Emory University
Computer Science and Informatics Program
Graduate Handbook

Department of Computer Science
Department of Biomedical Informatics
Department of Biostatistics
Department of Mathematics

2018-2019
# Table of Contents

- Handbook Overview .................................................. 3
- Department Information ............................................... 4
- Registration ................................................................. 4
- Email and Network Access ............................................ 4
- Physical Mail Service ................................................... 4
- Graduate Program Coordinator ...................................... 5
- Graduate Student Offices and Computers ......................... 5
- Copy/Work Room and Office Supplies ............................... 5
- Professional Development Funds ..................................... 5
- Expense/Travel Reimbursement ....................................... 6
- General Ph.D. Requirements .......................................... 7
- Teaching Requirements .................................................. 7
- Candidacy ..................................................................... 8
- Seminar Presentations ................................................... 9
- Dissertation and Defense ............................................... 9
- Laney Graduate School Jones Program in Ethics (JPE) .......... 9
- Professional Conduct .................................................... 9
- Yearly Progress Reports ................................................ 9
- Annual Evaluation ........................................................ 10
- Computer Science & Informatics Main Track: Academic Requirements ......................................................... 11
- Qualifying Examination ................................................. 13
- Sample Schedule .......................................................... 14
- Biomedical Informatics Concentration: Academic Requirements ................................................................. 15
- Qualifying Examination ................................................. 17
- Sample Schedule .......................................................... 18
- Financial Information ..................................................... 19
Fellowships and Assistantships 19
Duties 19
Conditions, Evaluation, and Renewal 19
Payment 20
M.S. Program in Computer Science 21
Main Computer Science Track: Academic Requirements 22
Computational Science Concentration 23
Data Science Concentration 24
Biomedical Informatics Concentration 25
MS in Computer Science Eligibility 26
Completing the coursework required for the PhD degree 26
Annual Evaluation 27
Grievance Policy 28
Handbook Overview

This Graduate Student Manual is intended to orient new graduate students to the Computer Science and Informatics Program at Emory University and to provide a summary of its policies and procedures regarding graduate study. The manual complements the Laney Graduate Handbook, which contains general degree requirements and Graduate School policies. The handbook may change but the students have the option to satisfy the requirements of the version when they entered the program or the current version. Before consulting this manual, students should be certain that they have the latest version (dated by school year). If unsure about some policy or rule, students should consult with their advisor, the graduate program coordinator, or the Director of Graduate Studies.
Department Information

Registration
Registration is typically held the week before classes begin. First time registration for new students is done by the Graduate Program Coordinator. In subsequent semesters, students will register online through the OPUS system (https://www.opus.emory.edu), which can also be accessed from the Emory home page (http://www.emory.edu). Students must consult with either the Director of Graduate Studies or their faculty advisor on matters related to registration (e.g., pre-registration, registration, drop, add). If a student does not consult his or her faculty advisor, he or she will be held responsible for any academic issues that may arise. Once a student has been registered, the student will need to pay his or her fees to Student Financial Services.

PLEASE NOTE:
Schedule changes are not allowed after the official add/drop period (normally the first week of class). It is not possible to retroactively enroll in, drop, or change the grading basis of a course. It is the student's responsibility to check and verify his or her registration.

Students must receive permission to enroll in directed study or research sections by their mentor/advisor. These courses are by permission only and enrollment will only happen if permission has been granted.

Students should not enroll in classes outside of the Computer Science and Informatics Program. To request enrollment into such courses students must obtain the following information: (1) permission from their faculty advisor, (2) proof that the course is part of their degree requirements, and (3) permission from a representative of the department teaching the course. Any problems with scheduling must be addressed during the add/drop period.

Email and Network Access
Each student will have a University Network account (NetID). Email and Network access is handled by the Emory University IT, not by the department. To obtain the NetID, please go to http://www.opus.emory.edu and select the “Obtain a Network ID and Password link. If you have any issues, please contact Emory University’s Technology Services (UTS) at 404-727-7777.

After the university NetID is set up, please see the systems administration to activate your CS account to access the department servers (as needed for classes and research). They can also be reached at help@mathcs.emory.edu

Physical Mail Service
The department provides mailboxes for all faculty, staff, and graduate students. The mailroom is located beyond the main reception desk in MSC W405. Graduate student mailboxes are divided between programs with the Computer Science Master’s (and the beginning of PhD) students on the right, above the staff and faculty mailboxes; the remaining Computer Science and Informatics PhD students will be located on the back wall in the wooden mailboxes. Each student’s name appears below his/her box. The department has two outgoing mail trays located inside the cabinet underneath the middle section of
faculty mailboxes. One is for campus mail only, and the other is for mail going out by the United States Postal Service, and they are marked accordingly. Personal letters should bear the appropriate postage and can be placed in the U.S. mail tray. The department does not pay for the postage of personal items. There is a branch of the USPS located on the Main Campus Mail Center at Few Hall, [http://www.mailservices.emory.edu/](http://www.mailservices.emory.edu/), where stamps may be purchased. Mail goes out twice daily: once in the morning (around 10:30 AM) and once in the afternoon (around 3:30 PM).

**Graduate Program Coordinator**
The Graduate Program Coordinator is Yvette Hilaire. She handles the day-to-day functions of the graduate program and serves as a liaison between the graduate students and the Laney Graduate School. Her office is MSC W431 and her email is yhilair@emory.edu. Please see the Graduate Program Coordinator with any problems or questions.

**Graduate Student Offices and Computers**
PhD students receiving financial support from faculty, the Laney Graduate School, or an external fellowship will be assigned a desk in one of the graduate student offices. Each PhD student will be given a key to the main door of the office and to his or her assigned desk. Office door keys and desk keys may be obtained from the Graduate Program Coordinator; a $10 cash refundable key deposit is required at the time of issuance. For the safety and consideration of all students, please keep the main door locked at all times, especially when there is no one else in the room. This is the only way to protect your personal items and those of your office mates. Do not leave anything of value to you unlocked or exposed.

The CSI Program will provide at least a basic desktop computer connected to the departmental UNIX file server. The specific computer configuration will vary based on the student’s arrangement with their advisor.

**Copy/Work Room and Office Supplies**
The copy machines and office supplies are for department faculty and staff use only. Exceptions to this are students currently teaching a course, assisting a professor/faculty member (and that faculty member asks you to make copies), or you need to make copies related to University or department business. No other personal copies by graduate students are permitted except for the above-mentioned reasons.

Office supplies are for the use of faculty, staff, and graduate students who are currently teaching or assisting a faculty member. **Supplies are not available to graduate students who do not meet one of the above criteria.**

**Professional Development Funds**
The LGS makes funds available to PhD students through a professional development support program (PDS). Students are eligible for up to $2500 in each of the three categories of training, research, and travel, over the course of their graduate career. These funds are not guaranteed, but are subject to application and review. To receive an award, a student must be in good standing, both in the LGS and in the program. Support beyond the $2500 limits may be possible, subject to a competitive application process.
Further details on the PDS program, consult the LGS handbook and the PDS website, http://www.gs.emory.edu/professional-development/pds/index.html.

**Expense/Travel Reimbursement**

Travel funding is available to all students enrolled in doctoral programs. The Laney Graduate School makes funds available to student for specific professional development activities. These funds are awarded on the basis of the merit of the proposed activity and the importance of the activity to the student's program of study. To receive an award a student must be in good standing, both in the Laney Graduate School and in the program.

Students are responsible for submitting their request no later than the 10th of each month. This will allow the Graduate Program Coordinator to approve the application before the Laney Graduate School will review the application. It is recommended that students apply for conferences early. If you apply after the conference and are denied funding, you will not be given a second chance to apply.

If you use Emory funds, you must comply with Emory University’s travel policies. Air travel bought with Emory funds must be purchased through the official Emory air travel provider, which may be accessed through a link found on the LGS website. This requirement includes travel expenses that are paid with personal funds and later reimbursed using Emory funds. To comply with the travel policy, you must access Travelocity through a link found on the Laney Graduate School website and log in using your Emory NetID.

For conference participation, there is both an annual limit and a cumulative career limit: students can receive no more than $650 each year (with one exception—see details on Conference Participation page located on the Laney Graduate School website), and no more than $2,500 during their Emory careers.

Supplementary training and research support are not subject to cumulative career limits. However, the amount of past support and the size of the current request affect how an application is reviewed. Support in either category up to a $2,500 threshold will be awarded on the basis of DGS and advisor approval, while support above the threshold will be reviewed by a faculty committee on a competitive basis. The thresholds are cumulative in nature: in either category, when a student’s current request plus any past awards exceeds $2,500, the faculty review will apply.

Occasionally, students may incur expenses on behalf of the department. Such items include meals with prospective students and seminar guests. Original, itemized receipts along with the event name or the names of all of those who attended the meal should be submitted to Graduate Program Coordinator for reimbursement. Receipts and any accompanying documentation must be taped neatly, without overlaps, to 8 ½ x 11 sheets of papers. Disorganized, cluttered, or unclear paperwork will be returned to the student for revision.

Allow 2-3 weeks processing time for all forms of reimbursement.
General Ph.D. Requirements
The Computer Science and Informatics (CSI) Ph.D. program main track is designed around departmental research strengths in data and information management, data mining, healthcare analytics, machine learning, natural language processing, security and privacy, and information access and retrieval. The program is distinguished by its interdisciplinary nature, and is a joint program between the departments of Mathematics, Computer Science, Biomedical Informatics, and Biostatistics and Bioinformatics. The program has collaborations with Emory’s computational and discrete mathematics faculty, departments of physics, biology, psychology, and chemistry, and highly regarded schools of medicine and public health.

The academic course work is expected to be finished within the first 2-3 years followed by a qualifying examination in the student's chosen concentration, and a thesis proposal followed by the thesis defense. By year 3 or often earlier, students are expected to begin working closely with an advisor on original research. On average, a PhD degree takes 5-6 years to complete.

Seminar Attendance
Each student in the program is required to enroll and maintain satisfactory attendance in the Computer Science Seminar (CS700) each semester that he/she is in residence. Each student is also required to present at least one thesis-related seminar prior to graduation.

Teaching Requirements
Teaching training is an important part of a student's overall preparation for possible academic careers.

Students must first complete summer TATTO (TATT 600) course offered through the Laney Graduate School prior to serving as a TA or Instructor. The student registers for TATT 605 during the semester of the teaching assistantship. Students must also register for TATT 610 while serving as Co-instructor for a Lab section. More details on the TATTO program can be found in the Laney Graduate School Handbook. http://gs.emory.edu/handbook/

All students must fulfill their minimal teaching requirements by serving at a Teaching Assistant, and as Co-Instructor/Lab leader/ for two courses. First, the student must server as Teaching Assistant (TA) for 1 course, which fulfills TATT 605. Second, the student must serve as Co-instructor for a course lab section, which fulfills TATT 610. Both TA-ship and Co-instructorship may include recitation instruction, teaching assistance, holding office hours and grading.

A student may also serve as a TA or Instructor for additional courses after satisfying the minimal requirements.

Each student instructor (or co-instructor) must attend CS590: Pedagogy and Professional Development fall of their first year, provided they have completed TATTO (or fall of their second year in exceptional circumstances). The seminar will review pedagogy, discuss classroom observations, address student and teaching issues, review homework and tests, and discuss relevant literatures on CS education. The seminar will also provide instructions
on scholarly issues that are part of the graduate school’s requirements on the Jones Program in Ethics (JPE – see 2.2.9 for more details). Each graduate instructor will have a faculty mentor for the course that they are teaching or co-teaching.

**Note:** All departing graduate students must provide copies of their grade books (or spreadsheets) for the courses they taught in the preceding year. If you teach during the academic year, you must send an electronic grade book to the Program Administrator before the department will sign off on your degree application. If there is an outstanding or incomplete grade in a class you taught, or in your grade book, you must also leave a statement to the program coordinator stating what is left for the student to complete in order to change the grade.

**Candidacy**

To be eligible for candidacy, a student must meet the following requirements:

- Complete all program requirements for candidacy: coursework and other training required by the degree program, including program required JPE training
- Complete qualifying examinations required by the degree program
- If required by the degree program, obtain approval of a dissertation prospectus
- Complete TATTO 600, TATTO 605, and JPE 600
- Resolve any Incomplete (I) or In Progress (IP) grades
- Be in good standing with a minimum cumulative 2.70 GPA
- Have earned at least 54 credit hours at the 500 level or above
- TATTO 610 and JPE 610 may be completed after entering candidacy. In addition, programs may reserve the dissertation prospectus and committee requirement to be completed after candidacy

After a student completes the course and rotation requirements, the qualifying examination, and the teaching requirement, he/she is eligible to apply for candidacy. Admission into candidacy is guided by the principle that a Ph.D. student should possess proficiency in multiple areas and mastery in at least one area. Proficiency in breadth is assessed through the student's performance on completed courses and rotation projects, while depth in an area is determined by passing the qualifying exam and other measures such as research publications.

Students must reach candidacy by **September 15** of their fourth year. Students who do not meet this deadline will be placed on academic probation, will not be eligible for PDS funds, and may forfeit financial support. These sanctions will be lifted when the student enters candidacy.

**Note:** Students cannot apply for Candidacy and graduate in the same semester.

A Ph.D. student must be in candidacy before they may submit an application for a Master’s degree based on candidacy.
**Seminar Presentations**
Each student must present one CS700 seminar on his or her thesis research. This is done while the student is in candidacy and prior to the dissertation defense.

**Dissertation and Defense**
Students must write a dissertation describing original research in their chosen area. They must deliver a public presentation of the dissertation before a dissertation committee consisting of the faculty advisor who is a member in the program, two additional faculty members from the program, and one or more members outside of the program with Ph.D. degrees.

**Laney Graduate School Jones Program in Ethics (JPE)**
All students must complete the program in ethics, consisting of the following three parts:
- A one-day graduate school workshop (JPE 600): this is typically scheduled the one week prior to the start of the fall semester during the student’s first year of study.
- Computing specific training (CS590, the annual department meeting and CS700, Graduate Seminar): CS590 should be completed in the fall of the second or third year of study.
- A minimum of 6 hours of graduate school hosted seminars (JPE 610): this is completed over the course of the student’s PhD study. Students must show their ID in order to get attendance credit.

The Laney Graduate School will notify students regarding the workshop and seminars. Instructions on computing-related topics such as data management in research (privacy, sharing), mentoring, human subjects, peer-review and scholarly misconduct will be provided in CS590, in an annual department meeting on teaching, and in CS700, the Graduate Seminar.

**Professional Conduct**
A graduate student involved in any form of undergraduate instruction (e.g., classroom instructor, TA, lab assistant, grader) is expected to behave as dedicated professionals and representatives of the University. Lack of preparation and unprofessional conduct undermine the efforts of the entire department and the University. The Director of Undergraduate Studies and the Chair will investigate reports and complaints by students of graduate instructors being late, rude, or unprepared. Substantiated neglect of duty can result in full or partial rescinding of the instructor’s stipend, and in serious cases result in the student reported to the Laney Graduate School for a conduct code violation.

**Yearly Progress Reports**
Every student is required to submit a yearly progress report to the Director of Graduate Studies. The report must be reviewed and signed by the student’s advisor. If the student does not yet have a Ph.D. advisor, then the DGS must review and sign the report. Reports are due by the end of May, and should contain information spanning the period from June 1 of the previous year to May 31 of the current year.
**Annual Evaluation**
The Laney Graduate School and each program have standards for academic performance that students must meet, including making satisfactory progress through the program. Students will be reviewed at the end of each semester, and will receive a written evaluation at the end of each year. The evaluation will be based on an assessment of the student’s overall performance including coursework, exams, research and work duties (e.g., teaching). The result of the evaluation is either (1): Satisfactory progress; (2) unsatisfactory progress. Unsatisfactory progress can result in academic probation, which requires the student to correct the problem over the following semester. Lack of satisfactory progress while on probation may result in termination from the program.
Computer Science & Informatics Main Track: Academic Requirements

Course Requirements
In addition to the general degree requirements listed in The Laney Graduate School Handbook, a summary of the specific course and exam requirements is described in the following sections. Students with insufficient background in computer science may need to complete additional undergraduate courses.

All courses are 3 credit hours unless otherwise indicated. Courses listed below are offered on a regular schedule, except for topics courses.

FOUR CORE COURSES: All students in the CSI PhD Main Track are required to take the following 4 core courses:
- CS 526 Algorithms or CS 523 Data Structures and Algorithms by permission
- CS 534 Machine Learning
- CS 551 Systems Programming
- CS 554 Database Systems

SEVEN ELECTIVE COURSES: Students are required to take at least 7 elective courses from the three areas listed below (including any topics e.g. 584’s or 700 level courses offered in that area). These courses serve as building blocks of a broad and rigorous training in computer science and informatics.

Data and IIS (Min. 2 courses): The objective of this area is to provide training in data management, statistical techniques, language theory and intelligent systems and to obtain rigorous training in underlying foundations.
- CS 557 Artificial Intelligence
- CS 570 Data Mining
- CS 571 Natural Language Processing
- CS 572 Information Retrieval
- CS 573 Data Privacy and Security
- CS 730 Advanced Topics in Data and Info Management

Systems (Min. 2 courses): The systems area provides strong foundations in computer operating systems, architecture, storage, language translation and related topics.
- CS 555 Parallel Processing
- CS 556 Programming Languages and Compilers
- CS 562: Advanced Computer Systems
- CS 580 Operating Systems
- CS 581 High Performance Computing
- CS 710 Advanced Topics in Computing Systems
Foundations and Applications (Min. 1 course): The objective of this area is to obtain the necessary background in probability, numerical analysis, theory of computing and/or an understanding of applications in various domains.

- BIOS 506 Statistical Methods (4)
- CS 524 Theory of Computing
- CS 563 Digital Image Processing
- MATH 515 Numerical Analysis I
- MATH 516 Numerical Analysis II
- MATH 561 Matrix Analysis and Applications
- MATH 771/772/789 Advanced Topics in Computational Math

A student may substitute at most 2 courses among the 7 required courses with an area-relevant course from Mathematics, Computer Science, Biology, Chemistry, Biomedical Informatics, the Rollins School of Public Health, School of Medicine, and appropriate schools at Georgia Tech. When substituting courses, a student must obtain prior written approval from their thesis advisor and the CSI co-DGS or DGS. Students must complete their core courses with a grade of B+ or higher and complete the remaining coursework by year three with a GPA of 3.5 or higher.

Two Rotation Projects CS 598R
Rotation projects aim to provide practicum opportunities to students prior to their dissertation research. The objective is to expose students to computational research problems in practical settings. Projects also serve as part of the qualifying process for candidacy. Each student must complete two rotation projects.

Students register for CS598R for each rotation project under the supervision of a faculty advisor/researcher. If the advisor is not a member of the program faculty, then a co-advisor from the program is required. Each student will submit an advisor-approved final report upon completion. An accepted or published paper may serve as the final report. If software development is involved in the project, it is important to clearly specify the deliverable at the start of the project. Both rotation projects must be completed by the 3rd year.

As part of the overall evaluation for admission into candidacy, the student's qualifying examination committee will review all project reports. For students with interdisciplinary research interests in biomedical or public health informatics, rotation projects may involve participation in research laboratories in Biology, Chemistry, Rollins School of Public Health, the School of Medicine, or external organizations such as the CDC.

Remarks on Course Requirements
A student may earn 3 hours of course credit for each rotation project through CS598R. A project that requires more than one semester to complete may continue as CS599R (not CS598R).
It is the student's responsibility to ensure that he/she meets the general degree requirements described in the Laney Graduate School Handbook. In particular, students must complete, in advanced standing, 18 hours of coursework (with no more than three hours of directed studies), and another 18 hours of research and coursework before candidacy.

**Qualifying Examination**

The exam committee consists of at least one program faculty advisor and two other department faculty members. Any committee member or the student may request additional committee members from outside the program.

There are two parts: the exam and the thesis research proposal. Both seek to establish the student's readiness to conduct original research in a chosen area. The exam covers fundamental knowledge in select topics according to the ACM Computing Classification, shown in the next table. The ACM Computing Classification encodings are indicated. The committee determines the format of the exam: oral, written, or a combination. Each student is required to select one major topic and one minor topic. Questions will be selected from a reading list.

<table>
<thead>
<tr>
<th>Topic</th>
<th>ACM Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems, Networks, Parallel Processing, Programming Languages</td>
<td>C.2, D.4, D.3.2-D.3.4</td>
</tr>
<tr>
<td>Numerical Analysis, Scientific Computing</td>
<td>G.1</td>
</tr>
<tr>
<td>Database Management, Data Mining, Information Extraction and Retrieval</td>
<td>H.2, I.5.2, I.5.3, I.5.4, H.3.2, H.3.3</td>
</tr>
<tr>
<td>Artificial Intelligence, Natural Language Processing, Machine Learning</td>
<td>I.2.4, I.2.5, I.2.6, I.2.7, I.2.8</td>
</tr>
<tr>
<td>Bio/Medical/Health Informatics</td>
<td>J.3</td>
</tr>
</tbody>
</table>

The proposal begins with a 30-minute presentation of the student's proposed research, and is followed by a question-answering session by the committee. The student must prepare a proposal write-up, including a comprehensive bibliography that is distributed to the committee at least two weeks prior to the exam.

The committee assigns a grade of pass, conditional pass, or fail to each exam. In the case of conditional pass, the committee will specify requirements that the student must satisfy for removing the contingency. In the case of fail, the student may retake the exam *once* more.
**Sample Schedule**
The following is a typical five-year schedule of the PhD study.

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CS526, CS534, CS551, CS554, two Courses, Seminar (CS700)</td>
</tr>
<tr>
<td>2</td>
<td>CS570, Four Courses, Seminar (CS700), TATTO, Rotation Project, Practicum</td>
</tr>
<tr>
<td>3</td>
<td>Rotation Project, Research, Seminar (CS700), TATTO, Qualifying Examinations</td>
</tr>
<tr>
<td>4</td>
<td>Research, Seminar (CS700) and Presentation</td>
</tr>
<tr>
<td>5</td>
<td>Research, Seminar (CS700), Dissertation Defense</td>
</tr>
</tbody>
</table>
Biomedical Informatics Concentration: Academic Requirements

The Biomedical Informatics Concentration (BMI) focuses on the effective use of biomedical data, information and knowledge for biomedical and clinical research, as well as decision support, driven by efforts to improve human health. Requirements for the concentration follow a similar structure to the Main Track of the Computer Science and Informatics Ph.D. program. Details of the coursework and rotation projects are different and described below.

Course Requirements
Students are required to take 3 core courses that establish a foundation of biomedical informatics, an additional 6 required courses from 3 areas, and two elective courses as detailed below. All courses are 3 credit hours unless otherwise indicated. Courses listed below are offered on a regular schedule, except for topics courses.

THREE CORE COURSES: All students are required to take the following 3 core courses:

- BMI 500 Introduction to Biomedical Informatics
- CS 534 Machine Learning
- BIOS 506 Statistical Methods (4)

SIX REQUIRED COURSES: Students are required to take 6 courses that serve as building blocks of a sound biomedical informatics training (including any topics e.g. 584’s or 700 level courses offered in that area). These courses are organized into three areas: Mathematical Foundations, Biomedical Applications, and Computational Techniques. Students must take two courses from each. Details about these three areas is described below.

TWO ELECTIVES: Students are required to take 2 additional graduate level courses. To meet this requirement, students may opt for courses from Mathematics, Computer Science, Biology, Chemistry, Biomedical Informatics, the Rollins School of Public Health, School of Medicine, and appropriate schools at Georgia Tech through the ARCHE program.

Mathematical Foundations (2 courses): The objective of this area is to provide training in mathematical and statistical techniques to analyze data, formulate and test hypotheses and obtain rigorous training in underlying foundations. Examples of courses that meet this requirement are listed below. Students may substitute other graduate courses from Math/CS, BIOS, EPI or other departments (with prior approval from the BMI program director, DGS, or the thesis advisor)

- BIOS 510 Probability Theory I (4)
- BIOS 710 Probability Theory II (4)
- BIOS 511 Statistical Inference I (4)
- BIOS 711 Statistical Inference II (4)
- BIOS 522 Survival Analysis (2)
- EPI 504 Fundamentals of Epidemiology (2)
- INFO 503 Management Principles for Informatics (2)
- MATH 515 Numerical Analysis I
**Biomedical Applications (2 courses):** The objective of this area is to provide training in the specific domains that motivate the methodological and applied activities of biomedical informatics research. Examples of courses that meet this requirement are listed below. Students may substitute other graduate level courses from GDBBS, BMI, and other departments (with prior approval from the BMI program director, DGS, or the thesis advisor)

- IBS 523 Cancer Biology I (4)
- IBS 524 Cancer Biology II (4)
- IBS 534 Computational Neuroscience (4)
- IBS 574 Computational Biology & Bioinformatics (4)
- BMI 614+ Machine Learning & Computational Biology
- BMI 615+ Biomedical Imaging Informatics
- BMED 6760/6790 Info Process Model Neural
- BMED 6780 Medical Image Processing
- BMED 6789 Technology Ventures
- BMED 7411 Mathematical Models in Biology & Medicine

**Computational Techniques (2 courses):** The objective of this area is to provide training in computational systems and techniques that are essential to the conduct of biomedical informatics research and development activities. Examples of courses that meet this requirement are listed below. Students may substitute other graduate level courses from Math/CS, BMI or other departments (with prior approval from the BMI program director, DGS, or the thesis advisor).

- CS 551 Systems Programming
- CS 554 Database Systems
- CS 556 Programming Languages and Compilers
- CS 557 Artificial Intelligence
- CS 562 Advanced Computer Systems
- CS 563 Digital Image Processing
- CS 570 Data Mining
- CS 571 Natural Language Processing
- CS 572 Information Retrieval
- CS 573 Data Privacy and Security
- CS 580 Operating Systems
- CS 581 High Performance Computing
- MATH 771 Numerical Optimization

The various courses listed above are illustrative of courses that meet a certain objective. Students must complete their core courses with a grade of B+ or higher and complete the remaining coursework by year three with a GPA of 3.5 or higher. Students may take a qualifying exam once they have completed the minimum course requirements.

**Rotation Projects: CS598R**

Students are required to complete one informatics and one domain specific rotation project before the start of years two and three of their study. A rotation is a three credit hour,
semester long project with pre-defined deliverables and a final evaluation. Students are not limited to the core faculty when choosing their rotations or research projects. Students are recommended to select a domain-focused rotation faculty mentor, in addition to their advisor, who will provide the biomedical, clinical or translational domain use cases that will drive their informatics training. It is expected that these rotations will provide students with valuable research experience and will help them focus on a specific area of research and help jump-start their dissertation. It is expected that the projects will be in areas relevant to the student’s dissertation topic.

Students will be helped by their thesis advisor (or the BMI program director, if they don’t have an advisor) when choosing a rotation faculty mentor. Prior to starting a rotation project, students are required to submit a project proposal with well-defined deliverables. The students' rotation mentor is required to submit a mid-term evaluation to the program director and the student's thesis advisor (if the student has one). Students are required to complete a final report and also present their work at a department seminar.

PhD students are expected to complete their first rotation before the start of Year 2 and the second rotation, before the start of Year 3.

Remarks on Course Requirements

A student may earn 3 hours of course credit for each rotation project through CS598R. A project that requires more than one semester to complete may continue as CS599R (not CS598R).

It is the student's responsibility to ensure that he/she meets the general degree requirements described in the Laney Graduate School Handbook. In particular, students must complete, in advanced standing, 18 hours of coursework (with no more than three hours of directed studies), and another 18 hours of research and coursework before candidacy.

Qualifying Examination

Students must declare their intention to take a qualifying exam at least one semester prior to taking the exam. The exam committee consists of at least one department faculty advisor and two other program members. Any committee member or the student may request additional committee members from outside the department.

There are two parts: the exam and the thesis research proposal. Both seek to establish the student's readiness to conduct original research in a chosen area. The committee determines the format of the exam: oral, written, or a combination. Questions will be selected from a reading list.

The proposal part of the qualifying exam is a presentation of the student's proposed research, and is followed by a question-answering session by the committee. The entire exam is an hour long. The student must prepare a proposal write-up, including a comprehensive bibliography that is distributed to the committee at least two weeks prior to the exam.

The committee assigns a grade of pass, conditional pass, or fail to each exam. In the case
of conditional pass, the committee will specify requirements that the student must satisfy for removing the contingency. In the case of fail, the student may retake the exam one more time.

**Sample Schedule**
The following is a sample of a five-year schedule of the PhD study.

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BMI500, CS534, IBS 523, CS581, CS572, 1 Elective, Seminar (CS700), Rotation Project</td>
</tr>
<tr>
<td>2</td>
<td>BIOS 506, BIOS 510, MATH 515, BMI 615+, 1 Elective, Seminar (CS700), TATTO Research, Rotation Project, Practicum</td>
</tr>
<tr>
<td>3</td>
<td>Qualifying Exam Research, Seminar (CS700), TATTO</td>
</tr>
<tr>
<td>4</td>
<td>Research, Seminar (CS700) and Presentation</td>
</tr>
<tr>
<td>5</td>
<td>Research, Seminar (CS700), Dissertation Defense</td>
</tr>
</tbody>
</table>
Financial Information

Fellowships and Assistantships
With the exception of students supported by external fellowships (e.g., DOD, DOE, and NSF), all full time students admitted to the PhD program typically receive either a Graduate School Fellowship (GSF) or a faculty research assistantship (RA). Award decisions are made at the time of admission into the program.

The Laney Graduate School guarantees full support (stipend) for the first 21 months in the PhD program (i.e., the first academic year, first summer, and second academic year). The expectation is that PhD students join a research group by the start of third year (after 21 months in the Program) and go on faculty grant support, i.e. receive a stipend through an RA or another form of external support. However, alternative arrangements are possible on case-by-case basis, based on performance evaluation and good progress in the program. Reappointment is not automatic.

The Laney GSF is not available to students in MS Degree Programs, although RA may be available to MS students in some cases.

Duties
Students receiving fellowships and assistantships are expected to participate in various activities relating to research and teaching that contribute to their overall professional development.

During the first two years of support by the LGS (fall, spring, summer of first year, and fall and spring of their second year), the students are expected to complete their TATTO requirements (two TA-ships or teaching assignments), and to complete their two required rotation projects (CS598Rs), with different faculty members/labs.

After the initial LGS support is over, the students’ Faculty advisors determine the research and other scholarly duties required for the RAs, while the CSI program and relevant department assigns the duties of students on the LGS or other internal support. This may involve lab and teaching assistance, grading, and teaching. For students with interdisciplinary research interest/focus, duties may involve assignments in non-departmental research and project activities at the School of Medicine, the School of Public Health, and other collaborating units on campus.

Conditions, Evaluation, and Renewal
A student receiving RA or LGS support must be registered as a full-time student. Students receiving full support from Emory sources, including grants, may not accept any remuneration for any other work either in or outside the university.

The performance of each GSF and RA recipient will be reviewed and evaluated annually by the department's Graduate Committee and when appropriate, the student's faculty advisor. In addition, the assistant's progress towards his or her degree will also be evaluated. The
student must continue to make satisfactory progress toward their degrees in order to maintain the support.

Fellowships and assistantships may be reduced, suspended, or terminated by the department in advance of the stated expiration date when the student's performance is unsatisfactory. Any of the following may result in an unsatisfactory performance rating: failure to maintain the stated minimum GPA, failure to earn minimum required credits toward degree each semester, failure to advance to candidacy in a timely manner, and/or failure to perform satisfactorily in assigned teaching or work duty.

**Payment**

Students who are receiving a stipend will receive their first payment at the end of September. Stipends are paid at the end of each month on the last working day. The first check for new students may be sent by regular mail if a direct deposit is not set up. **It is extremely important, particularly for new international students, that you immediately update your mailing address to your local address; failure to do so may result in your first paycheck being mailed to your home country** as this is most likely the only address Human Resources will have on file for you. Your address must be updated in two different places: Human Resources and OPUS.

**Everyone must be on Direct Deposit.** All students receiving a stipend will need to first meet with Graduate Program Coordinator, to be hired into the Emory payroll system. Students will then be instructed to an online orientation to complete the details of the direct deposit information.

If you have not yet found a local bank to handle your banking business, you may want to check in to the Emory Federal Credit Union. They usually offer free banking services to students and are usually a much “better deal” for students than the bigger commercial banks. They have two locations: a campus branch at the DUC (Dobbs University Center) and the main branch at 1237 Clairmont Road. If you decide to open an account with the credit union and it is to be used as your direct deposit account, you will have to ask them to set the account up for the direct deposit.
**M.S. Program in Computer Science**

The Master's program in Computer Science prepares students for professional jobs in computer industry or further graduate study. The academic course work is expected to be completed within 2 years. Students choosing to complete a thesis are expected to perform original research with their advisors.

Choose one of the following:

**Thesis Option:** An acceptable thesis based on independent research (9 credit hours) to be submitted to the Laney Graduate School.

**Course-Only Option:** Completion of 9 additional approved elective hours i.e. 3 courses from the electives list.

**Project Option:** Completion of one 3-hour approved elective and a faculty-supervised project (for up to 6 credit hours). The project result may be in the form of a report or documented software and will be made publicly available. Satisfactory completion of the project requires approval by the faculty advisor.

Students may substitute at most one of the above electives with a relevant course from Mathematics, Computer Science, Biology, Chemistry, Physics, Biomedical Informatics, the Rollins School of Public Health, School of Medicine, and appropriate schools at Georgia Tech through the ARCHE program. When substituting courses, a student must obtain prior written approval from their advisor and CSI DGS/program director(s).

Students must complete their core courses with a grade of B or higher and complete all coursework by year two with a GPA of 3.0 or higher.
Main Computer Science Track: Academic Requirements
The M.S. in Computer Science accommodates students whose primary interest is in computer science who wish to follow a core Computer Science trajectory focusing on hardware, software and network systems. Requirements for completing the degree are as follows.

Completion of CS526 (Algorithms), CS551 (Systems Programming), CS554 (Database Systems), and CS580 (Operating Systems) each with a grade of B or higher.

Completion of three additional 500-level or above courses chosen from:
- CS 524: Theory of Computing
- CS 534: Machine Learning
- CS 540: Software Engineering
- CS 556: Programming Languages and Compilers
- CS 557: Artificial Intelligence
- CS 562: Advanced Computer Systems
- CS 570: Data Mining
- CS 581: High Performance Computing
- CS 584: Topics in Computer Science

Completion of CS596R: Computer Science Master’s Practicum
This course aims to expose Master’s students to real life problems that Computer Science and Informatics professionals face in their working environment, and to help students to acquire crucial skills and experience in applying their Computer Science and Informatics skills in solving practical problems.

Students perform a project under direction of an Emory faculty member, or supervised by a Computer Science/Informatics expert in the industry. In both cases, the project to be undertaken should be described by the student and submitted for approval by the Director of Graduate Studies.

The course is nominally taken for 1 (one) credit hour and is repeatable for up to two (2) times. CS596R is taken for S/U only. The amount of work for the course varies from full time (i.e., in case of external internship) to part time of at least 10 hours per week (i.e., in case of internal internship). The course cannot be taken as the last solitary course in a student’s curriculum.
Computational Science Concentration
The Computer Science Master’s program with Computational Science Concentration combines key elements of graduate study in Computer Science augmented with advanced coursework and projects in modeling, simulation, applied mathematics and computationally focused scientific inquiry. Students must complete each of the following.

4 core courses, each must be completed with a grade of B or higher:

- Math 515: Numerical Analysis I
- CS 551: Systems Programming
- CS 581: High-Performance Computing
- BIOS 506: Statistical Methods I

3 courses at or above the 500 level (9 or more credit hours) chosen from:

- CS 526: Algorithms
- CS 534: Machine Learning
- CS 562: Advanced Computer Systems
- CS 563: Digital Image Processing
- CS 570: Data Mining
- CS 580: Operating Systems
- CS 584: Topics in Computer Science
- MATH 516: Numerical Analysis II
- MATH 533: Network Science
- BIOS 510: Probability Theory (4 credit hours)

Completion of CS596R: Computer Science Master’s Practicum
This course aims to expose Master’s students to real life problems that Computer Science and Informatics professionals face in their working environment, and to help students to acquire crucial skills and experience in applying their Computer Science and Informatics skills in solving practical problems.

Students perform a project under direction of an Emory faculty member, or supervised by a Computer Science/Informatics expert in the industry. In both cases, the project to be undertaken should be described by the student and submitted for approval by the Director of Graduate Studies.

The course is nominally taken for 1 (one) credit hour and is repeatable for up to two (2) times. CS596R is taken for S/U only. The amount of work for the course varies from full time (i.e., in case of external internship) to part time of at least 10 hours per week (i.e., in case of internal internship). The course cannot be taken as the last solitary course in a student’s curriculum.
**Data Science Concentration**

The Computer Science Master’s program with Data Science Concentration combines knowledge of quantitative techniques and computing algorithms used in the analysis of large datasets as a means of discovery and understanding. Students must complete:

12 hours of required core coursework (4 courses)

- CS 526: Algorithms
- CS 534: Machine Learning
- CS 551: Systems Programming
- CS 554: Database Systems

2 9 elective hours at or above the 500 level (at least 3 courses) chosen from:

- CS 557: Artificial Intelligence
- CS 562: Advanced Computer Systems
- CS 563: Digital Image Processing
- CS 570: Data Mining
- CS 571: Natural Language Processing
- CS 572: Information Retrieval
- CS 573: Data Privacy and Security
- CS 584: Topics in Computer Science
- BIOS 506: Statistical Methods (4 credit hours)
- BIOS 510: Probability Theory (4 credit hours)

**Completion of CS596R: Computer Science Master’s Practicum**

This course aims to expose Master’s students to real life problems that Computer Science and Informatics professionals face in their working environment, and to help students to acquire crucial skills and experience in applying their Computer Science and Informatics skills in solving practical problems.

Students perform a project under direction of an Emory faculty member, or supervised by a Computer Science/Informatics expert in the industry. In both cases, the project to be undertaken should be described by the student and submitted for approval by the Director of Graduate Studies.

The course is nominally taken for 1 (one) credit hour and is repeatable for up to two (2) times. CS596R is taken for S/U only. The amount of work for the course varies from full time (i.e., in case of external internship) to part time of at least 10 hours per week (i.e., in case of internal internship). The course cannot be taken as the last solitary course in a student’s curriculum.
Biomedical Informatics Concentration

The Computer Science Master’s program with Biomedical Informatics combines key elements of graduate study in Computer Science with advanced coursework and projects in medical informatics to apply computing methods to emerging challenges in health sciences and technology. Students must complete:

12 hours of required core coursework (4 courses):

- CS 526: Algorithms
- CS 534: Machine Learning
- BMI 500: Introduction to Biomedical Informatics
- BIOS 506: Statistical Methods (4 credit hours)

9 elective hours at or above the 500 level (at least 3 courses) chosen from:

- BIOS 510: Probability Theory I (4 credit hours)
- BIOS 511: Statistical Inference (4 credit hours)
- BIOS 540: Introduction to Bioinformatics (2 credit hours)
- BIOS 545: Introduction to R Programming (2 credit hours)
- CS 540: Software Engineering
- CS 563: Digital Image Processing
- CS 570: Data Mining
- CS 581: High Performance Computing (merged with CS 555)
- IBS 523: Cancer Biology I (4 credit hours)

Completion of CS596R: Computer Science Master’s Practicum

This course aims to expose Master’s students to real life problems that Computer Science and Informatics professionals face in their working environment, and to help students to acquire crucial skills and experience in applying their Computer Science and Informatics skills in solving practical problems.

Students perform a project under direction of an Emory faculty member, or supervised by a Computer Science/Informatics expert in the industry. In both cases, the project to be undertaken should be described by the student and submitted for approval by the Director of Graduate Studies.

The course is nominally taken for 1 (one) credit hour and is repeatable for up to two (2) times. CS596R is taken for S/U only. The amount of work for the course varies from full time (i.e., in case of external internship) to part time of at least 10 hours per week (i.e., in case of internal internship). The course cannot be taken as the last solitary course in a student’s curriculum.


**MS in Computer Science Eligibility**

**Degree by Candidacy:** Students enrolled in the CSI PhD program may also obtain a Master’s degree in Computer Science by Candidacy by completing the following requirements:

- Completing the coursework required for the PhD degree
- Passing the written qualifying examinations for the PhD degree
- Being admitted to candidacy

The specific concentration within the MS CS received by Candidacy will correspond to the particular set of coursework and other requirements completed by the student. No more than one M.S. may be obtained via Candidacy.
Annual Evaluation
The Laney Graduate School and each program have standards for academic performance that students must meet, including making satisfactory progress through the program. Students will be reviewed at the end of each semester, and will receive a written evaluation at the end of each year based on their coursework and project performance. The result of the evaluation is either (1) Satisfactory progress; (2) unsatisfactory progress. Unsatisfactory progress can result in academic probation, which requires the student to correct the problem over the following semester. Lack of satisfactory progress while on probation may result in termination from the program.
Grievance Policy

Students who have a grievance related to the CSI graduate program should report it to the Director of Graduate Studies. The student should describe the grievance and relevant details in a letter addressed to the DGS, who will try to resolve the grievance in conversations with the student and relevant parties. If this is unsuccessful, the Director will appoint a committee of three program faculty members or use an existing standing committee, who will review the grievance and propose an appropriate response. If it is not possible to resolve the grievance within this committee or the framework of the program’s administrative structure, the Director will forward the grievance to the Office of the Senior Associate Dean of the Laney Graduate School. At that time, the grievance will be handled according to the Grievance Procedure described in the Laney Graduate School Handbook. If the grievance is with the Director, the student submits the grievance directly to the Senior Associate Dean of the Laney Graduate School.