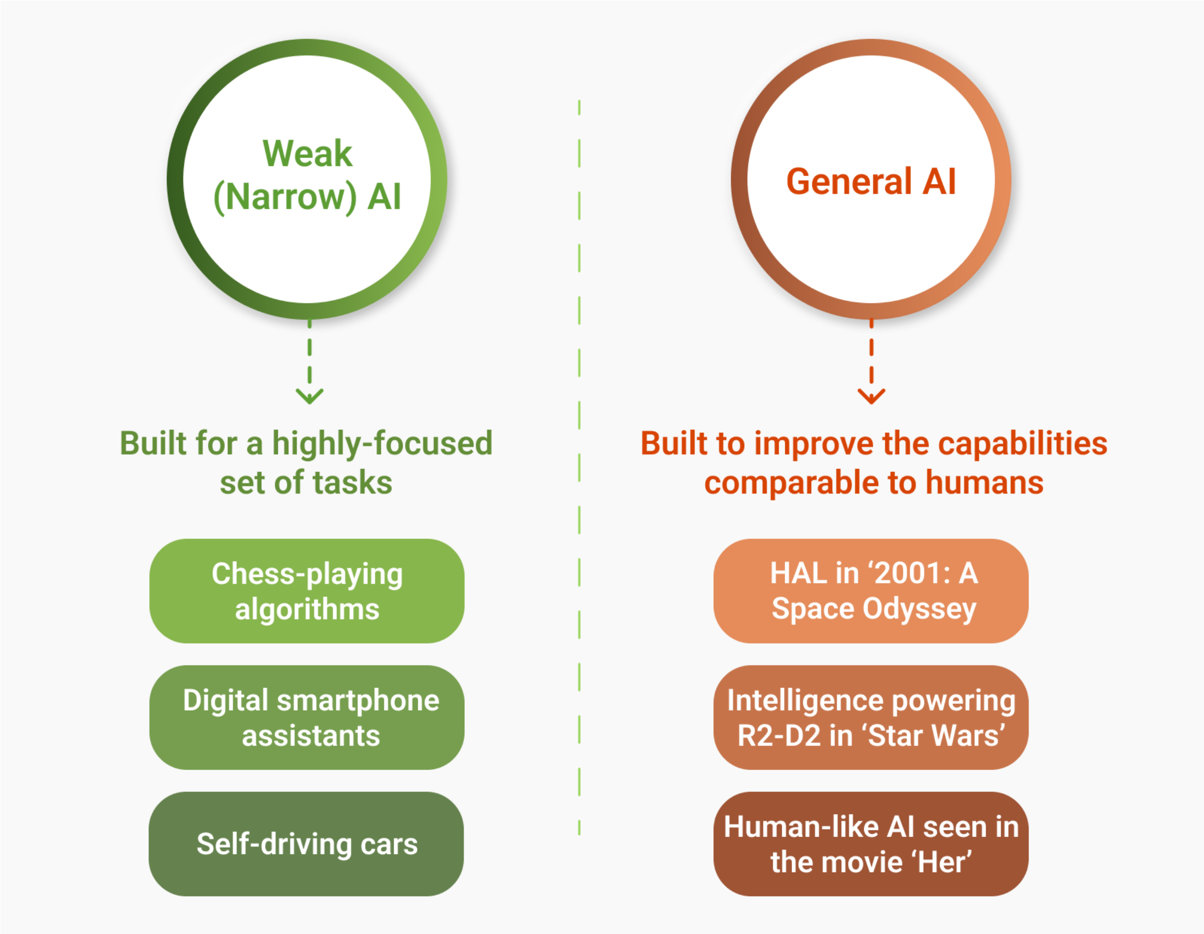
Narrow AI vs General AI



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

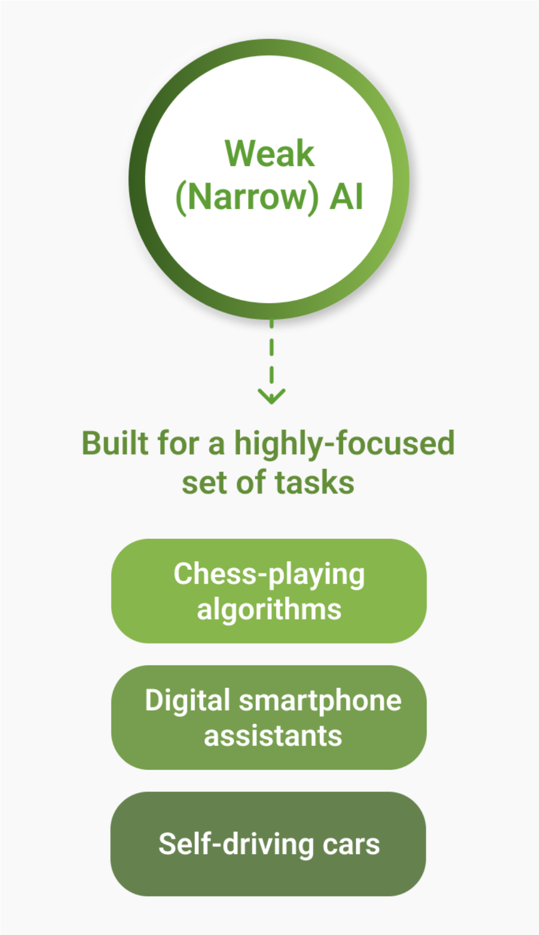
Part 1: What is AI?

Narrow AI vs General AI



Part 1: What is AI?

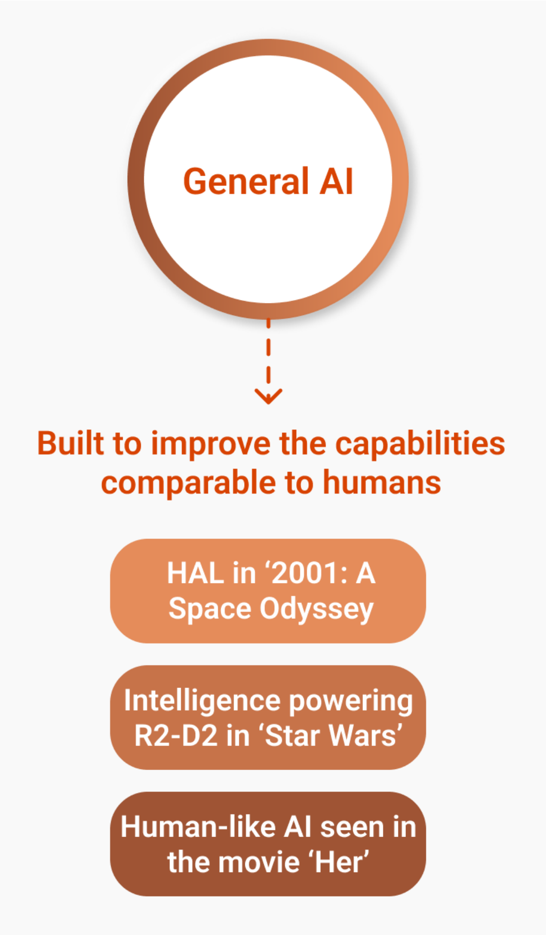
Narrow AI vs General AI



- Chess playing AI
- Image classification
- Image generation
- …

Part 1: What is AI?

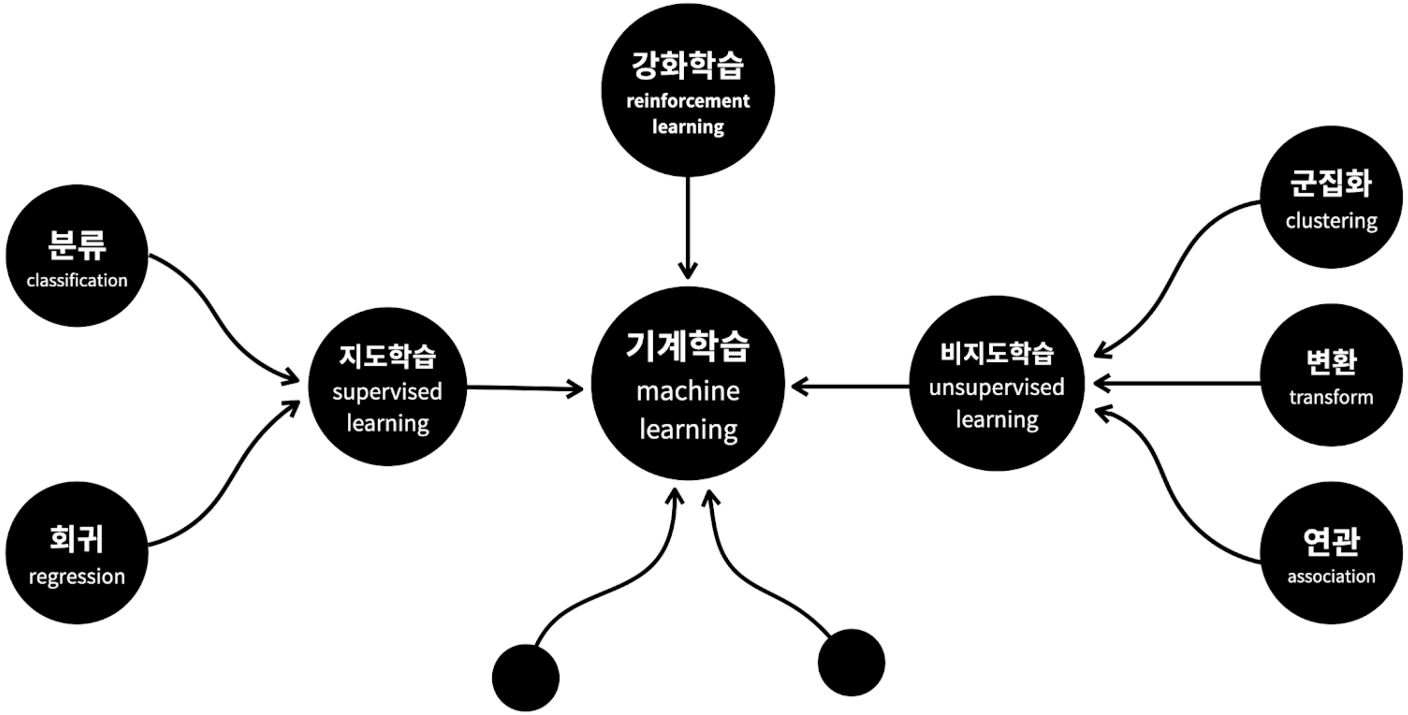
Narrow AI vs General AI



- Chatbots (ChatGPT, Bard)
- AI robots like in the movie
- ...

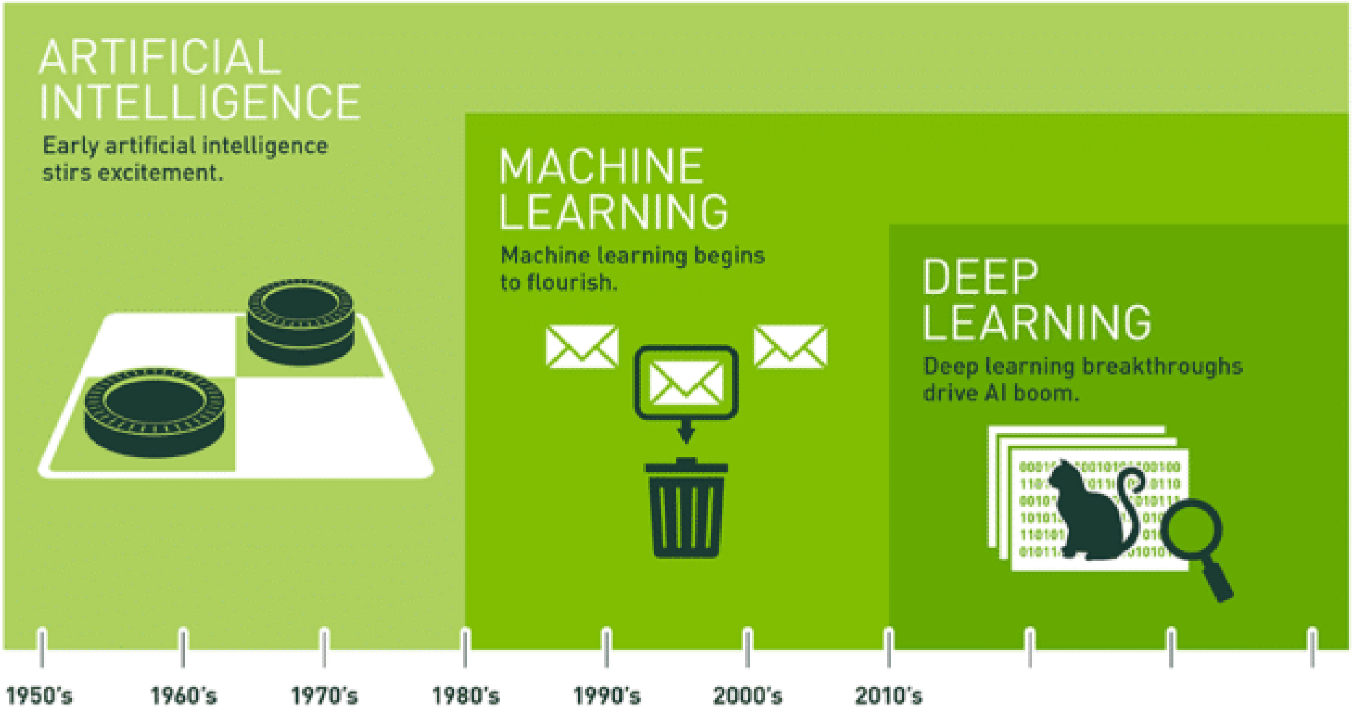
Part 2: Machine Learning Overview

Machine Learning



Part 2: What is AI?

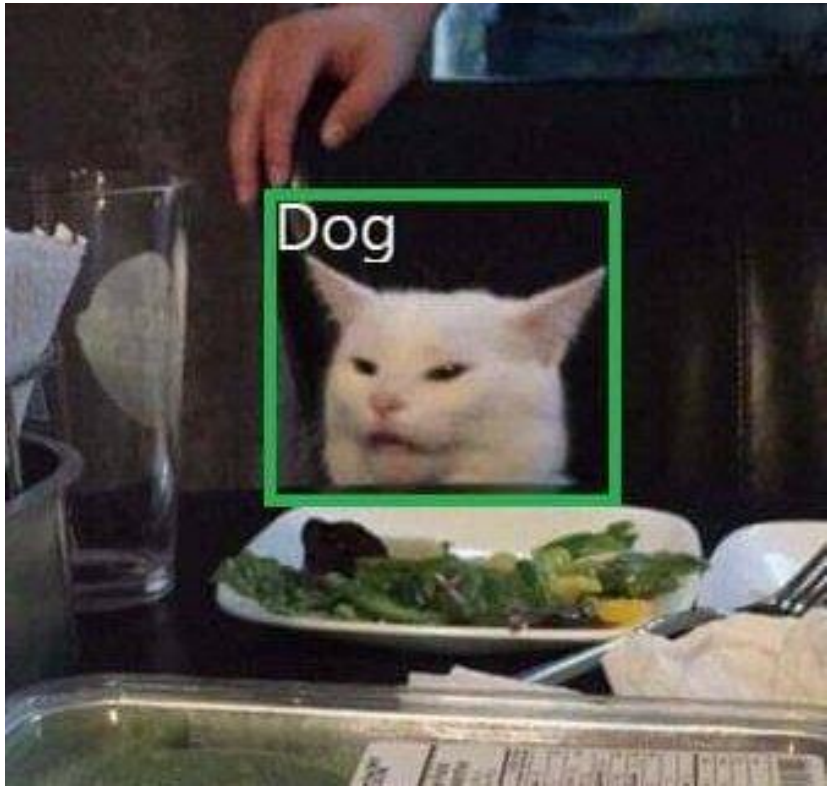
Machine Learning



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Part 3: Classification

Meme



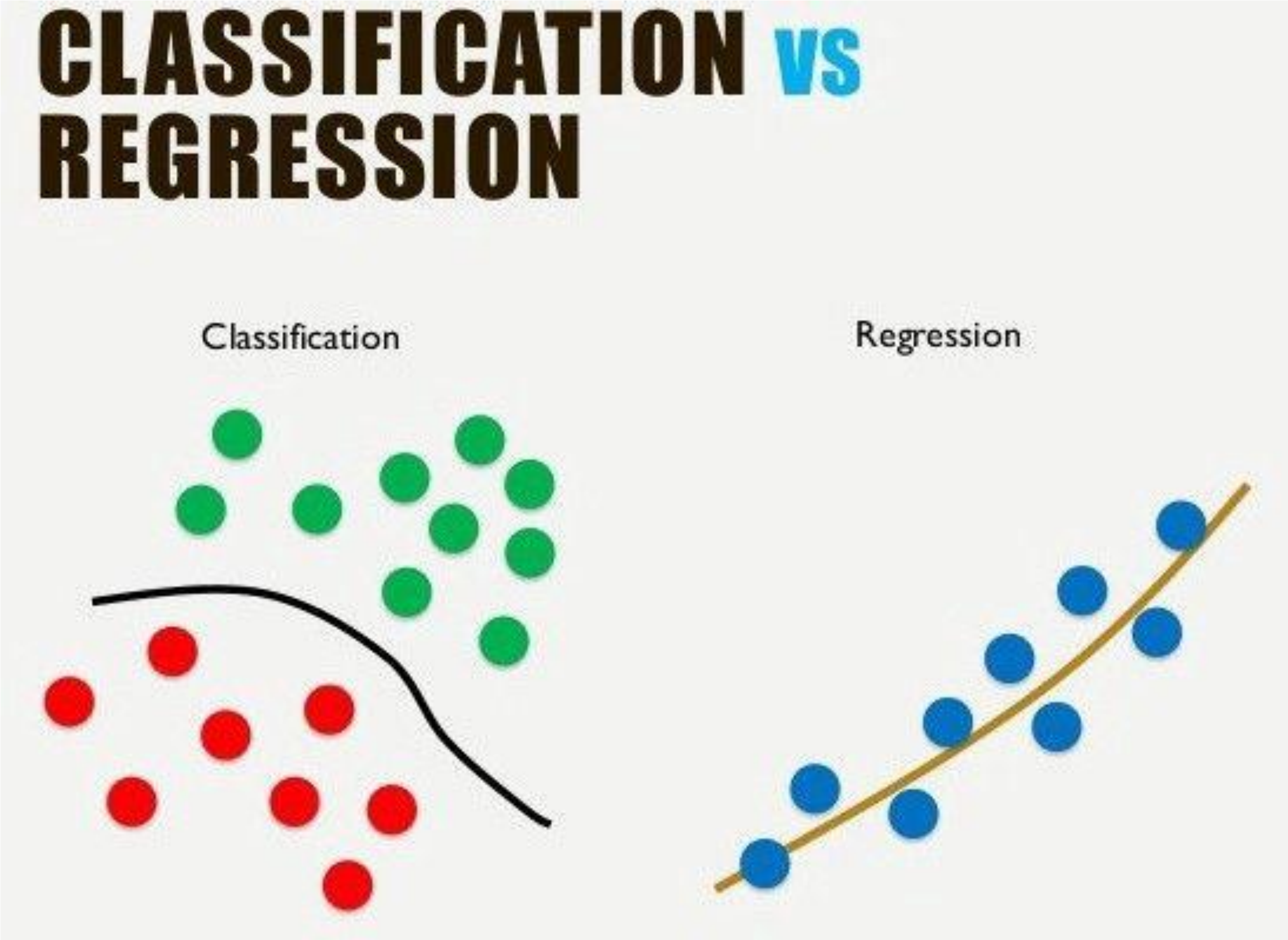
Part 3: Classification

Examples

독립변수 (Independent variable)	종속변수 (Dependent variable)	데이터를 만드는 방식
공부시간	합격 여부(합격, 불합격)	사람들의 공부 시간을 입력받은 후 합격 여부를 확인
꽃의 잎 길이, 줄기 길이, 넓이	꽃의 종	꽃마다 잎의 길이와 넓이, 줄기의 길이 등의 데이터와 꽃의 종을 같이 기록
키, 몸무게, 시력, 지병	현역, 공익, 면제	키, 몸무게, 시력, 지병 등을 토대로 현역, 공익, 면제인지 확인

Part 3: Classification

Machine Learning



Part 3: Classification

Notation in the industries

~~숫자~~
양적(Quantitative)
얼마나 큰지, 얼마나 많은지, 어느 정도인지를 의미

~~이름~~
범주(Categorical)
같은 특성을 지닌 부류나 범위를 의미

Part 4: Regression

Machine Learning

원인 결과

날짜	요일	온도	판매량
2020.1.3	금	20	40
2020.1.4	토	21	42
2020.1.5	일	22	44
2020.1.6	월	23	46
2020.1.7	화	24	48
2020.1.8	수	25	?

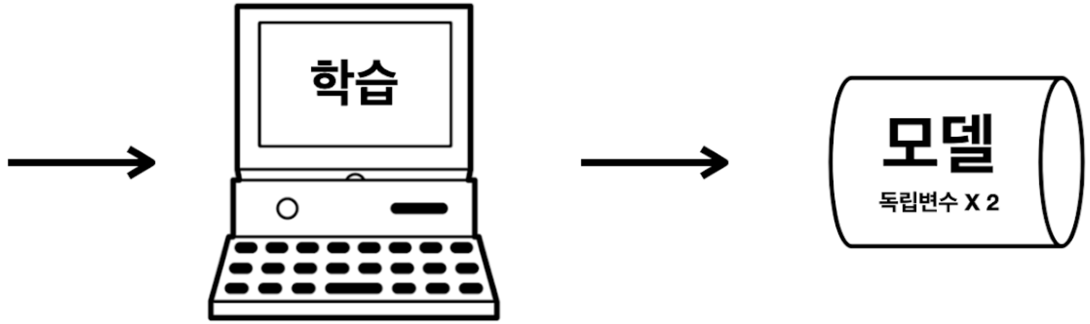
과거의 데이터

미지의 데이터

Part 4: Regression

Machine Learning

독립변수	종속변수
20	40
21	42
22	44
23	46



Part 4: Regression

Machine Learning

Part 4: Regression

Machine Learning

원인 결과

날짜	요일	온도	판매량
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2020.1.8	수	25	?

과거의 데이터

미지의 데이터

Part 4: Regression

Examples

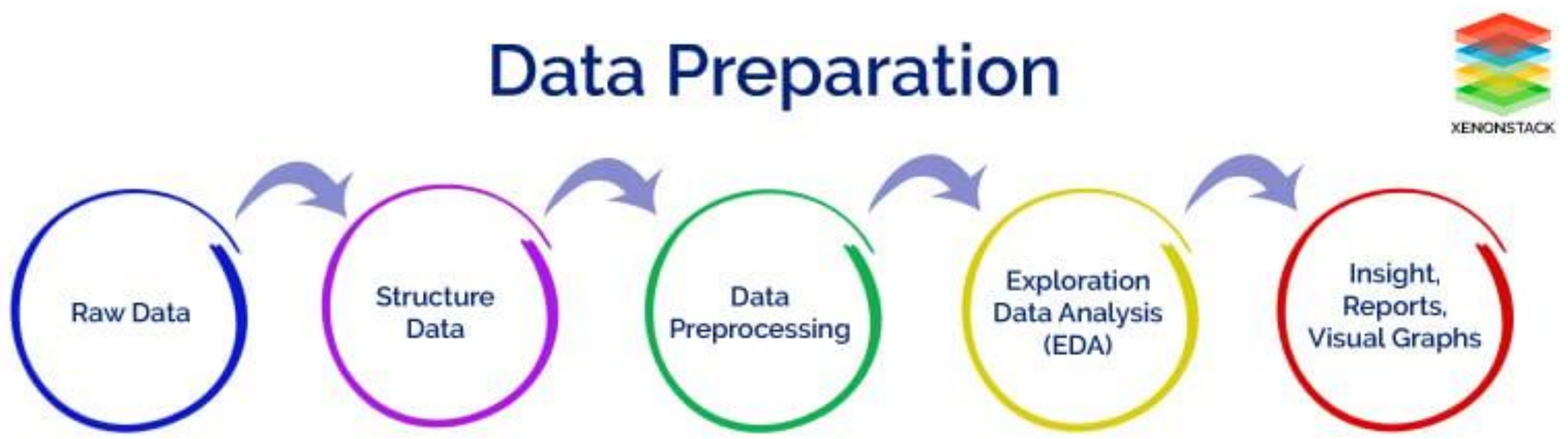
독립변수 (Independent variable)	종속변수 (Dependent variable)	How to make data?
공부시간	시험점수	사람들의 공부 시간을 입력받은 후 점수를 확인
온도	레모네이드 판매량	온도, 그날의 판매량 기록
집의 위치, 역세권 여부 등	집의 가격	집부터 역까지의 거리, 주변 편의시설 개수 등의 값을 기록

Quiz

면적(평)	온도(섭씨)	판매량(개)
1000	10	100
200	26	200
300	31	300

계절	날씨	휴가지
봄	비	바다
여름	흐림	산
가을	맑음	강

Part 5: Data preprocessing



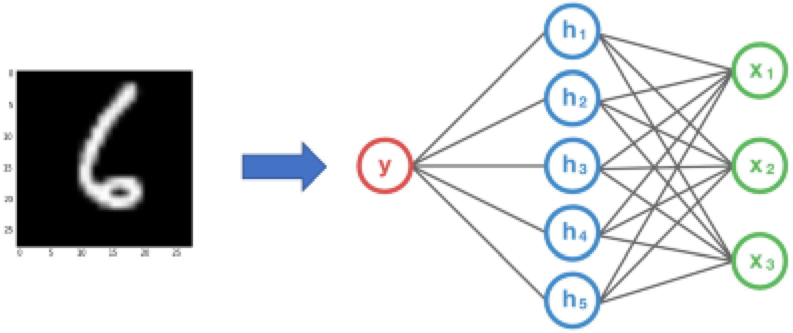
Part 5: Data preprocessing

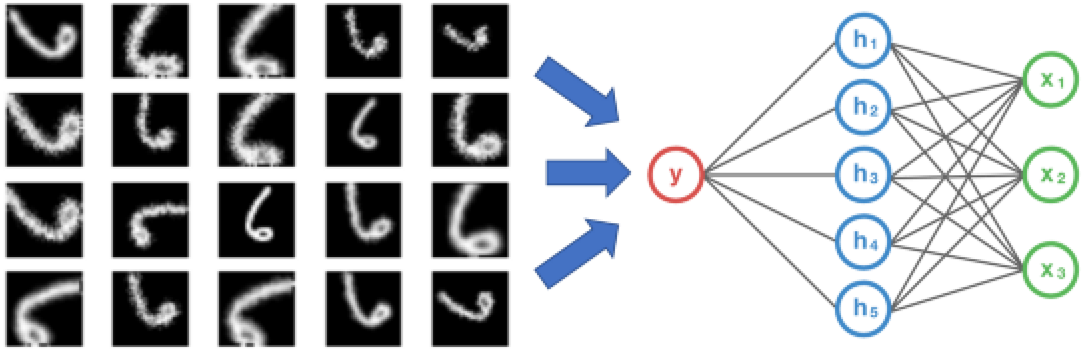
Why preprocessing is important?

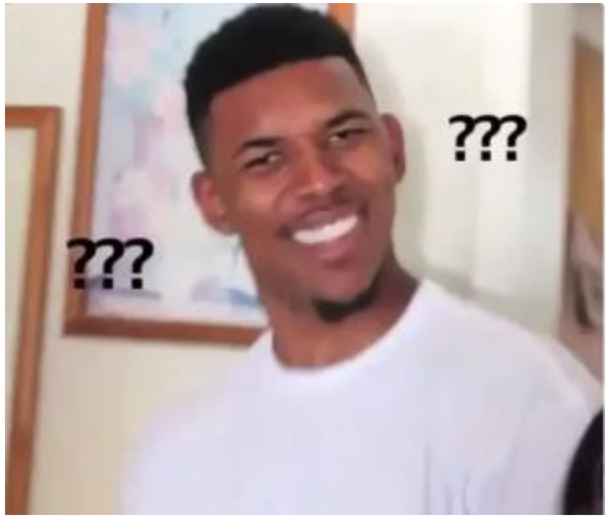
Part 5: Data preprocessing

Why preprocessing is important?

Training

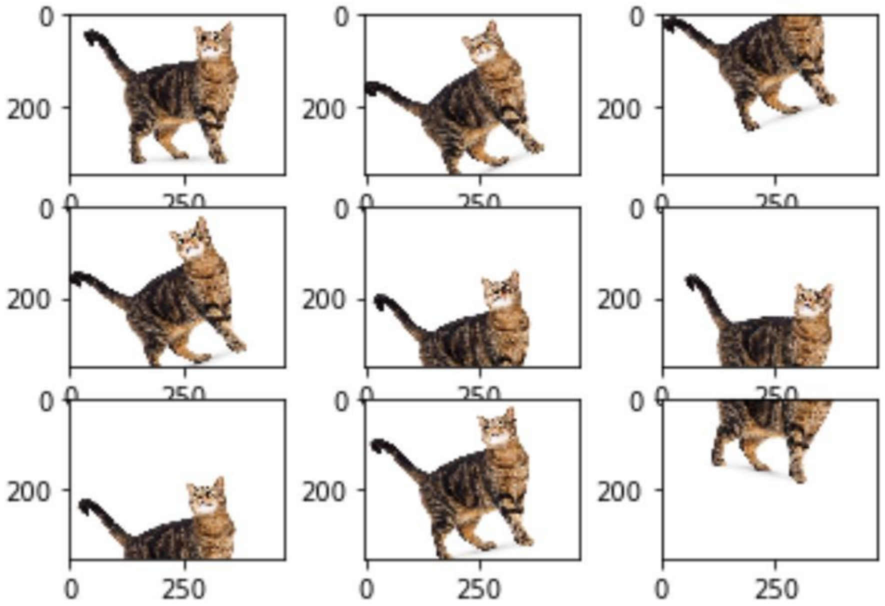






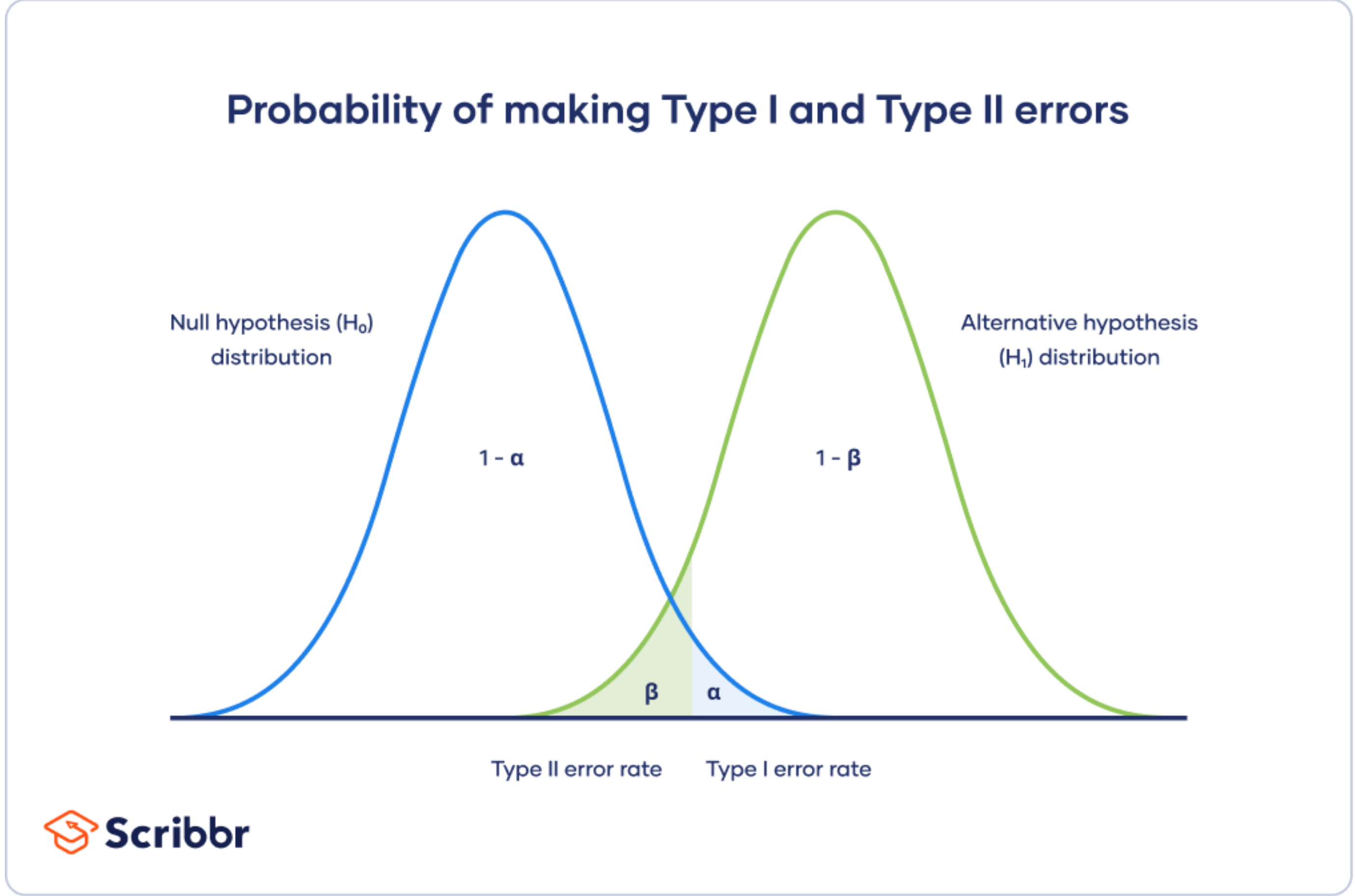
Part 5: Data preprocessing

Why preprocessing is important?



Part 5: Data preprocessing

Why preprocessing is important?



Better data
Better classification model

Better Result!
(Lower error)

Trends

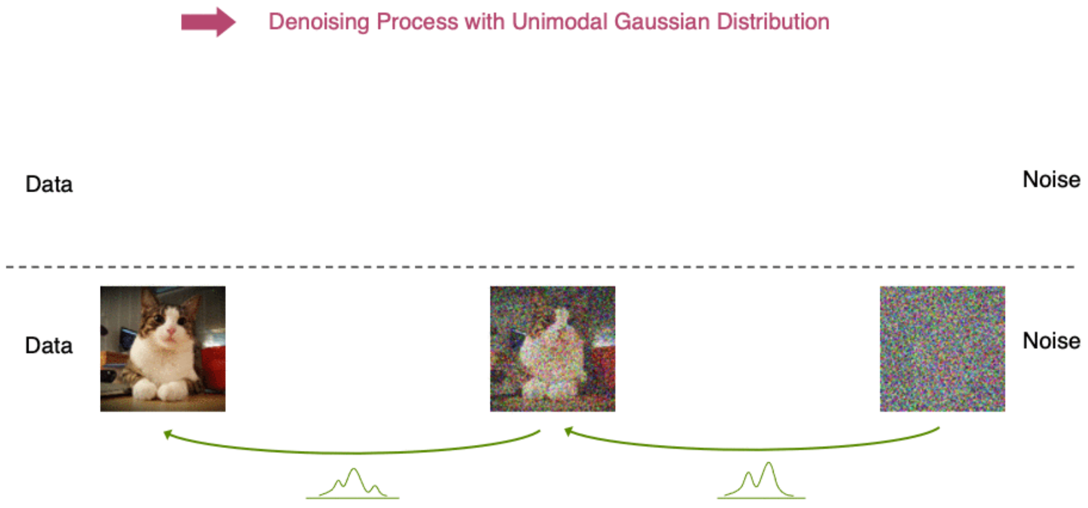
Source: Gartner
(red line overlay mine)

PyTorch

TensorFlow

Trends

ChatGPT

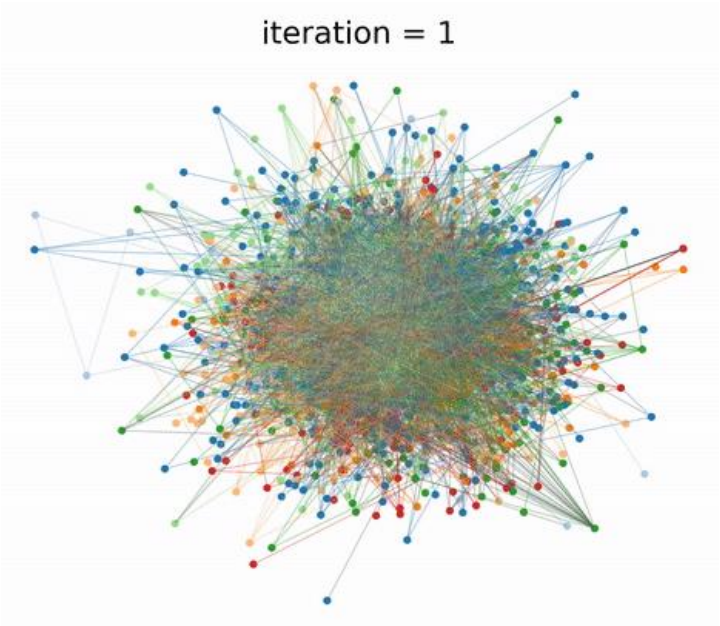


Large Language Model

Generative AI

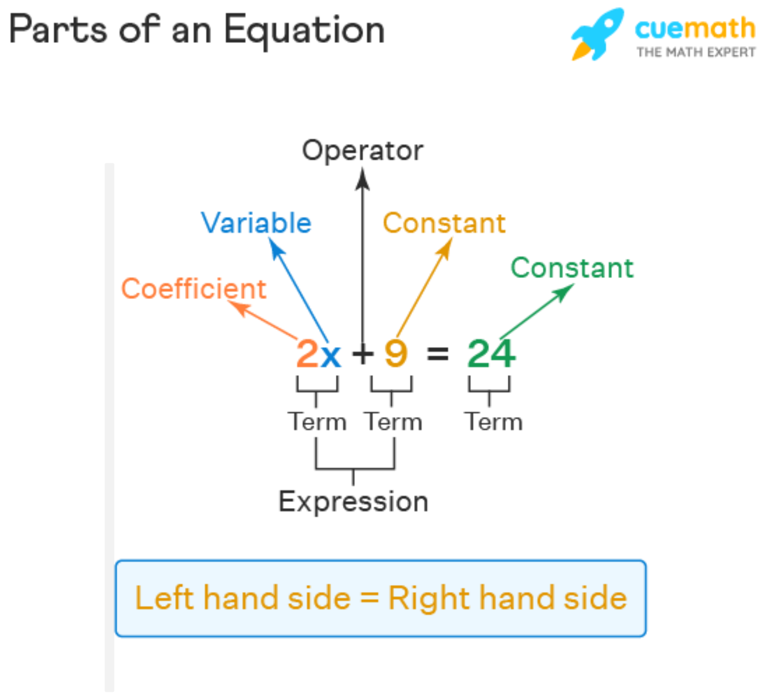
Reminder

LECTURE KEYPOINTS



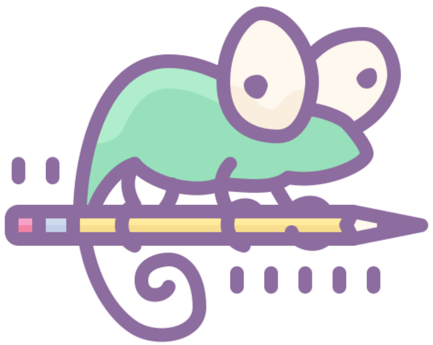
Intuitive understanding

With visualization



Understanding of equation

Q&A



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Member of BCML Lab.