



HAI Lecture

Lec 01. Machine **Learning**

Intro to ML and Deep Learning

| What is Machine Learning?

| Examples of ML

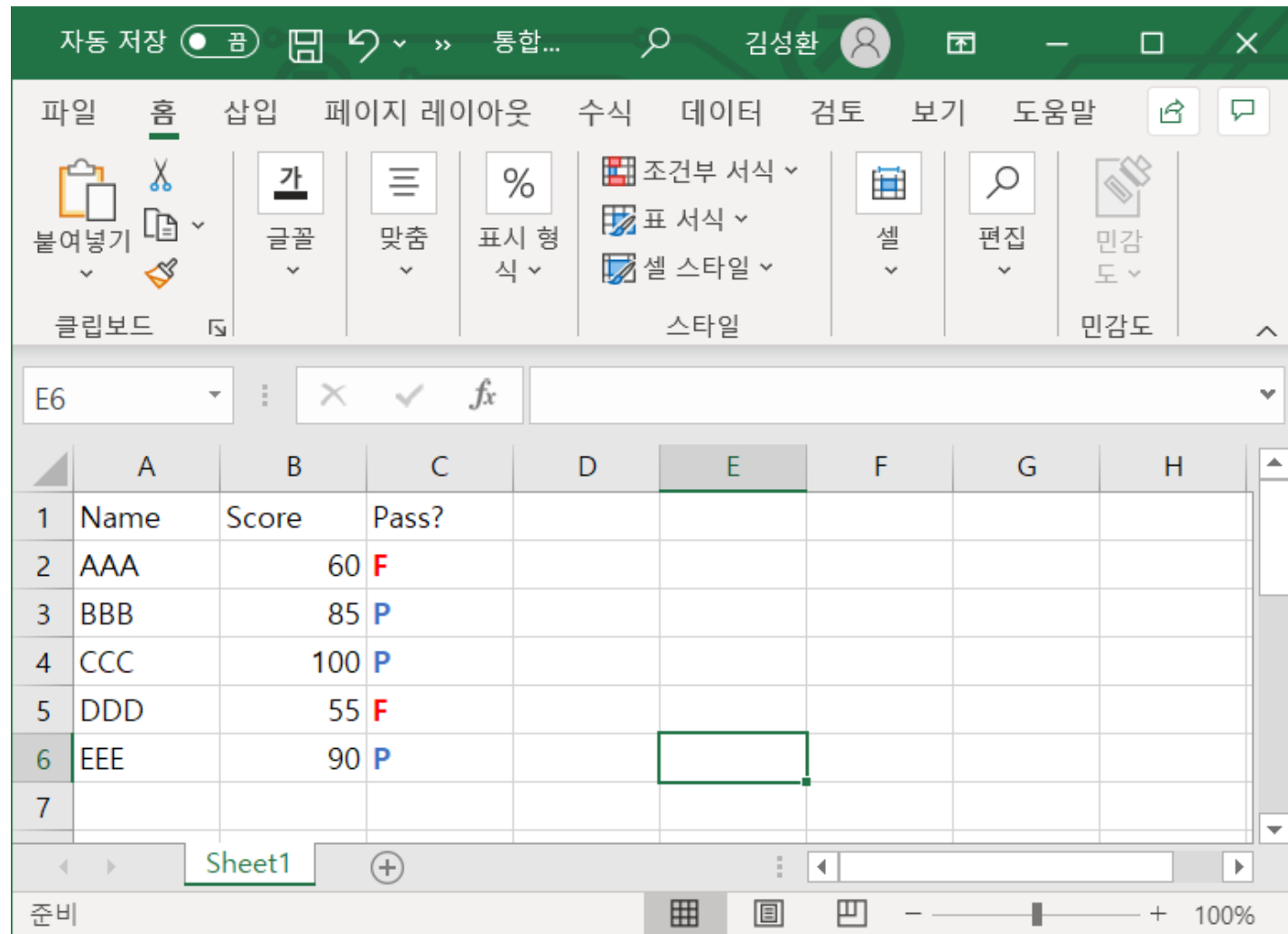
| Process of ML

| 실습 : Curve Fitting

| Frameworks for ML

INDEX

What is ML? : Classify Pass or Non-Pass

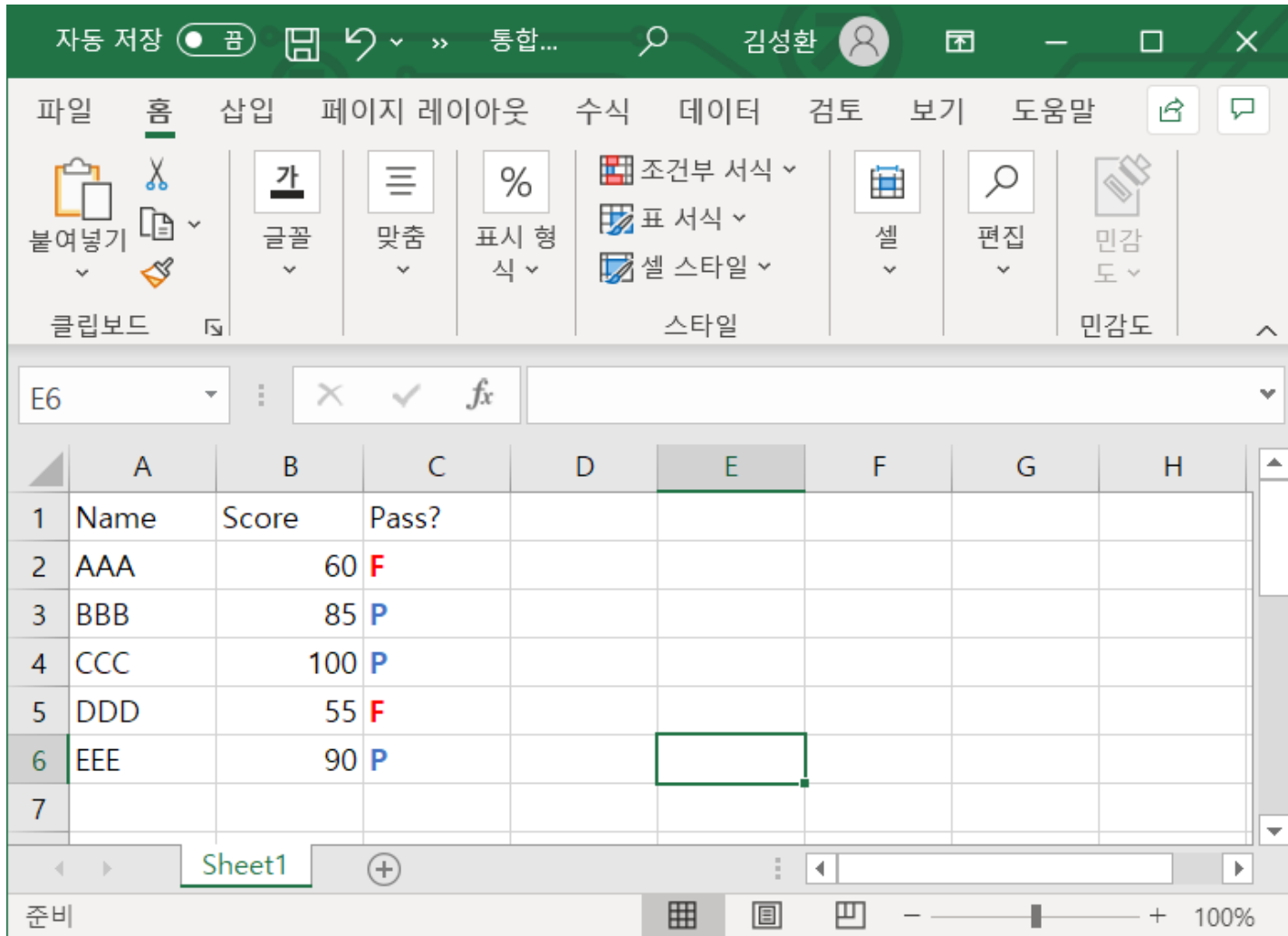


	A	B	C	D	E	F	G	H
1	Name	Score	Pass?					
2	AAA	60	F					
3	BBB	85	P					
4	CCC	100	P					
5	DDD	55	F					
6	EEE	90	P					
7								

Classification

80점이 넘으면 Pass!

What is ML? : Classify Pass or Non-Pass

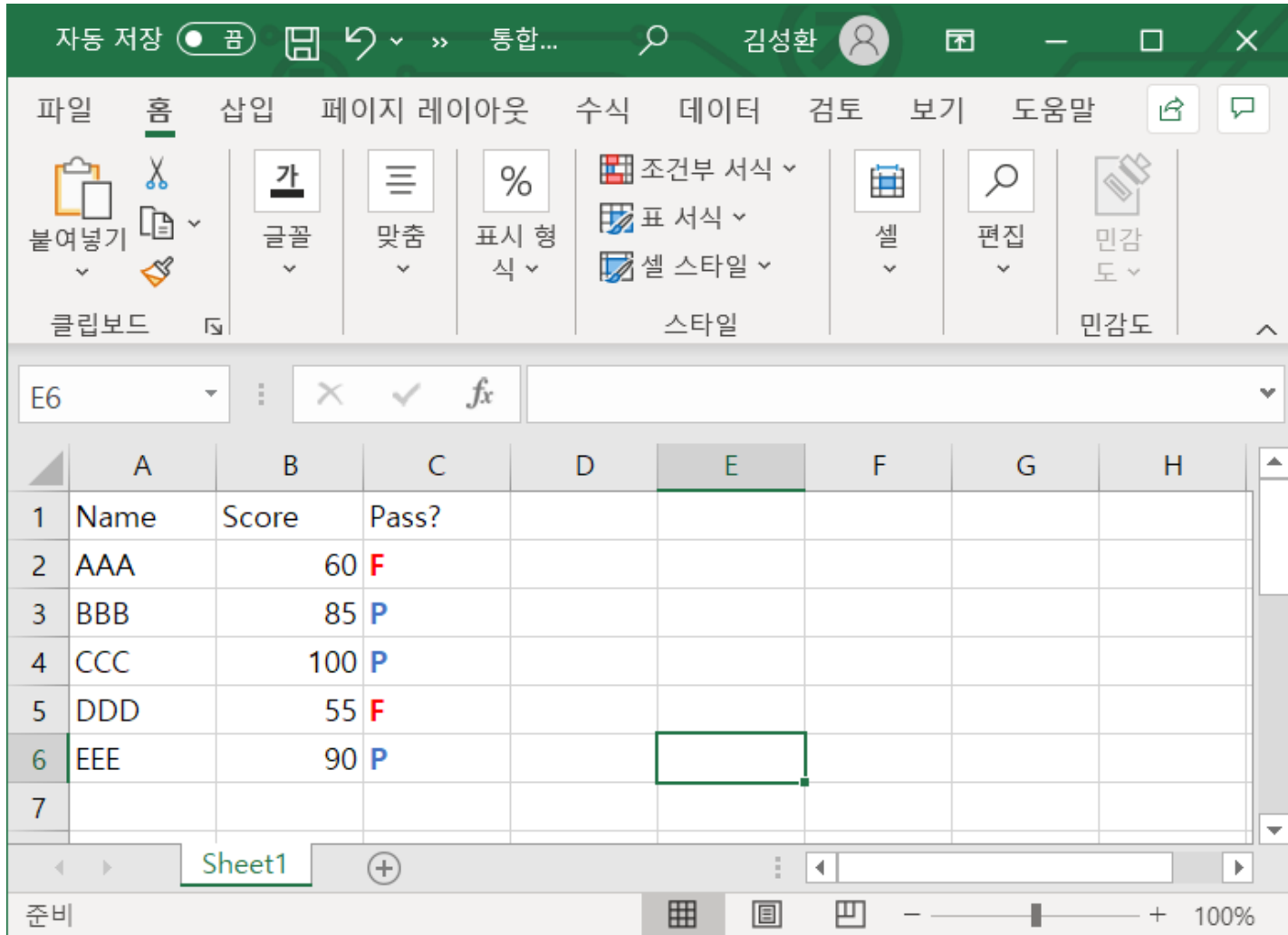


	A	B	C	D	E	F	G	H
1	Name	Score	Pass?					
2	AAA	60	F					
3	BBB	85	P					
4	CCC	100	P					
5	DDD	55	F					
6	EEE	90	P					
7								

“AAA는 Fail이고,
BBB는 Pass고,...”
Human Perspective



What is ML? : Classify Pass or Non-Pass



	A	B	C	D	E	F	G	H
1	Name	Score	Pass?					
2	AAA	60	F					
3	BBB	85	P					
4	CCC	100	P					
5	DDD	55	F					
6	EEE	90	P					
7								

“if score > 60
then [PASS]”
Machine Perspective



| What is ML? : Classify Cats and Dogs



Classification

어떤 것이 개이고 고양이일까?

| What is ML? : Classify Cats and Dogs



**“왼쪽이 개이고,
오른쪽이 고양이야!”**
In Human Perspective



| What is ML? : Classify Cats and Dogs



“if ... ??”

In Machine Perspective



| What is ML? : Classify Cats and Dogs



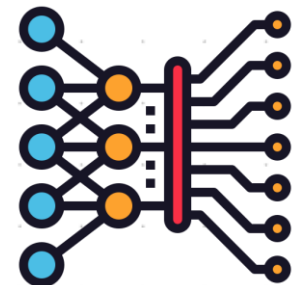
Dog



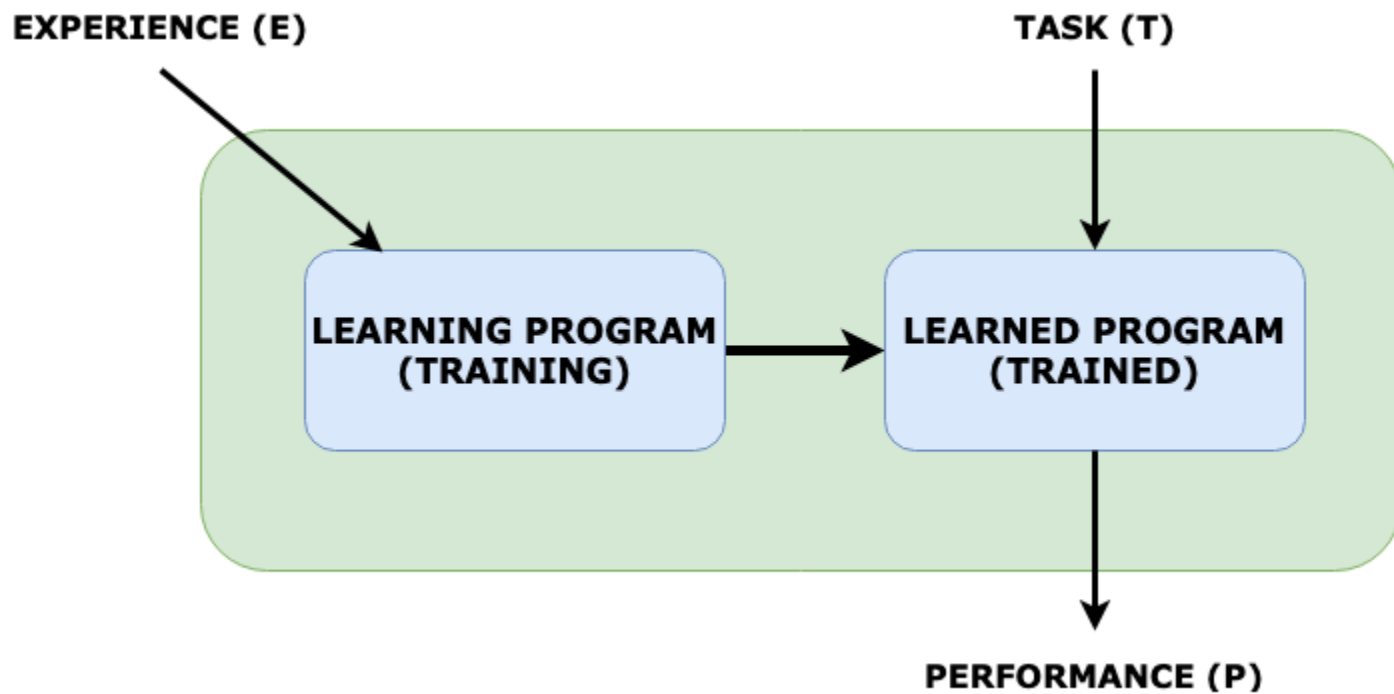
Cat

Machine Learning!

Machine Learns itself



What is ML? : Definition

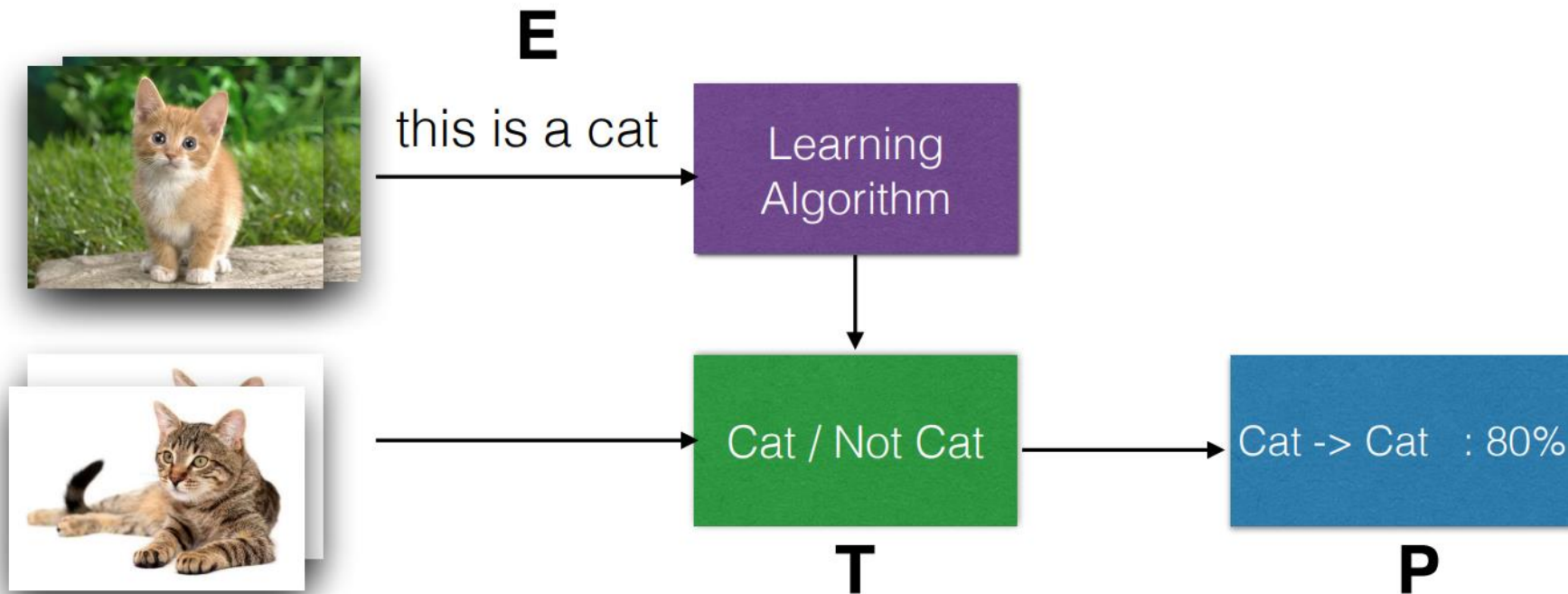


Definition

한 컴퓨터 프로그램이 어떤 **과제류(class of tasks) T** 에 속하는 과제들을 수행하며 그 수행의 **성과를 측정한 정도**를 **P** 라고 할 때, 만약 **어떤 경험 E** 때문에 **T** 의 어떤 과제에 대한 **성과 P** 가 개선되었다면, 그 컴퓨터 프로그램은 **경험 E 로부터 학습**한다고 말할 수 있다.

[Mitchell, 1997]

What is ML? : Definition



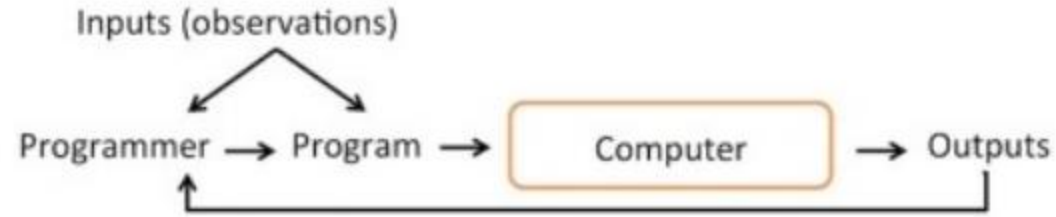
Definition

한 컴퓨터 프로그램이 어떤 **과제류(class of tasks)** **T**에 속하는 과제들을 수행하며 그 수행의 **성과를 측정한 정도**를 **P**라고 할 때, 만약 **어떤 경험 E**때문에 **T**의 어떤 과제에 대한 **성과 P**가 개선되었다면, 그 컴퓨터 프로그램은 **경험 E로부터 학습**한다고 말할 수 있다.

[Mitchell, 1997]

| What is ML? : Difference from Traditional Programming

The Traditional Programming Paradigm



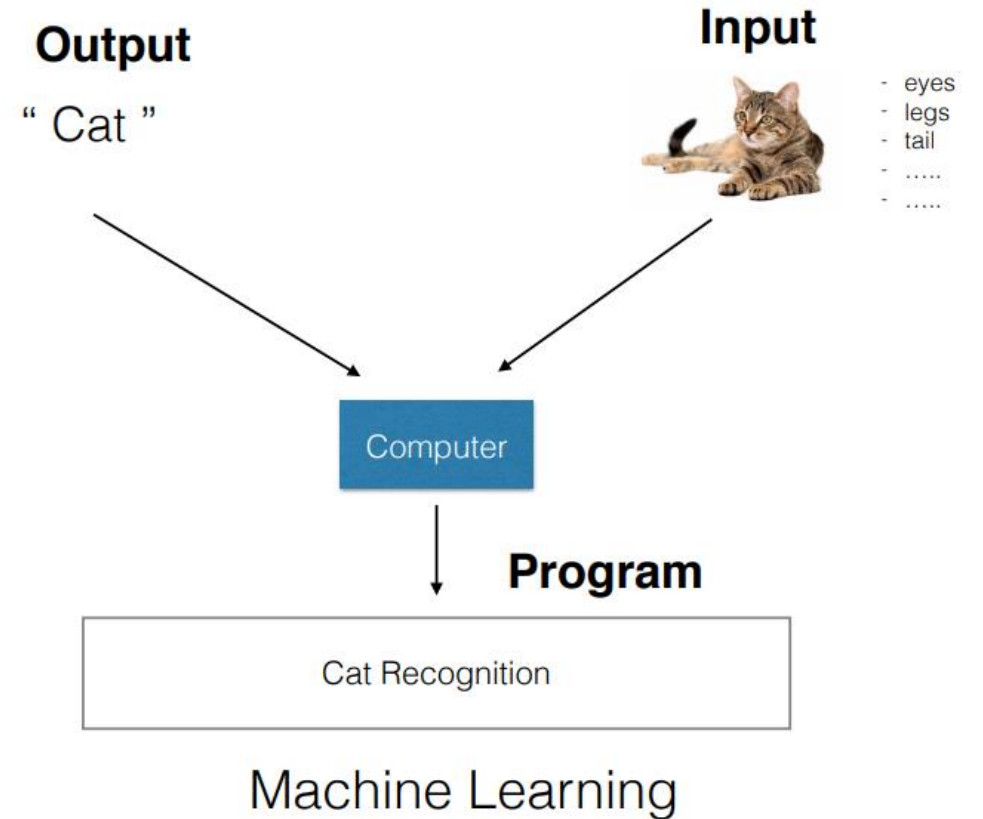
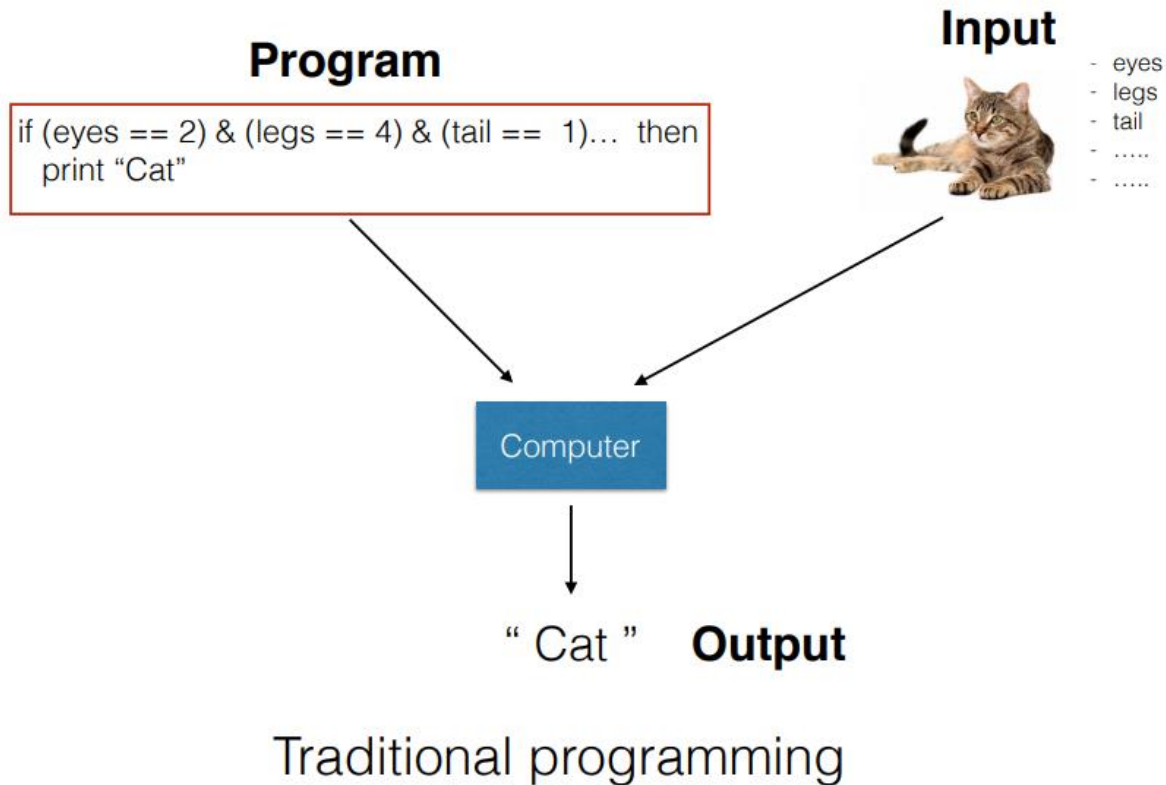
Machine Learning is the field of study that gives computers the ability to learn without being explicitly programmed
– Arthur Samuel (1959)

Machine Learning

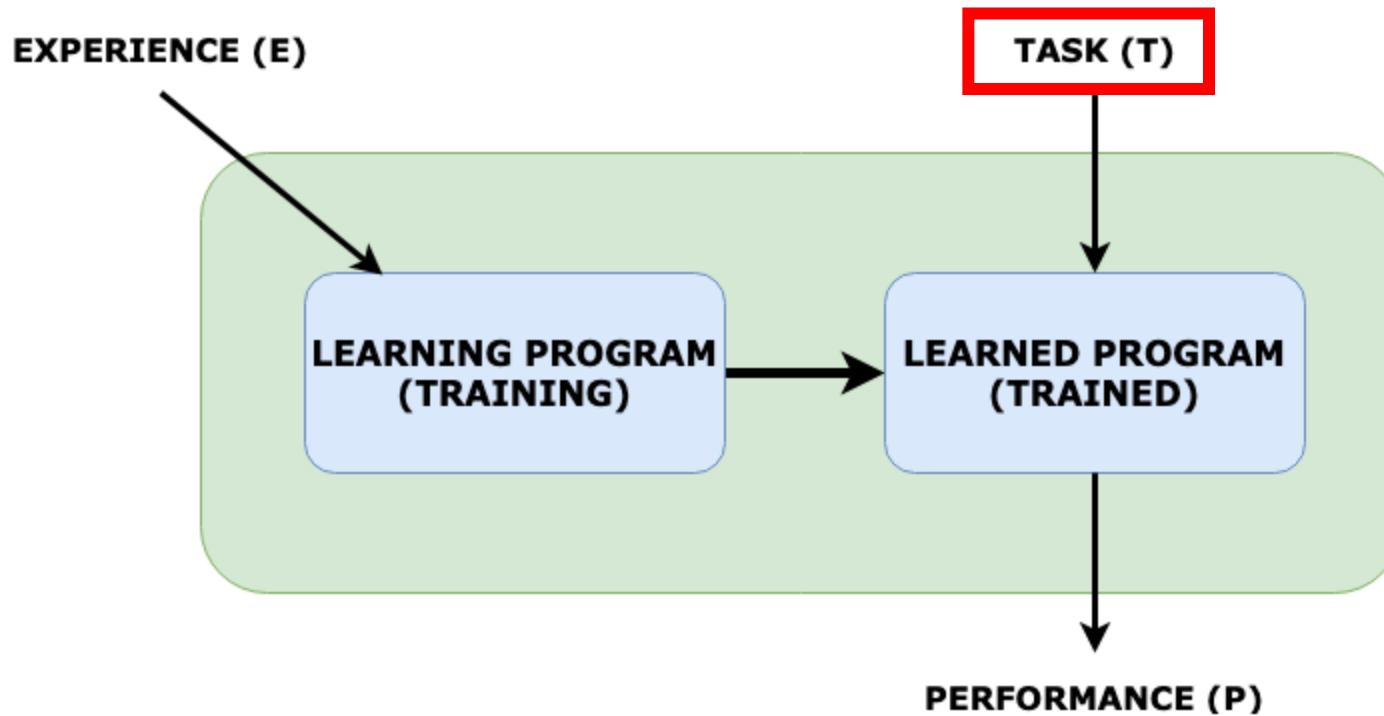


Sebastian Raschka, 2016

| What is ML? : Difference from Traditional Programming



Examples of ML Task(T)



Task

머신러닝이 무엇을 할 수 있나요?

| Examples of ML Task(T) : Computer Vision



CV

Computer processes image/video data
that we can “SEE”

Examples of ML Task(T) : Computer Vision

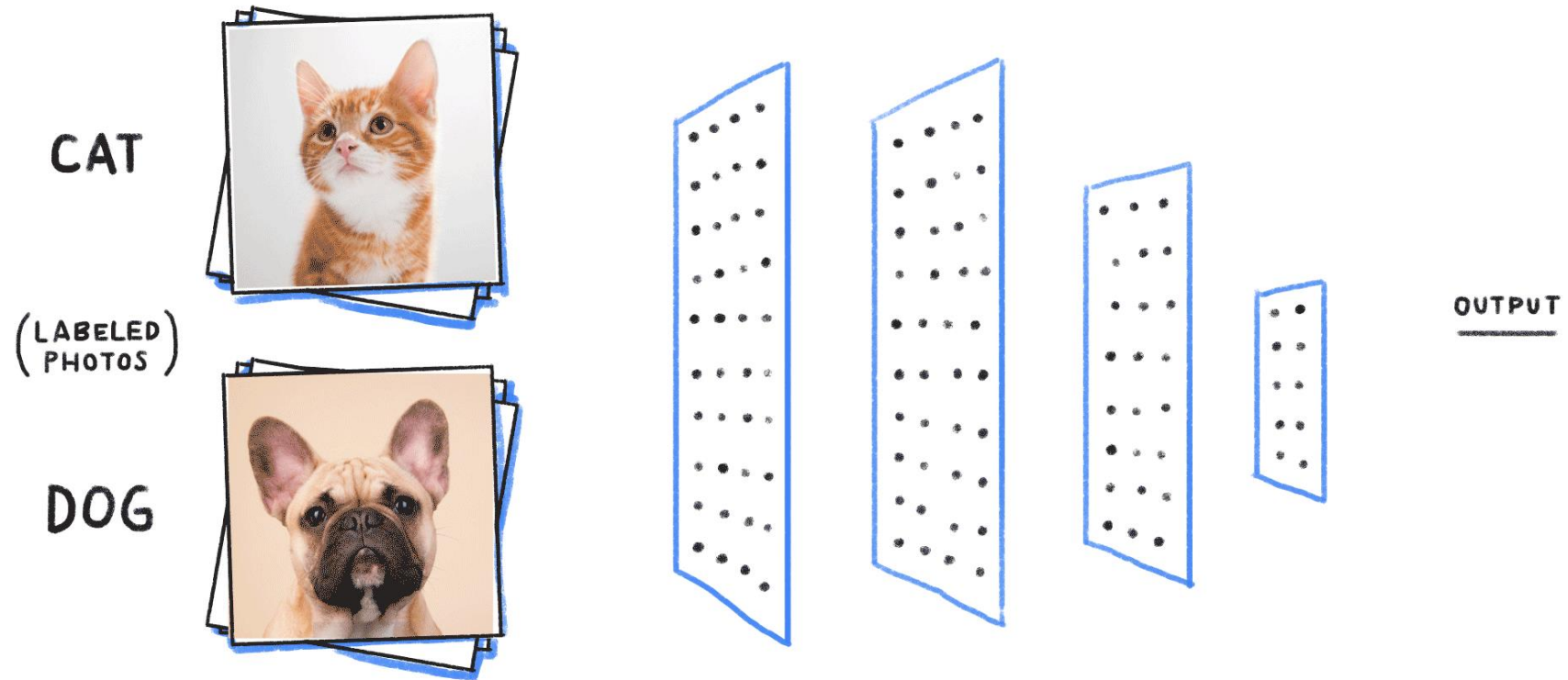
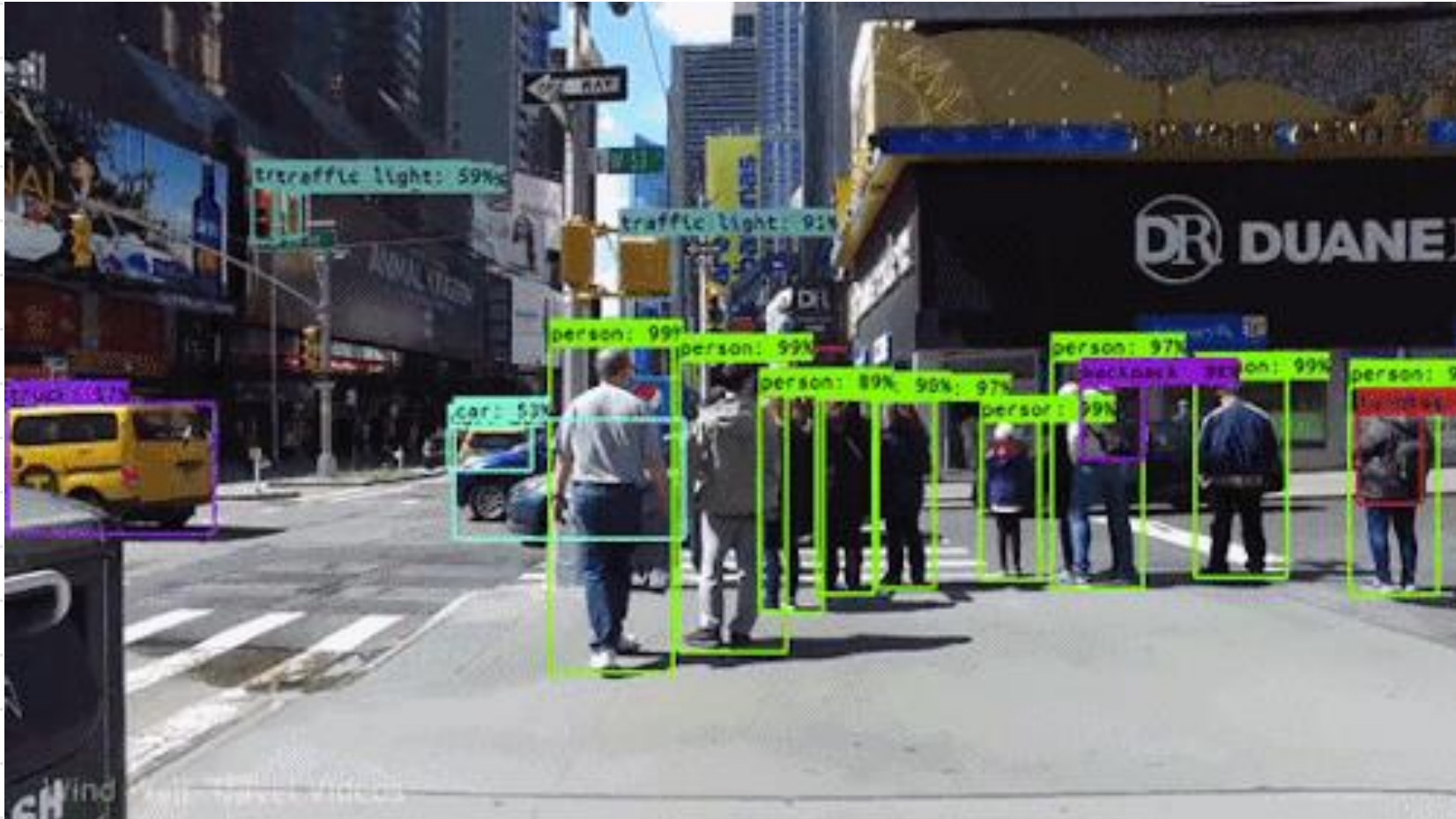


Image Classification

Examples of ML Task(T) : Computer Vision



Object Detection

Examples of ML Task(T) : Computer Vision



Image Segmentation

Examples of ML Task(T) : Computer Vision

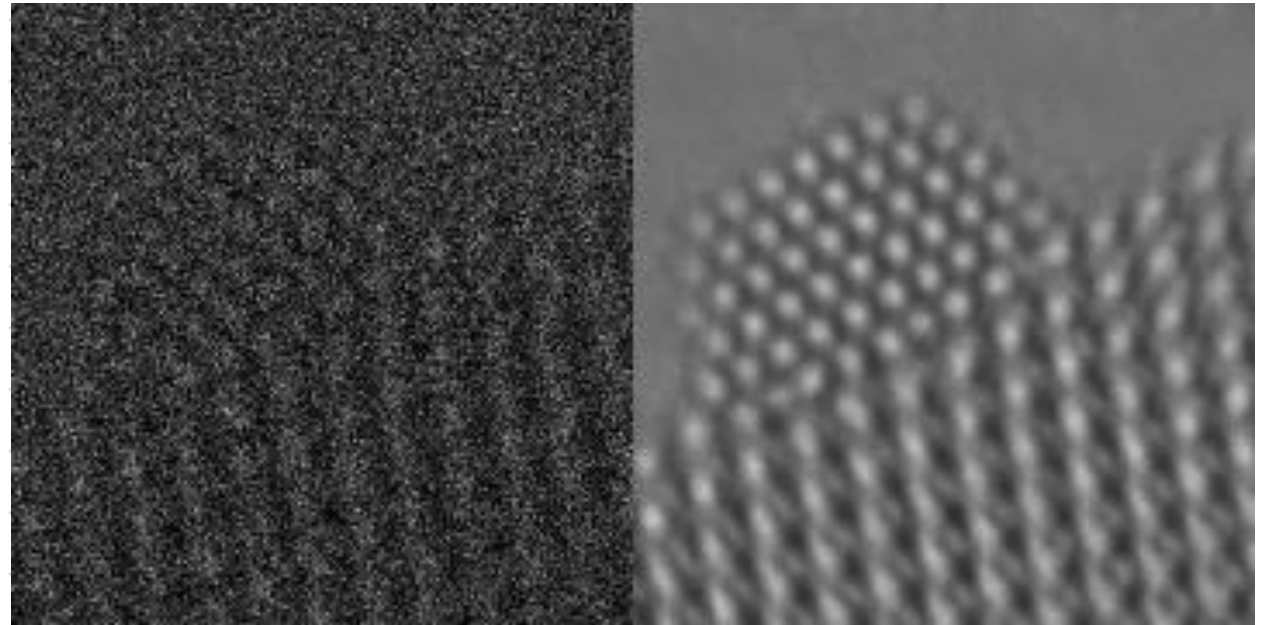
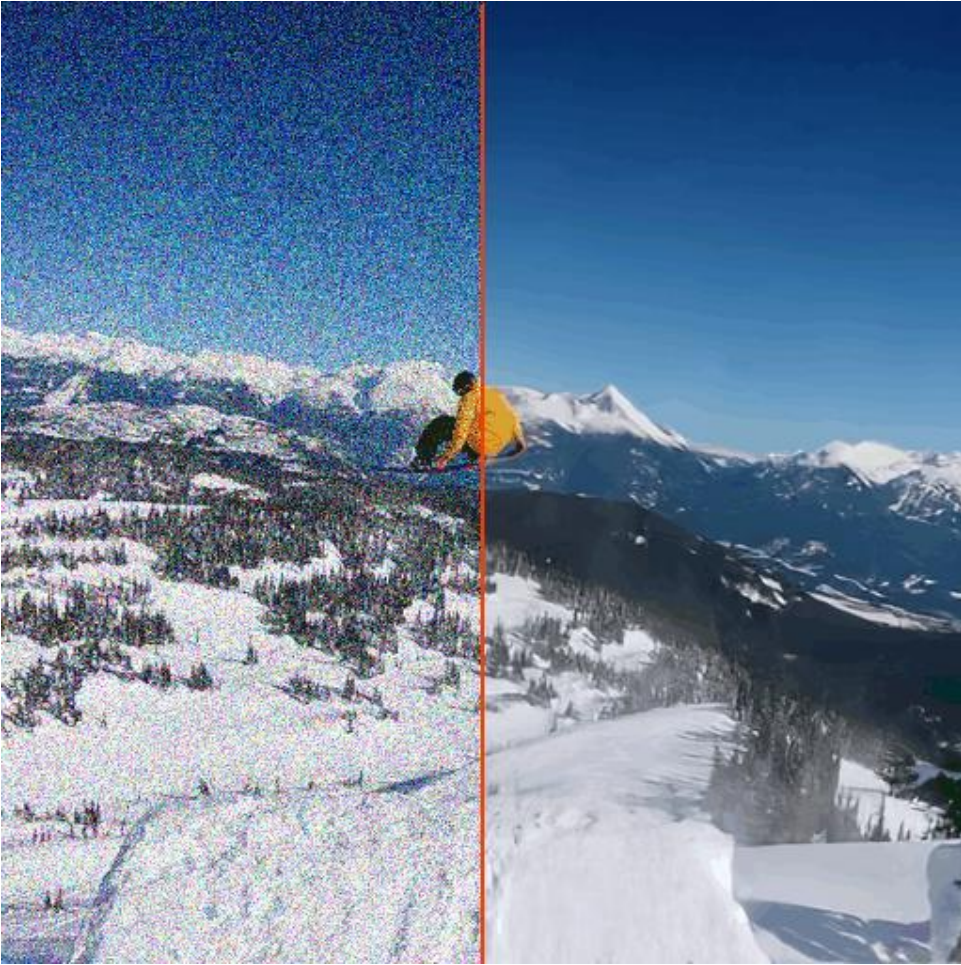


Image Denoising

| Examples of ML Task(T) : Computer Vision



Image Synthesis / Generation

Examples of ML Task(T) : Computer Vision



Image Synthesis(Style Transfer)

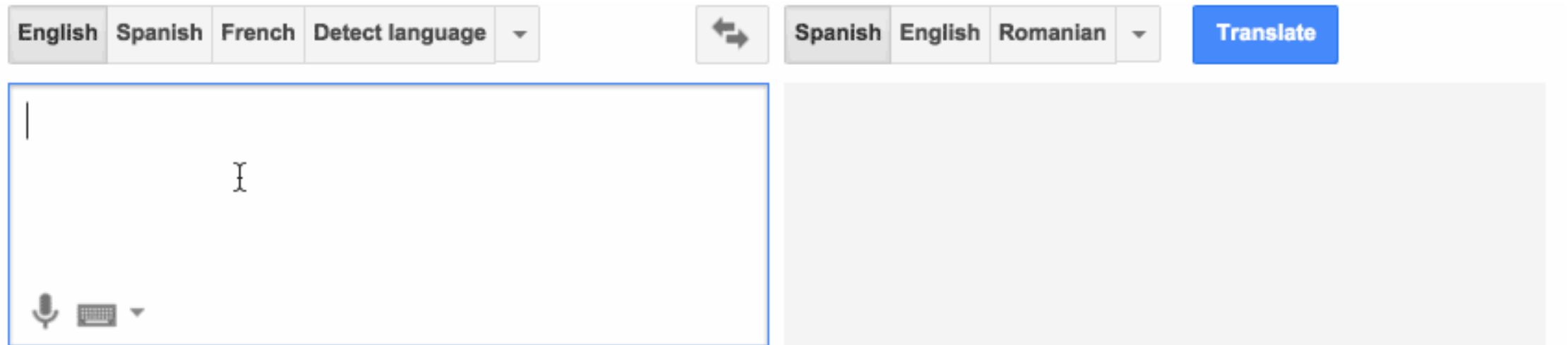
| Examples of ML Task(T) : Natural Language Processing



NLP

Computer processes text sequences
that we can “READ/WRITE/SPEAK”

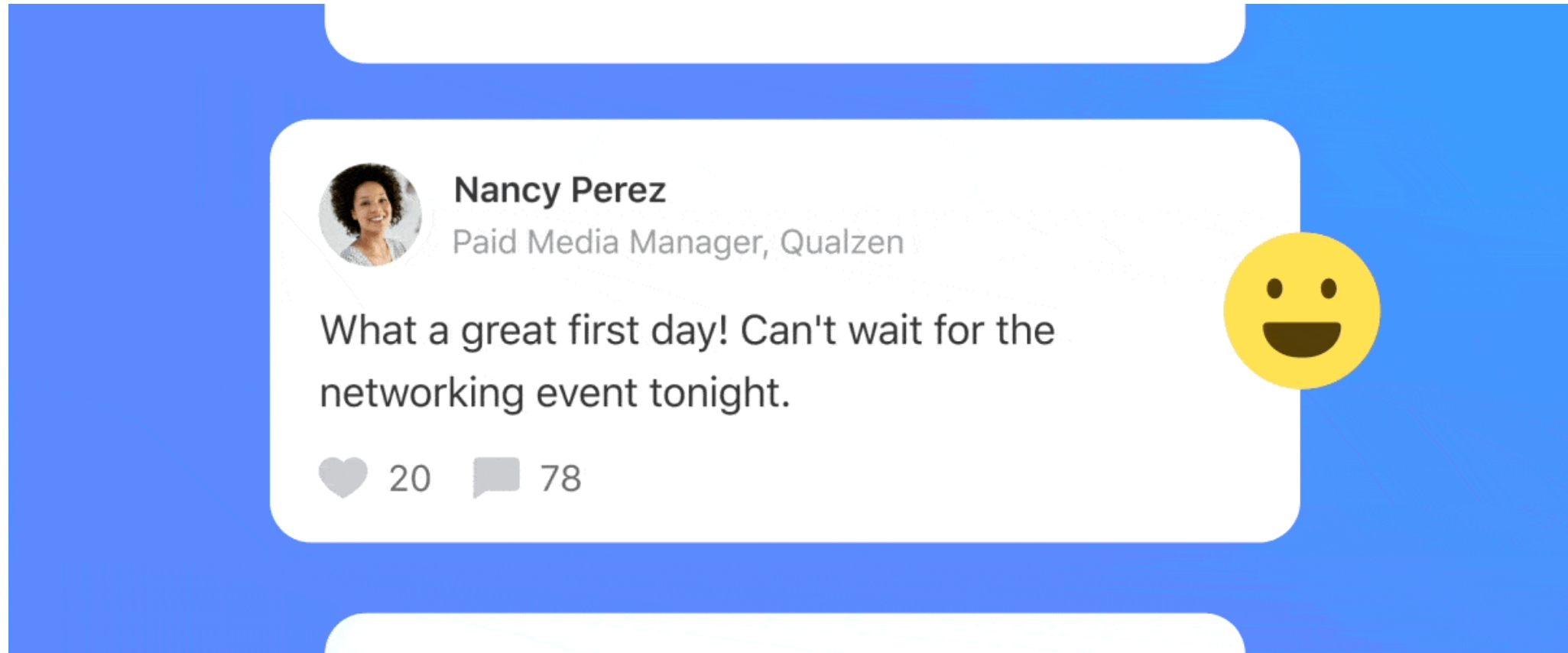
Examples of ML Task(T) : Natural Language Processing



A screenshot of a web-based machine translation interface. The interface features two rows of language selection buttons. The top row includes 'English', 'Spanish', 'French', and 'Detect language' with a dropdown arrow. The bottom row includes 'Spanish', 'English', and 'Romanian' with a dropdown arrow. A blue 'Translate' button is positioned to the right of the bottom row. Between the two rows of buttons is a double-headed arrow icon. Below the top row of buttons is a large text input area with a vertical cursor and a small icon at the bottom left. Below the bottom row of buttons is a large, empty gray rectangular area for the translated text.

Machine Translation

Examples of ML Task(T) : Natural Language Processing



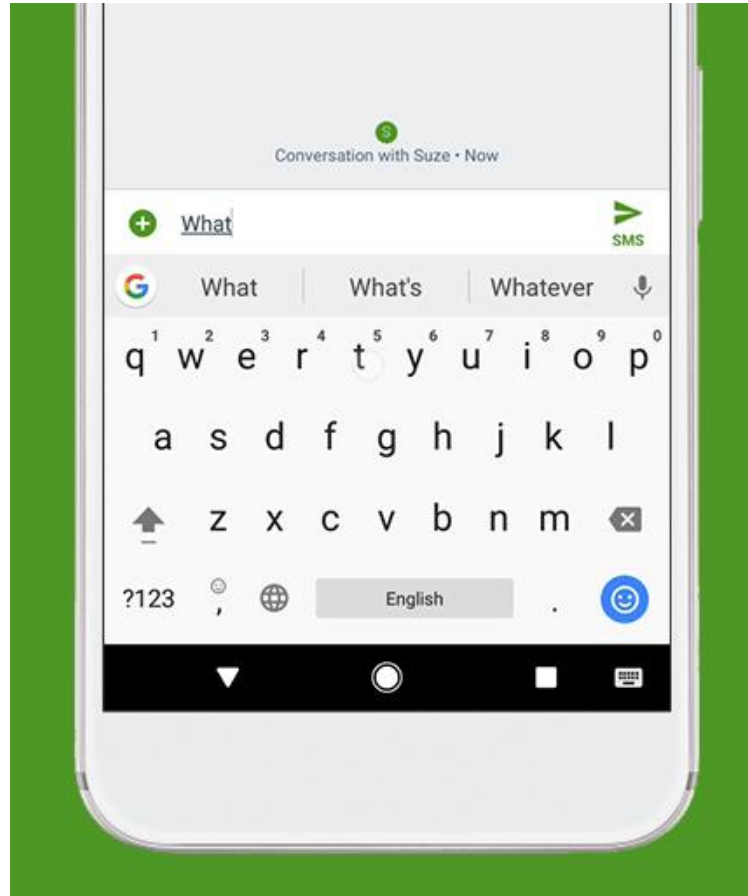
Sentiment Analysis

| Examples of ML Task(T) : Natural Language Processing



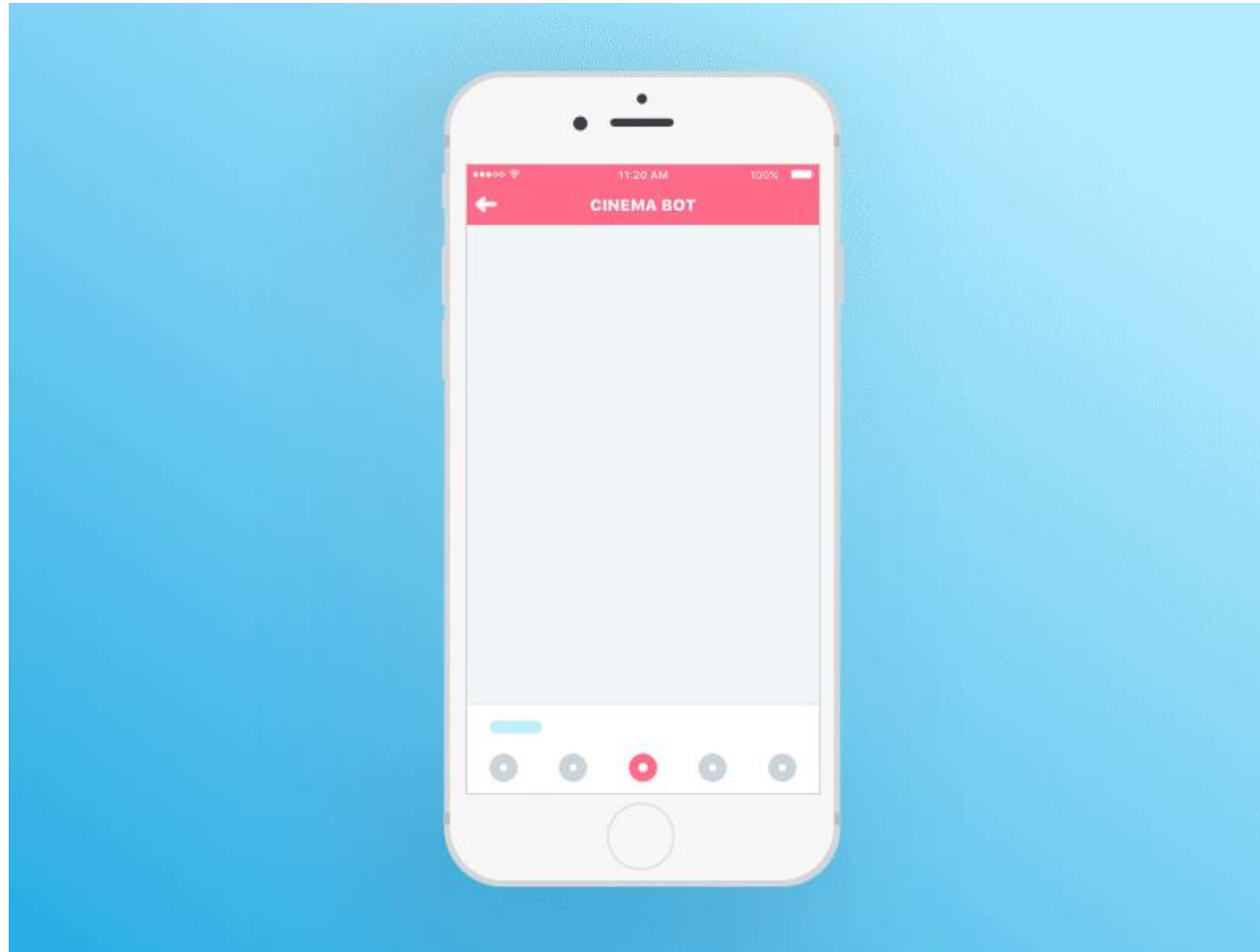
Speech to Text

Examples of ML Task(T) : Natural Language Processing



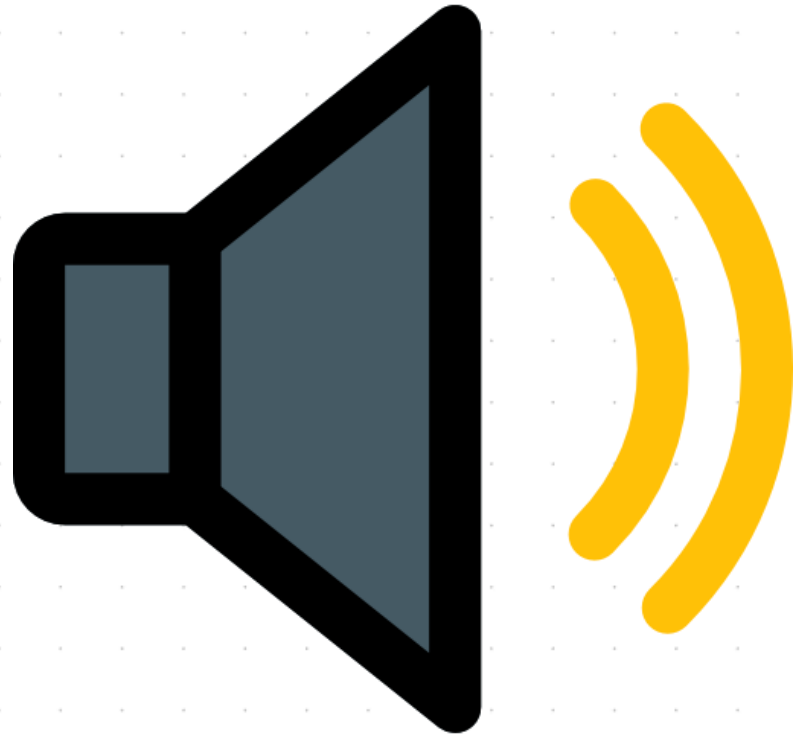
Word Prediction

| Examples of ML Task(T) : Natural Language Processing



Chatbot

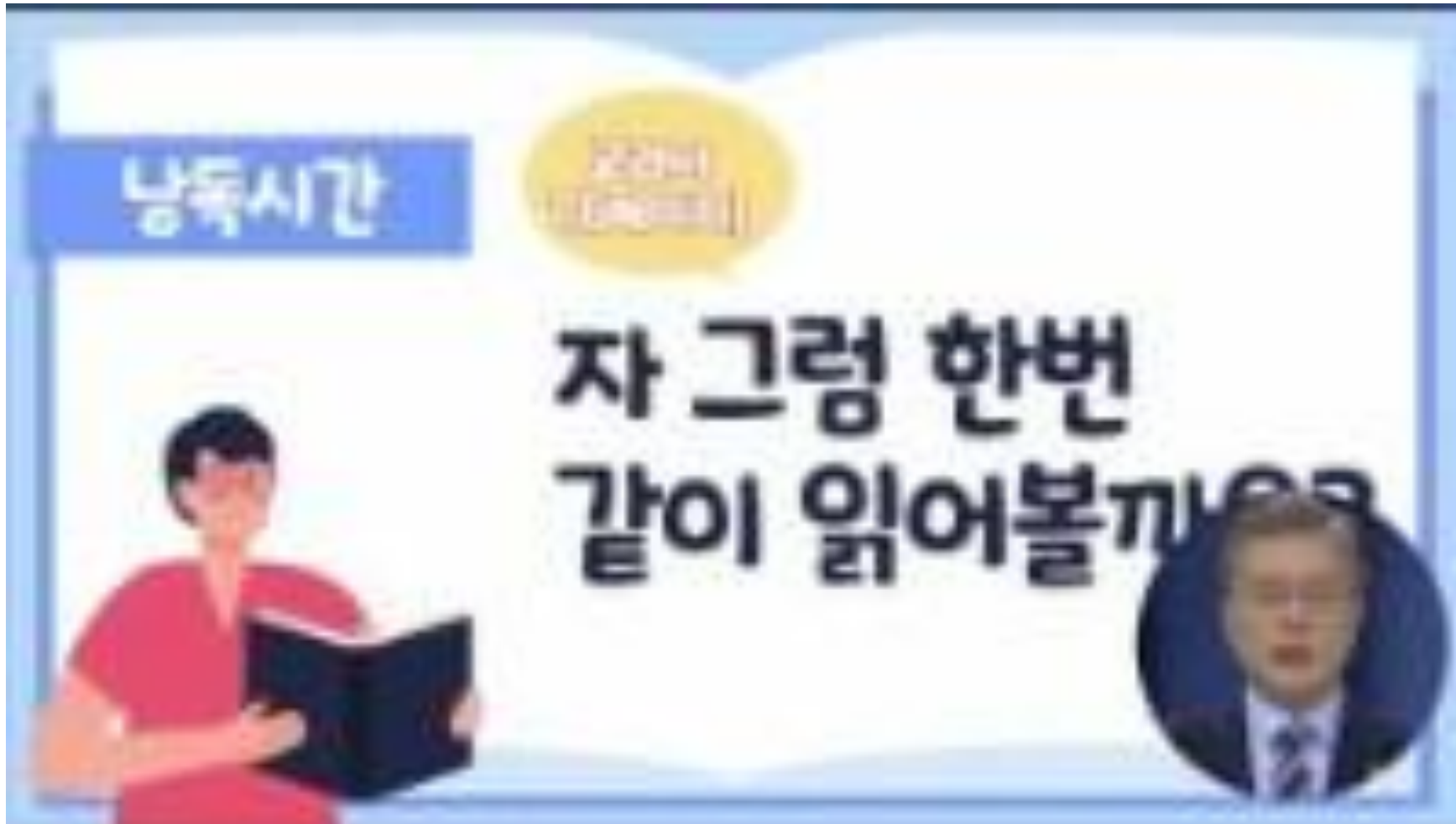
| Examples of ML Task(T) : Audio Processing



Audio

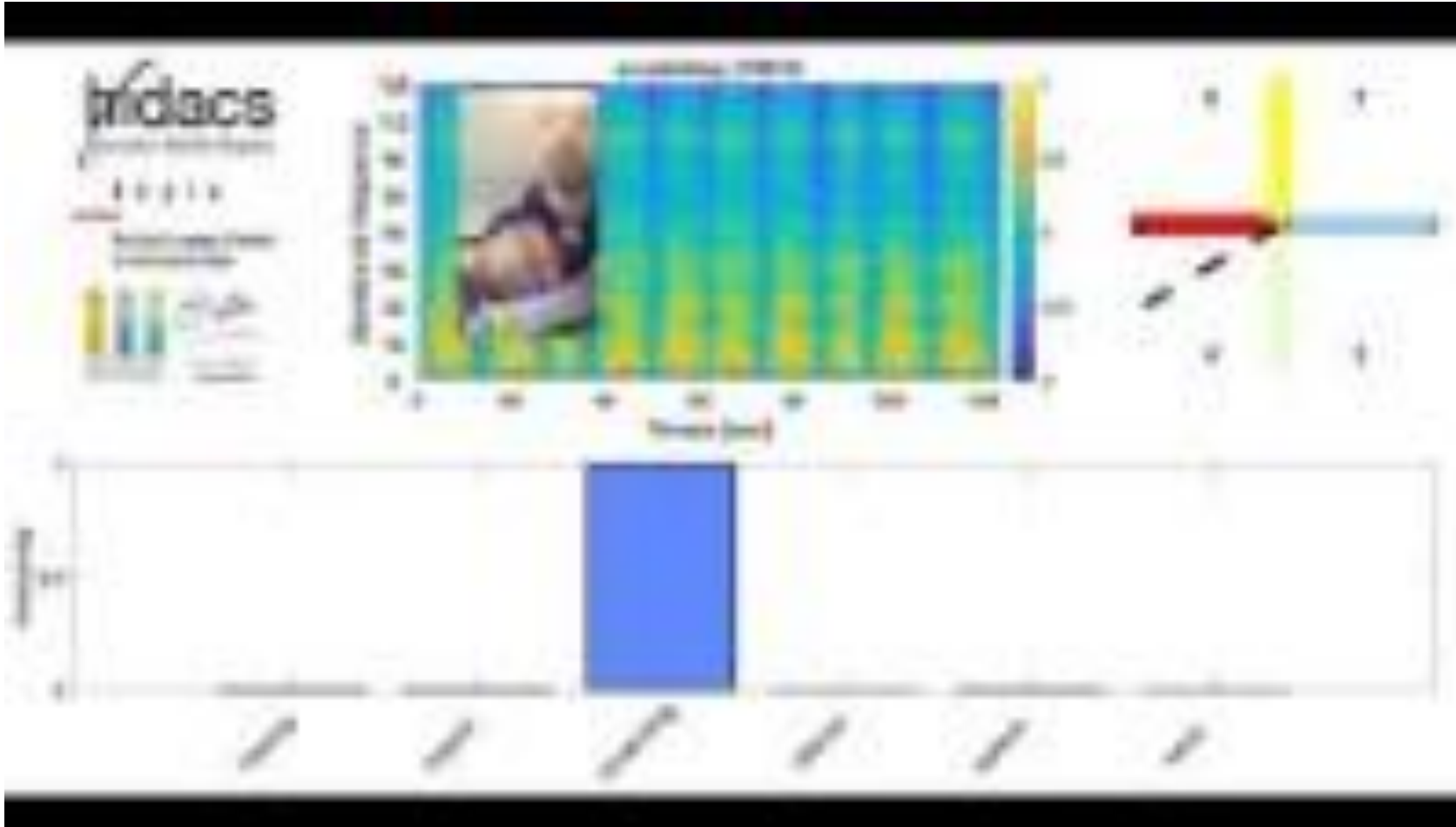
Computer processes audios
that we can “HEAR”

| Examples of ML Task(T) : Audio Processing



Speech Synthesis

Examples of ML Task(T) : Audio Processing



Audio Classification

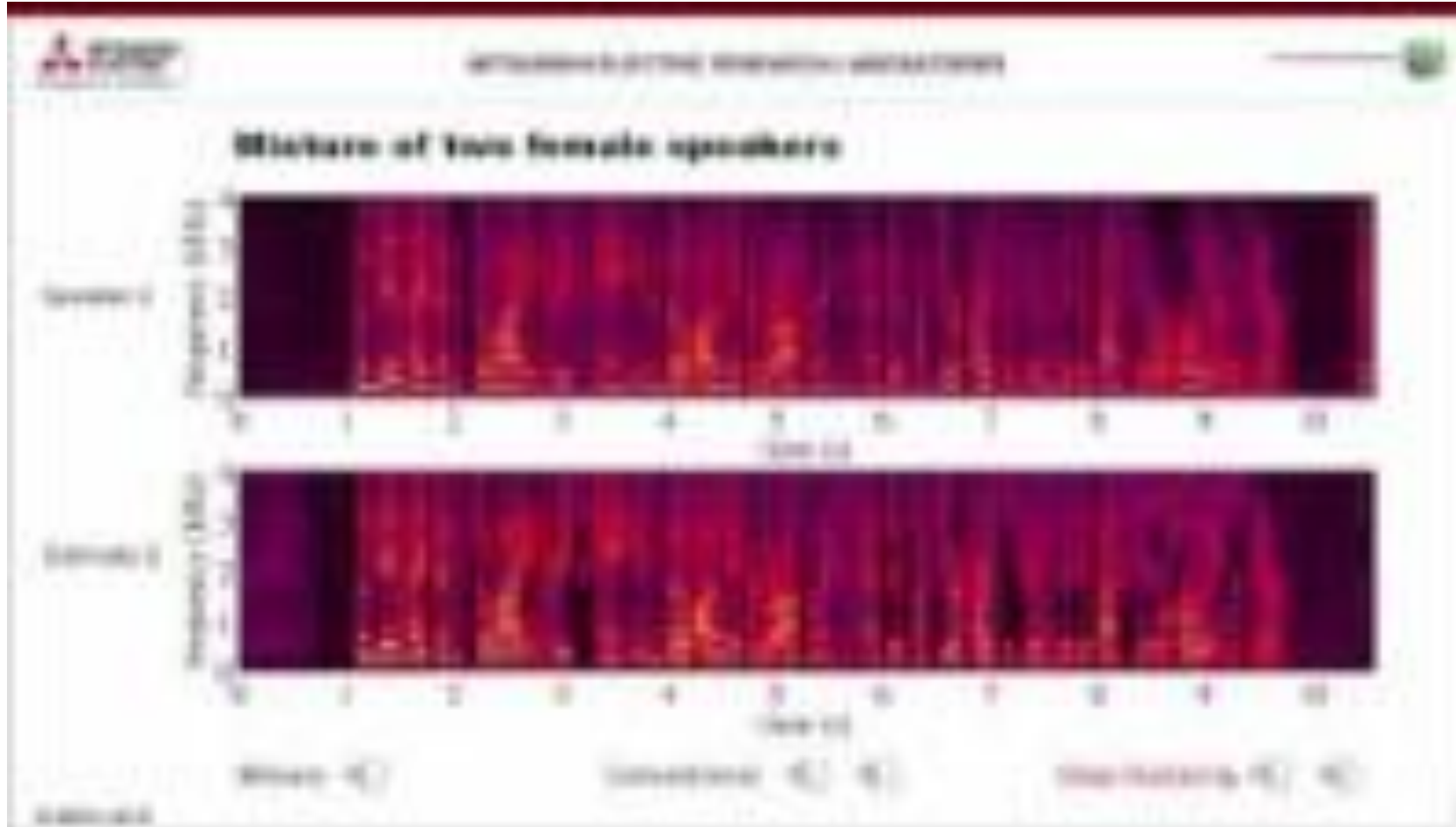
| Examples of ML Task(T) : Audio Processing



<http://open.unmix.app>

Audio Source Separation

Examples of ML Task(T) : Audio Processing



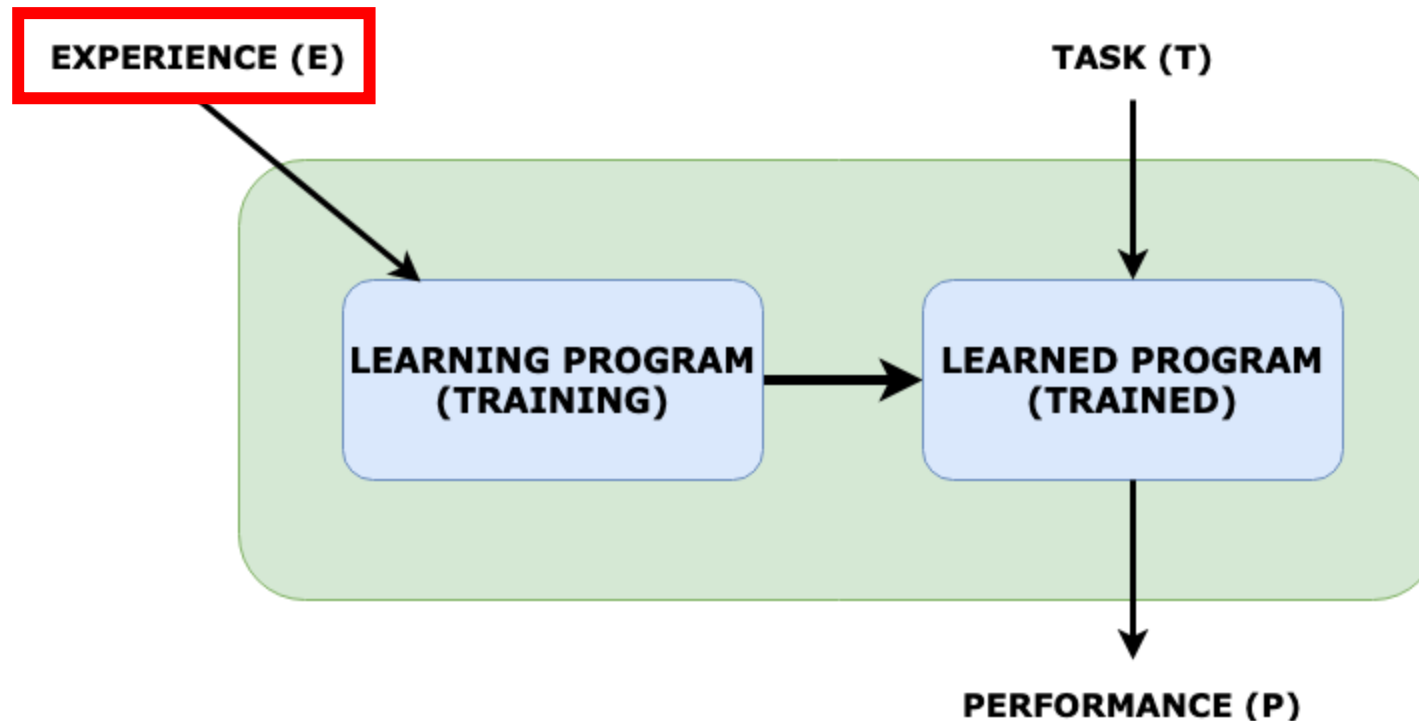
Multi Speaker Separation

| Examples of ML Task(T) : Audio Processing



Automatic Music Transcription

Examples of ML Experience(E)



Experience

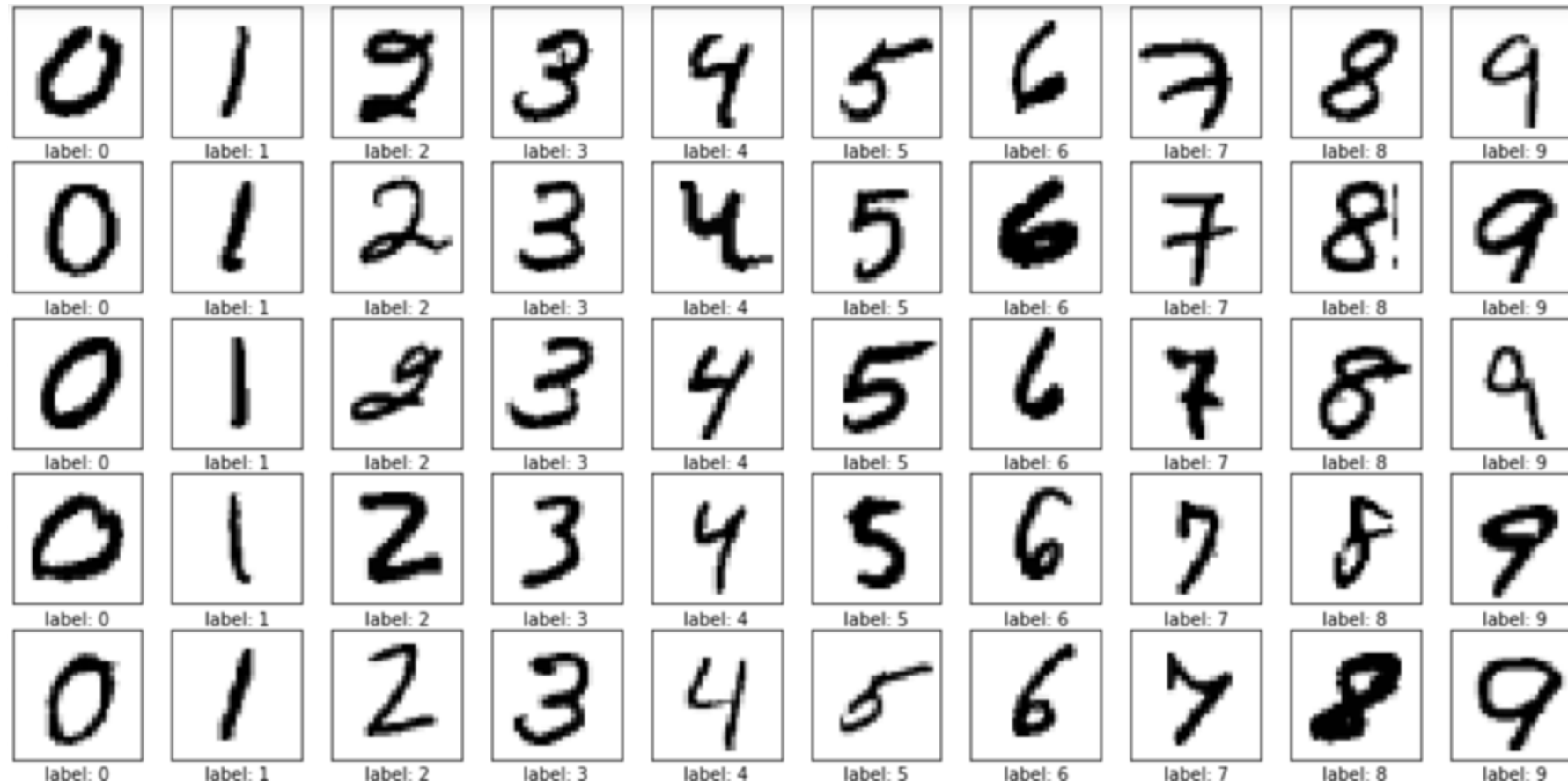
머신러닝이 무엇으로부터 배울 수 있나요?

Examples of ML Experience(E)

Transaction	Time stamp	ID	Age group	Fresh fruit	Seafood
1	April	1	Senior	Orange	Tuna
2	April	2	Teenager	Banana	Tuna
3	April	4	Teenager	Banana	Tuna
4	June	1	Senior	Orange	Anchovy
5	June	3	Adult	Banana	Tuna
6	July	1	Senior	Orange	Anchovy
7	July	2	Teenager	Banana	Tuna
8	July	2	Teenager	Orange	Tuna
9	July	4	Teenager	Banana	Tuna
10	December	2	Teenager	Banana	Tuna
11	December	3	Adult	Orange	Anchovy
12	December	1	Senior	Orange	Anchovy

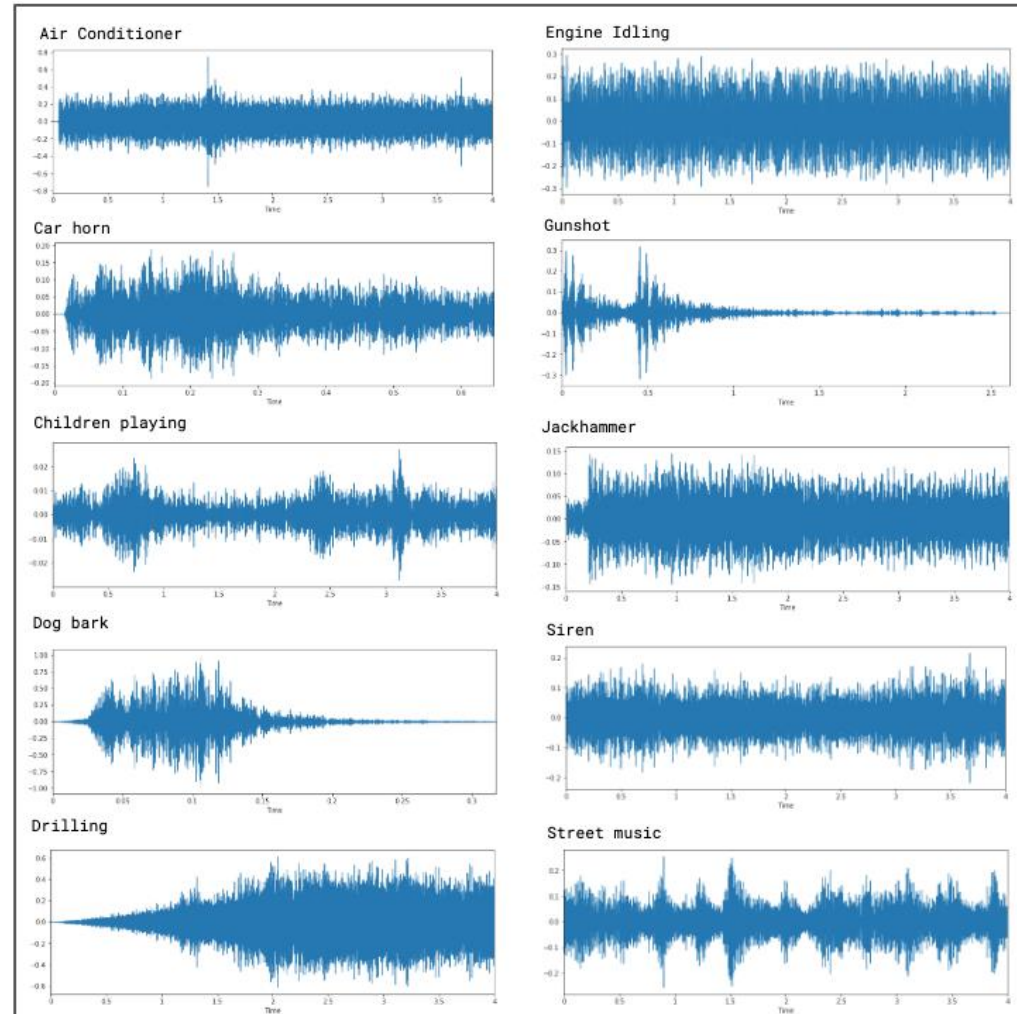
Dataset : Numeric/Categorical Data

Examples of ML Experience(E)



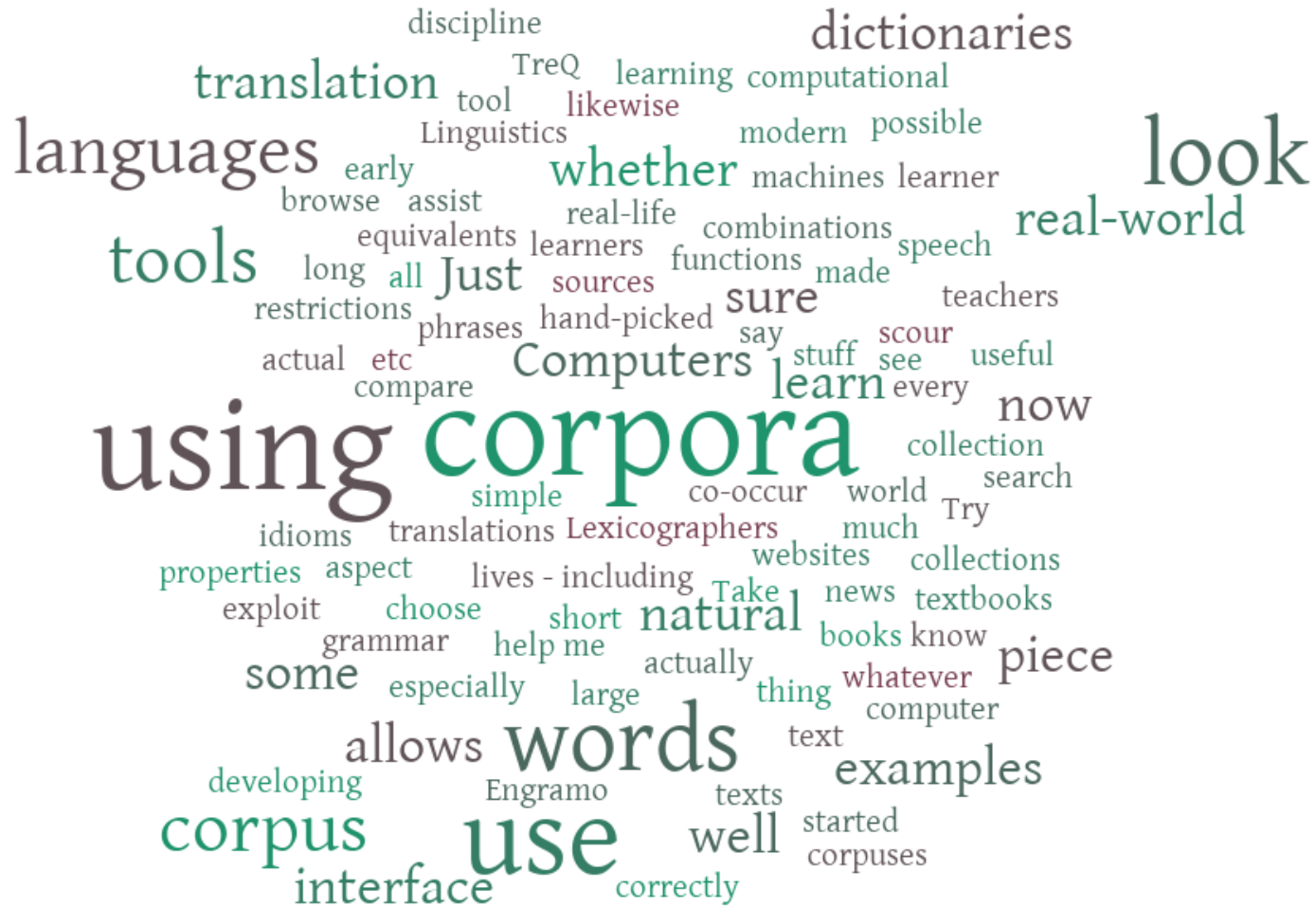
Dataset : Images with Labels

Examples of ML Experience(E)



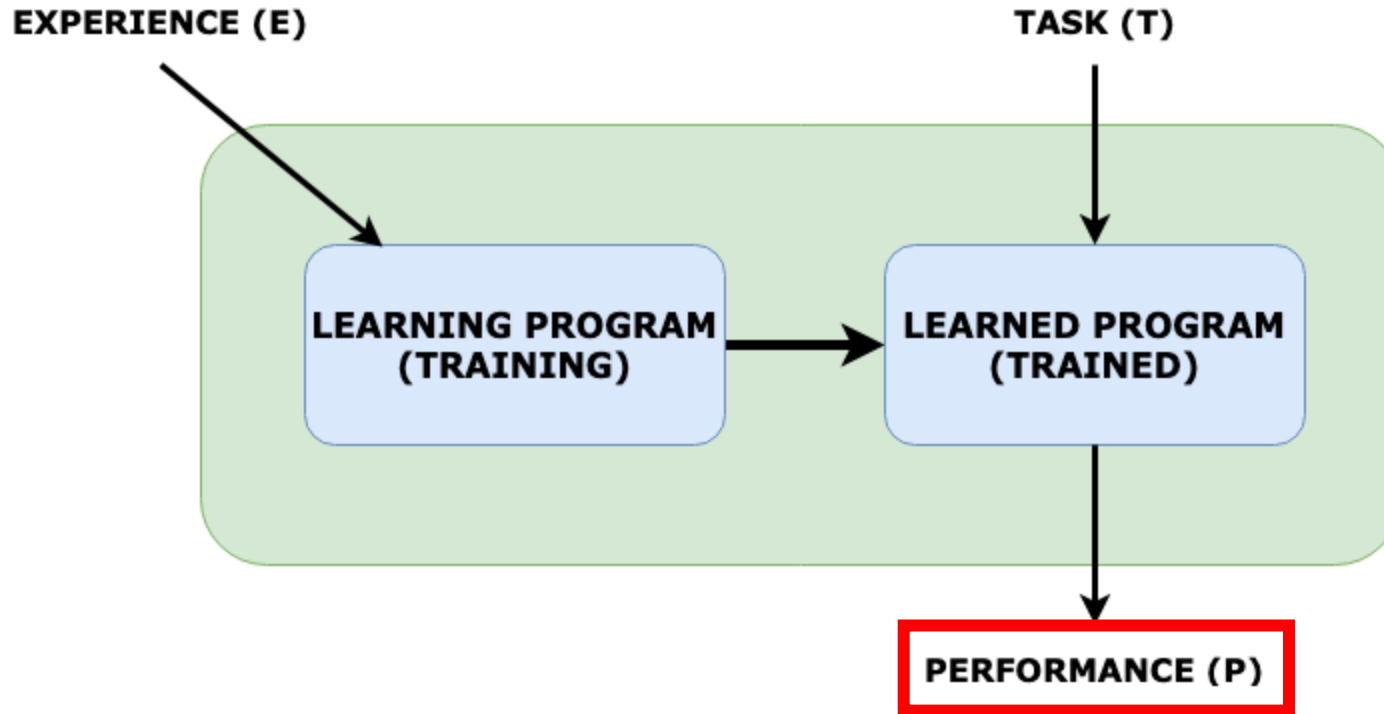
Dataset : Audios with Metadata

Examples of ML Experience(E)



Dataset : Text Corpus

Examples of ML Performance(P)



Performance

머신러닝은 어떻게 평가하나요?

Examples of ML Performance(P)

		실제 정답	
		True	False
분류 결과	True	True Positive	False Positive
	False	False Negative	True Negative

$$(Precision) = \frac{TP}{TP + FP}$$

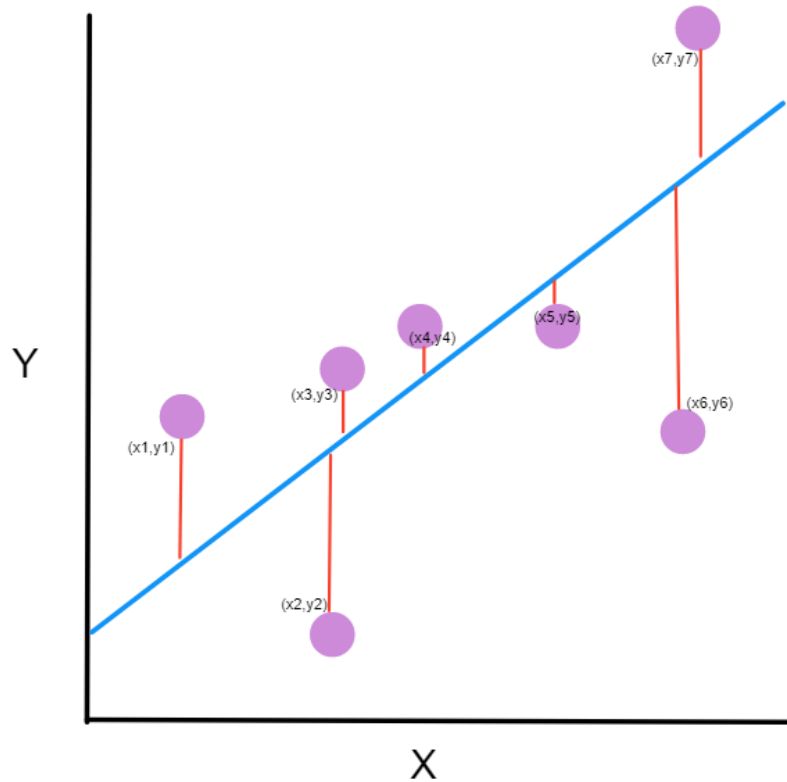
$$(Recall) = \frac{TP}{TP + FN}$$

$$(Accuracy) = \frac{TP + TN}{TP + FN + FP + TN}$$

$$(F1-score) = 2 \times \frac{1}{\frac{1}{Precision} + \frac{1}{Recall}} = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$

Accuracy (+Precision(정밀도), Recall(재현율), F1 Score)

Examples of ML Performance(P)



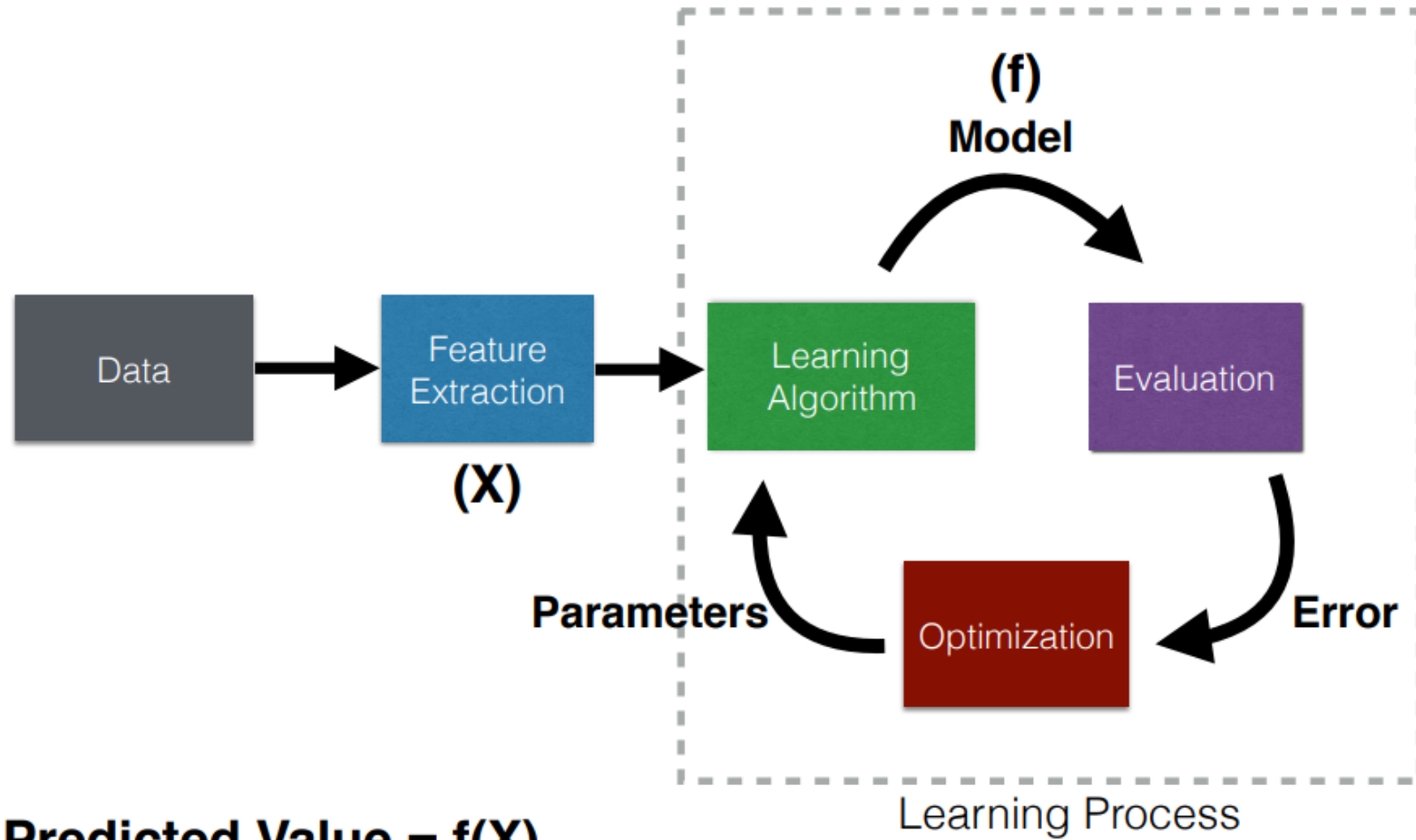
$$MSE = \frac{1}{n} \sum \left(\underbrace{y - \hat{y}}_{\substack{\text{The square of the difference} \\ \text{between actual and} \\ \text{predicted}}} \right)^2$$

$$H_p(q) = -\frac{1}{N} \sum_{i=1}^N y_i \cdot \log(p(y_i)) + (1 - y_i) \cdot \log(1 - p(y_i))$$

Binary Cross-Entropy / Log Loss

Loss


| Process of ML




Predicted Value = $f(X)$

We need **f** that **Predicted Value close to True Value**

| Process of ML

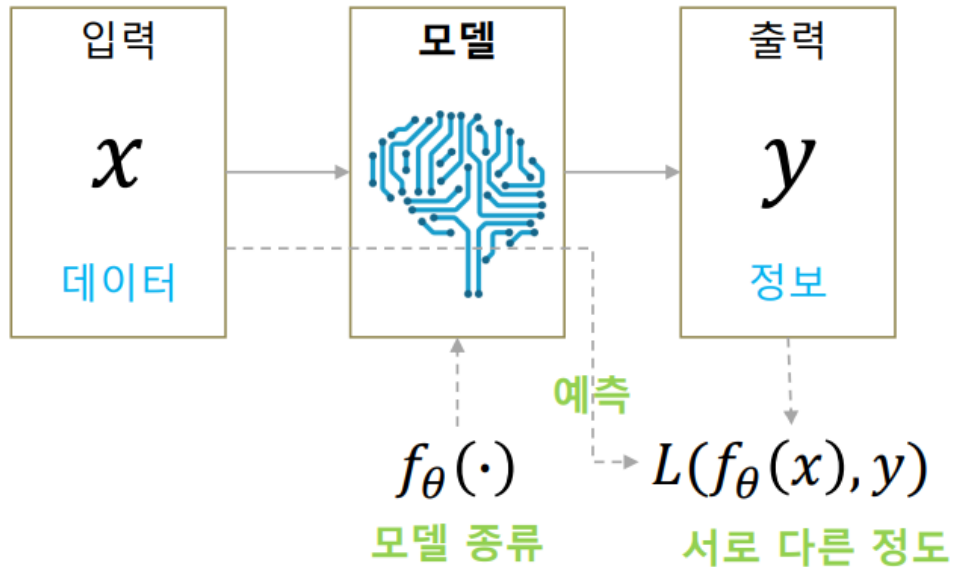
$$\text{" Cat " } = f(\text{)$$

$$\text{" Cat " } = f(\text{)$$

Model : $f(\cdot)$

입력을 주어진 Task 안에서 의미있는 Output를 반환하는 함수

| Process of ML



$$\theta^* = \operatorname{argmin}_{\theta} L(f_{\theta}(x), y)$$

주어진 데이터를 제일 잘 설명하는 모델 찾기

$$y_{new} = f_{\theta^*}(x_{new})$$

고정 입력, 고정 출력

Model : $f(\cdot)$

입력을 주어진 Task 안에서 의미있는 Output를 반환하는 함수

| Process of ML



Features:
1. Color: **Radish/Red**
2. Type : **Fruit**
3. Shape
etc...



Features:
1. Sky Blue
2. **Logo**
3. Shape
etc...

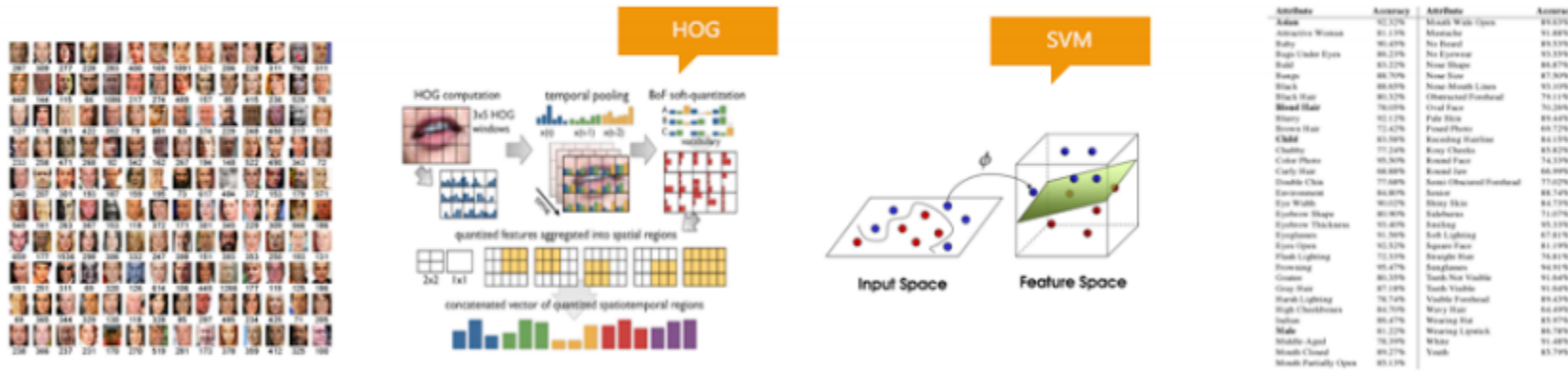
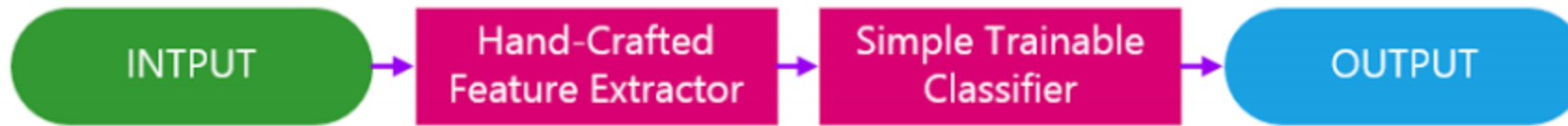


Features:
1. **Yellow**
2. **Fruit**
3. Shape
etc...

Feature Extraction

데이터에서 학습에 필요한 정보를 추출하여 정보를 압축

Process of ML

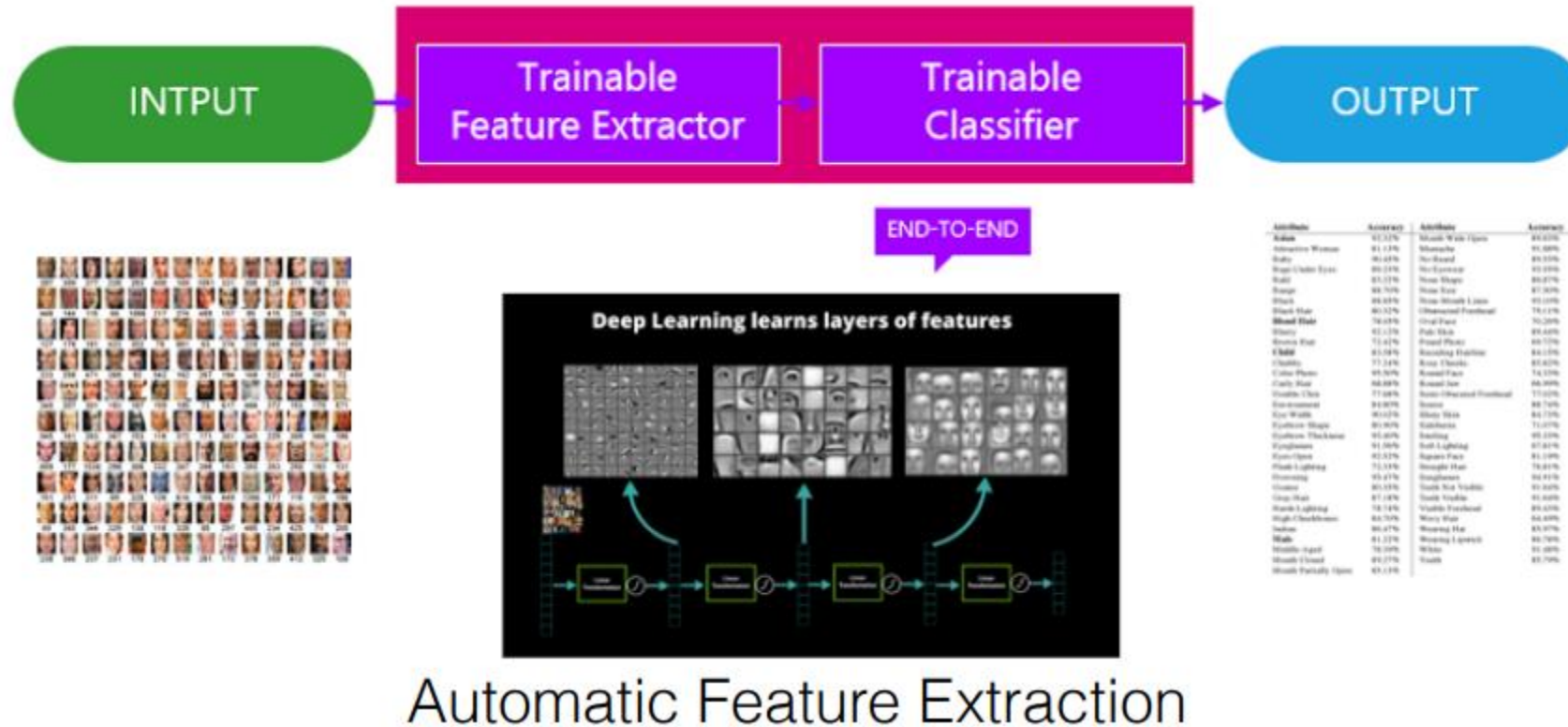


Hand-Crafted Feature Extraction

Deep Learning?

Deep Neural Network들을 이용하여 Feature도 자동으로 학습

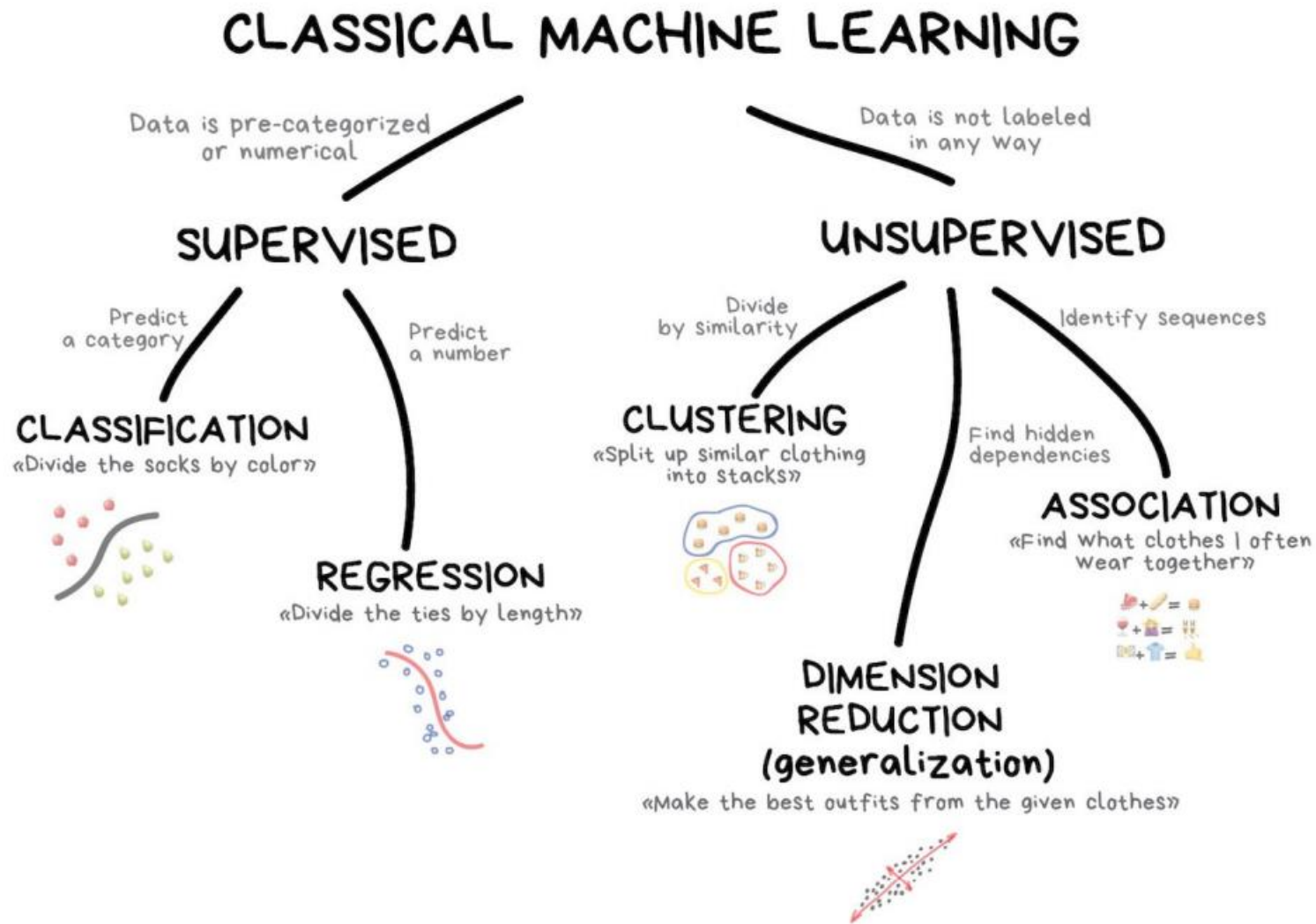
Process of ML



Deep Learning?

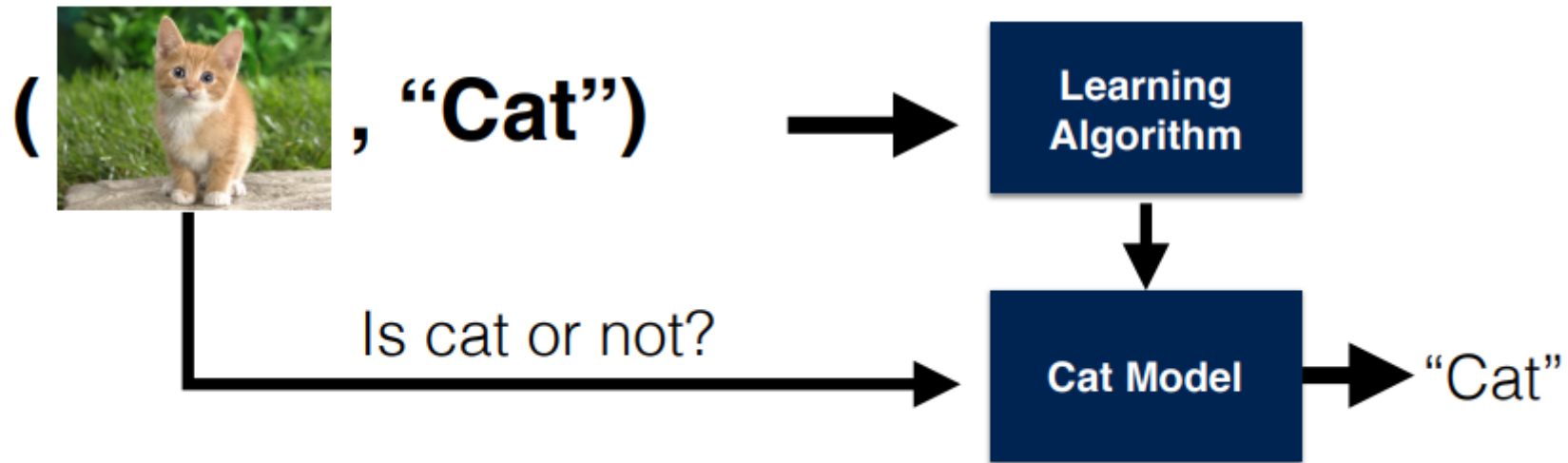
Deep Neural Network등을 이용하여 Feature도 자동으로 학습

| Process of ML



| Process of ML

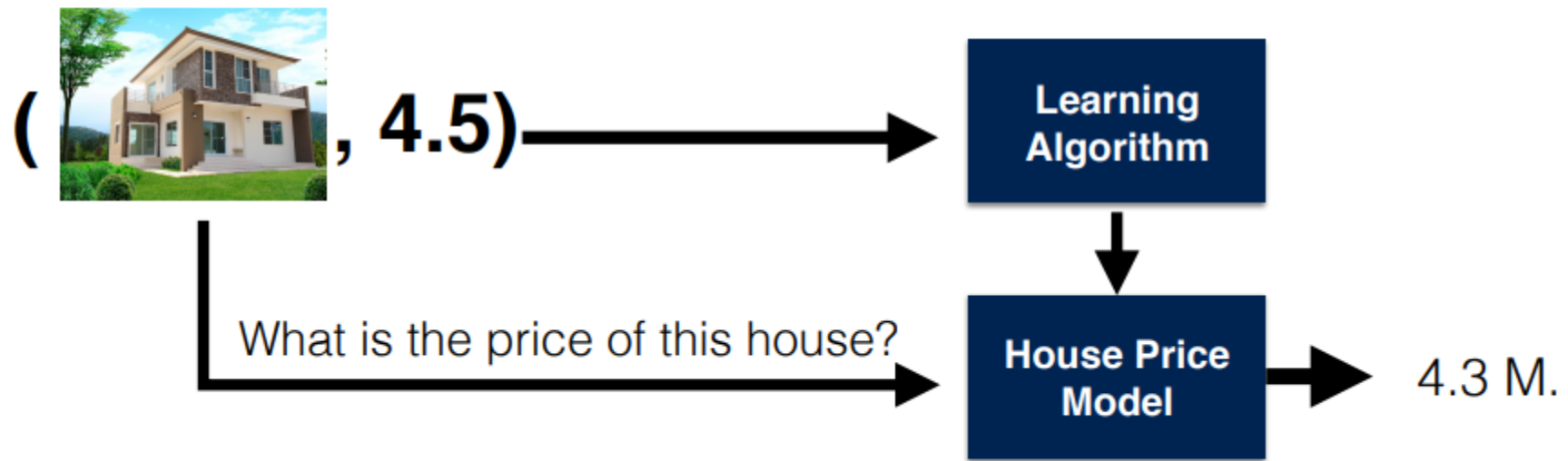
Supervised Learning > Classification



Supervised Learning : Classification

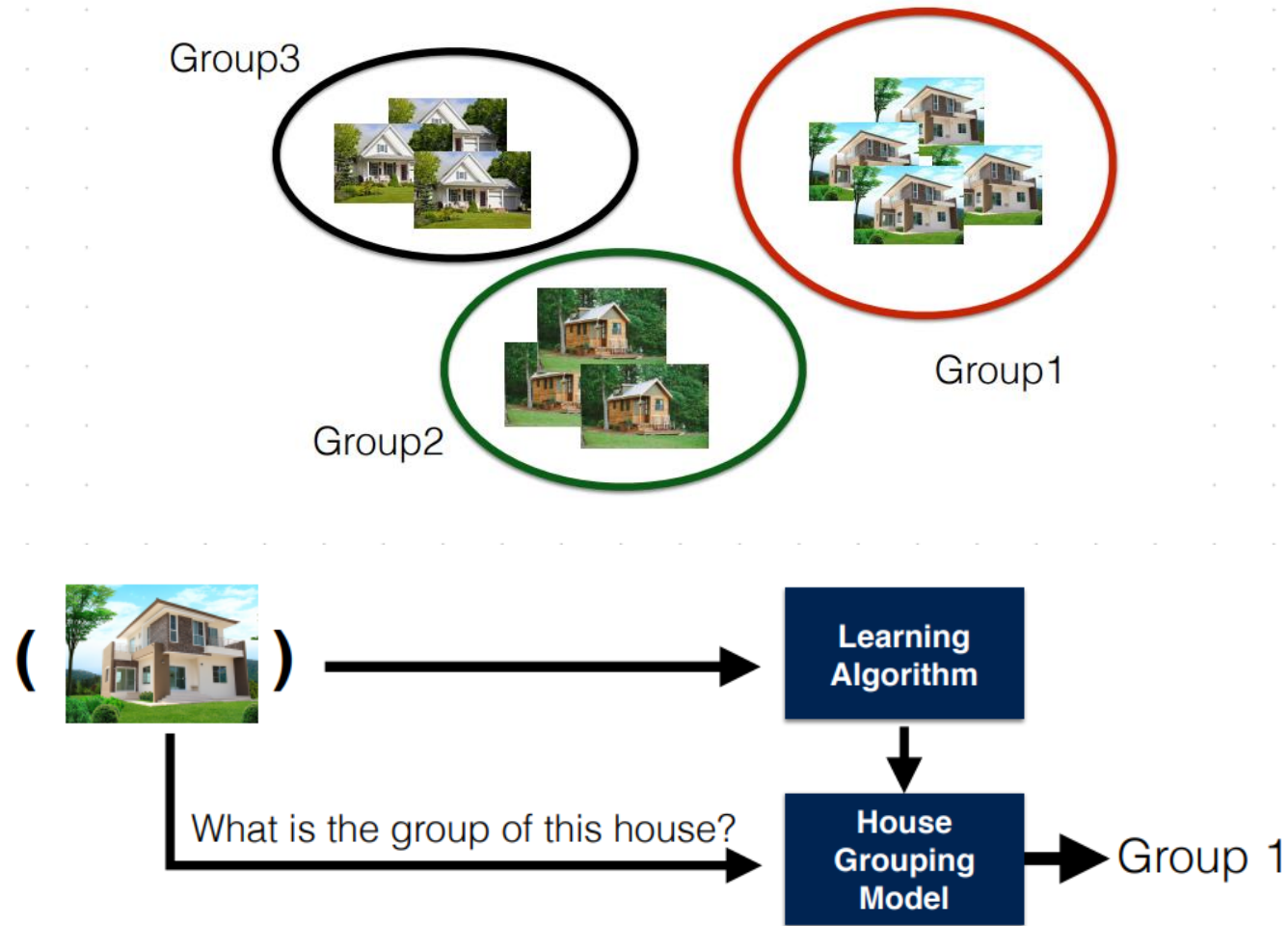
| Process of ML

Supervised Learning > Regression



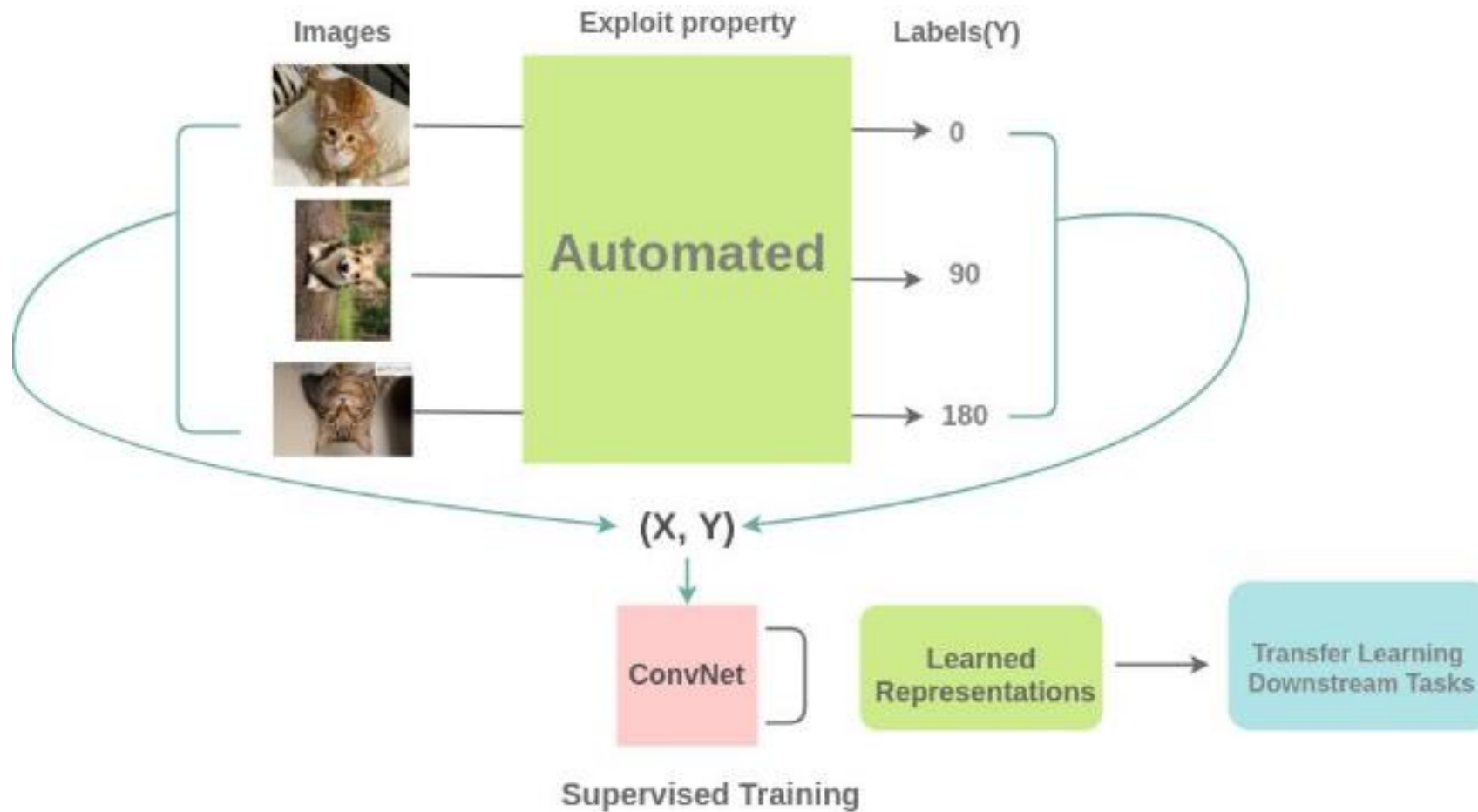
Supervised Learning : Regression

| Process of ML



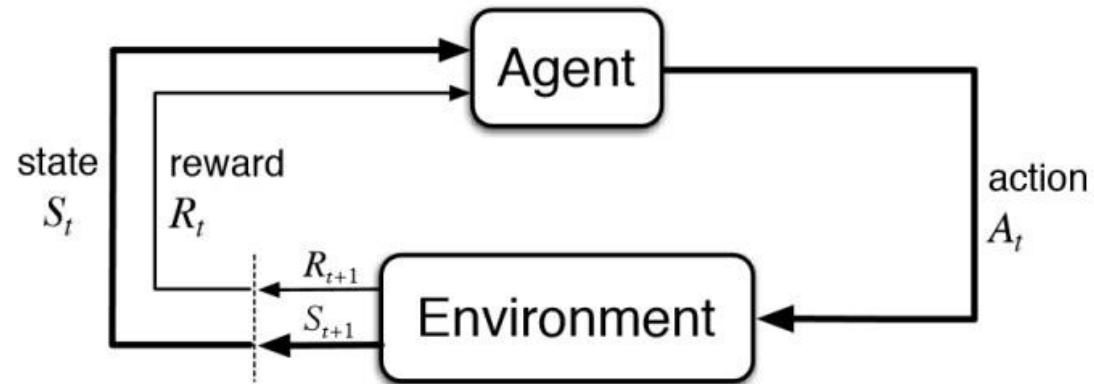
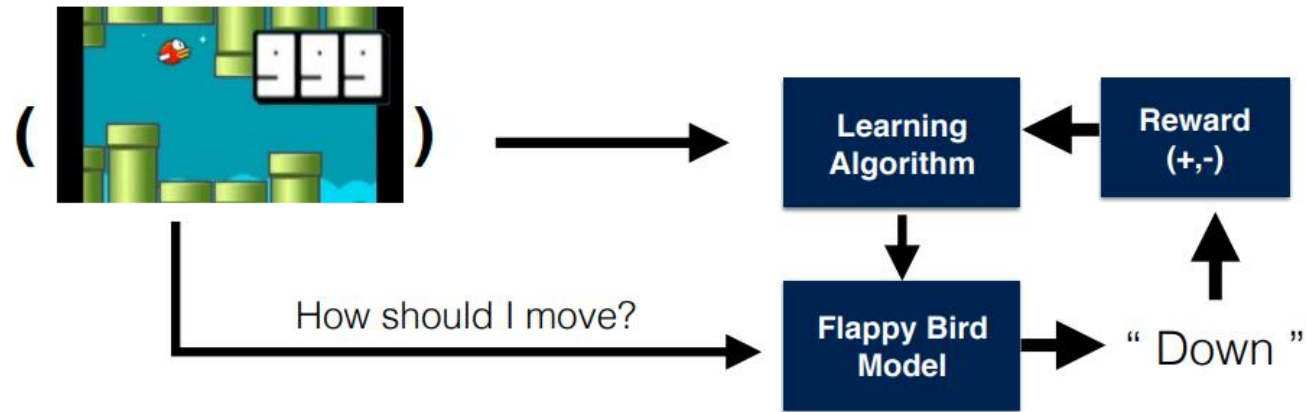
Unsupervised Learning : Clustering

| Process of ML



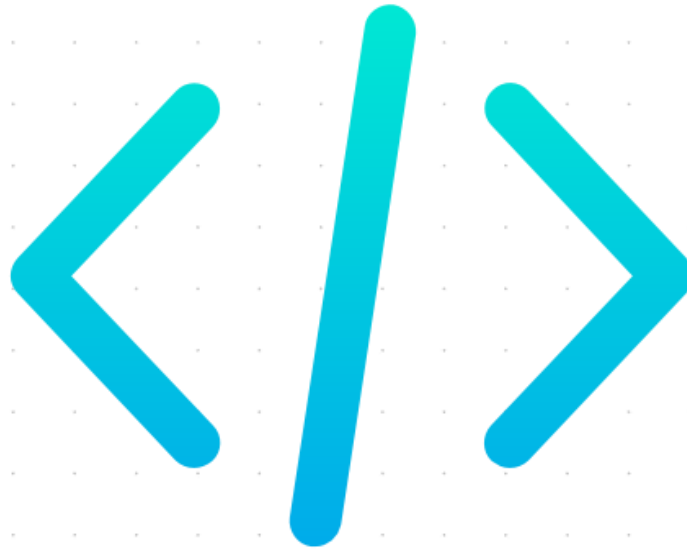
Self-Supervised Learning

| Process of ML



Reinforcement Learning

| 실습 : Polynomial Curve Fitting

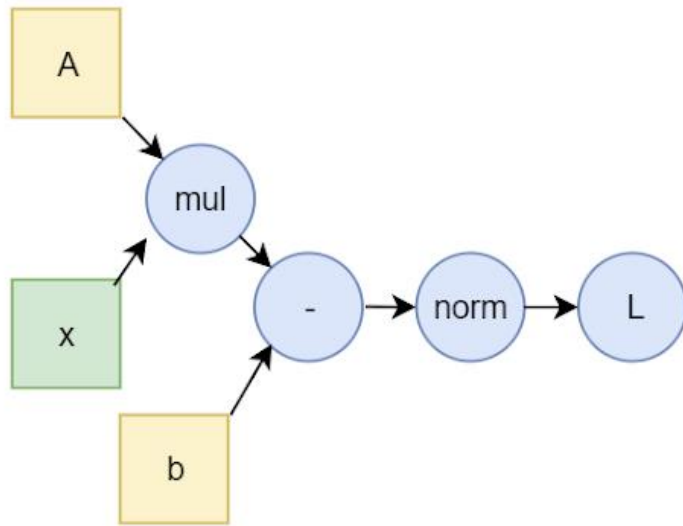


Code with Python!

| Frameworks of ML



| Frameworks of ML

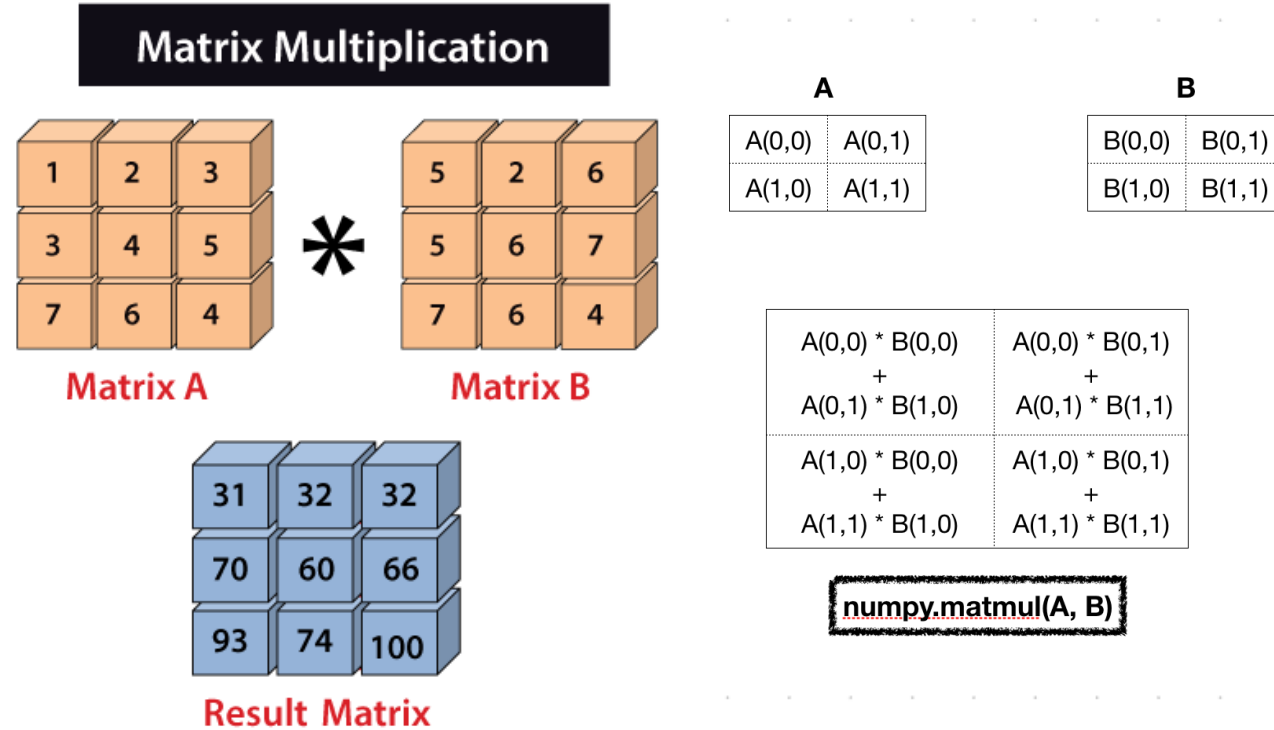


 TensorFlow

 PyTorch

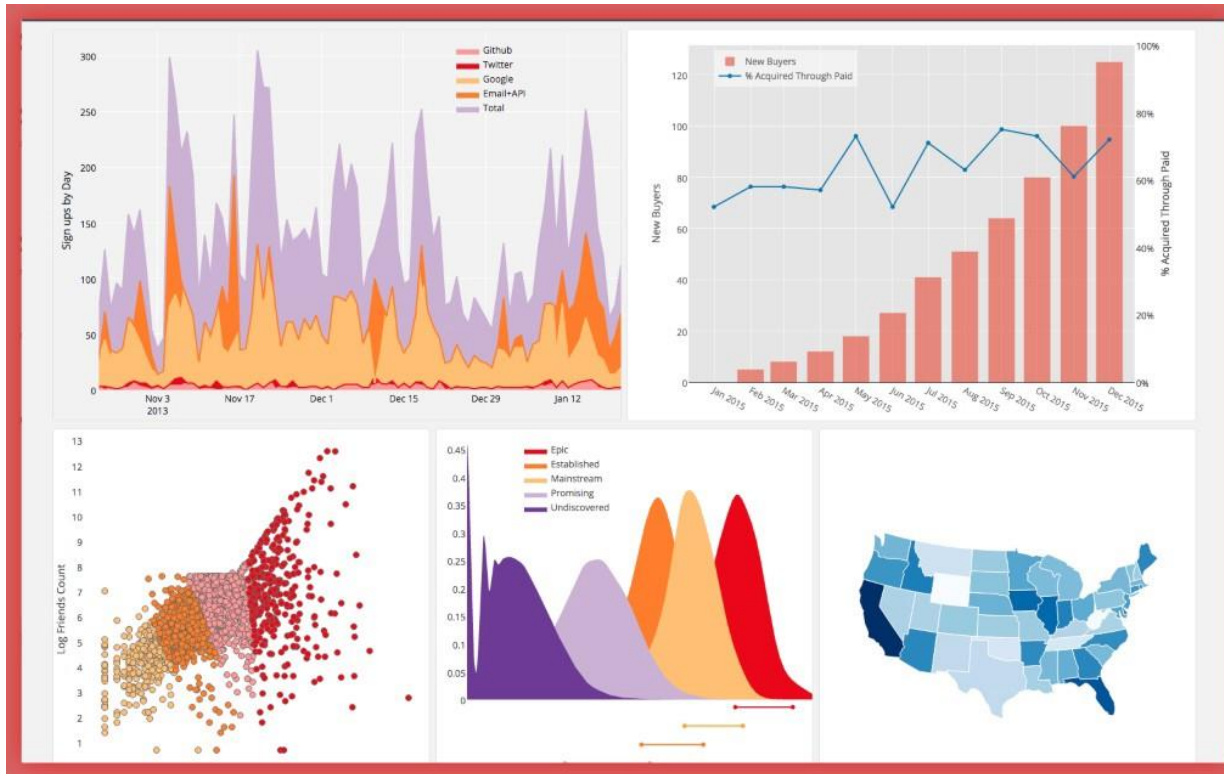
Architecting Deep Learning Computational Graphs

Frameworks of ML



Numeric & Matrix Computation

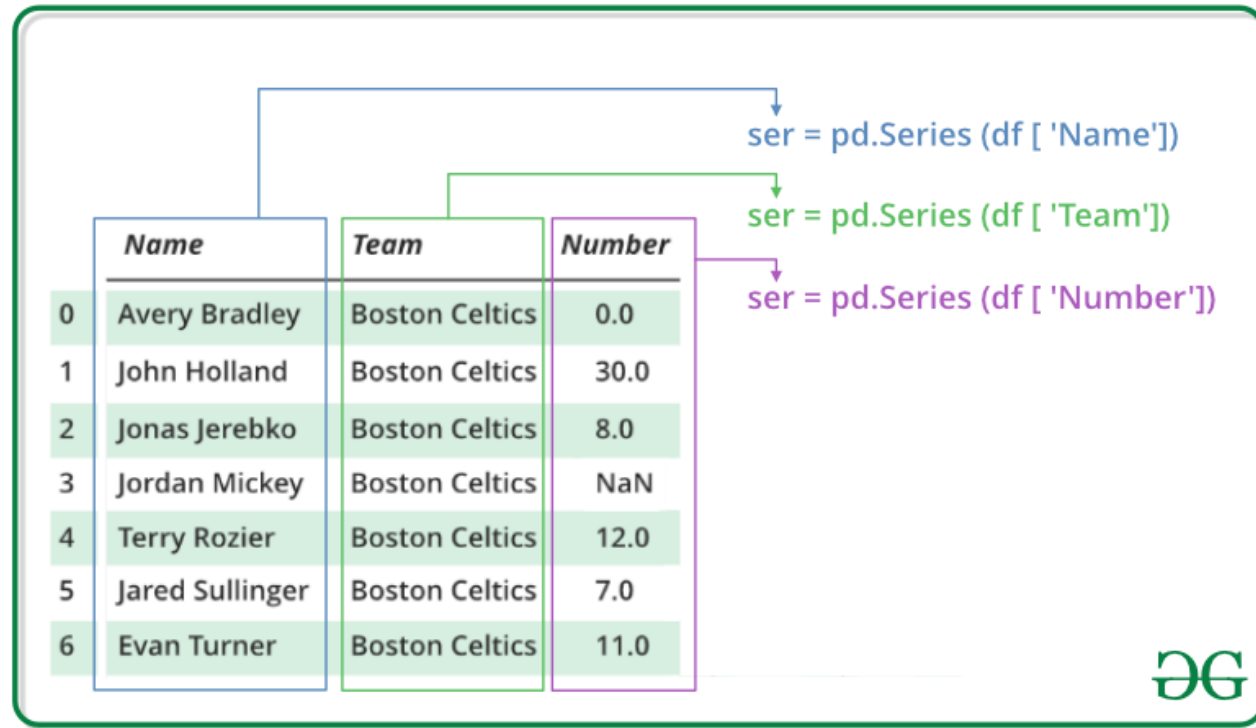
Frameworks of ML



matplotlib

Data Visualization Framework (Graphing)

Frameworks of ML



Data Analysis Library

A close-up, low-angle shot of a piano keyboard. The keys are white and black, and the piano's body is dark wood. The text "Thank You" is overlaid in white, bold, sans-serif font. The background is slightly blurred, showing the piano's frame and a faint "STEIN" logo on the right side.

Thank You