Artificial Intelligence Lab

Assignment 1

Design and Implementation of Fully Connected Neural Networks

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Fully Connected Neural Network Diagram

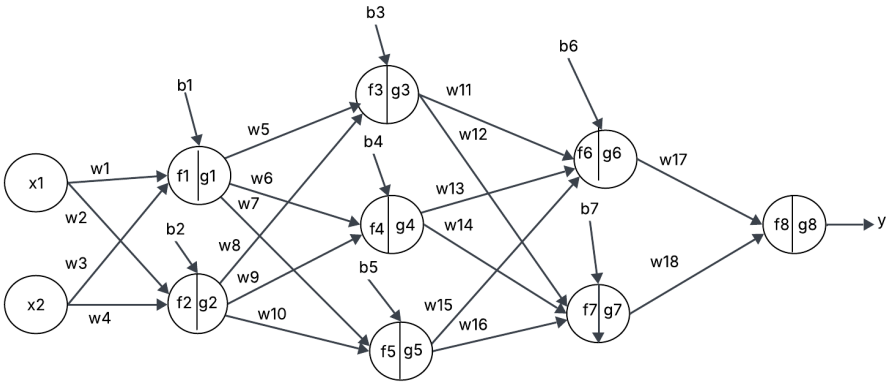

Figure 1: Fully Connected Neural Network Architecture

Explanation of the Diagram

The figure above represents a **Fully Connected Neural Network (FCNN)**, where each neuron in a layer is connected to all neurons in the next layer through weighted connections.

Layer Roles:

- **Input Layer:** - Accepts the input features from the dataset. - In this network, there are two input neurons (x_1 and x_2). - The input layer does not perform computation; it simply forwards the feature values to the first hidden layer.
- **Hidden Layers:** - Perform computations to transform inputs into more useful intermediate representations. - Each neuron calculates a weighted sum of inputs plus a bias term:

$$z = \sum_{i=1}^{n} w_i \cdot x_i + b$$

  - An activation function $f(z)$ is then applied to introduce non-linearity, allowing the network to learn complex patterns. - In this architecture:
    - Hidden Layer 1: 2 neurons ($f_1|g_1$ and $f_2|g_2$).
    - Hidden Layer 2: 3 neurons ($f_3|g_3$, $f_4|g_4$, $f_5|g_5$).
    - Hidden Layer 3: 2 neurons ($f_6|g_6$ and $f_7|g_7$).
- **Output Layer:** - Produces the final output prediction from the network. - Here, it has one neuron ($f_8|g_8$) that combines the outputs of the last hidden layer. - Depending on the activation function (e.g., sigmoid, softmax, linear), it can output probabilities (classification) or continuous values (regression).

Model Summary Output

Model: "functional"

Layer (type)	Output Shape	Param #
input_layer (InputLayer)	(None, 2)	0
dense (Dense)	(None, 2)	6
dense_1 (Dense)	(None, 3)	9
dense_2 (Dense)	(None, 2)	8
dense_3 (Dense)	(None, 1)	3

Total params: 26 (104.00 B)
Trainable params: 26 (104.00 B)
Non-trainable params: 0 (0.00 B)

Figure 2: Model Summary of the Fully Connected Neural Network

Explanation of Model Summary

The model consists of:

- Input Layer: Shape $(None, 2)$, 0 parameters.
- Dense Layer 1: 2 neurons, 6 parameters (4 weights + 2 biases).
- Dense Layer 2: 3 neurons, 9 parameters (6 weights + 3 biases).
- Dense Layer 3: 2 neurons, 8 parameters (6 weights + 2 biases).
- Output Layer: 1 neuron, 3 parameters (2 weights + 1 bias).
- **Total Parameters:** 26 trainable parameters.

Resources

- **GitHub Repository:** GitHub - Artificial Intelligence Lab
- **Google Colab Notebook:** Colab - FCNN Implementation