ChE 5480 Summer 2005 HPC Homework #3

Due in class Thu July 7 2005

Please feel free to discuss these questions with your classmates.

1. What is the important difference between instruction-level parallelism (ILP) and multiprocessing?

2. Name the four kinds of ILP, and briefly describe each.
   (a)

   (b)

   (c)

   (d)

3. Name any three kinds of instructions.

4. If my CPU is 1.5 GHz, how many times per second does its internal clock tick?

5. What is a clock cycle?

6. How many clock cycles does it take ...
   (a) ... to perform a 64-bit floating point addition on a POWER4 CPU?

   (b) ... to perform a 64-bit floating point multiplication on a POWER4 CPU?

   (c) ... to perform a 64-bit floating point addition on a Pentium4 CPU?

   (d) ... to perform a 64-bit floating point multiplication on a Pentium4 CPU?

7. What does it mean for two operations to be *independent*?

8. Why is it useful for operations to be independent?

9. Why are computers good at optimizing loops?

10. In the previous question, what does the word *optimize* mean?

11. Why is pipelining desirable?

12. What is a *reduction*?

13. What are the four commonly-observed performance characteristics?
    (a)

    (b)

    (c)

    (d)

14. On many platforms, the sum operation (which is a reduction) is substantially faster than the addition operation. Why?

15. List these operations from fastest to slowest:
    x^y (for real x and y), addition, logarithm, division

16. Name three things that can prevent pipelining.
    (a)

    (b)

    (c)

17. What is a vector instruction?