Essentials: Communication, Content, and Structure

1 Communication

Class Meetings:	Monday, Thursday 11:30 - 12:45; North Bldg C107
Office:	HN1090J
Office Hours:	Wednesdays 11:00 - 13:00, in Zoom, using the link `https://us02web.zoom.us/j/84693023051` See below for password information.
Email:	stewart.weiss@hunter.cuny.edu
Telephone:	(212) 772-5469

Regarding **email**, please note that I will not read email containing Microsoft Word-encoded documents. If you need to attach a document, it must be either plain text or PDF. Note too that all email must be sent from your "myhunter" account. It is a violation of federal law (FERPA) to have an email conversation about school-related matters using a non-school account because there is no proof that it is not spoofed and it might be insecure[1].

Regarding **office hours**, you can see me during my office hours *without an appointment*. If you need to see me at a different time, you need an appointment. The best way to make an appointment is to send me email with a few suggested times. I am usually unable to schedule meetings in a conversation before or after class because I need to read my calendar to know when I am available. The password will be given out on the first day of class, and also posted in Blackboard.

You can use the QR Code below to follow the meeting link:

2 Resources

Course Website	All course materials, including lecture notes, slides, assignments, syllabus, and other resources, including this document, are posted on my website, at `http://www.compsci.hunter.cuny.edu/~sweiss/course_materials/csci493.65/csci493.65_spr24.php`
Lecture Notes	The lecture notes are the primary resource for what we do in class. They are available on the course website, as noted above.

[1] Email sent from the *myhunter* account requires an authenticated login, it satisfies FERPA's written consent requirement. However because security measures for other email systems are not as strict, an email received from Gmail or other mail accounts, for example, would NOT satisfy FERPA requirements.

Optional Textbooks	Gerassimos Barlas. *Multicore and GPU Programming An Integrated Approach.* Elsevier Science & Technology, 2014. ISBN 978-0-12-417137-4. Michael J. Quinn. *Parallel Programming in C with MPI and OpenMP.* McGraw Hill, 2004. ISBN 0-07-282256-2. (Out of Print)
Computer Science Department Linux Network	Registered students are given user accounts on the *Computer Science Department's* network of instructional computers., if they do not already have them. All hosts run *Ubuntu 22.04*. Students must use the secure remote login program, *ssh* , to access these accounts or access them in person. See Section 9 below for more details about how to connect to these hosts. ***Students will be required to use this network for all class activities, including assignments.*** ***Students are expected to have used the Computer Science Department Linux network before taking this class and are presumed to know basic Linux commands in this class. I will not teach basic commands.*** If this is a student's first semester in Hunter, they should see me to discuss this.
Discussion Board	This class uses *Piazza* as a discussion board. The sign-up link is `https://piazza.com/hunter.cuny/spring2024/cs49365/info`.The *Piazza* discussion pages are at `https://piazza.com/class/lrjoocx2dkz3i5` Please see the section below entitled "Course Materials, the Web, *Piazza*, and Blackboard" for the details.
Supporting Programs	The directory on our server, */data/biocs/b/student.accounts/cs493.65/demos*, is a repository of demonstration programs that we'll study in class.
Grading and Exams	All exams will be in person. Grades will be posted in the ***Blackboard Grade Center***.

3 Prerequisites

CSci 235 and Math 160 or permission of the instructor.

4 Departmental Learning Goals

Material in this course supports the following departmental learning goals: 1a: (understanding the basic foundations and relevant applications of mathematics and statistics, particularly those branches related to computer science) through performance analysis of various software design choices; 1b: (understanding the relationship between computer architecture and software systems) by discussing how hardware supports parallel algorithms and how software can be mapped to different types of hardware; 3a: (ability to communicate ideas effectively) by requiring homework that is graded in part on clarity and proper use of the English language. This course fulfills GER 3/B requirement.

5 Course and Learning Objectives

Specific learning objectives of the course are that, after completing the course successfully, the student should be able to:

1. Write a correct and scalable parallel algorithm using both a message-passing based paradigm (MPI) and a shared-memory based paradigm (OpenMP).
2. Read and analyze a program using MPI and/or OpenMPI.
3. Parallelize a serial algorithm by applying task-based decomposition
4. Parallelize a serial algorithm by applying data-parallel decomposition.
5. Determine the speed-up, efficiency, and scalability of a parallel system.
6. Discuss the concept of parallel processing and the relationship between parallelism and performance.
7. Appreciate the need to express algorithms in a form suitable for execution on parallel processors.
8. Explain the basic types of parallel architectures and interconnection networks.
9. Characterize the kinds of tasks that are a natural match for SIMD machines and those more suited to SMP architectures.
10. Explain how various Monte Carlo methods work.

6 About C and C++ in This Course

Although both MPI and OpenMP support parallel programming in both C and C++ (as well as Fortran77 and Fortran90), most of the programming examples that I use and all that appear in the textbook are written in C. Some students have a knee-jerk reaction when they hear this, thinking, "but I don't know C." This is not quite true. The C++ language contains most of the C language. If you know C++, you know a great deal of C. There are minor differences that arise in the syntax of declarations (such as structure and function declarations), but the real problem is that most students never learn how to use the C standard libraries. Most students learn C++ stream I/O and never bother to learn what seem to them like archaic functions of the C standard I/O library. These functions are at times much more useful than any found in C++. In general, you ought to know some C, as a student of computer science, because there are things you can do much more easily and quickly in C than with C++. You will be free, however, to use C++ when writing code in the course, if that is your preference.

7 Assignments, Exams, and Grading

This is an honors seminar, not an ordinary lecture-style class. For this reason, students are expected to be self-motivated and self-disciplined, and are expected to do all of the assigned reading. Because the real learning takes place when doing, the major part of the grade is based on grades in assignments and projects. The final grade is based upon a weighted average of the following components:

Component	**Weight**
non-programming assignments	20%
programming projects	60%
final exam	20%

7.1 Assignments

There will be several assignments, some conceptual and others, programming projects of varying sizes. In all cases, the work is to be yours alone; working in groups is not allowed, unless the assignment states otherwise. ***Assignments must be submitted on time and will not be accepted after their due dates.*** There will be between two and four conceptual assignments and four programming assignments. Programs are worth about 15% each, though this can change, and the other assignments about 5% each. The percentage may

change slightly but it will be known at the time that the assignment is posted. Programs must comply with the rules specified in the Programming Rules document `http://www.compsci.hunter.cuny.edu/~sweiss/course_materials/csci493.65/programming_rules.pdf`. Please read it carefully.

7.2 Final Exam

The final exam is scheduled for May 20, 11:30 - 13:30.

7.3 Incomplete Grades

Assignments that are graded must be submitted by their due dates. **Late assignments will not be accepted and will be given a grade of zero**. Failure to take an exam counts as a zero grade on that exam. The only exceptions to these two rules are in the case that you have a legitimate, documented medical or personal emergency that prevents your timely completion of homework or sitting for an exam and have notified me in a timely manner about this emergency. "Timely" is defined as any time before the missed exam or at most 24 hours after it. I will schedule a make-up exam or grant a homework deadline extension only in that case. I do not give incomplete (IN) grades except to those students who were making progress through most of the semester and submitting assignments on time and who were unable to complete some work because of legitimate, documented medical or personal problems, and this is entirely at my discretion.

8 Class Calendar and Important Dates

There are no classes on February 12, February 19, April 22, April 25, and April 29. Classes follow a Monday schedule on Wednesday February 28. *The last day to drop without a W is February 14, the last day of class is May 13, and the last to withdraw is* May 15.

9 Programming and System Access

All students enrolled in the class are given accounts on the Computer Science Department's network. This entitles you to physical access to the 1001B lab, which is equipped with Linux workstations. This lab is normally open from early morning through late evening. You may also use the 1001B Linux/Windows Lab if there is no class using it. The account also enables you to work from home or another remote computer by connecting to any of the lab machines remotely. The details are described below.

The advantage of working in the lab, as opposed to working remotely, is that you will be sitting at the console of a Linux host and will not be subject to potential disconnections that can take place when working remotely. You will also be much less affected by network problems than if you connect remotely from outside of Hunter. The disadvantage is that you have to be in school to do this.

When you are in the lab there are a few important rules that must be followed:

- Never power down a machine for any reason.
- Never leave a machine without logging out.
- Never use lockscreen to lock the screen in your login.

There are several other rules regarding lab use, which are posted in the lab. Also, please read the documentation at

`http://www.compsci.hunter.cuny.edu/~csdir/`

for more information. Please take the time to read this page and the others referenced on it.

The Computer Science Department has a ***gateway*** machine named

`eniac.cs.hunter.cuny.edu`,

available to students who have accounts on the network. `eniac` is a gateway computer - you will be able to login to this host from any computer that has *ssh* client software on the Internet. Once you login to `eniac`, you must login from `eniac` to one of the computers in the network that are named `cslab1`, `cslab2`, `cslab3`, ... `cslab26`. If you enter the command '`ypcat hosts| grep cslab`', you'll see the list.

You cannot *ssh* directly to those machines from outside of Hunter College for security reasons. For example, you can first login to `eniac`, and then when it gives you a prompt such as "`$`", you would type

```
ssh cslab5
```

and reenter your network password at the prompt from `cslab5`.

Many computers come with a version of *ssh* already installed. If yours does not, you can get one for free. There are several free versions of *ssh*. *OpenSSH* is an open source version developed for the *OpenBSD* project. If you use a Microsoft operating system, search their resources for *ssh* clients if one is not already on your computer. Macintosh computers come with a command-line *ssh* client.

10 Course Materials, the Web, Piazza, and Blackboard

All lecture notes will be posted on the course's home webpage (whose URL is above), which does not require special privileges to access. The only thing for which I use Blackboard is for posting of grades, which will be posted in the grade center there. This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates and me. Rather than emailing questions to me, you are to post your questions on Piazza. If you have any problems or need feedback for the developers, email *team@piazza.com*.

You can find our class's discussion page at:

`https://piazza.com/class/lrjoocx2dkz3i5`.

An invitation to join the Piazza discussion board will be sent to your Hunter College email address close to the start of the semester. You should accept this invitation. Your Hunter email address can be used for reading and sending messages to the group, or you can change the email address or add another on the settings page. In fact, you can request to join the group with any email address you choose, at

`https://piazza.com/hunter.cuny/spring2024/cs49365/info`

I require that you use the following protocol if you have a question:

1. Check whether the question you want to ask has been posted and answered on Piazza.
2. If it has been answered, you are finished. If not, post the question on Piazza.
3. Anyone in the class can answer the question. If no one else answers the question in a timely manner, I will post an answer to it.

I will ignore any non-personal questions sent to my Hunter email address. Personal questions (such as a questions about a grade or a missed class or alternative times to meet with me) should be sent via private email to my Hunter email address, not to Piazza.

11 Academic Honesty

Unless I state otherwise, all assignments and projects are to be your work alone. If someone else does part of this for you, it is considered to be academic dishonesty. Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The college is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures. In this class, I will enforce the University's Policy on Academic Integrity and bring any violations that I discover to the attention of the Dean of Students Office.

12 ADA Compliance

In compliance with the *American Disability Act of 1990* (ADA) and with *Section 504* of the *Rehabilitation Act of 1973*, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (emotional, medical, physical and/or learning) consult the *Office of AccessABILITY* located in Room E1124 to secure necessary academic accommodations. For further information and assistance, the student can call (212-772-4857)/TTY (212-650- 3230).

13 Hunter College Policy on Sexual Misconduct

In compliance with the *CUNY Policy on Sexual Misconduct*, Hunter College reaffirms the prohibition of any sexual misconduct, which includes sexual violence, sexual harassment, and gender-based harassment retaliation against students, employees, or visitors, as well as certain intimate relationships. Students who have experienced any form of sexual violence on or off campus (including CUNY-sponsored trips and events) are entitled to the rights outlined in the *Bill of Rights for Hunter College*.

- Sexual Violence: Students are strongly encouraged to immediately report the incident by calling 911, contacting NYPD Special Victims Division Hotline (646-610-7272) or their local police precinct, or contacting the College's Public Safety Office (212-772-4444).
- All Other Forms of Sexual Misconduct: Students are also encouraged to contact the College's Title IX Campus Coordinator, Dean John Rose (jtrose@hunter.cuny.edu or 212-650-3262) or Colleen Barry (colleen.barry@hunter.cuny.edu or 212-772-4534) and seek complimentary services through the Counseling and Wellness Services Office, Hunter East 1123.
- CUNY Policy on Sexual Misconduct Link: `http://www.cuny.edu/about/administration/offices/la/Policy-on-Sexual-Misconduct-12-1-14-with-links.pdf`

14 Changes to This Syllabus

Except for changes that substantially affect the implementation of the grading statement, this syllabus is a guide for the course and is subject to change with advance notice. Any changes will be posted to the course website and to the Piazza group for the course.

15 Schedule of Content

The following table outlines the topics that we will cover during the semester. The lectures are based on my own lecture notes, available on the course website. The notes correspond to the chapters of the Quinn textbook, not necessarily in textbook order. The exact timing of each class is an approximation; we may deviate from this plan. You are expected to read the lecture notes before the class in which the topic is covered, so that you are prepared for the class.

Week	**Lecture Topic**
1	Background; Motivation and History of Parallel Computing; Parallel architectures
2	Parallel architectures
3	Parallel Algorithm Design
4	Message-Passing Programming
5	Floyd's Algorithm
6	Performance Analysis
7	Matrix-Vector Multiplication
8	Matrix-Vector Multiplication; Monte Carlo Methods
9	Monte Carlo Methods
10	Shared-Memory Programming with Threads
11	Shared-Memory Programming with Threads
12	Shared-Memory Programming with Threads and OpenMP
13	Shared-Memory Programming with OpenMP
14	Shared-Memory Programming with OpenMP