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Set 6 - Amdahl's Law,Roofline Model

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Question 1: Amdahl's Law

a) Assume you work on Euler and you have one node with 24 cores that you can use to solve a problem in parallel for which 91% of your code is parallelizable. Can you get a speedup of 8? If so, how many cores are needed at least?

b) Profiling a serial code for Molecular Dynamics you find that 90% of the time is spent in a large loop with independent iterations (perfectly parallelizable with N threads), another 5% is spent in a region that can be parallelized with at most 2 threads and the remaining part is purely serial.

Given Amdahl's law, what is the strong scaling for $N \to \infty$?

For what value of N is the speedup equivalent to 90% of the asymptotic maximum?

Question 2: Roofline Model

Given the following serial code snippet:

```
1  float A[N], B[N], C[N];
2  ...
3  const int P=2;
4  for (int i=0; i<N; ++i ) {
5    int j=0 ;
6    while (j < P) {
7       A[i] = B[i]*A[i]+0.5 ;
8      ++j;
9    }
10   C[i] = 0.9*A[i]+C[i] ;
11 }
```

a) What is the operational intensity of the code? Assume an infinite cache and state any further assumption you made. Show your calculations.

b) A compute node has a peak performance of 409.7 GFLOP/s (single precision) and a memory bandwidth of 34 GB/s. For which range of positive integer values P is the code of subquestion (a) memory bound? Show your calculations.