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Department of Biomedical Engineering

Course Name: 19AMT301 & DEEP LEARNING

III Year : V Semester

Unit I– INTRODUCTION TO NEURAL NETWORKS

Topic : Back propagation

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What is Back propagation?

• <u>Backpropagation</u> is a training algorithm used for training feedforward neural networks.
• It plays an important part in improving the predictions made by neural networks. This is because backpropagation is able to improve the output of the neural network iteratively.
• Feed forward NN- Input layer →Output layer
• Backpropagation – Output layer → Input layer

Back propagation in Feedforward NN

INPUT

Inputs

x1

x2

x3

W

W

W

ŷ Outputs

Input Layer

Hidden Layer

Output Layer

ERROR

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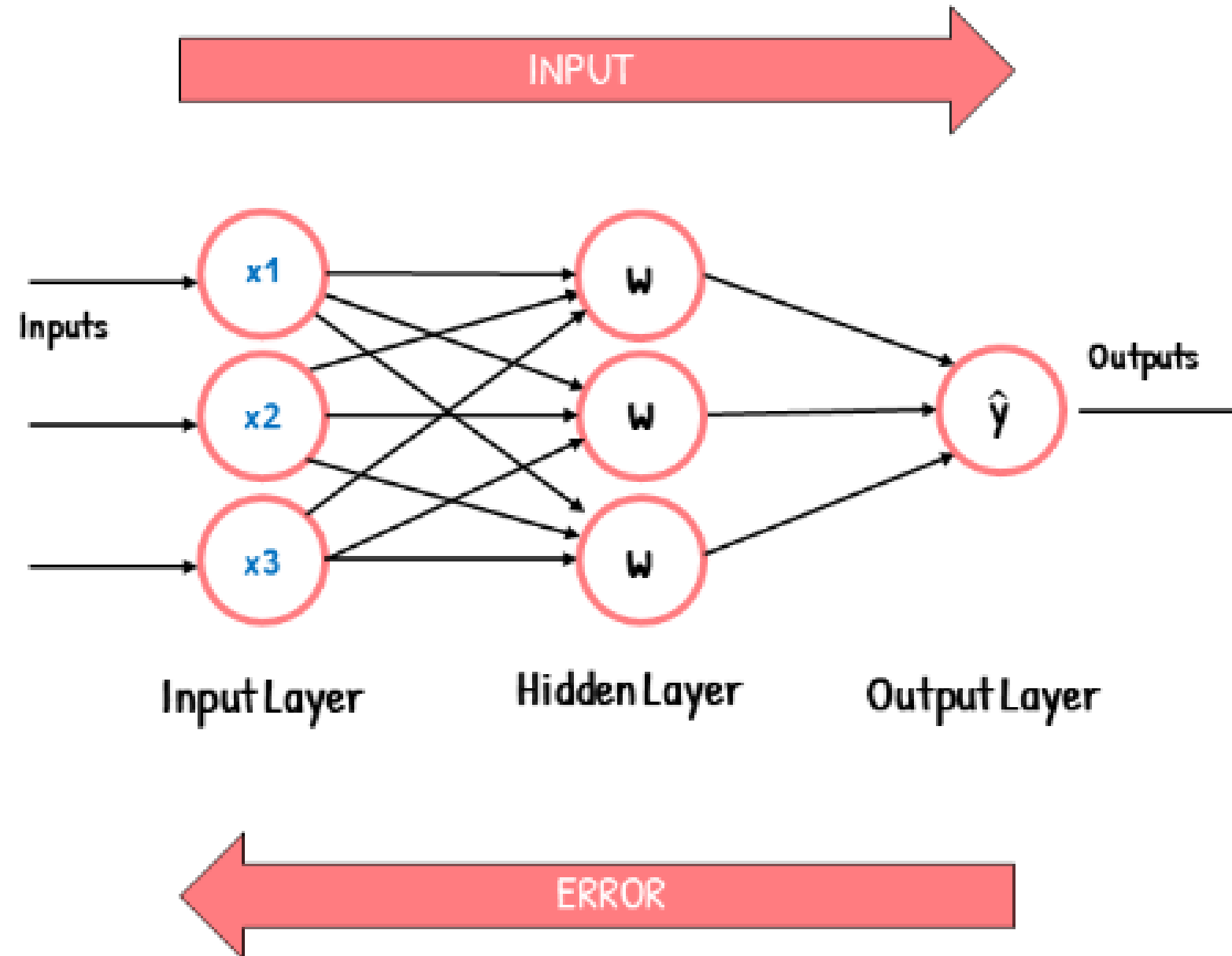
How does Back propagation works?

- **Feed Forward NN consists of One input layer, one or more hidden layer and one output layer**
- **Weights of inputs is proportional to the significance of the input**

Feed-Forward Neural Network

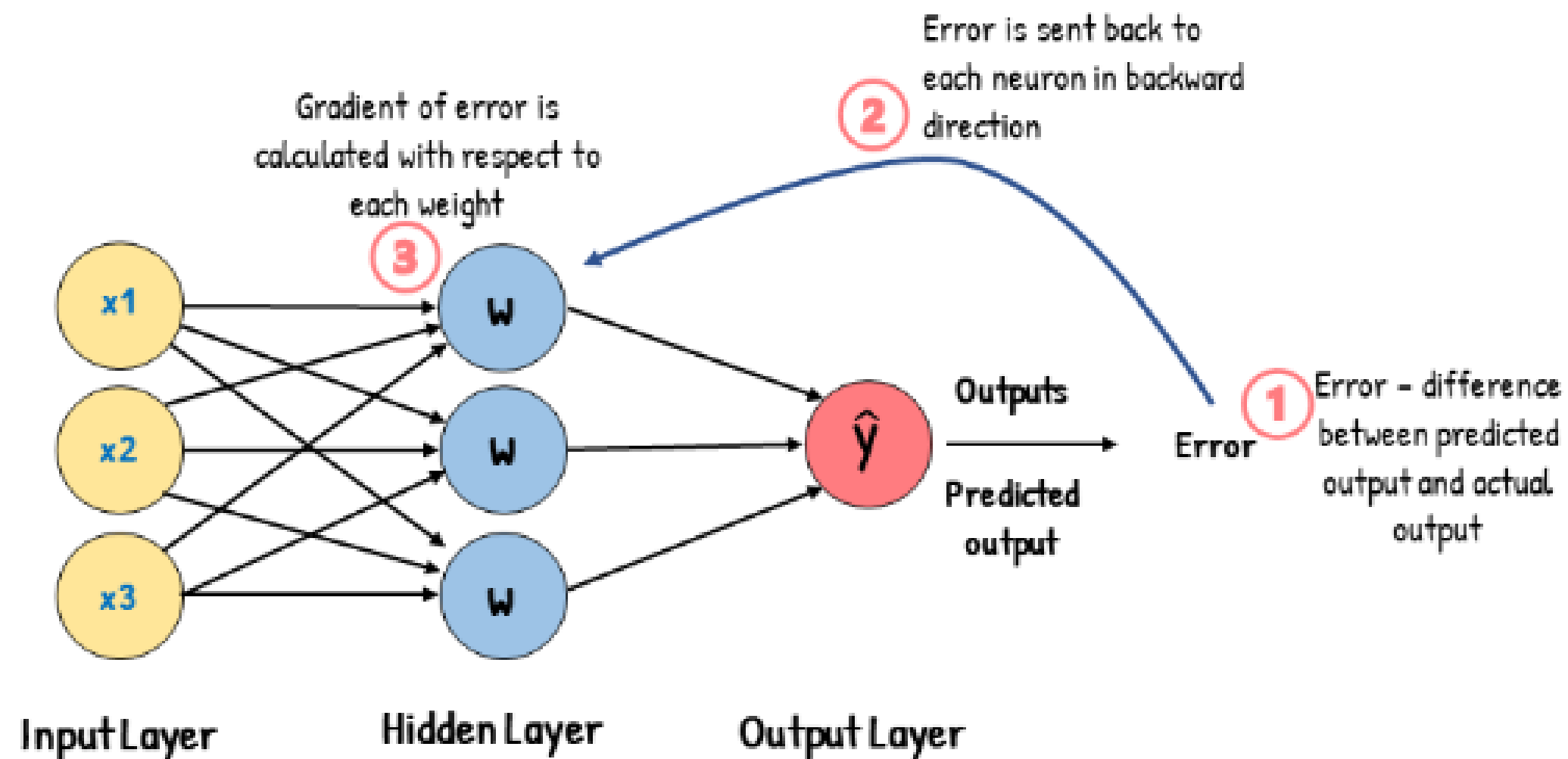19AMT301/Deep learning/Unit 1/Mr. Karthik G.L./AP/BME
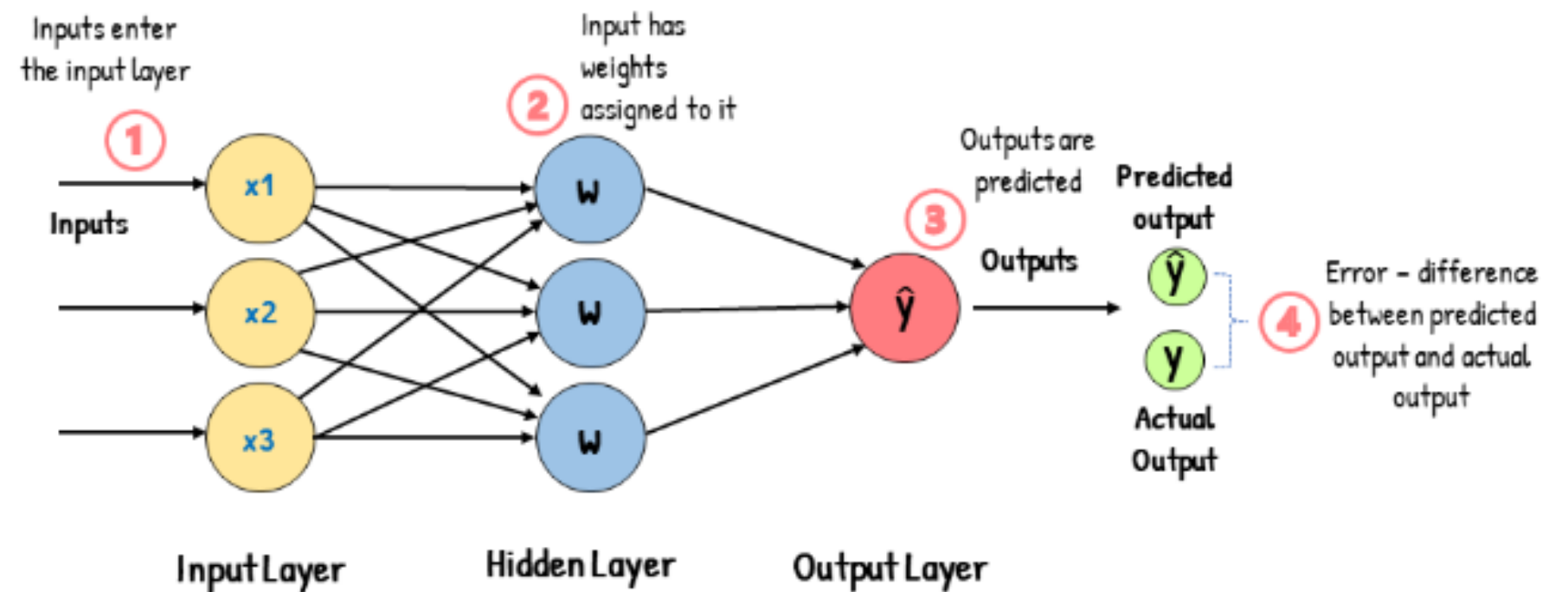
Cost Function (J)

• The **cost function (J) indicates how accurately the model performs**. It tells us how far-off our predicted output values are from our actual values. It is also known as the error. Because the cost function quantifies the error, we aim to minimize the cost function.

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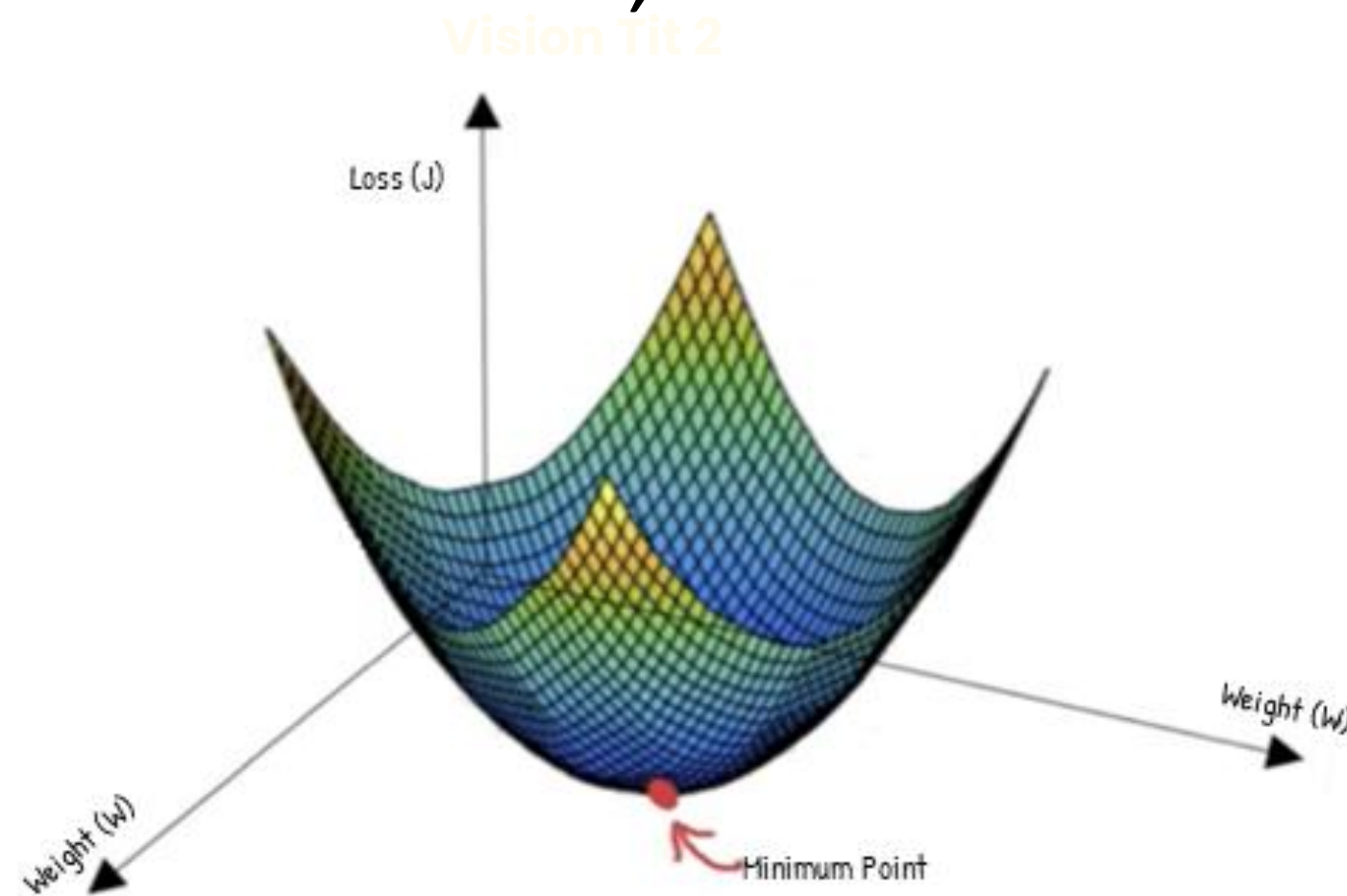
Backpropagation to reduce loss or error

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Gradient Descent

- The weights are adjusted using a process called gradient descent.
- Gradient descent is an optimization algorithm that is used to find the weights that minimize the cost function.
- Minimizing the cost function means getting to the minimum point of the cost function.
- So, gradient descent aims to find a weight corresponding to the cost function's minimum point.

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Navigation of cost function
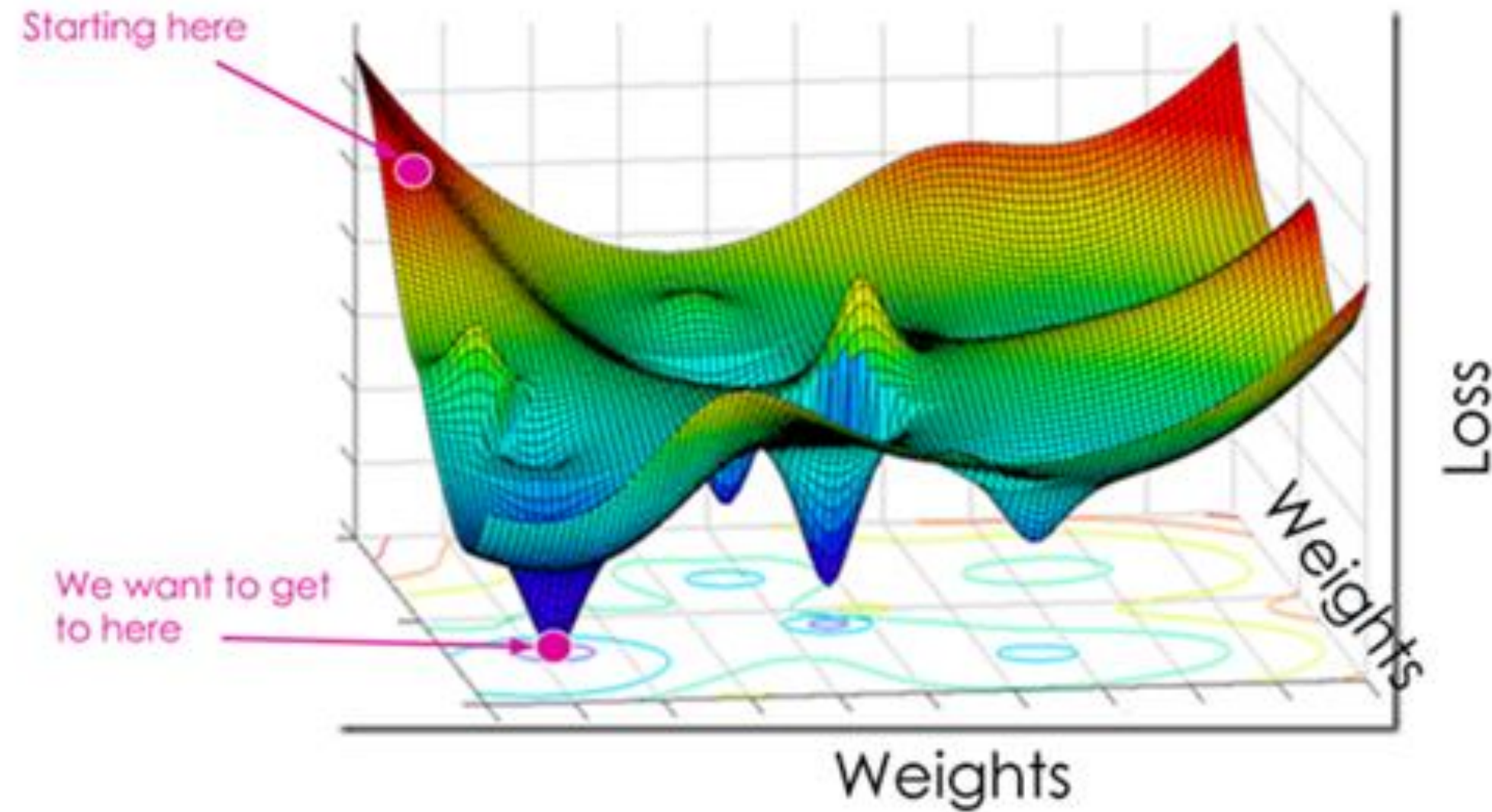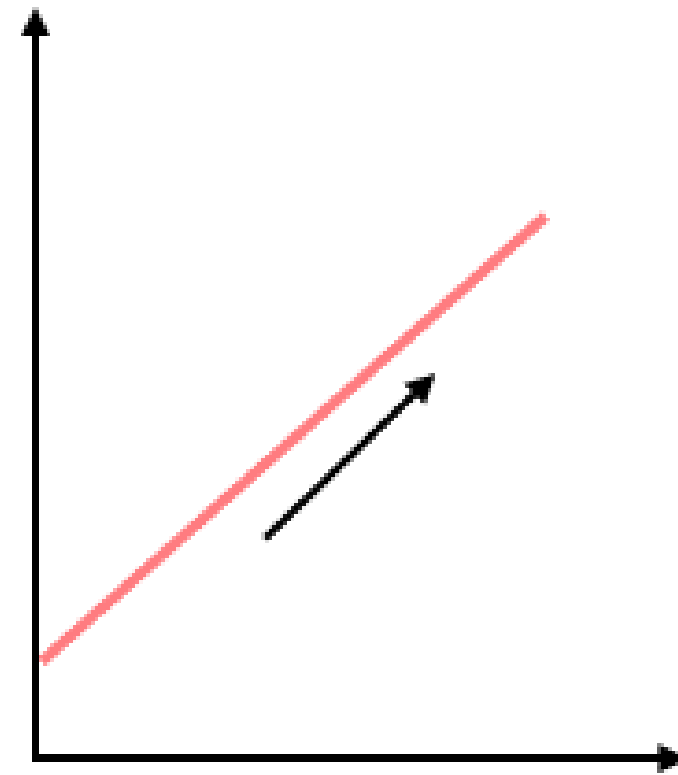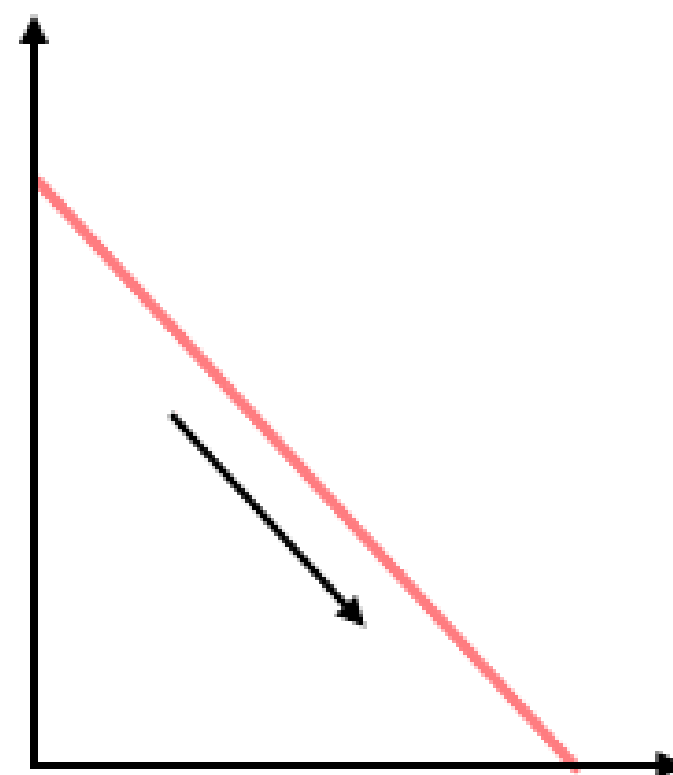
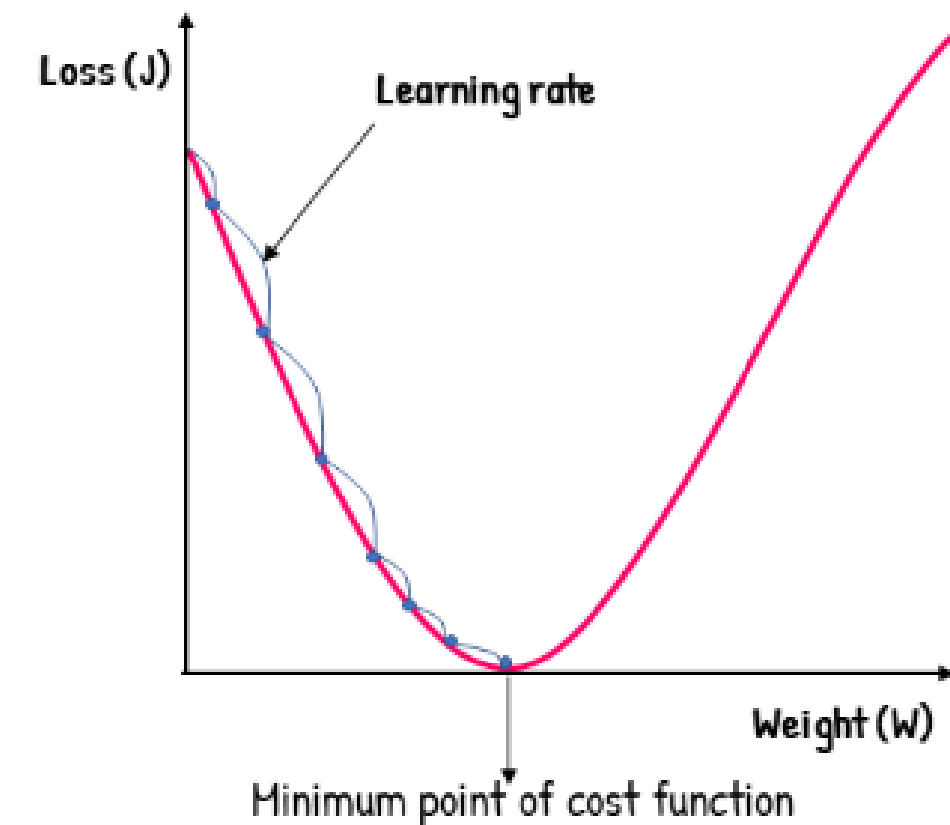# Finding direction using gradient

Positive Gradient   Negative Gradient

The step size and Learning rate

- The step size for navigating the cost function is determined using the learning rate.
- The learning rate is a tuning parameter that determines the step size at each iteration of gradient descent. It determines the speed at which we move down the slope.
- Alpha (α) is termed as the Learning rate
- The step size plays an important part in ensuring a balance between optimization time and accuracy.
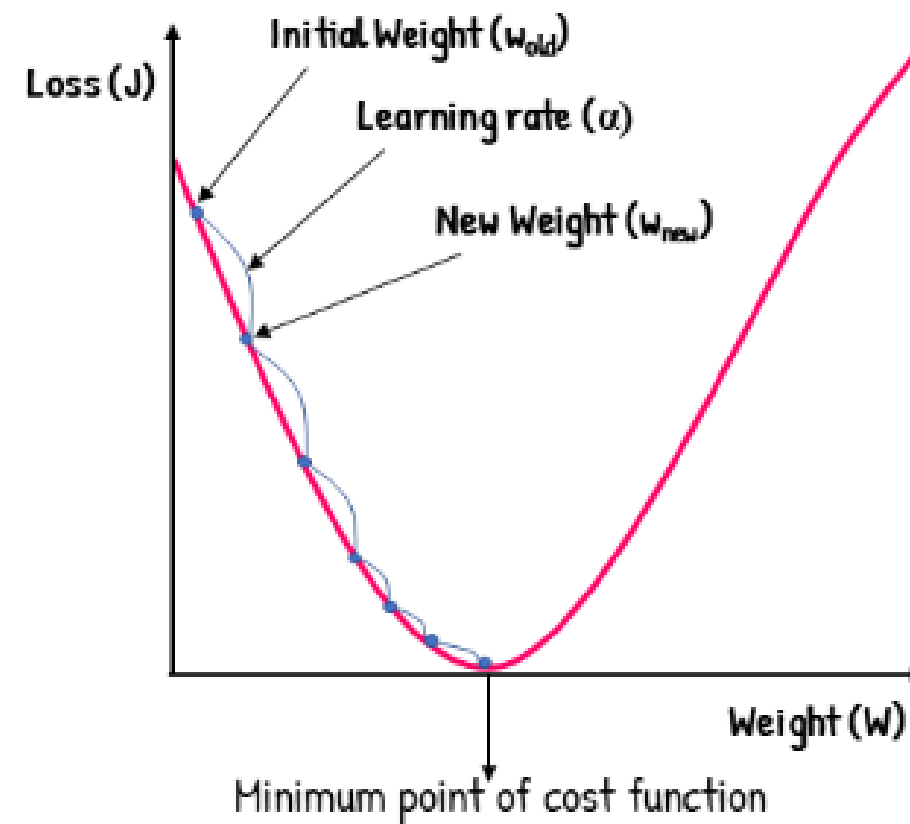
Learning Rate

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Descending the cost function

$$W_{new} = W_{old} - \alpha \frac{dJ}{dw}$$

Gradient

Gradient Descent

Loss (J)

Initial Weight (w_{old})

Learning rate (α)

New Weight (w_{new})

Weight (W)

Minimum point of cost function

$$W_{new} = W_{old} - \alpha \frac{\delta J}{\delta w}$$

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# Backpropagation Vs Gradient Descent

	Backpropagation	Gradient Descent
Definition	An algorithm for calculating the gradients of the cost function	Optimization algorithm used to find the weights that minimize the cost function
Requirements	Differentiation via the chain rule	•Gradient via Backpropagation •Learning rate
Process	Propagating the error backwards and calculating the gradient of the error function with respect to the weights	Descending down the cost function until the minimum point and find the corresponding weights

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Quiz

Identify the below diagram,
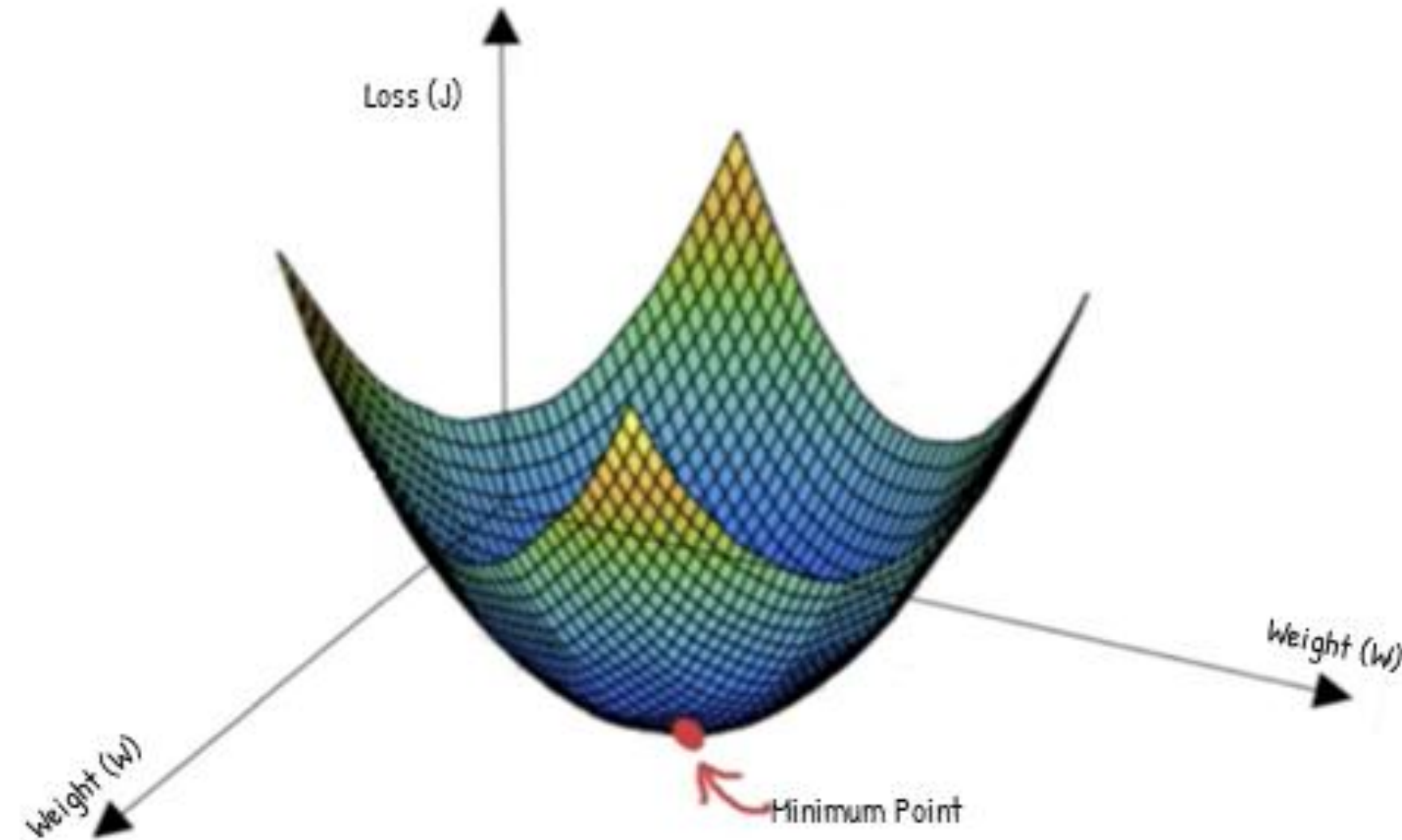
Quiz

What is the relation between Learning rate and Step size?

Vision Tit 2   Vision TItle 3
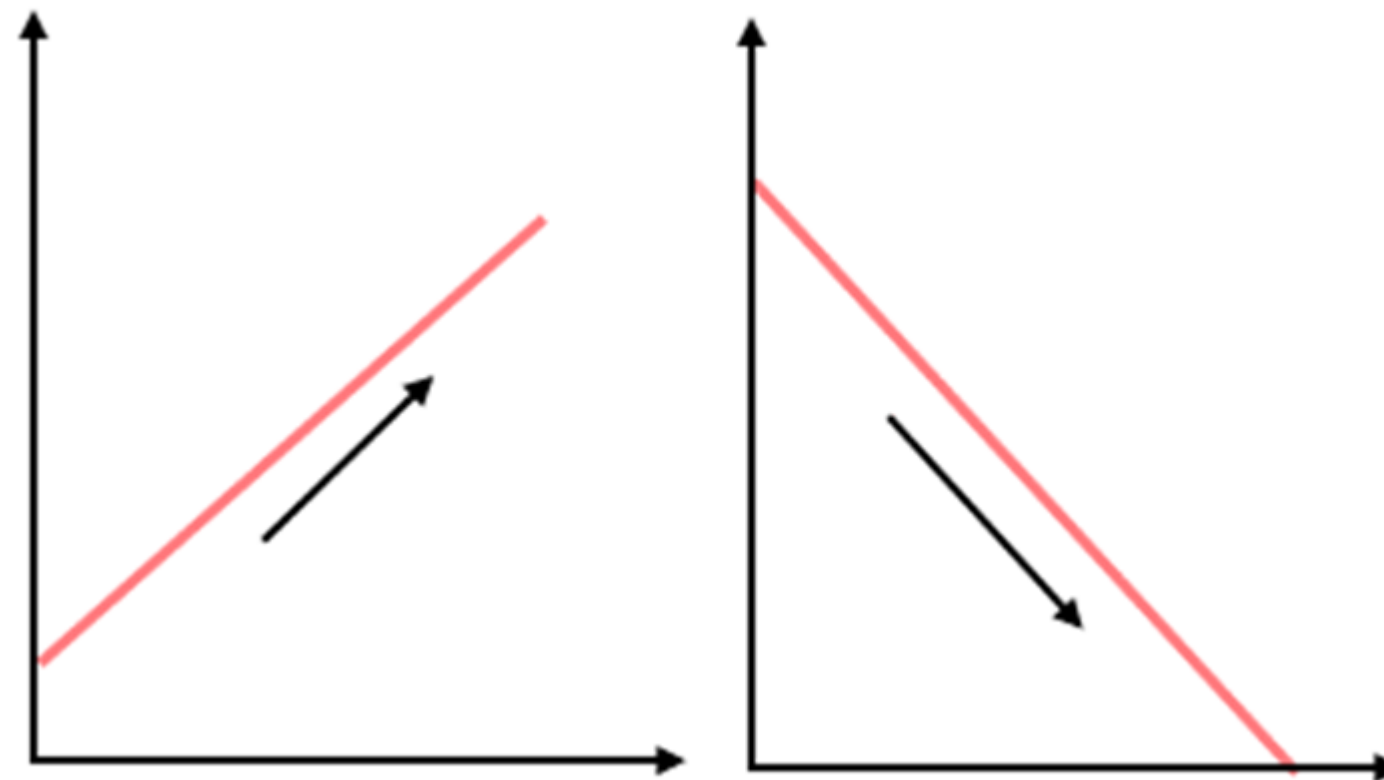
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Quiz

Identify the below diagrams,

Quiz

How to calculate error?

What is the relation between Step size and accuracy in Gradient descent?

Vision Tit 2   Vision TItle 3

THANK YOU !!!

Vision Tit 2   Vision Title 3

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