



**Course:** COMP 322 / ELEC 323  
**Term:** Spring 2015  
**Lecture Room:** Herzstein Hall 210  
**Lectures:** MWF, 13:00-13:50  
**Lab:** W, 19:00-20:30

## **COURSE TITLE**

FUNDAMENTALS OF PARALLEL PROGRAMMING (COMP 322 / ELEC 323)

## **INSTRUCTOR CONTACT INFORMATION**

**Instructor:** Vivek Sarkar

**Assistant:** Penny Anderson, anderson@rice.edu (contact for appointments)

**Office:** Duncan Hall 3131

**Email:** vsarkar@rice.edu

**Office Hours:** MW, 14:30-15:30, and by appointment

## **COURSE OBJECTIVES AND LEARNING OUTCOMES**

The primary goal of COMP 322 is to introduce you to the fundamentals of parallel programming and parallel algorithms, by following a pedagogic approach that exposes you to the intellectual challenges in parallel software without enmeshing you in the jargon and lower-level details of today's parallel systems. A strong grasp of the course fundamentals will enable you to quickly pick up any specific parallel programming system that you may encounter in the future, and also prepare you for studying advanced topics related to parallelism and concurrency in courses such as COMP 422. The desired learning outcomes fall into three major areas (course modules):

1) Fundamentals of Parallelism: creation and coordination of parallelism (async, finish), abstract performance metrics (work, critical paths), Amdahl's Law, weak vs. strong scaling, data races and determinism, data race avoidance (immutability, futures, accumulators, dataflow), deadlock avoidance, abstract vs. real performance (granularity, scalability), collective & point-to-point synchronization (phasers, barriers), parallel algorithms, systolic algorithms.

2) Fundamentals of Concurrency: critical sections, atomicity, isolation, high level data races, nondeterminism, linearizability, liveness/progress guarantees, actors, request-response parallelism, Java Concurrency, locks, condition variables, semaphores, memory consistency models.

3) Fundamentals of Distributed-Memory Parallelism: memory hierarchies, locality, cache affinity, data movement, message-passing (MPI), communication overheads (bandwidth, latency), MapReduce, accelerators, GPGPUs, CUDA, OpenCL, energy efficiency, resilience.

To achieve these learning outcomes, each class period will include time for both instructor lectures and in-class exercises based on assigned reading and videos. The lab exercises will be used to help students gain hands-on programming experience with the concepts introduced in the lectures.

## **REQUIRED TEXTS AND MATERIALS**

There are no required textbooks for the class. Instead, lecture handouts and video links will be provided for each course module. Students are expected to read the assigned lecture handout sections, and watch the assigned videos, before coming to the lecture. We will provide links to optional reference material in the lecture handouts and slides.

## **EXAMS AND PAPERS**

There will be one mid-term exam, and one final exam.

## **GRADE POLICIES**

Grading will be based on your performance on six homeworks (weighted 40% in all), two exams (weighted 20% each), weekly lab exercises (weighted 10% in all), and class participation including worksheets, in-class Q&A, and Piazza participation (weighted 10% in all). Additional grading policies will be posted on the course web site listed below.

## **ABSENCE POLICIES**

If a student misses a lecture, they are expected to inform the instructor, review the lecture material on their own, and complete and submit the worksheet for the lecture. If a student misses a lab, they are expected to complete and submit the lab on their own.

## **RICE HONOR CODE**

In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at <http://honor.rice.edu/honor-system-handbook/>. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

The following policies will apply to different work products in the course:

- In-class worksheets: You are free to discuss all aspects of in-class worksheets with your other classmates, the teaching assistants and the professor during the class. You can work in a group and write down the solution that you obtained as a group. If you work on the worksheet outside of class (e.g., due to an absence), then it must be entirely your individual effort, without discussion with any other students. If you use any material from external sources, you must provide proper attribution.
- Weekly lab assignments: You are free to discuss all aspects of lab assignments with your other classmates, the teaching assistants and the professor during the lab. However, all code and reports that you submit are expected to be the result of your individual effort. If you work on the lab outside of class (e.g., due to an absence), then it must be entirely your individual effort, without discussion with any other students. If you use any material from external sources, you must provide proper attribution.
- Homeworks: All submitted homeworks are expected to be the result of your individual effort. You are free to discuss course material and approaches to problems with your other classmates, the teaching assistants and the professor, but you should never misrepresent someone else's work as your own. If you use any material from external sources, you must provide proper attribution.
- Exams: Each exam will be a closed-book, closed-notes, and closed-computer individual written test, which must be completed within a specified time limit. No material from any external sources is permitted.

## **DISABILITY SUPPORT SERVICES**

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Disability Support Services (Allen Center, Room 111 / [adarice@rice.edu](mailto:adarice@rice.edu) / x5841) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

## **SYLLABUS CHANGE POLICY & COURSE WEB SITE**

This syllabus is only a guide for the course and is subject to change with advanced notice. The latest syllabus information for the course will always be available at the course web site, <https://wiki.rice.edu/confluence/display/PARPROG/COMP322>.