CSE 340 Midterm 3

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I. Question (15 points)

Use manager and worker paradigm to find the number of perfect numbers smaller than 10^{12}. A number is perfect if it is equal to the sum of its positive divisors excluding itself. 6 is a perfect number 6 = 1 + 2 + 3, 28 is a perfect number 28 = 1 + 2 + 4 + 7 + 14.

II. Question (15 points)

Use manager and worker paradigm to find the number of integer solutions to the equation

$$a + b^2 + c^3 = c + d^2 + e^3 \quad (1)$$

where $1 < a, b, c, d, e < 1000$.

III. Question (20 points)

Consider the following algorithm to generate a sequence of numbers. Start with an integer n. If n is even, divide by 2. If n is odd, multiply by 3 and add 1. Repeat this process with the new value of n, terminating when n = 1. For example, the following sequence of numbers will be generated for n = 12.

```
12 6 3 10 5 16 8 4 2 1
```

Use manager and worker paradigm to find the maximum sequence length for the numbers smaller than 10^{12}.

IV. Question (15 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?

V. Question (15 points)

A parallel program executes in 242 seconds on 16 processors. Through benchmarking it is determined that 9 seconds is spent performing initializations and cleanup on one processor. During the remaining 233 seconds all 16 processors are active. What is the scaled speedup achieved by the program?

VI. Question (20 points)

Benchmarking a parallel program on 1, 2, ..., 8 processors produces the following speedup results:

p	ψ
2	1.89
3	2.63
4	3.23
5	3.68
6	4.00
7	4.22
8	4.35

What is the primary reason for the parallel program achieving a speedup of only 4.35 on eight processors?