Artificial Neural Networks

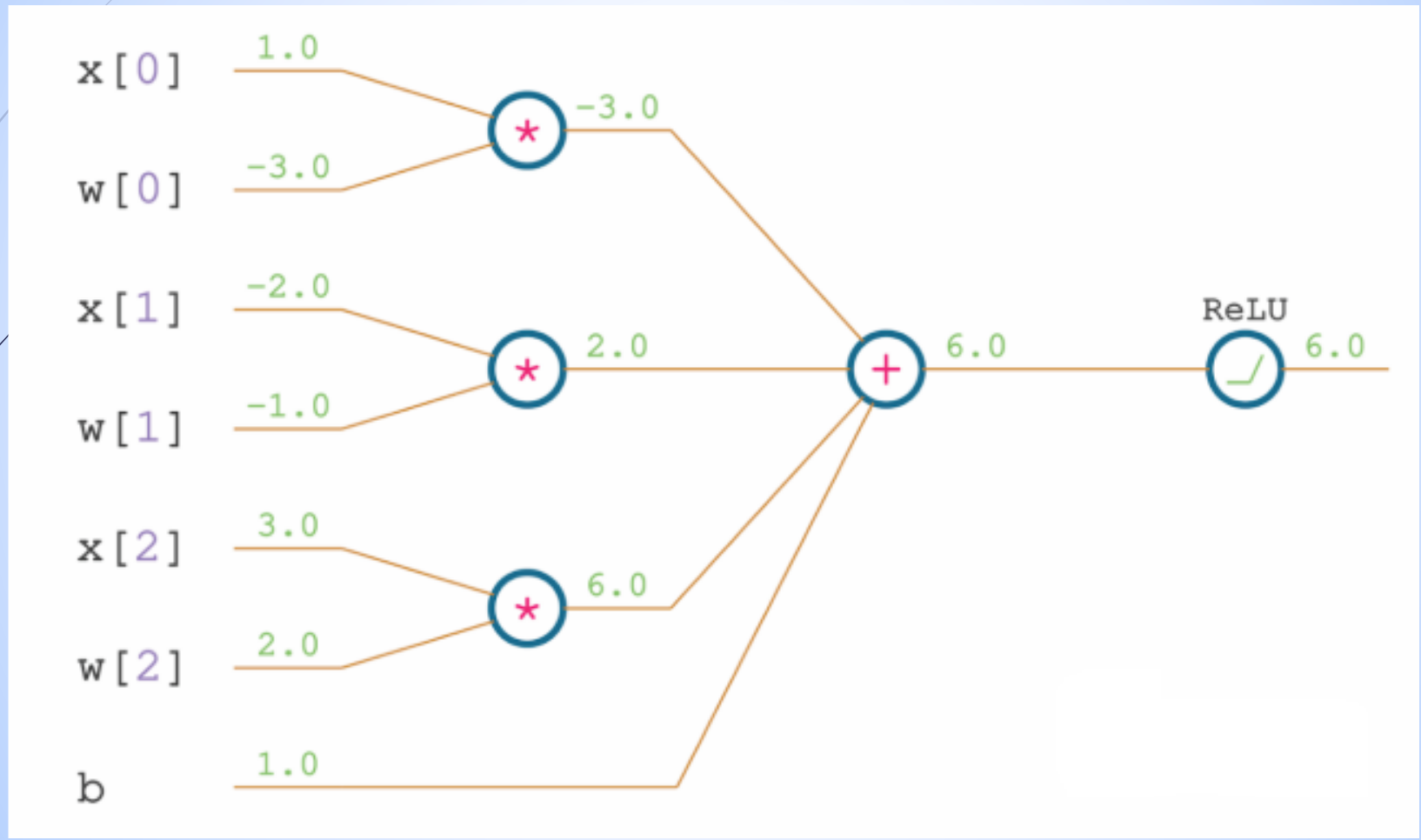
Dr. Muhammad Aqib

University Institute of Information Technology

PMAS-Arid Agriculture University Rawalpindi

Backpropagation

Application of ReLU to A Neuron Output



Application of ReLU to A Neuron Output (cont.)

- Full forward pass through a single neuron and a ReLU activation function.
- Takes input values (x), weights (w), and bias (b), as inputs, and outputs y.
- Consists of multiple simpler functions
  - Multiplication of input values and weights,
  - Sum of these values and bias,
  - A max function as the ReLU activation

Backpropagation

- Backpropagation is the method of fine-tuning the weights of a neural network based on the error rate obtained in the previous iteration.
- Proper tuning of the weights allows you to reduce error rates and make the model reliable by increasing its generalization.
- Backpropagation in neural network is a short form for "backward propagation of errors."
- It is a standard method of training artificial neural networks. This method helps calculate the gradient of a loss function with respect to all the weights in the network.

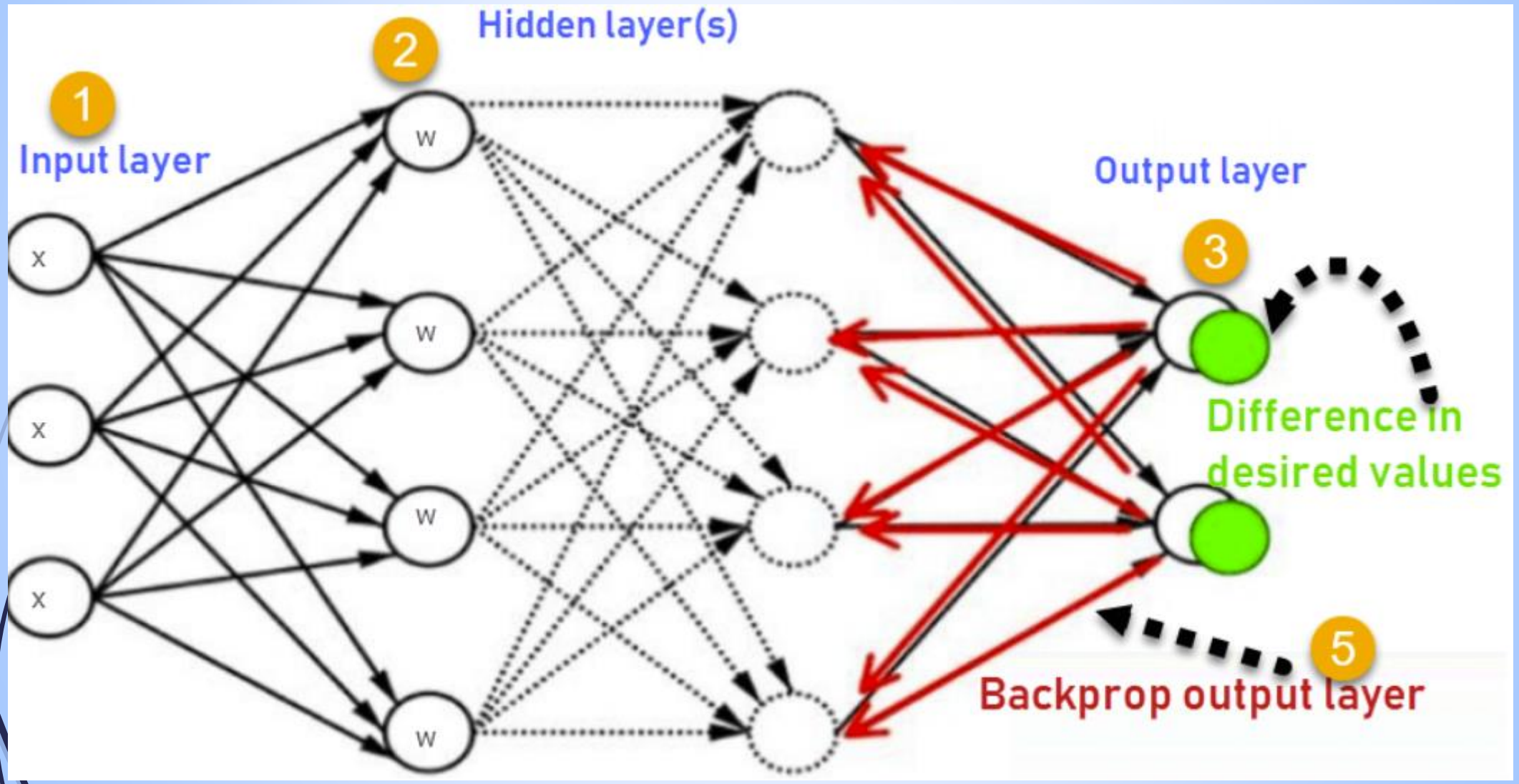
Backpropagation (cont.)

- The Back propagation algorithm in neural network computes the gradient of the loss function for a single weight by the chain rule.
- It efficiently computes one layer at a time, unlike a native direct computation.
- It computes the gradient, but it does not define how the gradient is used. It generalizes the computation in the delta rule.

How does it Work?

- Inputs X, arrive through the preconnected path
- Input is modeled using real weights W. The weights are usually randomly selected.
- Calculate the output for every neuron from the input layer, to the hidden layers, to the output layer.
- Calculate the error in the outputs
- Travel back from the output layer to the hidden layer to adjust the weights such that the error is decreased.

How does it Work? (cont.)



Why We Need Backpropagation?

- Backpropagation is fast, simple and easy to program
- It has no parameters to tune apart from the numbers of input
- It is a flexible method as it does not require prior knowledge about the network
- It is a standard method that generally works well
- It does not need any special mention of the features of the function to be learned.

Backpropagation Networks

- Two Types of Backpropagation Networks are
  - Static Back-propagation
  - Recurrent Backpropagation

Static back-propagation

- It is one kind of backpropagation network which produces a mapping of a static input for static output.
- It is useful to solve static classification issues like optical character recognition.

Recurrent Backpropagation

- Recurrent Back propagation in data mining is fed forward until a fixed value is achieved.
- After that, the error is computed and propagated backward.
- The main difference between both of these methods is: that the mapping is rapid in static back-propagation while it is non-static in recurrent backpropagation.

Backpropagation Key Points

- Simplifies the network structure by elements weighted links that have the least effect on the trained network.
- You need to study a group of input and activation values to develop the relationship between the input and hidden unit layers.
- It helps to assess the impact that a given input variable has on a network output. The knowledge gained from this analysis should be represented in rules.
- Backpropagation is especially useful for deep neural networks working on error-prone projects, such as image or speech recognition.
- Backpropagation takes advantage of the chain and power rules allows backpropagation to function with any number of outputs.

Thank You