Bais & Activation

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What Bais does

1.Shifts the Activation Function

- Bias allows the activation function to **shift left or right,** enabling the neuron to activate even when inputs are zero or unfavorable.

2.Essential for Non-zero Output

- If all inputs are zero, only the bias determines if the neuron activates.

Why do we need bias in Neural Network

- Demo how bais can help model plots that are not origin centered

- https://www.transum.org/Maths/Activity/Graph/Desmos.asp

Examples

1. House Price Prediction
- Input features: Square footage, number of rooms, age of house.
- Problem: Even if a house has 0 square footage or 0 rooms (hypothetically), the base land cost or location premium should still result in a non-zero price.
- Bias lets the model learn this minimum price floor.

2. Employee Salary Prediction
- Input features: Experience, education level, certifications.
- Reality: Even a fresher (0 experience) may have a base starting salary.
- Bias captures this starting wage, independent of other features.

Why we need Activation Function

What Activation Funcitons do:

- Introduce Non-linearity
  - Without activation, no matter how many layers you stack, the network remains a linear model.
  - Functions like ReLU, tanh, sigmoid introduce the ability to model complex, nonlinear relationships.

- Squash Output to a Range (in some cases)
  - Sigmoid: compresses to [0, 1]
  - Tanh: compresses to [-1, 1]
  - This helps in controlling gradient values and can be useful in probability or binary classification contexts.

- Enable Gradient-Based Learning
  - Activation functions are **differentiable**, which is necessary for **backpropagation** (computing gradients and updating weights).

Activation Functions

- If you **remove activation functions** from a neural network (especially non-linear ones like ReLU, sigmoid, or tanh), then **no matter how many layers you stack**, the entire network **collapses to a linear model**.

- These are what allow a neural network to **introduce non-linearity** and **learn complex, nonlinear mappings**.

Explain with Example

- Refer Jupyter Notebook: Why_Bias.ipynb