



Concurrent Programming – CS 511

School of Engineering & Science

Instructor:	Eduardo Bonelli
Contact Info:	Gateway South 350, ebonelli@stevens.edu, 201-216-5261
Office Hours:	TBD
Course Web Address:	See Canvas
Prerequisite(s):	Undergraduates: CS 392; Graduates: CS 520
Corequisite(s):	None

COURSE DESCRIPTION

The study of concurrency and thread synchronization at multiple levels of abstraction. Topics include: models of concurrency via transition systems; languages for expressing concurrency; the challenges of concurrent programming; race conditions; deadlock; live lock and nondeterministic behavior; starvation; prototypical synchronization problems, such as readers-writers, producers-consumers and dining philosophers; mechanisms for solving these problems, such as non-blocking primitives (eg. CAS), semaphores, and monitors; message passing; and formal reasoning about concurrency using model-checking. Substantial programming required.

Course Learning Outcomes

After successful completion of this course, students will be able to:

- Interleaving: Explain concurrent programming in terms of interleaving of atomic actions.
- Race conditions: Explain how multiple interleavings in the presence of shared resources may lead to race conditions.
- Mutual Exclusion - List the necessary conditions for a satisfactory solution to mutual exclusion.
- Mutual Exclusion Mechanisms - Explain how to achieve mutual exclusion using locks, specialized machine instructions, and semaphores.
- Semaphores - Define semaphores, use them to solve simple synchronization problems, and explain their advantages and disadvantages.
- Monitors - Define monitors, use them to solve simple synchronization problems, and explain their advantages and disadvantages.

- Message passing - Use message passing to solve simple synchronization problems and explain their advantages and disadvantages.
- Model Checking - Model solutions to synchronization problems based on semaphores, monitors and message passing and verify their correctness.
- Safety and liveness - Specify correctness for concurrent programs through safety and liveness.
- Java Implementation - Implement solutions to standard synchronization problems using Java's `util.concurrent` package.
- Erlang Implementation - Implement solutions to standard synchronization problems using message passing in Erlang.
- Spin Model Checker - Model simple solutions to standard synchronization problems using Promela.

FORMAT AND STRUCTURE

This course is comprised of three weekly lectures.

COURSE MATERIALS

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|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Textbook(s): | Mordechai Ben-Ari, Principles of Concurrent and Distributed Programming, Second Edition, Pearson, 2006, ISBN 978-0321312839 |
| Other Readings: | Doug Lea, Concurrent Programming in Java: Design Principles and Pattern, 2nd Edition, Addison-Wesley Professional, 1999, ISBN 978-0201310092
Francesco Cesarini and Simon Thompson, Erlang Programming, O'Reilly Media, 2009.
Joe Armstrong, Programming Erlang (2nd edition), The Pragmatic Bookshelf, 2013. |
| Materials: | To be given in class. |

COURSE REQUIREMENTS

Attendance	Students are required to attend all classes.
Assignments	There will be five (5) homework (programming) assignments throughout this course. Code that does not compile will not be accepted. Late submissions will be allowed at 2 points off per hour past the deadline. If urgent or unusual circumstances prohibit you from submitting a homework assignment in time, please e-mail the instructor.
Quizzes	There will be quizzes throughout the semester. Quizzes will be graded for accuracy. If a student is absent (unexcused) on a day that a quiz is given s/he will receive an automatic 0 for that quiz.
Exams	There will be two exams in this course, each covering one half of the topics. There is no final exam. There will be a review session the class immediately before each exam.

GRADING PROCEDURES

There are 100 possible points that a student can earn in this course. Percentages are listed below.

Assignments	(30%)
Quizzes	(20%)
Exam 1	(25%)
Exam 2	(25%)

ACADEMIC INTEGRITY

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at <http://web.stevens.edu/honor/>

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations. Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

EXAM ROOM CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Room Conditions on the quiz or exam.

1. Students may use the following devices during quizzes and/or exams. Any electronic devices that are not mentioned in the list below are not permitted.

Device	Permitted?	
	Yes	No
Laptops		x
Cell Phones		x
Tablets		x
Smart Watches		x
Google Glass		x
Other (specify)		x

2. Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

Material	Permitted?	
	Yes	No
Handwritten Notes		x
Typed Notes Conditions: one 8*10 sheet (front and back) is permitted	x	
Textbooks		x
Readings		x

3. Students are *not* allowed to work with or talk to other students during quizzes and/or exams, unless indicated otherwise by the instructor.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. Student Counseling and Disability Services works with undergraduate and graduate students with learning disabilities,

attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, and psychiatric disorders in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from SCDS staff. The SCDS staff will facilitate the provision of accommodations on a case-by-case basis. These academic accommodations are provided at no cost to the student.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the office of Student Counseling, Psychological & Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/sit/counseling/disability-services>. If you have any questions please contact: Lauren Poleyeff, Psy.M., LCSW - Disability Services Coordinator and Staff Clinician in Student Counseling and Disability Services at Stevens Institute of Technology at lpoleyef@stevens.edu or by phone (201) 216-8728.

INCLUSIVITY STATEMENT

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in education and innovation. Our community represents a rich variety of backgrounds, experiences, demographics and perspectives and Stevens is committed to fostering a learning environment where every individual is respected and engaged. To facilitate a dynamic and inclusive educational experience, we ask all members of the community to:

- be open to the perspectives of others
- appreciate the uniqueness of their colleagues
- take advantage of the opportunity to learn from each other
- exchange experiences, values and beliefs
- communicate in a respectful manner
- be aware of individuals who are marginalized and involve them
- keep confidential discussions private

TENTATIVE COURSE SCHEDULE

For a *tentative* course schedule, please see the file `schedule.pdf`.