Week 5

Challenges

ECE 410/510
Spring 2025

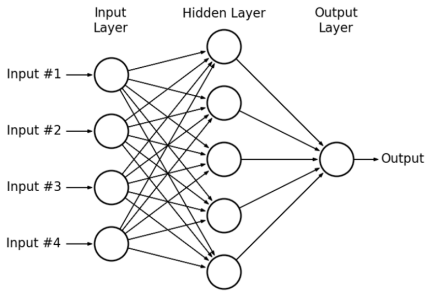
Instructions

- 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 #16: Benchmarking SAXPY with PyTorch

Learning goals:

- Compare the performance of a simple feed-forward neural network (as seen in class) accelerated with CUDA vs accelerated with PyTorch.



Tasks:

1. (Vibe) Code a CUDA-accelerated version of a simple multi-layer feedforward, e.g., 4 inputs, 5 hidden neurons, 1 output, fully connected (as seen in class).
2. (Vibe) Code the same network by using PyTorch.
3. Benchmark both implementations and compare. What can you conclude?
4. If you want to go further, increase the depth and the width of the network and compare its execution time for various sizes. What's the outcome? Can you beat PyTorch with CUDA? Or vice versa?

Challenge #17: Sorting on a systolic array

Learning goals:

- Learn how to implement Bubble sort on a systolic array.
- Evaluate its performance as a function of the problem size.

Tasks:

1. Design a systolic array that can do Bubble sort. What dimension does the array need to have?
2. (Vibe) Code a software version in your favorite language and test it.
3. Visualize the execution times for various sorting sizes. E.g., 10, 100, 1000, 10000, etc.