

Midterm Sample 2021

25 marks (1 hour 20 min)

1. Write a single sentence about any one aspect of OpenMP that you liked? [1 mark]
2. In one or two sentences, explain what Write-After-Write dependence is? [1 mark]
3. Provide an intuitive explanation (formal definition is also fine) of what efficiency is in terms of P and N , where P is the number of processors and N is the problem size, in or two sentences [1 mark]
4. OpenMP provides multiple mechanisms to control the number of threads. In one or two sentences explain one such method. [1 mark]
5. In one or two sentences, explain the difference between `firstprivate` and `lastprivate` data sharing attributes [1 mark]
6. Consider a program whose sequential execution time is 100 days. Part A of this program cannot be parallelized and accounts for 40% of total execution time. Part B of this program can be linearly be parallelized and the performance scales linearly in terms of number of processors. Part B accounts for 60% of total execution time. Write an expression to compute the parallel execution time in terms of P , where P is the number of parallel processors. [2 marks]
7. COO vs. CSR [3 marks]
 - a. Describe the CSR format and COO format with a small example
 - b. Explain the situation under which the COO format will have less storage requirement than CSR format.
8. Write all data dependences in the following codes (concise representation is fine for part B) [5 marks]
 - a) $a = b + c$
 $b = b * 2$
 $b = b - 2;$
 $d = b + a;$
 $c = (a > b) ? a : b;$

```

b) for (i =3; i<10; i++ )
    for (j =3; j<20; j++ )
        for(k=20; k<42; k++)
            A[i][j] += C[i][k] / D[k][j]
            B[i][j][k] = B[i-1][j][k] + E[i][j][k]
            F[i][j][k] = F[i][j-1][k] + E[i][j][k]
            G[i][j][k] = G[i][j][k-1] + E[i][j][k]

```

9. Sparse Matrix Vector Multiplication (SpMV) [5 marks]

- a) Write code to perform SpMV using COO format
- b) Explain your design considerations and potential performance problems with your code.

Note: For part a) you are only required to write code for the parallel part. You can skip other parts like initialization, printing, etc.

10. Filtering [5 marks]

- a) Assume that you are given a dense array where most elements are zero. Write code to convert this dense array to CSR format.
- b) Explain your design considerations and potential performance problems with your code.

Note: For part a) you are only required to write code for the parallel part. You can skip other parts like initialization, printing, etc.