Week 7

Challenges

ECE 410/510
Spring 2025

Instructions

- The challenges below are for you to delve deeper into the subject matter and to test your own knowledge.
- I'd suggest you try to solve at least one problem per week. More is obviously better.
- Practice "vibe coding" if necessary.
- Post your solution(s) in the `#weekly-challenges` Slack channel so everybody can appreciate what you did, ask questions, and make comments.
- Document everything for your portfolio and make your code available on Github.

Challenge #22: Broadening your horizon about neuromorphic computing

Learning goals:

- Read a recent, state-of-the-art review paper on neuromorphic computing.
- Be able to digest the information and answer questions about the paper.

Tasks:

1. Read the following paper: Kudithipudi, D., Schuman, C., Vineyard, C.M. *et al.* **Neuromorphic computing at scale**. *Nature* **637**, 801–812 (2025). https://doi.org/10.1038/s41586-024-08253-8
2. Consider writing a "blog" post for your portfolio with your answers to the following questions:
    1. The authors discuss several key features necessary for neuromorphic systems at scale (distributed hierarchy, sparsity, neuronal scalability, etc.). Which of these features do you believe presents the most significant research challenge, and why? How might overcoming this challenge transform the field?
    2. The article compares neuromorphic computing's development to the evolution of deep learning, suggesting it awaits its own "AlexNet moment." What specific technological or algorithmic breakthrough might trigger such a moment for neuromorphic computing? What applications would become feasible with such a breakthrough?
    3. The authors highlight the gap between hardware implementation and software frameworks in neuromorphic computing compared to traditional deep learning. Develop a proposal for addressing this gap, specifically focusing on how to create interoperability between different neuromorphic platforms.
    4. The review emphasizes the importance of benchmarks for neuromorphic systems. What unique metrics would you propose for evaluating neuromorphic systems that go beyond traditional performance measures like accuracy or throughput? How would you standardize these across diverse neuromorphic architectures?
    5. How might the convergence of emerging memory technologies (like memristors or phase-change memory) with neuromorphic principles lead to new computational capabilities not possible with traditional von Neumann architectures? What specific research directions seem most promising?