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*International College of Semiconductor Technology*

**國立陽明交通大學**

NATIONAL YANG MING CHIAO TUNG UNIVERSITY



# Midterm Report

**2023.04.25**

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# Projectile Motion

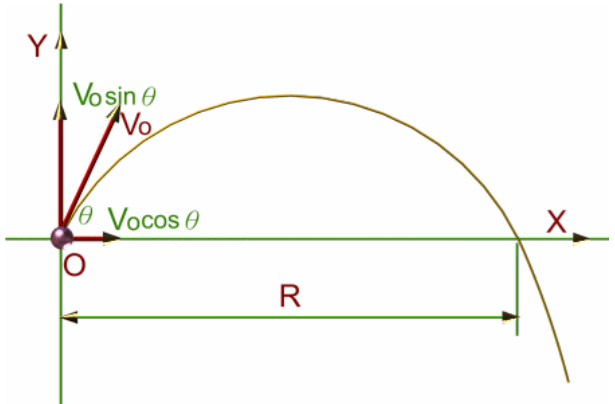
- **Data Preparation / Model**
- **Variables**
  1. Learning rate
  2. Epoch
  3. Layer numbers
  4. Neuron numbers
- **Results**
  1. True value-Prediction Scatter
  2. Loss / Accuracy



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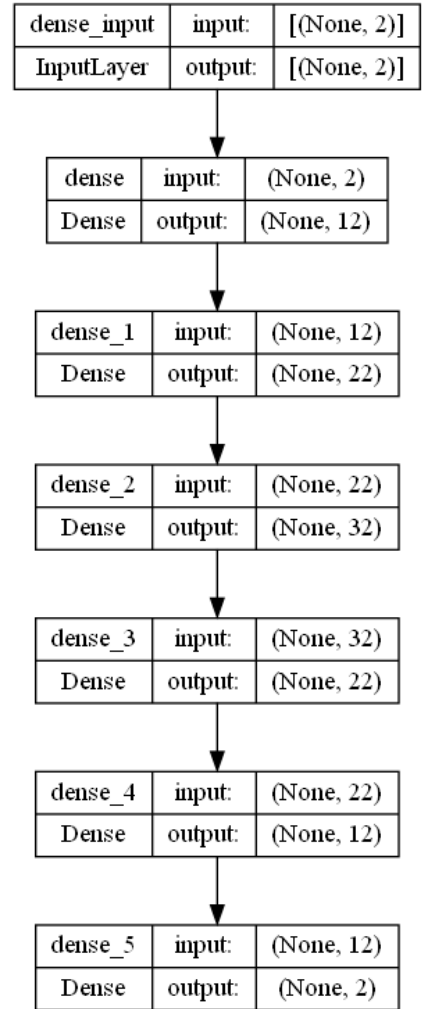
# ➤ Data preparation / Model

- Formula



$$R = \frac{V_0^2 \sin 2\theta}{g}$$
$$H = \frac{(V_0 \sin \theta)^2}{2g}$$

- Model



- ✓ Optimizer = Adam
- ✓ Learning = 0.001(default)
- ✓ Hidden layer = 5

- Dataset

$V_0$  : 1~100m/s , total 200 points  
 $\theta$  : 0~90度 , total 200 points  
Initial data : 40000

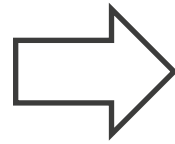
◆ **Variables : Learning rate**

**1. Learning rate = 0.0001**

**2. Learning rate = 0.001**

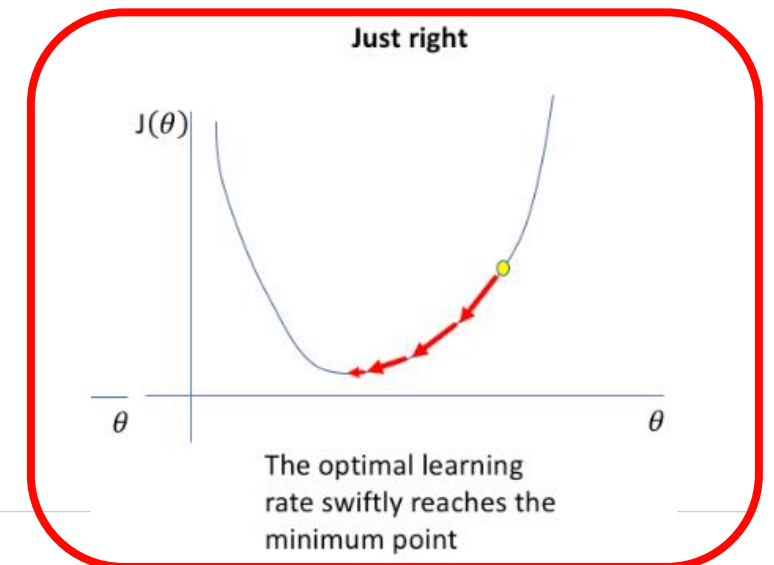
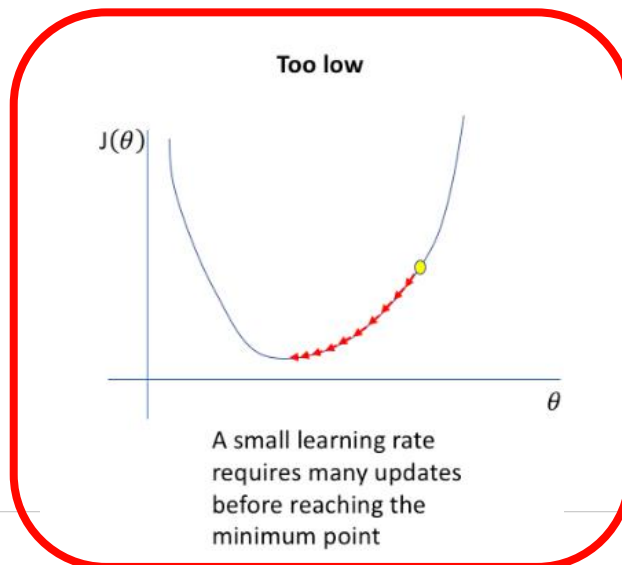
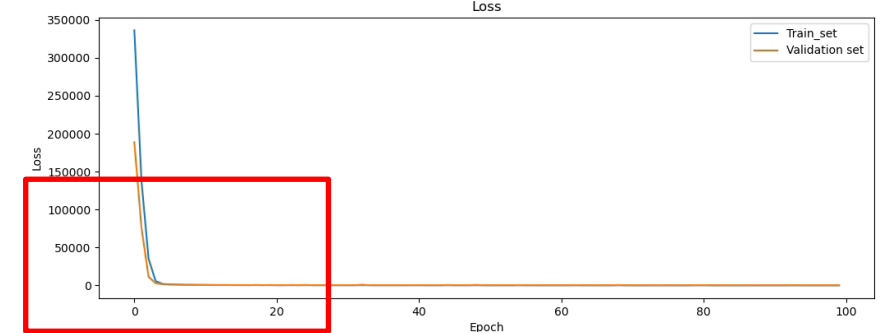
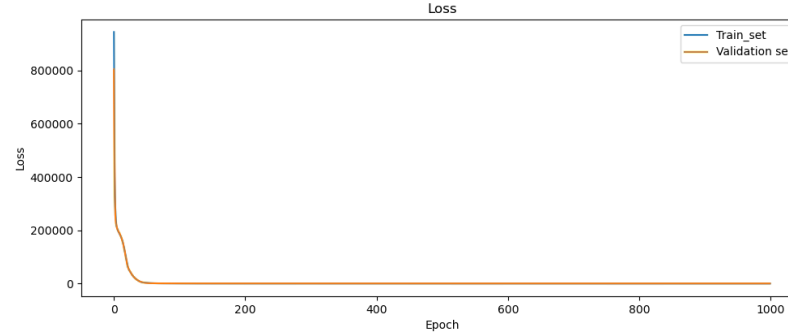
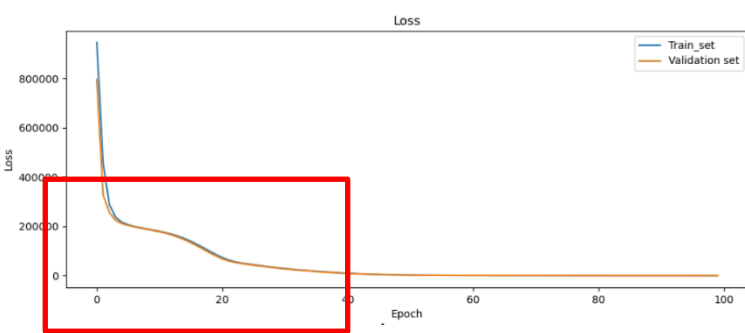
# Variables \_ Learning rate (Adam) \_ Loss / Accuracy

- Learning rate = 0.0001  
Epoch = 100



- Learning rate = 0.0001  
Epoch = 1000

- Learning rate = 0.001  
Epoch = 100



# Variables \_ Learning rate (Adam) \_ Scatter

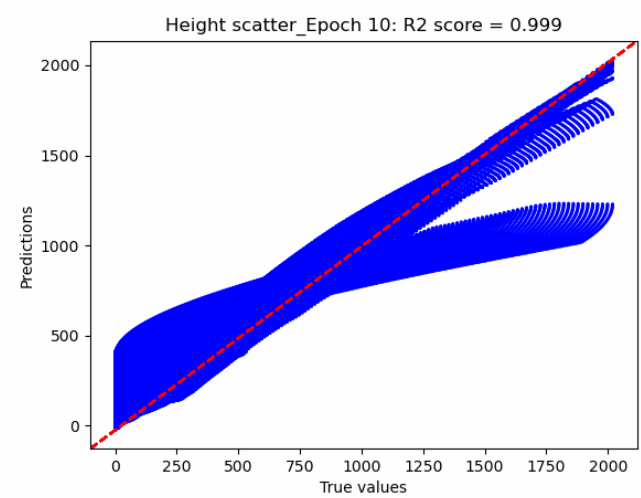
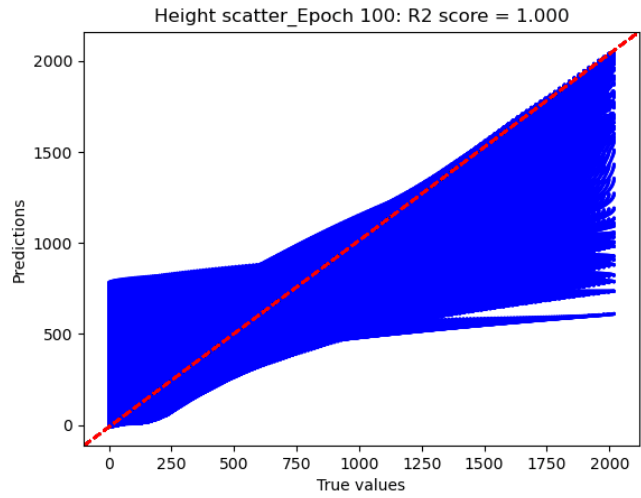
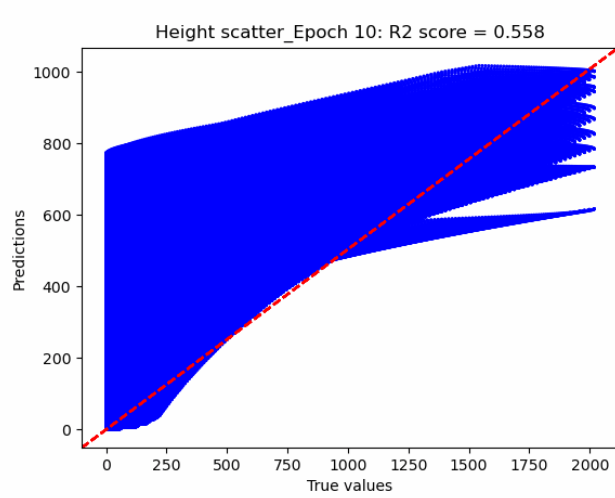


- Learning rate = 0.0001  
Epoch = 100

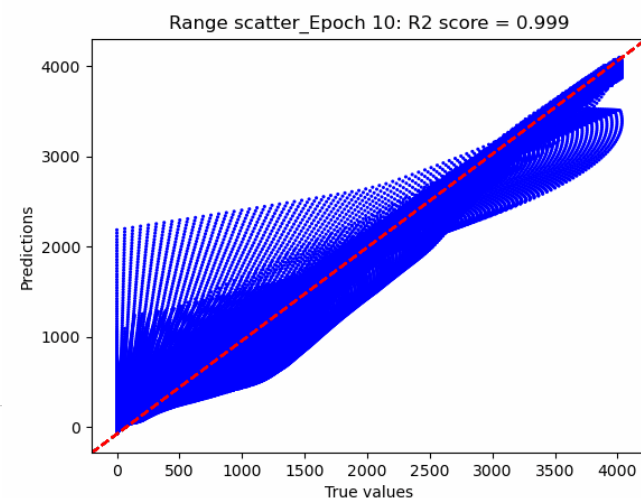
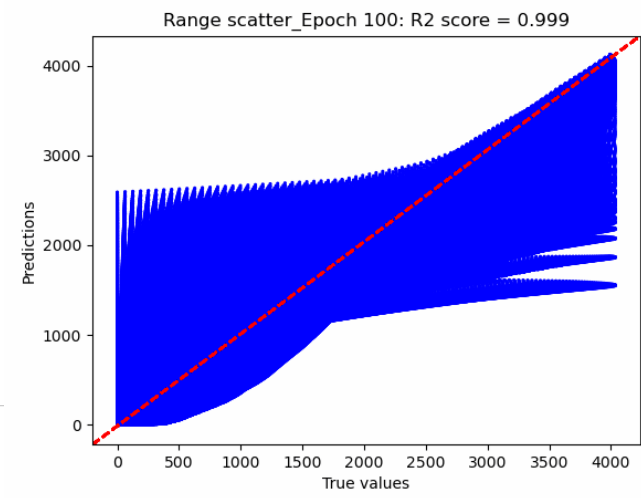
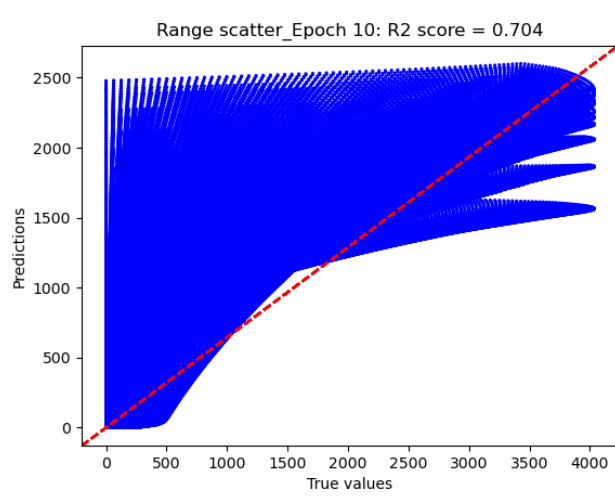
- Learning rate = 0.001  
Epoch = 100

- Learning rate = 0.0001  
Epoch = 1000

H



R



## ◆ Variables : Epoch

1. Epoch = 100

2. Epoch = 1000

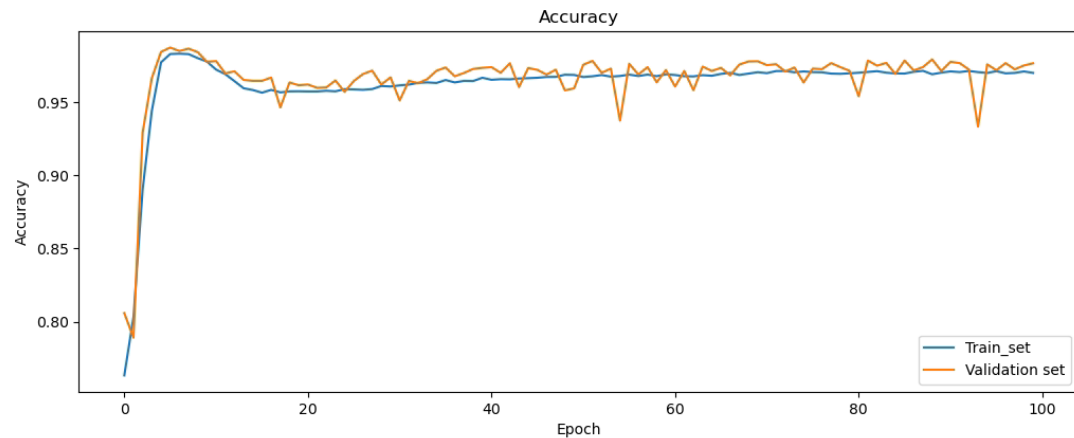
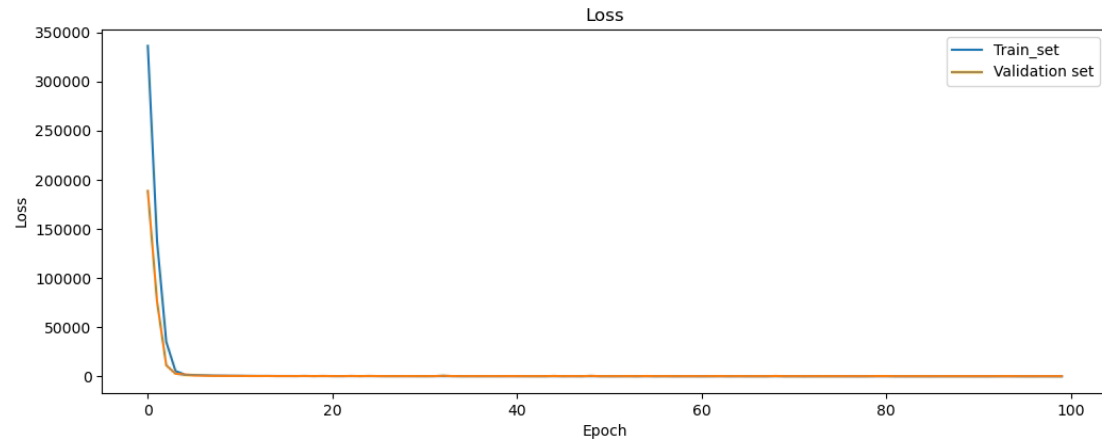


# Variables \_ Epoch \_ Loss / Accuracy

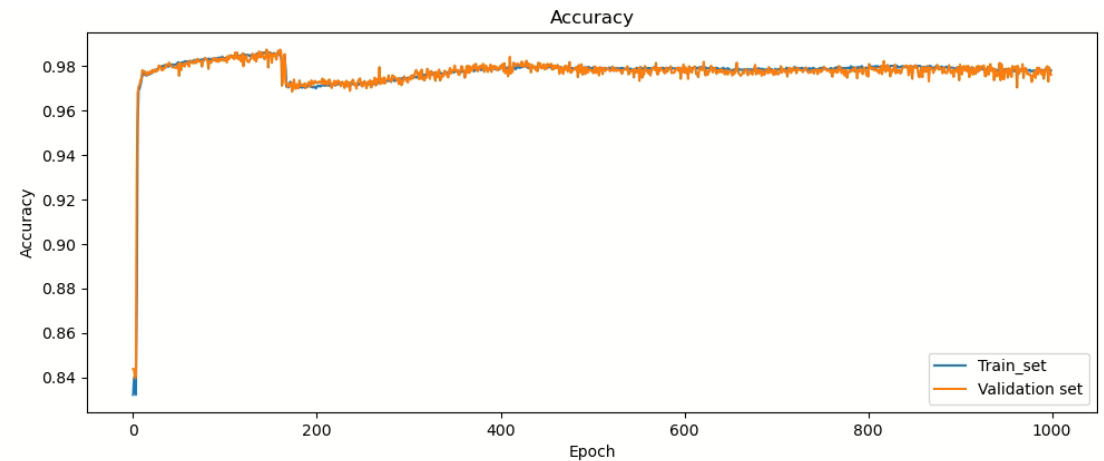
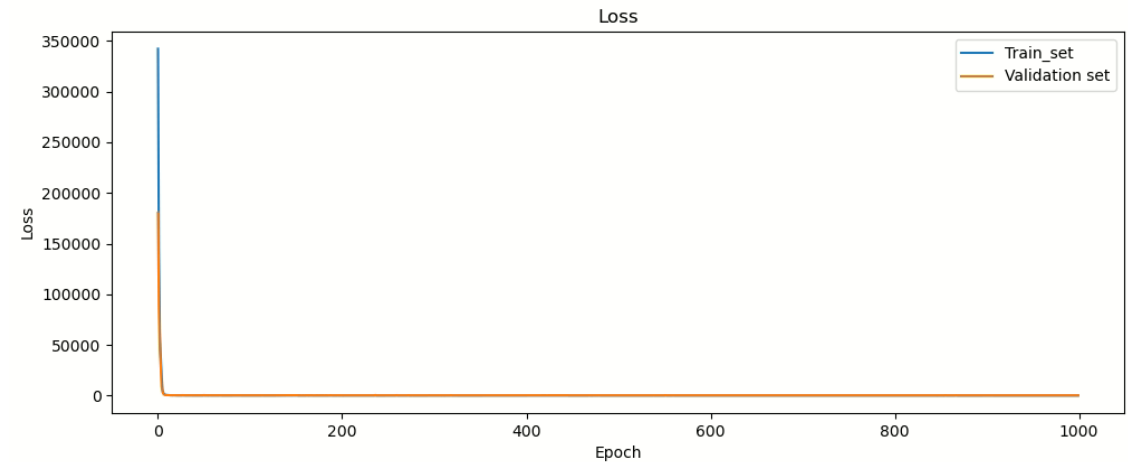


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- Epoch = 100



- Epoch = 1000



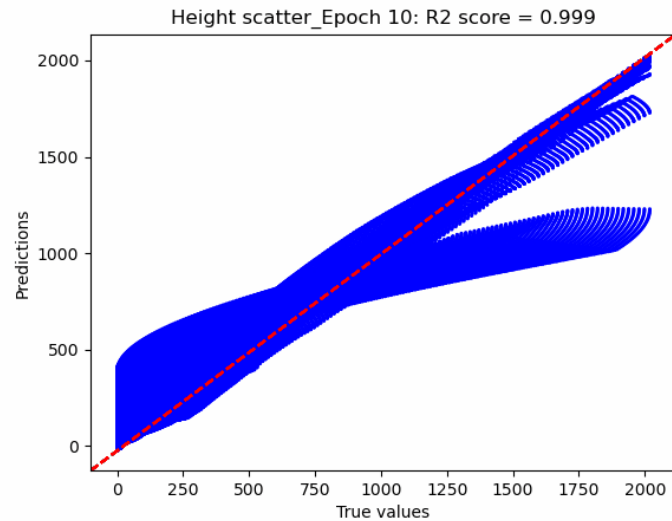


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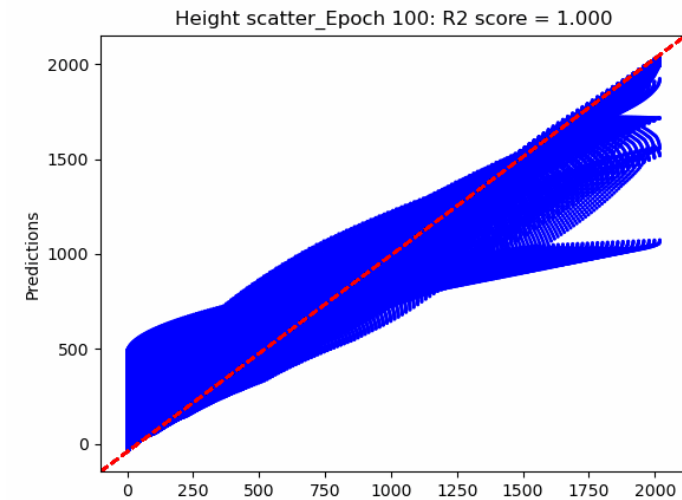
# Variables \_ Epoch \_ Scatter

- Epoch = 100

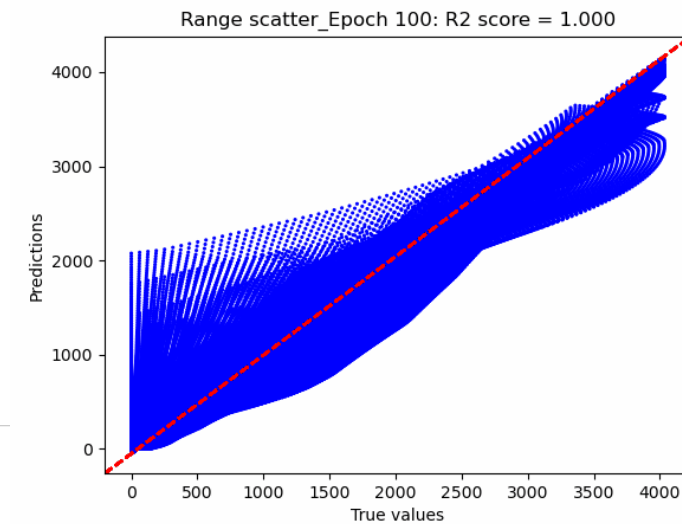
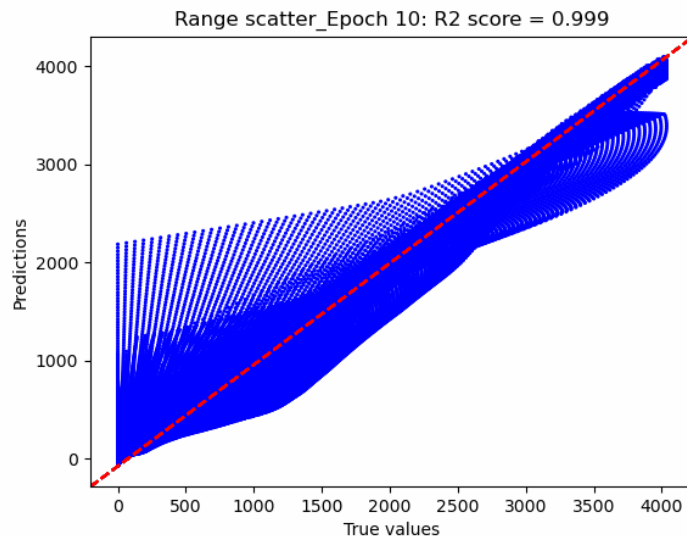
Height



- Epoch = 1000



Range



◆ **Variables : Layer numbers (add 5 Neuron / layer)**

**1. Hidden layers = 1**

**2. Hidden layers = 3**

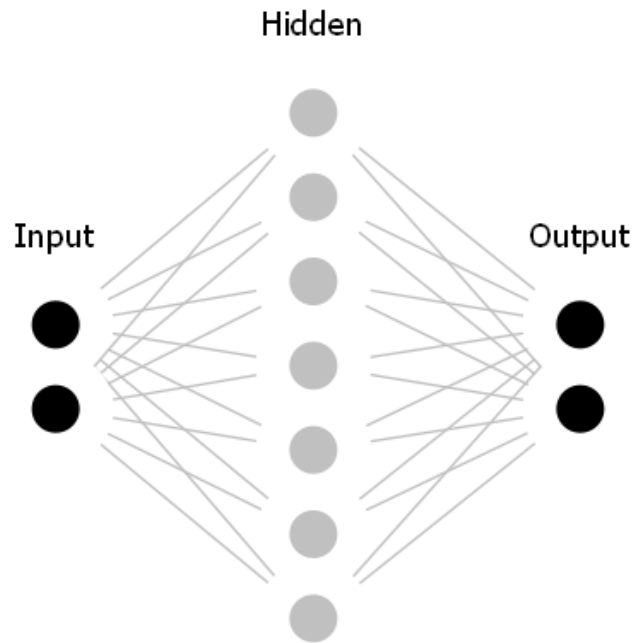
**3. Hidden layers = 5**

# Layer numbers\_(Epoch=500)

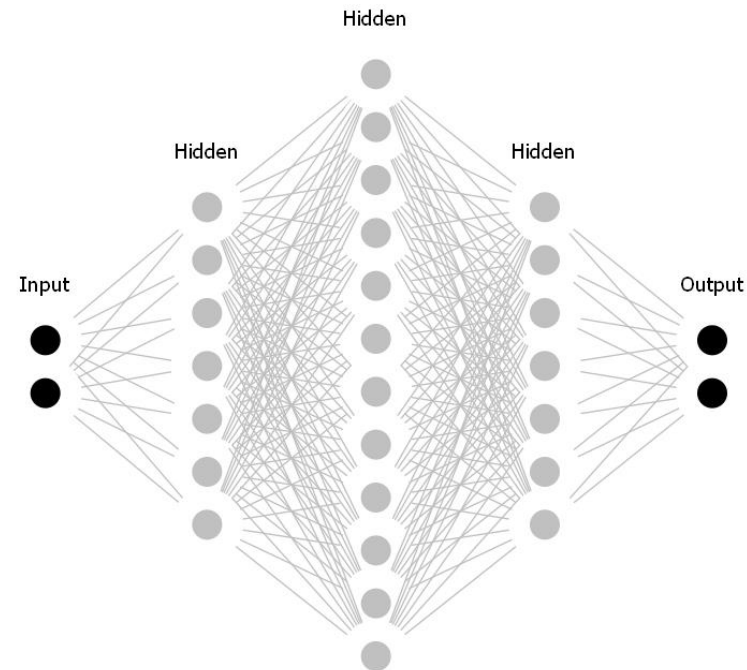


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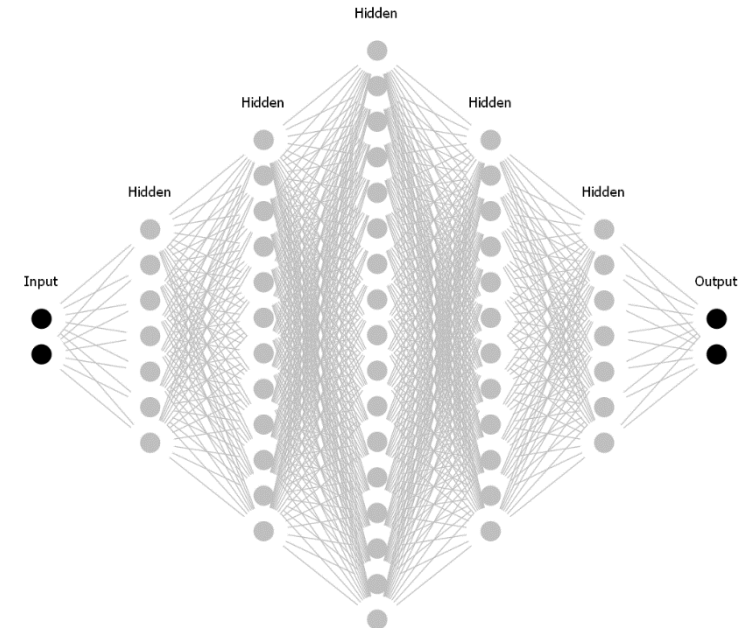
## 1 Hidden layers



## 3 Hidden layers



## 5 Hidden layers

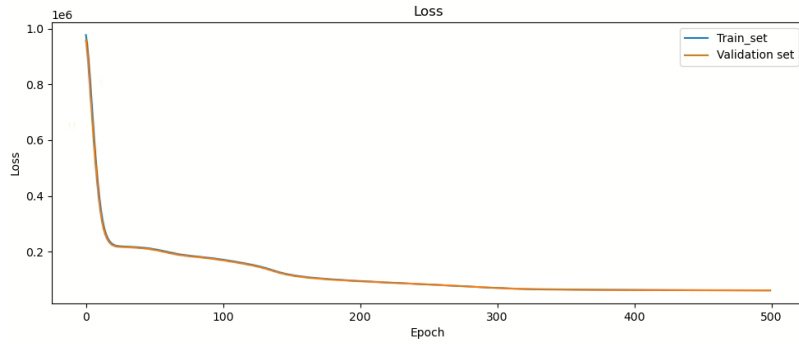


# Layer numbers\_ Loss / Accuracy

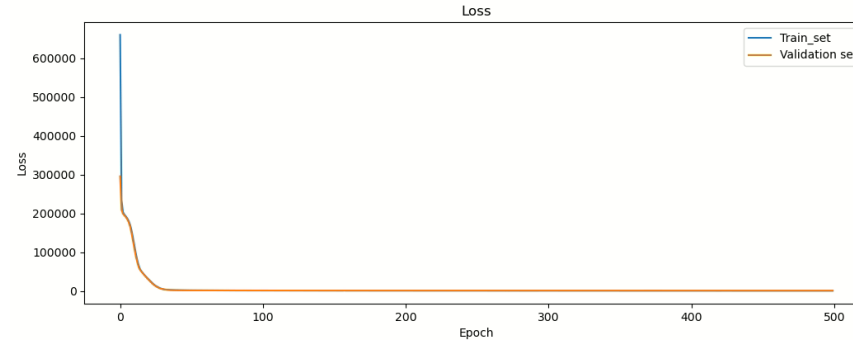


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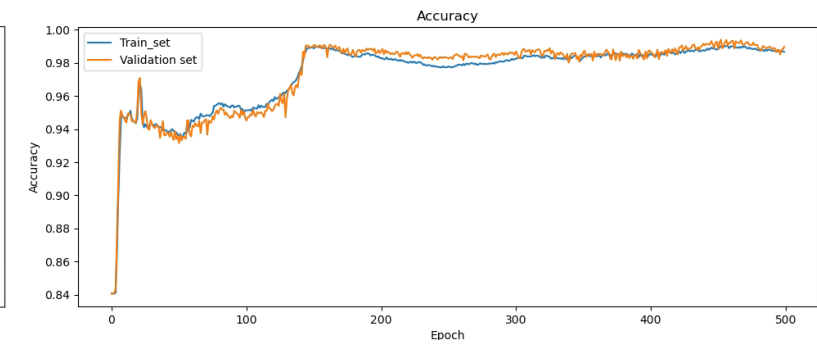
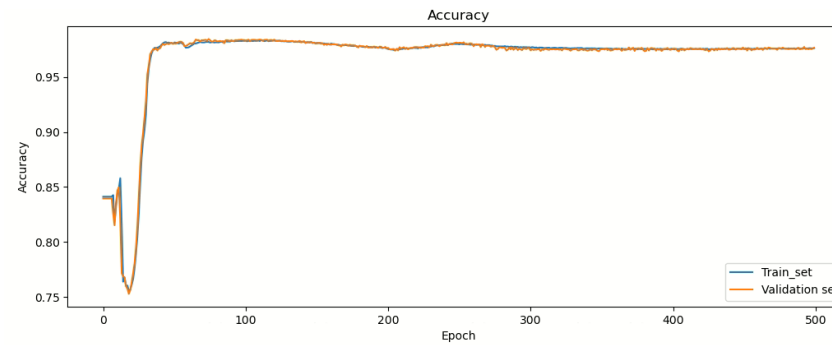
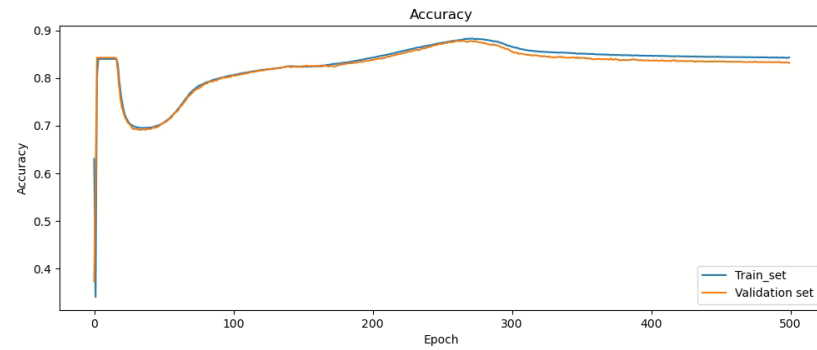
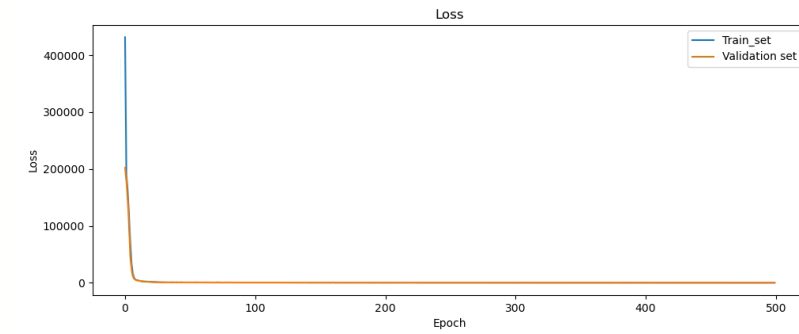
## 1 Hidden layers



## 3 Hidden layers



## 5 Hidden layers

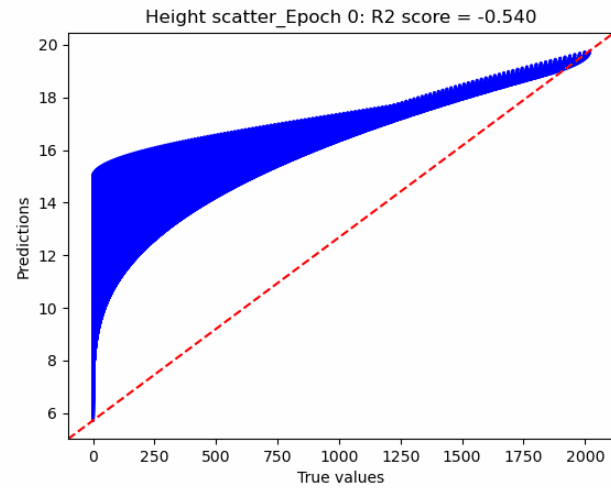




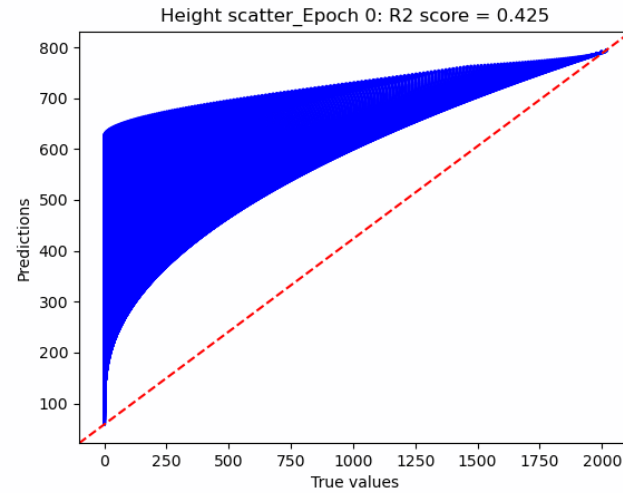
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# Layer numbers\_Scatter

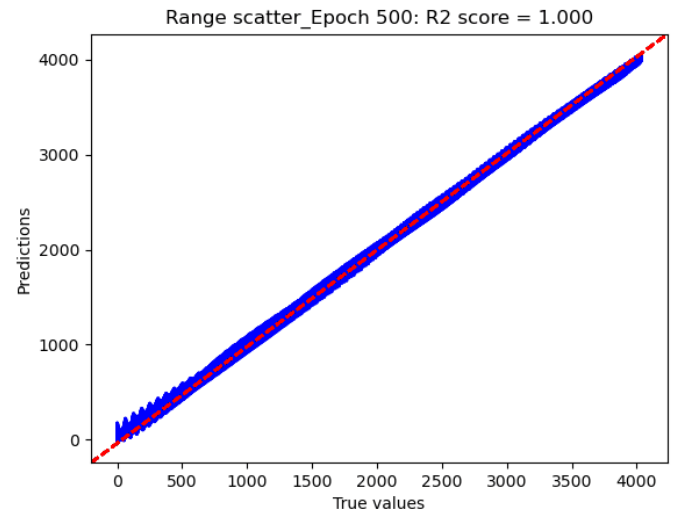
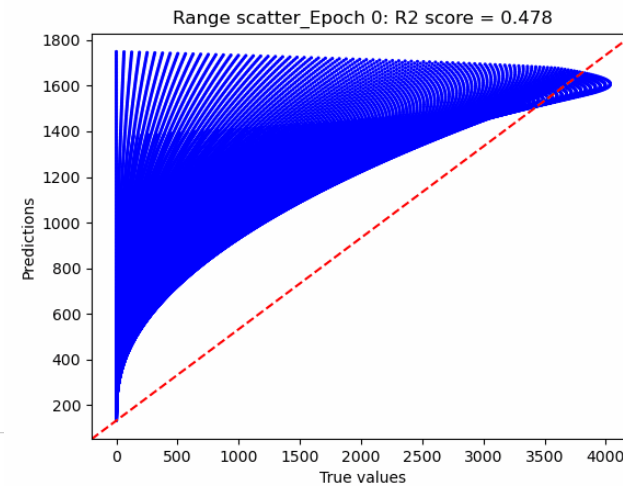
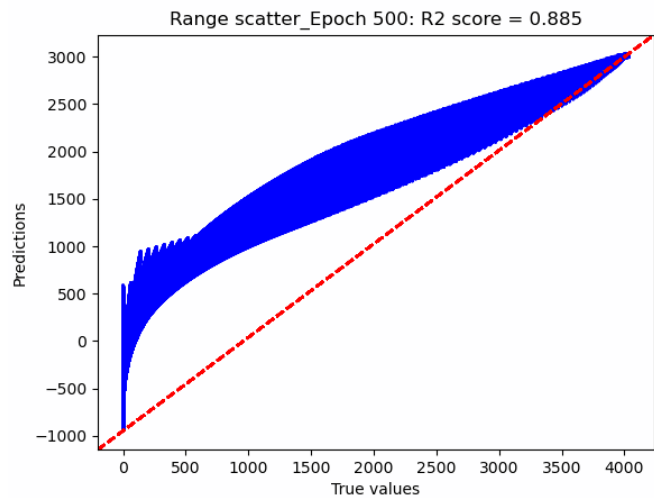
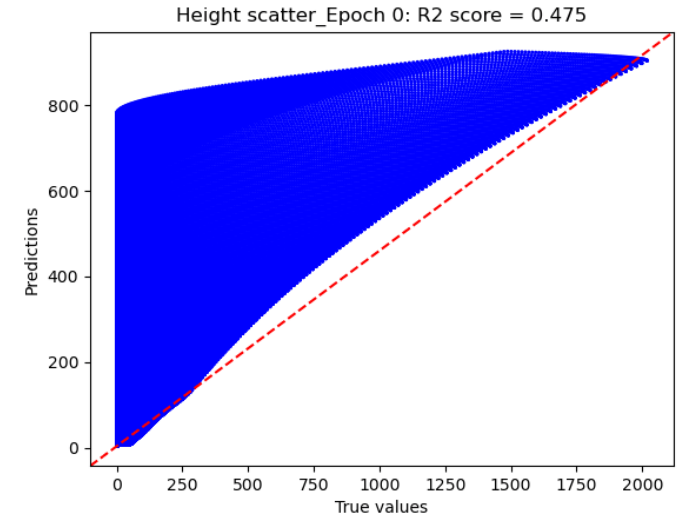
## 1 Hidden layers



## 3 Hidden layers



## 5 Hidden layers



H

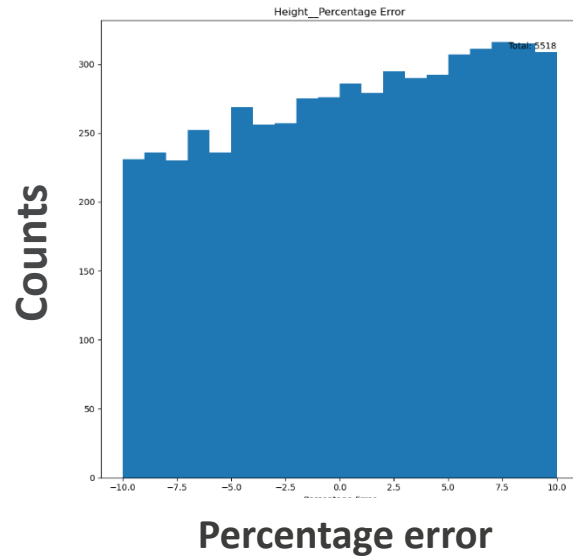
R



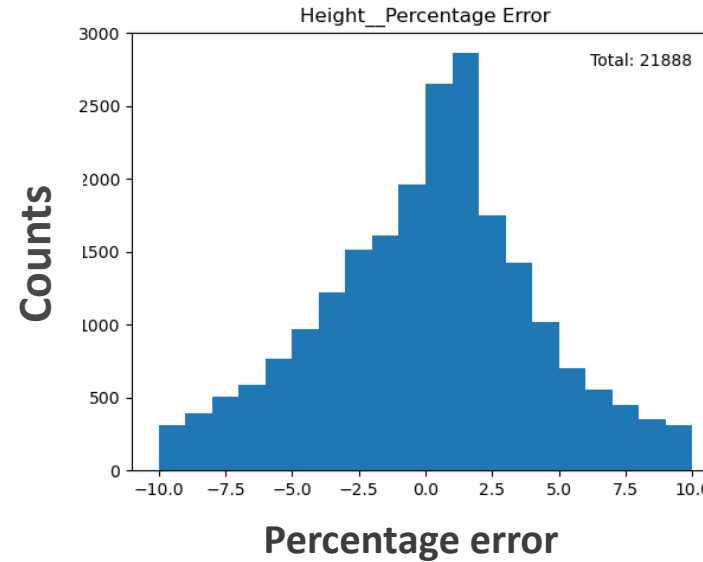
UOW

# Layer numbers\_ Percentage error (-10%~10%)

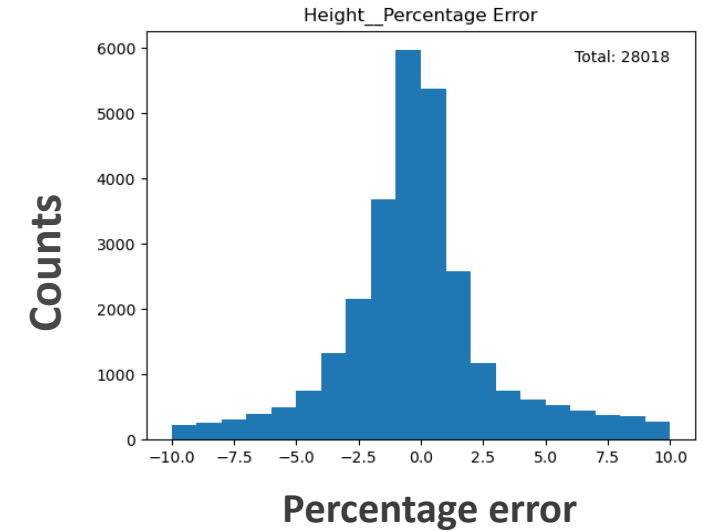
## 1 Hidden layers



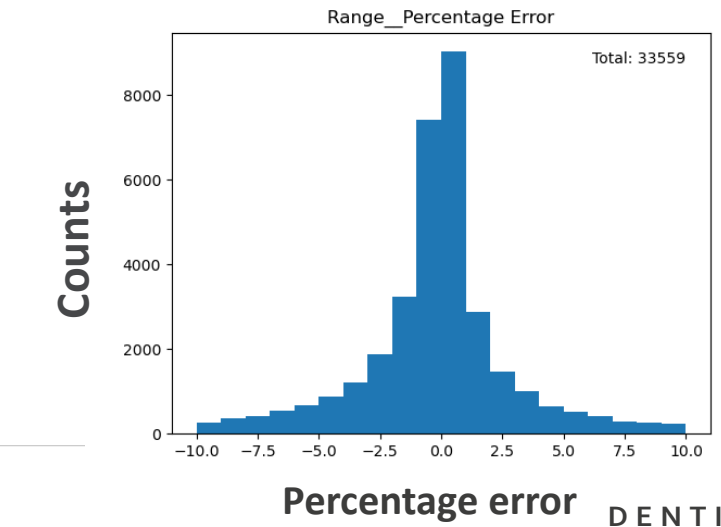
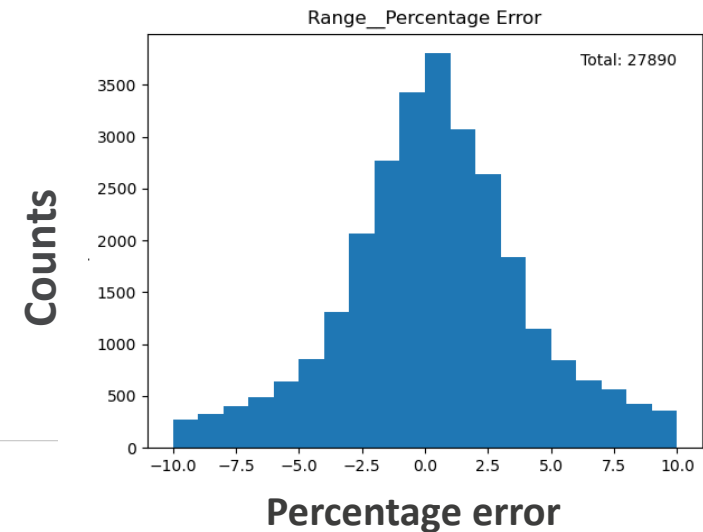
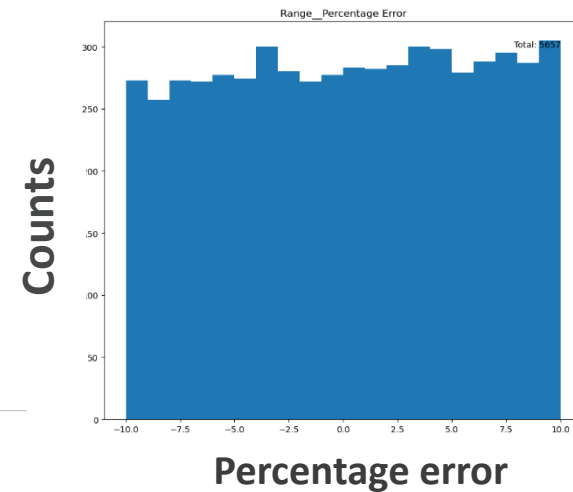
## 3 Hidden layers



## 5 Hidden layers



R



◆ **Variables : Neuron numbers**

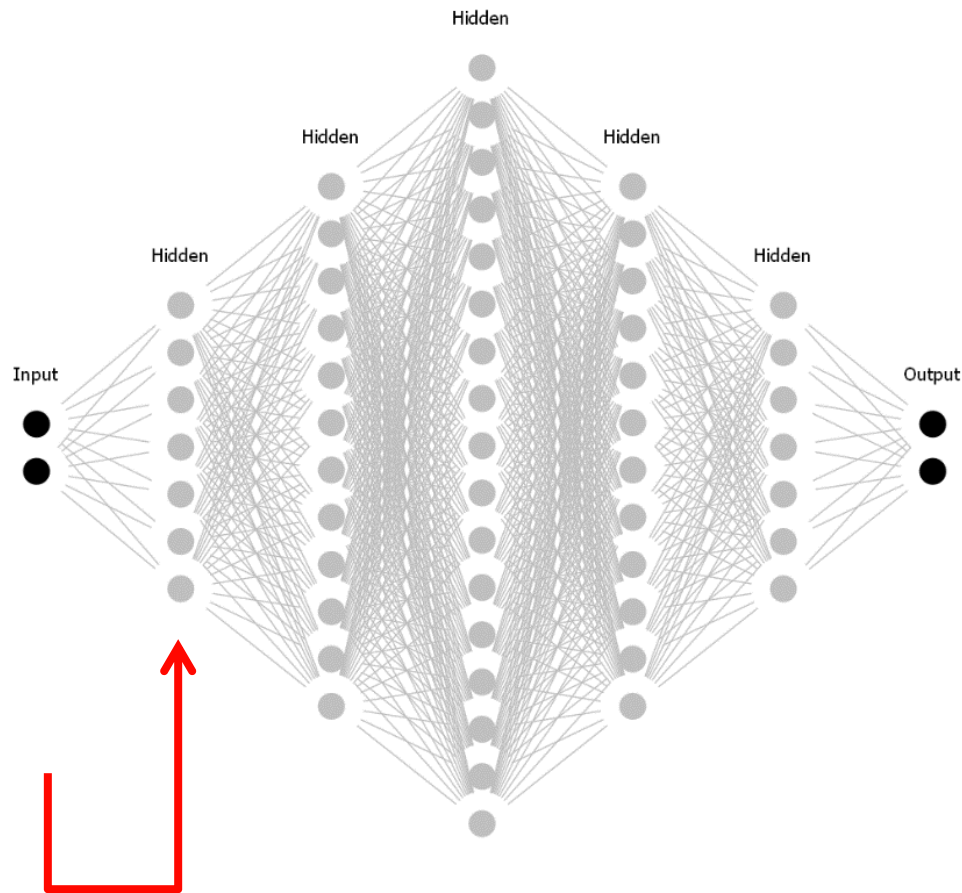
- 1. add 5 Neurons / layer**
- 2. add 10 Neuros / layer**



# Neuron numbers\_(Epoch=100, Hidden layers = 5)



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**+5 or +10**

1. add 5 Neurons / layer

Neuron = 7 / 12 / 17 / 12 / 7

2. add 10 Neurons / layer

Neuron = 12 / 22 / 32 / 22 / 12

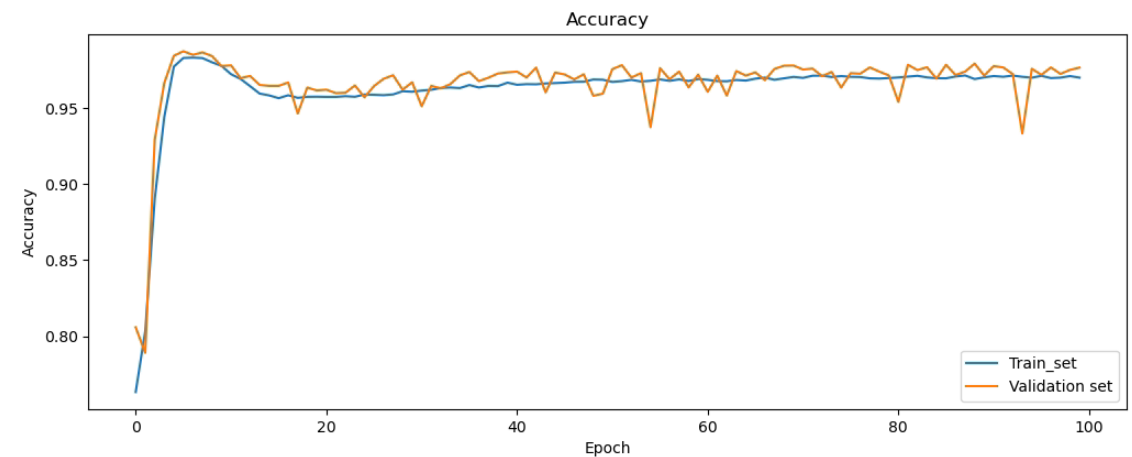
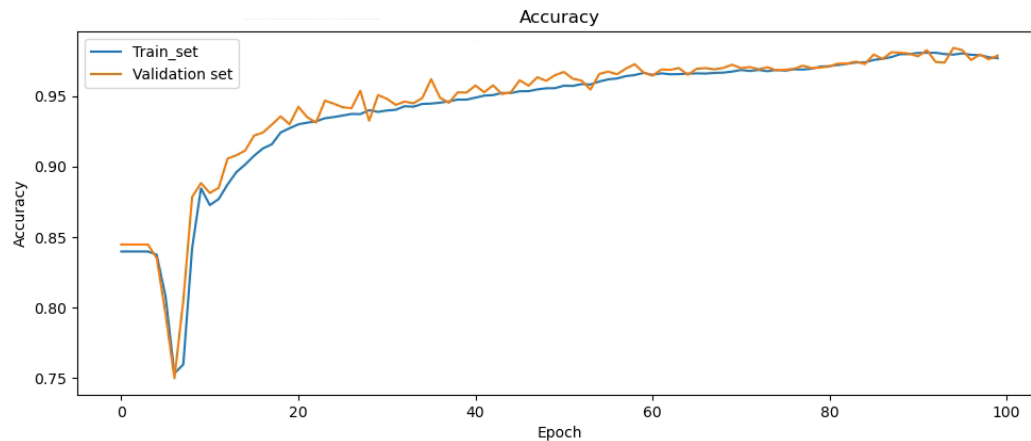
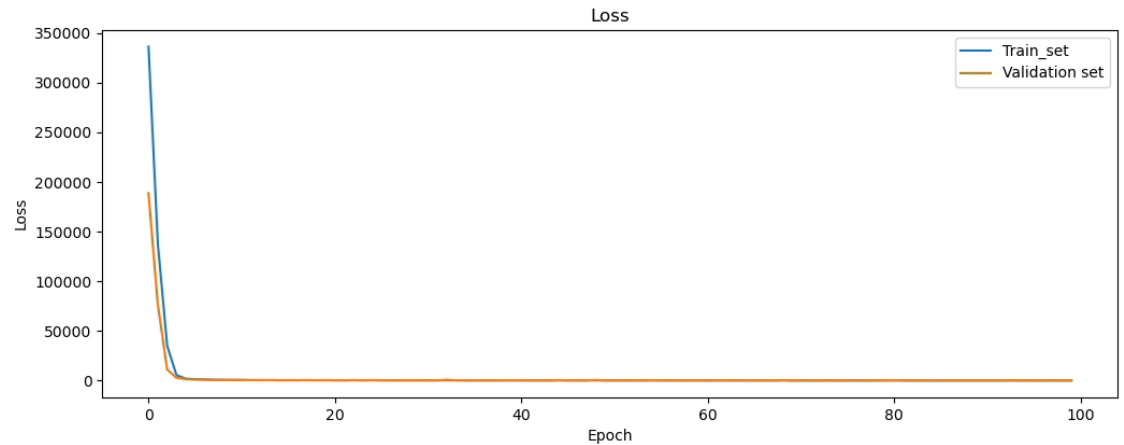
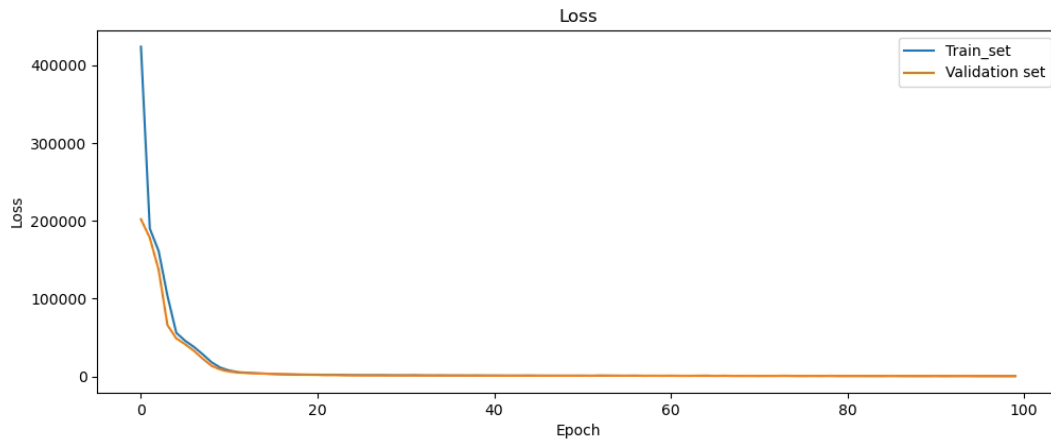
# Variables \_ Neuron numbers \_ Loss / Accuracy



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- add 5 Neurons / layer

- add 10 Neurons / layer



# Variables \_ Neuron numbers \_ Scatter

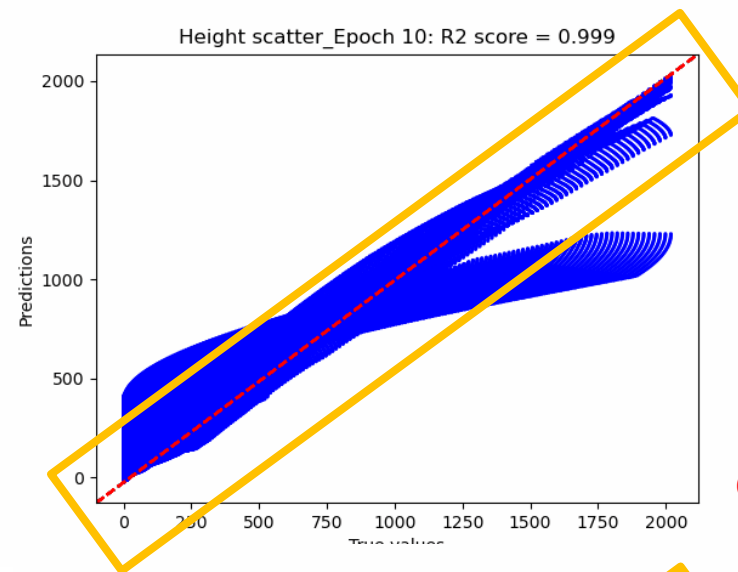
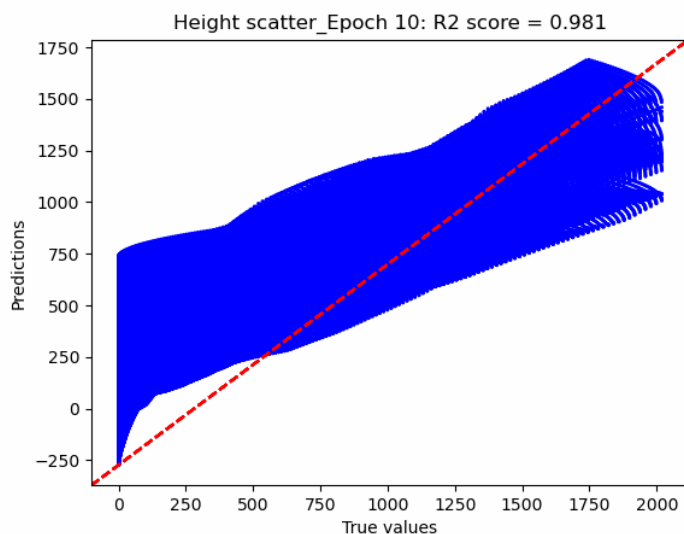


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- add 5 Neurons / layer

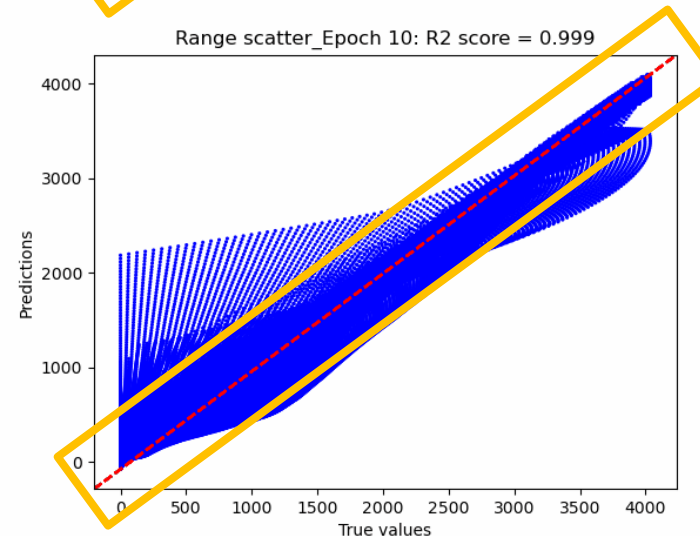
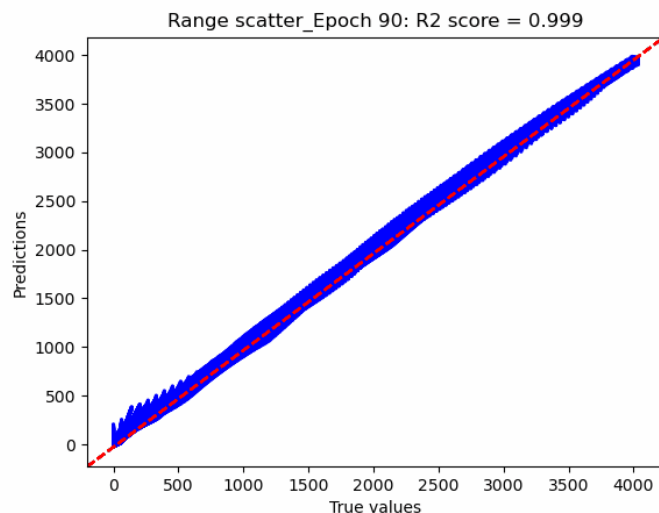
- add 10 Neurons / layer

Height



\*The convergence result is better.

Range





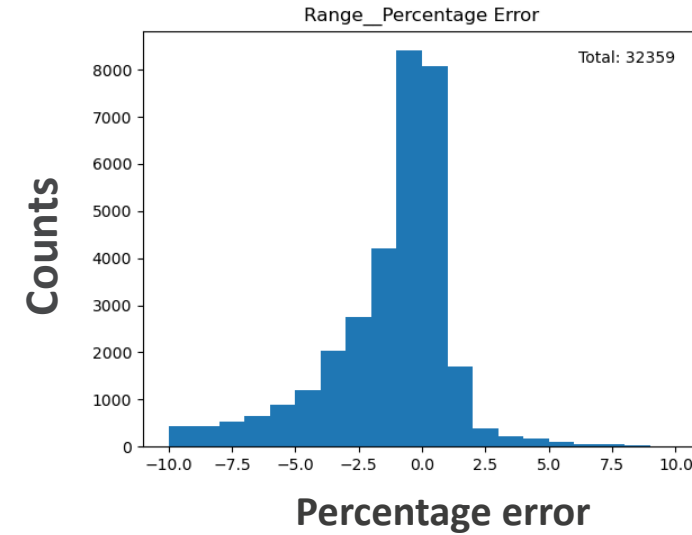
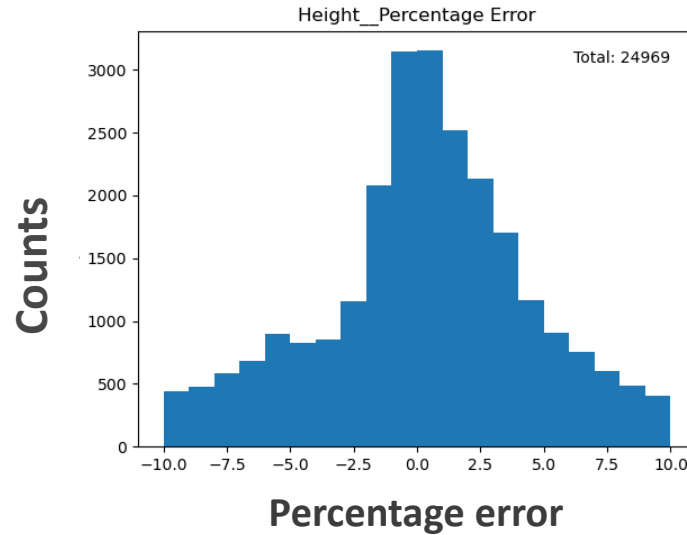
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# Variables \_ Neuron numbers \_ Percentage error (-10%~10%)

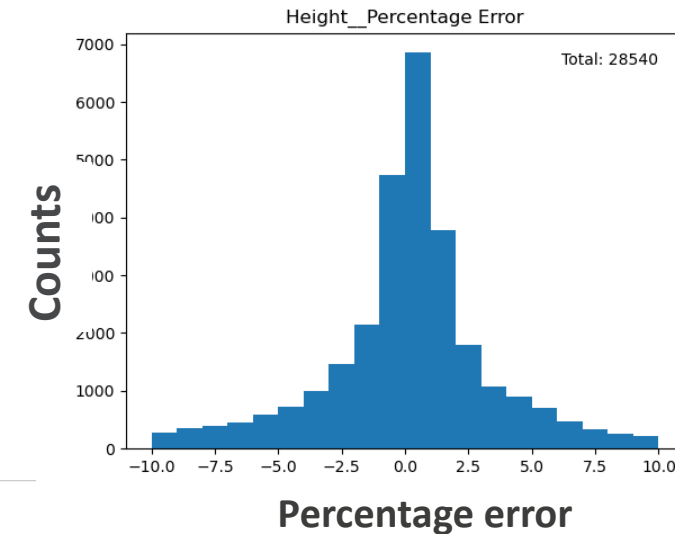
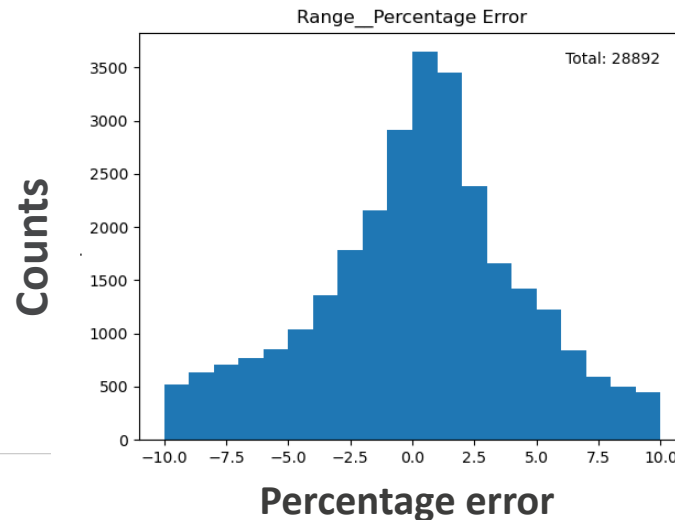
- add 5 Neurons / layer

- add 10 Neurons / layer

Height



Range

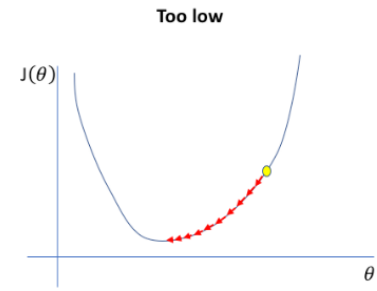


# Conclusion



## 1. Learning rate :

➔ For the same epoch, lower learning(0.0001) requires more update to minimum point.



## 2. Epoch :

➔ Add more epochs to make sure the result is in the minimum point.

➔ The two result is similar and the loss is down to close zero before 20<sup>th</sup> epoch .  
Therefore, 100 epoch is enough for this case.

# Conclusion



## 3. Layer numbers :

- ➔ The loss for 5 hidden layers model reaches zero quickly.
- ➔ The loss for 1 hidden layers models is higher than that for other two models.
- ➔ Models with 5 hidden layers have a higher count of samples with lower percentage error.

## 4. Neuron numbers :

- ➔ The convergence result of the model which add 10 Neurons per layer is better.
- ➔ Models which add 10 Neurons per layer have a higher count of samples with lower percentage error.

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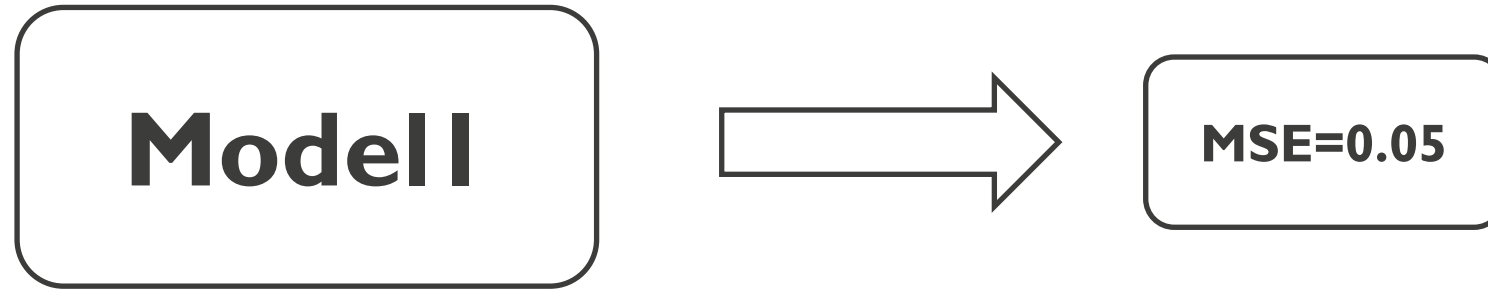


# Final project Ideas -Explainable AI

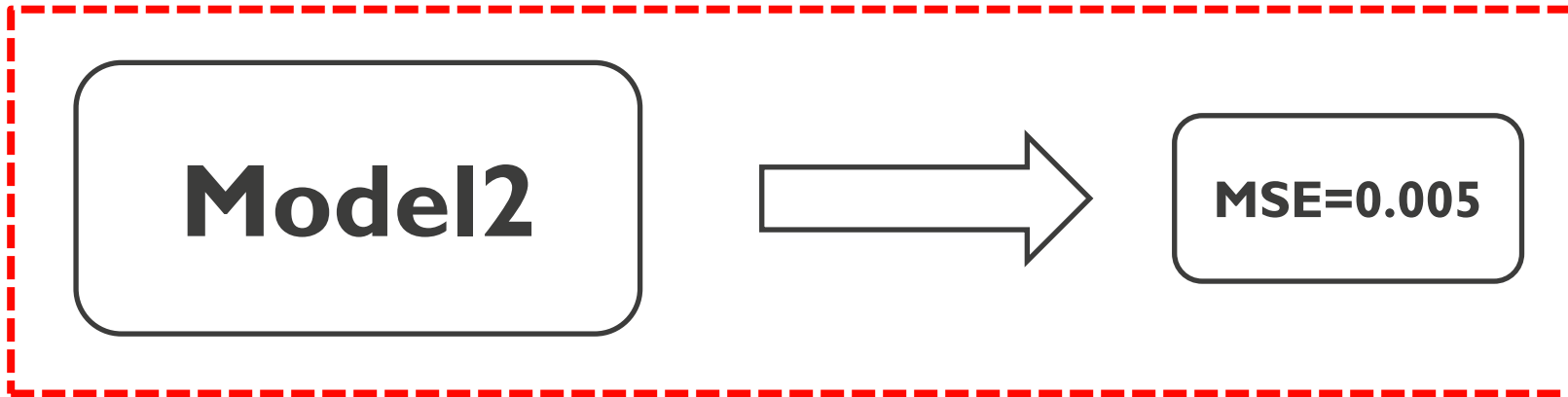


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## Problems to be solved



*Which one is better ?*

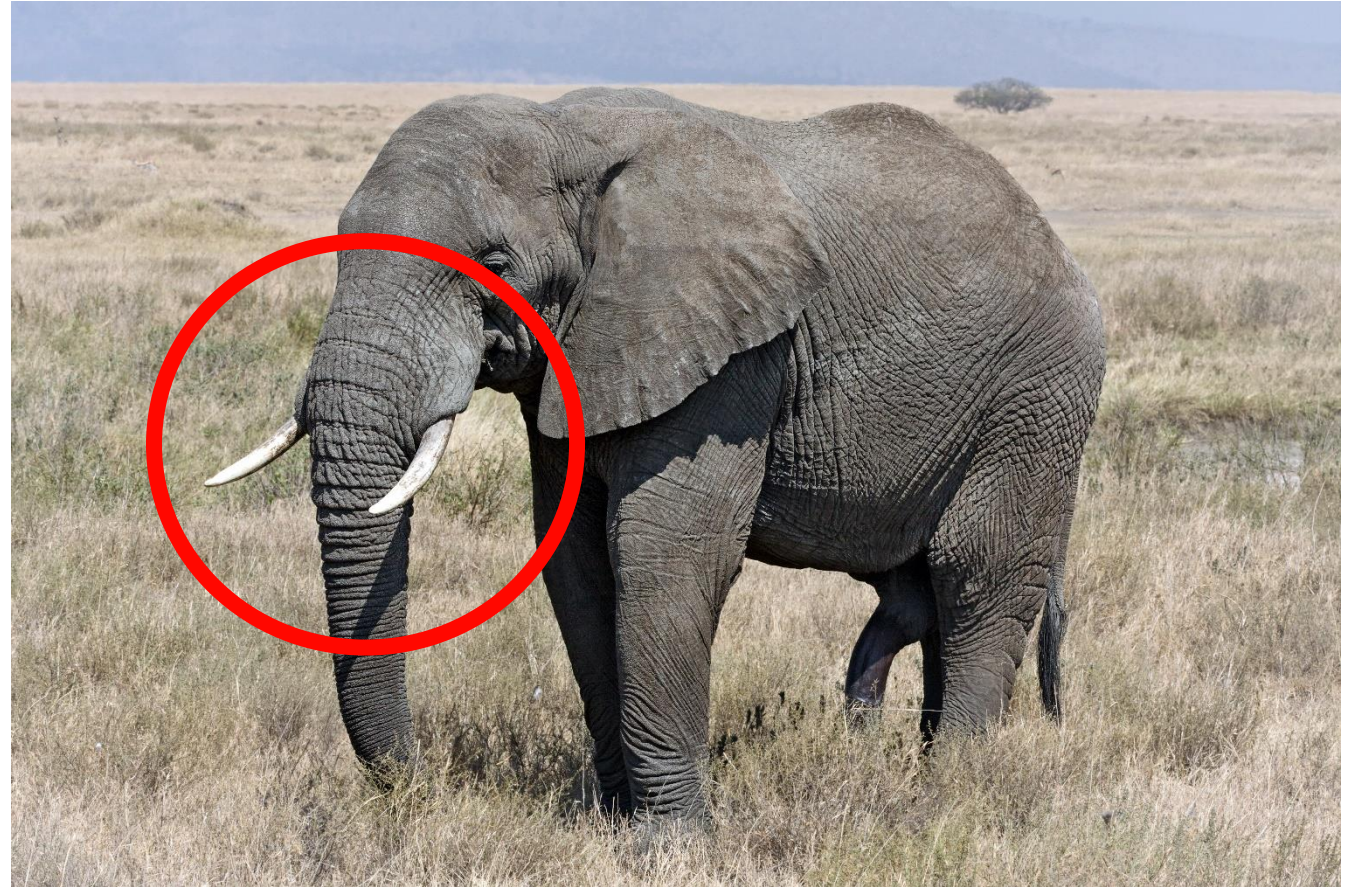




# Problems to be solved

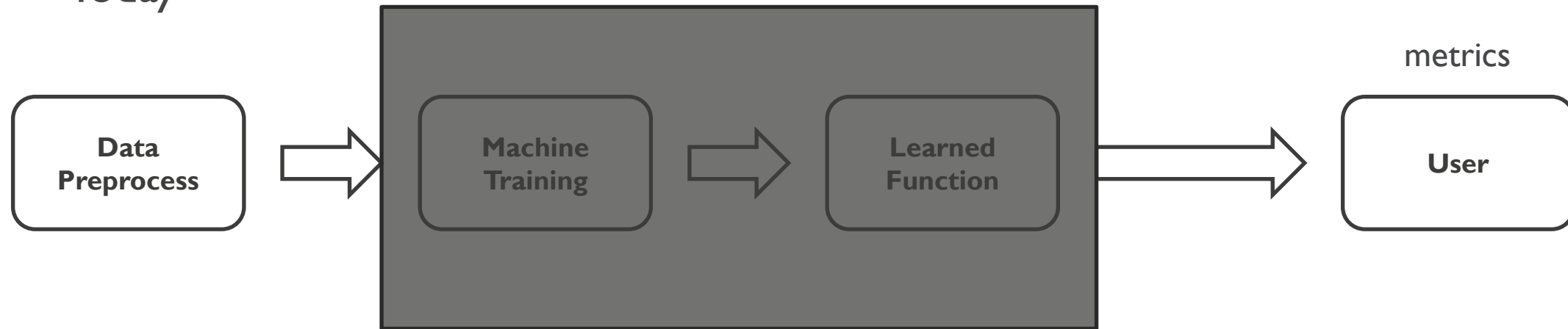


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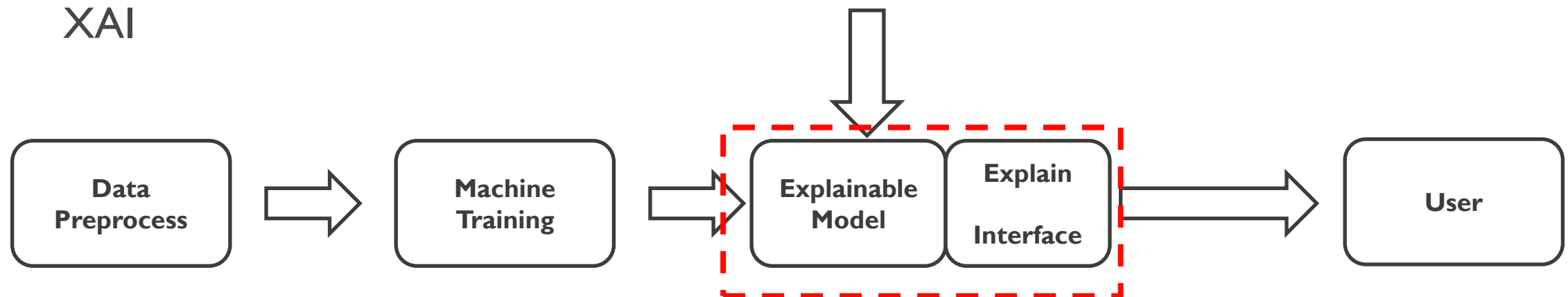


# Problems to be solved

Today



XAI

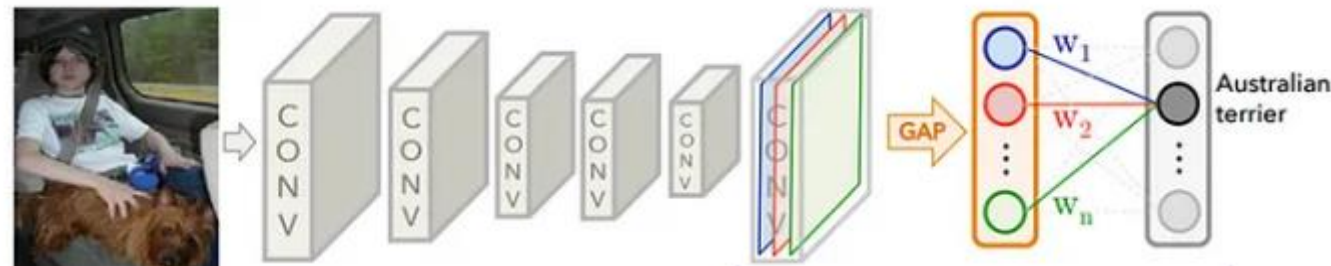




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# Explainable model

- CAM-base :The concept of CAM (Class Activation Map) is very straightforward, as shown in Fig. 1, the last convolutional layer of the network is formed into an  $n$ -dimensional vector after global average pooling, then a fully connected layer and softmax to predict the classification, and finally the trained weights ( $w_1, w_2, \dots, w_n$ ) are multiplied with the feature map of the last layer and weighted to obtain CAM, which is used to observe the effect of different locations on the output .





# Explainable interface



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## Brushing teeth



## Cutting trees



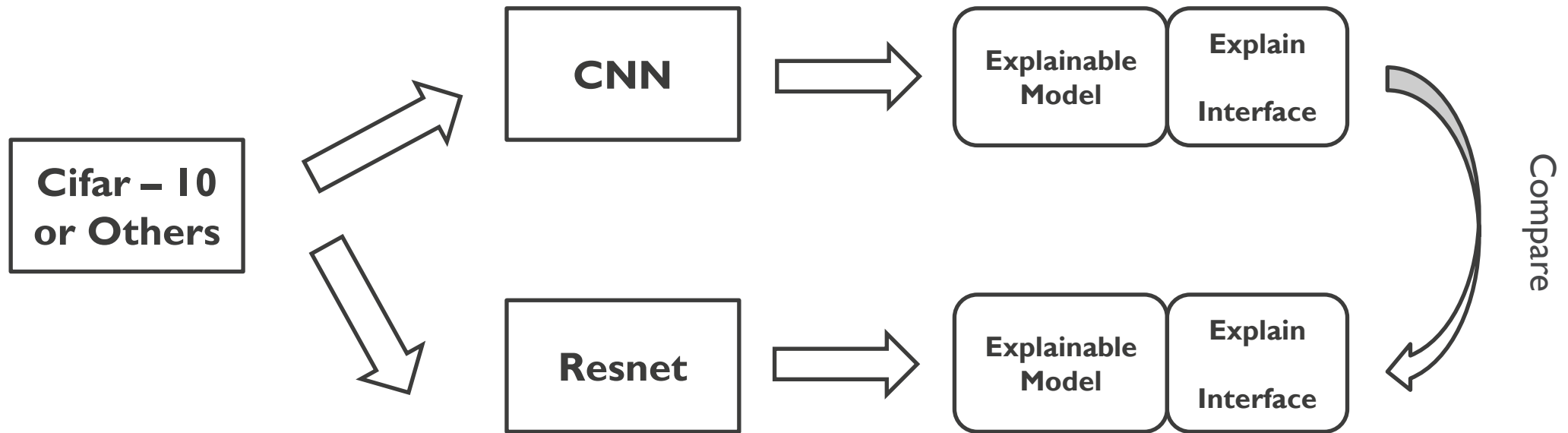
Figure 1: Heatmap visualization of the explainable interface for brushing teeth.

Figure 2: Heatmap visualization of the explainable interface for cutting trees.

# Flow



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**Thank you for attention**