**Data Centers and High Performance Computing**
**June 15th, 2016**

**Name**: _____ **Surname**: _____ **Student ID**: _____

*Remember to write your correct personal data on this sheet, and use it as a folder to wrap the exposition. If you think a question is ambiguous, write your interpretation and answer accordingly. You are not allowed to use any note or digital device. If you are found copying or consulting notes, you will not pass the written test.*

**Question 1 - (5 points)**
Discuss the problem of cache coherency, comparing the general idea of the Snooping cache and Directory-based coherency protocols.

**Question 2 - (9 points)**
State the definitions of *wait-free* and *lock-free* progress conditions. Then, in the context of a multi-thread/multi-process application, project and develop an *incremental counter.* Two operations must be developed to access this data structure, namely i (which adds 1 to the current value of the counter), and d (which subtracts 1 from the current value of the counter). Operations must be safely executed in parallel.
Two versions of the incremental counter should be implemented: a *wait-free* and a *lock-free* one. To this end, the student can use the following primitive:

Then, compare and discuss liveness and performance of the two implementations. The student can write the code for implementation in any programming language, or in pseudocode.

**Question 3 - (7 points)**
Discuss the Restricted Transactional Memory (RTM) facility offered by modern Hardware Transactional Memory-enabled Intel processors, emphasizing what are the pros and cons from a development point of view.

**Question 4 - (5 points)**
In the context of MPI, state what a communicator is, and what are the programmatical benefits of this kind of abstraction

**Question 5 - (5 points)**
Present simulation taxonomy, and discuss what are the main differences between different types of digital simulation.

I, the undersigned, according to the provisions of law N. 675/96, allow the teachers to publish on the website the results of this written test.

Legible signature in full: _____