CLEMSON
School of COMPUTING

2023-24 Graduate Handbook

Biomedical Data Science and Informatics (MS)

Computer Science (PhD and MS)

Human-Centered Computing (PhD)

Master of Applied Computing (MAC)

Please see the Digital Production Arts website for detail on the MS and MFA in DPA.
For the BDSI PhD, please see the joint Clemson-MUSC BDSI website.

Links to both can be found with the program's heading.

September 27, 2023

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Welcome

Welcome to the School of Computing (SOC) at Clemson University. We wish you success at every stage of your academic journey.

This handbook is intended to familiarize you, as a graduate student in the School of Computing, with the requirements and policies that govern your academic program. Any inconsistencies within this handbook or between this handbook and the Graduate School Policy Handbook should be brought to the attention of the appropriate Graduate Program Coordinator. The policies and curricula listed below are specific to the School of Computing. For Graduate School policies regarding registration, transfer credits, assistantships, and other University-wide policies, please see the Graduate School Policy Handbook.

Graduate School Policy Handbook

The Graduate School of Clemson University publishes a handbook of policies and procedures annually, which is available at https://www.clemson.edu/graduate/students/policies-procedures/index.html.

Graduate School Graduation Deadlines

The Graduate School publishes a list of deadlines for graduation, which is available at https://www.clemson.edu/graduate/students/deadlines.html.

Graduate School Admissions Requirements

The Graduate School admissions requirements can be found at https://www.clemson.edu/graduate//admissions/preparing-to-apply/supporting-materials.html. Any additional program-specific requirements will be listed with the program.

International Services

For policies related to International Services, please see https://www.clemson.edu/campus-life/campus-services/international/.

Revisions to the School of Computing Handbook

In cases where the School of Computing Handbook is revised while a student is enrolled but before the student completes their degree, that student can choose the Handbook year they would like to apply to their program requirements. In these cases, all policies in the year the student chooses will apply.

Terminology

Credit Hour	The semester credit hour used by Clemson University
Program Coordinator	The faculty member responsible for coordinating a degree program
Prof. Carrie Russell	M.S. Computer Science (CS M.S.); Master of Applied Computing (MAC)
Dr. Brian Dean	M.S. Biomedical Data Science & Informatics; Ph.D. Biomedical Data Science & Informatics (BDSI)
Dr. Federico Iuricich	Ph.D., Computer Science (CS Ph.D.)
Dr. Kelly Caine	Ph.D., Human Centered Computing (HCC)
Major Advisor	A student's Advisory Committee Chair

Support Services

Brittany Ryon, Payroll Coordinator, bhryon@clemson.edu, McAdams 100A
For questions regarding student employment
Katie Feaster, Registration Coordinator, kfeaste@clemson.edu, McAdams 105
For questions regarding registration and room reservations
Adam Rollins, Grad. Services Coordinator (BDSI, CS Ph.D., DPA, HCC Ph.D.), rollin7@clemson.edu
For questions regarding admission, assistantships, and graduation and program requirements
Becca Spilka, Grad. Services Coordinator (CS M.S., MAC, MS Ready), rbspilk@clemson.edu, McAdams 100E
For questions regarding admission and graduation and program requirements

Application Deadlines for the CS Ph.D. and HCC Ph.D. Programs

Fall Semester	Date
For priority consideration	January 1
Final deadline for complete applications	March 15
Spring Semester	**Date**
For priority consideration and final deadline for complete applications	September 15

Application Deadlines for the CS M.S. and MAC Programs

Fall Semester	Date
For complete applications, including official GRE and language scores	January 15
Spring Semester	**Date**
For complete applications, including official GRE and language scores	June 15

Registration

The Program Coordinators are the initial advisors for all new students. Students are encouraged to consult with their Program Coordinator prior to registration and should enroll in no more than three graduate courses during their first semester. It is possible to sit in on additional courses during the first session before deciding whether to drop or add a course. International students and students with assistantships must maintain a 9-credit hour minimum during Fall and Spring semester. Students with Summer Full Term assistantships must enroll in a minimum of 6 credit hours over the full summer term. Students with Summer I or Summer II assistantships must enroll in a minimum of 3 credit hours during the Summer I or Summer II session. Other policies regarding enrollment limits can be found in the Graduate School Policy Handbook.

For detail regarding the registration process, see https://www.clemson.edu/registrar/student-menu/registration/index.html.

Assistantships

Assistantships are awarded on a competitive basis to qualified students, both domestic and international. All qualified Ph.D. applicants are considered for assistantships when applications are processed. No separate applications are required. Students receiving an assistantship will receive an assistantship contract via Adobe Sign. These contracts can be signed electronically. Once signed, the student will receive guidance on the next steps of the hiring process.

Student Employment

Students employed by the School of Computing must follow all guidance and complete all necessary steps prior to beginning their employment. For U.S. citizens and permanent residents, this includes completing their employment verification form (I-9). For international students, this includes completing their SEVIS check-in and applying for and receiving a Social Security card.

YOU CANNOT BEGIN EMPLOYMENT OR RECEIVE PAY UNTIL YOU'VE BEEN THROUGH THIS PROCESS.

Paychecks will be issued twice a month and deposited directly into the student's bank account.

Social Security Card
All employees in the United States are required to have a Social Security card. International students who don't already have a Social Security Card will need to apply for one. International Employment Guidelines and the Social Security Application Procedure can be found at https://www.clemson.edu/human-resources/international/hiring-instructions.html. New international students must be in the US at least 10 days before applying. We recommend that new international students arrive at Clemson 15 days before classes begin.

Transfer Credits and Exemptions

Students with graduate credit earned at another institution must have their coursework evaluated for transfer credit. With the approval of their Major Advisor and Program Coordinator, students may transfer or exempt credits for recent graduate-level course work taken at other accredited institutions prior to admission to the program. For detail regarding the University's transfer credit policy, see the Graduate School Policy Handbook.

Curricular Practical Training

Students interested in curricular practical training (CPT) should review the guidelines at https://www.clemson.edu/campus-life/campus-services/international/employment-resources/practical-training.html. Computer Science M.S. and Master of Applied Computing students are encouraged to pursue CPT, particularly during the summer after the Fall and Spring semesters of their first academic year. Students entering in the Spring will need to enroll in both Spring and Summer semesters in order to qualify for CPT in the Fall.

To qualify for CPT, students must be [1] in good academic standing and [2] in compliance with all other guidelines regarding legal presence and enrollment as they relate to F1 visa requirements. Students taking more than 9 credits will be restricted to 10 hours per week of off-campus CPT.

M.S. en Route to Ph.D.

Students who are currently enrolled in the Computer Science or Human-Centered Computing Ph.D. programs and who have completed or plan to complete all requirements for an M.S. in Computer Science can apply for an M.S. en route. These students are expected to continue in the Ph.D. program after receiving the M.S. degree.

For the Computer Science M.S. course requirements, see pages 13-15.

The M.S. and Ph.D. cannot be conferred in the same semester, and while the same courses can sometimes be used to meet both an M.S. and Ph.D. requirement, certain minimum credit requirements still apply. These credit requirements are established by each degree program, individually, and by the minimum credits required for the Ph.D. by the Graduate School. For additional detail, please contact the Graduate Services Coordinator.

Ph.D. Advisory Committees

The Program Coordinator is the initial advisor for all new graduate students within their program and will serve as advisor until the student identifies an Advisory Committee. To select a committee, the student will first select a Major Advisor, who will assist the student in identifying the remaining members, and who will act as the student's Advisory Committee Chair. The Major Advisor must be a full-time faculty member at Clemson who is tenure track and has at least a 51% appointment in the School of Computing (SOC).

For Ph.D. students, the Advisory Committee must be composed of 4 faculty members, including the Major Advisor. The remaining 3 committee members, one of whom may be from outside the SOC, will be selected by the student in consultation with the Major Advisor and with the approval of the Ph.D. Program Coordinator. A step-by-step summary of the committee selection can be found below:

1	The student selects a Major Advisor.
2	The student consults with his or her Major Advisor in the selection of additional committee members.
3	The student e-mails the Program Coordinator with the names of their additional committee members and cc-es their Major Advisor. If the student wishes to have a committee member who is external to Clemson University, they should include that committee member's CV and cc the Graduate Services Coordinator.
4	The student submits the committee selection using the online GS2.

An Advisory Committee should be selected during the student's first year. Once the committee is finalized, it will assist the student in selecting courses, approve the student's course selection, approve the dissertation proposal, and evaluate the dissertation defense.

Selection of the student's committee members, including the Major Advisor, requires the mutual consent of the student and the faculty selected. A student is free to dissolve an existing committee and form a new one at any time. Similarly, the Major Advisor is free to step down as Advisor, and committee members to leave the committee, if research interests change or relationships prove to be incompatible.

The Graduate Committee Selection (GS2-Committee Selection)

The student will document their committee by submitting a GS2-Committee Selection. The GS2-Committee Selection must be completed and approved before a GS2-Plan of Study can be filed. The student's committee may be revised as necessary by submitting a new GS2.

Directions and filing deadlines for the online GS2-Committee Selection can be found at https://www.clemson.edu/graduate/students/plan-of-study/index.html.

For M.S. non-thesis students, a single committee member is all that is required. For the DPA M.S., that committee member is Dr. Eric Patterson. For the BDSI M.S., it is Dr. Brian Dean. For the Computer Science M.S. and Master of Applied Computing, it is Prof. Carrie Russell.

For Ph.D. students, both the GS2-Committee Selection and GS2-Plan of Study must be completed and approved before submitting their Ph.D. Portfolio.

The Graduate Plan of Study (GS2-Plan of Study)

The student's graduate degree curriculum will be selected in consultation with his or her Major Advisor and documented by filing a GS2-Plan of Study. The student's GS2-Plan of Study may be revised as necessary by submitting a new GS2.

Students must list on their GS2-Plan of Study all coursework they intend to use to satisfy the minimum credit requirements for their degree program, not just graded coursework. For simplicity, students are encouraged to list only the courses necessary to satisfy these minimums, unless additional courses are needed to satisfy the GPA requirement for GS2 courses.

Directions and filing deadlines for the online GS2-Plan of Study can be found at https://www.clemson.edu/graduate/students/plan-of-study/index.html.

Ph.D. Research

We encourage Ph.D. students to involve themselves in research under the supervision of a faculty member at the earliest possible opportunity. Coursework leading to the Doctorate of Philosophy is designed to give students a comprehensive knowledge of their field of specialization and a mastery of the methods of research. The degree is not awarded solely on the basis of coursework completed, residence, or other routine requirements. The final basis of granting the degree is a student's grasp of a broad field of study, competence in planning and conducting research, and ability to adequately express the results of research in both spoken and written form.

The Ph.D. Annual Review

Each program will conduct an annual review of its Ph.D. students, with each student submitting requested materials to their respective program coordinators. The material will be reviewed by program faculty and feedback provided to the student upon completion of the review.

The Ph.D. Portfolio

To be admitted to Ph.D. candidacy, a student must pass a comprehensive examination. The form of this examination is a portfolio review that is performed by program faculty. The review is intended to certify competency in the student's core areas of study, demonstrate potential for research, and promote scholarly and professional skill.

Students are given at most two opportunities to pass this exam. A student who is denied admission to candidacy after the first attempt may, at the discretion of faculty, be given one additional chance to correct the identified deficiencies. Graduate School policy requires that a student who fails his or her comprehensive examination a second time be dismissed from the graduate program.

The student is solely responsible for the contents of the portfolio, and it is important to begin the preparation of the portfolio early, in consultation with the student's Major Advisor. Students entering their Ph.D. program with an M.S. should submit their portfolio before the beginning of their fourth semester. Students entering their Ph.D. program without an M.S. should submit their portfolio before the beginning of their sixth semester.

The Program Coordinator of the student's degree program will initiate the call for portfolio submission. For program-specific portfolio requirements, see Programs of Study.

The Ph.D. Dissertation Proposal

The dissertation proposal serves several purposes. It ensures that the student has a clear grasp of a specific problem or set of problems; it provides a format for discussion of the solutions or approaches to solving the problem(s); and it provides documentation that the student has undertaken a reasonable survey of the literature related to his or her research.

The proposal itself is presented to the student's Advisory Committee. The purpose of the proposal is to inform the committee of the nature and scope of the proposed dissertation and to obtain their approval and guidance concerning the proposed research. The written proposal should include the following items:

- an outline of the included material
- a review of the state of knowledge in the general area of interest
- a description of the proposed dissertation area, along with a concise review of the state of knowledge in the specific area of the proposed dissertation
- an explanation of the problem(s) to be investigated
- a discussion of the results expected from solving the problem(s) and their impact on the state of knowledge in the general and specific areas of interest
- a bibliography

The written proposal must be presented publicly and approved by the student's Advisory Committee. The presentation must be scheduled in consultation with the Advisory Committee, and the written proposal must be available to the Advisory Committee at least two weeks before the presentation occurs. The Advisory Committee will be asked to document approval of the proposal after the presentation. Approval is based primarily on the written proposal. If the proposal is not approved, it may be repeated an indefinite number of times, subject to the consent of the Advisory Committee. The proposal must be approved at least six months prior to the student's graduation date.

Students can schedule their presentation by contacting the Graduate Services Coordinator at least one month prior to the expected presentation date.

A step-by-step summary of the proposal process can be found below:

1	Schedule a presentation date in consultation with Advisory Committee.
2	E-mail Graduate Services Coordinator at least one month prior to the presentation date.
3	Submit written proposal to Advisory Committee at least two weeks prior to presentation date.

The Ph.D. Dissertation

The research requirement is the most important aspect of Ph.D. study. The doctoral dissertation is the written record of the research that the student has conducted and must provide evidence of the student's ability to independently perform original research leading to the discovery of new and significant knowledge. The dissertation should demonstrate the student's technical mastery of the subject, independent scholarly work, and conclusions that modify or enlarge previously existing knowledge. The dissertation is expected to:

- Identify a significant open question or problem in the student's field of study.
- Describe the current state of knowledge of the area(s) involved.
- Present a solution or solutions to the problem identified.
- Report on the results of the research conducted, substantiate those results, and demonstrate their originality and contribution.

The format of the dissertation must conform to the current SOC and Graduate School standards. Copies of the dissertation must be delivered to the student's Advisory Committee at least two weeks prior to the final oral examination.

The Ph.D. Dissertation Defense

Ph.D. students will present a summary of their dissertation at a School of Computing colloquium. Attendance of the student's dissertation committee members may be remote but must be synchronous. Any committee member unable to attend the student's defense synchronously must abstain from voting. A majority vote of "pass" is required for the student to pass the defense. This presentation must include an explanation of the problem(s) addressed, a description of the results, and an explanation of their significance. After the presentation, a brief period may be allocated for questions from the general audience. At the end of the general Q&A, the Final Doctoral Oral Examination will be conducted by the student's Advisory Committee. Members of the faculty, as well as members of GAC and the Dean of the Graduate School are invited to attend the examination. The final examination demands a broad and penetrating interpretation by the student of the research project and its conclusions. It may also include examination of the student in the major and minor fields of specialization. A student who fails the final oral examination may be allowed a second opportunity, if recommended by the Advisory Committee. Failure of the second examination will result in dismissal from the Graduate School. The Advisory Committee will submit written approval to the Graduate School upon successful completion of the defense.

The dissertation defense should be scheduled following the same procedure as the dissertation proposal.

The Ph.D. Publication Requirement

Prior to graduation, each Ph.D. student must publish, or have accepted for publication, results of the research leading to their dissertation. The paper must be fully refereed, and either published in a peer-reviewed journal or accepted in the proceedings of a conference. The paper may be co-authored with the student's Major Advisor.

Programs of Study

Biomedical Data Science & Informatics, Doctorate

Program Coordinator: Dr. Brian Dean, bcdean@clemson.edu, 100D McAdams Hall

For program details for the Doctorate in Biomedical Data Science & Informatics, please see https://www.cs.clemson.edu/bdsi/.

Biomedical Data Science & Informatics, Master of Science

Program Coordinator: Dr. Brian Dean, bcdean@clemson.edu, 100D McAdams Hall

Overview of Program

The BDSI M.S. is an interdisciplinary program that leverages the broad strengths of a Tier 1 Research University, spanning the fields of computing, engineering, mathematics, biology, and public health. The objective of the program is to produce the next generation of data scientists, prepared to manage and analyze big data sources from mobile sensors to genomic and imaging technologies. Graduates will possess the necessary skills for informatics careers in biology, medicine, and public health, with a focus on the development of prescriptive analytics derived from large fields of data.

Graduates of the program will be able to:

1. Manage and analyze data, developing prescriptive analytics from large data sets.
2. Apply technological approaches in a biomedical context.
3. Identify the principles and limitations of public health programs as they relate to epidemiological problems.

Courses can be taken at The Medical University of South Carolina, the University Center of Greenville, and the Zucker Family Graduate Education Center at CURI campus, North Charleston, in addition to the courses offered at Clemson's main campus.

Typical time to completion is three to four full-time academic semesters. The program is not available online.

Admission Requirements

The BDSI M.S. program is designed for students with undergraduate computer science, math, engineering, or biomedical sciences experience who wish contribute to biomedical sciences and individual and societal health.

Admission requirements include:

- A bachelor's degree in biomedical or health sciences, computing, mathematics, statistics, engineering, or related discipline.
- One year of college calculus.

- One year of college biology.
- Computer programming coursework (e.g., at least one advanced programming course) or substantial experience in industry.

The following experiences are recommended, but not required:

- Competency in a second area—biomedical or health sciences, computing, mathematics, statistics, or engineering— beyond the bachelor's degree, as demonstrated by completion of a major, minor or certificate.
- Relevant research or work experience.
- Coursework in multivariate calculus, linear algebra, probability and statistics, and biostatistics.
- One year of computer science coursework that focuses on the fundamentals of computer science and software engineering principles, including abstraction, modularity, and object-oriented programming.

The annual deadline for a complete application is April 15. Applicants are admitted to the Fall semester only.

Degree Requirements

Each student will work with the Program Coordinator to construct a program of study that conforms to the following 32-34 hour requirement:

- Area I – Biomedical Informatics Foundations and Applications (12 hours)
- Area II – Computing/Math/Stats/Engineering (12 hours)
- Area III – Health Systems, Quality, and Safety (5-6 hours)
- Area IV – Domain Biology/Medicine (3-4 hours)

Specific courses that are either required for these areas or approved to satisfy these areas are maintained in an online curriculum grid linked at https://www.cs.clemson.edu/bdsi/. As this list may evolve over time, students may choose any single version of the curriculum grid that is in effect during their tenure in the program as a basis for their coursework requirements. Of the BDSI courses taught at the Medical University of South Carolina, BDSI MS students are restricted to Area I courses only.

In cases where the student comes to the program with prior coursework in a required area, or in other situations deemed necessary (e.g., if a student wants to take a relevant "special topics" course not on the curriculum grid), the Program Coordinator may approve a substitution. In cases where a student lacks pre-requisites for a required course, the student will be asked to complete both the pre-requisite coursework and the required course. A student may also be asked to complete additional pre-requisite coursework as part of their admission requirements.

Combined Bachelor's/Master's

The BDSI M.S. offers several combined B.S./M.S. course plans. Partner departments include Bioengineering, Computer Science, Computer Engineering, Mathematics, Health Science, and Genetics and Biochemistry. These course plans allow Clemson undergraduates to apply up to 12 hours of graduate coursework to both their B.S. and M.S. degrees.

To qualify for a combined B.S./M.S. course plan, students are required to have a minimum 3.4 GPA and to have completed at least 90 undergraduate credit hours.

Computer Science, Doctorate

Program Coordinator: Dr. Federico Iuricich, fiurici@clemson.edu, 305 McAdams Hall

Overview of Program

The objective of this program is to prepare exceptionally qualified individuals for research careers in academia and industry. The Ph.D. degree is viewed as a certification by the faculty that the student has a solid foundation in computer science and has performed original research in the area.

Graduates of the program will be able to:

1. Draw on a broad background of computing knowledge to address advanced computing problems.
2. Be able to perform original research, including formulation of problems and solutions, implementation and analysis, and communication of results.
3. Possess the skills necessary to sustain successful careers and leadership roles in both academia and industry.

Ph.D. in CS students may study at either Clemson University in Clemson, SC, or at the Zucker Family Graduate Education Center in Charleston, SC.

Because the curriculum will be tailored to each student, the time needed to complete the degree will vary, but in general, it is expected that students can complete the degree in five years or less.

The program cannot be completed online.

Admission Requirements

The program is designed for students who offer evidence of exceptional scholastic ability, intellectual creativity, and research motivation. The expected background includes:

- Programming (CPSC 1010 and 1020)
- Discrete math (CPSC 2070)
- Data structures (CPSC 2120)
- Computer organization (CPSC 2310)
- Operating Systems (CPSC 3220)
- Programming systems and paradigms (CPSC 3520)
- Algorithm analysis and theory (CPSC 3120 or CPSC 3500)

Students who are admitted with deficiencies in these areas may be required to take additional coursework as a condition of admission and as part of their graduation requirements.

Admission is available for both fall and spring semesters. Applicants are encouraged to submit GRE scores when applying to the program. While not required, GRE scores are an opportunity for applicants to strengthen their application.

Degree Requirements

The Ph.D. in Computer Science includes coursework requirements, a portfolio examination, a written dissertation—which includes a proposal and defense—and a publication requirement. Program-specific coursework and portfolio requirements can be found below. For information on dissertation and publication requirements, see pages 4-8.

Coursework Requirements

Coursework requirements for the Ph.D. vary depending on whether the student enters with a B.S. or M.S. degree. Courses are intended to demonstrate breadth in computer science as well as experience in research. All Ph.D. students are required to complete:

- 1 credit of New PhD Student Seminar (a CPSC 9500 offered in your first semester, formerly called Introduction to Faculty Research)
- at least 6 additional credits of PhD seminar courses (CPSC 9500)
- at least 21 credits of research hours (CPSC 9910, CPSC 8880, or CPSC 9500), at least 18 of which must be Dissertation Research (CPSC 9910)

For research hours, students typically register for CPSC 8880: Directed Projects prior to selecting an Advisory Committee. This can be a good mechanism for getting to know a prospective advisor. Students who have identified their Advisory Committee and who are performing research towards their dissertation should register for CPSC 9910: Dissertation Research.

Additional Coursework Requirements for Students Entering with a Master's Degree

In addition to the CPSC 9500, CPSC 8880 and CPSC 9910 requirements, students entering with a master's degree must also complete 12 hours of 8000-or-higher-level courses within the School of Computing (exclusive of 8810, 95x0, 9810, 9910, and any DPA prefix), for a total of 40 credit hours. One 3-credit 8000-or-higher-level course not meeting these restrictions may be included in the 12 credit hour requirement with the approval of both the student's Major Advisor and the Program Coordinator.

Of the 12 hours of required 8000-or-higher-level courses within the School of Computing, 9 credit hours, or 3 courses, will be submitted with the student's Ph.D. portfolio. For additional detail, see the Ph.D. portfolio requirements outlined below.

CPSC 6810/8810 MSCS Ready modules cannot be counted toward any Computer Science Ph.D. credit requirement.

Additional Coursework Requirements for Students Entering with a Bachelor's Degree

In addition to the CPSC 9500, CPSC 8880 and CPSC 9910 requirements, students entering with a bachelor's degree must also complete 32 additional hours of coursework for a total of 60 credit hours. Up to 12 credit hours of 6000-or-higher-level coursework at Clemson may be counted toward the 32 additional hours of required coursework. Of the remaining 20 credit hours, 18 must be 8000-or-higher-level courses within the School of Computing (exclusive of 8810, 95x0, 9810, 9910, and any DPA prefix). Any credit from courses external to the School of Computing must be approved by the Graduate Program Coordinator. Up to 6 credit hours of 8810 may also be counted. In exceptional cases, a higher amount may be approved by the Graduate Program Coordinator. Transfer of credit for courses external to Clemson is also possible, subject to approval of the Graduate Program Coordinator and all requirements and restrictions set forth by the University Graduate School Policies and Procedures manual.

Of the 18 hours of required 8000-or-higher-level courses within the School of Computing, 9 credit hours, or 3 courses, will be submitted with the student's Ph.D. portfolio. For additional detail, see the Ph.D. portfolio requirements outlined below.

CPSC 6810/8810 MSCS Ready modules cannot be counted toward any Computer Science Ph.D. credit requirement.

Ph.D. Portfolio Requirements

To pass the portfolio review for the Ph.D. in Computer Science, students must demonstrate superior mastery in three of six core areas of computing. These core areas are identical to the six core areas stated in the description of the M.S. requirements. A grade of 'A' in an 8000-or-higher level course listed in each chosen core area or a strong letter of support from the course instructor is expected. An 'A' grade generally provides much stronger evidence of mastery of the area, so students should exercise caution if considering submission of a portfolio without 'A' grades in their chosen core courses. Up to two of these courses may come from another university, in which case the approval of the Program Coordinator is required. Another mechanism for demonstrating mastery includes a strong research publication record in a core area.

For core area mastery, students are encouraged to submit courses already in the course catalogue. Occasionally, a student may request the inclusion of a special topics course with an 8810 course number. The Program Coordinator will consider these requests on a case-by-case basis. Students will be asked to submit a syllabus from the special topics course, along with a brief statement explaining why the special topics course should be considered for a specific core area in lieu of a course already in the course catalogue.

Students must also demonstrate potential for research. A research paper in which a significant component of the writing was done by the candidate must be included. The paper should be of sufficient quality to indicate that the student has the ability to conduct original research and make an acceptable written presentation of the results. Although not required, students are strongly encouraged to submit the paper to a journal, conference, or workshop. For such submissions, the student may be the sole author or may be a co-author with other faculty and/or other students. However, if the paper has joint authorship, the other authors must submit written documentation identifying those sections of the paper that were written by the candidate. The paper should exhibit the scope and quality of a publication-worthy paper, but it does not have to be accepted or published to be included in a successful portfolio. Although a published paper provides more convincing evidence for research potential, a rejected submission, along with peer reviews, can also be used to evaluate potential. The paper may or may not be related to the student's eventual dissertation area. A candidate's M.S. research paper, thesis, or a derivative thereof may be used to satisfy this requirement.

Additionally, the student must provide:

- A statement of purpose.
- A brief curriculum vitae.
- Two supporting letters of recommendation from School of Computing faculty.

Optional material may be included at the discretion of the student, and in consultation with the student's Major Advisor. This material may include:

- Significant accomplishments - An informal statement of two or three things the student is most proud of in this period. Examples include earning an 'A' in a difficult course, finishing an M.S. research paper, or having a peer-reviewed paper accepted.
- Honors and awards, such as awards of competitive fellowships and induction into honor societies.
- Presentations - Typical categories include seminars, professional presentations, and tutorials. Workshop, class, and conference presentations may be included.
- Proposals in preparation, in review, and accepted - Include fellowship applications, grant applications, applications to industrial affiliates, requests for travel money from conference organizers, etc. Note the status of the proposal: in preparation, under review, accepted, rejected, or under revision.

- Professional Reviewing - Include reviewing for journals, conferences, workshops, and book prospecti. Significant internal reviewing may also be included; for example, if more than a few hours were spent reviewing drafts of papers or proposals for faculty members.
- Service - Include University and School of Computing service other than research and teaching. Examples include service on standing and ad hoc School of Computing committees or as a graduate student representative.

Computer Science, Master of Science

Program Coordinator: Prof. Carrie Russell, crusse4@clemson.edu, 212 McAdams Hall

Overview of Program
The Master of Science program in Computer Science prepares individuals for a Ph.D. program, research careers in industry, or advanced technical positions in industry and government. The Student Outcomes are:

1. Students can frame a real-world problem such that it can be addressed computationally.
2. Students can evaluate multiple computational approaches to a problem and choose the most effective one. The different approaches may involve different algorithms and/or different software tools.
3. Students can apply reasoning and technical skills to solve a computational problem with minimal guidance.

Completion of the M.S. program normally requires from one and one-half years to two years beyond the undergraduate degree but may require additional time for students whose undergraduate degree is in an area other than computer science.

CS M.S. students may study at Clemson University in Clemson, SC, the Zucker Family Graduate Education Center in Charleston, SC, or at the ICAR campus in Greenville, SC.

The program cannot be completed online.

Requirements for Admission
Students accepted into the M.S. program, including Ph.D. students applying for an M.S. en route, must have a background equivalent to the MSCS Ready modules. Students without the necessary background are encouraged to apply to the MSCS Ready program as non-degree seeking students or to the Master of Applied Computing program, which includes the MSCS Ready modules.

With pre-approval from the Computer Science M.S. program coordinator, MATH 8650 will be accepted as a prerequisite equivalent to Module 4 of the MSCS Ready sequence but will not count toward the Computer Science MS degree requirements. Enrollment in MATH 8650 is at the discretion of the Mathematical and Statistical Sciences department and cannot be guaranteed by the School of Computing.

Admission is available for both fall and spring semesters. The GRE exam is required, but there are no other program-specific materials required as part of the application.

Degree Requirements
The requirements for the M.S. are based on 30 credits, which may be obtained through either:

- 30 credits of coursework, or
- 24 credits of coursework and 6 credits of M.S. thesis research (CPSC 8910).

The Coursework-Only Option: In this option, a student is required to complete ten approved courses. There is no thesis presentation or comprehensive examination required for the degree.

The Thesis Option: The thesis option is designed for students who have a strong interest in research and who can complete an original and creative research project. The quality of the research and presentation should be such that the thesis or a derivative work is acceptable for publication in a refereed conference proceeding or archival journal.

A thesis proposal must be presented to and approved by the student's Advisory Committee prior to substantive work on the thesis.

The final examination is an oral examination conducted by the student's Advisory Committee. The student is expected to demonstrate an in-depth understanding of both the research results presented and the pre-existing body of knowledge that the results extend.

Of the 30 credits required for graduation, the thesis-option student must have 6 credits of CPSC 8910. The student must also meet the Concentration and Breadth Requirements as defined below in the remaining 24 credits of coursework. A student may take more than six credits of CPSC 8910, but only six credits may be applied toward the degree.

Concentration and Breadth
During the M.S. program, students will choose a concentration in one of six core areas, and, to meet the breadth requirement, at least one course in two other core areas. The core areas are:

- Data Science and Informatics
- Foundations and Theory
- Human Centered Computing
- Networks, Systems, and Security
- Software Engineering
- Visual Computing

Concentration Requirement: Each student must take at least three courses in one core area. These courses can be selected from the courses listed in the table below or from approved CPSC 8810 special topics courses in that area.

Breadth Requirement: Each student must take one course in at least two other core areas.

MS Core Area	Courses
Data Science and Informatics	6300, 6420, 6430, 6550, 6620*, 8420, 8430, 8450, 8470, 8480*, 8490, 8620*, 8630, 8650
Foundations and Theory	8380, 8390, 8400, 8480*, 9400
Human Centered Computing	6110*, 6120, 6140, 6150, 6160*, 6180*, HCC 6400, 6510, 8310, 8330 8410, 8500, 8510
Networks, Systems, and Security	6180*, 6200, 6240, 6280, 6440, 6620*, 6770, 6780, 8200, 8220, 8240, 8510, 8520, 8550, 8570, 8580, 8620*, 8830, 8860

Software Engineering	6160*, 6720, 8270, 8280, 8290, 8700, 8710, 8720, 8730, 8750
Visual Computing	6030, 6040, 6050, 6110*, 6160*, 6170, 6190, 8030, 8050, 8110, 8190

* CPSC 6110, 6160, 6180, 6620, 8480, and 8620 span core areas but will count in only one core area each

For the course titles of each course, please see courses of instruction. For syllabi, please see the syllabus repository.

Course Selection
Computer Science M.S. students can enroll in a maximum of 12 credit hours per Fall and Spring semesters.

There are four considerations when selecting courses for an M.S. plan of study.

6000/8000/9000-Level Credits: For coursework-only students, at least 18 of the 30 credits must be at the 8000- or 9000-level. For thesis students, at least 21 of the 30 credits must be at the 8000- or 9000-level. For thesis students, six of their 8000/9000-level credits will be CPSC 8910.

Courses Outside the School of Computing: Coursework-only students may include up to 12 credits of approved courses from outside the School of Computing. Thesis students may include up to 9 credits of approved courses from outside the School of Computing.

Transfer Credits: Both coursework-only and thesis students may include up to 9 credits of approved computing courses transferred from another university. Transfer courses will be counted among the approved courses outside the School of Computing but will be listed as CPSC 6999 or CPSC 8999 on the student's GS2-plan of study.

Course Exclusions: Of the 30 credits of approved courses required for graduation, students may not include credits for CPSC 6810, 6890, 74xx, 8880, 95x0, 9810, or 9910; DPA 6000-6030, 6810-6830, 8600, 8800, or 8910; or HCC 8880, 9500, or 9910. Additionally, only six credits of CPSC 6820 or CPSC/DPA/HCC 8810 can be included, with the exception of CPSC 8810 MSCS Ready modules, which cannot be counted toward the Computer Science M.S. 30 credit requirement. Coursework-only students may not include credits for CPSC 8910.

The M.S. Advisory Committee
The M.S. Program Coordinator is the initial advisor of all new graduate students. At the end of the first semester of study, each M.S. student pursuing the thesis option should form an Advisory Committee of three members. Coursework-only students will continue to be advised by the M.S. Program Coordinator.

The chair of an M.S. Thesis Advisory Committee serves as the student's Major Advisor. The Major Advisor must be a tenured or tenure-track faculty member in the School of Computing. The student selects two additional members for an M.S. Thesis Advisory Committee, one of whom may come from outside the School of Computing.

Selection of M.S. Thesis Major Advisor and the additional two members of the M.S. Thesis Advisory Committee is by mutual consent of the student and the faculty members. A student is free to dissolve an existing M.S. Thesis Advisory Committee and form a new one at any time. Likewise, the Major Advisor is

free to dismiss a student. If a student is unable to find an M.S. Thesis Major Advisor, the student should follow the coursework-only option and will be advised by the M.S. Program Coordinator.

The M.S. Thesis Defense
The defense should be scheduled in concert with the student's Advisory Committee, and the Computer Science M.S. Graduate Services Coordinator should be contacted at least a month prior to the date of the presentation.

The M.S. Assessment
To assess attainment of the degree program's three student outcomes, each student must submit one course-related assignment and accompanying self-reflection per student outcome, prior to the approval of their GS2-Plan of Study. Review of the M.S. Assessment will be based on each assignment's fit with a Student Learning Outcome and the level of reflection demonstrated in the self-reflection; in particular, the acceptability of a submission is not based on the instructor's previous scoring of the assignment. For more detail about the submission format, please see
http://www.clemson.edu/cecas/departments/computing/academics/graduates/programsofstudy/msincsass essment.html.

Combined Bachelor's/Master's
A combined B.S. Computer Science/M.S. Computer Science is available. The complete B.S./M.S time to degree will typically take five and a half years. The School of Computing currently allows up to nine credit hours to apply to both degree programs

Digital Production Arts, Master of Fine Arts

Program Coordinator: Dr. Eric Patterson, ekp@clemson.edu, Charleston-Zucker

For program details for the Master of Fine Arts in Digital Production Arts, please see
https://computing.clemson.edu/dpa/.

Digital Production Arts, Master of Science

Program Coordinator: Dr. Eric Patterson, ekp@clemson.edu, Charleston-Zucker

For program details for the Master of Science in Digital Production Arts, please see
https://computing.clemson.edu/dpa/.

Human-Centered Computing, Doctorate

Program Coordinator: Dr. Kelly Caine, caine@clemson.edu, 213 McAdams Hall

Overview of Program
The objective of the Ph.D. in Human-Centered Computing is to prepare our graduates for advanced research positions in industry and the academy. The program is designed for students who offer evidence of exceptional scholastic ability, intellectual creativity, and research motivation. The HCC Ph.D. is viewed as a certification by the faculty that the student has a solid foundation in human-centered computing and has performed original research in the area.

Graduates of the program:

1. Will possess a deep knowledge of computing, people, and research methods, as well as a cognate or specialty area.
2. Will have extended, by way of innovative research, the frontier of knowledge in at least one area of computing as it relates to a human condition or concern.
3. Will be able to express ideas adequately and professionally in spoken and written language.

Because the curriculum will be tailored to each student and students join the program with different degrees (e.g., bachelors, M.S.), the time needed to complete the degree will vary. In general, it is expected that students can complete the degree in five years or less. The HCC Ph.D. program includes opportunities for interdisciplinary and interdepartmental research.

HCC Ph.D. students typically study at Clemson University in Clemson, SC, but study at the Zucker Family Graduate Education Center in Charleston, SC and/or at One Research Drive in Greenville, SC may be possible.

This program cannot be completed online.

Degree Requirements

The Ph.D. in Human-Centered Computing includes a prerequisite computing requirement, coursework requirements, a portfolio examination, a written dissertation—which includes a proposal and defense—and a publication requirement. Program-specific coursework and portfolio requirements can be found below. For information on dissertation and publication requirements, see pages 6-8.

Prerequisite Computing Requirement

The prerequisite computing requirement may be met by one of the following:

- undergraduate degree in computing
- master's degree in computing
- MSCS ready modules 1, 2 and 4
- DPA 6000 and 6010
- CPSC 1010 and 1020
- a letter of petition for alternative training approved by the student's Major Advisor and the HCC Program Coordinator; this letter must be presented at an HCC Faculty meeting by the student's Major Advisor and supported by a majority of HCC faculty; the student's Major Advisor will present evidence that the proposed alternative is high quality computing training; the proposed alternative must be approved prior to the student undertaking the training.

Note: no courses used to satisfy the computing requirement may be used to satisfy other HCC program requirements. For example, DPA 6000 or MSCS Ready courses (6810/8810) may NOT be used to satisfy the computing or cognate/specialty course requirements.

Coursework Requirements

The requirements for the Ph.D. in Human-Centered Computing include 60 credit hours of coursework, of which 36 credit hours are graded coursework and 24 credit hours are research hours. The requirements for all HCC Ph.D. students, regardless of whether they enter the program with a bachelors' or master's, include the following categories:

Coursework (graded)	Credits
Fundamentals of HCC	3 credits
Graduate Level Computer Science Courses	12 credits
Courses in People/Human Condition/HCI	6 credits
Research Methods courses	6 credits
Cognate or Specialty Area Approved by Advisor	9 credits
Research	**Credits**
Pre-dissertation Research (pre-portfolio, HCC 8880)	6 credits
Dissertation Research	**Credits**
Dissertation Research	18 credits

CPSC 6810/8810 MSCS Ready modules cannot be counted toward any HCC Ph.D. credit requirement.

In meeting the above requirements, students are also required to meet the Graduate School's minimum credit requirements, as outlined below:

Beginning Degree	Non-Research Coursework	Dissertation Research	Total Credits
M.S.	12	18	30
B.S.	42	18	60

Because of the Graduate School's policy on the independence of degrees, credit hours applied to previously completed degrees cannot be used to meet the Graduate School's minimum credit requirements.

Consistent with SACSCOC guidelines, the Clemson Graduate School requires that a doctoral degree comprise a minimum of 30 credit hours beyond the master's degree and 60 credit hours beyond the bachelor's degree. Therefore, the Graduate School's minimum credit hour requirements for the Ph.D. will vary depending on whether the student enters with a bachelor's degree or master's degree.

Coursework Requirements for Students Entering with a Master's Degree
Students entering with a master's degree must take a minimum of 30 credit hours beyond the master's degree. At least 12 credit hours of coursework beyond the master's degree must be taken at Clemson.

Regardless of whether a student enters with a master's degree, they must meet all HCC PhD coursework requirements. Some courses that were used to meet master's requirements may also be used to satisfy HCC Ph.D. requirements. For example, if a student received an M.S. in Computer Science and they took four graduate level computer science courses as part of that master's degree, those courses may satisfy the Graduate Level Computer Science Course Requirements.

Upon admission, students entering with a master's degree should consult with their advisor about which courses from their master's degree may be eligible to satisfy HCC Ph.D. program requirements. Once the advisor and student agree, then they should submit that list to the HCC Program Coordinator for review and approval.

Note that any such courses are not considered transfer courses and will not appear on the student's GS2 Ph.D. plan of study. For additional detail on transfer credit, see page 3.

Coursework Requirements for Students Entering with a Bachelor's Degree
Students entering with a bachelor's degree must take a minimum of 60 credit hours beyond the bachelor's degree. Direct entry students (those entering with a bachelor's degree but not master's degree) must complete 36 credit hours of graded coursework (12 courses), 6 credit hours of pre-dissertation research and 18 credit hours of dissertation research. Ph.D. direct entry students have an option to receive a master's degree en-route in the process of fulfilling their Ph.D. program requirements.

M.S. en Route Option
There is an option for Ph.D. students to obtain a Computer Science M.S. en route to the HCC Ph.D. Please see page 4 for detail.

Seminars
Full-time students in the HCC Ph.D. program are encouraged to take one seminar (HCC/CPSC 95x0 /9810) per semester.

Additional Coursework
Full-time students in the HCC Ph.D. program are encouraged to take one HCC course per semester until passing the comprehensive exam, and one per year until completion of the program.

Ph.D. Portfolio Requirements

- Two thirds of graded courses complete (8 courses out of 12 required courses)
- Transcripts – a minimum GPA of 3.5 on courses taken at Clemson and appearing on the plan of study is expected.
- Writing Sample – A research paper in which a significant component of the writing was done by the candidate must be included. The paper should be of sufficient quality to indicate that the student has the ability to conduct original research and make an acceptable written presentation of the results. Peer-reviewed published work is generally the strongest evidence, but other samples will also be considered. Therefore, students are strongly encouraged to submit the paper to a conference or workshop. For all submissions, the candidate may be the sole author or may be the first co-author with other faculty and/or students. If the paper has joint authorship, the candidate must submit written documentation identifying those sections of the paper that were written by the candidate. The paper does not have to be accepted or published to be included in a successful portfolio. Although a published paper provides more convincing evidence for research potential, a rejected submission, along with peer reviews, can also be used to evaluate potential. The paper may or may not be related to the student's eventual dissertation. A student's M.S. research paper, thesis, or a derivative thereof may be used to satisfy this requirement.
- Statement of Purpose – A one page description of research interests and intended topics of study.
- Plan of Study – The plan of study should be consistent with the student's statement of purpose and include a list of courses the student has taken or plans to take.

- Major Advisor's Letter of Support – The portfolio should be submitted under the direction of the student's Major Advisor, with the Major Advisor providing a letter of support.
- The student's curriculum vitae.

Portfolios are reviewed each semester by a committee of HCC tenured and tenure-track faculty.

Master of Applied Computing

Program Coordinator: Prof. Carrie Russell, crusse4@clemson.edu, 212 McAdams Hall

Overview of Program
The Master of Applied Computing (MAC) is designed for students without a computer science background who wish to obtain [1] the requisite computer science background relevant to graduate study in computer science and [2] a sequence of graduate-level courses in a specific area of interest. The program is intended to expand access to graduate degrees in the field of computing, and to develop the student's understanding of computer systems and their ability to make effective use of those systems. Students graduating from the program will be able to:

1. Design and test procedural and object-oriented computer programs.
2. Compare the performance and storage requirements for different data structures.
3. Identify and explain the functions and operations of the hardware and software components of a computer system.
4. Formulate requirements for a computational problem.
5. Select algorithms and programming tools appropriate to a computational problem's solution.
6. Apply and evaluate computer-based systems for a computatational problem's solution.

The program is designed for Fall entry. Completion as a full-time student will normally require two academic years and the intervening summer.

Requirements for Admission
Students with a baccalaureate degree in any field may apply. However, students who want to follow the Visual Computing track should have a good background in mathematics, including linear algebra. Students who want to follow the Artificial Intelligence and Machine Learning track or the Data Science track should have a course in statistics in their background or take a statistics course at Clemson in their first semester.

Degree Requirements
The MAC program combines 12 credit hours of the School of Computing's MSCS Ready program with 30 credit hours of advanced coursework, for a total program requirement of 42 credit hours. The MAC program is coursework only. MAC students who later become interested in thesis research should talk with the MAC Program Coordinator about a change of degree program to the M.S. in Computer Science.

Students must pick one of six tracks within the degree. Each track is 15 credit hours. Individual track requirements are given below.

Artificial Intelligence and Machine Learning track

At least three courses selected from:	CPSC 6300: Applied Data Science; CPSC 6420: Artificial Intelligence; CPSC 6430: Machine Learning: Implementation and Evaluation; CPSC 8420: Advanced Machine Learning; CPSC 8430: Deep Learning; CPSC 8650: Data Mining
Additional courses needed to meet the five-course track can be selected from:	AUE 8240: Autonomous Driving Technologies; ECE 6420: Knowledge Engineering; ECE 8560: Pattern Recognition; ECE 8720: Artificial Neural Networks; MATH 8710: Machine Learning I; MATH 8720: Machine Learning II

Cybersecurity track

At least four courses selected from:	CPSC 6180: Usable Privacy and Security; CPSC 6200: Computer Security Principles; CPSC 6240: System Administration and Security; CPSC 8570: Security in Advanced Networking Technologies; CPSC 8580: Security in Emerging Computing and Networking Systems; CPSC 8830: Malware Reverse Engineering; CPSC 8860: Distributed Denial of Service (DDoS) Attacks
Additional courses needed to meet the five-course track can be selected from:	ECE 6490: Computer Network Security; PADM 8540: Cybersecurity

Data Science track

Required:	CPSC 6300: Applied Data Science; CPSC 8650: Data Mining
Additional courses needed to meet the five-course track can be selected from:	CPSC 6030: Data Visualization; CPSC 6420: Artificial Intelligence; CPSC 6430: Machine Learning: Implementation and Evaluation; CPSC 6620: Database Management Systems; CPSC 8030: Scientific Visualization; CPSC 8420: Advanced Machine Learning; CPSC 8430: Deep Learning; CPSC 8470: Introduction to Information Retrieval; CPSC 8480: Network Science; STAT 6020: Introduction to Statistical Computing; STAT 8010: Statistical Methods I; STAT 8020: Statistical Methods II

Human Computer Interaction track

Required:	CPSC 6140: Human and Computer Interaction; at least two additional graduate-level HCC courses
Additional courses needed to meet the five-course track can be selected from:	CPSC 6120: Eye Tracking Methodology and Applications; CPSC 6150: Mobile Device Software Development; CPSC 6180: Usable Privacy and Security; IE 6880: Human Factors Engineering OR IE 8000, Human Factors Engineering (but not both); IE 8010: Design and Analysis of Human-Machine Systems; IE 8020: Design of Human-Computer Systems; PSYC 8350: Advanced Human Factors Psychology

Software Engineering track

Required:	CPSC 8710: Foundations of Software Engineering
At least two courses from:	CPSC 8700: Software Design; CPSC 8720: Software Specification and Design Techniques; CPSC 8730: Software Verification, Validation and Measurement; CPSC 8750: Software Architecture

Additional courses needed to meet the five-course track can be selected from:	CPSC 6140: Human and Computer Interaction; CPSC 6150: Mobile Device Software Development; CPSC 6720: Software Development Methodology; HCC 6400: Measurement and Evaluation of Human-Centered Computing Systems; HCC 8310: Fundamentals of Human-Centered Computing; HCC 8500: The Science of Teamwork and Technology

Visual Computing track

Required:	CPSC 6040: Computer Graphics Images; CPSC 6050: Computer Graphics
Additional courses needed to meet the five-course track can be selected from:	CPSC 6030: Data Visualization; CPSC 6110: Virtual Reality Systems; CPSC 6160: 2-D Game Engine Construction; CPSC 6170: 3D Game Programming: Algorithms and Techniques; CPSC 6190: Physical Modeling and Animation; CPSC 8030: Scientific Visualization; CPSC 8050: Advanced Computer Graphics; CPSC 8110: Technical Character Animation; CPSC 8190: Physically Based Visual Effects

For the course description of each course, please see courses of instruction. For syllabi, please see the syllabus repository.

Credit hours:
- 12 of the 42 total credit hours for the degree must be the MSCS Ready modules.
- At least 21 of the 42 total credit hours must be at the 8000-level.
- At least 27 of the 42 credit hours must be taken as CPSC and HCC courses.

Courses outside the School of Computing: Courses offered by other departments must be preapproved by the MAC Program Coordinator to be applied to the MAC degree. The courses appearing in the tables above are already pre-approved. Please note that courses offered by other departments may have field of study restrictions and/or prerequisites that individual instructors may not wish to override. Therefore, the School of Computing cannot guarantee enrollment in the courses offered by other departments. Please note that each track can be fulfilled by taking only CPSC and HCC courses.

Transfer Credits: Students may include up to 9 credits of approved computing courses transferred from another university. Transfer courses will be listed as CPSC 6999 or CPSC 8999 on the GS2-Plan of Study.

Course Exclusions: Of the 42 credits of approved courses required for graduation, students may not include credits for CPSC 6890, 74xx, 8880, 8910 95x0, 9810, or 9910; DPA 6000-6030, 6810-6830, 8600, 8800, or 8910; or HCC 8880, 9500, or 9910. Additionally, only six credits of CPSC 6820 or CPSC/DPA/HCC 8810 can be included.

Assessment
Each student must submit three course-related assignments and accompanying self-reflection prior to the approval of their GS2-committee selection.