



Department of Computer Science and Engineering  
Faculty of Engineering, University of Moratuwa

**CS4532 Concurrent Programming**

2014 Batch Semester 5 (Jan - Feb 2018)

- Class LMS <https://online.mrt.ac.lk/course/view.php?id=8237>
- Schedule Wednesday 8:15am – 10:15am and Thursday 3:15pm – 5:15pm at CSE Dept. (12 sessions)
- Instructors Dr. Dilum Bandara, [dilumb@cse.mrt.ac.lk](mailto:dilumb@cse.mrt.ac.lk), 011-265-0152
- Prerequisite(s) CS2012, CS2060, and CS2042  
No concurrent or parallel programming knowledge is assumed, but students have to be good with programming. Solid background in algorithms and data structures, operating systems, and networking would be a plus.
- Text No specific textbook. However, different topics will rely on the following readings:
- The Art of Multiprocessor Programming by Maurice Herlihy and Nir Shavit
  - The Little Book of Semaphores: The Ins and Outs of Concurrency Control and Common Mistakes (2<sup>nd</sup> edition) by Allen B. Downey
  - Other texts on parallel and concurrent programming and distributed systems
  - Several relevant research papers
- Assessment Distribution of marks is as follows:
- Take home labs (4) 32% (8 × 4)
  - Homework 8%
  - Quizzes – based on assigned readings (3) 10% (5 × 2)
  - Final Exam (2 hour, closed book) 50%
- Course Objectives To provide an in-depth understanding of parallel and concurrent algorithms, their designs, algorithmic techniques, and applications.  
At the end of the module, you will be able to identify a suitable algorithmic approach to solve a constrained problem, understand its complexity and trade-offs, justify its appropriateness, and be able to implement it. Required readings, homework, take home labs, and discussions will enhance both the analytical and soft skills.
- Syllabus We will start with concurrent programming where you will learn about theory, problems, and solution patterns. Then we will discuss about parallel programming with multi/many-cores and distributed systems. The goal for the class is to be broad rather than deep. Our plan is to touch upon the following tentative list of topics:

| Date   | Topic  |
|--------|--|
| Jan 3  | 1. Introduction to concurrent programming <ul style="list-style-type: none"><li>• Mutual exclusion</li></ul>   |
| Jan 4  | <ul style="list-style-type: none"><li>• Consumer producer problem, Reader-writer problem</li><li>• Amdahl's law, what kills parallelism, measuring parallelism</li></ul> |
| Jan 10 | 2. Introduction to programming multi/many core systems <ul style="list-style-type: none"><li>• PThreads &amp; Open MP</li></ul>  |
| Jan 11 | <ul style="list-style-type: none"><li>• GPU architectures &amp; CUDA</li></ul>   |

|        |   |
|--------|---|
| Jan 17 | 3. Basic constructs <ul style="list-style-type: none"> <li>Locks, Peterson's lock, Filter lock, Lamport's bakery algorithm</li> </ul>       |
| Jan 18 | <ul style="list-style-type: none"> <li>Semaphore, Monitors, Barriers, etc.</li> </ul>   |
| Jan 24 | 4. Writing concurrent programs <ul style="list-style-type: none"> <li>Writing parallel programs &amp; concurrent data structures</li> </ul> |
| Jan 25 | <ul style="list-style-type: none"> <li>Concurrent/parallel programming patterns</li> </ul>  |
| Feb 1  | <ul style="list-style-type: none"> <li>Classical concurrent programming problems</li> </ul>   |
| Feb 5  | 5. Communication intensive problems & solution patterns (MPI)   |
| Feb 7  |   |
| Feb 8  | 6. Mutual exclusion in distributed systems  |

We will select material adaptively based on the background, interests, and rate of progress of the students.

**Workload Expectations**

There is a normative workload expected of you while following this module. This is a 3-credit module. For the average student, this means 135 study hours over the semester. The following table provides a rough breakdown of how these hours might be spent over the whole semester – but this is only for guidance:

|   |            |
|---|------------|
| <b>Attendance</b>   |            |
| 2 hour lectures × 12 weeks  | 24         |
| <b>Independent work</b>   |            |
| Preparatory work – e.g., set reading, checking LMS announcements, preparation for lectures and labs<br>4 hours a week × 15 weeks + 1 hour | 67         |
| Homework (6)  | 6          |
| <b>Group work</b>   |            |
| Take home labs (9 × 4)  | 36         |
| <b>Assessment</b>   |            |
| Exams (quizzes are included in lecture slots)   | 2          |
| <b>TOTAL</b>  | <b>135</b> |

**Class policies**

- Topics to be discussed in each class will be posted on Moodle, along with relevant readings for each topic. You are expected to keep up with the readings as we go, as they will help provide the foundation for the homework, quizzes, and exam. Impromptu quizzes will be based on these assigned readings.
- All students are expected to actively participate in class and Moodle activities. Poor participation and/or poor performance in assigned course work can be grounds for failure in the course.
- University rule of 80% attendance will be strictly enforced.
- Discussing and exchanging ideas through study groups are encouraged, as this usually leads to a better depth of understanding. As part of the discussions, you may share ideas and thoughts, discuss the meaning of homework questions, or possible ways of approaching a solution. However, you must write homework solutions strictly. If one of your solutions is based on a key idea of someone else, you must acknowledge this in

your homework, to avoid the perception of cheating. This form of collaboration is not an opportunity to copy answers from others.

- Group assignments are given to encourage teamwork and discussion/toleration of alternative ideas/views; hence, they need to be done as a group. A penalty will be enforced for doing group assignments individually.
- Plagiarism, copying another person's work, letting another person copy your work, giving or receiving aid during any test or examination is all strictly not allowed. Any student caught in any of these will receive a failing grade regardless of marks earned on other assessed work.
- Proper netiquette should be observed in using the Moodle.
- Each assigned work will have either a deadline for submission or a specific date for performance. For each day delayed beyond a deadline, 10% of marks will be deducted. Not performing (e.g., not doing a presentation) on an assigned date will result in 0 marks unless there is a valid reason and another student/group is arranged as a replacement. Details of submission will be given with each assignment. All assignments must be submitted via the Moodle.
- The dictionary meaning of deadline is "the latest time or date by which something should be completed". Thus, as you may already experience during internship, deadlines are supposed to be met.
- All quizzes and final exam are closed book and closed note exams. The final exam will be comprehensive, covering material from the entire course including in class and Moodle discussions.
- You may not use cell phones, mp3 players, etc., during the class. All laptops, smart phones, and tablets must be closed, unless you use it to take notes or search for additional contents relevant to the ongoing class discussion. The reason is to prevent distractions to other students, and to prevent the temptation to check email, Facebook, etc.