Architecture of Parallel Computers

Program 1: GPU Programming

Plot 1:

$$C(x) = 4A(x)^4 - 2 * A(x)^2 D(x) + 8 * A(x)^3 B(x) + 7 * A(x)^2 B(x)^2 + 5 * A(x)B(x)^3 + 2B(x)^2 + 3 * B(x)^4 + 1$$

Plot 1	Base Code	Energy Optimized Code	% Improvement
Total instructions processed	2751584	2151584	**21.8056%**
Total number of cache accesses	51535	41973	**18.5544%**
Average Energy usage	85.727	76.7335	**10.4909%**

Plot 2:

$$C(x) = 3 * A(x)^4 / D(x) + 2 * B(x)^4 + 5 * A(x)^2 B(x)^2 / (E(x)D(x)) + 3 * A(x)^2 B(x) + 7 * A(x)B(x)^2 + 9/D(x)^2$$

Plot 2	Base Code	Energy Optimized Code	% Improvement
Total instructions processed	2601584	2301584	**11.5314%**
Total number of cache accesses	51543	46565	**9.65796%**
Average Energy usage	96.4213	87.5893	**9.1598%**

Analysis:

1. Why is the total number of instructions less than in the base code?

Efficient computation. I'm guessing that since the redundant calculations have reduced and reused computations were stored in temporary variables the instruction count was reduced.

2. Why are there fewer cache accesses?

Since redundant calculations were improved and values were based off of the values that we already defined, data locality was improved by possibly reusing data.

3. What is the parameter that is compromised for saving energy? Why?

I think the conventional execution is compromised. In this case we have to find similarities to create grouping. I think that is the parameter that is affected the most. In terms of the code and the variables, I couldn't think of any as of now.

4. Which code would you prefer to use, and under which circumstances?

I would personally use the energy optimized code as it transforms expressions to simpler terms to make execution both faster and more energy efficient. Yes, the actual optimization does take some work but it's worth the effort put in.

5. How did you find your first experience with a simulator?

The experience was quite good. I really liked getting to know CUDA and how expressions can be made faster and energy optimized at the same time.

6. Where do you think simulators will be helpful?

One example that I can think of is in image processing where one part does the image gathering while the other processes it.