



Reinforcement Learning

나는 강화학습으로 축구한다

Google Research와 Manchester City F.C.의
인공지능 축구 프로젝트를 대한민국에서
재조명하고 직접 구현해보는 캠프



5

SESSION

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딥러닝 = 인공신경망



Agenda

1. 각자 공부할 때 알고 있으면 도움이 될 만한 시각
2. 기존에 가지고 있는 생각을 버리고 Paradigm Shift!

AI \cong Deep Learning ?

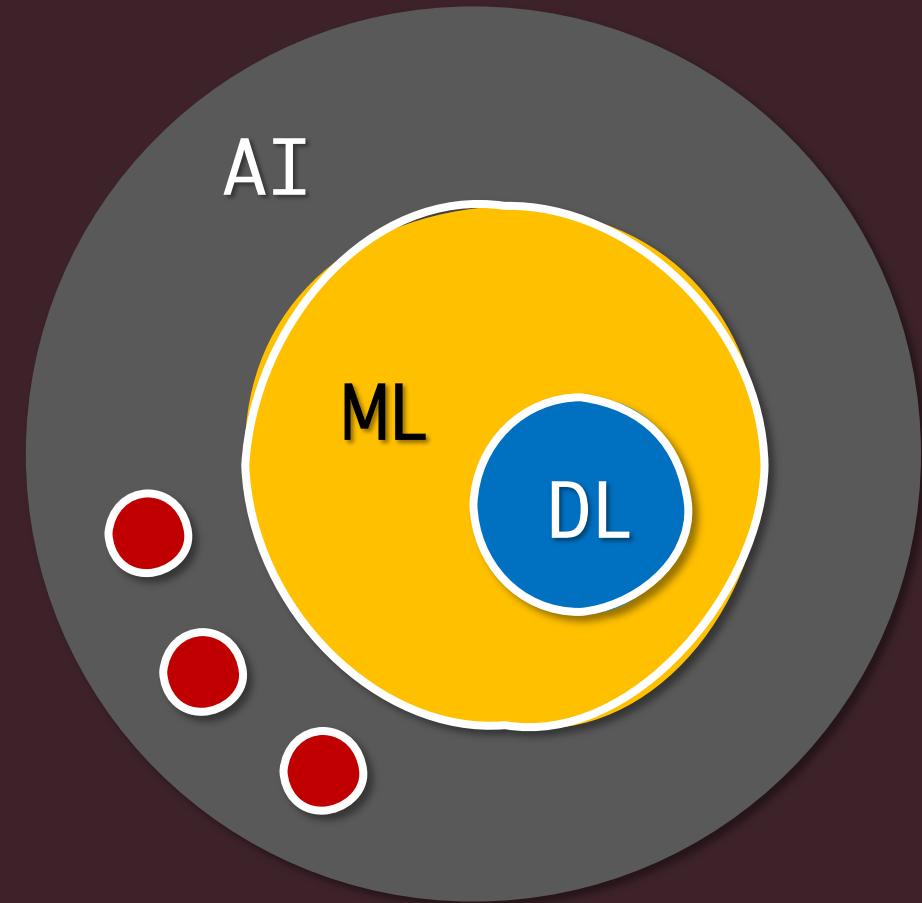
- Autonomous Vehicle
- Machine Translation
- Face Recognition
- Generative AI (ChatGPT, Midjourney, ...)
- ...

AI / ML / DL

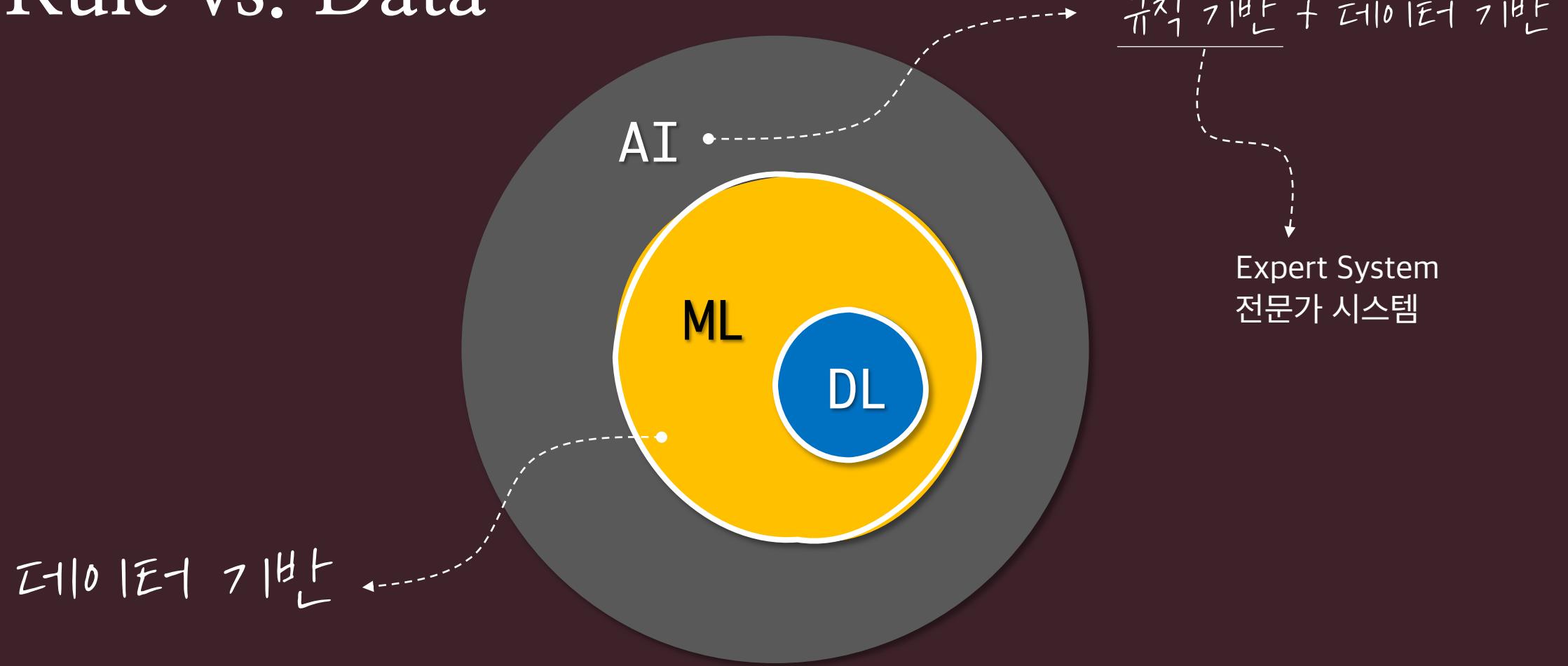
Artificial Intelligence
인공지능

Machine Learning
기계학습/머신러닝

Deep Learning
딥러닝



Rule vs. Data



규칙 기반

Rule-Based



규칙 기반

뭐뭐뭐이면

<90

뭐뭐뭐해라

F

```
if score < 90:  
    print("F")
```

Classification (분류)

뭐뭐뭐이면

<90

목이 길면

코가 길면

뭐뭐뭐이다

F



```
if score < 90:  
    print("F")
```



```
if [REDACTED] :  
    print("기린")
```

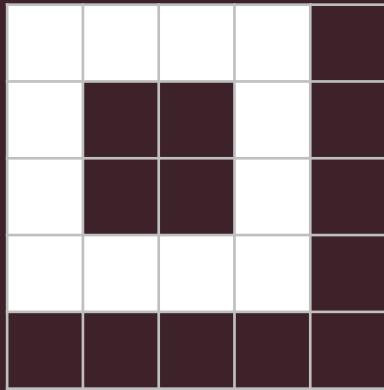
목이 길다?



53	191	239	241	255	225	181	111	61	180	255	255
35	168	244	255	243	210	119	85	176	244	252	
71		45	161	246	227	206	99	60	158	255	255
137	26	42	31	143	214	199	138	125	185	255	255
172	99	78	21	72	106	149	153	190	183	252	255
200	129	102	41	64	65	95	166	206	200	255	255
255	153	17		49	31	44	145	187	219	255	255
255	227	145	42	38	58	71	106	91	202	255	255
255	255	242	129	107	48	30	95	57	162	255	255
255	255	255	189	78		17	74	60	119	228	255
255	255	255	246	133	65	73	32	129	136	144	247
255	255	253	229	112	40	23	29	111	175	93	183

- The word “pixel” is derived from **picture element**.
- Each pixel is just a number (color).

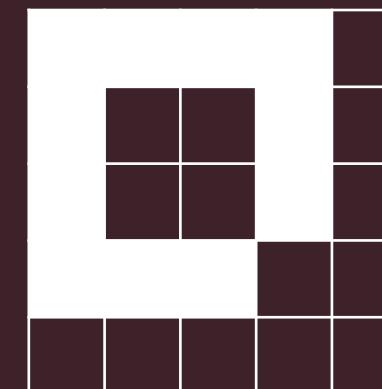
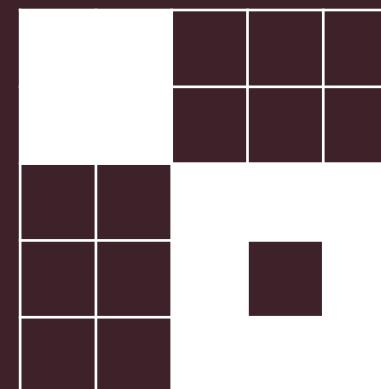
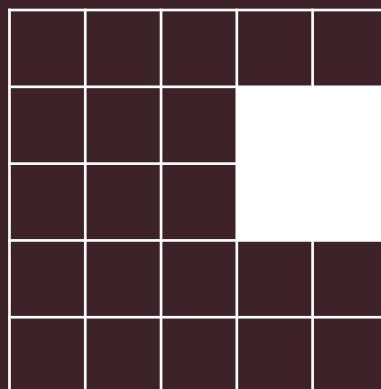
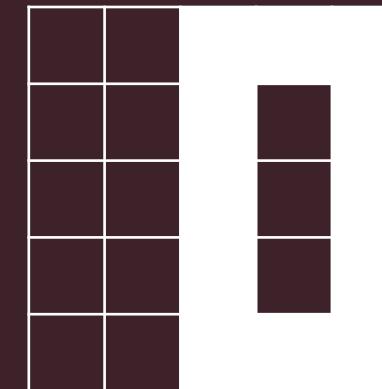
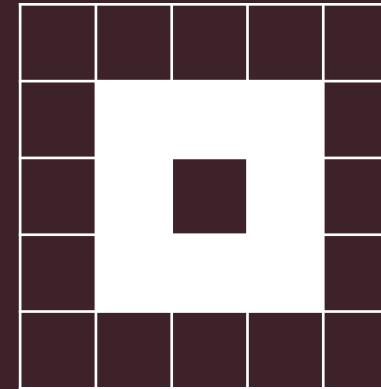
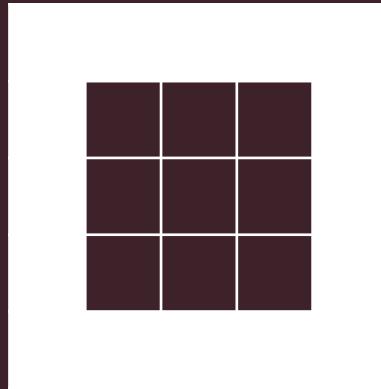
The Most Naïve way to Check



```
print(data)
>> [[1 1 1 1 0]
     [1 0 0 1 0]
     [1 0 0 1 0]
     [1 1 1 1 0]
     [0 0 0 0 0]]
```

```
if all(data[0] == [1,1,1,1,0]) and \
   all(data[1] == [1,0,0,1,0]) and \
   all(data[2] == [1,0,0,1,0]) and \
   all(data[3] == [1,1,1,1,0]) and \
   all(data[4] == [0,0,0,0,0]):
    print("Found a rectangle")
else:
    print("No rectangle found!")
```

Many Different Kinds of Rectangles



Classification (분류)

뭐뭐뭐이면

뭐뭐뭐이다

목이 길면

기린

타조

백조

라마

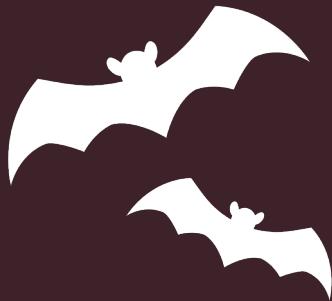
...

if :

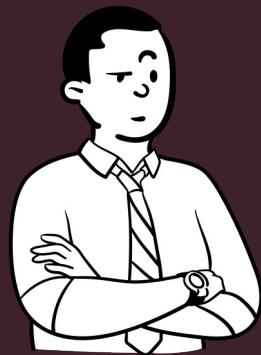
print("기린")

목이 긴 것을 코드로 표현했다 쳐도
목이 긴 것은 기린만 있는 것이 아니다.

특징을 어떻게 정의 하느냐에 따라...



날개 있고,
털도 있고,
...



날개가 있으니까 새?!?
털이 있으니까 표유류?!?

뭐뭐뭐이면

날개가 있으면
물에 살고 지느러미가 있으면

새

물고기

털이 있으면

포유류



Catahoula Bulldog
Catahoula Leopard Dog
Caucasian Shepherd Dog
Cav-a-Jack
Cavachon
Cavador
Cavalier King Charles Spaniel
Cavapoo
Central Asian Shepherd Dog
Cesky Terrier
Chabrador
Cheagle
Chesapeake Bay Retriever
Chi Chi
Chi-Poo
Chigi
Chihuahua
Chilier
German Wirehaired Pointer
Giant Schnauzer
Glen of Imaal Terrier
Goberian
Goldador
Golden Cocker Retriever
Golden Mountain Dog
Golden Retriever
...



if _____:
print(_____)

규칙 기반

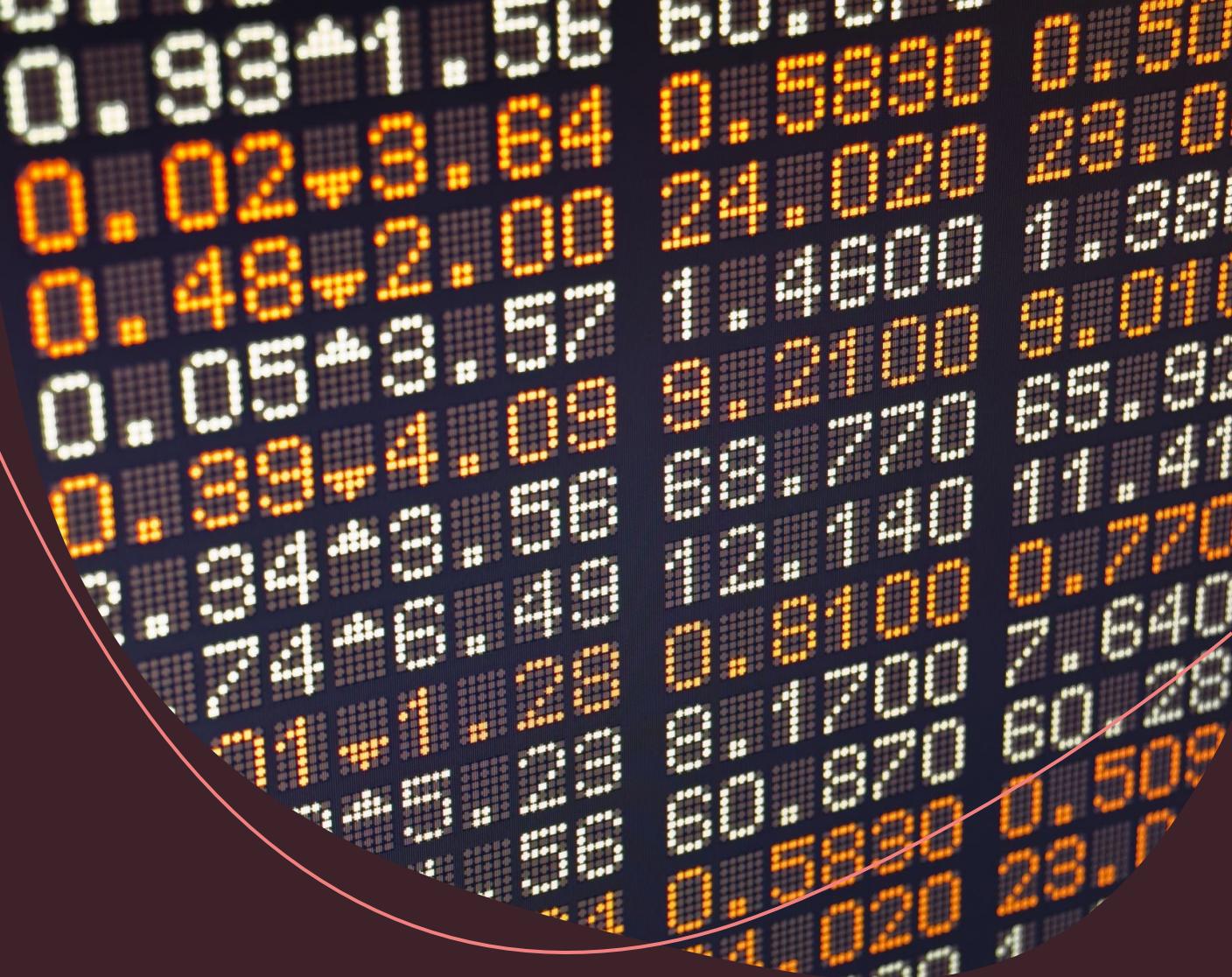


데이터 기반

Data-Driven



Paradigm Shift



Function / Mapping

Relationship (rules) between x and y

x	$y = f(x)$
-1.0	-3.0
0.0	-1.0
1.0	1.0
2.0	3.0
3.0	5.0
4.0	7.0

Mapping between
two numbers

$$f(x) = f(2.0) = 3.0$$

x	$y = g(x)$
>90	A
>80	B
>70	C
<70	F

Mapping between
an average math score
and a letter grade

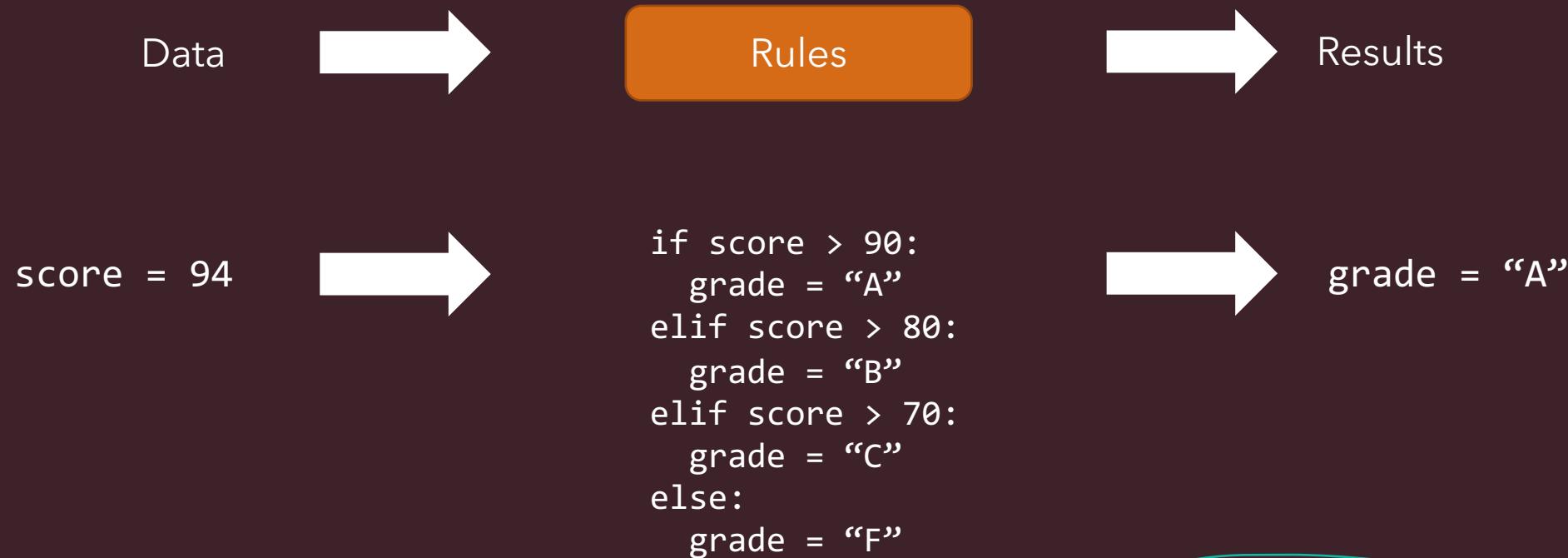
$$g(x) = g(94) = "A"$$

x	$y = h(x)$
빨가면	사과
사과는	맛있어
맛있으면	바나나
바나나는	길어
길으면	기차

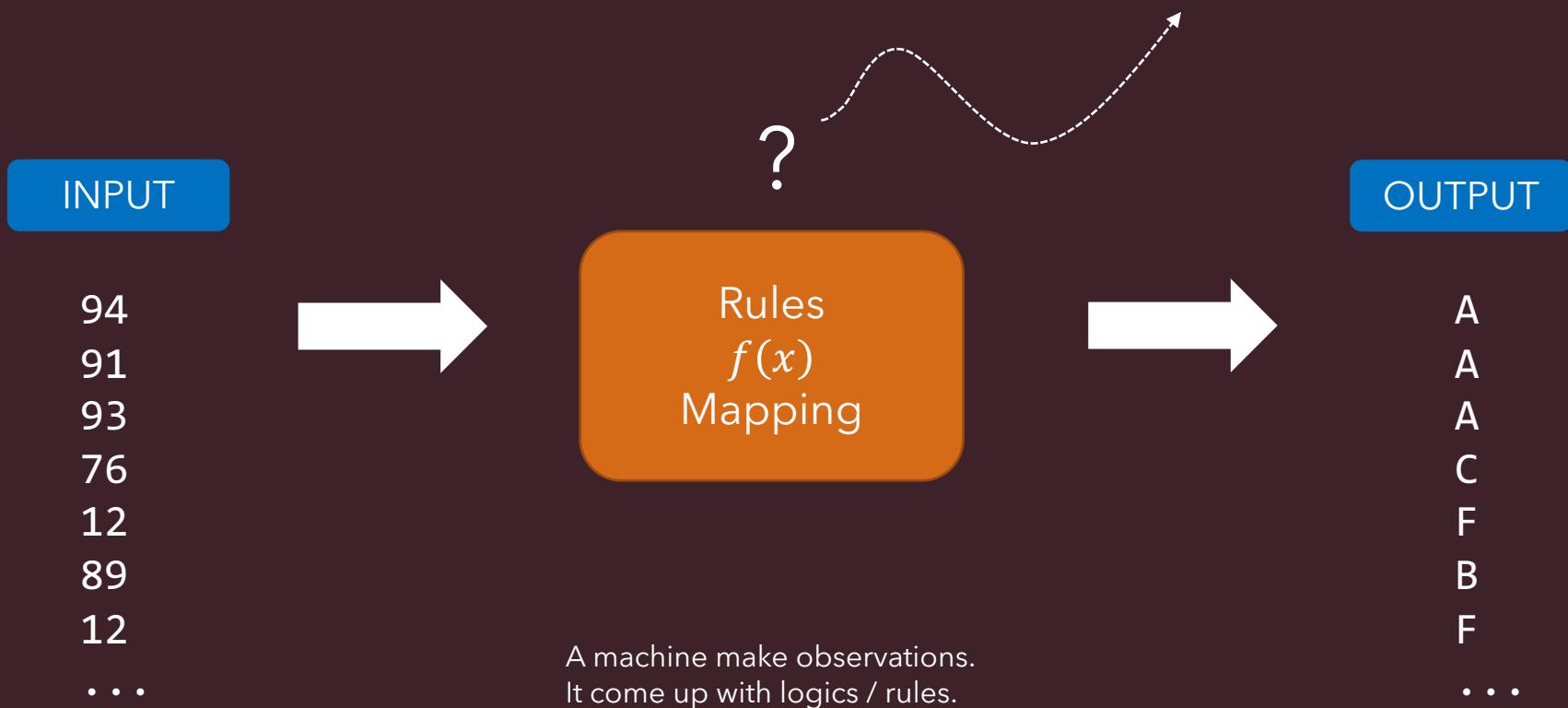
Mapping between
objects and adjectives (or vice versa)

$$h(x) = h("사과는") = "맛있어"$$

Traditional Programming



Data-Driven



Input을 Input을 주고
그 두 개를 연결해주는
규칙, 함수, 맵핑을 찾게끔 하는...

언제 Data-Driven이 특히 유용한가?



코끼리의 특징을 일일이 찾아내서
코드로 표현하기 힘든 경우

Data-Driven



Classification

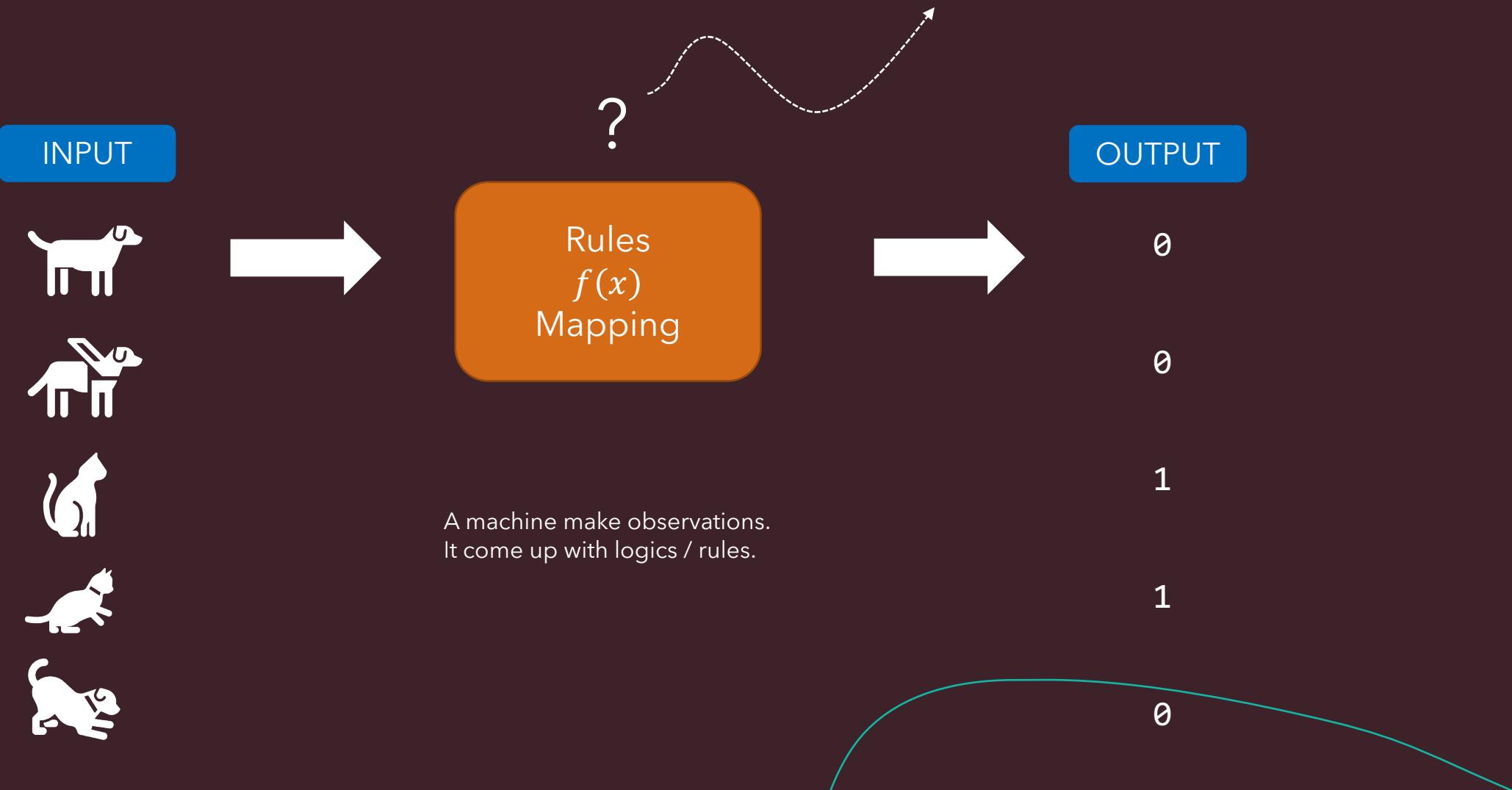
INPUT	OUTPUT
	0
	1

$$y = f(x)$$

$$f(\text{dog}) = 0$$

$$f(\text{cat}) = 1$$

Classification

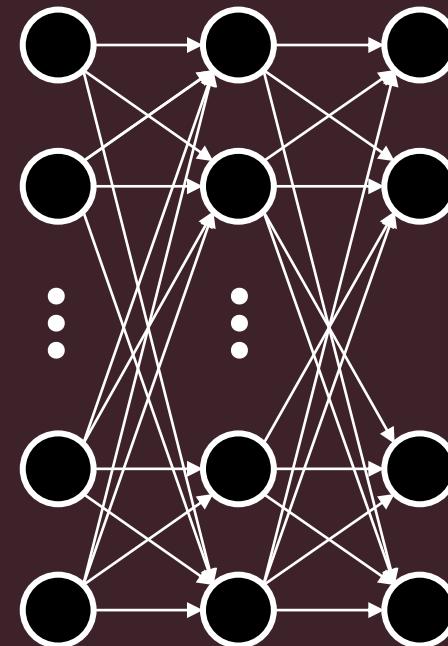


그 함수는 어떻게 생겨 먹은 넘일까?

Rules
 $f(x)$
Mapping

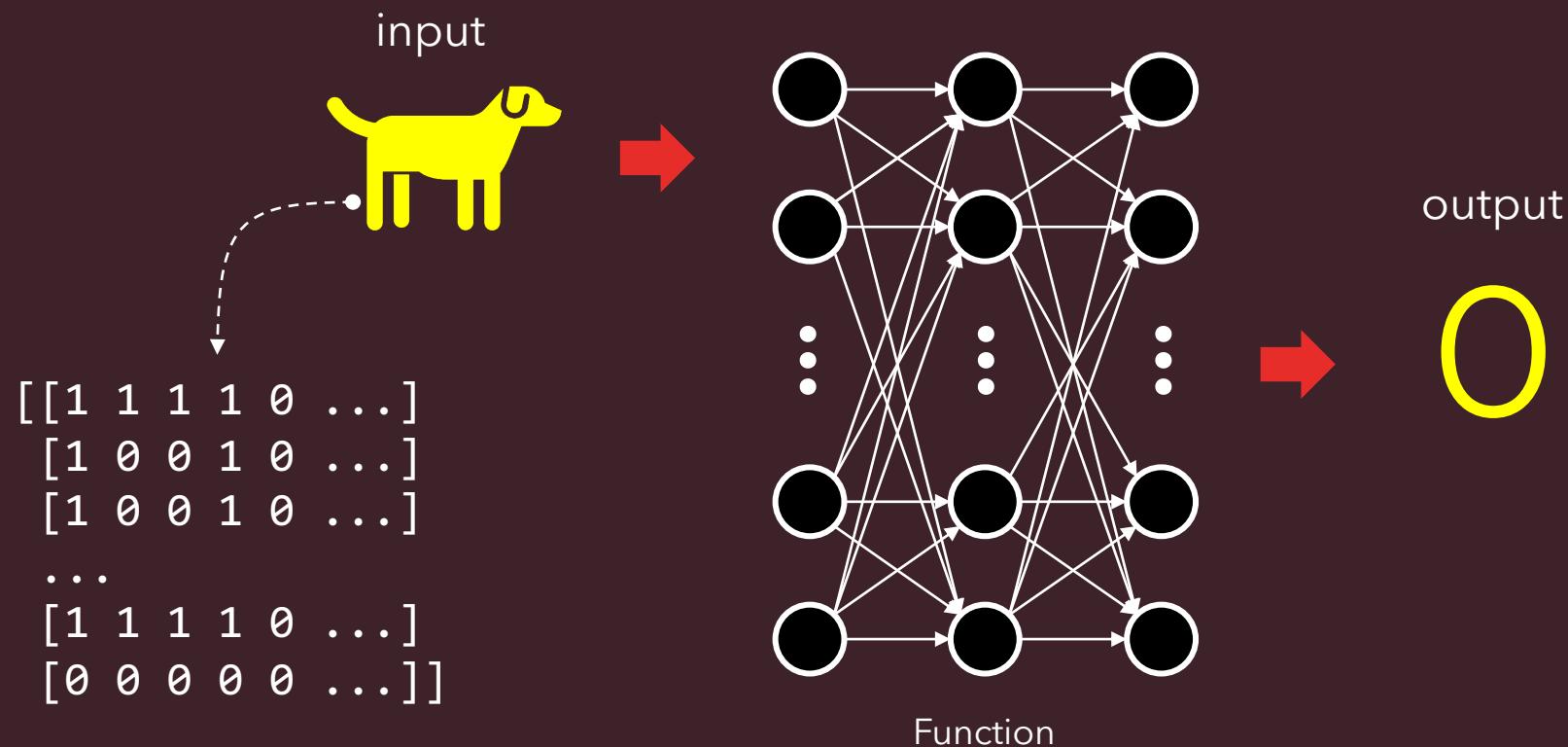


Artificial Neural Network (ANN)
Deep Neural Network (DNN)

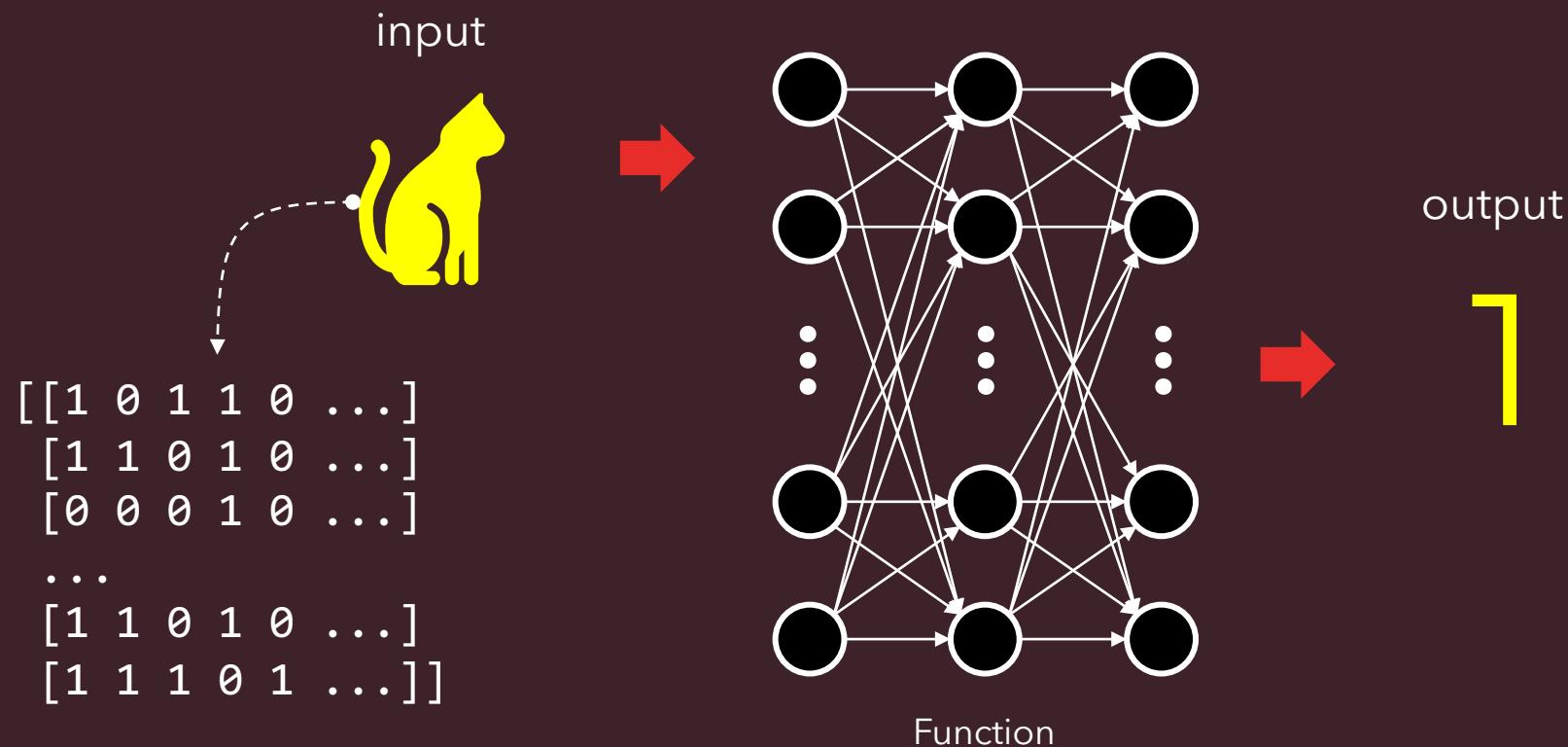


“
인공지능은 그냥 하나의 함수이다!

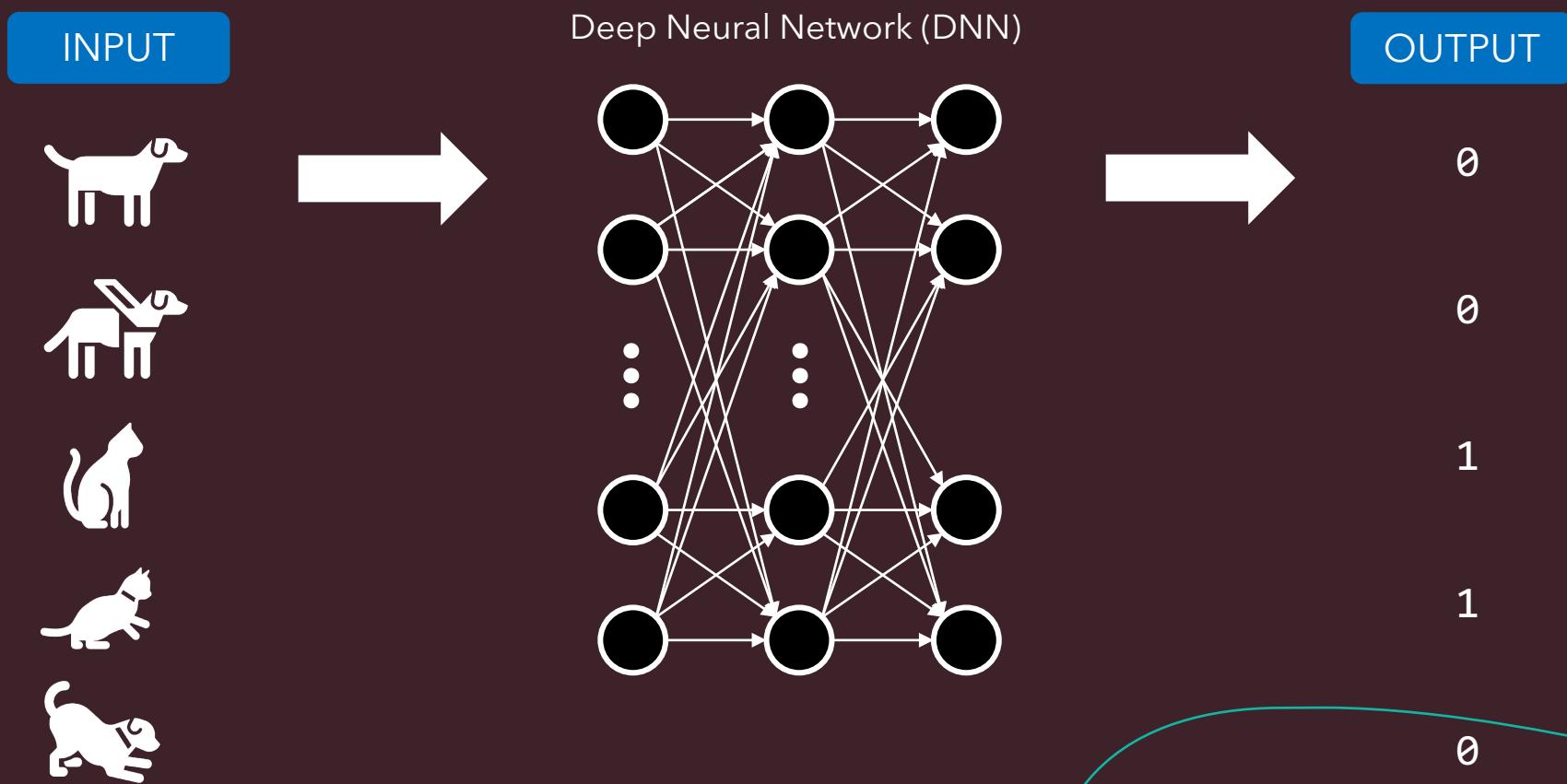
DNN as a Function



DNN as a Function



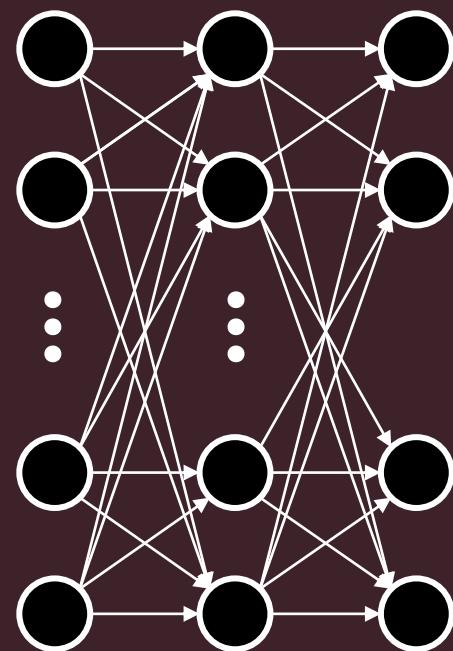
DNN as a Function



축구?



Deep Neural Network (DNN)



```
[ -1.0110294  -0.          0.          0.02032536  0.          -0.02032536  
-0.4266544   -0.19894461 -0.5055147  -0.06459399 -0.5055147   0.06459298  
-0.4266544   0.19894461  -0.18624374  -0.10739919 -0.2705252   -0.  
-0.18624374  0.10739919  -0.01011029  -0.2196155   0.          -0.  
0.          -0.          0.          -0.          0.          -0.  
0.          -0.          1.0110294   0.          0.05055147  0.  
...  
0.11061639  -0.          0.          0.00616395  1.          0.  
0.          0.          0.          0.          0.          0.  
0.          1.          0.          0.          0.          0.  
1.          0.          0.          0.          0.          0.  
0.        ]
```

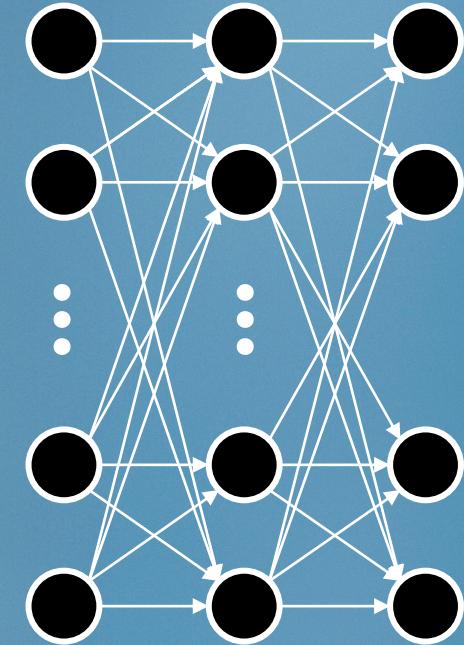
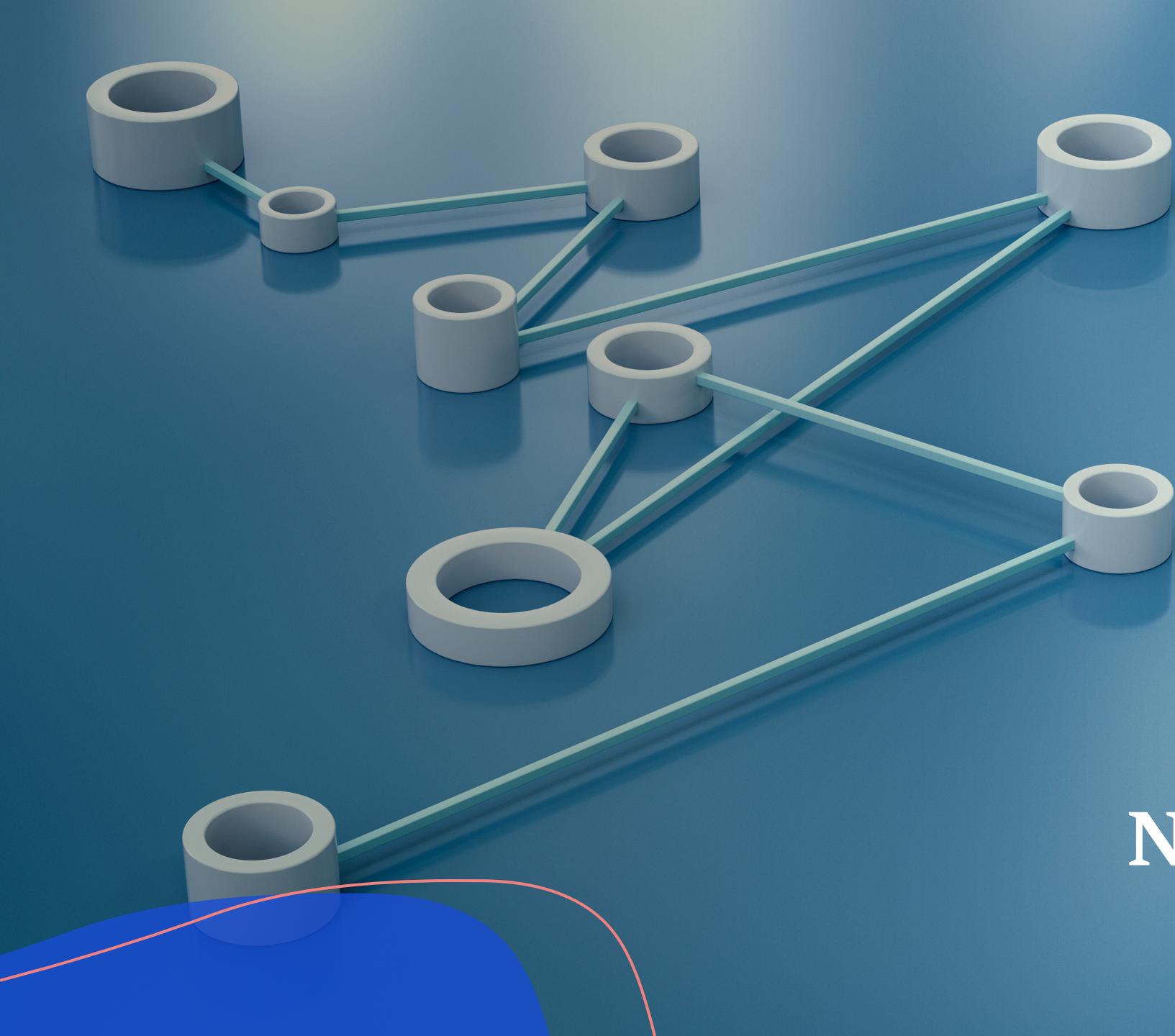
OUTPUT

action_idle = 0

action_top_right = 3

...

action_shot = 12



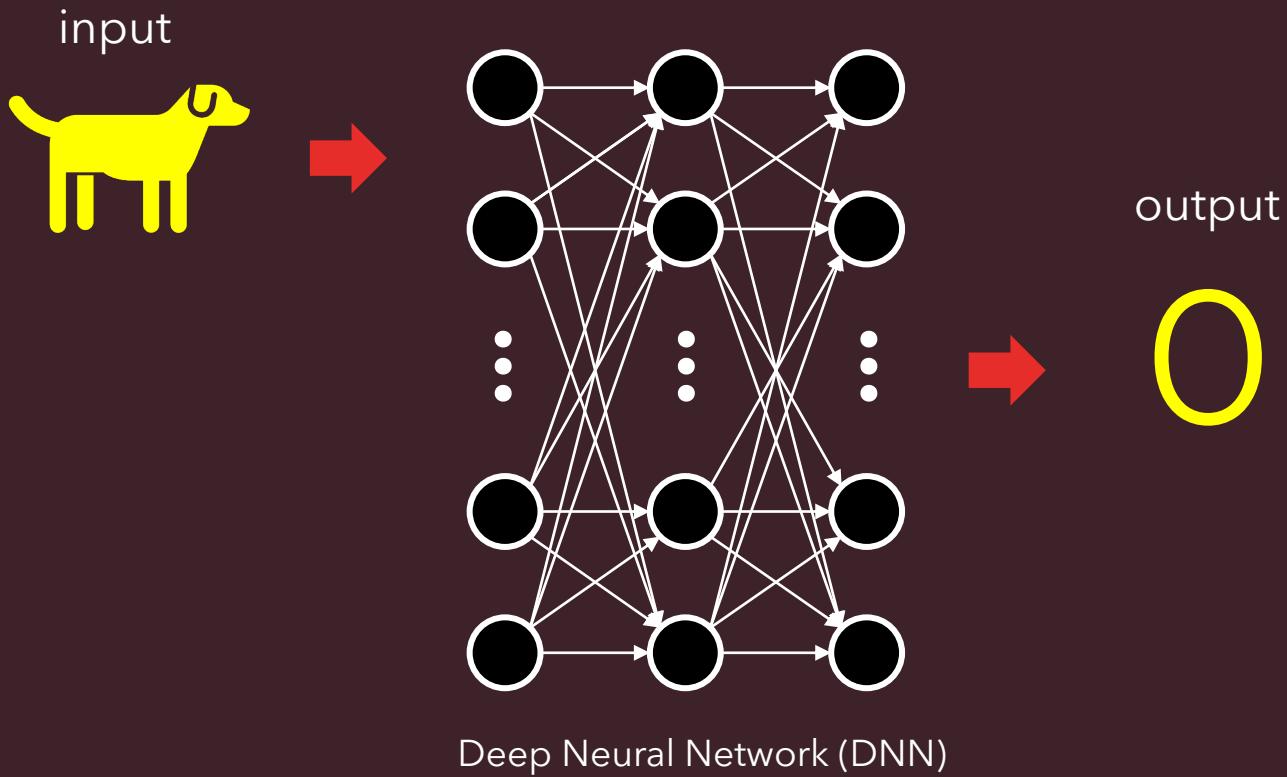
Neural Network

훈련 학습

Training / Learning

훈련

학습



 $\xrightarrow{\text{를 }} \text{입력하면}$
0이 출력되도록
weights & biases,
 $\xrightarrow{\text{즉 }} \text{parameters} \xrightarrow{\text{을 }} \text{찾아내는 작업!}$

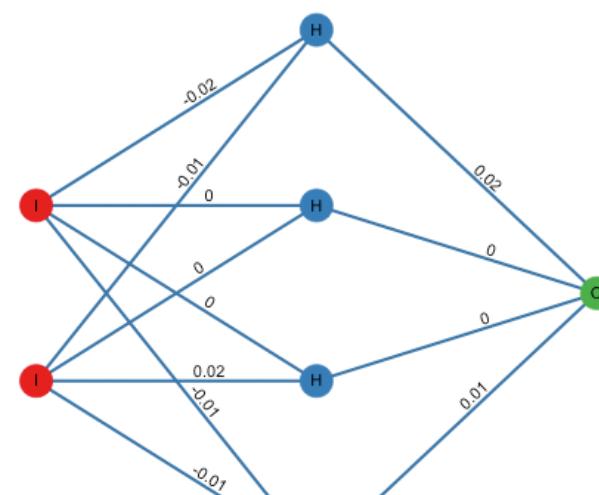
무식하게 랜덤하게 바꾸나?

parameters^를



x
-1.0
0.0
1.0
2.0
3.0
4.0

Weights after iteration 0



$y = f(x)$
-3.0
-1.0
1.0
3.0
5.0
7.0

딥러닝에서 배우는 것은...

어떻게 적합한 parameters를 찾는건가?

어떻게 빠르게 찾을 수 있는건가?

