

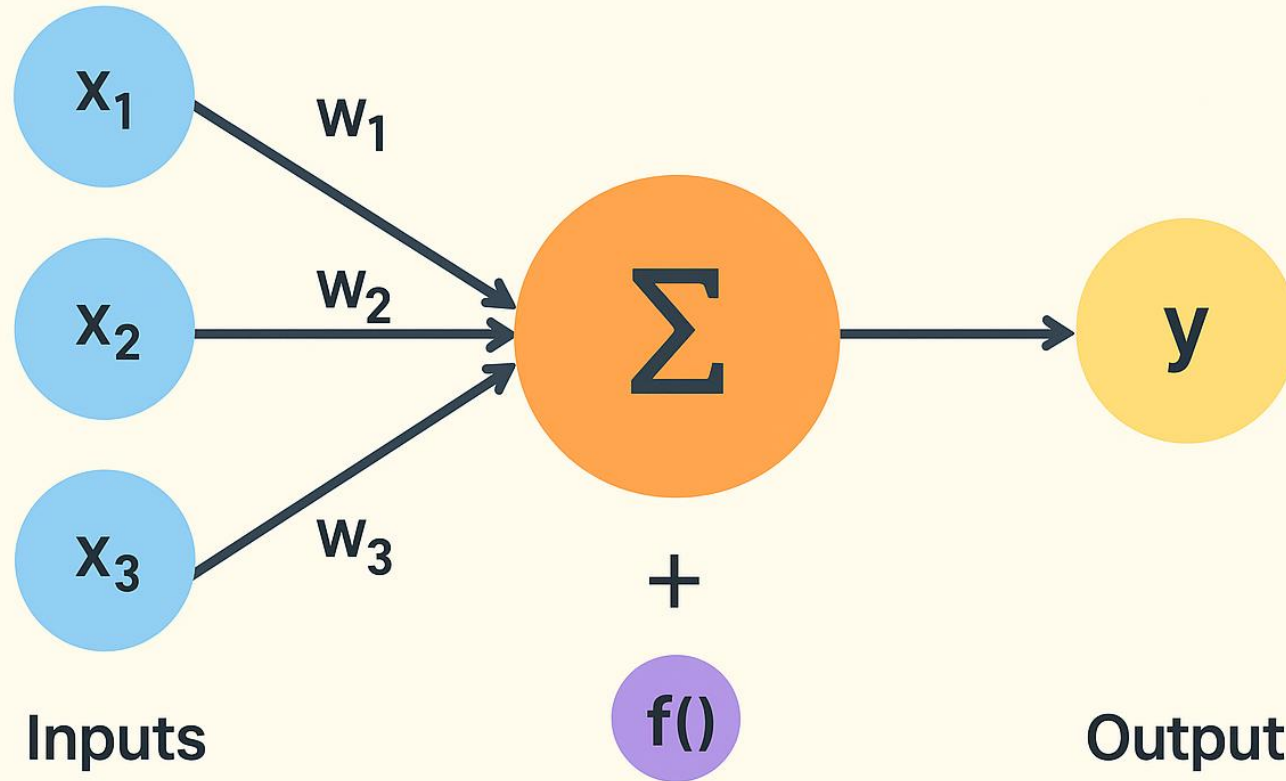
Single Layer Neural Network

A **single-layer neural network** consists of:

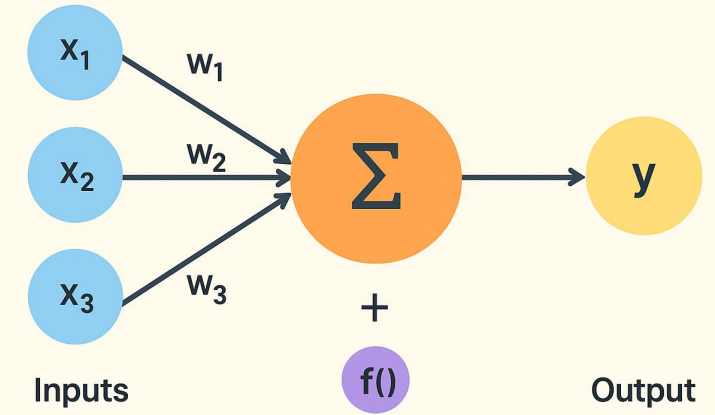
- ❑ **Input layer** → Receives input signals (features).
- ❑ **Output layer** → Produces the output (predictions).
- ❑ The network has **only one layer of trainable weights** that connects the input directly to the output.

Unlike multi-layer neural networks, it does **not have hidden layers**.

Single Layer Neural Network



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Explanation of the Image: Single Layer Neural Network

1. Inputs (x_1, x_2, x_3)

- These are the features or signals coming into the network.
- Example: in email classification, inputs could be "contains offer," "has link," "has attachment," etc.

2. Weights (w_1, w_2, w_3)

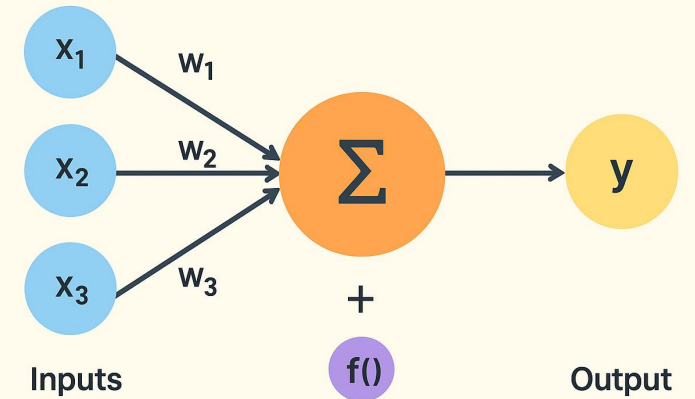
- Each input has an associated weight that determines its importance.
- A larger weight means that input has a stronger effect on the output.

3. Summation (Σ symbol inside orange circle)

- All inputs are multiplied by their weights and added together, plus a bias term:

$$z = (w_1x_1 + w_2x_2 + w_3x_3) + b$$

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4. Activation Function (purple circle labeled $f()$)

- This function decides how the weighted sum is transformed into the final output.
- Examples:
 - **Step function** → outputs 0 or 1 (binary classification).
 - **Sigmoid** → outputs values between 0 and 1 (probability).
 - **ReLU** → outputs only positive values.

5. Output (yellow circle labeled y)

- The final decision or prediction made by the network after applying the activation function.
- Example: output = 1 (spam) or 0 (not spam).

Characteristics:

- ❑ **Simple structure** (only one computational layer).
- ❑ Can only solve **linearly separable problems** (like AND, OR gates).
- ❑ Cannot solve **non-linear problems** like XOR (which require multi-layer networks).