Problem 1.

Solution

Amdahl's Law states that if P is the proportion of a program that can be made parallel, then the maximum speedup that can be achieved by using N processors is

$$s(N) = \frac{1}{(1-P) + P/N}$$

Part (a)

The maximum achievable speedup is $s(\infty) = 1/(1-P)$. Here $P = 4/5$, therefore the maximum speedup is 5.

Part (b)

If the desirable speedup is 50, the maximum percentage of the serial portion for the algorithm is 1/50.

Problem 2.

Solution

Assumption: Array A is of type *float*.

Part (a)

1024 B of data in main memory requires (150+$\frac{1024}{8}$ = 278) CPU cycles to process. Array A is of size $1024 \times 1024 \times 8$ Bytes. Therefore the cost to fetch the whole matrix is $278 \times 1024 \times 8 = 2277376$ CPU cycles.

Part (b)

Since FORTRAN stores in column-major order, cache needs to be overwritten for each element access. Each element takes 150 CPU cycles for memory fetch and 1 CPU cycle for cache fetch. Therefore the total cost to fetch A to perform the computation is $1024 \times 1024 \times 151 = 158334976$ CPU cycles which is about 70 times the number of CPU cycles required for C or any other row-major order language code.