Graduate Student Handbook

School of Computing and Information Sciences
College of Engineering and Computing
Florida International University

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Graduate Student Booklet

School of Computing and Information Sciences

Florida International University

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1 Overview

This document describes the policies and requirements of graduate programs housed in the School of Computing and Information Sciences (SCIS). While it is intended to be self-contained and accurate, SCIS reserves the right to correct errors, when found, without further notice.

Students should first familiarize themselves with the University Graduate School (UGS) policies and procedures appropriate to their program (http://gradschool.fiu.edu/students/). Students are also subject to university policy, including student conduct (see https://studentaffairs.fiu.edu/get-support/student-conduct-and-conflict-resolution/), as well as deadlines for financial responsibilities, enrollment, and graduation (see https://onestop.fiu.edu/Enrollment_Services_Calendar/fall/2018-2019_academic_calendar_04_2018.pdf). Failure to adhere to these policies, requirements, and deadlines could result in delay of graduation or dismissal from the program. It is ultimately the student's responsibility to make sure they are in compliance with SCIS, UGS, and university policies. For requirements that necessitate faculty action, it is the student's responsibility to allow the faculty enough time to meet the requirements.

2 Access Information about Graduate Program

Information about the graduate program at SCIS is available online at https://www.cis.fiu.edu/academics/degrees/graduate/, where you can find a host of documents (including the latest version of this booklet). You can also send mail to the general alias: grad-info@cis.fiu.edu, or contact individual staff and faculty members.

For further questions or clarification, the following people can be of assistance:

- **Rebeca Arocha**
  Senior Coordinator Academic Support Services / Graduate Program Advisor
  rarocha@fiu.edu
  305-348-7989
  Contact for advising and other graduate academic issues.
- **Olga Carbonell**
  Program Specialist
  ocarbone@cs.fiu.edu
  305-348-2014
  Contact for questions related to contracts, financial aid, etc. Graduate assistants should see the Program Specialist immediately upon arrival to complete required paperwork.
- **Dr. Bogdan Carbunar**
  Associate Professor and Graduate Program Director
  carbunar@cs.fiu.edu
  305-348-7566

3 General Information

3.1 Graduate Programs

The School of Computing and Information Sciences (SCIS) offers five Master of Science degrees and one Doctor of Philosophy degree. The Master of Science in Computer Science degree provides study in state-of-the-art computer applications as well as an introduction to the theoretical foundations of computer science. The Master of Science in Information Technology is intended to educate students in the area of technical aspects of information. The Master of Science degree in Telecommunications and Networking is intended to provide study in state-of-the-art telecommunications and networking technologies and management. The Master of Science in Cybersecurity will include student learning outcomes that address cybersecurity from several complementary perspectives. The Master of Science in Data Science provides broad and deep technical training in data science, with specialization in several key application areas of importance to industry. The Doctor of Philosophy in Computer Science is designed to provide study in all major areas of computer science while leading to the frontiers of knowledge in a chosen field of concentration.

3.2 Admission Process

3.2.1 Application

Please note that admission requirements and required materials vary by program. Before applying, the applicants should refer to the admissions section of their chosen program for program-specific information.

Step One: Apply Online

All applications and associated fees, with the exception of those for combined BS/MS programs, are submitted online at https://admissions.fiu.edu/how-to-apply/graduate-applicant/applications/index.html.

Through the website, applicants will have the opportunity to upload supporting documents, such as a statement of purpose, resume, residency documents for tuition purposes, immigration documents, and the like. They can also provide contact information for recommenders who are then prompted to submit the letters of recommendation through the online portal.

Once submitted, Graduate Admissions will promptly acknowledge receipt of the application via email and will provide a Panther ID as well as further instructions on how to access the MyFIU portal. On MyFIU, students can view the status of their application, including any missing documents. Missing documents are listed under the “To Do List” on the top right-hand corner of the screen.

Once the applicant has been issued a Panther ID, they should include the Panther ID in all communications to the unit representatives, Graduate Admissions, International Student and Scholar Services, and Student Health services.

Step Two: Submit Official Documents

Mailing address for regular U.S. mail:

FIU Graduate Admissions
P.O. Box 659004
Miami, FL 33265-9004

Mailing address for couriers (typically used for delivering documents from outside the United States):

FIU Graduate Admissions
11200 S.W. 8 St., BT 201
Miami, FL 33199

FIU requires official documents, even for the initial review of the applications. Required official documents include transcripts, proof of degree, translations, and test scores (if applicable).

Transcripts must be received in a sealed university envelope issued by the academic institution, from all institutions previously attended. FIU conducts evaluations of foreign transcripts internally. Any transcripts that have been evaluated by a third party (e.g. WES, Josef Sinly, etc.) are considered unofficial by Graduate Admissions and will not fulfil the official transcript requirement. FIU will use evaluated documents for translation purposes only.

Official test scores must be reported to the School by the testing agency. The School's code is 5206. IELTS scores may be verified directly by the admissions officer, if the applicant provides FIU with a copy of the score report.

Please note that applications are not referred to the unit for review until official transcripts, translations, and test scores (if applicable) have been received. Uploaded copies of any of these documents are considered unofficial and will not be used in evaluating the application.

Once admitted, international students will also be required to show an official proof of degree, typically a diploma, but can do so upon their arrival to FIU.

3.2.2 Deadlines

The deadlines are as follows. Please note that not all programs admit for every term. Visit the admissions sections for the selected program for more information.

All international applicants must abide the international applicant deadline. This includes international applicants residing in the United States and/or international applicants who do not require student visas.

MS			
	Fall	Spring	Summer
Domestic Applicants	June 1st	October 1st	March 1st
International Applicants	June 1st	October 1st	March 1st

PhD			
	Fall	Spring	Summer
Domestic and International Applicants	February 15th	August 1st	December 1st

3.2.3 Notification

Applicants are notified of their admission decision via email. Applicants will receive an official offer letter from Graduate Admissions stating the decision as well as any conditions and pending materials. Applicants should read this offer letter carefully and follow up accordingly.

PhD applicants who are selected for an assistantship will receive an official offer letter from SCIS in a separate email. The two letters, admissions offer and funding offer, will not necessarily be received at the same time.

3.2.4 Pre-Arrival Information

International Students

International students should verify that all required immigration documents have been received in order to avoid any delays in the issuing of the I-20 Form. Admitted international students can visit the International Student and Scholars Services webpage for important pre-arrival information: https://globalaffairs.fiu.edu/isss/international-students/new-f1-students.

Holds

Once a student has been admitted, holds, if applicable, can be viewed on My FIU (on the top right-hand corner of the screen). Below are the most common holds:

- **One term conditional admission.** This hold is placed on a student's account if they are missing any final documents. It is typically assigned for cases in which the student is admitted during the final semester of their undergraduate program. Students with a one-term conditional hold may register for their first semester, but any future registration will be blocked. In other words, the student has one term to produce the missing final documents. This hold can only be lifted by Graduate Admissions and no exceptions will be made to the condition.
- **Immunization.** Florida International University requires proof of immunization for MMR, Hepatitis B and Meningitis. These immunization holds will prevent the student from registering for classes. Students must provide proof of vaccination or waivers (where applicable) in order to release these holds. Only Student Health at the University can lift immunization holds. Find more information at:

https://studentaffairs.fiu.edu/health-and-fitness/student-health/registration-holds/immunization-holds/index.php

- **Insurance.** According to Florida Board of Governors and FIU policy, all International students with F and J status are required to have medical insurance prior to registration. Proof must be submitted to the Health Compliance Office at Student Health Services (SHC room 132-139), email to insurance@fiu.edu, or send fax to (305) 348-3336. An insurance hold will be placed on the student's account. Students will not be allowed to register for classes or continue enrollment without complying with the medical insurance requirement. Only Student Health can lift these holds and there are no exceptions to this rule. Please note that your insurance plan must be compliant with the university's requirements. Learn more information at: https://studentaffairs.fiu.edu/health-and-fitness/student-health/insurance/international-students/index.php. For students with assistantships, this hold will be lifted once the contract has been fully processed.

3.3 Assistantships and Fellowships

Only full-time students are eligible for assistantships. We hereby refer to Graduate Assistants as those students receiving Teaching Assistantships, Research Assistantships, and Fellowships from SCIS, UGS, the University, and other funding agencies. All Graduate Assistants must maintain full-time status. That is, they need to register for at least **nine** credits during the Fall and Spring terms and **six** credits during the Summer term to be eligible. PhD students with an approved D-2 Form on file with the University Graduate School (UGS) will need to enroll for only 3 dissertation credits in any term to be considered as full time.

Graduate Assistants cannot hold any external employment while on contract. They must notify the Program Specialist of any external employment (including internships) so that active contracts can be cancelled to comply with this rule.

Financial assistance is available on a highly competitive basis in the form of Graduate Assistantships for PhD students. Note that PhD applicants are automatically considered for assistantships and fellowships unless they inform the School otherwise. For best consideration, applicants should apply early and include their resume or CV in their application packet for review. Students awarded Graduate Assistantships will be formally notified via email. Awards are offered at each application cycle in all terms; however, Teaching Assistantships primarily begin in the Fall term.

3.3.1 Teaching Assistantships from SCIS

Teaching Assistants are expected to assist in both teaching and research duties. The exact assignment varies and depends on the student's skill, progress toward the degree, and performance. The student's academic performance is evaluated once a year; based on the evaluation, a student may be given an excellence award, be given a continuing appointment, or, in case of unsatisfactory performance, be discontinued from assistantship.

Graduate Assistants in the Ph.D. program are expected to find a faculty advisor who are willing to eventually supervise their dissertation by the end of their first year in the program. Failure to do so may result in the cancellation of assistantship.

3.3.2 Research Assistantships from Research Projects

Many faculty members have sponsored research projects from various funding agencies that provide Research Assistantships. These Research Assistantships are highly competitive and require specific background and skills. They are awarded by the individual faculty members associated with the sponsored research projects. Students should contact the faculty members directly to apply for these assistantships.

3.3.3 Fellowships

SCIS and UGS offer competitive fellowships to highly qualified students. Students are typically nominated for fellowships by the Graduate Committee or their Major Advisors, but may be eligible to apply without a nomination for certain fellowships. For more information on UGS fellowships, please visit: http://gradschool.fiu.edu/students/funding/fellowships/.

3.3.4 Tuition Waiver and Health Insurance

Most Graduate Assistantships carry a partial or full tuition waiver and health insurance. This funding is contingent on the budget allocation of the specific assistantship programs.

In 2017-2018, the tuition for in-state graduate students is $455.67 per credit hour for both regular coursework and dissertation or thesis credits. Tuition for out-of-state and international graduate students is $1,001 per credit for both regular coursework and dissertation credit. Graduate students who are on a full assistantship (i.e., 0.5 FTE appointment) pay $75.69 per credit for New Students (admitted and enrolled in Fall 2006 and after) or $73.97 per credit for Continuing Students (admitted and enrolled before Fall 2006). Graduate students who are on a part-time assistantship (0.25 FTE appointment) receive an out-of-state tuition waiver, but are still responsible for the in-state portion.

Students are charged $94 (per term) for health, athletic, and parking fees, which are not covered by assistantships or fellowships. Students are also responsible for any fees associated with particular courses. Assistants pay 25% of the health insurance premium (while the university pays for the other 75% as part of the assistantship).

3.4 Advisement

Graduate students have ample advising resources available to them. The first point-of-contact should be the Graduate Program Advisor. New students should see the Graduate Program Advisor prior to registering for their first semester. Graduate students may contact the Program Specialist or Graduate Program Director if further assistance is required.

PhD students should seek a Major Advisor to oversee their degree progress and eventually supervise their dissertation. The Major Advisor will set additional expectations for the student and will work with the Graduate Program Director, Graduate Program Advisor, and Program Specialist to help the student's progress.

3.5 Computing Resources

SCIS Computing Facilities are located on the second and third floor of the Engineering and Computer Science (ECS) building. The facility consists of a large number of networked workstations with contemporary hardware/software, which are used by faculty, staff, and graduate students.

The majority of these machines is dispersed throughout the various research and open laboratories located on the second floor. These systems are connected to the campus backbone that also provides our interface to the Internet.

Computing facilities are to be used only for work directly related to duties as a graduate student. Under no circumstances should students allow their accounts to be used by third parties.

Any student who is determined to have used the computer unethically will be expelled from the graduate program. This includes accessing other user's data (files, mail, etc.) without their permission (even if the protection modes allow access).

Any student who is found to have used the computing facilities in violation of any state or Federal laws will be expelled from the University and prosecuted to the full extent of the law. This includes using the computer to distribute material in violation of copyright laws, and attempting to violate security protocols on both FIU and non-FIU machines.

For more information about student labs and resources, please visit: https://www.cis.fiu.edu/students/labs/.

4 Master's Programs

4.1 General Requirements

This section lists the general requirements for all Master's programs. Requirements specific to each program are listed in the subsections describing the program accordingly.

4.1.1 Active Status

Master's students must be enrolled in a minimum of **one** credit hour per term to retain an active status. Lapses in enrollment for three or more consecutive terms, including Summer, will require the student to apply for readmission subject to the admission procedures, criteria, and policies in effect at the time when the reapplication is made. A student who finds it necessary to be excused from registration for two or more consecutive semesters should formally request a leave of

absence from the Graduate Program Director. Leaves will be granted only under exceptional circumstances.

Students pursuing the thesis option who have an approved M-2 on file with the University Graduate School are subject to the Continuous Enrollment requirement and must enroll in at least **one** thesis credit hour each term, including Summer. Any exceptions to this rule can only be made by University Graduate School via a formal request for leave of absence.

Students must be enrolled for at least **one** credit in the term in which they intend to graduate.

4.1.2 Time to Degree

All master's requirements, including the successful defense of a thesis (if pursuing the thesis option), must be completed within **six** years of first enrollment in the master's program.

4.1.3 Minimum Grade Requirements

Students must maintain a Grade Point Average of at least **3.0** for courses attempted in the graduate program. A student whose cumulative GPA falls below 3.0 will be placed on warning. If the cumulative GPA remains below 3.0 for a second semester, the student will be placed on probation. While on probation, the student's term GPA will be monitored. If a student's term GPA falls below a 3.0 while on probation, the student will be dismissed. Students are removed from probationary status once they have achieved a cumulative GPA of 3.0 or higher. Students must have a cumulative GPA of 3.0 or higher in order to graduate, without exception. Students whose GPA is lower than a 3.0 in the semester in which they plan to graduate will be unable to graduate until the GPA is raised to 3.0 or more.

Any undergraduate courses taken in graduate standing will not count toward the graduate GPA. No grade below a "C" will be accepted in any course taken to satisfy graduate program requirements.

Graduate Assistants must maintain a GPA above 3.3. Failure to do so may result in the cancellation of the student's assistantship.

4.1.4 Credit Transfers

Credit transfers are evaluated by the Graduate Committee for approval. Transfers are also regulated by the University Graduate School and must adhere to the policy found here: https://policies.fiu.edu/files/128.pdf

A maximum of **six (6)** credits of relevant graduate coursework may be transferred toward a master's degree. Please note that this maximum applies also to internal transfers between MS programs.

A maximum of **twelve (12)** credits of relevant graduate coursework taken in non-degree seeking status at FIU may be included in the master's degree.

Students wishing to apply transfer credits toward their degree should consult with the Graduate Program Advisor.

SCIS offers five Master of Science degrees: MS in Computer Science (MS-CS), MS in Information Technology (MS-IT), MS in Telecommunications and Networking (MS-TCN), MS in Cybersecurity (MS-Cyber), and MS in Data Science (MS-DS). They are described in more details in the subsequent sections.

4.2 Master of Science in Computer Science

Master of Science in Computer Science (MS-CS) degree provides study in state-of-the-art computer applications as well as an introduction to the theoretical foundations of computer science.

4.2.1 Admissions

Minimum Requirements

- A bachelor's degree or equivalent in computer science from a regionally accredited institution. A degree in a related field is acceptable if the applicant shows evidence of a computer science background suitable for entry into the master's program as judged by the Graduate Committee.
- 'B' average or better in all coursework attempted while registered as an upper-division student in the bachelor's program (3.0 on a 4.0 scale).
- For applicants whose native language is not English, English proficiency exam scores of at least 550 (paper-based) or 80 (internet-based) on the TOEFL or 6.5 on the IELTS. English proficiency exam exemptions are based on the country in which the applicant completed their undergraduate degree, not on nationality or language of instruction. See the list of exempt countries here: http://gradschool.fiu.edu/toefl-exempt-countries/.

Required Documents

- Online graduate application/application fee.
- Official university/college transcripts from all institutions previously attended, mailed in a sealed institution envelope. Applicants who graduated from FIU do not need to request FIU transcripts.
- Official translations of university/college transcripts (if in a language other than English).
- If applicable, official TOEFL or IELTS scores reported by the testing agency. TOEFL scores can be sent to FIU using the code 5206. IELTS scores can be verified directly by the admissions officer, if the applicant provides FIU with a copy of the score report.
- Official proof of degree/diploma. The student may provide this upon arrival to FIU (within one term) if admitted. Applicants who graduated from U.S. universities are typically only required to submit the final transcripts as proof of degree; some exceptions may apply.
- Translation of proof of degree/diploma (if in a language other than English).

Recommended Supporting Documents

- Statement of purpose
- Three letters of recommendation
- Resume

Immigration Documents for International Students

- Bank and Sponsor Letter
- Declaration and Certification of Finances
- F-1 Transfer Form (if currently in U.S.)
- See https://internationaladmissions.fiu.edu/graduate/ for details

Admissions Terms

- Fall, Spring, and Summer (see Section 3.2.2 for application deadlines)

4.2.2 Degree Requirements

Required Coursework: 9 credits

- COT 5407 Introduction to Algorithms

Choose 2 of the 3 courses listed below.

- COP 5614 Operating Systems
- COP 5725 Principles of Database Management Systems
- CEN 5011 Advanced Software Engineering

Elective Coursework

Non-thesis option: 21 credits of elective courses.

Thesis option: 15 credits of elective courses and 6 credits of master's thesis.

Elective courses may be selected from SCIS's graduate course offerings (Section 7.1) with the exception of courses marked not applicable to the MS or PhD in Computer Science or to SCIS degrees. A maximum of 6 credits can be chosen from courses other than those listed in Section 7.1. Of these 6 credits, a maximum of 3 credits can be taken as either a 3-credit Independent Study or a 3-credit co-op course, but not both.

Students who are interested in relevant courses outside of SCIS that are not on the pre-approved list found in Section 7.2 or on the student's degree audit should submit a request to the Graduate Program Advisor with the course details and a strong justification. The Graduate Program Director has final discretion over the inclusion of courses in a program of study.

4.2.3 Thesis Option

This option requires the completion of a master's thesis (6 credits) in addition to the 8 graduate courses (9 credits of required courses and 15 credits of elective courses). A student may commence work on the master's thesis at any time; however, thesis credits taken prior to the approval of the M-2 form will not count toward the 6 credits of master's thesis required to complete the degree. See http://gradschool.fiu.edu/students/#studentforms for the forms.

Thesis Committee

The Thesis Committee must consist of three members with Graduate Faculty Status, at least two of which hold appointments in SCIS. Typically, all three members hold appointments in SCIS. The Thesis Advisor is the Chairperson of the Thesis Committee. The M-1 Form must be completed to formally establish the Thesis Committee with UGS.

Thesis Proposal

A thesis proposal should be submitted after the Thesis Committee has been approved. The proposal will be given by the Thesis Advisor to the student's Thesis Committee for review. Based on the written recommendations of its members, the Thesis Committee will make a final decision. Upon acceptance of the proposal, the M-2 Form will be completed, to indicate that the proposal has been approved. Before the submission of the M-2 form, the Graduate School requires the M.S. candidate complete an on-line "Responsible Conduct of Research Certification" training course (http://gradschool.fiu.edu/rcr/#toggle-id-3).

The purpose of the thesis proposal is to convince the Committee that the chosen thesis topic and the student's approach have a reasonable chance of success. SCIS wants to minimize the chance that the thesis will be rejected when almost completed. In particular, the thesis proposal should:

- explain the basic idea of the thesis topic
- argue why that topic is important
- state what kind of results are expected
- make plausible that these results are sufficient for a master's thesis and that they are obtainable within the given timeframe with available resources
- demonstrate the student's academic qualifications for doing the proposed work

Once the M-2 Form has been approved by the University Graduate School, the student is subject to Continuous Enrollment requirements and must enroll in at least one thesis credit every term (including Summer) until he or she graduates. Exceptions to this rule can only be made by the University Graduate School via the approval of a formal leave of absence. Thesis credits taken prior to the approval of the M-2 form will not count toward the minimum 6 credits of the master's thesis.

Thesis Defense

The master's thesis must be a written account of a critical and scholarly study in an area in computer science. The Thesis Committee will review it critically for both content and form. The thesis may consist of:

- independent research work
- a critical study and analysis of known results that provide new significance and insights
- a significant and constructive contribution to computer applications such as software development for important applications.

Once the Thesis Committee has approved the student for a final defense, the student should submit the M-3 Form at least 3 weeks prior to the expected defense date. The student and the Thesis Advisor need to coordinate with the Program Specialist to schedule an oral presentation of the thesis in the form of a public lecture. The Thesis Committee makes the final pass or fail decision.

4.2.4 Accelerated BS/MS in Computer Science

Students interested in pursuing the either of the Accelerated BS/MS should first consult the Graduate Program Advisor to obtain the application approval and program information. Student should complete the application online, through their MyFIU student portal. Students selected for admission will be notified via email. Students should not begin taking graduate-level courses until they have been formally notified of their acceptance and their admission term has begun.

Admission Requirements

- Current enrollment in the approved Bachelor degree program at FIU, depending on the desired accelerate program.
- Completed at least 75 credits. The student should have about 30 credits left to complete for the major.
- Current GPA of 3.3 or higher.

Required Documents and Process

- Application Form for Admission to the accelerated BS/MS Degree Program (qualified students will see the application available in their MyFIU student portal).
- A non-refundable application fee in the form of a check or money order payable to Florida International University.

Degree Progress

- **Registration.** Admitted students meet with both the Graduate Program Advisor and the student’s undergraduate advisor to map out the graduate coursework that will be counted for both programs. Only 5000 or higher-level courses and no more than 6-12 graduate credits, as specified in the catalog description for the program, can be applied to both degree programs. Students must earn a grade of B or higher in any graduate-level courses

in order to apply them to the graduate degree while enrolled as an undergraduate student. Students who earn less than a B but still earn a passing grade may apply the course to their undergraduate degree only and will be expected to retake the course or a suitable substitution while in the master's program, as determined by the Graduate Program Director.

- **Graduation from BS Program**. Students are expected to apply for graduation from their bachelor's degree in the semester in which their undergraduate requirements are met. (Note: students who have yet to graduate from the bachelor's degree are considered undergraduates and are therefore ineligible for graduate assistantships and other graduate benefits.)
- **Entry into Graduate Program.** Once the bachelor's degree has been posted, students will receive their full admissions offer into the master's degree program.
- **Graduation from MS Program.** Students are expected to graduate from the master's degree program within a year of completing their bachelor's degree and will need to apply for graduation in the term in which they complete the master's degree program requirements. NOTE: The bachelor's degree and the master's degree cannot be awarded in the same semester. The bachelor's degree must be awarded before the master's degree.

General Requirements

The coursework includes 9 credits of required courses and 21 credits of elective courses as required for the regular M.S. students described in Section 4.2.2.

Overlap

Up to **four (4)** courses (12 credits) may be used in satisfying both the bachelor's and master's degree requirements. Courses must be 5000-level SCIS Graduate courses and must be completed with grade of B or higher. Students should consult the undergraduate advisor to ensure that the overlapping courses taken while in pursuit of the BS will satisfy undergraduate requirements. For a list of sample courses, please visit: https://www.cis.fiu.edu/academics/degrees/undergraduate/4plus1/.

4.3 Master of Science in Information Technology

Master of Science in Information Technology (MS-IT) is intended to educate students in the area of technical aspects of Information. It provides an emphasis on software technology, database technology, and security technology. The program is ideally suited for those who wish to obtain a higher level degree in Information Technology, and seek employment in the IT industry.

4.3.1 Admissions

Minimum Requirements

- A bachelor's degree in information technology, computer science, computer engineering, or a similar field from a regionally accredited institution, or a bachelor's degree in any field from a regionally accredited institution plus 3 years of information technology work experience. If the applicant wishes to have work experience considered for admission, they should submit a resume, statement of purpose, and letters of recommendation detailing this experience. The student's background will be evaluated by the Graduate Committee.
- 'B' average or better in all coursework attempted while registered as an upper-division student in the bachelor's program (3.0 on a 4.0 scale).
- For applicants whose native language is not English, English proficiency exam scores of at least 550 (paper-based) or 80 (internet-based) on the TOEFL or 6.5 on the IELTS. English proficiency exam exemptions are based on the country in which the applicant completed their undergraduate degree, not on nationality. See the list of TOEFL exempt countries here: http://gradschool.fiu.edu/toefl-exempt-countries/.

Required Documents

- Online graduate application/application fee.
- Official university/college transcripts from all institutions previously attended, mailed in a sealed institution envelope. Applicants who graduated from FIU do not need to request FIU transcripts.
- Official translations of university/college transcripts (if in a language other than English).
- If applicable, official TOEFL or IELTS scores reported by the testing agency. TOEFL scores can be sent to FIU using the code 5206. IELTS scores may be verified directly by the admissions officer, if the applicant provides FIU with a copy of the score report.
- Official proof of degree/diploma. The student may provide this upon arrival to FIU (within one term) if admitted. Applicants who graduated from U.S. universities are typically only required to submit the final transcripts as proof of degree; some exceptions may apply.
- Translation of proof of degree/diploma (if in a language other than English).

Recommended Supporting Documents

- Statement of purpose
- Three letters of recommendation
- Resume

Immigration Documents for International Students

- Bank and Sponsor Letter
- Declaration and Certification of Finances

- F-1 Transfer Form (if currently in U.S.)
- See https://internationaladmissions.fiu.edu/graduate/ for details

Admissions Terms

- Fall, Spring, and Summer (see Section 3.2.2 for application deadlines)

4.3.2 Degree Requirements

Required Courses: 9 credits

- CEN 5087 Software and Data Modeling
- CIS 5372 Fundamentals of Computer Security
- CIS 5027 Computer Systems Fundamentals

Track Courses: 6 credits

Students must complete 6 credits in a single track of their choosing from the following options: software, security, and system administration. Track courses must be selected from the approved list available online at:

https://www.cis.fiu.edu/academics/degrees/graduate/master-of-science-in-information-technology/.

Elective Courses: 15 credits

Elective courses may be selected from SCIS's graduate course offerings (Section 7.1) with the exception of courses marked not applicable to SCIS degrees. A maximum of 6 credits can be chosen from courses other than those listed in Section 7.1. Of these 6 credits, a maximum of 3 credits can be taken as either a 3-credit Independent Study or a 3-credit co-op course, but not both.

Students who are interested in relevant courses outside of SCIS that are not on the pre-approved list found in Section 7.2 or on the student's degree audit should submit a request to the Graduate Program Advisor with the course details and a strong justification. The Graduate Program Director has final discretion over the inclusion of courses in a program of study.

4.4 Master of Science in Telecommunication and Networking

Master of Science in Telecommunications and Networking (MS-TCN) is intended to educate individuals seeking employment with hardware and/or software companies, service providers, large user organizations, or telecommunications regulatory agencies as well as for those who are employed by these companies/organizations and wish to obtain formal, higher-level, specialized degree in Telecommunications and Networking. Telecommunication and Networking students learn how to lead in the ever changing environment of real-time global information networking, telecommunications, wireless and optical strategies and how to amplify business value through communications, technologies and systems.

4.4.1 Admissions

Minimum Requirements

- A bachelor's degree in a related field as judged by the School's Graduate Committee. The undergraduate degree must have been earned at a regionally accredited university.
- 'B' average or better in all coursework attempted while registered as an upper-division student in the bachelor's program (3.0 on a 4.0 scale).
- For applicants whose native language is not English, English proficiency exam scores of at least 550 (paper-based) or 80 (internet-based) on the TOEFL or 6.5 on the IELTS. English proficiency exam exemptions are based on the country in which the applicant completed their undergraduate degree, not on nationality. See the list of TOEFL exempt countries here: http://gradschool.fiu.edu/toefl-exempt-countries/.

Required Documents

- Online graduate application/application fee.
- Official university/college transcripts from all institutions previously attended, mailed in a sealed institution envelope. Applicants who graduated from FIU do not need to request FIU transcripts.
- Official translations of university/college transcripts (if in a language other than English).
- If applicable, official TOEFL or IELTS scores reported by the testing agency. TOEFL scores can be sent to FIU using the code 5206. IELTS scores may be verified directly by the admissions officer, if the applicant provides FIU with a copy of the score report.
- Official proof of degree/diploma. The student may provide this upon arrival to FIU (within one term) if admitted. Applicants who graduated from U.S. universities are typically only required to submit the final transcripts as proof of degree; some exceptions may apply.
- Translation of proof of degree/diploma (if in a language other than English).

Recommended Supporting Documents

- Statement of purpose
- Three letters of recommendation
- Resume

Immigration Documents for International Students

- Bank and Sponsor Letter
- Declaration and Certification of Finances
- F-1 Transfer Form (if currently in U.S.)
- See https://internationaladmissions.fiu.edu/graduate/ for details

Admissions Terms

- Fall, Spring, and Summer (see Section 3.2.2 for application deadlines)

4.4.2 Degree Requirements

Required Courses: 15 credits

- TCN 5030 Computer Communications and Networking Technologies (or an alternate course if waived)
- TCN 6430 Networks Management and Control Standards
- TCN 6275 Mobile Computing
- TCN 5080 Secure Telecommunications Transactions (or CIS 5372)
- TCN 5640 Telecommunications Enterprise Planning and Strategy

Focus Area Courses or Thesis: 6 credits

Students must complete 6 credits in a focus area of their choosing from the following options: Business, Communications, Software, Security, Wireless and Sensor Networks. Approved courses for each track are available online at: https://www.cis.fiu.edu/academics/degrees/graduate/master-of-science-in-telecommunications-and-networking-for-students-enrolled-on-or-after-fall-2012/.

Students enrolled in the Thesis Option will complete 6 thesis credits in lieu of fulfilling the track requirement.

Elective Courses: 9 credits

Elective courses may be selected from SCIS's graduate course offerings (Section 7.1) with the exception of courses marked not applicable to SCIS degrees. A maximum of 6 credits can be chosen from courses other than those listed in Section 7.1. Of these 6 credits, a maximum of 3 credits can be taken as either a 3-credit Independent Study or a 3-credit co-op course, but not both.

Students who are interested in relevant courses outside of SCIS that are not on the pre-approved list found in Section 7.2 or on the student's degree audit should submit a request to the Graduate Program Advisor with the course details and a strong justification. The Graduate Program Director has final discretion over the inclusion of courses in a program of study.

4.4.3 Thesis Option

This option requires the completion of a master's thesis (6 credits) in addition to the 8 graduate courses (15 credits of required courses and 9 credits of elective courses). A student may commence work on the master's thesis at any time; however, thesis credits taken prior to the approval of the M-2 form will not count toward the 6 credits of master's thesis. (See http://gradschool.fiu.edu/students/#studentforms for the forms).

Thesis Committee

The Thesis Committee must consist of three members with Graduate Faculty Status, at least two of which hold appointments in SCIS. Typically, all three members hold appointments in SCIS. The Thesis Advisor is the Chairperson of the Thesis Committee. The M-1 Form must be completed to formally establish the Thesis Committee with UGS.

Thesis Proposal

A thesis proposal should be submitted after the Thesis Committee has been approved. The proposal will be given by the Thesis Advisor to the student's Thesis Committee for review. Based on the written recommendations of its members, the Thesis Committee will make a final decision. Upon acceptance of the proposal, the M-2 Form will be completed, to indicate that the proposal has been approved. Before the submission of the M-2 form, the Graduate School requires the M.S. candidate complete an on-line "Responsible Conduct of Research Certification" training course (http://gradschool.fiu.edu/rcr/#toggle-id-3).

The purpose of the thesis proposal is to convince the Committee that the chosen thesis topic and the student's approach have a reasonable chance of success. SCIS wants to minimize the chance that the thesis will be rejected when almost completed. In particular, the thesis proposal should:

- explain the basic idea of the thesis topic
- argue why that topic is important
- state what kind of results are expected
- make plausible that these results are sufficient for a master's thesis and that they are obtainable within the given timeframe with available resources
- demonstrate the student's academic qualifications for doing the proposed work

Once the M-2 Form has been approved by the University Graduate School, the student is subject to Continuous Enrollment requirements and must enroll in at least one thesis credit every term (including Summer) until he or she graduates. Exceptions to this rule can only be made by the University Graduate School via the approval of a formal leave of absence. Thesis credits taken prior to the approval of the M-2 form will not count toward the minimum 6 credits of the master's thesis.

Thesis Defense

The master's thesis must be a written account of a critical and scholarly study in an area in computer science. The Thesis Committee will review it critically for both content and form. The thesis may consist of:

- independent research work
- a critical study and analysis of known results that provide new significance and insights
- a significant and constructive contribution to computer applications such as software development for important applications.

Once the Thesis Committee has approved the student for a final defense, the student should submit the M-3 Form at least 3 weeks prior to the expected defense date. The student and the Thesis Advisor need to coordinate with the Program Specialist to schedule an oral presentation

of the thesis in the form of a public lecture. The Thesis Committee makes the final pass or fail decision.

4.4.4 Accelerated BS in Electrical Eng/MS in Telecom & Networking

Students interested in pursuing the either of the Accelerated BS/MS should first consult the Graduate Program Advisor to obtain the application approval and program information. Student should complete the application online, through their MyFIU student portal. Students selected for admission will be notified via email. Students should not begin taking graduate-level courses until they have been formally notified of their acceptance and their admission term has begun.

Admission Requirements

- Current enrollment in Bachelor of Science in Electrical Engineering program at FIU.
- Completed at least 75 credits. The student should have about 30 credits left to complete for the major.
- Current GPA of 3.3 or higher.

Required Documents and Process

- Application Form for Admission to the accelerated BS/MS Degree Program (qualified students will see the application available in their MyFIU student portal).
- A non-refundable application fee in the form of a check or money order payable to Florida International University.

Degree Progress

- **Registration.** Admitted students meet with both the Graduate Program Advisor and the student's undergraduate advisor to map out the graduate coursework that will be counted for both programs. Only 5000 or higher-level courses and no more than 6-12 graduate credits, as specified in the catalog description for the program, can be applied to both degree programs. Students must earn a grade of B or higher in any graduate-level courses in order to apply them to the graduate degree while enrolled as an undergraduate student. Students who earn less than a B but still earn a passing grade may apply the course to their undergraduate degree only and will be expected to retake the course or a suitable substitution while in the master's program, as determined by the Graduate Program Director.
- **Graduation from BS Program**. Students are expected to apply for graduation from their bachelor's degree in the semester in which their undergraduate requirements are met. (Note: students who have yet to graduate from the bachelor's degree are considered undergraduates and are therefore ineligible for graduate assistantships and other graduate benefits.)
- **Entry into Graduate Program.** Once the bachelor's degree has been posted, students will receive their full admissions offer into the master's degree program.
- **Graduation from MS Program.** Students are expected to graduate from the master's degree program within a year of completing their bachelor's degree and will need to apply

for graduation in the term in which they complete the master's degree program requirements. NOTE: The bachelor's degree and the master's degree cannot be awarded in the same semester. The bachelor's degree must be awarded before the master's degree.

General Requirements

The coursework includes 15 credits of required courses, 6 credits of focus area courses, and 9 credits of elective courses as required for the regular M.S. students described in Section 4.4.2.

Overlap

Up to **four (4)** courses (12 credits) may be used in satisfying both the bachelor's and master's degree requirements. Courses must be 5000-level SCIS Graduate courses and must be completed with grade of B or higher. Students should consult the undergraduate advisor to ensure that the overlapping courses taken while in pursuit of the BS will satisfy undergraduate requirements.

4.5 Master of Science in Cybersecurity

Master of Science in Cybersecurity (MS-Cyber) is an interdisciplinary program providing broad and deep technical study of the ever-changing landscape of cybersecurity. Designed for students with a background in computer science, computer engineering, or information technology, the program aims to develop the skills needed for employment in the information technology industry or for further graduate study. Core courses offer three complementary perspectives: (1) a practical, hands-on study of current "best practices" in cybersecurity, along with their limitations; (2) a study of the principles of the growing science of cybersecurity; and (3) a study of the broader human context of cybersecurity, including social, economic, and policy aspects. Elective courses provide the opportunity for specialization in one or more areas of interest.

4.5.1 Admissions

Minimum Requirements

- A bachelor's degree or equivalent in computer science, computer engineering, information technology, or a similar field as judged by the Graduate Committee from a regionally accredited institution.
- 'B' average or better in all coursework attempted while registered as an upper-division student in the bachelor's program (3.0 on a 4.0 scale).
- For applicants whose native language is not English, English proficiency exam scores of at least 550 (paper-based) or 80 (internet-based) on the TOEFL or 6.5 on the IELTS. English proficiency exam exemptions are based on the country in which the applicant completed their undergraduate degree, not on nationality. See the list of TOEFL exempt countries here: http://gradschool.fiu.edu/toefl-exempt-countries/.

Required Documents

- Online graduate application/application fee.
- Official university/college transcripts from all institutions previously attended, mailed in a sealed institution envelope. Applicants who graduated from FIU do not need to request FIU transcripts.
- Official translations of university/college transcripts (if in a language other than English).
- If applicable, official TOEFL or IELTS scores reported by the testing agency. TOEFL scores can be sent to FIU using the code 5206. IELTS scores may be verified directly by the admissions officer, if the applicant provides FIU with a copy of the score report.
- Official proof of degree/diploma. The student may provide this upon arrival to FIU (within one term) if admitted. Applicants who graduated from U.S. universities are typically only required to submit the final transcripts as proof of degree; some exceptions may apply.
- Translation of proof of degree/diploma (if in a language other than English).

Recommended Supporting Documents

- Statement of purpose
- Three letters of recommendation
- Resume

Immigration Documents for International Students

- Bank and Sponsor Letter
- Declaration and Certification of Finances
- F-1 Transfer Form (if currently in U.S.)
- See https://internationaladmissions.fiu.edu/graduate/ for details

Admissions Terms

- Fall and Spring (see Section 3.2.2 for application deadlines)

4.5.2 Degree Requirements

Required Coursework: 15 credits

- CEN 5079 Secure Application Programming
- CIS 5208 Social, Economic, and Policy Aspects of Cybersecurity
- CIS 5370 Principles of Cybersecurity
- CNT 5415 Practical Applied Security
- COT 5428 Formal Foundations for Cybersecurity

Elective Coursework: 15 credits

Elective courses must be selected from the list of approved electives available online at:

https://www.cis.fiu.edu/academics/degrees/graduate/master-of-science-in-cybersecurity/.

Students who are interested in relevant courses not on the approved list should submit the request to the Graduate Program Advisor with the course details and a strong justification; these courses must have significant security content to be considered. The Graduate Program Director has final discretion over the inclusion of courses in the program of study.

A maximum of 6 credits from approved courses with codes ISM and PAD may be applied toward the degree.

Students in this program are allowed to take up to 6 credits from the University of South Florida's online M.S. in Cybersecurity program with approval. Students interested in pursuing coursework at USF should contact the Graduate Program Advisor early to learn what is required.

4.6 Master of Science in Data Science

SCIS offers an interdisciplinary Master of Science in Data Science (MS-DS) to impart broad and deep technical training in data science, drawing on faculty expertise across the FIU campus, and allowing for specialization in several key application areas of importance to the industry. The program has separate tracks to prepare students to become data scientists with specializations in areas such as Computational Data Analytics, Business Data Analytics, Public Policy Analytics and Biostatistics Data Analytics.

4.6.1 Admissions

Minimum Requirements

- A bachelor's degree that is appropriate for the selected specialization, from a regionally accredited institution.
    - Computational Data Analytics students are required to have a bachelor's degree in computer science, computer engineering, information technology, mathematics, statistics, or a related discipline.
    - Business Analytics students are required to have a highly quantitative undergraduate business degree, including Accounting, Finance or Information Systems. The program also encourages applicants with degrees in Computer Science, Industrial Engineering, Mathematics, and Statistics. Applicants with several years work experience in a quantitative role would also be competitive absent a relevant undergraduate degree and coursework completed.
    - Biostatistics Data Analytics students are required to have the appropriate background as judged by the track's Admissions Committee
    - Public Policy Analytics: Within this track, students will master the use of statistics, computer science, quantitative methods, and big data tools to create more effective public policies. They will be able to meld machine-generated data (e.g. sensors) with citizen-gathered data to predict events, mine social media and the internet for behavior pattens, and create effective and appealing data visualization programs to demonstrate the effects of decisions to politicians.

- 'B' average or better in all coursework attempted while registered as an upper-division student in the bachelor's program (3.0 on a 4.0 scale). Applicants should have achieved undergraduate grades of B (at a minimum) in all undergraduate mathematics, statistics, and quantitative methods coursework.
- For applicants whose native language is not English, English proficiency exam scores of at least 550 (paper-based) or 80 (internet-based) on the TOEFL or 6.5 on the IELTS. English proficiency exam exemptions are based on the country in which the applicant completed their undergraduate degree, not on nationality. See the list of TOEFL exempt countries here: http://gradschool.fiu.edu/toefl-exempt-countries/.
- GRE scores with a minimum quantitative score of 148.

Required Documents

- Online graduate application/application fee.
- Official university/college transcripts from all institutions previously attended, mailed in a sealed institution envelope. Applicants who graduated from FIU do not need to request FIU transcripts.
- Official translations of university/college transcripts (if in a language other than English).
- If applicable, official TOEFL or IELTS scores reported by the testing agency. TOEFL scores can be sent to FIU using the code 5206. IELTS scores may be verified directly by the admissions officer, if the applicant provides FIU with a copy of the score report.
- Official GRE scores sent to FIU using code 5206.
- Official proof of degree/diploma. The student may provide this upon arrival to FIU (within one term) if admitted. Applicants who graduated from U.S. universities are typically only required to submit final transcripts as the proof of degree; some exceptions may apply.
- Translation of proof of degree/diploma (if in a language other than English).
- Three letters of recommendation.

Recommended Supporting Documents

- Statement of purpose
- Resume

Immigration Documents for International Students

- Bank and Sponsor Letter
- Declaration and Certification of Finances
- F-1 Transfer Form (if currently in U.S.)
- See https://internationaladmissions.fiu.edu/graduate/ for details

Admissions Terms

- Fall (see Section 3.2.2 for application deadlines)

4.6.2 Degree Requirements

When applying, students will select a specialization track among the following: Computational Data Analytics, Business Analytics, Biostatistics Data Analytics. Students will complete the core and specialization curriculum according to their selected track.

Required Coursework: 12 credits

- CAP 5768 Introduction to Data Science (new course)
- CAP 5771 (or COP 5577) Principles of Data Mining
- STA 6244 Data Analysis I (or equivalent course)
- STA 6247 Data Analysis II (or equivalent course)

For Biostatistics Students only: Replace STA 6244 and STA 6247 with the following Biostatistics equivalents:

- PHC 6052 Biostatistics 1 (equivalent course to STA 6244 Data Analysis I)
- PHC 6091 Biostatistics 2 (equivalent course to STA 6247 Data Analysis II)

Capstone: 3 credits

- ISM 6930 Special Topics in Management Information Systems (for Business Analytics Only), or
- IDC 6940 Capstone Course in Data Science

For students in the IDC course: The goal of the capstone course is to carry out an industry-relevant project in applied data science that synthesizes concepts from databases, analytics, visualization, and management of data. The class will meet bi-weekly to learn from analysis case histories, monitor project progress, have class presentations, and evaluate project progress reports. Projects may involve individual or team effort. Students will identify a project mentor among FIU faculty to identify, plan, outline, and execute the data science project. Students are also encouraged to identify an industry mentor to serve as a secondary mentor. Industry mentors may be closer to the data source and well-suited to help with interpreting the results of data analysis. Students will meet periodically with their project mentors to discuss progress and results, and to troubleshoot. Projects will be implemented in Python, SQL, R, and/or using other specialized analysis toolkits used by data scientists. Students will be evaluated by a committee of faculty members and assigned a letter grade. The capstone course will have a coordinator in addition to the mentors/supervisors for individual projects. Sample projects can be found at data analysis challenge websites like http://www.kaggle.com and http://dreamchallenges.org

Specialization: 15 credits

Elective courses must be selected from the list of approved electives for each track, available online at https://www.cis.fiu.edu/academics/degrees/graduate/masters-data-science/.

Students who are interested in taking a course that is not approved for their particular track must submit the request to the respective track coordinator. Students should include course details and

a strong justification for its inclusion. Any inclusions are subject to Graduate Program Director approval.

4.6.3 Accelerated BS/MS Data Science

With their advisor's approval, students from all undergraduate majors including Computer Science, Information Systems and Biostatistics may apply to the Data Science 4+1 Program. If accepted, students will be allowed to take up to 12 credits of graduate data science courses which will apply towards both their undergraduate degree requirements and the master's degree program in data science.

Students interested in pursuing the either of the Accelerated BS/MS should first consult the Graduate Program Advisor to obtain the application approval and program information. Student should complete the application online, through their MyFIU student portal. Students selected for admission will be notified via email. Students should not begin taking graduate-level courses until they have been formally notified of their acceptance and their admission term has begun.

Admission Requirements

- Current enrollment in an approved bachelor's degree program at FIU.
- Completed at least 75 credits. The student should have about 30 credits left to complete for the major.
- Current GPA of 3.3 or higher.
- GRE quantitative score of 148 or higher.
- Completed prerequisites for the Master's in Data Science program or demonstrated competencies in the specialization areas (the latter option requires approval by the Graduate Program Director of the appropriate specialization area).

Required Documents and Process

- Application Form for Admission to the accelerated BS/MS Degree Program (qualified students will see the application available in their MyFIU student portal).
- Official GRE scores must be submitted from ETS, school code 5206.
- A non-refundable application fee in the form of a check or money order payable to Florida International University.

Degree Progress

- **Registration.** Admitted students meet with both the Graduate Program Advisor and the student’s undergraduate advisor to map out the graduate coursework that will be counted for both programs. Only 5000 or higher-level courses and no more than 6-12 graduate credits, as specified in the catalog description for the program, can be applied to both degree programs. Students must earn a grade of B or higher in any graduate-level courses in order to apply them to the graduate degree while enrolled as an undergraduate student. Students who earn less than a B but still earn a passing grade may apply the course to their undergraduate degree only and will be expected to retake the course or a suitable

substitution while in the master's program, as determined by the Graduate Program Director.

- **Graduation from Bachelor's Program**. Students are expected to apply for graduation from their bachelor's degree in the semester in which their undergraduate requirements are met. (Note: students who have yet to graduate from the bachelor's degree are considered undergraduates and are therefore ineligible for graduate assistantships and other graduate benefits.)
- **Entry into Graduate Program.** Once the bachelor's degree has been posted, students will receive their full admissions offer into the master's degree program.
- **Graduation from MS Program.** Students are expected to graduate from the master's degree program within a year of completing their bachelor's degree and will need to apply for graduation in the term in which they complete the master's degree program requirements. NOTE: The bachelor's degree and the master's degree cannot be awarded in the same semester. The bachelor's degree must be awarded before the master's degree.

General Requirements

The coursework includes 12 credits of required courses, 3 credits of capstone, and 15 credits of specialization courses as required for the regular M.S. students described in Section 4.6.2.

Overlap

Up to **four (4)** courses (12 credits) may be used in satisfying both the bachelor's and master's degree requirements. Courses must be 5000-level Graduate courses and must be completed with grade of B or higher. Students should consult the undergraduate advisor to ensure that the overlapping courses taken while in pursuit of the bachelor's degree will satisfy undergraduate requirements.

5 Ph.D. in Computer Science

The Doctor of Philosophy in Computer Science is designed to provide study in all major areas of computer science while leading to the frontiers of knowledge in a chosen field of concentration.

5.1 Admissions

5.1.1 Minimum Requirements

- A bachelor's or master's degree in computer science or a related field as judged by the School's Graduate Committee. Undergraduate degrees must have been earned at a regionally accredited university.
- For students without a master's degree in a related field: A minimum of a 3.2 average (on a 4.0 scale) on all undergraduate upper division work and acceptable courses in Calculus and Statistics.

- For students with a master's degree in a related field: A minimum of a 3.0 average on all undergraduate upper division work and acceptable courses in calculus and statistics, and a minimum GPA of 3.3 (on a 4.0 scale) in related graduate work.
- For applicants whose native language is not English, English proficiency exam scores of at least 550 (paper-based) or 80 (internet-based) on the TOEFL or 6.5 on the IELTS. English proficiency exam exemptions are based on the country in which the applicant completed their undergraduate degree, not on nationality. See the list of TOEFL exempt countries here: http://gradschool.fiu.edu/toefl-exempt-countries/.
- GRE (general test).

5.1.2 Required Documents

For all applicants:

- Online graduate application/application fee.
- Official university/college transcripts from all institutions previously attended, mailed in a sealed institution envelope. Applicants who graduated from FIU do not need to request FIU transcripts.
- Official translations of university/college transcripts (if in a language other than English).
- If applicable, official TOEFL or IELTS scores reported by the testing agency. TOEFL scores can be sent to FIU using the code 5206. IELTS scores may be verified directly by the admissions officer, if the applicant provides FIU with a copy of the score report.
- Official GRE scores sent to FIU using code 5206.
- Official proof of degree/diploma. The student may provide this upon arrival to FIU (within one term) if admitted. Applicants who graduated from U.S. universities are typically only required to submit final transcripts as the proof of degree; some exceptions may apply.
- Translation of proof of degree/diploma (if in a language other than English).
- Three letters of recommendation.
- Statement of purpose.
- Resume.

For international students, the following documents are also required:

- Bank and Sponsor Letter
- Declaration and Certification of Finances
- F-1 Transfer Form (if currently in U.S.)
- See https://internationaladmissions.fiu.edu/graduate/ for details

Applications are accepted to start in Fall, Spring, and Summer. See Section 3.2.2 for specific application deadlines.

5.2 General Requirements

5.2.1 Active Status

FIU requires doctoral students to enroll in a minimum of **three** credit hours per semester to retain active status. Lapses in enrollment for three consecutive semesters, including summer, will require the student to apply for readmission. Readmissions is subject to the admission procedures, criteria, and policies in effect at the time the reapplication is made. A student who finds it necessary to be excused from registration for two or more consecutive semesters should formally request a leave of absence from the Graduate Program Director. Leaves will be granted only under exceptional circumstances.

Doctoral students who have advanced to candidacy (i.e., with an approved D-2 on file with the University Graduate School) are subject to Continuous Enrollment Requirements. Doctoral candidates must enroll in at least **three** dissertation hours each term, including Summer. Any exceptions to this rule can only be made by University Graduate School via a formal request for a leave of absence.

Doctoral students must be enrolled in at least **three** dissertation credit hours in the term in which they intend to graduate.

5.2.2 Time to Degree

In accordance with the University Graduate School, at the doctoral level, all requirements, including the successful defense of a dissertation, must be completed within **nine** years of first enrollment in the doctoral program.

Graduate assistants in the doctoral program are expected to finish the requirements for the Ph.D. within **five** years.

The result of the qualifying exam is valid for five years unless the Graduate Committee deems it appropriate to extend the time limit up to the period the student is allowed to be a graduate student by the university.

The following table shows a five-year timeline for a typical fresh PhD student (without taking any previous graduate courses). Individual experience may differ:

Year	Semester	Credits	Milestones
1	Fall	9	
	Spring	9	
	Summer	6	
2	Fall	9	Establish the Dissertation Committee (D-1)
	Spring	9	Complete 15-30 credits of coursework; Appear for Qualifying Exam
	Summer	6	
3	Fall	9	
	Spring	9	Advancement to Candidacy (D-2)
	Summer	3 or 6	

4	Fall	3	Proposal Defense (D-3); Apply for external funding
	Spring	3	
	Summer	3	
5	Fall	3	Dissertation Defense (D-5, ETD)
	Spring	3	

5.2.3 Grade Requirements

Students must maintain a Grade Point Average of at least 3.0 for courses attempted in the graduate program. A student whose cumulative GPA falls below 3.0 will be placed on warning. If the cumulative GPA remains below 3.0 for a second semester, the student will be placed on probation. While on probation, the student's term GPA will be monitored. If a student's term GPA falls below a 3.0 while on probation, the student will be dismissed. Students are removed from probationary status once they have achieved a cumulative GPA of 3.0 or higher. Please note that students must have a cumulative GPA of 3.0 or higher in order to graduate, without exception. Students whose GPA is lower than a 3.0 in the semester in which they plan to graduate will be unable to graduate until the GPA is raised to 3.0.

Any undergraduate courses taken in graduate standing will not count toward the graduate GPA. No grade below a "C" will be accepted in any course taken to satisfy graduate program requirements.

PhD students are required to earn a grade of "B" or higher in their three core courses.

Graduate assistants must maintain a GPA above 3.3. Failure to do so will result in the discontinuation of the student's assistantship.

5.2.4 Credit Transfers

The transfer of credits to the Ph.D. in Computer Science must adhere to the University Graduate School policy found here: https://policies.fiu.edu/files/128.pdf

Transfers are evaluated by the Graduate Committee for approval. The information below states the maximum number of transfer credits possible and but does not guarantee the transfer of the full amount listed.

Students with incomplete graduate degrees in computer science may apply up to **15** credits of graduate coursework toward the Ph.D.

Students with complete or incomplete degrees in a field other than computer science may apply up to **6** credits of relevant coursework toward the PhD. Relevance will be determined by the Graduate Committee and the Graduate Program Director.

A maximum of **12** credits of relevant graduate coursework taken in non-degree seeking status at FIU may be included in the PhD program of study.

In any event, students with completed graduate degrees in computer science may transfer no more than **36** credits of graduate coursework to the Ph.D.

Students wishing to apply transfer credit toward their degree should contact the Graduate Program Advisor.

Please note that Ph.D. students with transfer credits are ineligible to earn an M.S. in Computer Science en route.

5.2.5 Master's En Route

PhD students who have **completed the requirements** of the MS in Computer Science may be eligible to receive a master's en route. In order to be eligible, the student cannot have any transfer credits and must have an approved D-3 form (Dissertation Proposal) on file with the University Graduate School. Students who meet these eligibility requirements will be contacted by the Graduate Program Advisor with more information.

5.2.6 Annual Evaluation

The Annual Student Evaluation and Mentoring Plan is required of all PhD students on an annual basis, after having taken 18 credits in their PhD program, until they successfully complete their program. Students are expected to comply with all University Graduate School and SCIS deadlines regarding the annual evaluation. Visit http://gradschool.fiu.edu/students/doctoral-student-annual-evaluation/ for more information.

5.2.7 Termination

PhD students will be terminated if they have not advanced to candidacy within **three** years, unless an extension is granted by the Graduate Program Director. Students who have already advanced to candidacy, and who meet the graduate school's continuous enrollment requirements, may only be terminated by a vote of the faculty. Such a decision will be based on the recommendation of the student's Dissertation Committee.

5.3 Degree Requirements

The student needs to fulfil the following requirements:

1. A total of 75 credits beyond the bachelor's degree are required. The student must complete 3 required courses (9 credits) with a grade of B or higher in each, at least 7 SCIS specific elective courses (21 credits) and 10 free electives (30 credits). In addition, the student must earn at least 15 dissertation credits.
2. The student must pass the Qualifying Exam, which is a written and oral examination of the student's knowledge in a broad research area. A written exam may be waived based on the student's performance in the core subjects.
3. The student must pass the Proposal Defense, which is an oral examination of his or her dissertation proposal.
4. The student must write a dissertation on his or her research and successfully defend it orally in the Dissertation Defense.

Students must comply with all University Graduate School requirements regarding enrollments and deadlines. More information is available at http://gradschool.fiu.edu/

5.3.1 Ph.D. Credit Requirements

Required Courses: 9 credits

All students must complete the following three courses and receive a grade of B or higher in each. If a student receives a grade of B- or lower, he or she will be required to retake the course.

- COP 5614 Operating Systems
- COP 5310 Theory of Computation
- COT 6405 Analysis of Algorithms

Elective Courses: 21 credits

The student must pass at least seven SCIS elective approved courses (21 credits), for a total of 30 semester credit hours of coursework, including the core classes. Elective courses are listed in Section 7.1. Other courses may be used as electives; however, they must be approved by the Graduate Program Director. Students interested in taking courses not listed in either Section 7.1 or Section 7.2 should consult their major advisor, the Graduate Program Director, and the Graduate Program Advisor on whether the courses can be considered as electives. Please note that independent studies and co-op courses, such as those listed in Section 7.3, do not count toward the 30 credit hours of core and elective coursework. Students may take these courses to accumulate the 75 credits required beyond the bachelor's.

Free Elective Courses: 30 credits

The student must pass at least ten elective courses (30 credits), for a total of 30 semester credit hours. Free electives include graduate research work complete with the major professor.

Dissertation Research: 15 credits

Students must earn at least 15 dissertation research credit hours. Note that students graduating in or before Spring 2019 are still required to take 24 dissertation research credit hours, according to the previous guideline.

Total Credit Hours: 75 credits

The minimum required credits for core courses (9 credits), elective courses (21 credits), and dissertation research (15 credits) are 45 credits. Students are required to take at least 75 credits beyond the bachelor's degree. The additional credits (30 credits) may be fulfilled by Graduate Research and other graduate-level courses, including internships.

5.3.2 Qualifying Exam

Eligibility

1. The student must be in good academic standing (3.0) and have active status, i.e. must be enrolled for at least 3 graduate credit hours
2. The student may take the Qualifying Exam as early as in the semester in which he or she is completing at least 15 credits of coursework, which must include the 3 core courses, but no later than the first 2 years in the Ph.D. program. (Note that Independent Studies and Graduate Research do not count toward the 15 credits of coursework.) Students who fail to take or cannot pass the Qualifying Exam with the first 2 years of their PhD program must seek an extension from the Graduate Program Director. A student failing to pass the Qualifying Exam in two attempts during the designated period will be dismissed from the program. Qualifying Exams are held during the fall and spring semesters only.
3. The student must earn B or higher in the three core courses.
    a. Any student wishing to improve their core GPA, will need to have taken the core course (having a grade of B or lower), prior to their first attempt in presenting the QE.
4. The student must have an approved D1 form on file with UGS. Students who wish to take the exam without an approved D1 form must seek permission from the Graduate Program Director, under the condition that the D1 form be submitted in the same semester that the Qualifying Exam is taken.
5. The student must have the approval from his or her major advisor to take the Qualifying Exam in a given subject area.

The Qualifying Exam consists of an oral examination in a subject area. However, students with a core-course GPA lower than 3.4 must take a written examination in addition to the oral examination. The subject or subjects of the written examination will be determined by the Graduate Committee. Written examination will be waived for students with a core-course GPA of 3.4 or higher.

If the student is taking or retaking the core courses in the same semester as the Qualifying Exam, the student may only take the oral examination with approval from the GPD. If the resulting core-course GPA is lower than 3.4 when the grades are posted, additional written examination will be required.

Procedure

- A student planning to take the qualifying exam must declare his or her intention to take the exam to the Graduate Program Advisor within the first two weeks of the semester in which the exam is expected to be taken. The PhD Qualifying Exam, Declaration of Intent form must be submitted to the Graduate Program Advisor within this timeframe. The Graduate Program Advisor will check whether the student is eligible to take the exam (see previous section for criteria).

- The student's Major Advisor must agree that the student is ready to take the exam and confirm the subject area of the student's exam by signing the student's Declaration of Intent form.
- An Exam Committee that consists of three faculty members (including the student's major advisor) will be formed based on the student's D1 Form. The student and the Exam Committee members will be notified via email.
- The student and Exam Committee will be responsible for scheduling the exam, typically held during the last two weeks of the same semester. The Graduate Program Advisor will assist with scheduling as needed. The student and Exam Committee must notify the Graduate Program Director, Graduate Program Advisor, and Program Specialist of the agreed-upon date and time of the oral exam as well as the proposed reading list (below) via the Announcement of Oral Exam form (submit to the Graduate Program Advisor approximately 12 weeks prior to the exam).
- The Exam Committee members for the oral exam will determine the reading list of papers. The list should include 5 classic papers in the subject area as well as 2-3 papers specific to the student's research area. The Exam Committee will provide the list to the student approximately 12 weeks before the scheduled oral exam.
- The student will write an area paper for the qualifying exam. The area paper should include a survey of a research topic and initial original research. 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. If the student has submitted or published a paper in the subject area, the paper may qualify as an area paper with approval from the Major Advisor.
- The oral exam is typically an hour and a half in length. The exam begins with the student presenting the area paper, followed by an intensive questioning by the Exam Committee. Questions from the Exam Committee members may include questions about the area paper, as well as questions about the papers in the reading list. These questions are intended to test the student's understanding of these papers and the subject area both in breadth and depth.
- If the student needs to take written exam in addition to the oral exam (see previous section for criteria), the Graduate Committee will arrange for the exam with the student i.e. determine which subjects are to be tested and assign an Exam Committee to create and evaluate the written exams. Written exams will be proctored by the Graduate Program Advisor and held prior to the oral exam. Students will be notified of the date and time via email.
- If necessary, the written exam can run up to two hours per subject area. The exam consists of questions and problems for the student to solve, relating to the core subjects of computer science. The specific subject or subjects of the written examination for the student will be determined by the Graduate Committee.
- The Exam Committee must communicate the results of the Qualifying Exam to the student, the Graduate Program Director, the Graduate Program Advisor, and the Graduate Program Specialist, by the end of the semester using the Result of Exam form. The Exam

Committee will submit one composite Result of Exam form. The Exam Committee will also submit the assessment rubric for institutional research purposes. Each individual committee member will fill out the assessment rubric. Both forms should be returned to the Graduate Program Advisor.

Criteria

The student needs to have a solid grasp of the core subjects of computer science, as evident either by earning a core-course GPA of 3.4 or higher, or by the result from the written exam.

For the oral portion of the Qualifying Exam, the Exam Committee will be looking for evidence of both general and specific research skills.

The general research skills include the ability to identify a problem, evidence of scholarship, critical analysis, and communication skills (both in terms of writing and spoken language).

The specific research skills include the student's ability and preparedness for undertaking research in her or her chosen subject area. The Exam Committee will consider the following questions in making the decision:

- Did the student demonstrate a breadth of knowledge in his or her chosen subfield?
- Did the student demonstrate adequate technical depth?

All committee members must be satisfied that the student has met these criteria in order to pass the examination. Apart from the presentation and discussion during the examination itself, the Exam Committee may use other means at its disposal to determine the outcome of the examination, including a review of the student's full academic record.

The Exam Committee may pass the student (perhaps with stipulation of further requirements), fail the student, or fail to come to a conclusion.

- If the student passes the exam, congratulations for achieving this important milestone.
- If the student passes the exam with stipulation of further requirements, typical stipulations for further requirements may include completion of additional coursework or passing a further written examination by a certain date. The student must meet the requirement in the given time, or the student is considered to have failed the exam.
- In the case of an inconclusive outcome from the Exam Committee, a second examination will be scheduled in the following semester. The second examination may consist of only the parts that the Exam Committee considers the student needs to improve. The result of the second examination must be conclusive.
- Students who fail to take or cannot pass the Qualifying Exam with the first 2 years of their PhD program must seek an extension from the Graduate Program Director. A student failing to pass the Qualifying Exam in two attempts during the designated period will be dismissed from the program.

5.3.3 Advancement to Candidacy

Advancement to candidacy is established via the submission of the D-2 form to the University Graduate School. In order to advance to candidacy, a student must have:

1. passed the Qualifying Exam,
2. achieved the minimum GPA requirement (3.0), and
3. taken a minimum of 60 credit hours of graduate work, including 30 credits of coursework, plus any additional courses, Graduate Research, independent studies, and internships.

Students may only take dissertation credits after they have advanced to candidacy. In other words, the students should take the needed courses, independent studies, and internships before they declare candidacy. Once candidacy has been reached and the D-2 has been approved, the students are only expected to take their dissertation credits to finish their thesis. In particular, international students will be ineligible for CPT after candidacy.

Once the D2 form is submitted, students can take only 3 dissertation credits per semester to be considered as full-time student. Exceptions are made only in the student's final semester. Please consult the Graduate Program Advisor for more information.

International students on F1 or J1 visas need to submit a reduced course load form in the semester in which they advance to candidacy. Please see the Graduate Program Advisor for more information.

5.3.4 Dissertation Requirements

Dissertation Committee

The Dissertation Committee is established via the submission of the D1 form to the University Graduate School. Visit http://gradschool.fiu.edu/students for more information, including the UGS deadlines. The Dean's Office at the College of Engineering and Computing has an internal deadline of one week prior to the University Graduate School deadline for all forms requiring the Dean's approval. Please plan accordingly.

SCIS requires that committees consist of a minimum of five members: at least four faculty members from the field of computer science (three of which must be Graduate Faculty members from FIU's School of Computing and Information Sciences) and at least one FIU Graduate Faculty member external to SCIS (i.e. from another discipline but within FIU). The Dissertation Advisor (i.e., the student's Major Advisor) is the Chairperson of the Dissertation Committee and must be a Graduate Faculty member with Dissertation Advisor Status.

Proposal Defense

The purpose of the proposal is to convince the Committee that the chosen dissertation topic and the student's approach will have a reasonable chance of success. SCIS wants to minimize the chance that a dissertation will be turned down when almost complete. In particular the proposal should:

1. Explain the basic idea of the thesis topic
2. Argue why that topic is important
3. State what kind of results are expected

4. Make plausible that these results are sufficient for a Ph.D. thesis and that they are obtainable within the given time frame with the available resources
5. Demonstrate the student's academic qualifications for doing the proposed work by including a comprehensive survey of the area of specialization.

After the student has entered candidacy, the student will write a dissertation proposal. The Major Advisor will conduct an initial review of the proposal and will give the proposal to the student's Dissertation Committee for further review. If approved, the student and the Dissertation Committee will schedule an oral presentation of the proposal in the form of a public lecture. The student and the Major Advisor should coordinate the proposal defense with the Graduate Program Specialist. The student needs to provide an abstract, bio, and photo for the announcement of the public lecture. On the day of the exam, the Graduate Program Specialist will provide the committee members with the assessment forms.

Based on the reviews from the written proposal and on the student's oral presentation, the Dissertation Committee will make a final decision. Upon acceptance of the proposal, the D-3 Form will be completed and signed, to indicate that the proposal has been approved.

Dissertation Defense

The dissertation must describe a piece of original and high-quality work and must describe it well. It is on this basis that the School of Computing and Information Sciences certifies the qualification of the new Ph.D. Furthermore, it is the most important basis on which the rest of the scientific community judges the initial achievement and potential of that individual.

The final public oral defense is a public presentation describing the contributions of the dissertation. The student, Major Advisor, and Dissertation Committee members should schedule the dissertation defense in accordance with the University Graduate School's guidelines http://gradschool.fiu.edu/calendar-deadlines/. The student and Major Advisor should work with the Program Specialist to coordinate the dissertation defense.

The Dissertation Committee makes the final decision whether the student passes or fails based on the content and form of the dissertation, as well as the outcome of the dissertation defense.

6 Research at SCIS

6.1 Faculty and Research Interests

Malek Adjouadi, Professor (dual appointment: Engineering and Computer Science); Ph.D., Electrical Engineering, University of Florida, 1985. Graphic/Image Processing, Computer Vision, Human Computer Interface, Algorithm and Medical Imaging. **GF/DAS**

Alex Afanasyev, Assistant Professor; Ph.D., Computer Science, University of California, Los Angeles, 2013. Networking, Information-Centric Networking (ICN), Named Data Networking (NDN), Network Security. **GF/DAS**

M. Hadi Amini, Assistant Professor, Ph.D., Electrical and Computer Engineering, Carnegie Mellon University, 2019. Distributed/Federated Machine Learning and Optimization, Distributed

Computing and Intelligence, Interdependent Networks, Cyber-physical Resilience, Smart Cities, and Healthcare

Antonio Bajuelos, Associate Teaching Professor; Ph.D., Applied Mathematics, Specialization in Computer Science, Joint Institute for Nuclear Research, Russian Federation, 1990.

Janki Bhimani, Assistant Professor, Ph.D., Northeastern University, 2019. Storage Systems, Flash-Based Devices and Emerging Non-Volatile Memories such as 3D-Xpoint, Key-Value Storage, and Multi-Stream SSDs.

Leonardo Bobadilla, Associate Professor; Ph.D., Computer Science, University of Illinois, Urbana-Champaign, 2013. Robotics, Artificial Intelligence, and Cyber-Physical Systems.

Kianoosh G. Boroojeni, Assistant Teaching Professor; Ph.D., Florida International University, 2017.

Bogdan Carbunar, Associate Professor & Graduate Program Director; Ph.D., Computer Science, Purdue University, 2005. Security, Privacy, Social Networks, Mobile Computing, Cryptocurrencies, Blockchains.

Maria Cristina Charters, Associate Teaching Professor; M.S., Computer Science, Nova Southeastern University, 2000.

Dong Chen, Assistant Professor; Ph.D., Computer Engineering, University of Massachusetts, Amherst, 2018, Ph.D., Computer Science, Northeastern University China, 2014. Data Analytics, Cybersecurity and Privacy Implications of Cyber-Physical Systems.

Shu-Ching Chen, Professor; Ph.D., Electrical and Computer Engineering, Purdue University, 1998. Data Science, Multimedia Big Data, Disaster Information Management, Distributed Multimedia Database Systems.

Trevor Cickovski, Associate Teaching Professor; Ph.D., Computer Science, University of Notre Dame, 2008.

Peter Clarke, Associate Professor; Ph.D., Computer Science, Clemson University, 2003. Software Engineering, Software Testing, Software Maintenance, and Programming Languages.

Debra Davis, Associate Teaching Professor; Ph.D., Cognitive Developmental Psychology, minor: Statistics, University of Texas at Austin, 2004.

Timothy Downey, Senior Instructor; M.S., SUNY Albany, Computer Science, 1986.

Mark A. Finlayson, Associate Interim Director & Eminent Scholar Chaired Professor; PhD, Computer Science, Massachusetts Institute of Technology, 2012. AI, Natural Language Processing (NLP), Cognitive Modeling.

Xudong He, Professor; Ph.D., Computer Science, Virginia Tech, 1989. Software Engineering, Formal Methods.

Antonio Hernandez, Assistant Teaching Professor; Ph.D., Mathematics, University of Hiroshima, 1997.

Julio E. Ibarra, Research Professor and Assistant Vice President for Technology Augmented Research; Ph.D., Telematics & Information Technology, University of Twente. Software Defined

Networks, Autonomic Network Architectures, Network Automation, and Network Control and Manage.

Sitharama S. Iyengar, Distinguished University Professor; Ph.D., Engineering, Mississippi State University, 1974. Computational Sensor Networks, Parallel and Distributed Algorithms and Data Structures, Autonomous and Distributed Systems. Quantum computing and digital forensics.

Amin Kharraz, Assistant Professor; Ph.D., Information Assurance – Systems Security, Northeastern University, 2017. Cybersecurity, building systems to facilitate a data-driven approach to security.

Christine Lisetti, Associate Professor; Ph.D., Computer Science, Florida International University, 1995. Affective Computing, Cognitive Science, Intelligent User Interfaces, Serious Games, Believable Agents for Health Communication and Health Promotion.

Jason Liu, Interim Director & Eminent Scholar Chaired Professor, Ph.D., Computer Science, Dartmouth College, 2003. Parallel and Distributed Simulation, High Performance Simulation and Modeling, Computer Networks, Computer Systems, Parallel Computing.

Patricia McDermott-Wells, Associate Teaching Professor; Ph.D., Computer Information Systems, Nova Southeastern University, 2015.

Masoud Milani, Associate Professor; Ph.D., Computer Science, University of Central Florida, 1986. Computer Science Education, Theory of Computation, Software Engineering.

Ananda Mondal, Assistant Professor, Ph.D., Computer Science and Engineering, University of South Carolina, 2011. Big Data Analytics, Bioinformatics, Machine Learning, Data Mining, and Algorithms.

Giri Narasimhan, Professor; Ph.D., Computer Science, University of Wisconsin, 1989. Design and Analysis of Geometric Algorithms, Experimental Algorithmic, Computational Biology, Bioinformatics, Biotechnology and Biomedical Engineering, Computational Statistics, Neural Networks and Genetic Algorithms, Graph Theory and Combinatorics.

Jainendra Navlakha, Professor; Ph.D., Computer Engineering and Information Sciences, Case Western Reserve, 1977. Analysis of Algorithms, Software Metrics, Expert Systems Development and Applications, Neural Network Applications, Computer Education.

Cuong Nguyen, Assistant Professor; Ph.D., Computer Science, National University of Singapore, 2015. Machine Learning, Computer Vision, Natural Language Processing.

Deng Pan, Associate Professor; Ph.D., Computer Science, SUNY Stony brook, 2007. High-Performance Routers and Switches, High-Speed Networking, Quality of Service, Network Processors, Network Security.

Sergio Pisano, Assistant Teaching Professor, Doctorate of Education, Northeastern University.

Agoritsa Polyzou, Assistant Professor; Ph.D., Computer Science, University of Minnesota, 2020. Big Data, Machine Learning, Ethics, Fairness.

Niki Pissinou, Eminent Scholar Chair Professor & Director of Telecommunications and Information Technology Institute; Ph.D., Computer Science, University of Southern California, 1991. Privacy and Security; Wireless, Sensor, Li-Fi, 4D and Societal Networks and Systems;

Augmented Reality based Networks; Internet of Things; Aspects of nontraditional data management for emerging applications.

Christian Poellabauer, Professor, Ph.D., Computer Science, Georgia Institute of Technology, 2004. Mobile Sensing, Analytics.

Nagarajan Prabakar, Associate Professor; Ph.D., Computer Science, University of Queensland, 1985, Database Systems and Computer Networks.

Caryl Rahn, Associate Teaching Professor; M.S., Computer Science, University of Pittsburgh, 1986.

Raju Rangaswami, Eminent Scholar Chaired Professor; Ph.D., Computer Science, University of California at Santa Barbara, 2004. Operating Systems, Storage Systems, Virtualization, and Security.

Gregory Reis, Assistant Teaching Professor, Ph.D., Computer Science, Florida International University, 2018.

Naphtali Rishe, Professor; Ph.D., Computer Science, Tel Aviv University, 1984. Geographic Information Systems, Database Management, Health Informatics.

Michael Robinson, Associate Teaching Professor; M.S., Computer Science, Florida International University, 2007.

Monique Ross, Assistant Professor; Ph.D., Engineering Education, Purdue University, 2016. Broadening Participation in Engineering, Discipline-based Education Research.

S. Masoud Sadjadi, Associate Professor; Ph.D., Computer Science, Michigan State University, 2004. Distributed Computing, Software Engineering, Adaptive Middleware, and Component-based Design.

Fahad Saeed, Associate Professor; Ph.D., Electrical and Computer Engineering, University of Illinois at Chicago, 2010. Computational Biology, High Performance Computing, Big Data, Proteomics, Genomics, Connectomics

Mo Sha, Associate Professor; Ph.D., Computer Science, Washington University in St. Louis, 2014. Wireless Networking, IoT, Applied Machine Learning, Network Security, Cyber-Physical Systems.

Gregory Shaw, Associate Teaching Professor; M.S., Barry University, 1992. Computer Science.

Joslyn Smith, Associate Teaching Professor; M.S., New Brunswick, Canada, 1994. Computer Science.

A. Selcuk Uluagac, Associate Professor; Ph.D., Electrical and Computer Engineering, Georgia Institute of Technology, 2010. Cybersecurity and privacy with an emphasis on its practical and applied aspects.

Charlyne Walker, Assistant Teaching Professor; Doctorate in Leadership and Education-Education Technology, Barry University, 1998.

Jill Weiss, Teaching Professor; M.S., Barry University, 1992. Computer Science.

Mark A. Weiss, Eminent Scholar Chaired Professor and Associate Dean for Undergraduate Education, College of Engineering and Computing; Ph.D., Computer Science, Princeton University, 1987. Data Structures and Algorithm Analysis.

Richard Whittaker, Assistant Teaching Professor; PhD in Computer Science & Economics.

Ning Xie, Associate Professor, Ph.D., Computer Science, Massachusetts Institute of Technology, 2012. Theory and Algorithms.

Note: For **GF and DAS** status, please check the University Graduate School webpage: https://gradschool.fiu.edu/facultystaff/#toggle-id-14 Membership in the Graduate Faculty, **GF**, is a necessary qualification to be a *member* of a dissertation or thesis committee, including chair of a *thesis* committee. **DAS** denotes Dissertation Advisors Status. Dissertation Advisor Status is a necessary qualification to serve as *chair* of a dissertation committee.

6.2 Areas of Study

There are many areas of specialization within the School, including:

- Bioinformatics and Computational Biology.
- Cognitive Science, with emphasis on the philosophical, psychological, and linguistic underpinnings of artificial intelligence.
- Computer networks, including network protocols, multimedia networking, and wireless communications.
- Database systems, including database design, database management systems and applications, database theory and implementation, database machines, distributed databases, information retrieval in heterogeneous databases, multimedia databases, data mining and digital libraries.
- Data Science and big data, including data analytics, data mining, machine learning, multi-discipline research.
- Intelligent systems, including artificial intelligence, machine learning, neural networks, expert systems, intelligent tutoring systems, affective computing, intelligent user interfaces, intelligent agents for health communication.
- Parallel and distributed systems, including formal specification methodologies, distributed file systems, distributed multimedia systems and operating systems.
- Security, including network security, privacy, applied cryptography, protocol analysis, IoT security, and quantitative information flow
- Software Engineering, including large-scale software design, programming language environments, software development and maintenance methodologies, object-oriented techniques, software reuse, and software quality assurance.

- Theory, including data structures, design and analysis of algorithms, theory of computational complexity.
- Programming languages, including programming languages, program verification, and logic.

6.3 Research Centers and Laboratories

SCIS features the following research centers and laboratories:

1. Bioinformatics Research Group (BioRG)
2. Center for Advancing Education and Studies on Critical Infrastructures Resilience (CAESCIR)
3. Center for Cyber Infrastructure Education and Research for Trust and Assurance (CIERTA)
4. Cognition, Narrative, & Culture Laboratory (Cognac)
5. Cyber Security and Privacy Research (CaSPRLab)
6. Discovery Lab
7. Distributed Multimedia Information Systems Laboratory (DMIS)
8. High-performance Database Research Center (HPDRC)
9. Industry/University Cooperative Research Center for Advance Knowledge Enablement (I/UCRC-CAKE)
10. Modeling and Networking Systems Lab (ModLab)
11. Saeed Lab: A Parallel Computing and Data Science Group
12. Software Testing Research Group (STRG)
13. Systems Research Laboratory (SyLab)
14. Telecommunications and Information Technology Institute (IT2)
15. Virtual Intelligent Social AGEnts (VISAGE) Laboratory

A brief description of the above research centers and laboratories is provided in the following subsections.

6.3.1 Bioinformatics Research Group (BioRG)

Dr. Giri Narasimhan (Head) and Dr. Trevor Cickovski

The Bioinformatics Research Group (BioRG) conducts research on problems in the interdisciplinary fields of Bioinformatics, Machine Learning, Computational Biology, Data Mining, and Information Retrieval. The group's research projects includes Microbiome Analysis, Visualization, High-Performance Computing, Causality and Inference, Comparative Genomics of Bacterial genomes, Genomic databases, Pattern Discovery in sequences and structures, micro-array data analysis, prediction of regulatory elements, primer design, probe design, phylogenetic

analysis, medical image processing, image analysis, data integration, data mining, information retrieval, knowledge discovery in electronic medical records, and much more.

The group also collaborates with scientists from a wide variety of fields outside computer science including biology, medicine, biophysics, biochemistry, pharmacology, finance, social sciences, statistics, mathematics, environmental sciences, soil sciences, and more. This is an active group with a strong publication record. The National Institutes of Health, National Institute of Justice, Florida Department of Health, National Science Foundation and private industry have funded this group's research.

For more details, visit the URL: http://biorg.cis.fiu.edu.

6.3.2 Center for Advancing Education and Studies on Critical Infrastructures Resilience (CAESCIR)

Dr. Jason Liu, Director

Florida International University's Center for Advancing Education and Studies on Critical Infrastructures Resilience (CAESCIR) is funded by a Scientific Leadership Award granted by the United States Department of Homeland Security. CAESCIR aims to improve our nation's critical infrastructures security and resilience via an integrated research and education framework that covers Homeland Security Science, Technology, Engineering, and Mathematics (HS- STEM) areas of interest in computer science, information technology, and cybersecurity.

The Center engages a wide range of education and research activities:

1. The Center provides scholarships for undergraduate and graduate students specialized in HS-STEM areas and provides them with proactive advising, peer mentoring, career guidance, as well as assistance in internship opportunities in our research labs, at industry/government labs, and at partner DHS Center of Excellence (COE), the Critical Infrastructure Resilience Institute (CIRI) at the University of Illinois at Urbana Champaign (UIUC).
2. The Center coordinates the teaching of HS-STEM topics, by incorporating related materials and integrating research outcomes in existing Computer Science, Information Technology, and Cybersecurity courses at FIU, and develops new courses to explore new areas and emerging technological challenges in critical infrastructure resilience.
3. The Center leverages our strong research expertise and pursue innovative research projects in important areas of critical infrastructure resilience.
4. The Center engages early career faculty with the support of senior faculty participants to pursue integrated HS-STEM research and education activities.

For more details, visit the URL: http://caescir.cs.fiu.edu.

6.3.3 Center for Cyber Infrastructure Education and Research for Trust and Assurance (CIERTA)

Dr. S. S. Iyengar, Director

Cyberspace, the ubiquitous collection of interconnected IP networks and hosts that has proliferated over the last two decades, has become the nervous system of the country. Healthy functioning of Cyberspace is essential for the proper operation of numerous critical infrastructures, such as telecommunication, energy and transportation. It is also necessary to support the ever-expanding business infrastructure, including commerce and banking. The increasing reliance on Cyberspace has been paralleled by a corresponding increase in the variety, frequency and impact of attacks from a range of assailants. Both commercial companies and government agencies face continuous and increasingly more sophisticated cyber-attacks ranging from data exfiltration and spear phishing to sophisticated worms and logic bombs. The targets include not only computer information systems, but also the network communication infrastructure and power grids. Moreover, commercial companies and government agencies are themselves engaging in information gathering whose implications for privacy are disturbing.

Therefore, there is an increasing need of a concerted and cooperative effort on the part of the government and the private sector to address these attacks and threats. Research and education are the main ways to help detect, react, and reduce the impact of cyber threats and attacks. There is a dearth of educational cyber security programs at universities, despite a very strong demand for qualified graduates. Moreover, Miami's status as a gateway for international commerce, tourism, and immigration, especially with Latin America, makes it a particularly appropriate host location for a research and education consortium focusing on cyber infrastructure.

The goal of this center is two-fold -- first, to inspire a new generation of cyber research warriors and cyber savvy intelligence agents to take up the torch, to better understand our need for smart intelligence, and to defend the homeland. Since their work cannot be done alone, our second goal is to advance technology through the concept of subliminal contextual information in the production of subliminal contextual intelligence.

For more details, visit the URL: https://cyber.cs.fiu.edu.

6.3.4 Cognition, Narrative, & Culture Laboratory (Cognac)

Dr. Mark Finlayson, Director

How does culture shape our understanding of the world? What makes stories so powerful? How can computation shed light on these questions? Culture surrounds us and affects our behavior and thoughts in ways large and small. Narratives are everywhere, and we know of no culture or society that does not use it as a fundamental form of communication for activities as diverse as the explanation, education, and entertainment. The Cognac lab investigates these and related questions from a computational and cognitive point of view, and the unifying interest of researchers in the lab is the computational modeling of culture, narrative, language, and their interaction with cognition. For the purpose of scope, we construe culture in a broad sense, as any set of shared knowledge structures that mold the behavior of a group of people. Researchers in the lab conduct inter-disciplinary research spanning artificial intelligence, computational linguistics, cognitive science, and the digital humanities, and use techniques are drawn from machine learning, natural language processing, linguistic annotation, knowledge representation, computational inference to tackle key questions in this space, including: How is shared knowledge—commonsense and cultural—represented in language and narrative? How do people and how can machines extract this shared knowledge from data? And how do we apply

these insights to achieve advances in machine intelligence, educational practice, health and medicine, social science theory, and the humanities?

For recent work, current and former students, and more details generally, visit the lab's homepage: http://cognac.cs.fiu.edu.

6.3.5 Cyber Security and Privacy Research (CaSPRLab)

Dr. Bogdan Carbunar, Director

CaSPR develops efficient solutions to ensure a trustworthy use of mobile and social networks. Problems of interest include online service fraud and abuse, mobile authentication, social media validation, and cryptocurrencies.

For more details, visit the URL: https://users.cs.fiu.edu/~carbunar/caspr.lab/caspr.html.

6.3.6 Discovery Lab

Dr. S. S. Iyengar, Director

Dr. Iyengar is the founding director of the Discovery Lab and a team of CIS researchers headed by Col. Miller who are currently performing advanced research in areas of intelligent systems, advanced security systems, autonomous mobile robots, and sensor networks, and smart grids.

The Discovery Lab provides an infrastructure to promote collaborative research among universities and research organizations across the nation. In addition to addressing a comprehensive set of fundamental research topics, the Lab is pursuing commercialization, distinguishing itself from traditional research labs through its focus on translating research discoveries into technology transfer outcomes. At the same time the laboratory provides students with the hands-on experiences they need to solve real-world challenges, develops student-led research opportunities, fosters students' entrepreneurial skills, and trains a new generation of IT professionals who reflect the diversity of South Florida.

For more details, visit the URL: http://discoverylab.cis.fiu.edu.

6.3.7 Distributed Multimedia Information Systems Laboratory (DMIS)

Dr. Shu Ching-Chen, Director

The Distributed Multimedia Information Systems Laboratory (DMIS) has a mission to conduct leading edge research with the focus on new forms of multimedia data (such as text, numbers, tags, networking, signals, geo-tagged information, graphs/relationships, 3D/VR/AR and sensor data, etc.) for many applications in addition to traditional multimedia data (image, video, audio).

Other research areas include:

- Data Science
- Multimedia Big Data
- Multimedia Content-based Retrieval
- Machine Learning/Deep Learning/Data Mining
- Disaster Information Management

- Multimedia Systems
- 3D Interactive Applications (VR/AR/GIS)

This laboratory receives funding from NSF, National Oceanic and Atmospheric Administration (NOAA), Department of Homeland Security, Army Research Office, Naval Research Laboratory (NRL), Environmental Protection Agency (EPA), Florida Office of Insurance Regulation, IBM, and Florida Department of Transportation. The students graduated from DMIS have found jobs in academia and leading industries.

For more details, visit the URL: http://dmis.cis.fiu.edu.

6.3.8 High-performance Database Research Center (HPDRC)

Dr. Naphtali Rishe, Director

The High-performance Database Research Center (HPDRC) conducts research on database management systems and various applications, leading to the development of new types of database systems and the refinement of existing database systems, as well as on the dissemination of information via the Internet. HPDRC has a strong commitment to training graduate students and preparing them for their future roles as scholars and specialists employed by industry. It has been awarded over $50 million in research grants and donations by Government and Industry, including NASA, NSF, IBM, DoI, and DOT.

The amount and varied types of geospatial information, such as remotely-sensed imagery, available today is vast, offering numerous applications to industries and scientists in all fields. However, an inherent problem with this is the complexity often involved with the manipulation and extraction of these data. Spatial data sets come from varied sources and in many different formats, often requiring separate specialized geographic systems to view, extract and manipulate them. The time, expense and level of difficulty introduced by such applications preclude their utilization by many potential users. In order to facilitate access to this growing collection of visual information, the HPDRC has created TerraFly, a Web based Geographic Information System.

TerraFly is a technology and tools for fusion, visualization and querying of geospatial data. The visualization component of the system provides users with the experience of virtual "flight" over maps comprised of aerial and satellite imagery overlaid with geo-referenced data. The data drilling and querying component of the system allows the users to easily explore geospatial data, to create geospatial queries, and get instant answers supported by high-performance multidimensional search mechanisms. TerraFly's server farm ingests, geo-locates, cleanses, mosaics, cross-references, and fuses 100TB of basemap data and user-specific data streams. TerraFly's Application Programming Interface allows rapid deployment of interactive Web applications and has been used to produce systems for disaster mitigation, ecology, real estate, tourism, and municipalities. TerraFly's Web-based client interface is accessible via any standard Web browser, with no client software to install.

TerraFly tools include user-friendly geospatial querying, data drill-down, interfaces with real-time data suppliers, demographic analysis, annotation, route dissemination via autopilots, customizable applications, production of aerial atlases, and an application programming interface (API) for production of Web-based map applications.

The TerraFly project has been featured on TV news programs (including FOX TV News), worldwide press, covered by the New York Times, USA Today, NPR, and Science and Nature journals. The project's primary sponsor is the National Science Foundation (NSF). Of the 53,000 NSF-funded projects in 2009, it chose 120, including TerraFly, for the NSF annual report to Congress. TerraFly is on the cover of NSF 2014 Compendium of I/UCRC Technology Breakthroughs -- a book to advise U.S. Congress on the state of science and technology.

The 100TB TerraFly data collection includes, among others, 1-meter aerial photography of almost the entire United States and 3-inch to 1-foot full-color recent imagery of major urban areas, and selected areas at 1cm resolution drone-capture and balloon-captured imagery. TerraFly vector collection includes 3 billion geolocated objects, 100 billion data fields, 2B polylines, 250M polygons, including: all World roads (90M roads, 130M intersections, 1B segments), the U.S. Census demographic and socioeconomic datasets, 150 million polygons of buildings, 150 million U.S. parcels with property lines and ownership data current and historical, 270 million U.S. residential records, 15 million records of businesses with company stats and management roles and contacts, various public place databases (including the USGS GNIS and NGA GNS), Wikipedia, extensive global environmental data (including daily feeds from NASA and NOAA satellites and the USGS water gauges), and hundreds of other datasets.

The Informed Traveler System Suite Phase 1 (ITS1) provides commuting users and regional operators with (1) intelligent parking recommendations in garages and streets where crowd-source data is collected in real time; (2) monitoring transit vehicles; (3) travel decisions related to transit vehicles. Videos of the system suite, comprising an app and a back-end system, are at http://cake.fiu.edu/ITPA_Product_Videos/. Fundamental science of the project was created by researchers at FIU, University of Illinois and others under the NSF IIS-1213026 award, which is also presently sponsoring the effort of packaging the software for its open-sourcing. Much of the applied software was developed with funding of U.S. Department of Transportation (US-DOT) on the TerraFly Geospatial platform.

The final inspection report by the U.S. DOT-mandated independent inspectors produced on 4/27/2017 concludes with: "The ITPA software is an advanced traffic management package developed by Florida International University's HPDRC. The system is well engineered and the development of the software is exemplary. The final IV&V testing of the Phase A and B concluded that the ITPA Test Plan and the ITPA Test Procedure documents were sufficient to provide direction to the ITPA test team. It is our conclusion that the ITPA will provide customized, real-time, and predictive information to individual ITPA users, via their smart phones and by other means. This information includes the access of available parking spaces and access to multimodal and intermodal services in the "UniversityCity" region, which encompasses FIU's Modesto A. Maidique Campus and certain portions of the City of Sweetwater. Real-time parking occupancy in the UniversityCity's parking garages and parking lots is available. Real-time transit vehicle locations, routes, estimated times of arrival, and passenger load percentages are available to ITPA users. The system is also able to broadcast events and other information from service providers to smart-phone users and available dynamic message signs at bus stops and parking garages. The information should enable the individual user to make optimum route and mode choices and will also enable the service providers to manage individual traffic, transit and parking more effectively."

The Center also conducts research on such theoretical and applied issues as Internet-distributed heterogeneous databases, database design methodologies, database design tools, information analysis, multimedia databases, database languages, data compression, spatial databases, and data visualization.

For more details, visit the URL: http://hpdrc.cis.fiu.edu.

6.3.9 Industry/University Cooperative Research Center for Advance Knowledge Enablement (I/UCRC-CAKE)

Dr. Naphtali Rishe, Director

The CAKE Center was established by the NSF to develop long-term partnerships among industry, academe and government. The Center is supported primarily by industry center members, with NSF taking a supporting role in its development, evolution, and core funding. The FIU High Performance Database Research Lab, the FIU TerraFly Geospatial Data Services, Computational Transportation Lab, the Healthcare Information Technology Initiative, and the Autonomic Research Laboratory are operating under the Center's organizational structure. The Center's Director, Naphtali Rishe, is the inaugural Outstanding University Professor of FIU and the principal investigator of $55M in grants. The FAU Site Director is Borko Furht. The Dubna International University, Russia, Site Director is Academician Eugenia Cheremisina. The Greenwich Site Director is Liz Bacon. The Center's Chair of the Industrial Advisory Board is Radha Ratnaparkhi, IBM Vice President for Research Impact. The Center conducts industry-relevant studies in the representation, management, storage, analysis, search and social aspects of large and complex data sets, with particular applications in geospatial location-based data, transportation, and healthcare.

For more details, visit the URL: http://cake.fiu.edu.

6.3.10 Modeling and Networking Systems Lab (ModLab)

Dr. Jason Liu, Director

A common research theme of ModLab is to develop efficient and effective modeling and simulation techniques for studying computer systems and computer networks, in particular, high-performance computing (HPC) systems and large-scale computer networks. General research topics include:

- Designing effective models for simulating large-scale systems
- Developing parallel simulation for modeling large-scale systems
- Applying data analyses for understanding complex behaviors

Specific research areas are listed as follows:

- HPC Modeling and Simulation:
    - Scalable HPC simulation models, including system architectures and scientific applications
    - Job scheduling and resource provisioning algorithms

    - HPC power models and energy-efficient methods
- Network Modeling, Simulation, Emulation, and Testbeds:
    - Parallel network simulators for internet, wireless networks, and mobile ad-hoc networks
    - High-performance traffic models for at-scale network studies
    - Real-time simulation for interactive and hybrid network experimentation
    - Performance modeling of data center networks, software-defined networks, future internet.
- Parallel Discrete-Event Simulation:
    - Parallel simulation tools for large complex systems
    - Parallel simulation synchronization algorithms
- Other Areas:
    - Data analytics
    - Machine learning applications
    - Operating systems: file systems, I/O, caching, and virtualization
    - Cybersecurity and other topics

For more details, visit the URL: http://modlab.cis.fiu.edu.

6.3.11 Saeed Lab: A Parallel Computing and Data Science Group

Dr. Fahad Saeed, Director

Saeed Lab is an interdisciplinary research group in parallel and high-performance computing focusing on applications-driven algorithmic research, primarily in the area of computational and systems biology. We are particularly interested in solving big data problems in high-throughput proteomics, genomics and connectomics using variety of high-performance architectures and algorithms.

Saeed Lab is primarily a computational lab which builds computational infrastructure driven by scientific questions and needs. We are currently in an era marked by extreme and pervasive data generation as a result of high-throughput technologies with dramatic changes in the scale and nature of cyberinfrastructure requirements such as modelling scientific data more holistically, desire (and the need) for near-real time processing and the scalability of the proposed infrastructure. This is exciting as well as challenging for computational scientists.

We therefore, at Saeed Lab, address challenges and opportunities which allows us to solve a spectrum of research problems related to computational, data, software, networking, high performance computing and human capital development that collectively can enable new discoveries across science, especially in systems biology

Our long term research goal is to design, develop, and implement computational infrastructure that allows us to discover genomic and proteomics underpinning of mental disorders. To this end, this requires high performance computing infrastructure development that is scalable and can deal simultaneously with: 1) Genomic Big Data (from next generation sequencing techniques) 2)

Proteomics Big Data (from high-throughput mass spectrometry techniques), and 3) Connectomics Big Data (from brain imaging such as fMRI data). These algorithms will play a vital role in peering into genomic, proteomics and mental disorders and will be akin to the role that microscope played for diagnostic medicine in the early 19th century.

For more details, visit the URL: https://saeedlab.cis.fiu.edu/

6.3.12 Software Testing Research Group (STRG)

Dr. Peter Clark, Director

STRG is comprised of MS and PhD students and associated researchers under the guidance of Dr. Peter Clarke. The group's research objectives areas as follows:

- Investigate new ways to perform automated software testing that use new research techniques and methods from AI and ML.
- Explore how model-driven engineering techniques can improve software testing.
- Develop a cyberlearning platform to support computer science education by using various learning and engagement strategies (https://stem-cyle.cis.fiu.edu/).
- Collaborate with companies and researchers to find solutions to previously mentioned objectives.

6.3.13 Systems Research Laboratory (SyLab)

Dr. Raju Rangaswami, Director

The mission of the Database and Systems Research Laboratory (DSRL) is to perform cutting-edge research on (i) extracting knowledge from structured and unstructured databases, and (ii) building high performance, reliable, power-efficient, and secure systems. DSRL sponsors include the National Science Foundation and the Department of Energy.

Current projects at DSRL include:

- Information Discovery on Clinical and Biomedical Databases
- Searching Domain Data Graphs
- Searching Text Streams
- Analyzing Disaster Management Data
- Semi structured Storage Systems
- Resource Management in Virtualized Data Centers
- Energy-efficient Mobile and RAID Storage Systems
- Reliable RAID Storage Systems
- High-performance Storage Systems
- Block-layer Storage Infrastructure for Operating Systems

For more details, visit the URL: http://dsrl.cs.fiu.edu.

6.3.14 Telecommunications and Information Technology Institute (IT2)

Dr. Niki Pissinou and Dr. S. S. Iyengar, Co-Directors

Funded by the State of Florida, industry and federal government, the Telecommunications and Information Technology Institute (IT2) is a unique hub for research, technology transfer and education at the graduate and undergraduate levels. With a sustainable growth model as the basis for its development, IT2's portfolio now boasts cutting edge research, active alliances with industry and unique academic programs. It is now a leading resource for education, training, research and technology development in United States of America and abroad.

The Telecommunications and Information Technology Institute's research cross traditional disciplinary boundaries to investigate a broad range of advanced topics in communications and computers. Its researchers model, design and implement systems that include these goals:

- Pioneering new core technologies along with supportive algorithms, architectures, toolkits and prototypes.
- Exploring ways to scale networks that are pervasive, unattended, and widely embedded throughout the physical environment.
- Exploring research, development and commercialization in mobile and wireless communications, networks and software.
- Creating new technologies and solutions utilizing networking, software and hardware solutions essential to the advancement and practical proliferation of new technologies.
- Offering access to advanced multidisciplinary and collaborative research and real-world virtual applications support to the revolutionary next generation of telecommunications and information technologies.

To fulfill the Institute’s vision of developing next-generation technologies, the efforts of the research groups are segmented into a few, somewhat complementary thrusts that naturally coincide with industrial needs. The fundamental science and technologies are distinctively unique; hence, different approaches are required within each group. IT2's researchers have lead research efforts and development projects targeted at solving complex problems conducive to early identification of high impact solutions in a wide range of areas including security, privacy, wireless ad-hoc and sensor networks.

6.3.15 Virtual Intelligent Social AGEnts (VISAGE) Laboratory

Dr. Christine Lisetti, Director

The Virtual Intelligent Social AGEnts (VISAGE) Laboratory conducts research in Affective Computing, a field of computer science that studies how to build socially intelligent computers that can adapt to human’s emotions and social communication cues to provide natural human-computer interaction. Our research is highly interdisciplinary in nature, and lies at the intersection of Artificial Intelligence (AI) and Human-Computer Interaction (HCI), and human Social Communication.

Our research goal is to create engaging, embodied socially intelligent agents (3D graphics or robotic) that can learn to interact with humans via expressive multi-modalities in a variety of contexts involving socio-emotional content (e.g. social companions, cyber-therapy, intelligent

training systems, serious games). Although application domains of interest are manifold, we currently focus on the medical and education domains with (1) building health avatars for health promotion, and (2) building virtual reality 3D environments for training social skills with virtual social agents (e.g. simulating disruptive students for teachers' behavior management training).

In a specific context, these agents must:

- sense the affect, preferences, and personality of their interlocutor (bio-sensing, pattern matching, knowledge elicitation and representation of affective phenomena);
- make decisions (logic-based and probabilistic reasoning) that are socially acceptable based on their dynamic user-model (knowledge representation);
- carry out their interactions (HCI design principles) within the domain-knowledge (expert systems)
- while displaying social competence (social communication theory);
- and learn to tailor and adapt (machine learning) their interactive styles to the specific socio-emotional profile (user-modeling) of their human counterpart.

7 Regularly Scheduled Graduate Course Offerings

7.1 SCIS Courses

CAP 5011 Multimedia Systems and Applications (3). Course covers organization of multimedia systems, data representation, quality of service, scheduling algorithms, synchronization and tele-communication of multimedia streams. Prerequisite: COP 4610.

CAP 5109 Advanced Human-Computer Interaction (3). Fundamental concepts of human-computer interaction, cognitive models, user-centered design principles, evaluation techniques, and emerging technologies in various contexts and domains

CAP 5507 Game Theory (3). Game representations, solution concepts, algorithms & complexity, repeated games, learning, auctions, voting application to many disciplines. Familiarity with mathematical proofs would be helpful.

CAP 5510C Introduction to Bioinformatics (3). Introduction to bioinformatics; algorithmic, analytical and predictive tools and techniques; programming and visualization tools; machine learning; pattern discovery; analysis of sequence alignments, phylogeny data, gene expression data, and protein structure. Prerequisites: COP 3530, or equivalent and STA 3033 or equivalent.

CAP 5602 Introduction to Artificial Intelligence (3). Presents the basic concepts of AI and their applications to game playing, problem solving, automated reasoning, natural language processing and expert systems. Prerequisite: COP 3530.

CAP 5610 Introduction to Machine Learning (3). Decision trees, Bayesian learning reinforcement learning as well as theoretical concepts such as inductive bias, the PAC learning, minimum description length principle. Prerequisite: Graduate standing.

CAP 5627 Affective Intelligent Agents (3). Design and implementation methods using artificial intelligence (AI) techniques, human-computer interaction (HCI) principles, emotion theories; applications, e.g. health informatics, education, games. Prerequisites: Graduate standing or permission of the instructor.

CAP 5640 Graduate Introduction to Natural Language Processing (3). The concepts and principles of computer processing of natural language, including linguistic phenomena, formal methods, and applications. Students will conduct an independent research project. Prerequisites: M.S. or Ph.D. standing or permission of the instructor.

CAP 5701 Advanced Computer Graphics (3). Advanced topics in computer graphics: system architecture, interactive techniques, image synthesis, current research areas. Prerequisites: COP 3530 and CAP 3710 or equivalent, or by permission. This course will have additional fees.

CAP 5738 Data Visualization (3). Advanced class on data visualization principles and techniques. Students propose, implement, and present a project with strong collaborative and visual components.

CAP 5768 Introduction to Data Science (3). Foundations of databases, analytics, visualization and management of data. Practical data analysis with applications. Introduction to Python, SQL, R, and other specialized data analysis toolkits. Prerequisites: STA 3164 or equivalent.

CAP 5771 Principles of Data Mining (3). Introduction to data mining concepts, knowledge representation, inferring rules, statistical modeling, decision trees, association rules, classification rules, clustering, predictive models, and instance-based learning. Prerequisites: COP 4710 and STA 3033.

CAP 6736 Geometric Modeling and Shape Analysis (3). Techniques for 2D/3D geometric modeling and analysis, including representation, reconstruction, processing, modeling and shape analysis, and applications in science and engineering. Prerequisites: SCIS graduate standing or by permission of the instructor.

CAP 6776 Advanced Topics in Information Retrieval (3). Information Retrieval (IR) principles including indexing and searching document collections, as well as advanced IR topics such as Web search and IR-style search in databases. Prerequisite: COP 5725.

CAP 6778 Advanced Topics in Data Mining (3). Web, stream data, and relational data mining, graph mining, spatiotemporal data mining, privacy-preserving data mining, high-dimensional data clustering, social network, and linkage analysis. Prerequisite: CAP 5771 or permission of the instructor.

CDA 5655 Virtualized Systems (3). Topics include the concepts and principles of virtualization and the mechanisms and techniques of building virtualized systems, from individual virtual machines to virtualized networked infrastructure. Prerequisites: COP 4610 or permission of the instructor.

CDA 6939 Special Topics: Advanced Topics in Computer Architecture (3). This course deals with selected special topics in computer architecture. Prerequisite: Permission of the instructor.

CEN 5011 Advanced Software Engineering (3). This course deals with the design of large scale computer programs. Included are topics dealing with planning design, implementation, validation, metrics, and the management of such software projects. Prerequisite: CEN 4010.

CEN 5064 Software Design (3). Study of object-oriented analysis and design of software systems based on the standard design language UML; case studies. Prerequisite: CEN 5011.

CEN 5076 Software Testing (3). Tools and techniques to validate software process artifacts: model validation, software metrics, implementation-based testing, specification-based testing, integration and systems testing. Prerequisites: CEN 4010 or CEN 5011.

CEN 5079 Secure Application Programming (3). Development of applications that are free from common security vulnerabilities, such as buffer overflow, SQL injection, and cross-site scripting attacks. Emphasis is on distributed web applications. Prerequisite: Graduate standing.

CEN 5082 Grid Enablement of Scientific Applications (3). Fundamental principles and applications of high performance computing and parallel programming using OpenMP, MPI, Globus Toolkit, Web Services, and Grid Services. Prerequisites: Graduate standing or permission of the instructor.

CEN 5087 Software and Data Modeling (3).*** Essential software and data modeling methods and techniques such as UML, XML, and ER. Prerequisite: Graduate standing. (Note: This class cannot be applied to MS or PhD in Computer Science.)

CEN 5120 Expert Systems (3). Introduction to expert systems, knowledge representation techniques and construction of expert systems. A project such as the implementation of an expert system in a high level AI-language is required. Prerequisites: COP 3530 or permission of the instructor.

CEN 6070 Software Verification (3). Study of formal verification of software systems; verification methods; verification of sequential and concurrent software systems. Prerequisite: CEN 5011.

CEN 6075 Software Specification (3). Study of formal specification in the software development process; specification methods; specification of sequential and concurrent systems. Prerequisite: CEN 5011.

CGS 5166 Introduction to Bioinformatics Tools (2).*** Introduction to bioinformatics; analytical and predictive tools; practical use of tools for sequence alignments, phylogeny, visualizations, pattern discovery, gene expression analysis, and protein structure. Prerequisites: PCB 6025 or equivalent. (Note: This class cannot be applied SCIS degrees. Students in graduate programs in SCIS should enroll for the section listed under CAP 5510C Introduction to Bioinformatics.)

CGS 6834 Programming for the Web (3).*** Installation and maintenance of servers. Techniques for building secure multimedia interactive web pages. A hands-on project to develop an educational interactive multimedia web site is required. (Note: This class cannot be applied to MS or PhD in Computer Science.)

CIS 5027 Computer Systems Fundamentals (3).*** Fundamentals concepts of IT Systems: operating systems, networking, distributed systems, platform technologies, web services and human-computer interaction. Covers design principles, algorithms and implementation techniques. Prerequisite: Graduate standing. (Note: This class cannot be applied to MS or PhD in Computer Science.)

CIS 5208 Social, Economic, and Policy Aspects of Cybersecurity (3). The broader human context of cybersecurity, from the perspective of society, economics, and policy. Prerequisite: Graduate standing.

CIS 5346 Storage Systems (3). Introduction to storage systems, storage system components, storage architecture, devices, trends and applications, performance, RAID, MEMS and portable storage, file systems, OS storage management. Prerequisite: Graduate standing.

CIS 5370 Principles of Cybersecurity (3). Cybersecurity algorithms, techniques. Mathematical foundations. Symmetric and public key encryption. Authentication, key infrastructure, certificates. Covert channels. Access control. Vulnerabilities. Prerequisite: Graduate standing.

CIS 5372 Fundamentals of Computer Security (3). Information assurance algorithms and techniques. Security vulnerabilities. Symmetric and public key encryption. Authentication and Kerberos. Key infrastructure and certificate. Mathematical foundations. Prerequisite: Graduate standing.

CIS 5373 Systems Security (3). Risk, Trust, and Threat models; Types of Attacks; Safe Programming Techniques; Operating System Mechanisms, Virtual Machine Systems; Hardware Security Enforces; Application Security; Personal Security. Prerequisite: CIS 5372.

CIS 5374 Information Security and Privacy (3). Information Security Planning, Planning for Contingencies, Policy, Security Program, Security Management Models, Database Security, Privacy, Information Security Analysis, Protection Mechanism. Prerequisite: CIS 5372.

CIS 5432 Advanced IT Automation (3). Advanced topics in system/network management including monitoring, help desk, antivirus, anti-malware, backup, disaster recovery, discovery, audit, remote control, automated response, policies, and reports. Prerequisites: CIS 4431 or permission of the instructor.

CIS 5931 Special Topics (VAR). A course designed to give groups of students an opportunity to pursue special studies not otherwise offered.

CIS 6612 Special Topics: Advanced Topics in Software Engineering (3). This course deals with selected topics in software engineering. Prerequisite: Permission of the instructor.

CIS 6930 Advanced Special Topics (3). A course designed to give groups of students an opportunity to pursue special advanced studies not otherwise offered. (Note: Certain sections of this course are program-specific. Please consult the Graduate Program Advisor for approval.)

CIS 6931 Special Topics: Advanced Topics in Information Processing (3). This course deals with selected special topics in information processing. Prerequisite: Permission of the instructor.

CIS 6933 Computer Science Seminar (1). Regularly scheduled seminar series featuring speakers on computer science related topics. Prerequisite: Graduate standing.

CNT 6207 Distributed Processing (3). Study of distributed processing using networking and distributed computing techniques. Investigation of distributed algorithms and models of distributed computing. Prerequisite: Graduate Standing.

CNT 6208 Advanced Topics in Concurrent and Distributed Systems (3). Study of the major aspects of concurrent and distributed systems. Topics include foundations of concurrent computation, languages and tools for concurrent systems, distributed real-time systems, distributed multimedia systems, and concurrent object-oriented systems.

COP 5614 Operating Systems (3). Operating systems design principles, algorithms and implementation techniques: process and memory management, disk and I/O systems, communications and security.

COP 5621 Compiler Construction (3). Basic techniques of compilation; scanning; grammars and LL and LR parsing, code generation; symbol table management; optimization. Prerequisites: MAD 3512 and CEN 4010.

COP 5725 Principles of Database Management Systems (3). Overview of Database Systems, Relational Model, Relational Algebra and Relational Calculus; SQL; Database Applications; Storage and Indexing; Query Evaluation; Transaction Management. Selected database topics will also be discussed.

COP 6007 Computer Programming Concepts (3).* ** For non-computer science graduate students. Concepts of object-oriented programming, introduction to an object oriented programming language; internet programming; applications of programming to learning technologies. Prerequisite: Permission of the instructor. (Note: This class cannot be applied SCIS degrees.)

COP 6556 Semantics of Programming Languages (3). This course provides an overview of systematic and effective approaches to programming. Abstraction; formal specification techniques; program verification and semantics of programming languages. Prerequisite: COT 5310.

COP 6611 Advanced Operating Systems (3). Advanced topics in operating system design; microkernel; memory architecture; multi-processor issues; multimedia operating systems; case studies. Prerequisite: Graduate standing.

COP 6727 Advanced Database Systems (3). Design, architecture and implementation aspects of DBMS, distributed databases, and advanced aspects of databases selected by the instructor. Prerequisite: Graduate standing.

COP 6795 Special Topics on Databases (3). Study of selected advanced topics in databases and related areas. Prerequisite: Permission of the instructor.

COT 5310 Theory of Computation I (3). Abstract models of computation; including finite automata, regular expressions, context-free grammars, pushdown automata, Turing machines. Decidability and undecidability of computational problems. Prerequisite: MAD 3512.

COT 5407 Introduction to Algorithms (3). Design of efficient data structures and algorithms; analysis of algorithms and asymptotic time complexity; graph, string, and geometric algorithms; NP-completeness.

COT 5428 Formal Foundations for Cybersecurity (3). Formal models and methods for achieving rigorous security guarantees. Cryptographic indistinguishability properties, reduction proofs. Formal analyses of security APIs. Secure information flow. Prerequisite: CIS 5370.

COT 5520 Computational Geometry (3). Design and analysis of efficient algorithms to solve geometric problems: geometric searching, convex hull, proximity problem, Voronoi diagram, spanning tree, triangulation, graph drawing applications. Prerequisite: COP 3530 (or equivalents).

COT 6405 Analysis of Algorithms (3). Design of advanced data structures and algorithms; advanced analysis techniques; lower bound proofs; advanced algorithms for graph, string, geometric, and numerical problems; approximation algorithms; randomized and online algorithms. Prerequisite: Graduate standing.

COT 6421 Theory of Computation II (3). Verification of program correctness; program schemes; fixed-point theory of programs; resolution and theorem proving. Prerequisite: COT 5310.

COT 6446 Randomized Algorithms (3). Topics include moments and deviations, tail inequalities, random walk and Markov chains, stochastic processes, the probabilistic method, and applications of these tools and techniques in data structure, geometric algorithms, graph algorithms, secure systems and property testing, etc. Prerequisite: COT 5407.

COT 6930 Special Topics: Advanced Topics in Theory (3). This course deals with selected special topics in computing theory. Prerequisite: Permission of the instructor.

COT 6931 Topics in Cognitive Science (3). A "top-down" view of Computer Science, in particular artificial intelligence, by studying the computational aspects of human cognition. Prerequisite: Permission of the instructor.

COT 6936 Topics in Algorithms (3). Advanced data structures, pattern matching algorithms, file compression, cryptography, computational geometry, numerical algorithms, combinational optimization algorithms and additional topics. Prerequisite: COP 3530.

IDC 6940 Capstone Course in Data Science (3).* ** Projects course using Python, SQL, R, and/or other specialized analysis toolkits to synthesize concepts from data analytics and visualization as applied to industry relevant projects. Prerequisite: CAP 5768 (Note: This course is open to students in the Computational Data Analytics track of the M.S. in Data Science program only.)

TCN 5010 Telecommunications Technology and Applications (3). An in-depth introduction to voice and data networks, signaling and modulation, multiplexing, frequency band and propagation characteristics, special analysis of signals, and traffic analysis. Prerequisite: Permission of the instructor.

TCN 5030 Computer Communications and Networking Technologies (3). Teaches the dynamics related to computer communications, how computers are grouped together to form networks, various networking implementation strategies, and current technologies. Prerequisite: Permission of the instructor.

TCN 5060 Telecommunications Software and Methodologies (3). A high-level look into network architectures and distributed applications, client-server models, network software platforms and advanced techniques for programs specifications through implementation. Prerequisites: TCN 5030 or permission of the instructor.

TCN 5080 Secure Telecommunications Transactions (3). Telecom and information security issues such as: digital signatures, cryptography as applied to telecom transactions, network policing, nested authentication, and improving system trust. Prerequisites: TCN 5030 or permission of the instructor.

TCN 5150 Multimedia Computer Communications (3). Covers multimedia computer communications technologies including, multimedia over networks, videoconferencing,

telephone, compression algorithms and techniques for transmitting data efficiently. Prerequisites: TCN 6210 or permission of the instructor.

TCN 5421 Theory of Network Computation (3). Fundamental mathematical models of general and network computation: finite state automata, regular languages, decidability; scholastic processes, Markov chains, queuing theory.

TCN 5440 Software Development for Telecommunication Networks (3). Focuses on the aspects, tools, and techniques of developing software applications for telecommunications networks. Prerequisites: TCN 5030 or equivalent.

TCN 5445 Telecommunications Networking Programming (3). Advanced telecommunications network programming skills including Router and Bridge Software, socket programming and protocol handler. Prerequisite: Permission from instructor.

TCN 5455 Information Theory (3). Entropy and measure of information. Proof and interpretation of Shannon's fundamental theorem for various channels, including noiseless, discrete, time-discrete and time-continuous channels. Prerequisite: Permission of the instructor.

TCN 5640 Telecommunications Enterprise Planning and Strategy (3). Methodologies for re-engineering, project management, strategic planning, change management, RFPs, and life-cycle management within the telecommunications and IT arena. Prerequisite: Permission of the instructor.

TCN 5710 Cyber Sustainability (3). In-depth introduction to sustainable development and optimization of cyber systems, such as mobile networks and data centers, with an emphasis on cost, energy, water and life-cycle assessment.

TCN 6210 Telecommunications Network Analysis and Design (3). A systematic, analytic and descriptive approach to the evaluation of telecommunications networks, networking principles, and control and quality of service. Prerequisite: Permission of the instructor.

TCN 6215 Advanced Network Algorithms (3). This course will cover algorithms that are used in network research and implementation. Prerequisites: TCN 6210 or consent of the instructor.

TCN 6230 Optical Networks (3). Enabling technologies, multiplexing techniques, WDM, broadcast networks, wavelength-routed networks, network architectures, protocols, network algorithms, and device-network interfaces. Prerequisites: TCN 5030 or equivalent.

TCN 6260 Internetworking (3). The course will discuss advanced topics, current trends and control of internetworking. An analytical and descriptive approach will be used to cover the subject of internetworking.

TCN 6270 Mobile and Wireless Networks (3). Techniques in the design and operation of wireless networks; LANs, MANs, and WANs; analytical models; application of traffic and mobility models; mobility control, and wireless ATM. Prerequisites: TCN 5030 or equivalent.

TCN 6275 Mobile Computing (3). Enabling technologies and impediments of mobile computing. It includes mobile architectural design, mobile-aware and transparent adaptation, mobile data access and file systems, and adhoc networks. Prerequisite: Permission of the instructor.

TCN 6420 Modeling and Performance Evaluation of Telecommunications Networks (3). Covers methods and research issues in the models and performance evaluation of high-speed

and cellular networks. Focuses on the tools from Markov queues, queuing networks theory and applications. Prerequisites: TCN 5030 or equivalent.

TCN 6430 Networks Management and Control Standards (3). Protocols for management of telecom networks, including Simple Network Management Protocol and Common Management Information Protocol. Extension of protocols to optimize network performance. Prerequisites: TCN 5030 or equivalent.

TCN 6450 Wireless Information Systems (3). Enabling technologies and impediments of wireless information systems. Focuses on software architectures, and information and location management in the wireless environment. Prerequisite: Permission of the instructor.

TCN 6820 Industrial Development of Telecommunications (3). This course, from a management perspective, addresses the evolution of the telecom industry, the impact it has on reshaping our world, and the importance of management decisions in telecom.

TCN 6880 Telecommunications Public Policy Development and Standards (3). A concept-oriented examination of the domestic and international telecommunications policy processes and standards setting environment. Prerequisite: Permission of the instructor.

7.2 Non-SCIS Courses

No more than one course from the below list may be applied towards a graduate degree without advisor approval. Exceptions must be approved by the Graduate Program Director.

EEL 6167 VLSI Design (3). Study of VLSI Design concepts in MOS/CMOS environment, CAD techniques, VLSI array processors and wavefront array processors, and implementation of array processors. Prerequisites: EEL 5741, EEE 4314. (SS, alternating years)

EEE 5348 Digital Electronics (3). Analysis and design of logic gates using saturated and non-saturating elements, transmission gates, interfacing of logic families, bistable circuits, A/D and D/A converters. Prerequisites: EEE 4304 or permission of the instructor.

EEL 5500 Digital Communication Systems I (3). This course will consider the most important aspects of digital communication systems such as noise related subjects, random signals, linear systems, and baseband digital modulation and multiplexing. Prerequisites: EEL 3514 or permission of the instructor. (SS)

EEL 5718 Computer-Communication Network Engineering (3). System engineering synthesis, analysis, and evaluation of computer-communication networks. Network design, routing and flow control, telecommunication traffic engineering, transmission, switching, etc. Prerequisite: Permission of the instructor. (SS)

EEL 5813 Neural Networks-Algorithms and Applications (3). Various artificial neural networks and their training algorithms will be introduced. Their applications to electrical and computer engineering fields will be also covered. Prerequisite: Permission of the instructor. (SS)

EEL 5820 Digital Image Processing (3). Image Fundamentals, Image Transforms, Image Enhancement, Edge Detection, Image Segmentation, Texture Analysis, Image Restoration, and Image Compression. Prerequisite: EEL 3135 and knowledge of any programming language (FORTRAN, Pascal, C). (F)

EEL 6787 Network Security (3). Network Security Requirements, Number Theory, Steganography, Encryption Design Principles and Algorithms, Message Authentication and Digital Signature Principle and Designs, Network System Security Design. Prerequisite: Permission of Instructor.

ESI 6546 Network Flow Analysis (3). Deterministic and stochastic network flow analysis; minimal cost flow, shortest route, max-flow, and out-of-kilter algorithms; constrained network analysis; and stochastic queuing networks.

STA 5236 Regression Analysis (3). Simple, multiple and polynomial regression, analysis of residuals, model building and other related topics. Credit for both STA 4234 and STA 5236 will not be granted. Prerequisites: STA 3112 or STA 3123 or STA 3164, or STA 6167

STA 6807 Queuing & Stat Models (3). Review of probability concepts, basic probability distributions, Poisson process, queuing models, statistical models. Prerequisites: Permission of the instructor, MAC 2312 and either STA 3033 or STA 4321.

7.3 Independent Study, Dissertation, and Thesis

CIS 5900 Independent Study (1-10). Individual conferences, assigned readings, and reports on independent investigations. Prerequisite: Permission of the department.

CIS 5910 Project Research (1-6). Advanced undergraduate or master's level research for particular projects. Repeatable. Prerequisite: Permission of the department.

CIS 5915 Research Experience for Graduate Students (0-9). Participation in ongoing research in the research centers of the school.

CIS 6900 Independent Study (1-10). Individual conferences, assigned readings, and reports on independent investigations. Prerequisite: Permission of the department.

CIS 6970 Thesis (1-10). Prerequisite: Completion of all other requirements for the M.S. Degree in Computer Science.

CIS 7910 Graduate Research (1-25). Doctoral research prior to candidacy. Repeatable. Prerequisite: Permission of the department.

CIS 7980 Ph.D. Dissertation (1-10). Prerequisite: Permission of the Major Professor and Doctoral Candidacy.

COP 5949 Cooperative Education in Computer Science (1-3). One semester of full-time work, or equivalent, in an outside organization, limited to students admitted to the CO-OP program. A written report and supervision evaluation is required of each student.

Revision History

- July 2018: first draft based on previous booklet published in October 2016 with up-to-date information on the programs
- March 2019: Booklet was updated to reflect a change in policy concerning Qualifying Exam eligibility, which was adopted by the faculty on February 11th, 2019. The change allows students to appear for the Qualifying Exam as early as in the semester in which he or she is completing at least *15 credits of coursework*, including the core courses. 15 credits was previously 30 credits.
- September 2021: Handbook was updated to reflect a condition in the terms retaking core courses for the QE qualifications. Also updated Accelerated BS/MS program information and faculty list.