
Solutions Manual

AUTHOR NAME

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CONTENTS

I	Lecture Slides	5
9	Monitors and Condition Variables	7
9.1	What's wrong with <i>semaphors</i> ?	7
9.2	Monitors	7
II	Notes From Text	9
	Index	11

PART I

LECTURE SLIDES

CHAPTER 9

MONITORS AND CONDITION VARIABLES

WHAT'S WRONG WITH *semaphors*?

- are shared global variables
- no linguistic connection between semaphores and data they control
- can be accessed from anywhere
- dual purposed (mutex and sched constraints)
- no guarantee of proper usage

Solution: use a higher level construct

MONITORS

A monitor is similar to a class that ties data/operations and synchronization together.

They differ from classes by guaranteeing mutual exclusion and requiring all data to be private.

Definition. 1. (From Wikipedia) A *monitor* is a synchronization construct that allows threads to have both mutual exclusion and the ability to wait (block) for a certain condition to become true.

2. (From slides) A *monitor* is a defines a *lock* and zero or more *condition variables* for managing concurrent access to shared data.

- Monitors use a *lock* to ensure that only a single thread is active in the monitor at a given time
- The *lock* also provides mutual exclusion for shared data
- *Condition variables* enable threads to go to sleep inside the critical sections, by releasing their lock at the same time it puts the thread to sleep

Monitor Operations:

- Encapsulates shared data to protect
- Acquires the mutex at start
- Operates on the shared data
- Temporarily release mutex if it can't complete
- Reacquires the mutex when it can continue
- Releases the mutex at the end

Implementing Monitors in Java

It is simple to turn a Java class into a monitor:

- Make all data private
- Make all methods synchronized (or at least the non-private ones)

```
class Queue{
    private data;        // queue data

    public void synchronized Add(Object item) {
        put item on queue;
    }

    public void synchronized Remove(){
        if (queue not empty){
            remove item;
            return item;
        }
    }
}
```

PART II

NOTES FROM TEXT

INDEX

monitor, 7

semaphors, 7