Assignment 3

1. Which of the following was the first scientific computing language?
   a. Fortran
   b. C
   c. C++
   d. Python

Correct option: a

2. Which time component is not considered when deriving Amdahl's law?
   a. Communication overhead between processors
   b. Runtime of the sequential portion
   c. Runtime of the parallel portion
   d. Overall runtime

Correct option: a

3. If a sequential program takes 100 seconds and then when parallelized on a 10-core CPU, it takes 20 seconds, what are the speedup and efficiency?
   a. 10, 100%
   b. 10, 50%
   c. 5, 50%
   d. 5, 100%

Correct option: c

Explanation: Speedup = Tserial/Tparallel = 100/20 = 5

Efficiency = Speedup/Number of cores = 5/10 = 0.5 or 50%

4. If a sequential program takes 25.6 seconds and then when parallelized on a 64-core CPU, it takes 0.8 seconds, what are the speedup and efficiency?
   a. 16, 100%
   b. 32, 50%
   c. 16, 50%
   d. 32, 100%

Correct option: b

Explanation: Speedup = Tserial/Tparallel = 25.6/0.8 = 32

Efficiency = Speedup/Number of cores = 32/64 = 0.5 or 50%

5. According to Amdahl's Law, what is the approximate speedup on 10 processors if the total runtime for sequential code is 50 seconds and that for the parallel component is 40 seconds?

(a) 1.66
(b) 2
(c) 3.6
(d) 10

Correct option: c

Explanation: Speedup according to Amdahl's Law:$1/(1-f+f/N)$ where f is the parallelized time fraction, and N is the number of processors.

Time fraction that is parallelized = 40/50 = 0.8

Speedup = 1/ (1- 0.8+ 0.8/10) = 3.57

6. What is the speedup (rounded to the nearest integer) according to Amdahl's Law if the parallelized time fraction is 0.5 and there are 20 processors?

a. 2
b. 5
c. 10
d. 20

Correct option: a

Explanation: Speedup according to Amdahl's Law:$1/(1-f+f/N)$ where f is the parallelized time fraction, and N is the number of processors.

Time fraction that is parallelized = 0.5

Speedup = 1/ (1- 0.5+ 0.5/20) = 1.90.

After rounding up to the nearest integer S = 2.

7. According to Amdahl's Law, theoretically, what is the best speedup we can get for code with a parallelized 90%- time fraction?

a. 10
b. 20
c. 50
d. 90

Correct option: a

Explanation: $S < 1/(1-f)$

For f = 0.9, S = 10

8. According to Gustafson's Law, what is the speedup if the parallelized time fraction is 0.8 and there are 20 processors?
   a. 2.5
   b. 10.2
   c. 16.2
   d. 20

Correct option: c

Explanation: Speedup according to Gustafson's Law:1-f+N*f where f is the parallelized time fraction, and N is the number of processors.

Time fraction that is parallelized = 0.8

Speedup = 1- 0.8+ 0.8*20 = 16.2

9. What is the main advantage of distributing data evenly among processors?
   a. Improved memory allocation
   b. Enhanced computational efficiency
   c. Easier programming
   d. Reduced power consumption

Correct option: b

Explanation: Distributing data evenly among processors ensures that the workload is balanced, which minimizes idle time for any processor. This leads to more efficient utilization of computational resources, thereby enhancing computational efficiency.

10. Which of the following is NOT a feature of MPI?
    a. Scalability across nodes
    b. Shared memory programming
    c. Explicit communication
    d. Support for distributed systems

Correct option: b