Advanced Parallel Programming Exercise 4

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Please solve the following tasks by 12.06.2025. The results are not graded, but a solution is discussed on 12.06.2025.

Task 1: Synchronization

Suppose you need to synchronize two tasks:

- A task notifies a second, asynchronously running task that a particular event has occurred, because the second task cannot proceed until the event has taken place;
- The event occurs only once;
- There is no data to be transferred between the two tasks;
- Whether the raw event has occurred is only available to the first task.

1a) Benefits

What are the possible approaches to implement such communication? Give your solutions in code, and discuss their advantages and disadvantages.

1b) Multiple tasks

If there are multiple tasks needed to be notified, what changes are necessary for each of your proposed approach?

Task 2: Creation of a custom mutex type

In this task, you should create a custom mutex type. Firstly, make yourself familiar with the methods a `std::mutex` provides[1]. You do not need to implement the `native_handle`, but the other functionality should be present.

As an internal locking/unlocking mechanism, you can use an `std::atomic_flag` with the provided functionality – even though it will technically be covered later in the course.[2] You can choose between “busy-waiting”, i.e., the thread will test the flag repeatedly, or a defered waiting mechanism by calling `wait`.

[1] `https://en.cppreference.com/w/cpp/thread/mutex.html`
[2] `https://cplusplus.com/reference/atomic/atomic_flag/`