September 15th, 2015 Pre-Class Questions

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Question 0

I started these pre-class exercises on September 14th at about 8PM and finished around 9PM. I then came back and made some edits on September 23rd.

Question 1

For the slides on the Game of Life, I was confused by how exactly the coarse blocking scheme would work for the high performance implementation. (This was later cleared up in lecture).

Question 2

Because of the periodic boundary conditions, this implementation stores the board state in $(n+2)^2$ bytes. Given that the size of the L3 cache on one of the totient nodes is 15MB, we see that we can store one board in the cache when:

$$(n+2)^2 < 15 \cdot 2^{20}$$

which is

$$n < \sqrt{15 \cdot 2^{20}} - 2 \approx 3963$$

Question 3

To improve the operational intensity, we could divide the domain into a set of blocks that each processor is responsible for. Then for each block, the respective processor would also contain information about n cells to each side, so that each processor could compute n steps in the future without needing to communicate.

Question 4

In order to parallelize this code, we would need some method of communicating what cells are occupied on the borders of each domain. For the totient nodes, parallelizing the work would mean the computations could be done much faster. However, there are also

additional communication costs, but I think for the nodes, which have a relatively smaller number of cores compared to say, the accelerator boards, these communication costs would not be too high.

Question 5

I think this code could be improved by switching the loop ordering so that each processor only has to communicate the properties of particle j once and then calculate the forces with each particle i, rather than gathering the properties of particle j every time for each i. This should reduce communication costs significantly.