CONCURRENCY:
MULTI-CORE PROGRAMMING & DATA PROCESSING

Lab03 - Atomic type and volatile

RECAP

- Creating a Thread in Java
  - Implement Runnable interface
  - Extend Thread class
- Implicit locks
  - Synchronized methods
  - Synchronized statements
- Explicit locks
  - Lock interface
  - ReentrantLock class

JAVA ATOMIC DATA TYPES

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- Lock-free thread safe programming on single variables
- Atomic equivalente for usual data types
  - AtomicBoolean
  - AtomicInteger
  - AtomicIntegerArray
- Direct use of hardware primitives
- Operations
  - Main: get() and set(newValue)
  - Conditional update: compareAndSet(expected, update)
  - Other utility functions:
    - getAndIncrement(), getAndDerement()
    - IncrementAndGet(), decrementAndGet()
    - addAndGet(delta)

VOLATILE

- Declaring a volatile Java variable means:
  - The value of this variable is **never cached thread-locally**
  - Access to the variable acts as enclosed in a synchronized block, **synchronized on itself**

ATOMIC TYPES VS. VOLATILE

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- Atomic operations get() and set() has the memory effects of reading/ writing a volatile variable
- … but it extends volatile semantics with conditional update primitives
- … and introduces atomic arrays
    - Array elements can be manipulated in an atomic manner
- Attention!

  Declaring an array `volatile`, doesn't make each element `volatile`.

EXERCISES

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1. Implement a class `VolatileCounter` using Java's volatile keyword. Test your counter with several threads running in parallel and report whether the `VolatileCounter` is thread-safe or not. Justify your answer.

2. Implement a class `AtomicCounter` using Java's AtomicInteger type and its method `compareAndSet(expectedValue, updateValue)`. Test your counter with several threads running in parallel and report whether the `VolatileCounter` is thread-safe or not. Justify your answer.

3. Submit the two classes `VolatileCounter` and `AtomicCounter` together with a text file containing your explanations.