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CS 4407
Data Mining & Machine Learning

LEARNING JOURNAL UNIT 6

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What I Did and How I Did It

This week I explored the foundations of **artificial neurons**, their structure, and how they function as the basic computational units in a neural network. Through readings and discussions, I analyzed how neurons combine weighted inputs, biases, and activation functions to generate output. In my discussion post, I focused on explaining the **sigmoid activation function**, its role in non-linearity, and its historical importance in early neural networks. I compared this function to biological neurons, emphasizing how both share a threshold-like behavior when responding to stimuli.

In my **programming assignment**, I applied these theoretical concepts by creating a neural network model using a **7-segment display encoding task**. I first generated binary patterns for digits and letters, representing which display segments were activated. I then built a three-layer neural network with seven input units, five hidden units, and seven output units. I trained and tested the model using pattern files I created manually, observing the weight adjustments and the resulting prediction accuracy.

My Reactions

Working through the programming task helped me bridge the gap between mathematical formulas and practical computation. While the discussion reinforced theoretical understanding, the coding task provided concrete experience in training and testing a model. Seeing how a network learns to recognize binary patterns was both challenging and rewarding.

Feedback and Interactions

The peer and instructor feedback from the discussion forum highlighted the clarity of my explanation of the sigmoid function. I received comments appreciating the link I drew between

biological neurons and their artificial counterparts, which reinforced my confidence in articulating complex concepts simply.

Feelings and Attitudes

Initially, I felt intimidated by the mathematical depth of neural networks, particularly understanding how weight updates occur. However, hands-on experimentation made the process more intuitive. I also realized that errors during testing were not failures, but indicators of how well the network was learning, which shifted my mindset toward iterative improvement rather than perfection.

What I Learned

This week deepened my understanding of how neural networks approximate non-linear relationships. I learned how activation functions influence the model's ability to learn, and why the **sigmoid**—although conceptually significant—is now often replaced by ReLU in deeper architectures due to gradient-related limitations (Datacamp, 2025). Additionally, constructing and training the network taught me how **perceptron weighting** operates and how learning rates and biases affect performance (GeeksforGeeks, 2025).

Reflections and Challenges

One surprising insight was how closely the mathematical representation of artificial neurons parallels biological processes. The most challenging part was configuring the correct pattern files and interpreting weight outputs during training, as small errors in encoding could disrupt the entire model. Through this, I recognized that I am developing stronger analytical and problem-solving skills, as well as patience for debugging.

Key Takeaway

The most important realization this week is that neural networks, while inspired by biology, rely heavily on mathematical precision and iterative training. Understanding this relationship not only strengthens my technical foundation in machine learning but also enhances my appreciation of how data-driven systems can simulate aspects of human cognition.

References

Datacamp. (2025). *Sigmoid activation function: Deep learning basics.* https://www.datacamp.com/articles/sigmoid-activation-function

GeeksforGeeks. (2025). *Activation functions in neural networks.* https://www.geeksforgeeks.org/machine-learning/activation-functions-neural-networks/

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