Politecnico di Milano

Dipartimento di Elettronica, Informazione e Bioingegneria

prof. Fabrizio Ferrandi

Advanced Algorithms and Parallel Programming I part–January 17th, 2023

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:30m.

Exercise 1 (4 points) _____

Exercise 2 (4 points) _____

Exercise 3 (4 points) _____

Exercise 4 (4 points) _____

Exercise n. 1

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

A. Please describe the matrix multiply algorithm on PRAM (Pseudo code. Complexity). (1)

B. Please describe the type of Read/Write abilities a PRAM may have. (1)

C. The PRAM algorithm computing the prefix sum of a vector uses concurrent reads. True/False? Where? (1)

D. Gustafson says that the Amdahl law is wrong. True/False? Why? (1)

Exercise n. 2

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

A. Describe the algorithm selecting the i^{th} smallest of n elements (Pseudo code, complexity). (2)

B. Is there a Select i^{th} smallest of n elements algorithm that runs in linear time in the worst case? (1)

C. In which class of randomized algorithms could the algorithm described in A be inserted? (1)

Exercise n. 3

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

A. Please explain what the competitive analysis is meant for. (2)

B. Describe the Karger and Stein algorithm and its complexity. (2)

Exercise n. 4

Consider a stack data structure storing elements of a given type, which can be assumed to be empty at the start time.

Users can push one element on top of the stack using a PUSH operation, which has a constant cost of 1 and remove the top with a POP operation, which has a constant cost of 1.

Compute the real cost of the MULTIPOP(k) operation that removes min{k,s} elements from the top of the stack where s is the number of elements in the stack.

Determine the worst possible sequence of n operations on this stack and compute the amortized cost for the operations contained in the sequence using one of the methods seen during the course.