인 공 지 능

人工知能

Artificial Intelligence, AI

박상현 / twodude@naver.com / 010-2741-0064

I 지능

- 경험을 통한 학습(learning)으로 지능을 축적한다.
  기억(memorization) → 적응(adaptation) → 일반화(generalization)

- 추론(reasoning)
- 논리적 연역(logical deduction)
  ex) PROLOG https://swish.swi-prolog.org
- Etc.

Program

```
1  parent(X, Y) :- mother(X, Y).
2  parent(X, Y) :- father(X, Y).
3  grandparent(X, Y) :- parent(X, Z), parent(Z, Y).
4  sibling(X, Y) :- mother(M, X), mother(M, Y), father(F, Y), father(F, Y).
5
6  mother(soonja, dongsoo).
7  mother(soonja, soonsoo).
8  mother(heeja, soonja).
9  father(doowhan, dongsoo).
10 father(doowhan, soonsoo).
11
```

// Database of Facts and Rules

parent(soonja, dongsoo).

true

Next | 10 | 100 | 1,000 | Stop

parent(soonja, X).

X = dongsoo

X = soonsoo

false

grandparent(heeja, dongsoo).

true

Next | 10 | 100 | 1,000 | Stop

sibling(X, Y).

X = Y, **Y** = dongsoo

X = dongsoo,
Y = soonsoo

X = soonsoo,
Y = dongsoo

X = Y, **Y** = soonsoo

false

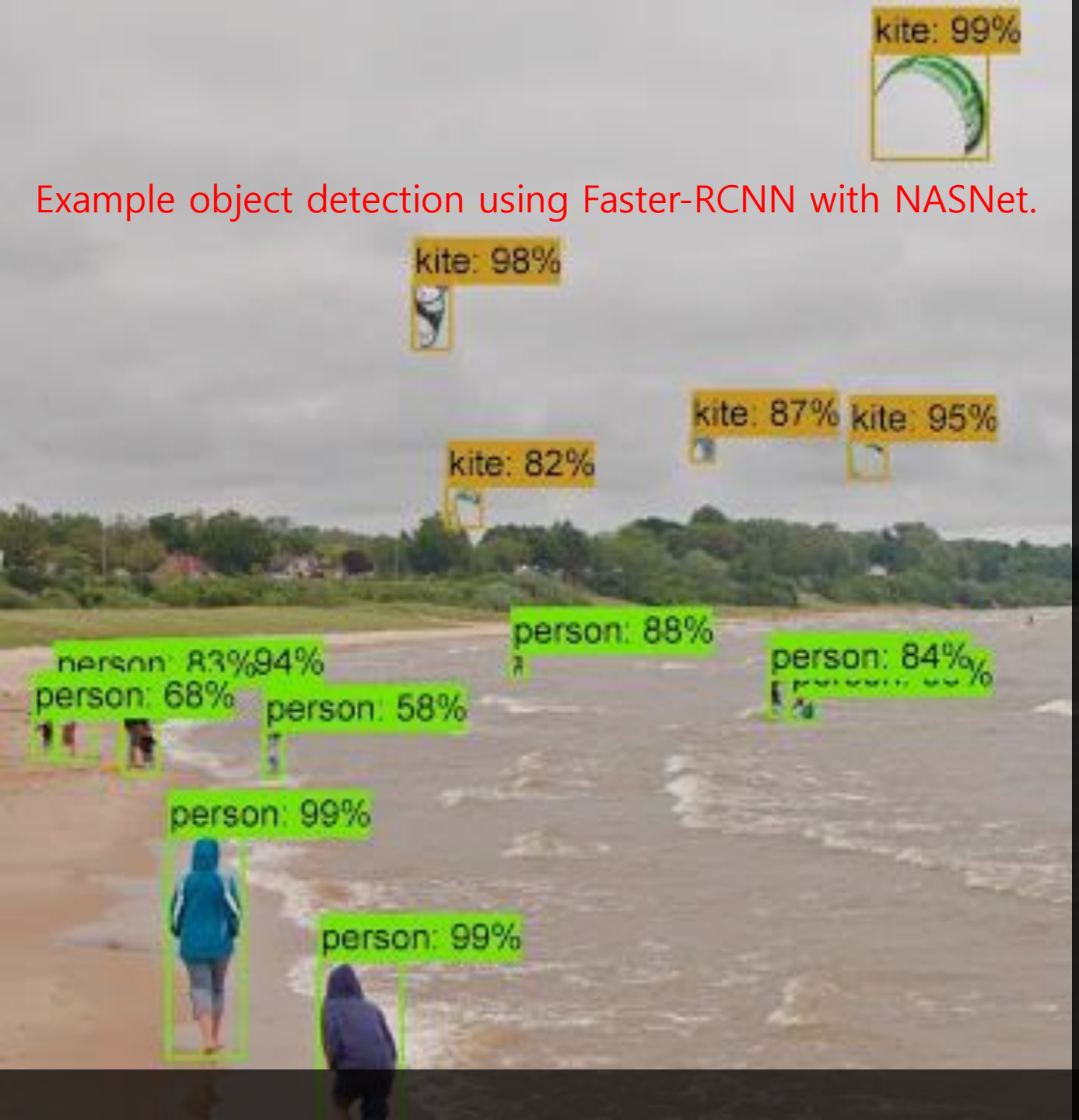
// Query to DB and Results

머신러닝

- 경험을 통한 **학습(learning)**으로 지능을 축적한다.
  기억(memorization) → 적응(adaptation) → 일반화(generalization)

  - 지도학습(Supervised learning): 트레이닝 세트와 각각에 대한 목표값이 제공되고, 이 제공된 데이터세트를 통해 모든 입력값에 대해 **정답을 도출해 낼 수 있도록 일반화**시킨다.
    회귀(regression): 함수를 찾는 문제 vs 분류(classification): 어느 그룹에 속할지를 결정
  - 비지도학습(Unsupervised learning): 정답이나 목표값이 제공되지 않는 경우, 알고리즘이 정답을 제공하기보다는 유사점을 찾아 **분류** 체계를 확립 할 수 있게 한다.
  - 강화학습(Reinforcement learning): 지도학습과 비지도학습의 중간에 속한다. 알고리즘이 출력하는 결과값에 대해 정/오답 여부는 알려주지만, 어떻게 고쳐야 하는지는 알려주지 않는다.
  - 진화학습(Evolutionary learning): 생물학적인 유기체는 살아남을 확률을 높이고 후손을 남기기 위해 환경에 적응한다. **적합도** 개념을 통해 모델을 적용한다.

- 데이터 수집&정제 → 피처(feature) 선택 → 알고리즘 고르기 → 파라미터 설정 → 트레이닝 → 평가(Evaluation)



Example object detection using Faster-RCNN with NASNet.

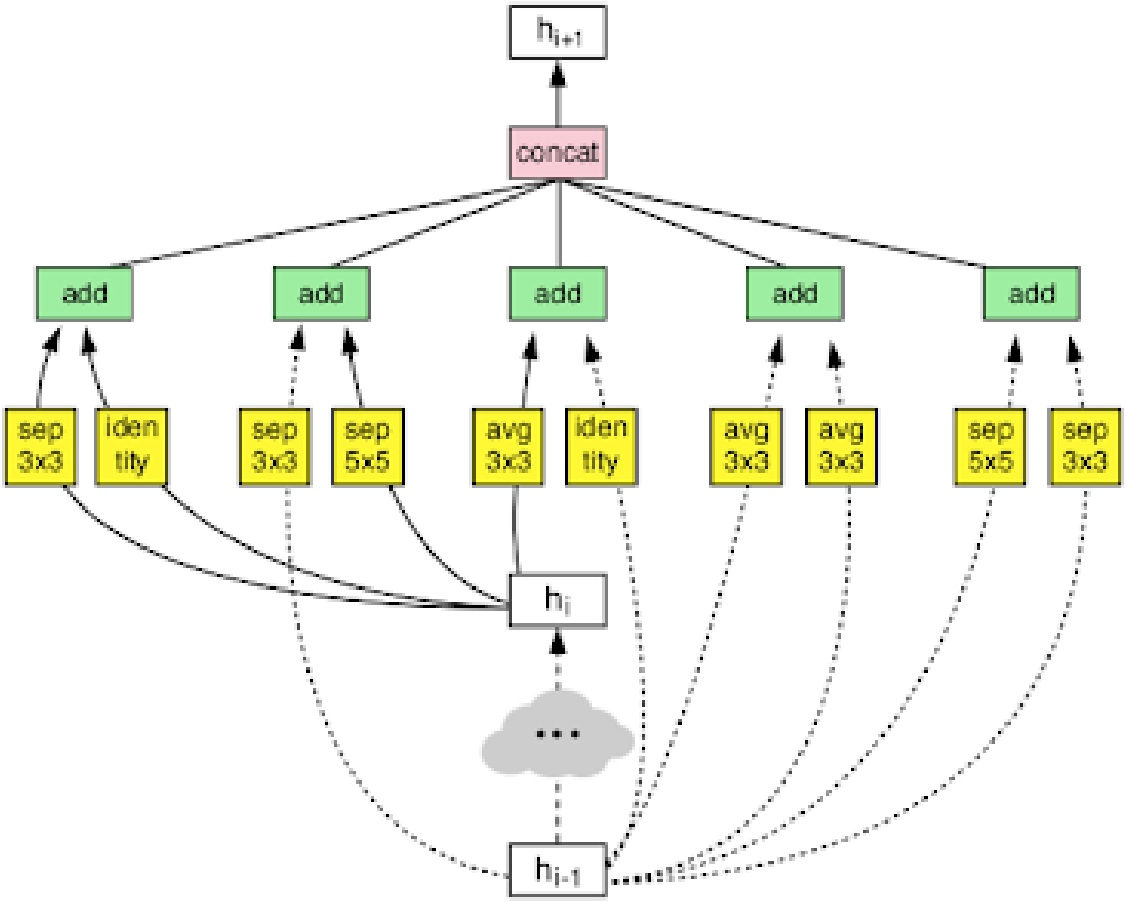
A few months ago, we introduced our "**AutoML**" project, an approach that automates the design of machine learning models.

With this method, AutoML was able to find the best layers that work well on CIFAR-10 but work well on ImageNet classification and COCO object detection. These two layers are combined to form a novel architecture, which we called **"NASNet"**.

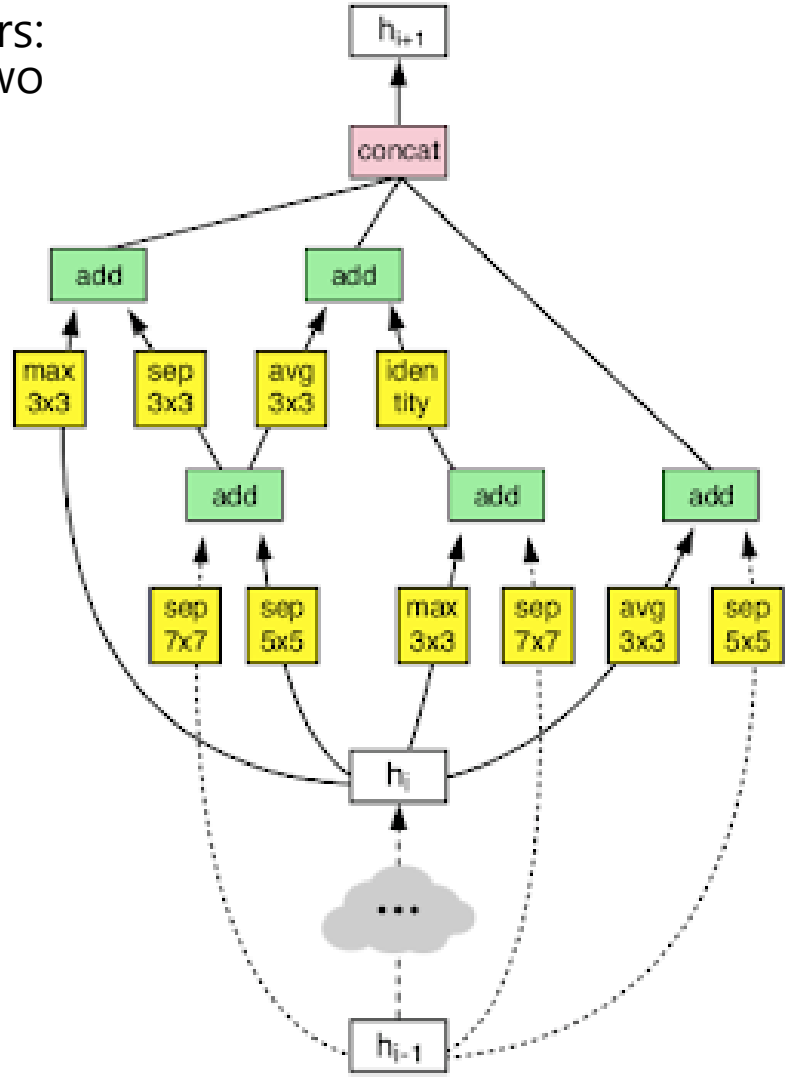
ref. https://research.googleblog.com

박상현 / twodude@naver.com / 010-2741-0064

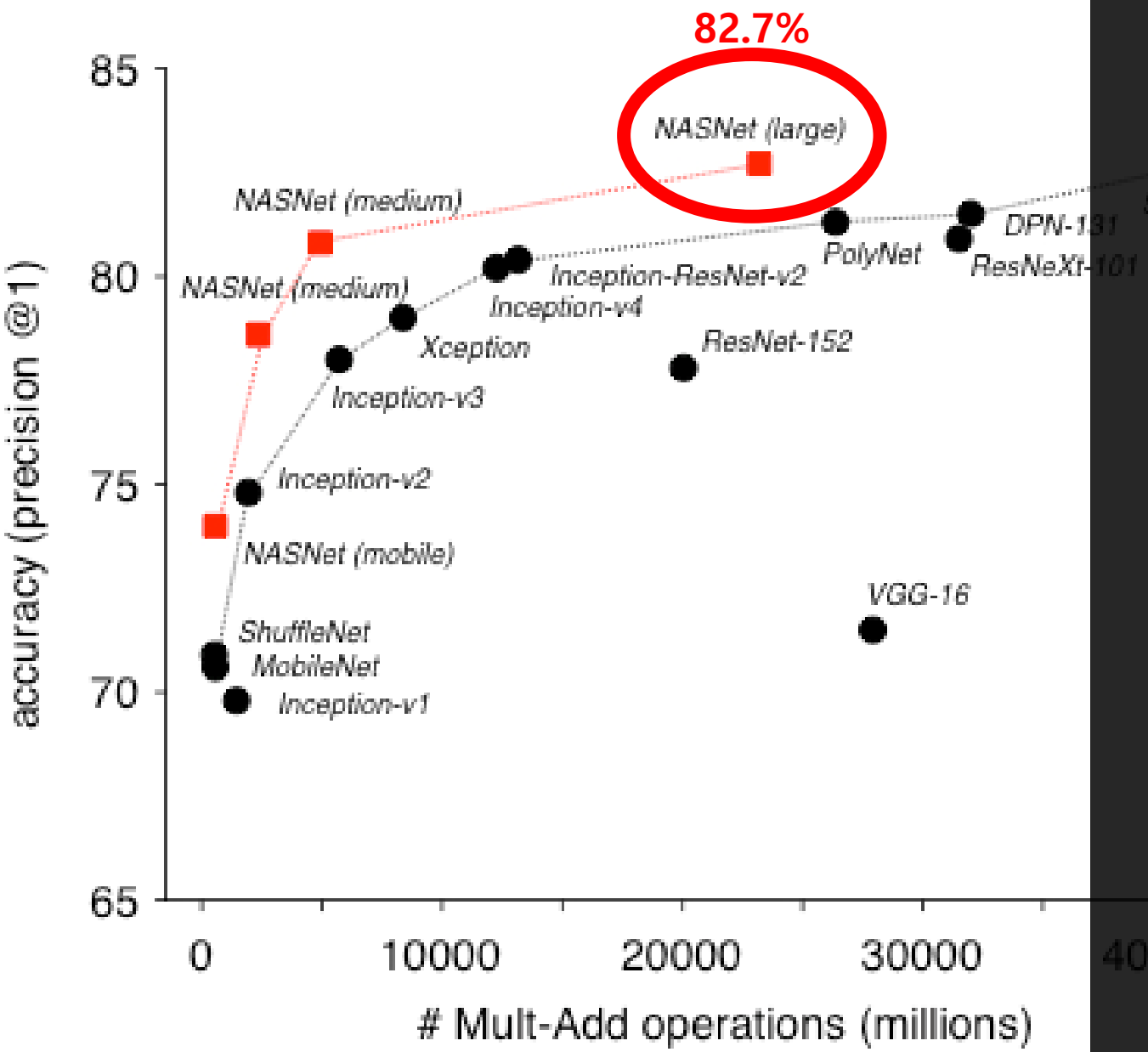
Our NASNet architecture is composed of two types of layers: Normal Layer (left), and Reduction Layer (right). These two layers are designed by AutoML.



Normal Cell



Reduction Cell



On ImageNet image classification, NASNet achieves a prediction accuracy of 82.7% on the validation set, …

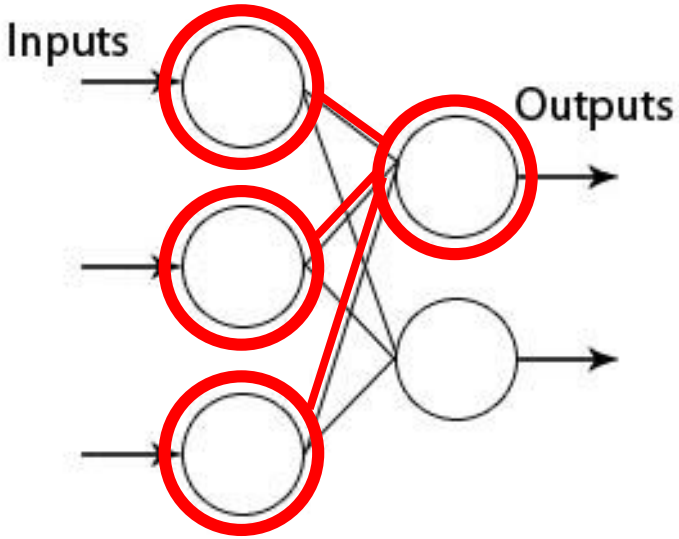
Additionally, NASNet performs 1.2% better than all previous published result.

Furthermore, NASNet may be resized to produce a family of models that achieve good accuracies while having very low computational costs. For example, a small version of NASNet achieves 74% accuracy, which is 3.1% better than equivalently-sized, state-of-the-art models for mobile platforms.

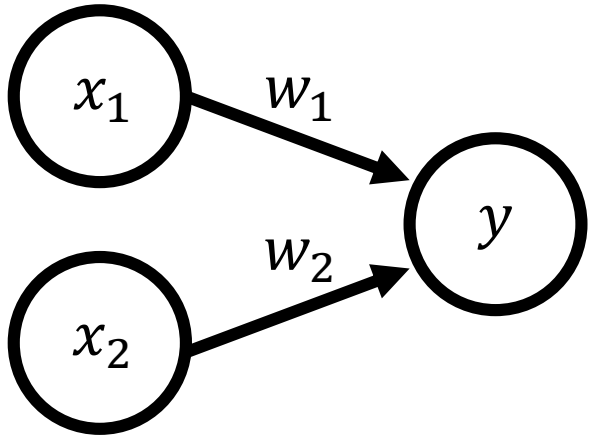
The large NASNet achieves state-of-the-art accuracy while halving the computational cost of the best reported result on arxiv.org (i.e., SENet).

퍼셉트론

- Perceptron; Frank Rosenblatt, 1957
- 퍼셉트론 → 신경망 → 딥러닝으로 나아간다.

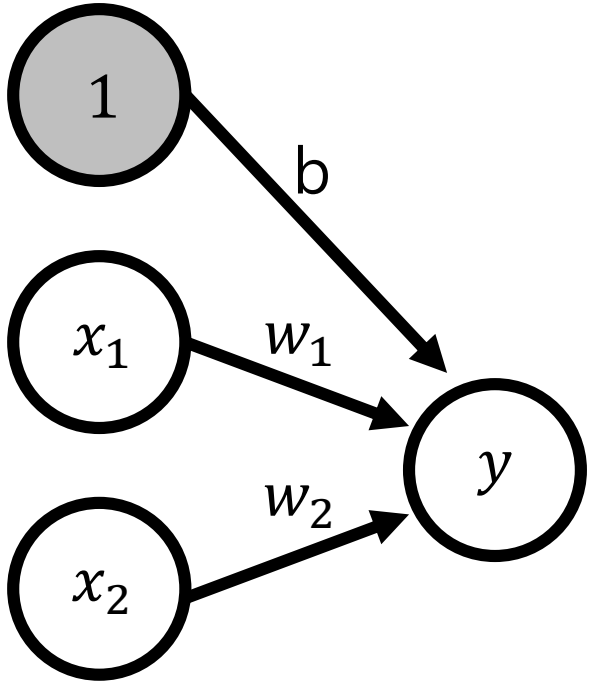


다수의 신호를 입력으로 받아
하나의 신호(0/1)를 출력한다.



$$y = \begin{cases} 0\ (w_1x_1 + w_2x_2 \leq \theta) \\ 1\ (w_1x_1 + w_2x_2 > \theta) \end{cases}$$

매개변수 조합 (w_1, w_2, θ)에 따라
기능이 달라진다.
AND, NAND, OR



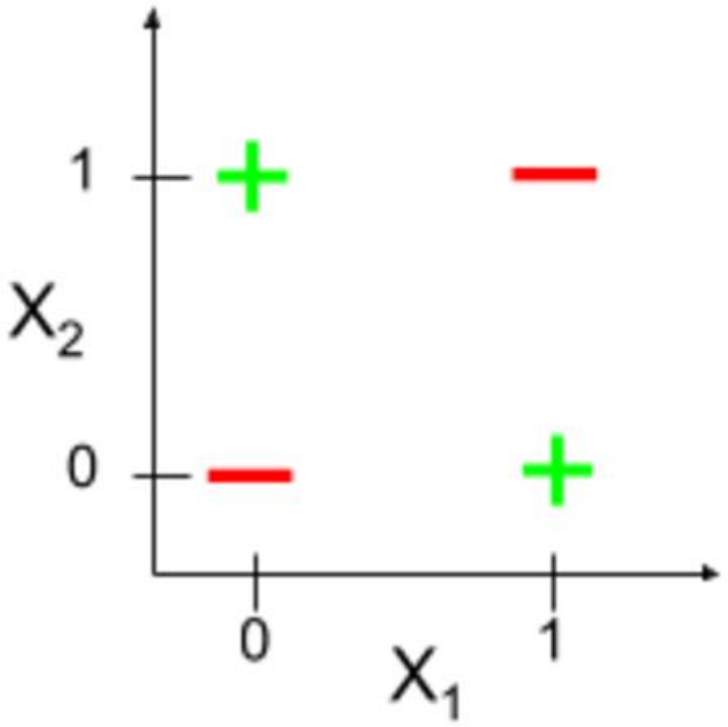
$$y = \begin{cases} 0\ (b + w_1x_1 + w_2x_2 \leq 0) \\ 1\ (b + w_1x_1 + w_2x_2 > 0) \end{cases}$$

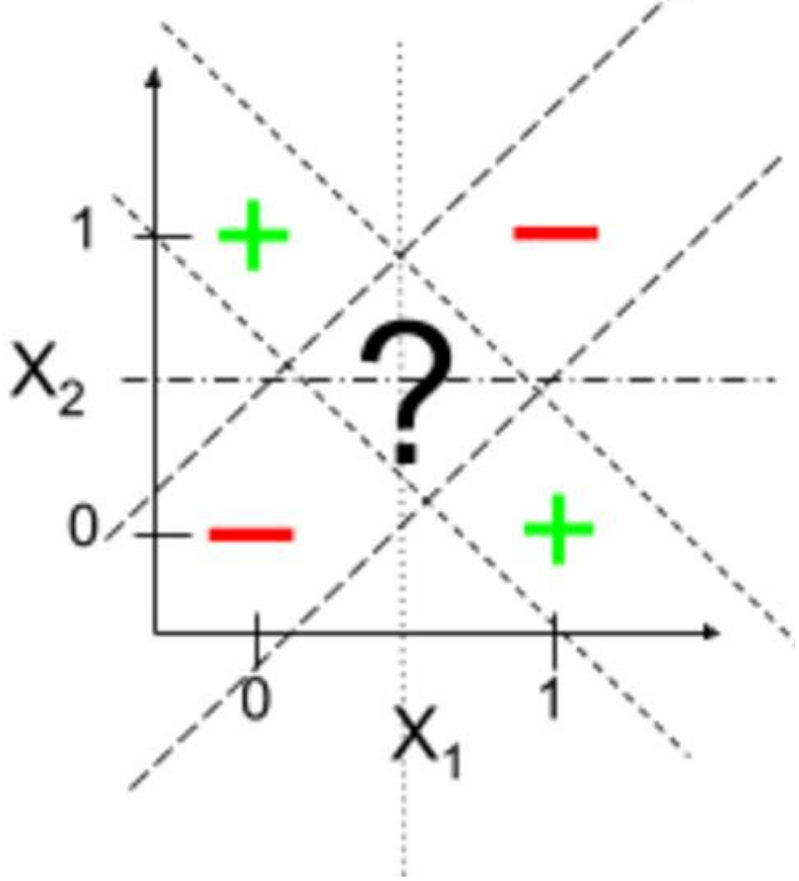
b: 편향(bias)
뉴런이 얼마나 쉽게 활성화되는가

퍼셉트론의 한계

XOR 게이트를 구현하려면 매개변수를 어떻게 설정해야 할까?

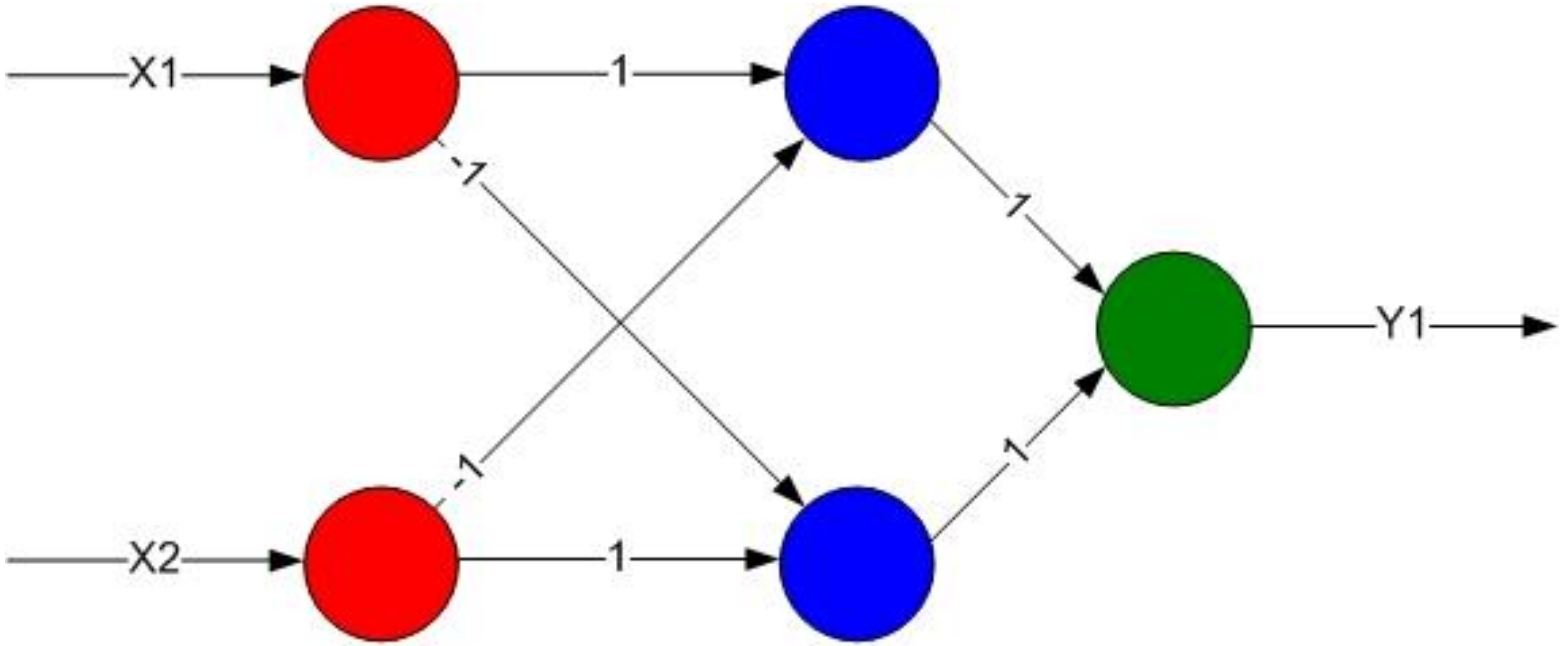
x	y	x XOR y
0	0	0
0	1	1
1	0	1
1	1	0





AND, NAND, OR 게이트를 조합하여 XOR 게이트를 만들 수 있다.
= 퍼셉트론을 층을 쌓아 다층(multi-layer) 퍼셉트론으로 구현한다.

다층 퍼셉트론

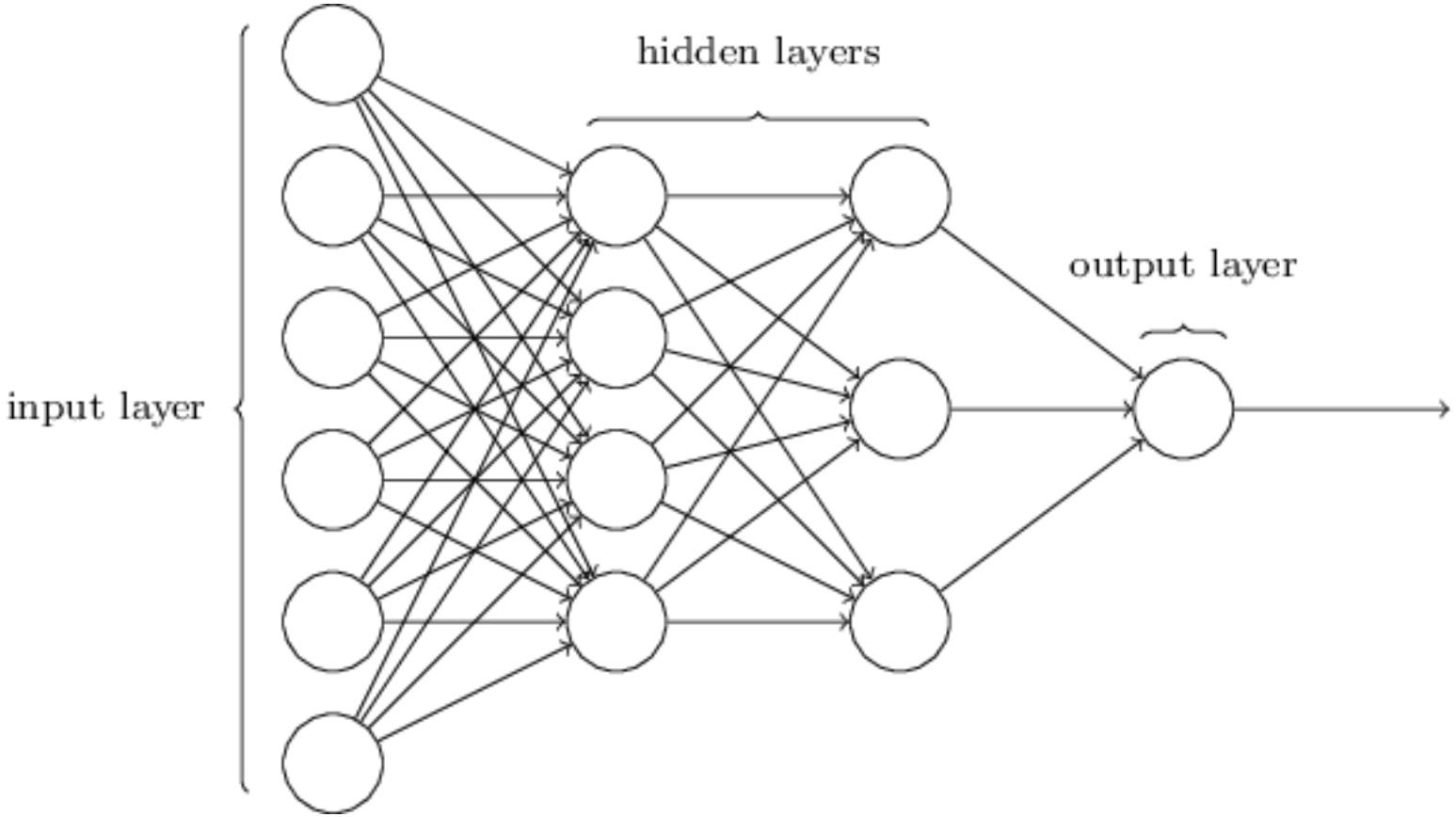


층을 쌓아 XOR 게이트를 만들 수 있다. 층을 더함으로써 보다 복잡한 회로도 표현할 수 있다.

NAND 게이트만으로 컴퓨터를 만들 수 있다. → 퍼셉트론으로 컴퓨터를 표현할 수 있다!
사실, 이론상 2층 퍼셉트론만으로도 임의의 함수를 표현할 수 있다는 사실이 증명되어 있다.
* 비선형인 시그모이드 함수를 활성화 함수로 이용하면

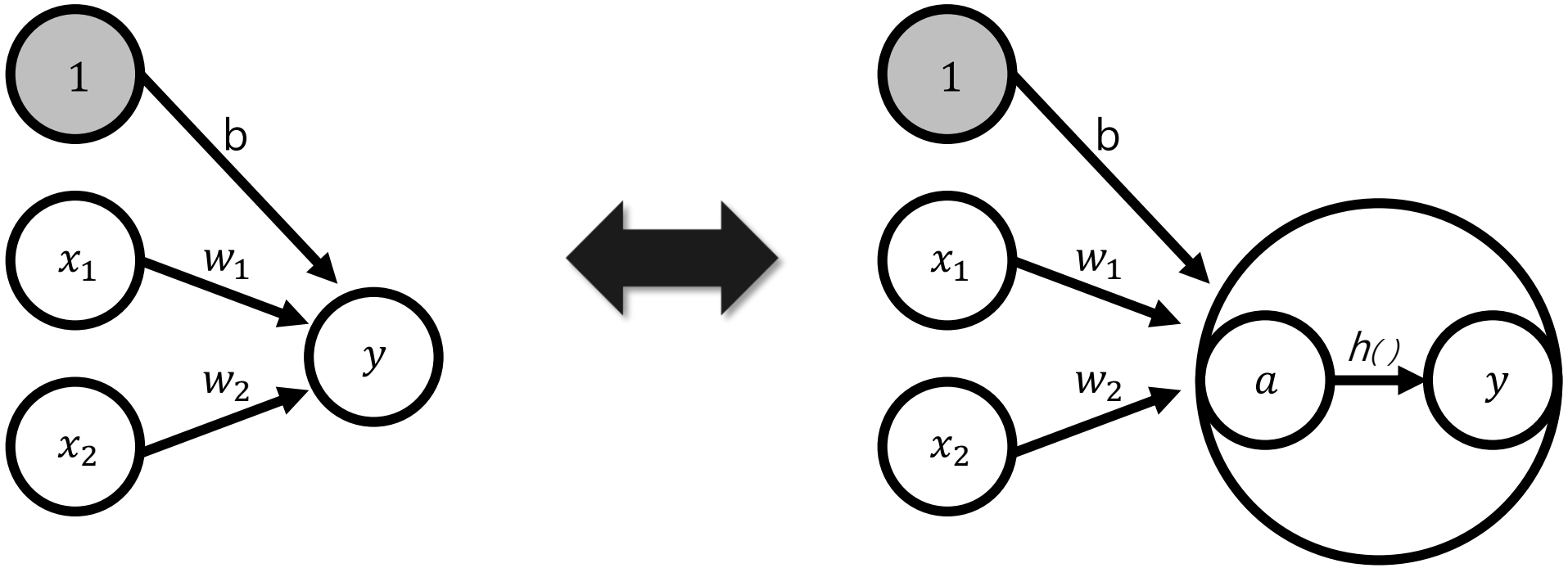
신경망

- 퍼셉트론에서는 적절한 매개변수를 사람이 정해줘야 했지만, 신경망에서는 매개변수를 데이터로부터 자동으로 학습한다.



- 퍼셉트론과 신경망은 무엇이 다른가? **활성화 함수(activation function)**에서 차이를 보인다.

활성화 함수



$$y = \begin{cases} 0\ (b + w_1x_1 + w_2x_2 \leq 0) \\ 1\ (b + w_1x_1 + w_2x_2 > 0) \end{cases}$$

$$y = h(b + w_1x_1 + w_2x_2)$$

$h(a)$

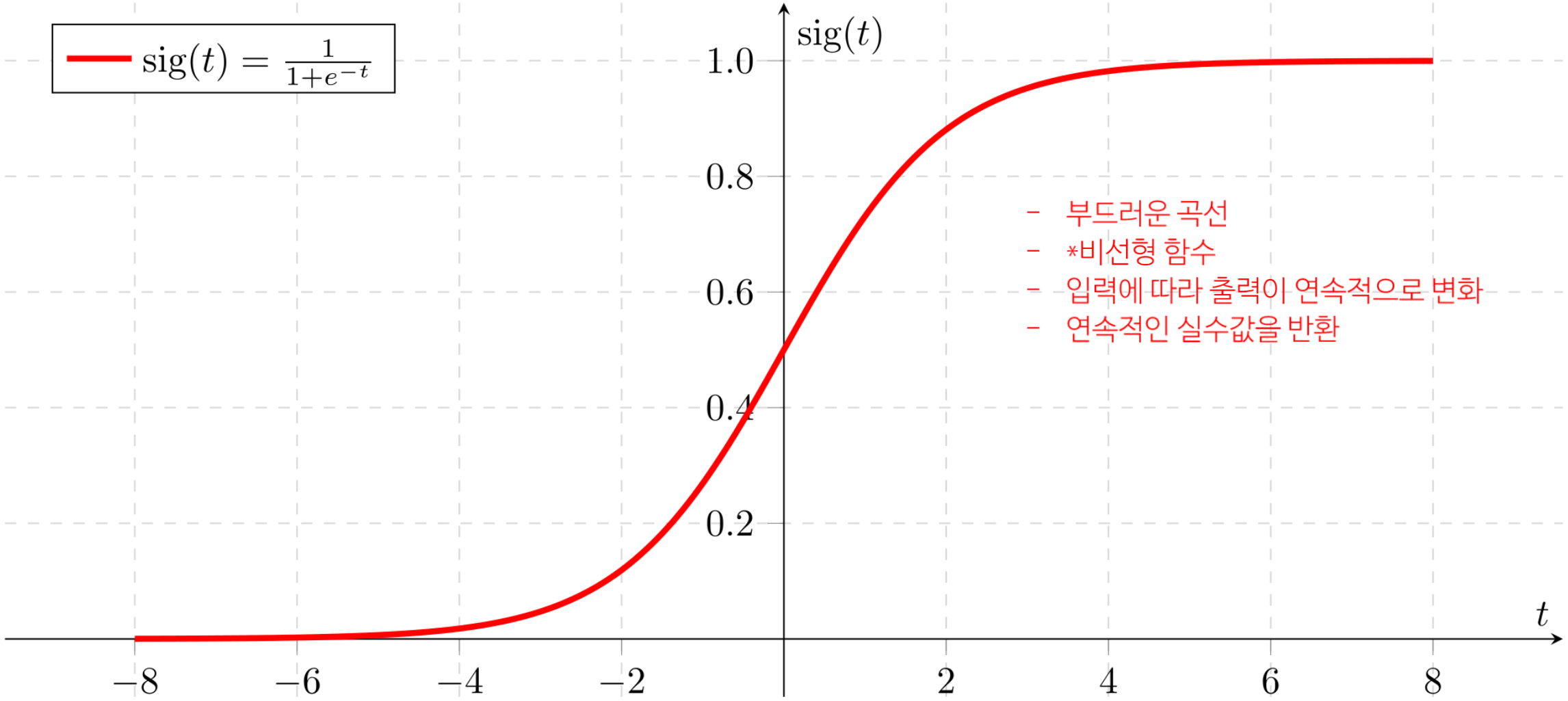
$$h(x) = \begin{cases} 0\ (x \leq 0) \\ 1\ (x > 0) \end{cases}$$

활성화 함수

- 활성화 함수를 계단함수(퍼셉트론에서의 활성화 함수)에서 다른 함수로 변경할 수 있다.

활성화 함수

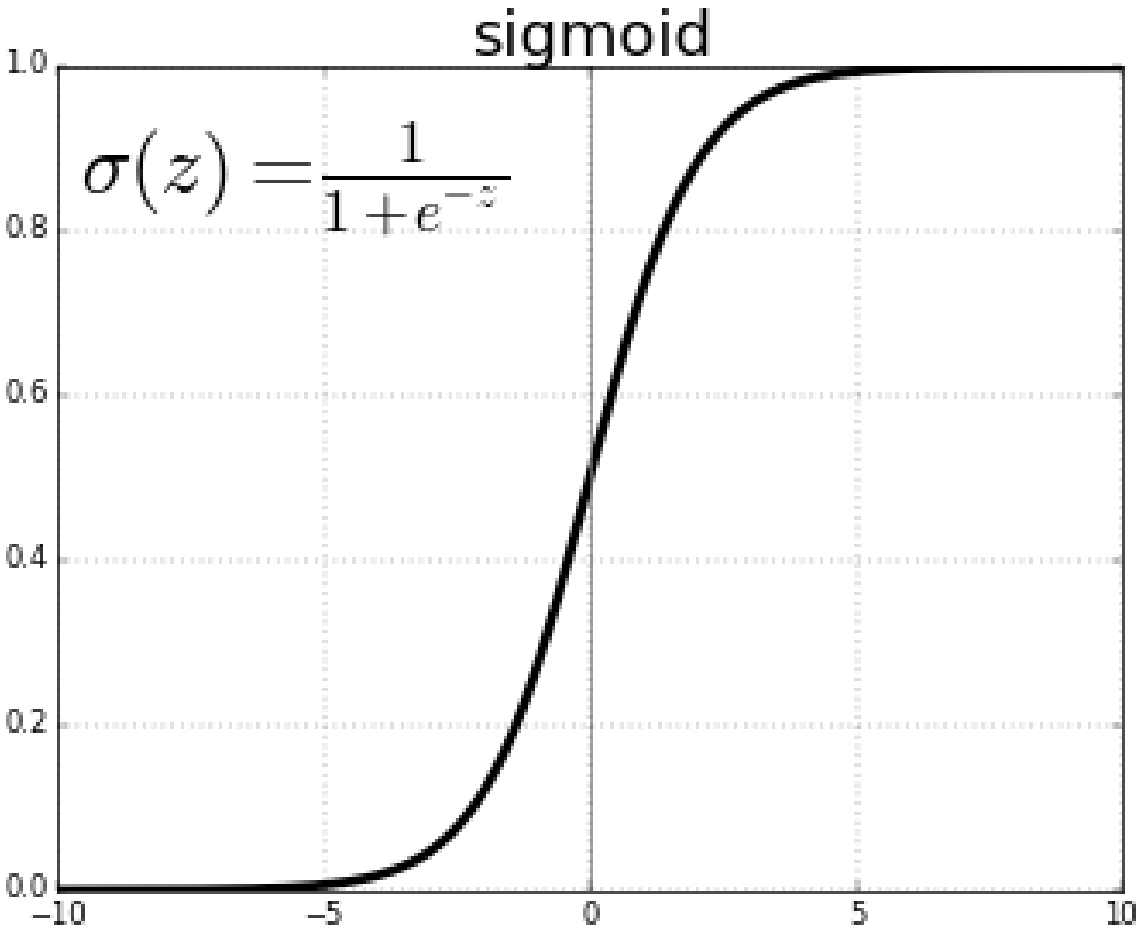
- 시그모이드 함수(sigmoid function)
- 활성화 함수로 시그모이드 함수를 이용하여 신호를 변환하고, 그 신호를 다음 뉴런에 전달한다.

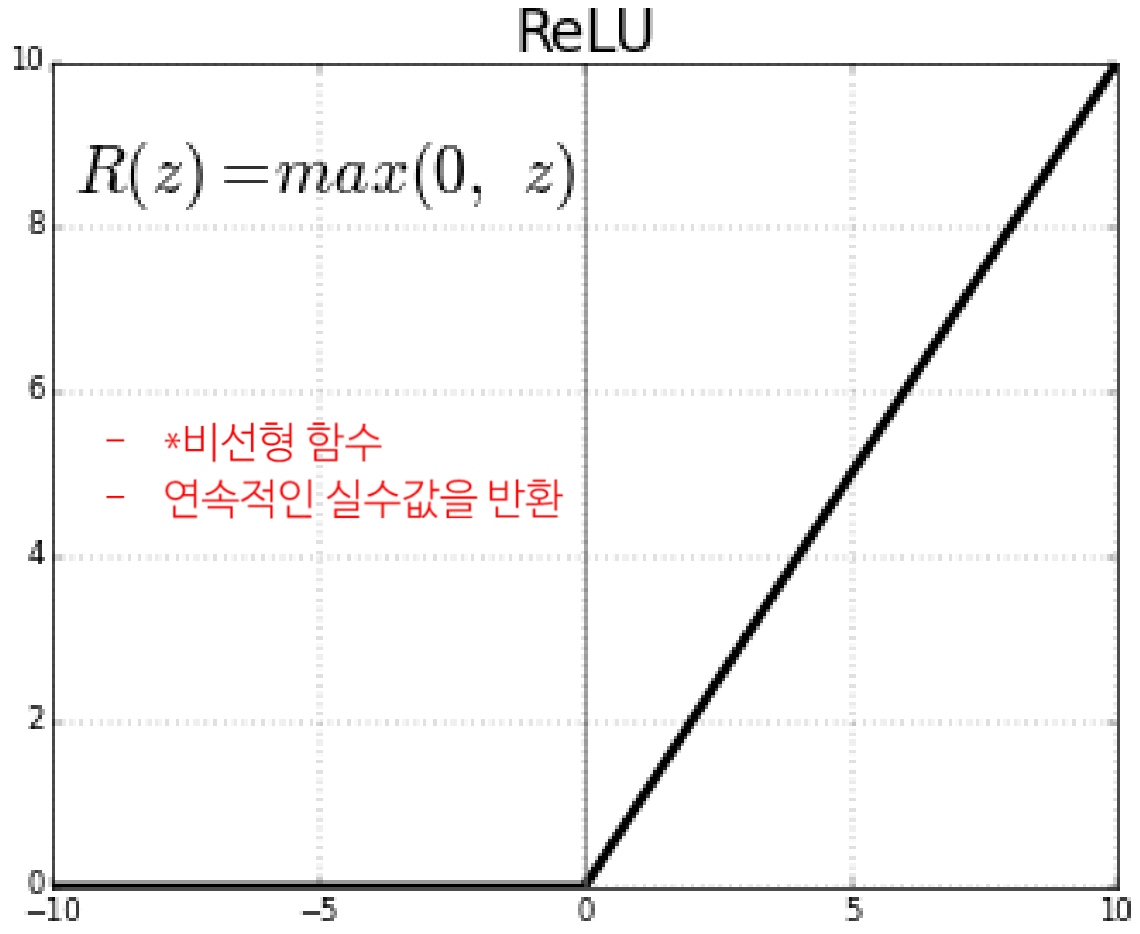


- 부드러운 곡선
- *비선형 함수
- 입력에 따라 출력이 연속적으로 변화
- 연속적인 실수값을 반환

I 활성화 함수

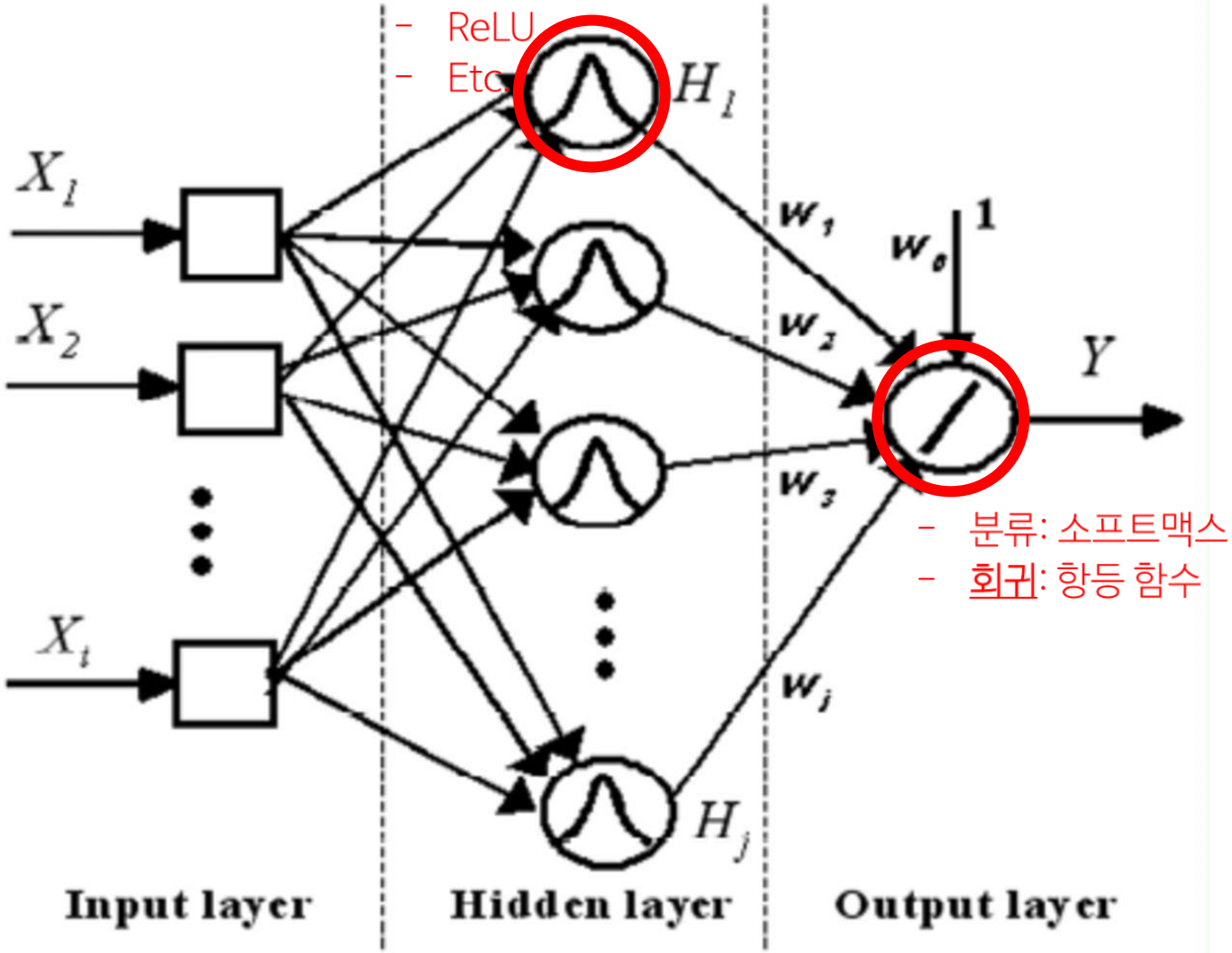
- ReLU 함수(Rectified Linear Unit function)
- 근래 주로 사용되는 함수이다.



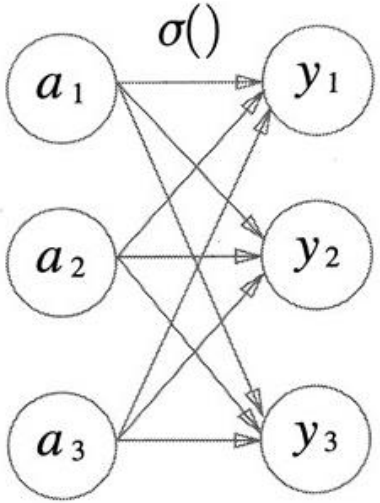


I 활성화 함수

출력층의 활성화 함수는 풀고자 하는 문제의 성질에 맞게 결정한다.



- 분류: 소프트맥스 함수
- 회귀: 항등 함수

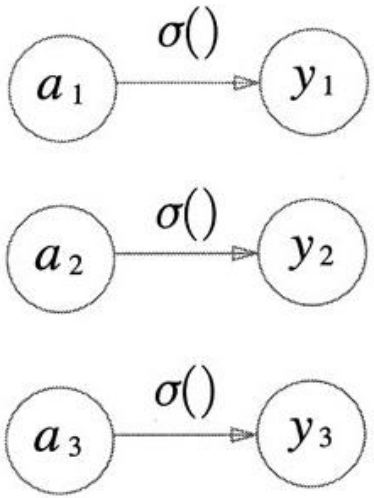


Softmax 함수

출력의 총합이 1이므로 확률로 해석할 수 있다.

$$y_k = \frac{exp(a_k)}{\sum_{i=1}^{n} exp(a_i)}$$

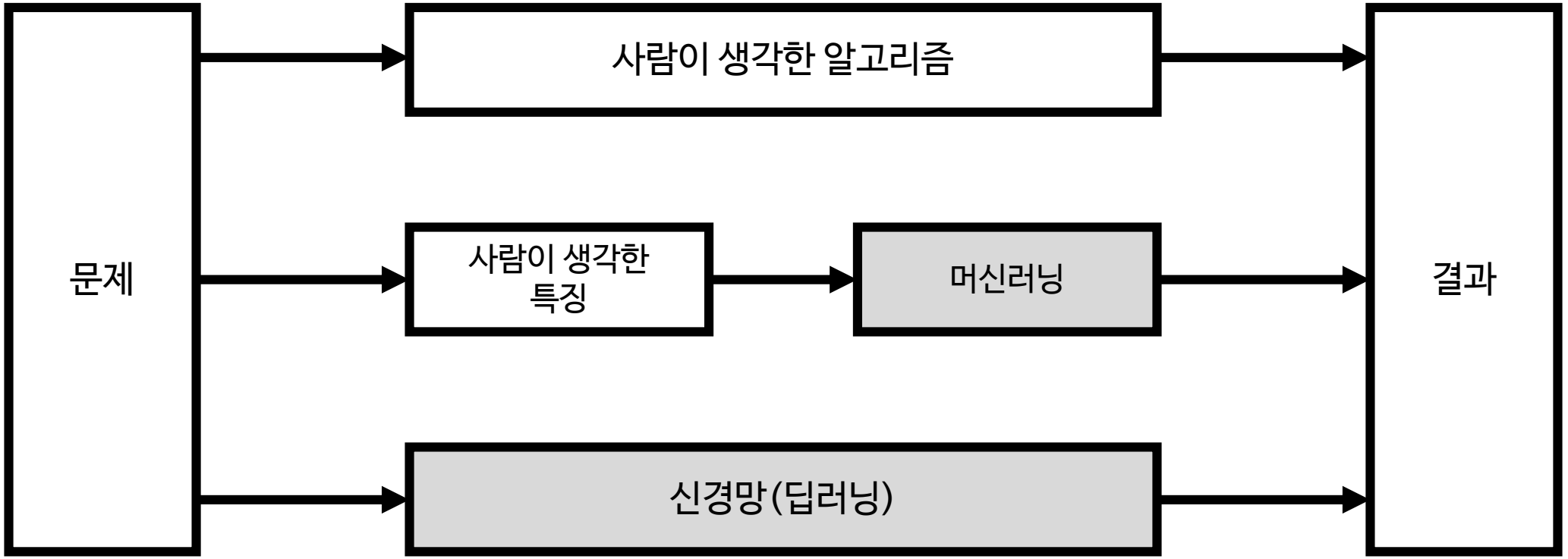
함수 적용 전후로 각 원소의대소관계는불변



항등 함수

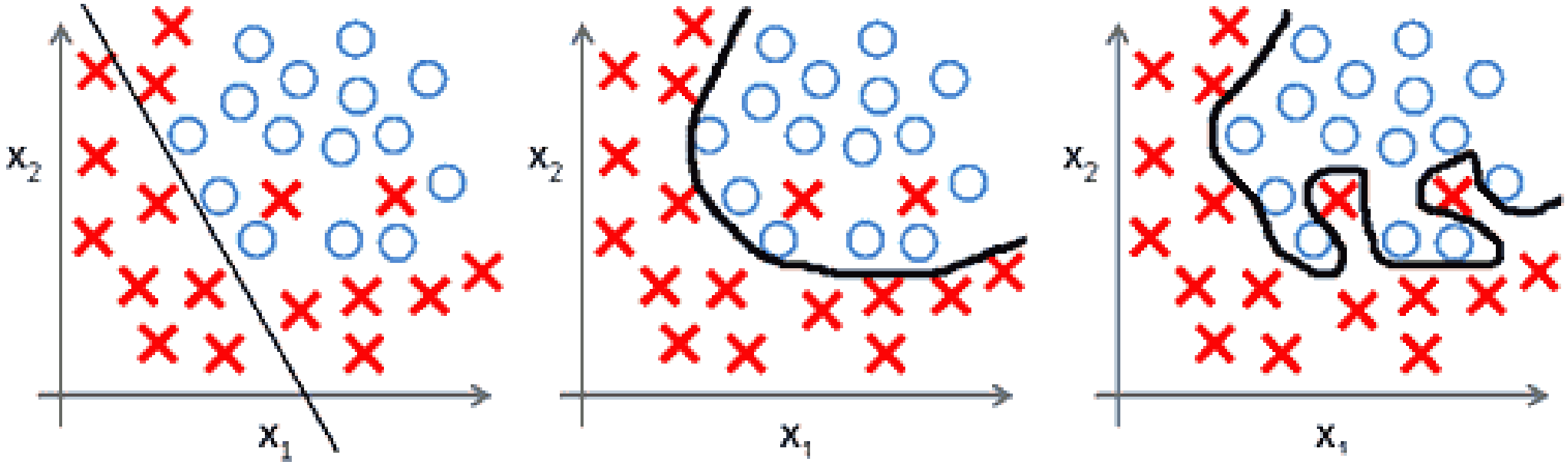
신경망 학습

- 신경망에서는 데이터를 보고 학습할 수 있다. 즉, 가중치 매개변수의 값을 자동으로 결정한다.
- 퍼셉트론에서는 사람이 수작업으로 매개변수를 설정했다. (진리표를 보면서)
- 사실, 퍼셉트론에서도 학습이 가능하지만, 오직 선형 분리 가능 문제로 한정된다.



- 딥러닝은 종단간(end-to-end) 머신러닝이다. 데이터에서 결과에 이르기까지 사람의 개입이 없다. 문제의 세부사항과 관계없이 신경망은 데이터를 학습하고 패턴을 발견하려 시도한다.

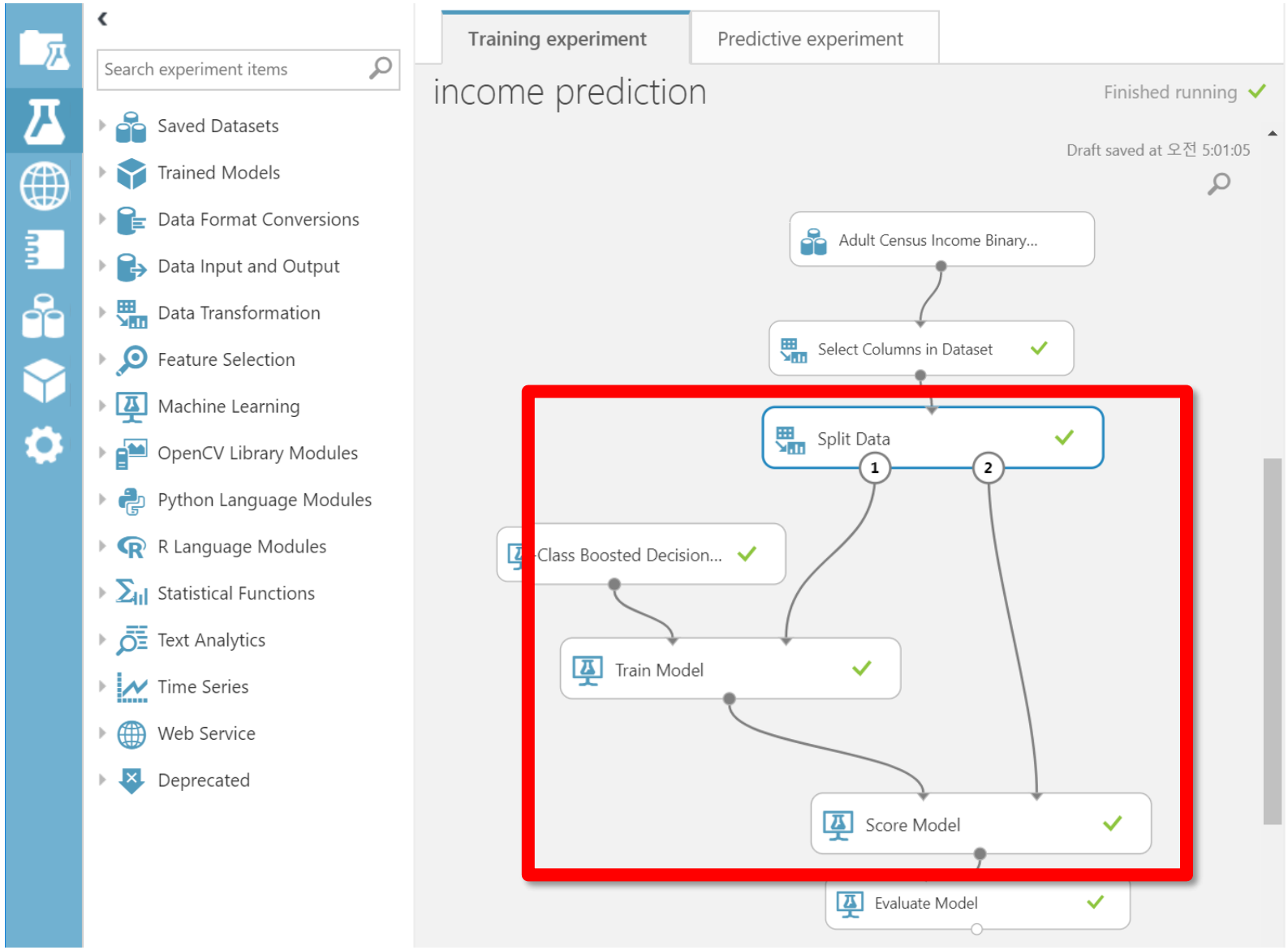
I 오버피팅

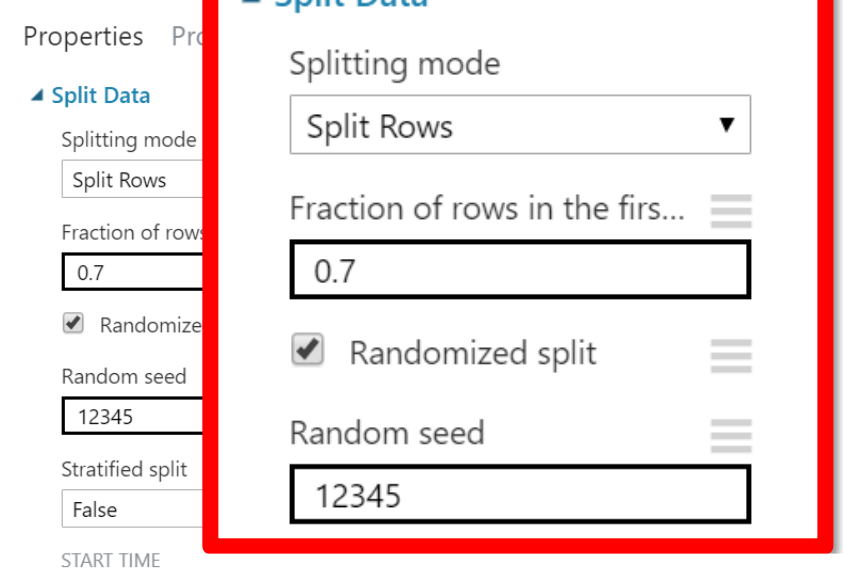


Underfit Normal Overfit

- **Overfitting** is the use of models or procedures that violate Occam's razor, for example by including more adjustable parameters than are ultimately optimal, or by using a more complicated approach than is ultimately optimal.
- **Occam's razor** is the problem-solving principle that, when presented with competing hypothetical answers to a problem, one should select the one that makes the fewest assumptions.

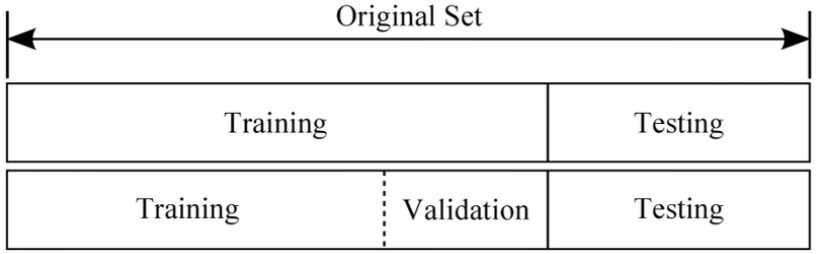
I 오버피팅

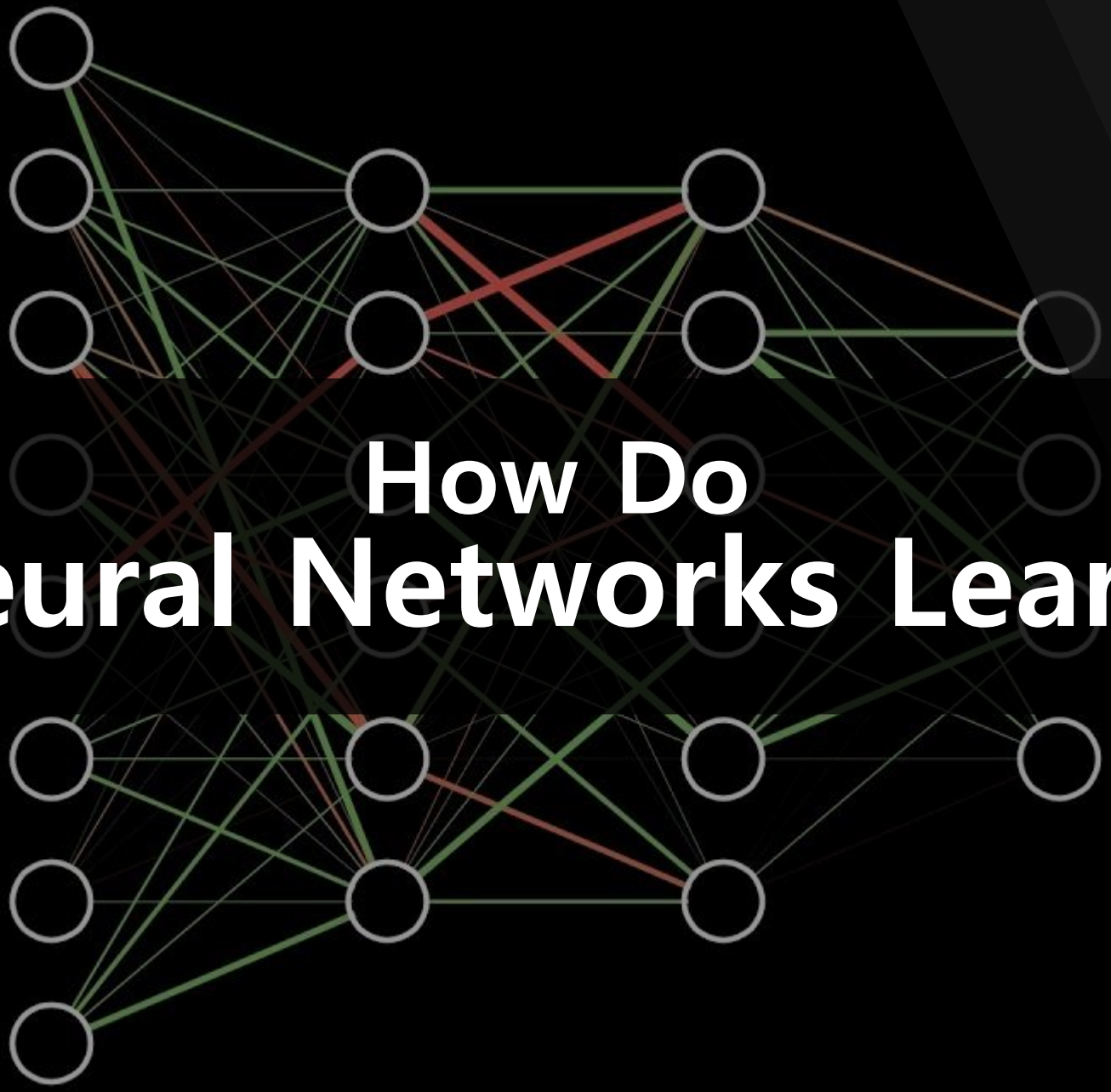




일반적으로, 훈련(training) 데이터와 시험(test) 데이터로 나누어 실험 수행
: 오버피팅(overfitting)을 피하기 위함

+ Validation set





How Do Neural Networks Learn?

박상현 / twodude@naver.com / 010-2741-0064

손실 함수

- 최적의 매개변수 값을 탐색하는 지표로, 보통 **평균 제곱 오차**와 **교차 엔트로피 오차**를 사용한다.
- 신경망 성능의 '나쁨'을 나타내는 지표이다. 즉, 현재의 신경망이 훈련 데이터를 얼마나 잘 처리하지 못하는가를 나타낸다. 음의 값을 곱하는 것으로 '좋음'을 나타내는 지표로 활용할 수 있다.

- 평균 제곱 오차(mean squared error, MSE)

$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y_i)^2$$

n: 원소의 개수

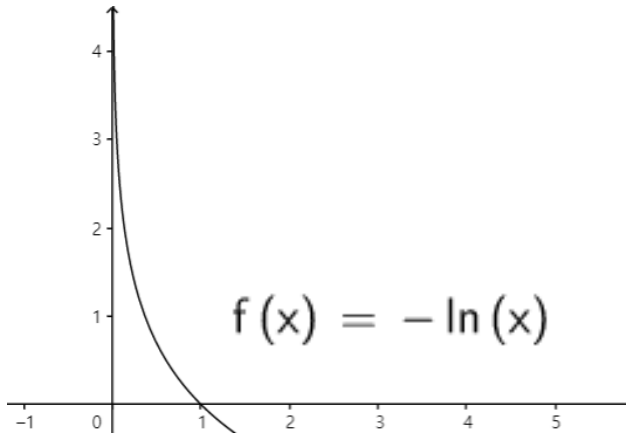
$\hat{Y}$: 신경망이 추정한 값

Y: 정답 레이블 (원-핫 인코딩)

Y = [0, 0, 1, 0, 0, 0, 0, 0, 0, 0]

- 교차 엔트로피 오차(cross entropy error, CEE)

$$CEE = -\sum_{n} Y \log \hat{Y}$$



손실 함수

- 왜 손실 함수를 설정하는가? 궁극적인 목표는 높은 정확도를 끌어내는 매개변수 값을 찾는 것인데, '정확도'라는 지표 대신 '손실 함수'를 사용해 우회적인 방법을 취하는 이유는 무엇인가?

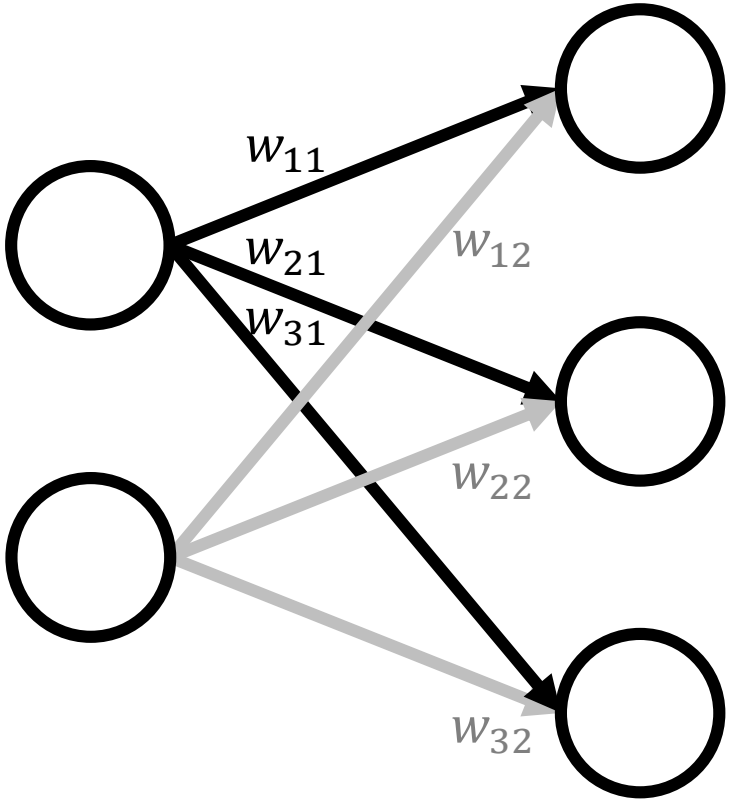
- 신경망 학습에서는 최적의 매개변수(가중치와 편향)를 탐색할 때 **손실 함수의 값을 가능한 한 작게(error가 거의 없는)** 만드는 매개변수 값을 찾는다. 이 때 매개변수에서의 손실 함수의 미분-기울기-을 구해 활용할 수 있다. 가령 미분 값이 음수면 그 매개변수를 양의 방향으로 변화시켜 저점을 찾아갈 수 있다. 한편 미분 값이 양수면 매개변수를 음의 방향으로 변화시켜 저점을 찾아 갈 수 있다. 경사법

- 정확도를 지표로 삼는다면, 미분 값이 대부분의 장소에서 0이 되므로 매개변수를 갱신하기 어려워진다. 즉, 매개변수를 약간 조정하는 것으로는 정확도가 개선되지 않고 일정하게 유지되거나, 불연속적인 띄엄띄엄한 값으로 변하게 된다. (정확도가 산출되는 과정을 생각해보자!)

- 비슷한 이유로 활성화 함수에 '계단 함수'를 사용하지 않는다. 매개변수의 작은 변화가 주는 파장을 계단 함수가 말살하여 손실 함수의 값에는 아무런 변화가 나타나지 않기 때문이다. 한편 시그모이드에서는 모든 장소에서 미분이 0이 되지 않는다.

기울기

- 신경망에서의 기울기는 무엇인가?
- 가중치 매개변수에 대한 손실 함수의 기울기이다.



$$W = \begin{pmatrix} w_{11} & w_{21} & w_{31} \\ w_{12} & w_{22} & w_{32} \end{pmatrix}$$

$$\frac{\partial L}{\partial W} = \begin{pmatrix} \frac{\partial L}{\partial w_{11}} & \frac{\partial L}{\partial w_{21}} & \frac{\partial L}{\partial w_{31}} \\ \frac{\partial L}{\partial w_{12}} & \frac{\partial L}{\partial w_{22}} & \frac{\partial L}{\partial w_{32}} \end{pmatrix}$$

w_{32}를 조금 변경했을 때
손실 함수 L이 얼마나 변화하느냐

경사법(경사 하강법)

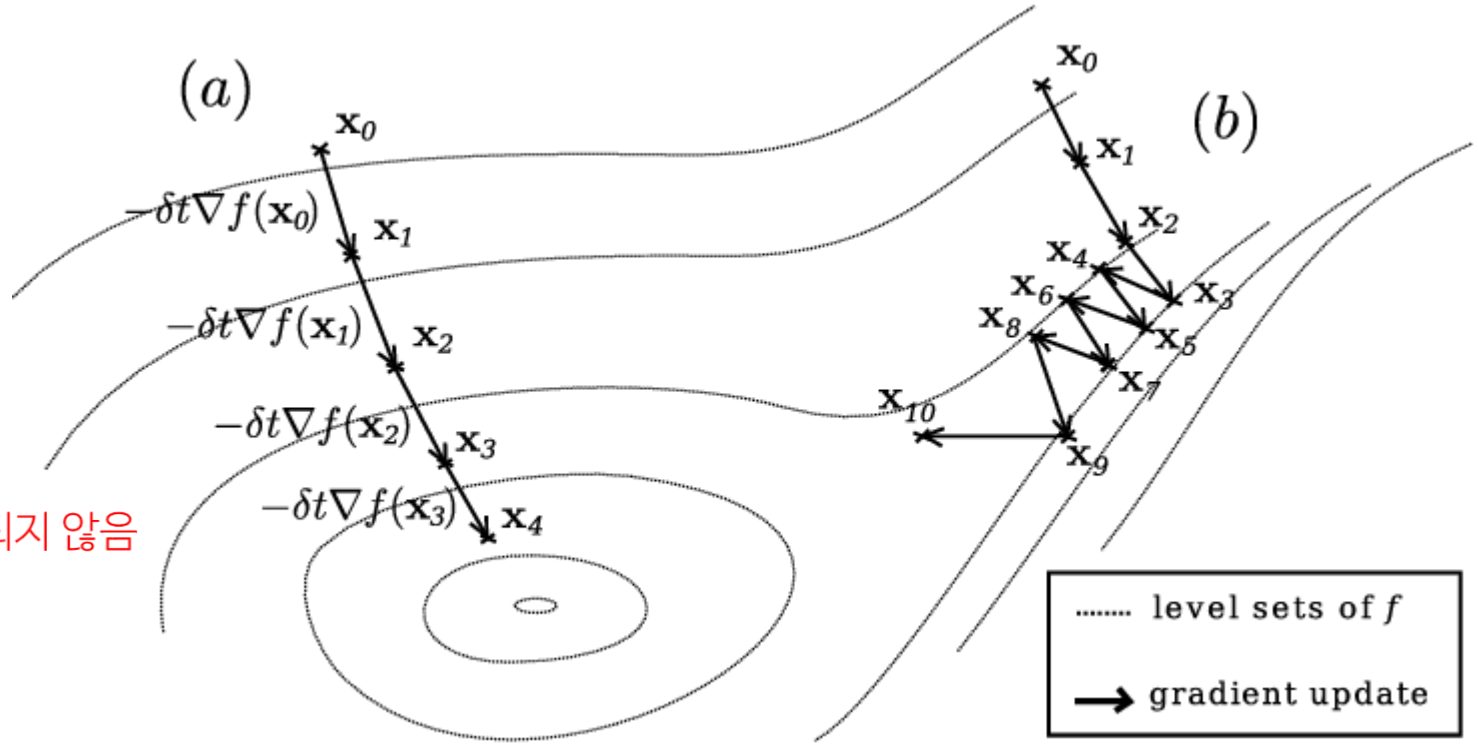
- 손실 함수가 최솟값이 되는 매개변수 값을 찾아야 한다. 즉, 최적의 매개변수(가중치와 편향)를 찾아야 한다. 그러나 일반적인 경우 손실 함수가 매우 복잡하고 매개변수 공간이 광활하여 어느 지점에서 최솟값이 되는지를 파악하기가 어렵다.
- 경사법에서는 기울기를 이용해 함수의 최솟값을 찾고자 한다. 최솟값이 아닐지라도 가능한 한 작은 값-극솟값-을 찾을 수 있다. 최솟값을 찾기 때문에 경사 하강법(gradient descent method)으로 칭하기도 한다.

$$x_i = x_i - \eta \frac{\partial f}{\partial x_i}$$

학습률 η(eta, 에타)는
갱신의 정도를 나타낸다.

발산 갱신이 거의 되지 않음

학습률이 너무 크거나 작으면
좋은 결과를 얻을 수 없다.



확률적 경사 하강법(stochastic -)

- 확률적 경사 하강법(SGD)은 확률적으로 무작위로 골라낸 훈련 데이터(미니배치, mini batch)에 대해 수행하는 경사 하강법이다. 미니배치의 손실 함수는 일부 표본 데이터로 전체를 비슷하게 계측할 수 있다.

하이퍼파라미터(hyper parameter)

- 학습률과 같은 매개변수를 하이퍼파라미터라 칭한다. 하이퍼파라미터는 가중치와 편향과 같은 신경망의 매개변수와는 달리, 사람이 직접 설정해야 하는 매개변수이다. 일반적으로 여러 후보 값 중에서 시험을 통해 가장 적절한 값을 찾는다.

에폭(epoch)

- 1에폭은 학습에서 훈련 데이터를 모두 소진했을 때의 횟수에 해당한다. 가령, 훈련 데이터 10,000개를 100개의 미니배치로 학습할 경우 확률적 경사 하강법을 100회 반복하면 모든 훈련 데이터를 소진한게 된다. 이 경우 100회가 1에폭이 된다.

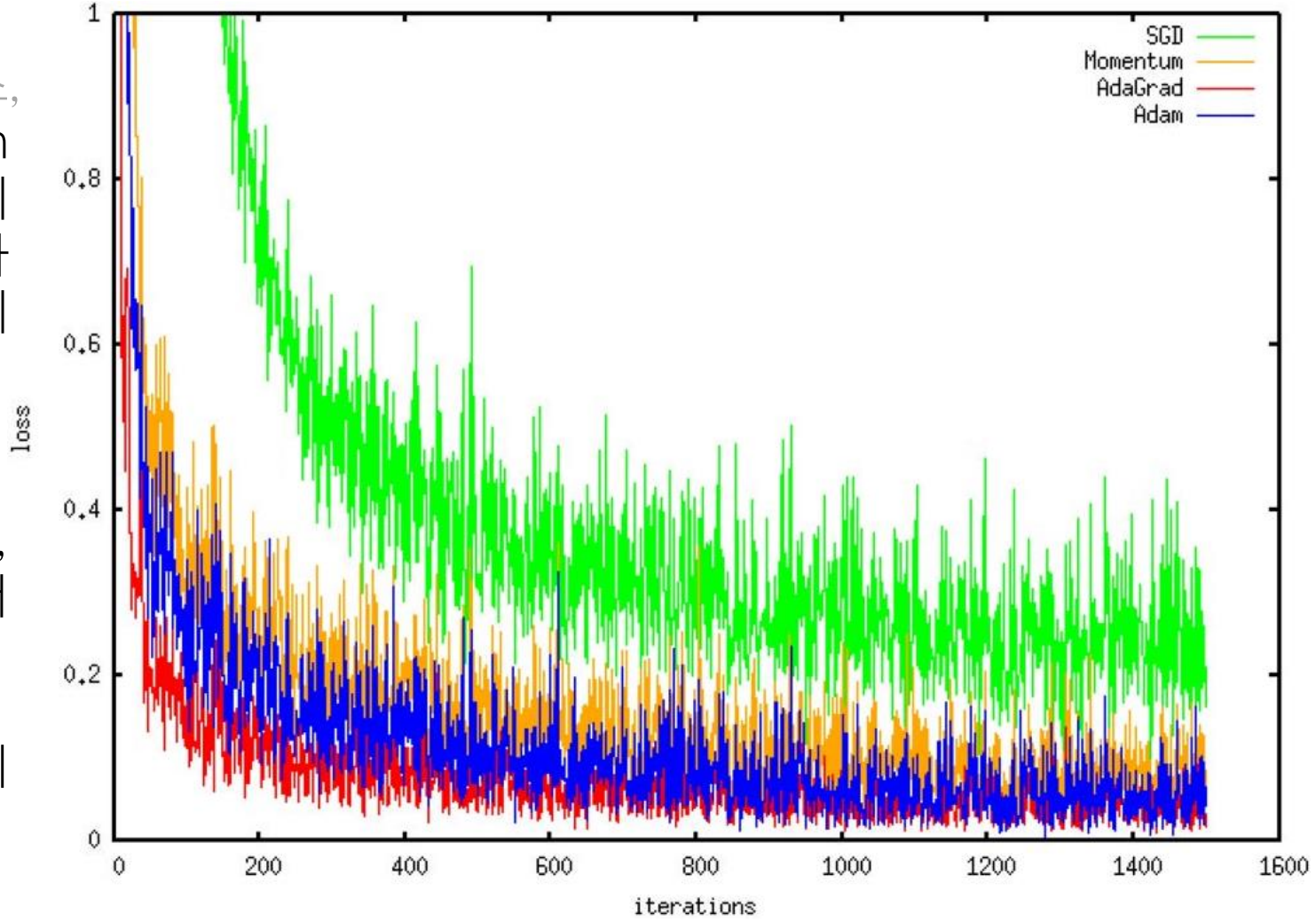
더 살펴보기

- 오차역전파법(backpropagation): 수치 미분은 계산 시간이 오래 걸린다는 단점이 있다. 이 때 오차역전파법을 사용하면 가중치 매개변수의 기울기를 빠르고 효율적으로 계산할 수 있다.

- 모멘텀(momentum), 학습률 감소, AdaGrad, RMSProp, Adam : 확률적 경사 하강법(SGD) 이외의 최적화 기법들로, 풀어야 할 문제가 무엇이냐에 따라 선택한다. 각자의 장단이 있다.

- 이외에도 가중치 초깃값 설정 문제, 오버피팅 억제 기술, 적절한 하이퍼파라미터 찾기 등의 이슈들이 있다.

- CNN(합성곱 신경망), 딥러닝 등의 신경망을 살펴볼 수 있다.

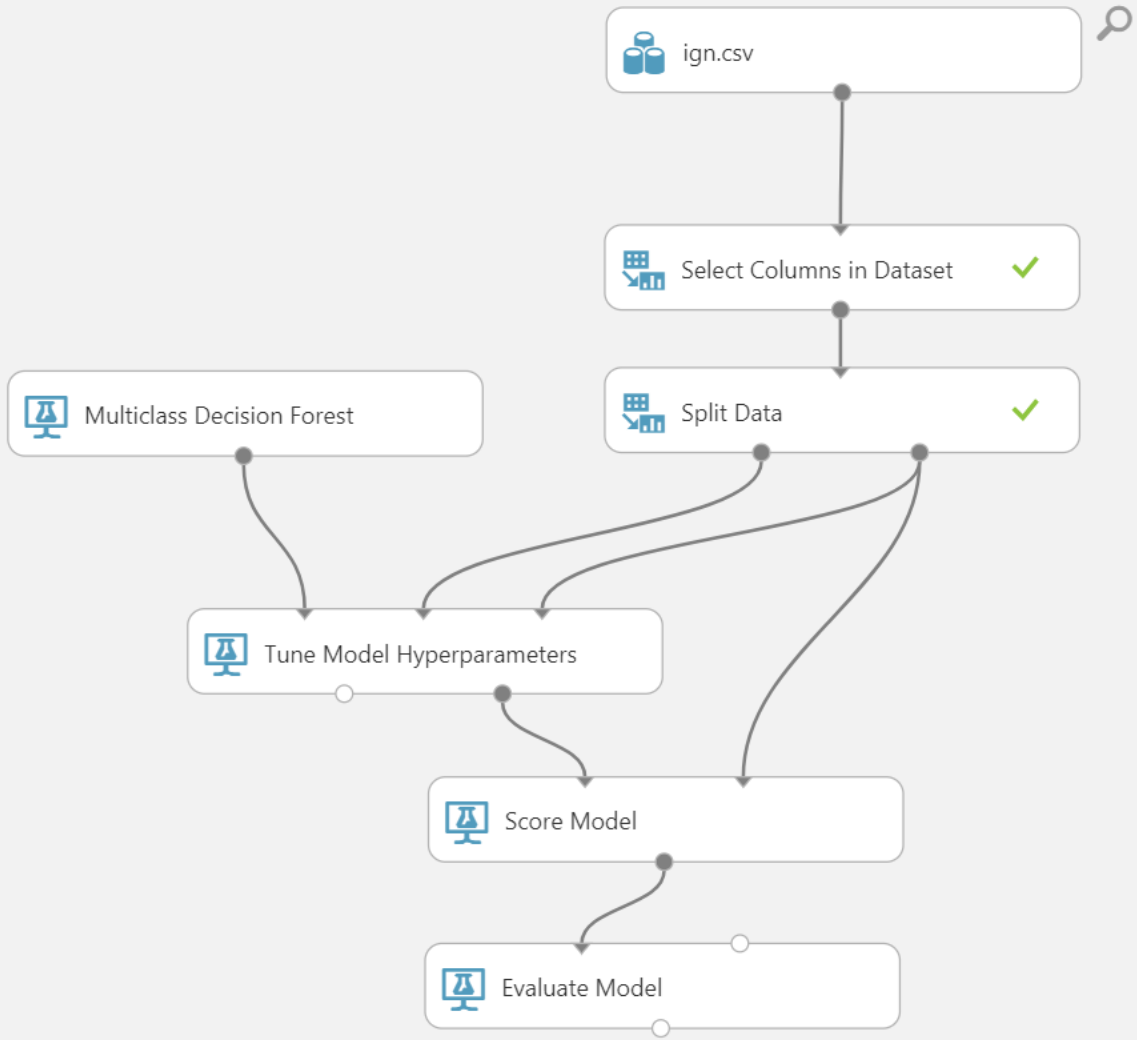


Microsoft Azure Machine Learning Studio

Search experiment items

- Saved Datasets
- Trained Models
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
- OpenCV Library Modules
- Python Language Modules
- R Language Modules
- Statistical Functions
- Text Analytics
- Time Series
- Web Service
- Deprecated

In draft



Properties Project

Experiment Properties

START TIME -
END TIME -
STATUS CODE InDraft
STATUS DETAILS None

Prior Run

Summary

Enter a few sentences describing your experiment (up to 140 characters).

Description

Enter the detailed description for your experiment.

Microsoft Azure Machine Learning Studio

https://studio.azureml.net/

NEW RUN HISTORY SAVE SAVE AS DISCARD CHANGES RUN SET UP WEB SERVICE

박상현 / twodude@naver.com / 010-2741-0064

Microsoft Azure Machine

안전함 | https://studio.azureml.net

Microsoft Azure Machine Learning Studio

Sign In

Welcome to Azure Machine Learning

Try it for free

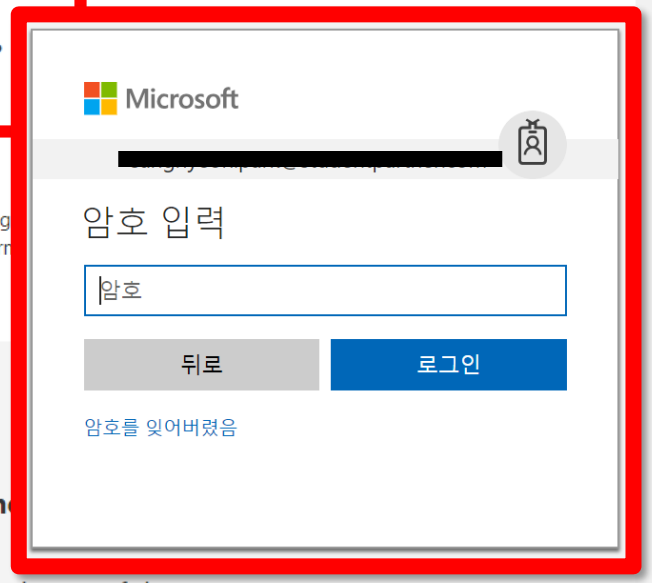
No Azure subscription? No credit card? No problem! Choose anonymous Guest Access, or sign in with your work or school account, or a Microsoft account.

Sign In

Not an Azure ML user?
Sign up here

Pricing & FAQ

By using this free version, you ag
the Microsoft Azure Website Terr



Announcements NEW!

Mining Campaign Funds
Aired on August 02, 2017
Play with 2016 Presidential Campaign finance data while learning how to prepare a large

Inside the Data Science VM
Aired on June 21, 2016
DSVM is a custom Azure Virtual Machine image that is published on the Azure marketplace and

Predictive Maintenan
Aired on July 05, 2016
Predictive maintenance is one of the top demand

Experiments - Microsoft

안전함 | https://studio.azureml.net/Home/ViewWorkspaceCached/eb7363718b1244efa2488083867403f4#Workspaces/Experiments/Experiment/eb7363718b1244efa24...

Microsoft Azure Machine Learning Studio

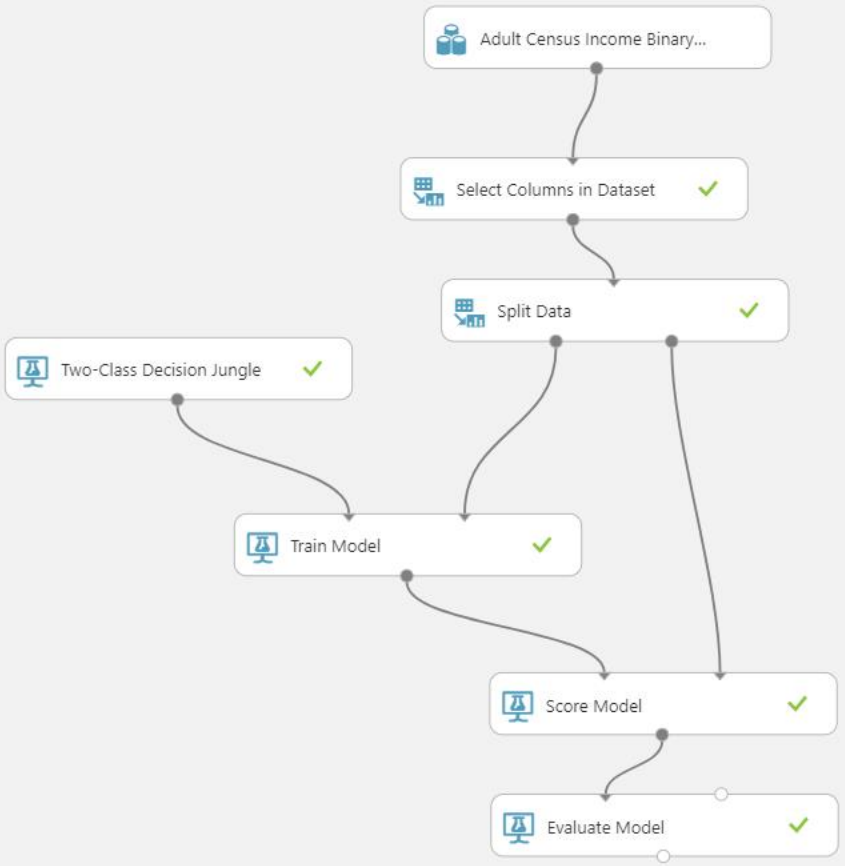
Search experiment items

- Saved Datasets
- Trained Models
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
- OpenCV Library Modules
- Python Language Modules
- R Language Modules
- Statistical Functions
- Text Analytics
- Time Series
- Web Service
- Deprecated

Training experiment | Predictive experiment

income prediction

Finished running



Properties | Project

Experiment Properties

START TIME	1/23/20...
END TIME	1/23/20...
STATUS CODE	Finished
STATUS DETAILS	None

Prior Run

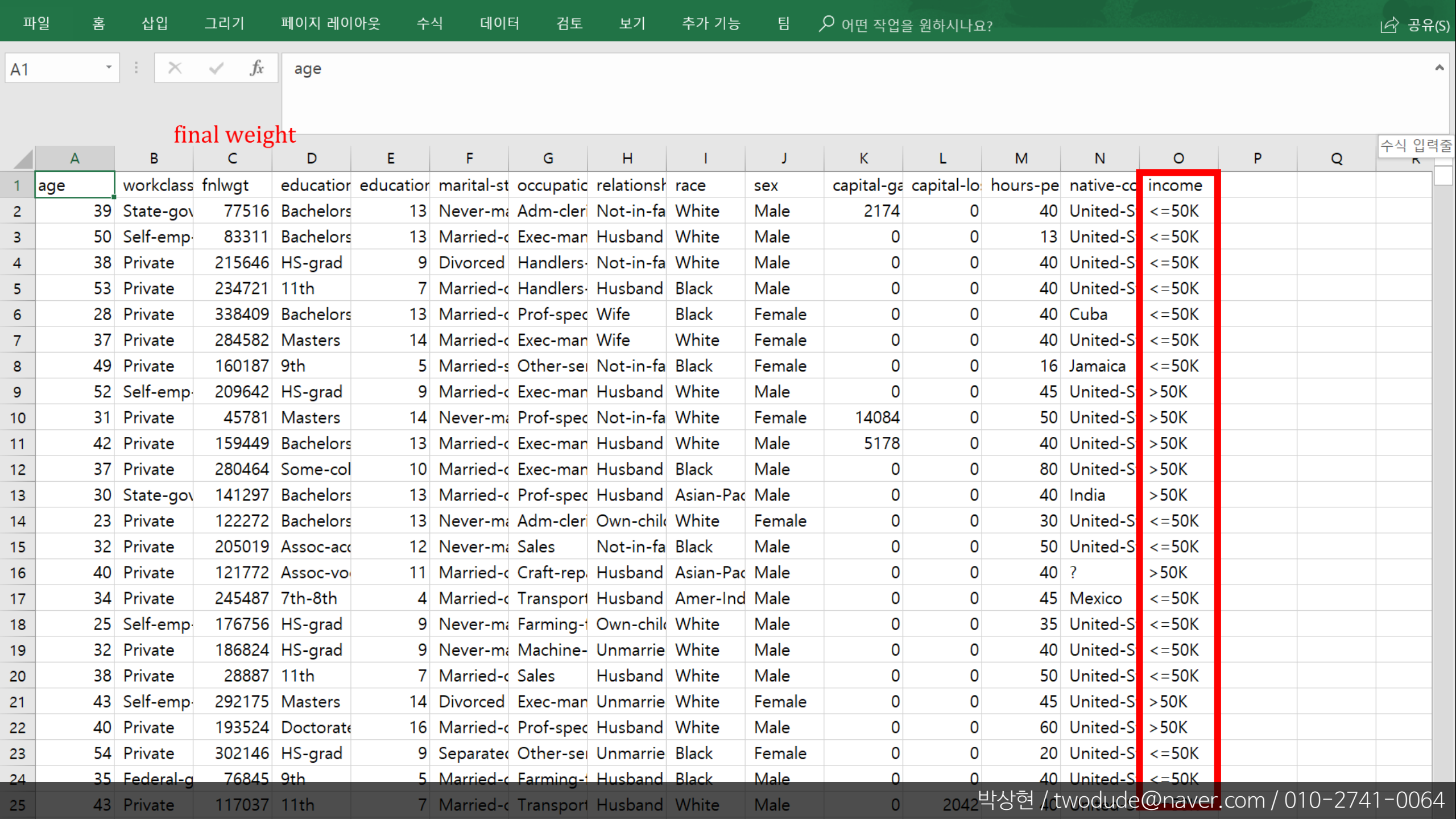
Summary

Enter a few sentences describing your experiment (up to 140 characters).

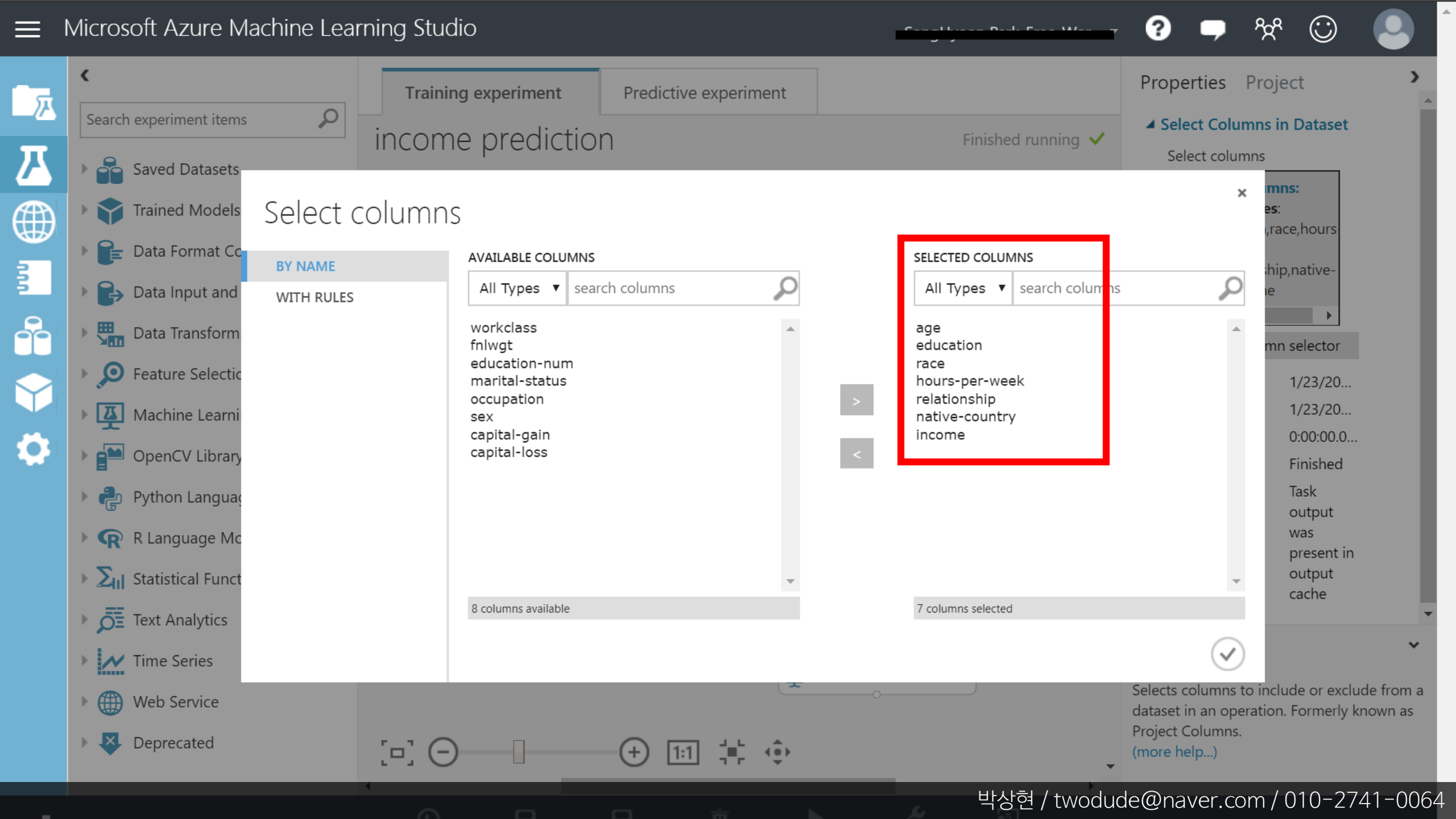
Description

Enter the detailed description for your experiment.

Quick Help



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	age	workclass	fnlwgt	education	education	marital-st	occupatic	relationsh	race	sex	capital-ga	capital-lo	hours-pe	native-co	income
2	39	State-gov	77516	Bachelors	13	Never-ma	Adm-cleri	Not-in-fa	White	Male	2174	0	40	United-S	<=50K
3	50	Self-emp	83311	Bachelors	13	Married-c	Exec-man	Husband	White	Male	0	0	13	United-S	<=50K
4	38	Private	215646	HS-grad	9	Divorced	Handlers-	Not-in-fa	White	Male	0	0	40	United-S	<=50K
5	53	Private	234721	11th	7	Married-c	Handlers-	Husband	Black	Male	0	0	40	United-S	<=50K
6	28	Private	338409	Bachelors	13	Married-c	Prof-spec	Wife	Black	Female	0	0	40	Cuba	<=50K
7	37	Private	284582	Masters	14	Married-c	Exec-man	Wife	White	Female	0	0	40	United-S	<=50K
8	49	Private	160187	9th	5	Married-s	Other-ser	Not-in-fa	Black	Female	0	0	16	Jamaica	<=50K
9	52	Self-emp	209642	HS-grad	9	Married-c	Exec-man	Husband	White	Male	0	0	45	United-S	>50K
10	31	Private	45781	Masters	14	Never-ma	Prof-spec	Not-in-fa	White	Female	14084	0	50	United-S	>50K
11	42	Private	159449	Bachelors	13	Married-c	Exec-man	Husband	White	Male	5178	0	40	United-S	>50K
12	37	Private	280464	Some-col	10	Married-c	Exec-man	Husband	Black	Male	0	0	80	United-S	>50K
13	30	State-gov	141297	Bachelors	13	Married-c	Prof-spec	Husband	Asian-Pac	Male	0	0	40	India	>50K
14	23	Private	122272	Bachelors	13	Never-ma	Adm-cleri	Own-chil	White	Female	0	0	30	United-S	<=50K
15	32	Private	205019	Assoc-acd	12	Never-ma	Sales	Not-in-fa	Black	Male	0	0	50	United-S	<=50K
16	40	Private	121772	Assoc-voc	11	Married-c	Craft-rep	Husband	Asian-Pac	Male	0	0	40	?	>50K
17	34	Private	245487	7th-8th	4	Married-c	Transport	Husband	Amer-Ind	Male	0	0	45	Mexico	<=50K
18	25	Self-emp	176756	HS-grad	9	Never-ma	Farming-	Own-chil	White	Male	0	0	35	United-S	<=50K
19	32	Private	186824	HS-grad	9	Never-ma	Machine-	Unmarrie	White	Male	0	0	40	United-S	<=50K
20	38	Private	28887	11th	7	Married-c	Sales	Husband	White	Male	0	0	50	United-S	<=50K
21	43	Self-emp	292175	Masters	14	Divorced	Exec-man	Unmarrie	White	Female	0	0	45	United-S	>50K
22	40	Private	193524	Doctorate	16	Married-c	Prof-spec	Husband	White	Male	0	0	60	United-S	>50K
23	54	Private	302146	HS-grad	9	Separated	Other-ser	Unmarrie	Black	Female	0	0	20	United-S	<=50K
24	35	Federal-g	76845	9th	5	Married-c	Farming-	Husband	Black	Male	0	0	40	United-S	<=50K
25	43	Private	117037	11th	7	Married-c	Transport	Husband	White	Male	0	2042	40	United-S	



Experiments - Microsoft

안전함 | https://studio.azureml.net/Home/ViewWorkspaceCached/eb7363718b1244efa2488083867403f4#Workspaces/Experiments/Experiment/eb7363718b1244efa24...

Microsoft Azure Machine Learning Studio

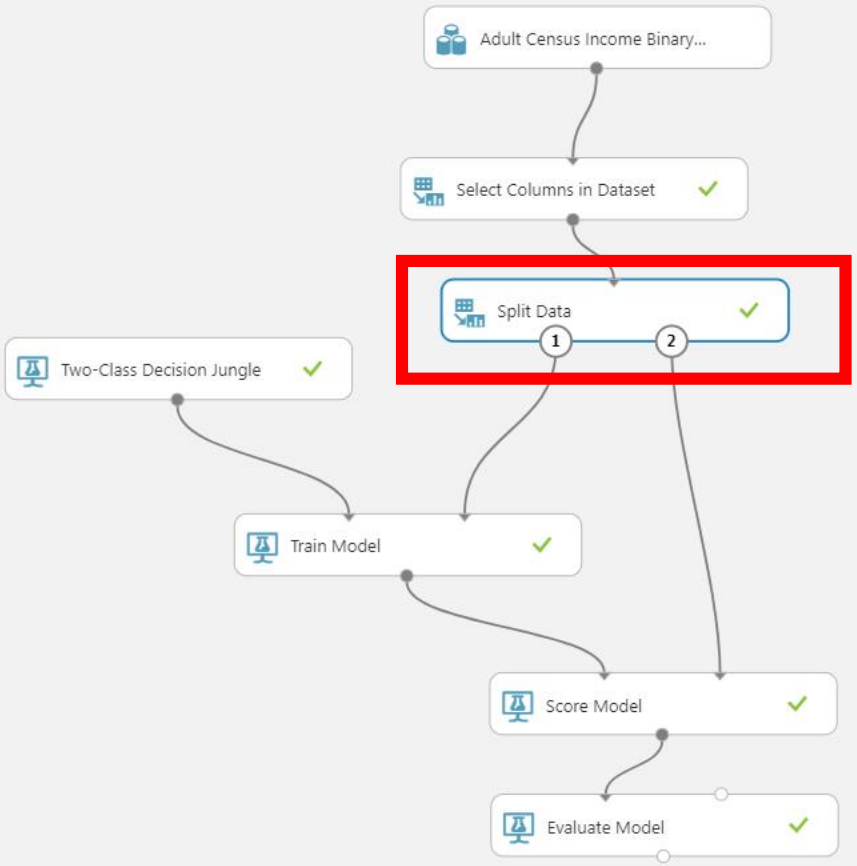
Search experiment items

- Saved Datasets
- Trained Models
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
- OpenCV Library Modules
- Python Language Modules
- R Language Modules
- Statistical Functions
- Text Analytics
- Time Series
- Web Service
- Deprecated

Training experiment | Predictive experiment

income prediction

Finished running



Properties | Project

Split Data

Splitting mode: Split Rows

Fraction of rows in the f...: 0.7

Randomized split

Random seed: 12345

Stratified split: False

START TIME	1/23/20...
END TIME	1/23/20...
ELAPSED TIME	0:00:00.0...
STATUS CODE	Finished
STATUS DETAILS	Task output was

Quick Help

Split the rows of a dataset into two distinct sets

Microsoft Azure Machine Learning Studio

SangHyeon Park-Free-Wor...

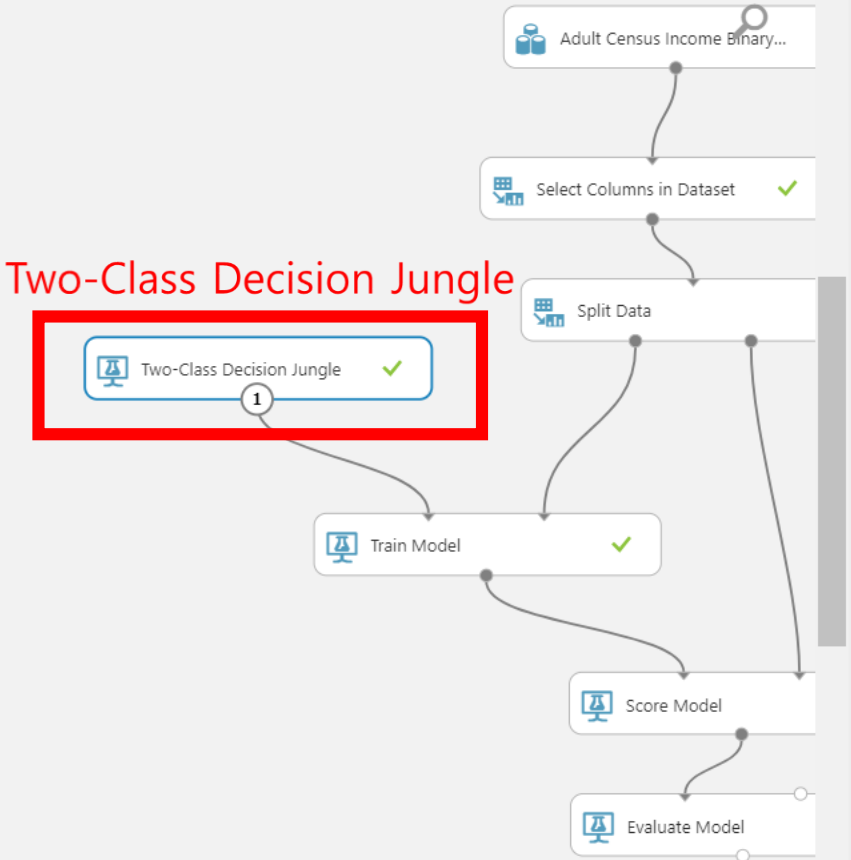
Search experiment items

- Saved Datasets
- Trained Models
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
- OpenCV Library Modules
- Python Language Modules
- R Language Modules
- Statistical Functions
- Text Analytics
- Time Series
- Web Service
- Deprecated

Training experiment | Predictive experiment

income prediction

Finished running



Two-Class Decision Jungle

Properties | Project

Two-Class Decision Jungle

Resampling method: Bagging

Create trainer mode: Single Parameter

Number of decision DAGs: 8

Maximum depth of the decision DAGs: 32

Maximum width of the decision DAGs: 128

Number of optimization steps per decision DAG layer: 2048

Allow unknown values for categorical features

START TIME 5/4/2018 8:46:13 PM

END TIME 5/4/2018 8:46:13 PM

Quick Help

Creates a two-class classification model using the decision jungle algorithm

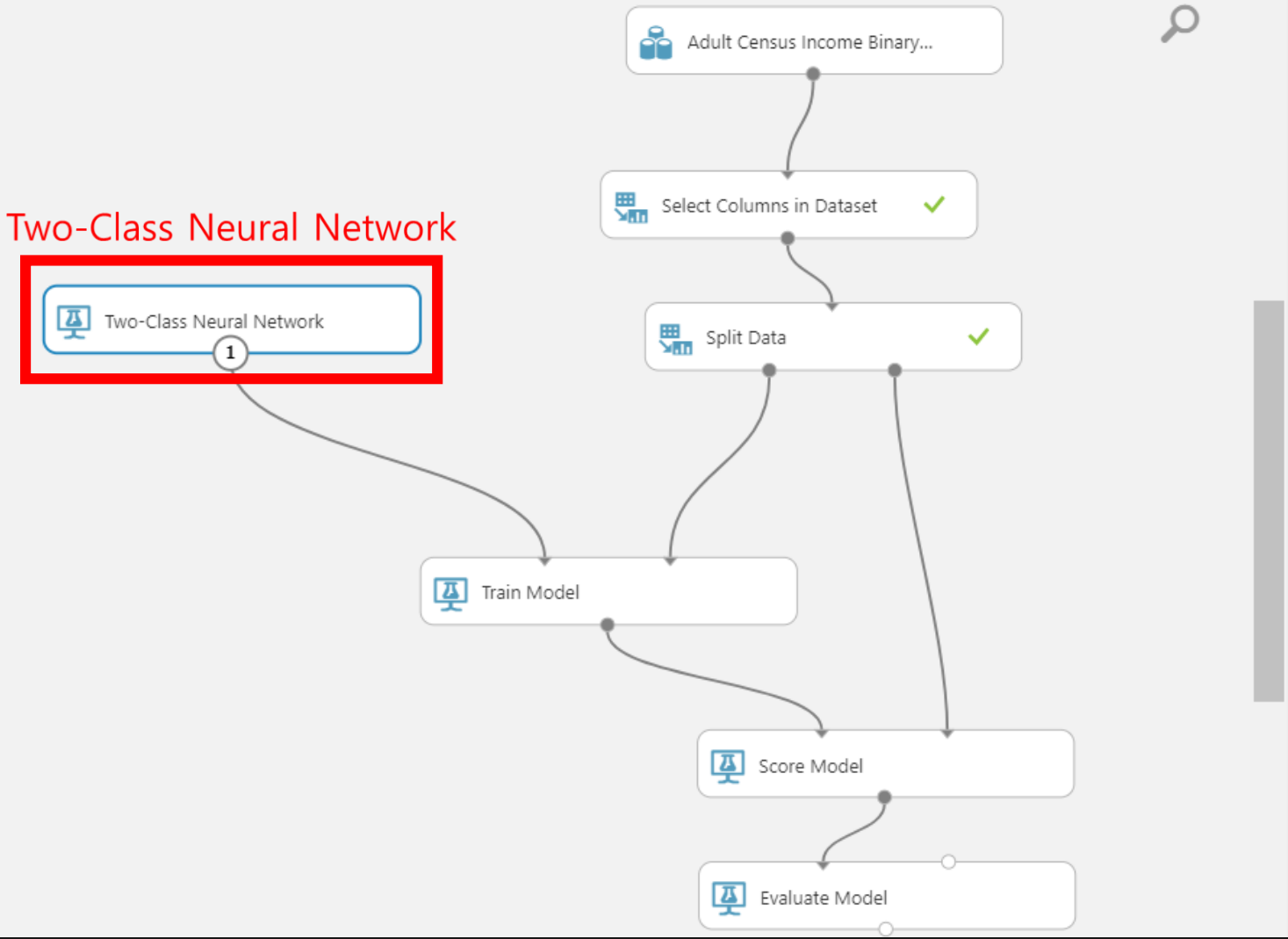
(more help...)

Training experiment | Predictive experiment

income prediction

In draft

Draft saved at 오전 12:21:59



Properties | Project

Single Parameter

Hidden layer specification

Fully-connected case

Number of hidden nodes

100

Learning rate

0.1

Number of learning iterations

100

The initial learning weights d...

0.1

The momentum

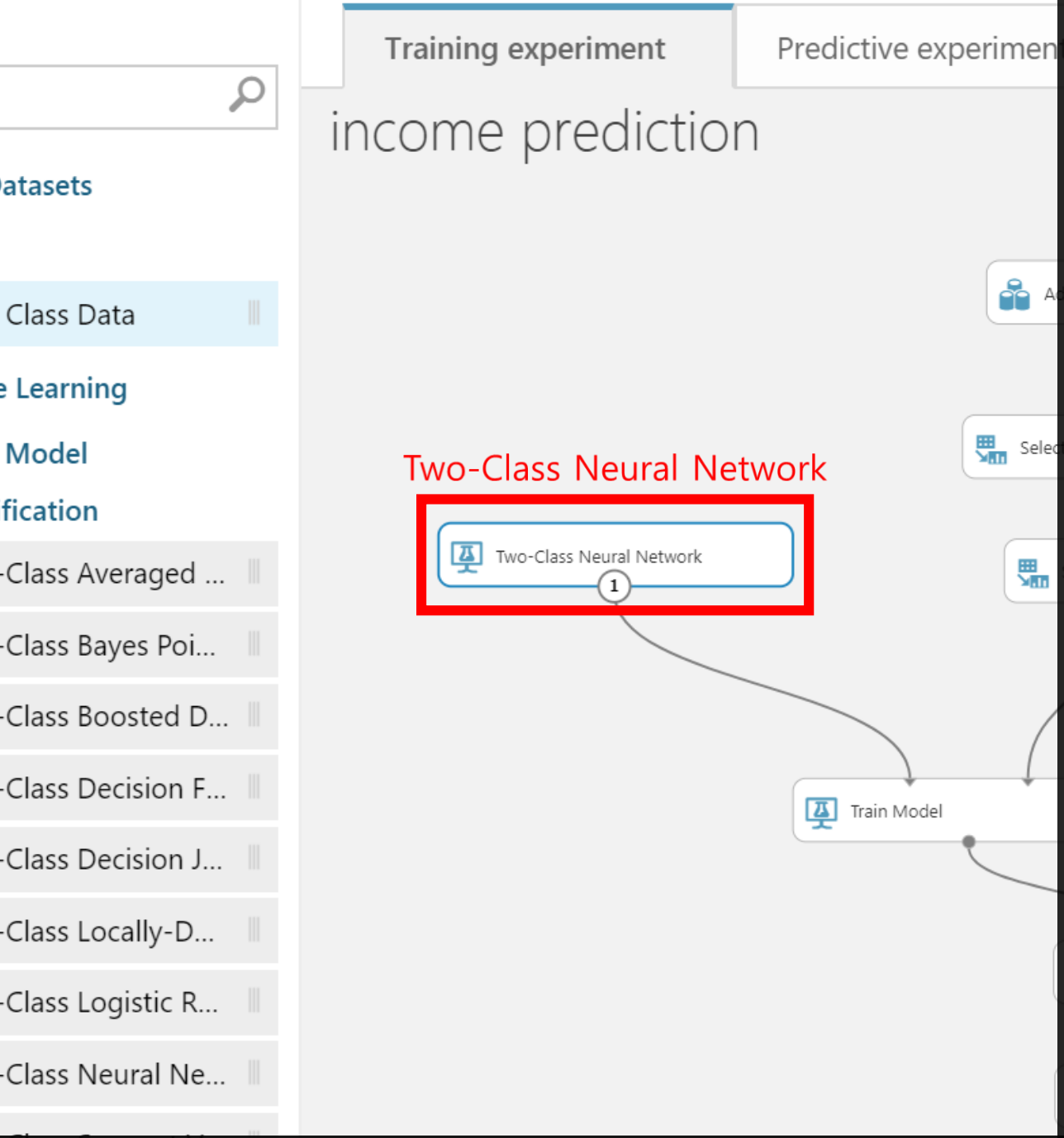
0

The type of normalizer

Min-Max normalizer

Shuffle examples

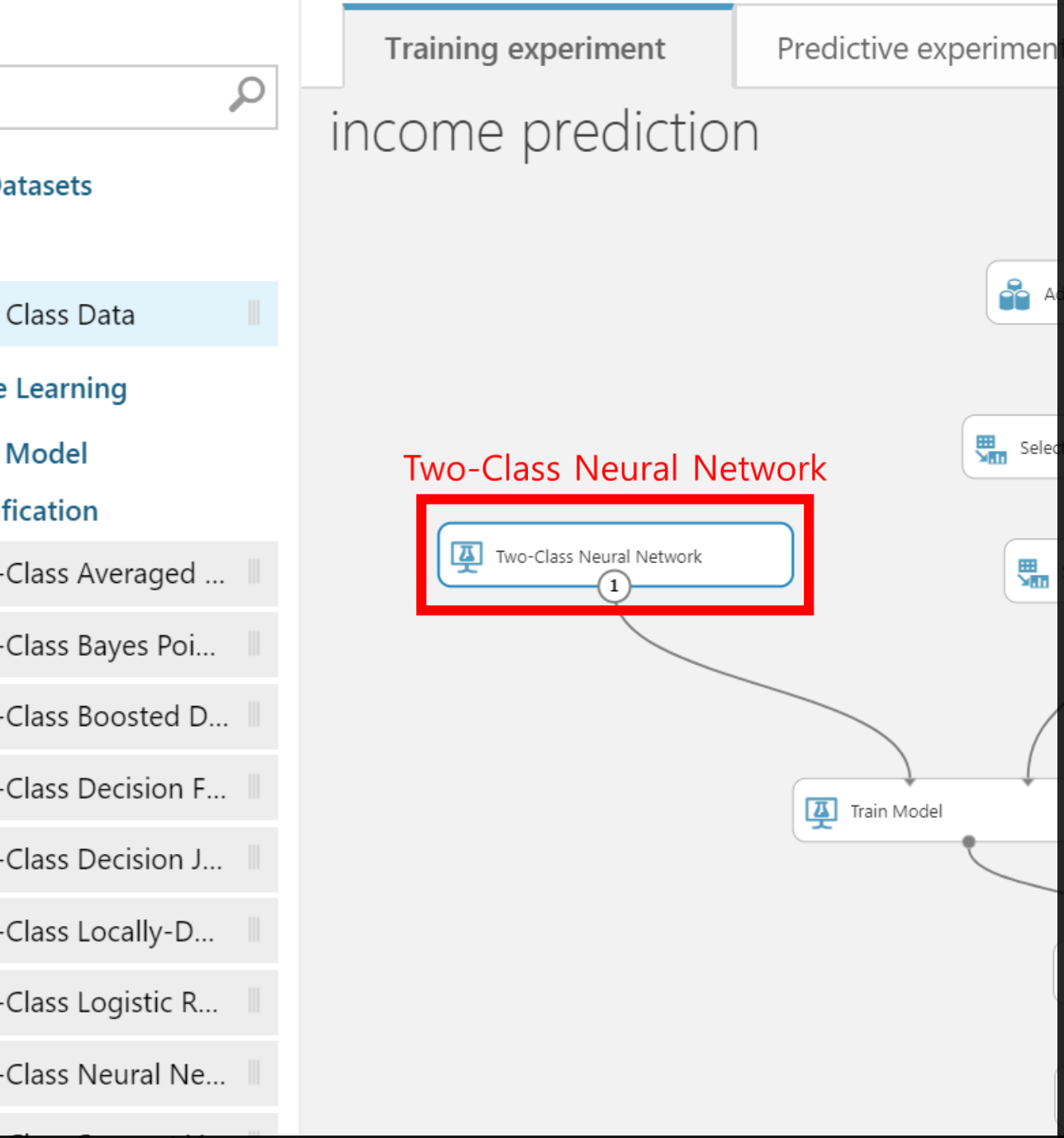
Random number seed



For Hidden layer specification, select the type of network architecture to create.

- Fully-connected case: Uses the default neural network architecture, defined for two-class neural networks as follows: 1) Has one hidden layer. 2) The output layer is fully connected to the hidden layer, and the hidden layer is fully connected to the input layer. 3) The number of nodes in the input layer equals the number of features in the training data. 4) The number of nodes equals the number of classes. For a two-class neural network, this means that all inputs must map to one of two nodes in the output layer.

ref. https://docs.microsoft.com/en-us/azure/machine-learning/studio-module-reference/two-class-neural-network



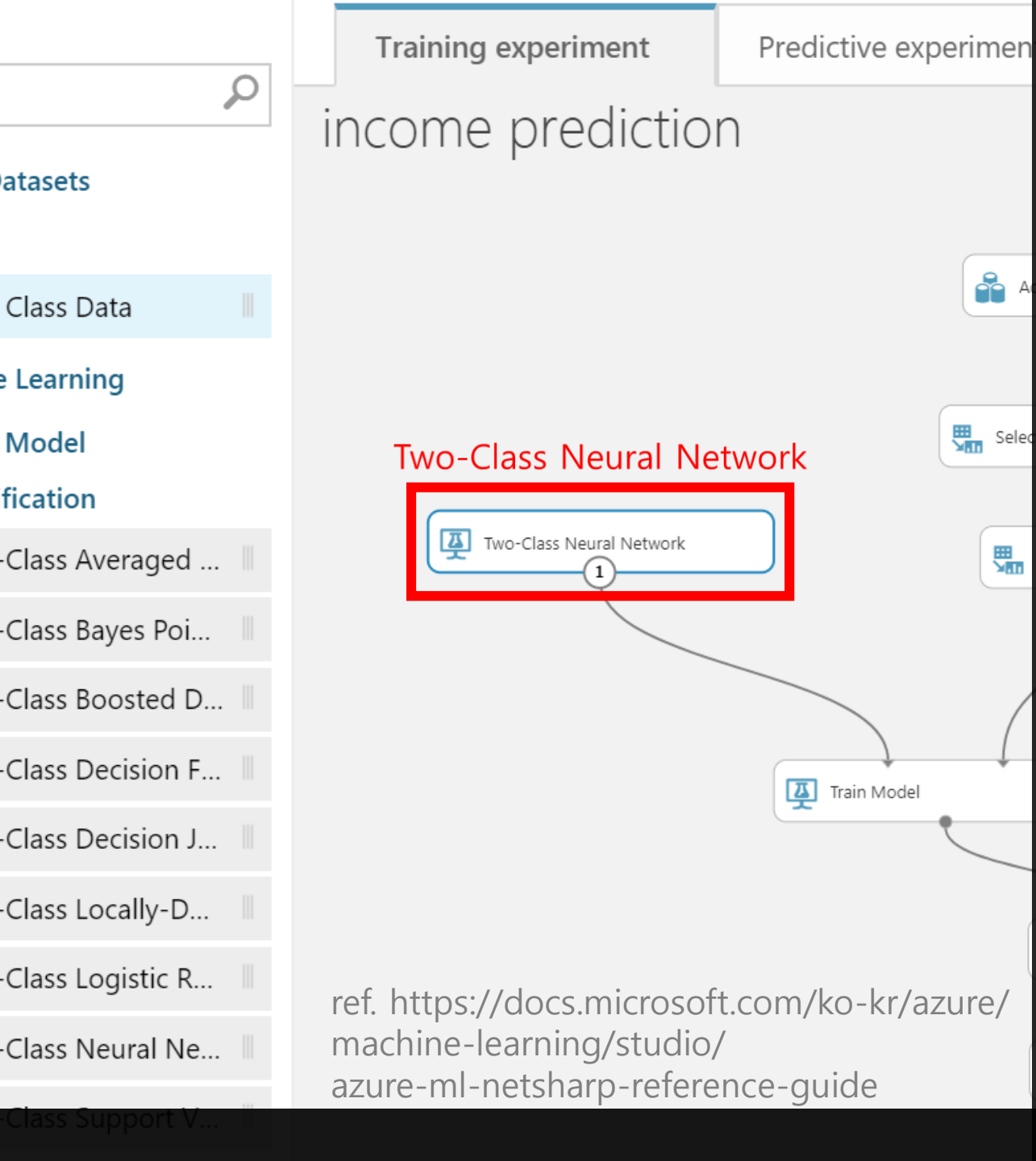
For Hidden layer specification, select the type of network architecture to create.

- Custom definition script: Choose this option to create a custom neural network architecture, using the **Net# language.** With this option, you can define the number of hidden layers, their connections, and the mappings between layers.

- After selecting the custom script option, in the Neural network definition text box, type or paste Net# statements that define the network.

ref. https://docs.microsoft.com/en-us/azure/machine-learning/studio-module-reference/two-class-neural-network#bkmk_Customizing

박상현 / twodude@naver.com / 010-2741-0064



ref. https://docs.microsoft.com/ko-kr/azure/machine-learning/studio/azure-ml-netsharp-reference-guide

Net# Language

```
input Data auto;
hidden Hidden[5,20] from Data all;
output Result[2] from Hidden all;
```

```
input Image [29, 29];
hidden Conv1 [5, 13, 13] from Image convolve
{
  InputShape  = [29, 29];
  KernelShape = [ 5,  5];
  Stride      = [ 2,  2];
  MapCount    = 5;
}
hidden Conv2 [50, 5, 5]
from Conv1 convolve
{
  InputShape  = [ 5, 13, 13];
  KernelShape = [ 1,  5,  5];
  Stride      = [ 1,  2,  2];
  Sharing     = [false, true, true];
  MapCount    = 10;
}
hidden Hid3 [100] from Conv2 all;
output Digit [10] from Hid3 all;
```

Experiments - Microsoft

https://studio.azureml.net/Home/ViewWorkspaceCached/eb7363718b1244efa2488083867403f4#Workspaces/Experiments/Experiment/eb7363718b1244efa24...

Microsoft Azure Machine Learning Studio

SangHyeon Park-Free-Wor...

jungle

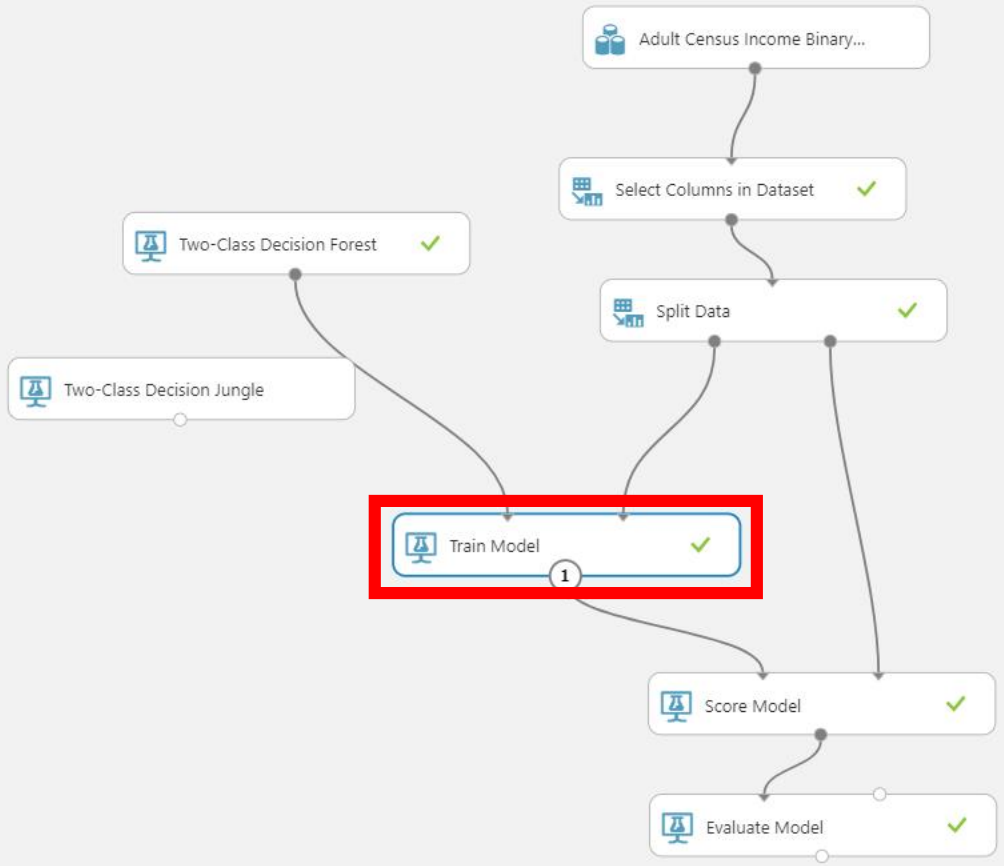
- Machine Learning
  - Initialize Model
    - Classification
      - Multiclass Decision J...
      - Two-Class Decision J...

Training experiment | Predictive experiment

income prediction

In draft

Draft saved at 오후 9:11:09



Properties | Project

Train Model

Label column

Selected columns:
Column names: income

Launch column selector

START TIME	5/4/2018 9:08:31...
END TIME	5/4/2018 9:08:31...
ELAPSED TIME	0:00:00.000
STATUS CODE	Finished
STATUS DETAILS	Task output was present in output cache

Quick Help

Train a previously created classification or regression model

Experiments - Microsoft

https://studio.azureml.net/Home/ViewWorkspaceCached/eb7363718b1244efa2488083867403f4#Workspaces/Experiments/Experiment/eb7363718b1244efa24...

Microsoft Azure Machine Learning Studio

SangHyeon Park-Free-Wor...

jungle

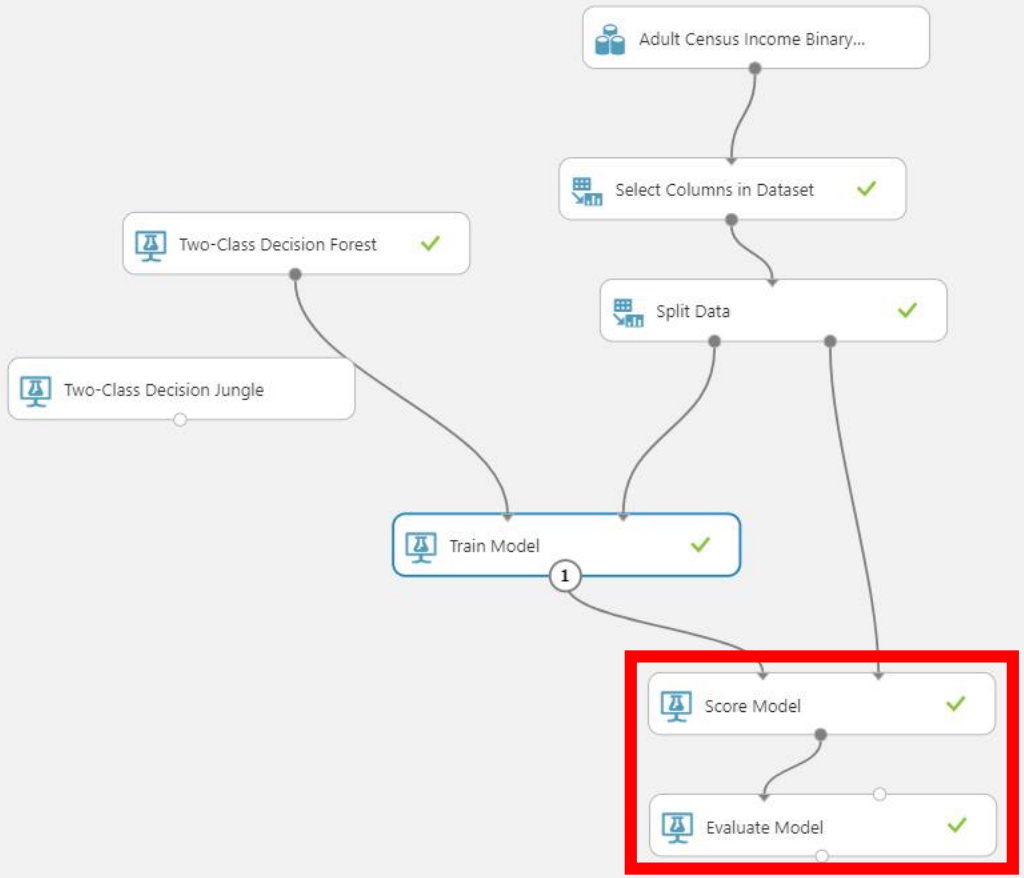
- Machine Learning
  - Initialize Model
    - Classification
      - Multiclass Decision J...
      - Two-Class Decision J...

Training experiment | Predictive experiment

income prediction

In draft

Draft saved at 오후 9:11:09



Properties | Project

Train Model

Label column

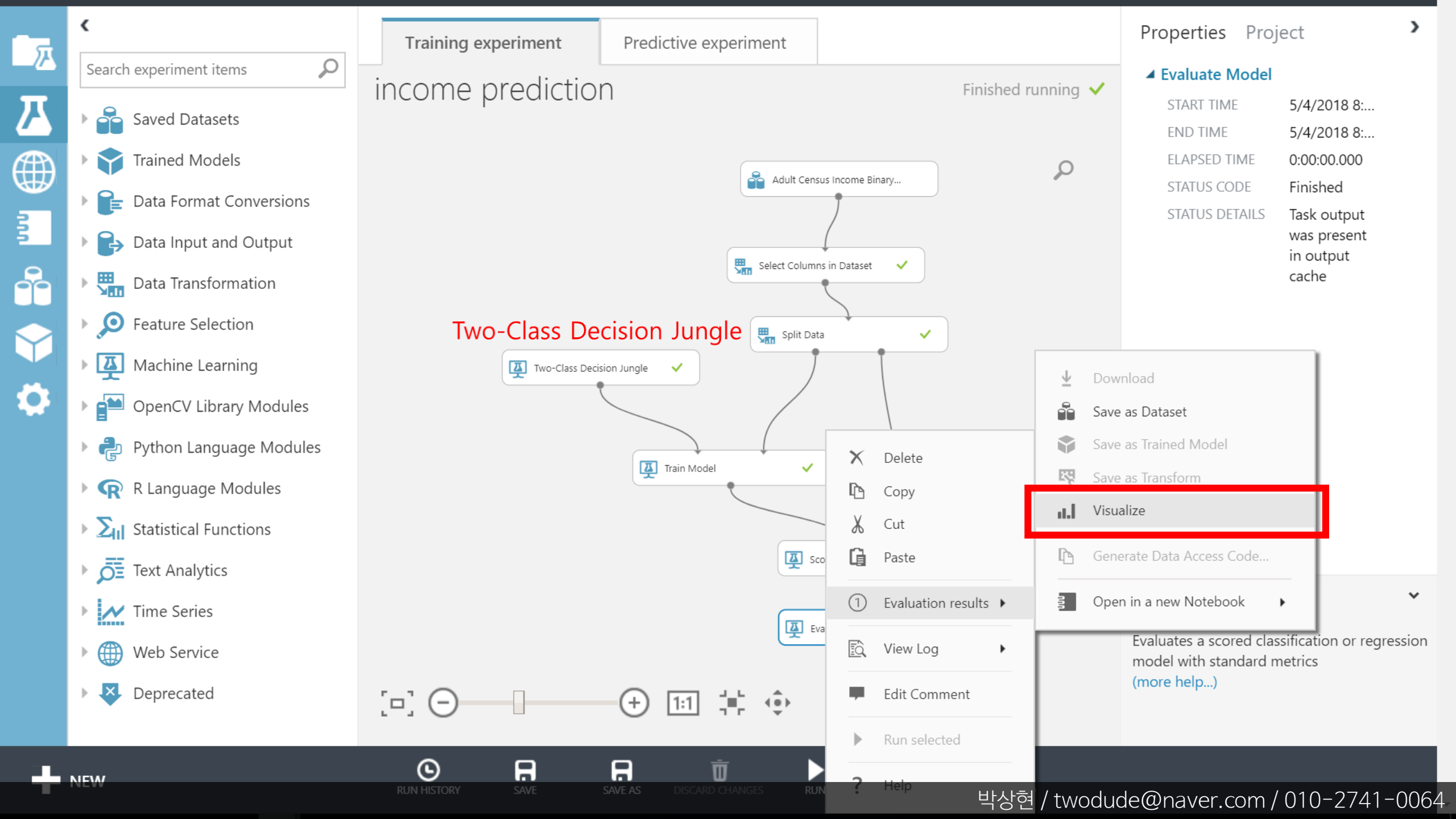
Selected columns:
Column names: income

Launch column selector

START TIME	5/4/2018 9:08:31...
END TIME	5/4/2018 9:08:31...
ELAPSED TIME	0:00:00.000
STATUS CODE	Finished
STATUS DETAILS	Task output was present in output cache

Quick Help

Train a previously created classification or regression model



income prediction › Evaluate Model › Evaluation results

Predict Class

True Class

Two-Class Decision Jungle

True Positive	False Negative	Accuracy	Precision	Threshold	AUC
1050	1330	0.819	0.706	0.5	0.873

False Positive	True Negative	Recall	F1 Score
437	6951	0.441	0.543

Positive Label	Negative Label
>50K	<=50K

- **Measuring classifier performance**

  Sensitivity = TP / (TP + FN) = (Number of true positive assessment)/(Number of all positive assessment)

  Specificity = TN / (TN + FP) = (Number of true negative assessment)/(Number of all negative assessment)

  Accuracy = (TN + TP) / (TN+TP+FN+FP) = (Number of correct assessments)/Number of all assessments)

Score Bin	Positive Examples								
(0.900,1.000]	0								
(0.800,0.900]	166	27	0.020	0.771	0.129	0.860	0.070	0.769	0.996	0.000
(0.700,0.800]	470	149	0.083	0.803	0.398	0.783	0.267	0.805	0.976	0.004
(0.600,0.700]	312	157	0.131	0.819	0.518	0.740	0.398	0.831	0.955	0.011
(0.500,0.600]	102	104	0.152	0.819	0.543	0.706	0.441	0.839	0.941	0.017
(0.400,0.500]	543	548	0.264	0.819	0.643	0.618	0.669	0.891	0.867	0.059
(0.300,0.400]	372	814	0.385	0.773	0.640	0.522	0.826	0.931	0.756	0.142
(0.200,0.300]	153	503	0.452	0.738	0.623	0.479	0.890	0.951	0.688	0.201
(0.100,0.200]	140	914	0.560	0.658	0.575	0.412	0.949	0.972	0.565	0.315
(0.000,0.100]	122	4172	1.000	0.244	0.392	0.244	1.000	1.000	0.000	0.873

Properties Project

income prediction › Evaluate Model › Evaluation results

Two-Class Neural Network

True Positive	False Negative	Accuracy	Precision	Threshold	AUC
1240	1093	0.825	0.680	0.5	0.870

False Positive	True Negative	Recall	F1 Score
583	6675	0.532	0.597

Positive Label	Negative Label
>50K	<=50K

Score Bin	Positive Examples	Negative Examples	Fraction Above Threshold	Accuracy	F1 Score	Precision	Recall	Negative Precision	Negative Recall	Cumulative AUC
(0.900,1.000]	164	36	0.021	0.770	0.129	0.820	0.070	0.769	0.995	0.000
(0.800,0.900]	277	78	0.058	0.791	0.305	0.795	0.189	0.791	0.984	0.002
(0.700,0.800]	385	146	0.113	0.816	0.483	0.761	0.354	0.823	0.964	0.007
(0.600,0.700]	122	70	0.133	0.821	0.525	0.742	0.406	0.833	0.955	0.011
(0.500,0.600]	292	253	0.190	0.825	0.597	0.680	0.532	0.859	0.920	0.028
(0.400,0.500]	377	493	0.281	0.813	0.643	0.600	0.693	0.896	0.852	0.070
(0.300,0.400]	214	365	0.341	0.797	0.653	0.560	0.785	0.921	0.801	0.107
(0.200,0.300]	150	500	0.409	0.761	0.633	0.505	0.849	0.938	0.733	0.163
(0.100,0.200]	166	722	0.502	0.703	0.601	0.446	0.920	0.961	0.633	0.252
(0.000,0.100]	186	4595	1.000	0.243	0.391	0.243	1.000	1.000	0.000	0.870

Web services - Microsof

안전함 | https://studio.azureml.net/Home/ViewWorkspaceCached/eb7363718b1244efa248808 .azureml.net/Home/ViewWorkspaceCached/eb7363718b1244efa2488083867403f4#Workspaces/Experiments/E

Microsoft Azure Machine Learning Studio

arning Studio

SangHyeon Park-Free-Wor...

income prediction [predictive exp.]

DASHBOARD CONFIGURATION

General New Web Services Experience preview

Published experiment

View snapshot View latest

Description

No description provided for this web service.

API key

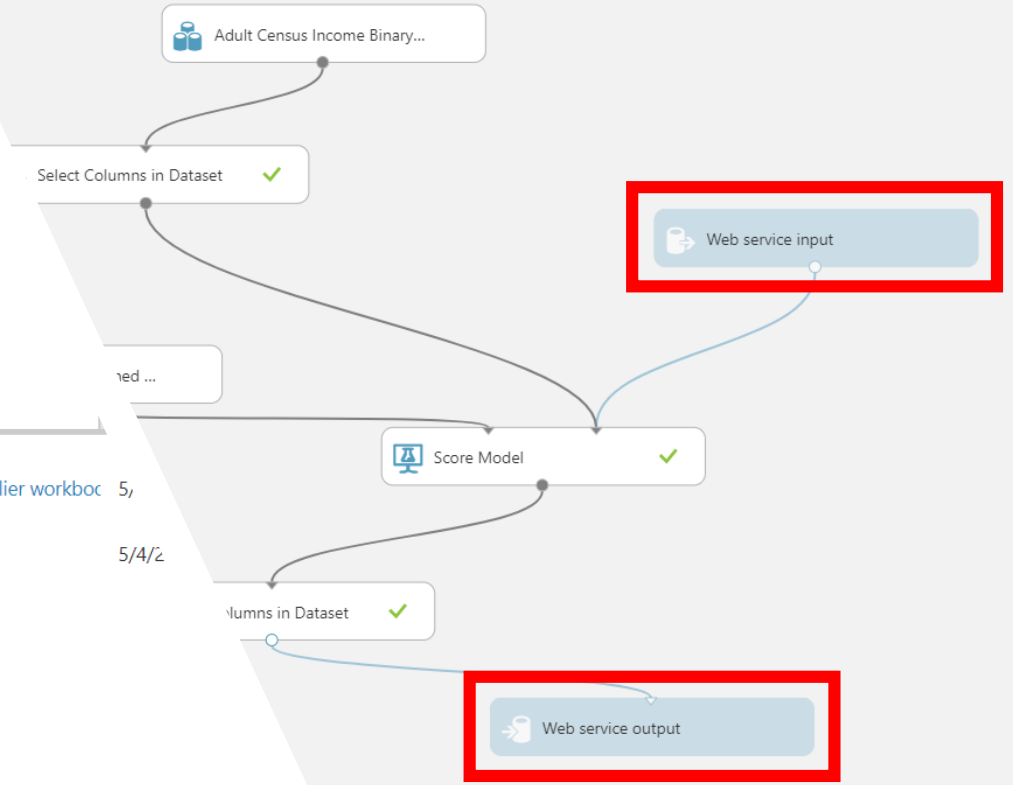
f/zO67+gayAB7wazqghXWSeqYkDQc4kzK1r0JM+0yWC5Rd8xNX7zUlEPDldtcNSUny3YBeWIqOTaUlGM9tNVbw==

Default Endpoint

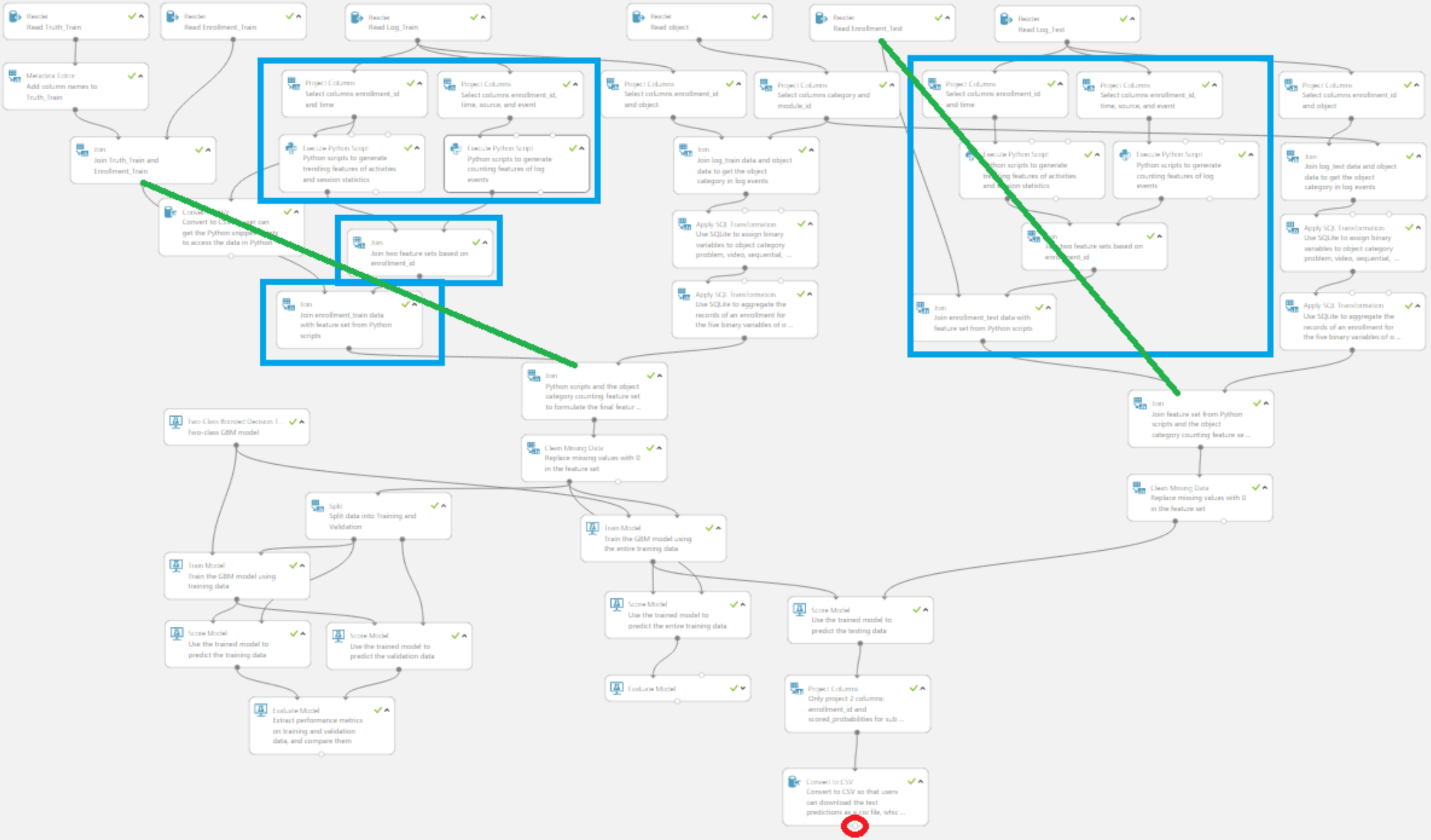
API HELP PAGE	TEST	APPS
REQUEST/RESPONSE	Test Test preview	Excel 2013 or later | Excel 2010 or earlier workboc 5/
BATCH EXECUTION	Test preview	Excel 2013 or later workbook 5/4/2

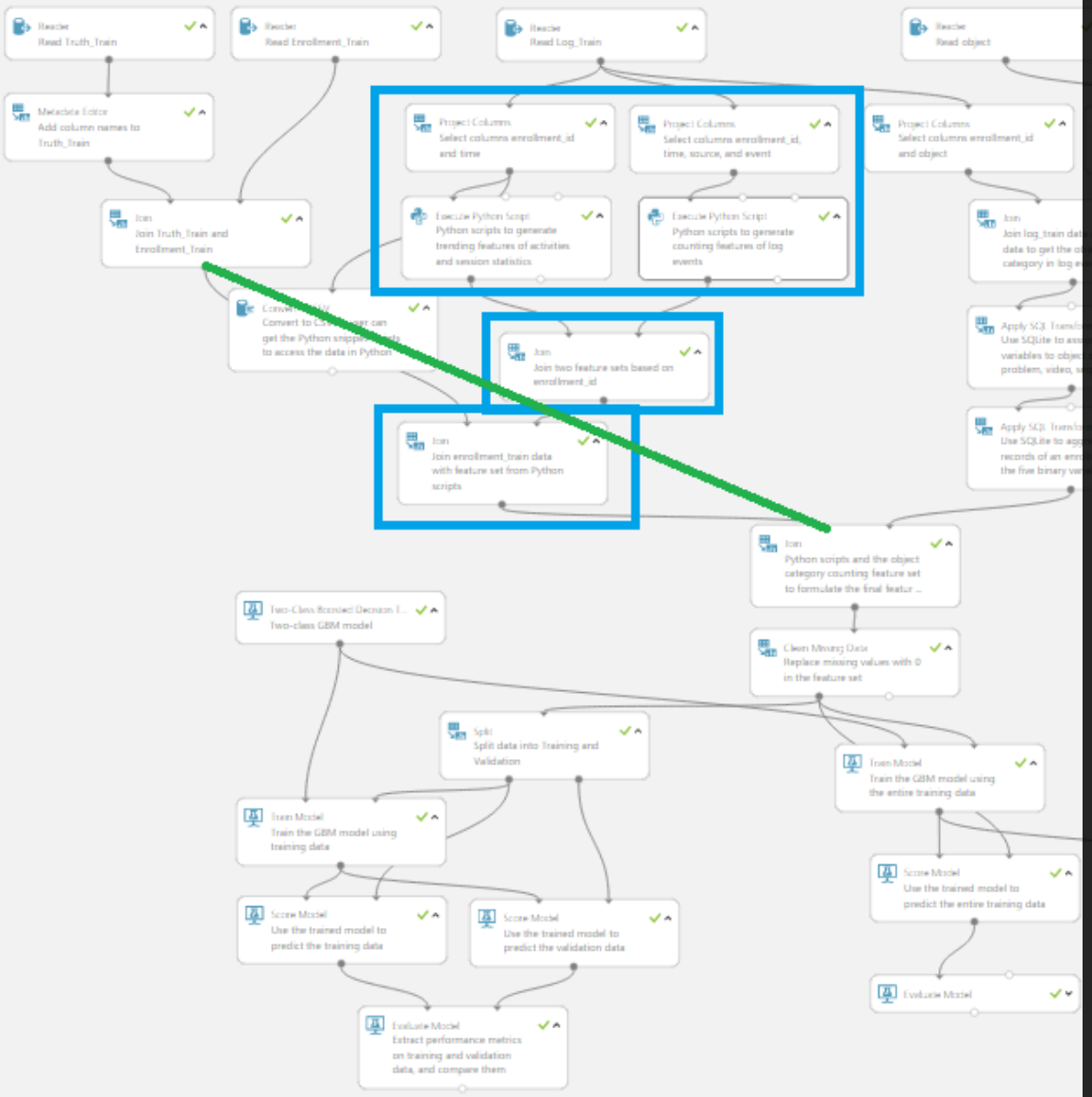
Predictive experiment

redictive Exp.]



NEW DELETE


Reader
Read Truth_Train
Reader
Read Enrollment_Train
Reader
Read Log_Train
Reader
Read object
Reader
Read Enrollment_Test
Reader
Read Log_Test
Metadata Editor
Add column names to Truth_Train
Project Columns
Select columns enrollment_id and time
Project Columns
Select columns enrollment_id, time, source, and event
Project Columns
Select columns enrollment_id and object
Project Columns
Select columns category and module_id
Project Columns
Select columns enrollment_id and time
Project Columns
Select columns enrollment_id, time, source, and event
Project Columns
Select columns enrollment_id and object
Join
Join Truth_Train and Enrollment_Train
Execute Python Script
Python scripts to generate trending features of activities and session statistics
Execute Python Script
Python scripts to generate counting features of log events
Join
Join log_train data and object data to get the object category in log events
Execute Python Script
Python scripts to generate trending features of activities and session statistics
Execute Python Script
Python scripts to generate counting features of log events
Join
Join log_test data and object data to get the object category in log events
Convert to CSV
Convert to CSV so that users can get the Python snippet directly to access the data in Python
Join
Join two feature sets based on enrollment_id
Apply SQL Transformation
Use SQLite to assign binary variables to object category problem, video, sequential, ...
Join
Join two feature sets based on enrollment_id
Apply SQL Transformation
Use SQLite to assign binary variables to object category problem, video, sequential, ...
Join
Join enrollment_train data with feature set from Python scripts
Apply SQL Transformation
Use SQLite to aggregate the records of an enrollment for the five binary variables of o ...
Join
Join enrollment_test data with feature set from Python scripts
Apply SQL Transformation
Use SQLite to aggregate the records of an enrollment for the five binary variables of o ...
Join
Python scripts and the object category counting feature set to formulate the final featur ...
Join
Join feature set from Python scripts and the object category counting feature se ...
Two-Class Boosted Decision T...
Two-class GBM model
Clean Missing Data
Replace missing values with 0 in the feature set
Clean Missing Data
Replace missing values with 0 in the feature set
Split
Split data into Training and Validation
Train Model
Train the GBM model using the entire training data
Train Model
Train the GBM model using training data
Score Model
Use the trained model to predict the entire training data
Score Model
Use the trained model to predict the testing data
Score Model
Use the trained model to predict the training data
Score Model
Use the trained model to predict the validation data
Evaluate Model
Project Columns
Only project 2 columns: enrollment_id and scored_probabilities for sub ...
Evaluate Model
Extract performance metrics on training and validation data, and compare them
Convert to CSV
Convert to CSV so that users can download the test predictions as a csv file, whic ...



Solving the KDD Cup 2015 Challenge Using Azure ML

- High version
  (AUC=0.873, running time = ~2 hours)

- Low version
  (AUC=0.853, running time = ~18 mins)

ref. https://blogs.technet.microsoft.com/machinelearning/2015/06/24/solving-the-kdd-cup-2015-challenge-using-azure-ml/

박상현 / twodude@naver.com / 010-2741-0064

인 공 지 능

人工知能

Artificial Intelligence, AI

박상현 / twodude@naver.com / 010-2741-0064