

CSC718 Parallel Programming Final Exam

1. (10 points) What is GPU programming? What are the strengths of GPU programming over CPU programming?
2. (10 points) An oceanographer gives you a serial program and asks you how much faster it might run on 8 processors. You can only find one function amenable to a parallel solution. Benchmarking on a single processor reveals 80% of the execution time is spent inside this function. What is the best speedup a parallel version is likely to achieve on 8 processors using Amdahl's law?
3. (10 points) For a problem size of interest, 6 percent of the operations of a parallel program are inside I/O functions that are executed on a single processor. What is the minimum number of processors needed in order for the parallel program to exhibit a speedup of 10?
4. (20 points) Average memory access time can be calculated using $AMAT = \text{Hit time} + \text{Miss rate} \times \text{Miss penalty}$.
 - 1) (10 points) If a direct mapped cache has a hit rate of 95%, a hit time of 4 ns, and a miss penalty of 100 ns, what is the AMAT?
 - 2) (10 points) If replacing the cache with a 2-way set associative increases the hit rate to 97%, but increases the hit time to 5 ns, what is the new AMAT?
5. (50 points) Programming Assignment: The simplest harmonic progression is

$$\frac{1}{1}, \frac{1}{2}, \frac{1}{3}, \dots$$

Let $S_n = \sum_{i=1}^n \frac{1}{i}$.

A harmonic progression sequential summary program (hst.c) is given in the exam and the program can compute the sums to arbitrary precision after the decimal point. The program requires two parameters, n and d , and computes S_n to d digits of precision after the decimal point. For example, $S_7 = 2.592857142857$, to 12 digits of precision after the decimal point.

- 1) (25 points) Convert the C sequential program, hst.c, to MPI parallel program (the hst.c source code can be found in the hps.zip file). Benchmark the program computing $S_{1,000,000}$ to 100 digits of precision, using 1, 2, 3, 4 processors.

Problem	Np=1	Np=2	Np=3	Np=4
Programming				

- 2) (25 points) Convert the C sequential program, hst.c, to OpenMP parallel program. Benchmark the program computing $S_{1,000,000}$ to 100 digits of precision, using 1, 2, 3, 4 threads.

Problem	Nt=1	Nt=2	Nt=3	Nt=4
Programming				

Submit the following items to 'Final Exam' dropbox in D2L website:

- A short description about how to compile and run your program
- MPI source code in 3.1)
- OpenMP source code 3.2)
- Benchmark results from 3.1) and 3.2)