



Politecnico di Milano

Dipartimento di Elettronica, Informazione e Bioingegneria

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Parallel Computing – II part– Friday, August 30th, 2024

Polimi ID _____

Surname _____ **Name** _____

- This is a closed-book examination. You cannot use computers, phones, or laptops during the exam.
- Paper will be provided, but you should bring and use writing instruments that yield marks dark enough to be read easily. Erasable pens can be used.
- Total available time: 1h:00m.

Exercise 1 (4 points) _____

Exercise 2 (4 points) _____

Exercise 3 (4 points) _____

Exercise 3 (4 points) _____

Exercise n. 1

Answer the following questions about parallel patterns and briefly explain (without an explanation, the answer will be considered invalid)

- A. Please describe how the parallel zip pattern works, its complexity, and how it could be parallelly implemented. (2)

- B. Can you remove a flow dependency? Yes/No, and in case, how? (1)

- C. Which loop can be parallelized and under which conditions? Does the overhead of the runtime have an impact on the parallelization of the loops? When and on which target architecture? (1)

```
for (j=1; j<1000; j++)  
    for (i=0; i<10; i++)  
        a[i][j] = f(a[i][j]);
```

Exercise n. 2

Answer the following questions about parallel programming languages (without an explanation, the answer will be considered invalid).

- A. Describe briefly the shared memory programming model with threads and two of its implementations. (2)

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- B. Describe three scenarios in which a combination of different parallel programming languages is suitable. (2)

[illegible]

Exercise n. 3

Answer the following questions about OpenMP (without an explanation, the answer will be considered invalid).

A. What is "false sharing"? Write an example of an OpenMP program that suffers from it. (3)

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B. What happens when a variable is declared as `firstprivate` in an OpenMP pragma? (1)

Exercise n. 4

Answer the following questions about CUDA (without an explanation, the answer will be considered invalid).

- A. If we want to copy 3000 bytes of data from host array h_A (h_A is a pointer to element 0 of the source array) to device array d_A (d_A is a pointer to element 0 of the destination array), what would be an appropriate API call for this in CUDA? (1) **This question can be skipped in case of a passed challenge.**

- B. How is error handling implemented in a CUDA host program to check whether a kernel launch has been successful? (1.5)

- C. What is asynchronous memory prefetching, and when is it useful? (1.5)
