

# Metropolitan State University: Parallel and Distributed Algorithms ICS 440-01

Fall 2021

4 credits - classroom lecture

August 23 – December 6 (15 meetings; no class September 6)

## Instructor and Department Contact Information

Instructor Information	Department Information
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**Please note that email is my preferred method of contact and will result in faster responses to you. Be sure to put the course name in the subject line so that I can differentiate between all the different students and other University community members I work with.**

## About the Course

### Course Description

Covers design and development of parallel and distributed algorithms and their implementation. Topics include multiprocessor and multicore architectures, parallel algorithm design patterns and performance issues, threads, shared objects and shared memory, forms of synchronization, concurrency on data structures, parallel sorting, distributed system models, fundamental distributed problems and algorithms such as mutual exclusion, consensus, and elections, and distributed programming paradigms. Programming intensive.

### Prerequisites

ICS 340 - Algorithms and Data Structures; MATH 215 - Discrete Mathematics

## Text and Supplemental Readings

### Textbook

The Art of Multiprocessor Programming, Revised 1st Ed., by Maurice Herlihy and Nir Shavit

### Suggested Supplementary Readings, Databases, and Sources

Java Thread Programming, by Paul Hyde

## Course Learning Outcomes

### Learning Outcomes

Upon completion of this course, students will:

- Employ parallel algorithm design principles and programming paradigms
- Write correct and scalable parallel algorithms for multiprocessor and multicore architectures
- Develop algorithms at fine- and coarse-grained granularities
- Use synchronization appropriately in parallel algorithms
- Factor in performance issues in the implementation of parallel algorithms
- Characterize the kinds of tasks that are a natural match for SIMD machines
- Explain the different distributed system models
- Explain important distributed problems and algorithms
- Select appropriate distributed programming paradigms for implementing distributed algorithms

## Learning Methods

This course uses a variety of assignments in order to measure student outcomes. In this course you will need to:

- 10% of grade - submit homework assignments (6 to 8 assignments). Homework is graded leniently and attempt and effort matter most. No homework is accepted late (one second late is a zero). Your two lowest homework grades are dropped.
- 30% of grade - 4, in-class quizzes (40-60 minutes). Lowest quiz is dropped. No makeups: miss a quiz, that's the one dropped. Students can bring note sheets to the quizzes: 1 sheet for Quiz #1, 2 sheets for Quiz #2, 3 sheets for Quiz #3, 4 sheets for Quiz #4. Sheets are 8.5"x11" double-sided paper (printouts or handwritten). Quiz dates will be announced one week ahead of time.
- 30% of grade - final graded project. Details of the project will be given in class meeting session #11, projects are due by the start of class for session #14 (3 weeks to work on the project—which should be plenty of time, but start work on it as soon as it's assigned). Projects are an individual effort—students can discuss general techniques, **but must each submit original code**

**written only by the student.** No project is accepted late (one second late is a zero for the project). There is no need to be late as there are 3 weeks to work on the project.

- 30% of grade - comprehensive two-hour final exam. Students can bring 5 sheets of 8.5"x11" double-sided paper (printouts or handwritten). Missing the final exam should only happen under extreme situations and may require documentation to prove the reason attendance was impossible. Students will not get to see feedback except just their final exam grade.
- No incompletes are given in this course: everything missing as of the end of the class will be a zero.

## Course Policies

### Attendance

Attendance is required for one of the first two sessions of class, for all quizzes, and for the final exam. Attendance is highly encouraged for all of the remaining sessions. This course is very difficult to pass without attending most sessions.

*Note: Federal Financial Aid regulations require that the University track ongoing attendance.*

**Please note: If a student is found to not be making adequate progress assessed by not checking into the course site regularly or extensive late or missing assignments or discussions, the instructor may withdraw the student from the course.**

## Assignment Information

### Assignments

Assignments will be given throughout the course, see the grading information above about what to expect.

## Late Policies for Assignments

### Late Policy for Assignments

1. Nothing is accepted late. One second late and it is worth 0 points. See comments earlier.

## Technical Assistance

**IT Helpdesk** ([it.desk@metrostate.edu](mailto:it.desk@metrostate.edu); 651-793-1240) provides general computer assistance.

**Center for Online Learning** ([online.learning@metrostate.edu](mailto:online.learning@metrostate.edu); 651-793-1650) provides general assistance with online learning and course access. Please include your tech id number and course name and number.

## Incompletes for Course

No incompletes are given except for missing the final exam due to an extreme circumstance (such as hospitalization, death in the family, etc.) and documentation may be required. No extension of time is given for the final project because students have three weeks to complete it.

## Plagiarism and Copyright

Plagiarism is defined as the act of claiming another person's work as one's own. This can be copying or copying even parts of sentences from an article, journal, internet site, another student's work, or other written work. It can also mean using another student's assignment and making minor changes. Changing a few words around in content is still plagiarism. Renaming variables in code is still plagiarism. Any plagiarized work submitted will be scored as a zero. There are no second chances and no exceptions: you must only ever submit your own crafted source code. You may use patterns we discussed in class, but your work will still be crafted by you and you alone.

As part of academic honesty, students are expected to respect intellectual property laws, including copyright law. No parts of this site, your textbook, other publisher materials, or contribution from other class members can be used or distributed outside of this class without the permission of the author(s). Copyright law provides that any creative thought fixed into tangible form is copyrighted the moment it is created, whether or not a copyright notice is affixed.

## Additional Resources for Students

### Center for Accessibility Resources

#### Diversity and Disability Statement:

Our institution values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify the instructor as soon as possible. Students with disabilities are also welcome to contact the Center for Accessibility Resources to discuss a range of options to removing barriers in the course, including accommodations.

The Center for Accessibility Resources is located in New Main, Suite L223. Phone number is 651-793-1549 and email is [accessibility.resources@metrostate.edu](mailto:accessibility.resources@metrostate.edu).

#### Tutoring:

The Center for Academic Excellence provides tutoring services free of charge in most academic areas. They can be reached at [centerfolk@metrostate.edu](mailto:centerfolk@metrostate.edu) or 651-793-1460. Tutoring is available on the Saint Paul and Midway campuses.

### Make up Exams and Placement Testing:

The Academic Testing Center is located on the Saint Paul Campus in New Main L205. The Academic Testing Center provides make-up, independent study and waiver exam services. You may reach them via email at [testingcenter@metrostate.edu](mailto:testingcenter@metrostate.edu) or 651-793-1576.

### Veterans and Military Student Services:

Programs and support for veterans and students connected to the military. They can be reached at [veterans.services@metrostate.edu](mailto:veterans.services@metrostate.edu) or 651-763-1561.

### TRIO Student Support Services:

Support for first-generation students, low-income students and students with disabilities. They can be reached at [trio.center@metrostate.edu](mailto:trio.center@metrostate.edu) or 651-793-1525.

### Counseling Services:

Mental health support for individuals and groups. They can be reached at [counseling.services@metrostate.edu](mailto:counseling.services@metrostate.edu) or 651-763-1568.

#### Library and Information Services:

The university's hub for information, research help, study rooms and more. You may reach them online through the [Library pages](#) on the Metropolitan State University website or at 651-793-1616.

#### LGBTQ+ Student Services:

Programs and advocacy for Metropolitan State University's LGBTQA community. They can be reached at 651-793-1300 or through the [LBGTQ pages](#) on the Metropolitan State University website.

## Technology Requirements and Expectations

### Computer Hardware and Software

For this course, your computer must fully pass the System Check found on the [D2L login page](#). Students must have internet access and a computer that can run Java and Eclipse to complete assignments.

### Email

Please include in the subject line of your emails the course number and a brief description that summarizes the content of the email as well. It is very important to at least include your course number ("ICS 440") in the subject line to assure proper feedback and credit for your work.

## Grading

Please see the section "Learning Methods" for specific information on how the grading is scored. The Late policy applies to all assignments. Following are the assignments, points assigned and grade points.

### Grade Scale

Minimum needed:	Letter Grade
93%	A
90%	A-
87%	B+
83%	B
80%	B-
77%	C+
73%	C
70%	C-
67%	D+
63%	D
60%	D-
0%	F

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## Schedule of Topics

Session	Topics	Book Chapters
1	Course Introduction Object Oriented Technology Introduction (textbook Ch 1)	1
2	Java Threading – Getting Started	
3	Java Threading – Controlling Concurrent Access	
4	Java Threading – Inter-thread Signalling with Wait/Notify	
5	Java Threading – Inter-thread Signalling with Wait/Notify	
6	Mutual Exclusion	2
7	Concurrent Objects	3
8	Concurrent Objects	3
9	Shared Memory	4
10	Primitive Synchronization Operations Read-Modify-Write	5
11	Consensus	6
12	Distributed Coordination	12
13	Spin Locks and Contention Concurrent FIFO and LIFO	7
14	Graded Project Due Transactional Memory	18
15	Final Exam	

## University Academic Policies & Information

### University Non-Attendance and Reporting Policy and Procedure

The purpose of the Non-Attendance and Reporting Policy is to ensure Federal Title IV regulations are adhered to with respect to a student's enrollment level for the purpose of calculating and paying financial aid. While Metropolitan State University is not required to take attendance, Federal Title IV financial aid regulations require a procedure to establish that students have attended, at a minimum, one day of class for each course in which the student's enrollment status was used to determine eligibility for the Pell Grant Program. In addition, the university needs to determine a last date of attendance for those students who receive all failing grades or unofficially withdraw. Attendance is defined based on course delivery mode. A student is "in attendance" if he or she meets the following conditions before the end of the second week of the course:

- Classroom Courses –the student is present in the classroom.
- Web-Enhanced (Reduced Seat Time Courses) –the student is present in the

classroom or submits at least one academically relevant assignment.

- Online Courses –the student submits at least one academically relevant assignment
- Independent Studies – the student contacts the instructor or submits at least one academically relevant assignment

If a student does not attend the first two classes, either live and/or online, that student is automatically dropped from the course. If a student adds the course past the drop/add date, he/she will not receive points for any assignments, discussions, quizzes, or exams for which the due date has already occurred. Refer to the Non-Attendance & Reporting Policy 2259 [Policy 2259](#), and the Non-Attendance and Reporting Procedure 259 [Procedure 259](#).

Note to the student: The above description is the University Policy, but for some courses, based on how it is listed in the registration materials, participation must occur during the first week of class or the student is dropped from the course.

### Academic Appeals

The university has written procedures for appealing decisions concerning grades. The student should first attempt to resolve an appeal issue informally with the instructor. To file a formal appeal, the student must begin the formal appeal process within 60 calendar days of the posting of the grade or evaluation. A staff member in Student Affairs serves as ombudsperson to work with students in preparing formal appeals. For details, refer to [Procedure 202, Academic Appeal Procedure](#).

### Email

Metropolitan State University has designated e-mail as an official method of communication with students. **The university expects** students to be responsible for all information sent to them via their official university email account. Refer to [Policy 1050, University E-mail](#), for further information.

### Student Code of Conduct

Students at Metropolitan State University deserve the opportunity to pursue an education, and it is the responsibility of the university to provide an environment that promotes learning and protects the safety and well-being of the university community. Therefore, the university establishes this Student Conduct Code. Any action by a student that interferes with the education of any other student or interferes with the operations of the university in carrying out its responsibility to provide an education will be considered a violation of this code. The Student Code of Conduct balances individual student due process rights with the broader interests of the safety, wellbeing and academic integrity of the university community. The Office of Judicial Affairs operates with the philosophy of balancing the need for student accountability with the opportunity for education and making amends. Students are encouraged to review the [Student Conduct Code University Policy #1020](#) and the [Student Conduct Code Procedure #112](#) to understand their rights and responsibilities under the Code.

### Academic Integrity

The University does not accept knowingly copying the work of others without attribution (plagiarism), or colluding with other students to share answers unless permitted by the



instructor (e.g. group project). At my discretion, the consequence of these activities may include failure for the assignment, failure for the entire course. You should be aware that the university subscribes to plagiarism detection software, and that your papers may be selected for plagiarism checking. In instances of plagiarism or other forms of academic dishonesty, instructors may impose academic sanctions. Allegations of plagiarism or other forms of academic dishonesty are also subject to investigation and additional conduct sanctions under the [Student Academic Integrity Policy #2190](#), and [Procedure #219: Student Academic Integrity](#).

If you have questions about the use of footnotes or other notations, talk to your instructor, consult the Library and Information Services website, or seek assistance in the proper way of writing a paper by contacting a tutor in the [Center for Academic Success](#). Students who believe that they have been falsely accused of plagiarism should request assistance from the Ombudsperson at (651) 793-1517.