University of North Florida
Ph.D. in Computing
CIP 11.0101

Proposal Documents

Faculty curriculum vitae are available upon request.

**STATE UNIVERSITY
SYSTEM OF FLORIDA**

State University System of Florida Board of Governors
REQUEST TO OFFER A NEW DEGREE PROGRAM
In accordance with Board of Governors Regulation 8.011
(Please do not revise this proposal format without prior approval from Board staff)

University of North Florida	Fall 2024
Institution Submitting Proposal	**Proposed Implementation Term**
College of Computing, Engineering and Construction (CCEC)	School of Computing
Name of College(s) or School(s)	**Name of Department(s)/Division(s)**
Computing	Doctor of Philosophy in Computing
Academic Specialty or Field	**Complete Name of Degree**
11.0101	**Proposed Program Type**
Proposed CIP Code (2020 CIP)	☒ **E&G Program** ☐ **Market Tuition Rate Program** ☐ **Self-Supporting Program**

The submission of this proposal constitutes a commitment by the university that, if the proposal is approved, the necessary financial resources and the criteria for establishing new programs have been met before the program's initiation.

_12/8/2023_	_Moz Li_	12/7/2023
Date Approved by the University Board of Trustees	**President's Signature**	**Date**
[signature] 12/7/23	_K Patterson_	12/7/2023
Board of Trustees Chair's Signature Date	**Provost's Signature**	**Date**

Form Updated June 2023

Projected Enrollments and Program Costs

Provide headcount (HC) and full-time equivalent (FTE) student estimates for Years 1 through 5. HC and FTE estimates should be identical to those in Appendix A – Table 1. Indicate the program costs for the first and the fifth years of implementation as shown in the appropriate columns in Appendix A – Table 3A or 3B. Calculate an Educational and General (E&G) cost per FTE for Years 1 and 5 by dividing the total E&G by FTE.

Implementation Timeframe	HC	FTE	E&G Cost per FTE	E&G Funds	Contract & Grants Funds	Auxiliary/ Philanthropy Funds	Total Cost
Year 1	3	2.25	$16,124	$ 36,279			$ 36,279
Year 2	6	4.5					
Year 3	9	6.75					
Year 4	12	9					
Year 5	12	9	$8,387	$ 75,485			$ 75,485

Programs of Strategic Emphasis Waiver *(for baccalaureate programs only)*

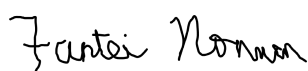**Does the program fall under one of the CIP codes listed below?**

☒ **Yes**
☐ **No**

If yes, students in the program will be eligible for the Programs of Strategic Emphasis (PSE) waiver. See Board Regulation 7.008 and the PSE Waiver Guidance for additional details.

CIP CODE	CIP TITLE	CATEGORY
11.0101	Computer and Information Sciences	STEM
11.0103	Information Technology	STEM
13.1001	Special Education and Teaching	EDUCATION
13.1202	Elementary Education and Teaching	EDUCATION
14.0801	Civil Engineering	STEM
14.0901	Computer Engineering	STEM
14.1001	Electrical and Electronics Engineering	STEM
27.0101	Mathematics	STEM
40.0801	Physics	STEM
52.0301	Accounting	GAP ANALYSIS
52.0801	Finance	GAP ANALYSIS
52.1201	Management Information Systems	STEM

Additional Required Signatures

I confirm that I have reviewed and approved Need and Demand Section III.F. of this proposal.

Fantei Norman
_____
Signature of Equal Opportunity Officer

9/11/2023
_____
Date

I confirm that I have reviewed and approved Non-Faculty Resources Section IX.A. and IX.B. of this proposal.

_____   _31 Aug 23_____
Signature of Library Dean/Director   **Date**

Introduction

I. Program Description and Relationship to System-Level Goals

A. Describe within a few paragraphs the proposed program under consideration and its overall purpose, including:
- **degree level(s)**
- **majors, concentrations, tracks, specializations, or areas of emphasis**
- **total number of credit hours**
- **possible career outcomes for each major (provide additional details on meeting workforce need in Section III)**

The University of North Florida (UNF) School of Computing (School) in the College of Computing, Engineering and Construction (College) is requesting to add a new PhD program in Computing (CIP Code:11.0101). The proposed program of study will provide candidates with advanced, research-based studies in the field of computing in two concentrations: _intelligent systems_ and _cybersecurity_. The program will consist of 72 total graduate credits beyond the undergraduate degree, which will include a minimum of 48 credit hours of coursework and a minimum of 24 credit hours dissertation research. The overall purpose of the proposed program is to prepare candidates for intelligent systems and cybersecurity research and development positions in the private and public sectors as well as academic positions in universities and colleges. The two chosen concentrations are of great importance to the Northeast Florida economy as it spans the sectors of logistics, healthcare, financial technology, and advanced manufacturing. The program will recruit students from the pool of traditional domestic and international students with a variety of undergraduate backgrounds such as computing, engineering, and the physical, natural, life, and social sciences, as well as working professionals in Northeast Florida (who currently do not have a viable access to such advanced degrees). In addition to the traditional and well-established, research methods, the program will encourage multidisciplinary research approaches and prioritize research problems with direct economic and community impacts. The program will fill a need in the Northeast Florida region by preparing computing professionals to become advanced-level researchers who will contribute to computing higher education, economic and technological development as well as international collaboration.

The intelligent systems concentration will focus on studying theories, concepts, and systems that are inspired by the intelligent behaviors of humans, species and biological systems. Given the research focus of the degree, the students pursuing this concentration will tackle research problems whose solutions are currently unknown or don't exist, or can be improved in measurable ways, and contribute to the artificial intelligence literature. Graduates of this concentration may become employed as artificial intelligence researchers or consultants in the healthcare and financial sectors, big data researchers, business intelligence specialists, data science researchers, machine learning researchers or consultants, natural language processing researchers, robotics researchers, or university professors of computing and a variety of subfields related to intelligent systems. Such employment opportunities are generally available with large companies such as Google, IBM, or Amazon at the national level; federal agencies such as the National Science Foundation or NASA and contracting companies that work with such agencies;

and organizations such as Mayo Clinic and Citibank in the health and financial sectors at the regional level. The PhD graduates of the intelligent systems concentration will also be prime candidates for full-time tenure track faculty and research faculty positions at higher educational institutions.

The cybersecurity concentration will focus on studying concepts, theories, and security underpinnings of computing and communication systems with the aim of developing innovative solutions for improving the security of computing environments and contributing to the cybersecurity literature. Graduates of this concentration may become chief technology officers, chief information security officers, cybersecurity researchers, information security architects, information security consultants in the healthcare and financial sectors, information security directors, information security engineers, or university professors of computing and a variety of subfields related to cybersecurity. Such employment opportunities are generally available with medium- and large-sized companies such as Google, IBM, or Amazon at the national level; federal agencies such as the National Security Agency and the FBI; and several healthcare and banking organizations, including Mayo Clinic and Citibank in the health and financial sectors at the regional level. The PhD graduates of the cybersecurity concentration will also be prime candidates for full-time tenure track faculty and research faculty positions at higher educational institutions.

B. If the proposed program qualifies as a Program of Strategic Emphasis, as described in the Florida Board of Governors 2025 System Strategic Plan, indicate the category.

- **Critical Workforce**
  - ☐ Education
  - ☐ Health
  - ☐ Gap Analysis

- **Economic Development**
  - ☐ Global Competitiveness
  - ☒ Science, Technology, Engineering, and Math (STEM)

☐ **Does not qualify as a Program of Strategic Emphasis.**

II. Strategic Plan Alignment, Projected Benefits, and Institutional Mission and Strength

A. Describe how the proposed program directly or indirectly supports the following:
- **System strategic planning goals (see the link to the 2025 System Strategic Plan on the [New Program Proposals & Resources](#) webpage)**
- **the institution's mission**
- **the institution's strategic plan**

The below Table shows the extent to which the proposed program will support the System goals.

System Goals	Excellence	Productivity	Strategic Priorities
Teaching and Learning (Directly)	The proposed program will be UNF's first PhD program. UNF will be the first System institution to make a PhD program in computing intentionally available to	By the end of Year-4, the program would produce 3 PhD graduates, and after that the program will produce 3 PhD graduates annually.	Computing is a major STEM field, and the concentrations of intelligent systems and cybersecurity are fields of strategic importance to the nation.

	working professionals in the Northeast Florida region.		
Scholarship, Research, and Innovation (Directly)	The program's concentrations will be focused on studying and creating innovative solutions to computationally modeled real-life problems in intelligent systems and cybersecurity.	Program faculty members have already demonstrated significant research productivity. Research partnerships with local industry will enable further increase in research and scholarly activity.	Increased production of PhD graduates will help educational institutions to recruit more qualified faculty. Industry-driven research will lead to increased external funding opportunities.
Community and Business Engagement (Indirectly)	The College and the School are well connected with industry partners, which will help with the recruitment of students to the program.	Concentrations in intelligent systems and cybersecurity will provide additional opportunities for UNF-industry collaborations.	Increased community engagement through this program will provide a mechanism to grow other programs offered through the School, College, and UNF.

The System is committed to a deliberate strategy to increase the number of undergraduate and graduate degrees in science, technology, engineering, and mathematics (STEM) and health and other Programs of Strategic Emphasis disciplines. Computing is a major STEM field that is intertwined with many other fields of physical, natural, life, and social sciences, as well as engineering. Many faculty members have ongoing collaborations with researchers in specific areas such as biology, business, chemistry, education, engineering, medicine, physics, and psychology. The proposed program will enhance the ability of UNF to attract talented graduate students to support both teaching and research activities in computing in general, and intelligent systems and cybersecurity in particular. Moreover, the proposed concentrations are integral to economic development, and advanced research-based degrees in these concentrations will contribute to university teaching with the overarching goal to support the development of the future workforce in these subject areas. Both economic development and university teaching are included in the categories of the System's strategic planning goals. The program will directly support teaching and learning, as well as scholarship, research, and innovation, and indirectly support community and business engagement.

The UNF mission is to "… ignite a passion for learning and discovery through transformational education in a supportive environment that leads students to rewarding careers and lifelong success, (and be a) hub for talent development, relevant research and community engagement, (to) enrich lives and fuel the economic and overall prosperity of Northeast Florida and beyond."

The goals of the proposed PhD program in Computing are well aligned with UNF's mission. The program will fill a need in the Northeast Florida region by preparing computing professionals to become advanced-level researchers who will contribute to computing higher education, economic and technological development as well as international collaboration.

In its proposed 2023 strategic plan, UNF identifies the following five areas of focus:
- Advanced Manufacturing
- Coastal Resilience
- Data Science, Cybersecurity, and Information Technologies
- Health Care and Health Sciences
- Transportation and Logistics

The proposed PhD program in Computing will be the main contributor to the focus area of Data Science, Cybersecurity, and Information Technologies.

Next, under one of its top priorities to "Inspire Relevant Research and Impactful Innovation," UNF seeks to:

- Expand impactful and relevant research, scholarship and creative activity (RSCA) to

expand on its research activity, and
- o Increase number of innovative research doctoral degree programs that serve the strategic growth of UNF and NE Florida.

The School of Computing feels privileged to be the academic unit within UNF to take the first step in this direction by proposing the PhD program in Computing with concentrations in intelligent systems and cybersecurity with plans for recruiting working professionals to pursue the research-based doctoral program.

Another UNF strategic priority is to "Expand Mutually Beneficial Partnerships with the Community." One of the goals under this priority is to "Develop new programs such as (its ongoing) UNF+Pathways that enhance the University's role in fulfilling the life-long educational and professional development needs of the Northeast Florida community." Given that the proposed program will also seek to recruit students from Northeast Florida working professionals, it is expected that the program's connections to the region's organizations and businesses will strengthen over time to unprecedented levels.

B. Describe how the proposed program specifically relates to existing institutional strengths. This can include:
- **existing related academic programs**
- **existing programs of strategic emphasis**
- **institutes and centers**
- **other strengths of the institution**

The proposed program directly relates to the following programs of strategic emphasis that the School offers:

1) BS in Computer Science
2) BS in Computing & Information Sciences: Data Science
3) BS in Information Science
4) BS in Information Systems
5) BS in Information Technology

It is important to emphasize that all of the above-listed programs are ABET accredited. Furthermore, UNF is federally designated as a Center of Academic Excellence in Cyber Defense Education (CAE-CDE), based on the School's ABET-accredited BS in Information Technology program. UNF's Center for Cybersecurity exists to provide program guidance and oversight, general cyber defense information as well as collaboration and outreach opportunities among students, faculty and other institutions in Jacksonville, Florida.

Additionally, the proposed program is also directly related to the innovative, research-based Master of Science in Computing and Information Sciences (MS-CIS) with concentrations in Computer Science, Cybersecurity, Data Science, and Information Systems. This MS-CIS program, which is also a program of strategic emphasis (CIP 11.0101), is friendly to different student populations including working professionals by providing evening classes and a variety of graduate courses. The proposed PhD program will leverage the existing inventory of computing graduate courses so that the PhD program may be immediately launched with no additional time and effort required for the development of new courses.

The School also collaborates with the Coggin College of Business in the delivery of its Business Analytics certificate program, and with the Brooks College of Health in the delivery of its Health Informatics MS program. This collaboration has been possible because these curricula include graduate computing courses such as Data Analytics, Computing Practicum, and Programming for Data Science. In a similar manner, the Information Systems and Data Science concentrations within the master's program offered by the School include courses such as Data Visualization and

Management of Information Technology that are offered by the Coggin College of Business.

UNF's other strengths include ongoing collaborative research among the School's faculty and across the different colleges within UNF in artificial intelligence, data science, cybersecurity, blockchains, data science, robotics, and virtual/augmented reality.

The strengths of the proposed program are: (1) a strong core group of faculty in intelligent systems and cybersecurity to teach, mentor, and direct dissertation research; (2) flexibility to accommodate students' diverse academic backgrounds and professional preparation; (3) a clear market niche in the region; and (4) support from UNF and the College administration for the program.

C. Provide the date the pre-proposal was presented to the Council of Academic Vice Presidents Academic Program Coordination (CAVP ACG). Specify any concerns raised and provide a narrative explaining how each concern has been or will be addressed.

The pre-proposal was presented to the SUS Council of Academic Vice-Presidents (CAVP) on April 7, 2021. The review group unanimously supported the pre-proposal.

D. In the table below provide an overview of the institutional planning and approval process leading up to the submission of this proposal to the Board office. Include a chronology of all activities, providing the names and positions of university personnel and external individuals who participated.

- **If the proposed program is at the bachelor's level, provide the date the program was entered into the APPRiSe system, and, if applicable, provide a narrative responding to any comments received through APPRiSe.**

- **If the proposed program is a doctoral-level program, provide the date(s) of the external consultant's review in the planning table. Include the external consultant's report and the institution's responses to the report as Appendix B.**

Dr. Donna Reese, Computer Science Professor Emerita, reviewed the proposal during the period from August 31, 2023 through September 21, 2023, and met virtually via Zoom with the CCEC Dean and the Interim Director of the School of Computing to get some clarifications. Dr. Reese has had extensive experience in program reviews as an ABET-CAC chair, vice-chair operations, executive committee member, commissioner, review team chair, and program evaluator. She has served in the capacity of associate dean and computer science department head at Mississippi State University. She has been a senior member of IEEE (Institute of Electronics and Electric Engineers), ACM (Association for Computing Machinery), and CSAB (Computer Science Accreditation Board). She has supervised several graduate students' theses and dissertations at the Master's and Ph.D. levels.

In her review report, Dr. Reese highlights three key strengths of the proposal as: 1) individuals in the northeast Florida region who are interested in a PhD program would be well served by the proposed program; 2) the program includes a meaningful set of prerequisite courses that will prepare candidates with no background in computing for work in this area without unnecessarily delaying their entrance into the program; and 3) the emphasis areas of intelligent systems and cybersecurity are both currently areas of national need, and the proposed program should provide a strong economic payback for this region of the state.

Dr. Reese also made several suggestions in her report for strengthening the proposal, and these

suggestions include: 1) differentiating between the timeline for degree completion of students entering the program with bachelor's degrees and master's degrees in computing; 2) clarifying what is meant by "quality publication" in the qualification process; 3) adding information on how student progress will be regularly reviewed once the student reaches candidacy status and starts working on the dissertation; 4) providing separately sequenced coursework details for students entering the program with different background preparation in computing; 5) how the current faculty capacity and the student enrollments in currently offered graduate courses would be able to absorb the addition of the projected number of PhD students; 6) showing the institution's commitment to ensuring that the stipends for those students pursuing full-time academic work are sufficient to be competitive; and 7) showing the institution's commitment to proving the space needed for full-time students to carry out research on campus.

Dr. Reese's review report and the institutional response are attached as Appendix-B.

Planning Process

Date	Participants	Planning Activity
2019-2020	School of Computing faculty	Study/Compare PhD programs offered by other Florida SUS institutions
2020-2021	School of Computing faculty	Identify concentrations for UNF's PhD program; Prepare pre-proposal
March 19, 2021	UNF Academic Affairs and Provost	Pre-proposal approved by UNF
April 7, 2021	Council of Academic VPs (CAVP)	Pre-proposal approved by CAVP.
Summer 2021	School of Computing faculty	Discuss program structure; study different System program models;
2021-2022	School of Computing faculty	Develop PhD curriculum
2022-2023	School of Computing faculty	Identify and package courses appropriate to each concentration
Jun-Aug 2023	School of Computing faculty	Develop proposal (Request To Offer)
Sept 21, 2023	Dr. Donna Reese Professor Emeritus of Computer Science, Mississippi State University	External consultant review of proposal
Fall 2023	Office of the Provost College Deans, UNF	Review and approval of the proposal by the Provost Leadership Team and the Council of Deans
Fall 2023		APC and Faculty Association approval
Fall 2023		UNF BOT approval
Dec 2023		Submission of proposal to Florida Board of Governors
Feb 2024		Florida Board of Governors approval

The proposed program has been developed as a natural extension of the current innovative, research-based master's program being offered by the School. The School's 30-credit Master of Science in Computer and Information Science (MS-CIS) program consists of 24 credits of coursework and 6 credits of research for both the thesis and non-thesis options in the concentrations of computer science, cybersecurity, data science, and information systems. The student population in the MS-CIS program is a mix of traditional, domestic and international students as well as working professionals. While the non-thesis option provides the School faculty members with the assistance they need in order to pursue their research in the absence of a PhD program, the model for including a research requirement in the non-thesis option has gained momentum in the last few years among working professionals. Motivated by this observation, conversations regarding the development of a PhD in Computing began during the 2019-2020 academic year. Taking into consideration our School size, faculty expertise, the subject areas of immediate importance to the Northeast Florida region, the guidance provided by our advisory board, the limited resources that may become available to support a PhD program, and a careful study of the PhD programs offered by the other institutions in the Florida System so that

unnecessary duplication of efforts may be avoided, the School faculty came to the conclusion that concentrations in intelligent systems and cybersecurity would best serve the needs of the working professionals in the region as well as students with undergraduate/graduate-level backgrounds other than computing, while enabling the School to advance its research agenda. The discussions that continued virtually through the Covid season and lockdowns led to the development of the pre-proposal that was approved in April 2021. The School faculty met several times virtually through the summer of 2021 to further study in depth the structure of the PhD curricula offered at other Florida System institutions so that a comparable high-quality program can be offered at UNF. By the conclusion of the academic year 2021-2022, the School successfully put together the curriculum described in this proposal. A major part of the academic year 2022-2023 was spent in packaging the concentrations with appropriate coursework that would allow us to offer the program efficiently and fairly quickly, without the need to develop a large number of new courses. This planning process is summarized in the table shown above.

E. **In the table below, provide a timetable of key events necessary for implementing the proposed program following approval of the program by the Board office or the Board of Governors through to the addition of the program to the State University System Academic Degree Program Inventory.**

Events Leading to Implementation

Date	Implementation Activity
March 2024	Marketing and student recruitment begin
April 2024	Prospective PhD student applications review and selection
May 2024	First cohort of 3 students admitted to program
August 2024	Student onboarding

Institutional and State-Level Accountability
III. Need and Demand

A. **Describe the workforce need for the proposed program. The response should, at a minimum, include the following:**
- **current state workforce data as provided by Florida's Department of Economic Opportunity**
- **current national workforce data as provided by the U.S. Department of Labor's Bureau of Labor Statistics**
- **requests for the proposed program from agencies or industries in the university's service area**
- **any specific needs for research and service that the program would fulfill**

According to a 2020 Computing Research Association report[1] entitled "Addressing the National Need for Increasing the Domestic PhD Yield in Computer Science," the demand for PhD graduates in computing is increasing faster than the supply, and both industry and academia are competing to hire these PhD graduates in short supply. The report points out that about 60% of new PhD graduates are employed by the industry. Thus, the need to grow the number of doctoral degrees in computing to support workforce development for the future cannot be overestimated. The report makes a strong case for taking a novel approach to PhD programs through two of its many recommendations: 1) "Explore innovative ways to leverage diverse non-CS backgrounds and industry experience in the PhD programs," and 2) "Create and support new pathways into

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[1] https://rb.gy/l0m7z

the PhD program that attract and support talented individuals who realize their research passion at a later stage in life." In line with these recommendations, the proposed program seeks to recruit students to the PhD program from the pool of traditional domestic and international students with undergraduate backgrounds in computing, and a variety of non-computing backgrounds such as engineering and the physical, natural, life, and social sciences, as well as working professionals in Northeast Florida who currently do not have a viable access to such advanced degrees.

The areas of intelligent systems and cybersecurity have seen tremendous growth and advancements in recent years. In 2017, Gartner[2] predicted that AI technologies will be integrated in almost every new software product by 2020, which turned out to be largely accurate. The unprecedented demand in both areas is confirmed by the US Department of Labor, which projects 15% annual growth of computer and information research jobs, which is much faster than average. As the 2022 Taulbee survey[3] of the Computing Research Association points out, a high percentage of Computing PhD graduates pursue industry jobs (62.5%), and this poses a great challenge for academic institutions to recruit qualified professors to respond to the growing enrollments at the undergraduate level. The unprecedented demand in both areas is confirmed by the US Department of Labor's Occupational Outlook Handbook[4] projecting a 21% annual growth of computer and information research jobs, which is much faster than average. Therefore, the lack of availability of PhD graduates in the high-demand areas such as intelligent systems and cybersecurity who pursue academic and research careers requires innovative solutions and recruiting from multiple pools of prospective students.

Included in Appendix-J are support letters from the chairs of the Computing Advisory Board and the College Dean's Leadership Council, who represent the local UNF business and industry partners. These letters emphasize the importance of having a PhD program that provides access to an advanced research degree to the local population of industry professionals.

National and Florida Workforce Demand

In the table below, provide occupational linkages or jobs graduates will be qualified to perform based on the training provided for the proposed program that does not currently appear in the most recent version of the Search by CIP or SOC Employment Projections Data Tool provided periodically by Board staff.

Occupational Linkages for the Proposed Program

SOC Code (XX-XXXX)	Occupation Title	Source / Reason for Inclusion
15-1221	Computer and Information Research Scientists	Description fits both concentrations

The proposed PhD program is best aligned with the SOC code 15-1221, Computer and Information Research Scientists. The graduates of the proposed program would be qualified to teach in Computer and Information Sciences programs, as well as work for the industry and national research laboratories as computer and information research scientists.

Complete the table below and summarize its contents in narrative form. Include data for all linked occupations, including those in the table above. Use data from

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[2] https://rb.gy/ino3c

[3] https://rb.gy/k47bw

[4] https://rb.gy/rilh9

the Search by CIP or SOC Employment Projections Data Tool provided periodically by Board staff.

Labor Market Demand, CIP Code 11.0101

Occupations	Percent Change in Job Openings		Annual Average Job Openings		Total # of New Jobs		Education Level Needed for Entry
	FL 2022-30	U.S. 2021-31	FL 2022-30	U.S. 2021-31	FL 2022-30	U.S. 2021-31	
Computer & Information Research Scientists CIP Code: 11.0101	23.7%	21%	1,151	33,500	322	7,100	Master's degree or higher

Sources:
Date Retrieved: 08/17/2023
U.S. Bureau of Labor Statistics - https://data.bls.gov/projections/occupationProj
Florida Department of Economic Opportunity - http://www.floridajobs.org/labor-market-information/data-center/statistical-programs/employment-projections

Employment of computer and information research scientists is projected to grow 21 percent nationally from 2021 to 2031, which is much faster than the average for all occupations. About 33,500 openings for computer and information research scientists are projected each year, on average, over the decade. Computer and information research scientists are able to teach a variety of subjects within the discipline beyond the high school level. Overall employment of computer and information research scientists is projected to grow 23.7% in Florida from 2022 to 2030, resulting in 1,151 available jobs. Nationally, 33,500 openings for computer and information research scientists are projected each year, on average over the decade.

According to the National Center for Education Statistics[5,] 2572 doctoral degrees in Computing and Information Sciences were awarded in 2021 by all post-secondary institutions in the United States, and this number translates roughly to 7.749 doctoral degrees per million people (based on the US population of 331.9 million in 2021). On the other hand, according to the Florida SUS Data Dashboards[6], the SUS institutions awarded 82 doctoral degrees in Computing and Information Sciences in 2021. Accounting for the number of doctoral degrees awarded by other private institutions in Florida, the number of doctoral degrees in Computing is estimated not to exceed 120 in the entire State of Florida, and this number translates roughly to 5.510 doctoral degrees per million people (based on the Florida population of 21.78 million in 2021), which is significantly lower than the doctoral degree production in Computing at the national level. Thus, there is definitely a significant need to increase Florida's capacity to award more doctoral degrees in Computing and thus the need to have more Computing doctoral degree programs to be offered through the Florida SUS institutions.

B. Provide and describe data that support student demand for the proposed program. Include questions asked, results, and other communications with prospective students.

The School routinely receives inquiries regarding the possibility of pursuing a PhD in Computing at UNF from currently enrolled students in the Bachelor's and Master's degree programs, students completing their Master's degrees in engineering and the sciences, and industry professionals in the region with significant work experience in the Computing field.

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5 https://nces.ed.gov/programs/digest/d22/tables/dt22_324.25.asp
6 https://www.flbog.edu/resources/data-analytics/dashboards/

A brief Qualtrics survey, included in Appendix K, was distributed to current UNF Computing undergraduate and graduate students, and 67 students responded. The results are summarized below and demonstrate a strong student demand for the program.

Q1 – Would you be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Intelligent Systems/Artificial Intelligence at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	37	55%
Maybe	16	24%
No	14	21%

Q2 – Do you know of any non-UNF students who may be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Intelligent Systems/Artificial Intelligence at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	19	28%
Maybe	13	19%
No	35	52%

Q3 – Would you be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Cybersecurity at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	20	30%
Maybe	17	26%
No	29	44%

Q4 – Do you know of any non-UNF students who may be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Cybersecurity at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	14	21%
Maybe	15	22%
No	38	57%

Q5 – Would you like more information about this PhD program in Computing with Intelligent Systems/Artificial Intelligence and Cybersecurity concentrations?

Answer	Number of Responses	Percentage
Yes	54	81%
Maybe	5	7%
No	8	12%

Q6 – If interested in UNF's new PhD degree program, please provide which concentration you will be most interested?

Answer	Number of Responses	Percentage

Intelligent Systems	46	75%
Cybersecurity	15	25%

Q7 – If interested in UNF's new PhD degree program, please provide your email address.

51 (76%) students provided their email addresses.

Several UNF alumni who completed their bachelor's or master's degrees in recent years and who are working in the Jacksonville IT sector have been in face-to-face and email communications with faculty members and keeping track of the School's progress through the approval process for the PhD program so that they can join the program once it is in place.

The brief Qualtrics survey, included in Appendix K (the same survey as was used for current students), was distributed to UNF Computing alumni, and 22 alumni responded. The results are summarized below and demonstrate a strong student demand for the program from the alumni.

Q1 – Would you be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Intelligent Systems/Artificial Intelligence at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	5	23%
Maybe	13	59%
No	4	18%

Q2 – Do you know of any non-UNF students who may be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Intelligent Systems/Artificial Intelligence at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	4	18%
Maybe	4	18%
No	14	64%

Q3 – Would you be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Cybersecurity at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	7	32%
Maybe	5	23%
No	10	45%

Q4 – Do you know of any non-UNF students who may be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with a concentration in Cybersecurity at UNF sometime in the future?

Answer	Number of Responses	Percentage
Yes	3	14%
Maybe	2	9%
No	17	77%

Q5 – Would you like more information about this PhD program in Computing with

Intelligent Systems/Artificial Intelligence and Cybersecurity concentrations?

Answer	Number of Responses	Percentage
Yes	15	68%
Maybe	2	9%
No	5	23%

Q6 – If interested in UNF's new PhD degree program, please provide which concentration you will be most interested?

Answer	Number of Responses	Percentage
Intelligent Systems	15	68%
Cybersecurity	7	32%

Q7 – If interested in UNF's new PhD degree program, please provide your email address.

15 (68%) alumni provided their email addresses.

Thus, the School now has the ability to do direct marketing to those students and alumni who have provided us their email addresses through the two surveys.

Furthermore, although Northeast Florida has a flourishing IT sector that is being recognized as one of the fastest growing nationally, Jacksonville is in a very short list of large US cities without a PhD program in Computing. The region's working professionals who may seek to advance their education toward a PhD in cybersecurity or intelligent systems, being amongst the country's areas of strategic importance, are left with the only options of either driving for two or more hours to attend an in-person program at another System campus or attend an online program. The former option is either not viable or not convenient for most and the latter is not typically preferred for the perceived inferior quality given the research nature of doctoral degrees. The proposed PhD program will provide a high-quality and convenient option. Recent email messages from current students, alumni, and/or working professionals in the area are included in Appendix L.

It is also important to note that UNF provides pathways for its own computing, engineering, and science undergraduate students to enter the computing graduate program through an accelerated BS-MS program and an express application mechanism for the BS graduates within three semesters of graduation. Similar mechanisms may be used to enroll students in the proposed PhD program as well in the future.

C. Complete Appendix A – Table 1 (1-A for undergraduate and 1-B for graduate) with projected student headcount (HC) and full-time equivalents (FTE).
- **Undergraduate FTE must be calculated based on 30 credit hours per year**
- **Graduate FTE must be calculated based on 24 credit hours per year**

In the space below, explain the enrollment projections. If students within the institution are expected to change academic programs to enroll in the proposed program, describe the anticipated enrollment shifts and impact on enrollment in other programs.

We plan on recruiting and attracting students from the industry in the region, from recent UNF graduates, and from other traditional or international populations more easily accessible within the State of Florida. Thus, we will recruit one student from each of these populations for a cohort of 3 students in Year 1. This is reflected in Appendix A, Table 1-B in the three rows corresponding to: 1) individuals from local industries/agencies; 2) individuals who recently graduated from UNF;

and 3) individuals who recently graduated from non-public Florida institutions, for a total of 3 students in Year 1. While it may be possible to bring in more students, we would like to achieve efficient and effective use of faculty time and assign one PhD student per faculty member and bring faculty on board gradually. Thus, during each subsequent year, we will recruit 3 additional students and involve 3 additional faculty as mentors. This information is reflected in Appendix A, Table 2 showing percent-time effort by faculty.

Each student is expected to complete, on an average,18 credits each year, so that 3 students will correspond to 3 * 18/24 = 2.25 FTE in Year 1. For each subsequent year, we would admit 3 more students. Thus, there will be a total of 3 students in Year 1, 6 in Year 2 that includes the 3 from Year 1 and so on. The average completion time for the program is expected to be 4 years, and thus in Year 5, 3 new students will join while 3 students from Year 4 will be graduating.

Therefore, the Year 5 headcount is the same as Year 4 headcount. Thus, the FTE will be 2.25, 4.5, 6.75, 9, and 9 in Year 1, Year 2, Year 3, Year 4, and Year 5 respectively. This information is reflected in Table 1-B in Appendix A.

No enrollment shifts and impact on other programs within the institution are anticipated as there would be no students changing from another current academic program to the proposed program.

D. Describe the anticipated benefits of the proposed program to the university, local community, and the state. The benefits of the program should be described both quantitatively and qualitatively.

The projected benefits of the proposed Ph. D. program may be summarized as follows:

1. University: The program will directly support the advancement of the University in its focus areas of cybersecurity, data science, and information technologies, and also its strategic priorities of expanding impactful and relevant research and increasing the number of innovative doctoral degree programs. Over a period of 5 years from the beginning, the program will bring 15 doctoral students to UNF. The program will produce three PhD graduates each year, beginning with Year 4. On the average, the program expects to produce at least three research publications in refereed journals and/or conference proceedings each year, beginning with Year 3. With increasing amounts of faculty efforts devoted to the program, it is expected that the program will support the development and submission of at least three grant proposals every three years.

2. Northeast Florida Region: The proposed program will increase the ability of the School faculty to collaborate with researchers from the industry partners in the region and researchers from other disciplines, create more innovative solutions, and attract more extramural funding. With increasing amounts of faculty efforts devoted to the program, it is expected that the program will support the development and submission of at least one grant proposal every three years, in collaboration with the industry.

3. State and Beyond: Graduates of the proposed PhD program will be employed in faculty positions, industrial research labs, product development, and national laboratories.

E. If other public or private institutions in Florida have similar programs at the four- or six-digit CIP Code or in other CIP Codes where 60 percent of the

coursework is comparable, identify the institution(s) and geographic location(s).   Summarize the outcome(s) of communication with appropriate personnel (e.g., department chairs, program coordinators, deans) at those institutions regarding the potential impact on their enrollment and opportunities for possible collaboration in the areas of instruction and research.

The data provided in the following table pertains to PhD programs offered at other System institutions under the CIP codes of 11.0101 (Computer and Information Sciences, General, same as the proposed program) and other related CIP codes of 11.0401 (Information Sciences/Studies), 11.0104 (Informatics) and 11.0102 (Artificial Intelligence). Summarized in the table are the Fall 2021 PhD enrollments and the number of PhD degrees awarded in 2020-2021 by these programs.

Institution	CIP code	Enrollments	PhD's Awarded
Florida Atlantic University	11.0101	62	6
Florida International University	11.0101	88	13
Florida State University	11.0101	71	10
	11.0401	26	4
University of Central Florida	11.0101	184	30
University of Florida	11.0101	106	12
	11.0104	39	7
University of South Florida	11.0104	3	Not available
University of West Florida	11.0102	13	Not available

The chairs of the PhD programs in Computer and Information Sciences (with the CIP code of 11.0101) at the other System institutions were contacted in 2021 by the former Director of the UNF School of Computing, and those chairs indicated that they have no objection to the proposed program at UNF. No impact on these programs is expected.

F. If the proposed program substantially duplicates a program at Florida Agricultural and Mechanical University (FAMU), a letter of support from FAMU must be provided. The letter must address whether the proposed program may adversely affect FAMU's ability to achieve or maintain student diversity in its existing program. The institution's Equal Opportunity Officer shall review this section of the proposal, sign, and date the additional signature page to indicate that all requirements of this section have been completed.

FAMU does not offer the PhD in computing under the CIP code 11.0101 or other related CIP codes.

IV. Curriculum

A. Describe all admission standards and all graduation requirements for the program. Hyperlinks to institutional websites may be used to supplement the information provided in this subsection; however, these links may not serve as a standalone response. For graduation requirements, describe any additional requirements that do not appear in the program of study (e.g., milestones, academic engagement, publication requirements).

UNF Graduate School Admissions Requirements
The following are the minimum formal admissions requirements. Admission will be competitive and accepted applicants are expected to significantly exceed these standards.

- o GPA: 3.0 (B) for all upper-level courses
- o GRE: see School of Computing requirement below
- o TOEFL: 550 on paper-based; (213 on computer-based; 79 on Internet-based).
- o TOEFL may be substituted with:
  - IELTS with a minimum score of 6.5; or
  - Duolingo with a minimum score of 110
- o Official transcripts are required from every previously attended post-secondary institution
- o Applicants with coursework earned from institutions outside the United States are required to provide a course-by-course foreign college transcript evaluation of all attended non-U.S. institutions. The evaluation report that includes the overall academic GPA must be from an approved third-party accredited evaluation service

School of Computing Admissions Requirements
- GRE: GRE scores will be used in the context of a holistic credential review process. A strong performance is expected. For reference, the average accepted GRE scores are expected to be at least 150 on the verbal section and at least 155 on the quantitative section.
- If applicant has a graduate degree in Computing, graduate courses may be considered if the undergraduate GPA is less than 3.0.
- If the previously earned degree (undergraduate or graduate) were not in Computing, completion of the following background subjects at the undergraduate level is required for entry into the doctoral program.
  - Procedural and Object-Oriented Programming (COP3503)
  - Data Structures (COP3530)
  - Applied Discrete Structures (COT3100)
  - Databases (COP3703)
  - Computer Networks (CNT4504)

Grades of "B" or above are expected in any undergraduate preparatory course work.

PhD in Computing Program/Graduation Requirements
- o Successful completion of a minimum of 72 credits beyond the undergraduate degree
  - A minimum of 48 credits of graduate coursework
  - A minimum of 24 credits of doctoral dissertation research
- o Successful completion of the qualification process
  - A minimum of 36 credits hours with an average GPA of at least 3.0
  - A high-quality publication within the last 5 years
  - Review and approval of student portfolio of courses and publication by a departmental committee (different from the student's dissertation committee)
- o Successful completion of the candidacy process
  - Completion of the qualification process
  - Completion of a minimum of 6 credits of dissertation research
  - A written research proposal and presentation to the dissertation committee
  - Written answers to committee' s questions on the proposal within a specified timeframe after the presentation
- o Successful completion of the defense examination
  - Completion of the candidacy process
  - Completion of a minimum of 6 credits of dissertation research after the completion of the candidacy process
  - Submission of a dissertation describing research and results
  - An open-to-public presentation of research and results
  - Answering questions from the open presentation attendees (open part)
  - Answering questions from the dissertation committee (closed part)

B. Describe the specific expected student learning outcomes associated with the

proposed program and include strategies for assessing the proposed program's learning outcomes. If the proposed program is a baccalaureate degree, include a hyperlink to the published Academic Learning Compact and the document itself as Appendix C.

Student Learning Outcomes:
1. An ability to design, implement, and evaluate a computing-based solutions to problems arising in the physical, life, and social sciences, and engineering
2. An ability to conduct critical, in-depth literature reviews relevant to the computing discipline
3. An ability to use the techniques, skills, and tools necessary for computing practice at an advanced level in intelligent systems or cybersecurity
4. An ability to carry out independent research and document results
5. An understanding of professional and ethical responsibility
6. An ability to communicate effectively

The above outcomes have been adapted from the language that ABET-accredited undergraduate programs are expected to use in describing student learning outcomes.

The attainment of the above student learning outcomes will be assessed as follows:

- Attainment of outcomes 2, 5, and 6 will be assessed through CIS6913 Research Methods in Computing, which is a required course for all students.

- Attainment of outcomes 1, 3, and 4 will be assessed through evaluation by: a) the thesis supervisor each term; b) a committee evaluation during the qualification process; c) a committee evaluation during the candidacy process; and d) a committee evaluation at the final defense examination.

C. If the proposed program is an AS-to-BS capstone, provide evidence that it adheres to the guidelines approved by the Articulation Coordinating Committee for such programs, as outlined in State Board of Education Rule 6A-10.024. Additionally, list any prerequisites and identify the specific AS degrees that may transfer into the proposed program.

☒ **Not applicable to this program because it is not an AS-to-BS Capstone.**

D. Describe the curricular framework for the proposed program, including the following information where applicable:
- **total number of semester credit hours for the degree**
- **number of credit hours for each course**
- **required courses, restricted electives, and unrestricted electives**
- **a sequenced course of study for all majors, concentrations, tracks, or areas of emphasis**

The proposed PhD in Computing program will require a minimum of 72 credits beyond the undergraduate degree to be completed successfully. At least 48 credits of graduate courses work, and at least 24 credits of doctoral dissertation research will be required. The following provisions and conditions apply to satisfying these requirements:

- A student may transfer a maximum of 30 relevant graduate credits toward the coursework requirement. Students must apply for the credit transfer during their first term of enrollment. Graduate director approval is required.
- No coursework credits older than 10 years can be counted toward fulfilling the program requirements.

- A maximum of six credits of directed independent studies is allowed. Graduate Director approval is required.
- A graduate course in Research Methods in Computing (UNF's CIS6913 or equivalent from elsewhere) is required.
- For courses completed at UNF, a maximum of 6 credits can be at the 5XXX level. The remainder of the course work must be at the 6XXX or 7XXX level. Graduate director approval is required.
- The specific coursework that a student may complete will be determined based on the chosen concentration and the available course offerings each term for the first two years in the program. The remaining coursework will be determined in consultation with the student's thesis supervisor.

In addition to the coursework, each student will be required to complete a qualification process, a candidacy process, and the final defense examination. These aspects of the program are described below in the separate sections that are devoted to each.

Course Requirements
Students who have completed a Master's degree in a Computing-related discipline from another university may petition to have courses taken during their Master's degree count towards the required set of courses (described below). Such petitions will be accepted only after the Graduate Committee has determined that the outside course is similar in rigor and in scope to the equivalent course offered by the School of Computing. Graduate director approval is required for all graduate course registrations. Past 30 credits, students must consult with their PhD dissertation supervisor before seeking graduate director approval.

Courses Available for the Intelligent Systems Concentration
CAP5605 Introduction to AI
CAP6100 User Experience Design
CAP6610 Machine Learning
CAP6635 Advanced AI
CAP6768 Data Analytics
CAP6776 Info Retrieval & Text Mining
CAP6777 Data Mining
CIS5930 Special Topics in CIS
CIS6913 Research Methods in Computing
CIS6930 Special Topics in CIS
CIS7434 Emerging Topics in Intelligent Systems
CIS7980 Dissertation Research
COP5615 Operating Systems
COP6284 Programming for Data Science
COP6616 Parallel Computing
COT6405 Design & Analysis of Algorithms

Courses Available for the Cybersecurity Concentration
CEN6079 Secure Software Development
CEN6086 Cloud Computing
CIS5930 Special Topics in CIS
CIS6371 Applied Cryptography
CIS6372 Information Assurance
CIS6913 Research Methods in Computing
CIS6930 Special Topics in CIS
CIS7625 Emerging Topics in Cybersecurity
CIS7980 Dissertation Research
CNT5505 Computer Networks
CNT6167 Internet of Things

CNT6407 Internet Security
CNT6519 Wireless Network Security
CNT6707 Network Architecture
COP5615 Operating Systems
COP6611 Advanced Operating Systems

Other Courses Open to Both Concentrations
CEN6001 Software Requirements Engineering
CEN6016 Engineering of Software
CEN6036 Software Architecture
CEN6070 Software QA & Testing
CEN6940 Computing Practicum
CIS5949 Experiential Studies in Computing
CIS6900 Directed Individual Study
CIS7931 Computing Research Seminar
COT6416 Computational Complexity

All courses in the program will be 3-credit courses, with the exception of CIS6900 Directed Individual Study, CIS7931 Computing Research Seminar, and CIS7980 Dissertation Research, which will be variable-credit courses ranging from 1 to 3 credits.

Ph. D. Supervision
Every entering PhD graduate student must attend the UNF Computing New Graduate Student Orientation, usually given right before or at the beginning of Fall and Spring semesters. The student must form a dissertation committee and identify a dissertation supervisor, who is a Graduate Faculty member and will chair this committee, by the completion of 30 credits in the program (post Bachelor). The dissertation committee will consist of 4 members including the dissertation supervisor. One of the remaining three committee members may be from outside the School of Computing, including from another University/institution. All committee members should be familiar with the student's area of research. The dissertation supervisor plays a significant role in directing the dissertation research and the selection of the next 18 course credits of the student's program of study; 6 of these 18 credits may be DIS credits (thus the DIS courses are assumed to be taken after the completion of 30 credits).

The Qualification Process
A student becomes eligible for the qualification process upon completing 36 credits hours with an average GPA of at least 3.0, and a high-quality publication within the last 5 years preferably with a program faculty coauthor. Recent notices of acceptance will be considered. More specifically, the publication could be an article that appeared in a School-approved peer-reviewed journal or in the proceedings of a School-approved, peer-reviewed conference in the subject area under the student's chosen concentration. The publication could have resulted from the candidate's previous research as the principal author or coauthor/researcher. A graduate faculty committee appointed by the School Director in consultation with the graduate director and the student's PhD supervisor will oversee the qualification process. The committee will evaluate the student's research portfolio, including pertinent course grades and publications. During a given semester, if a student applies for the qualification process and does not receive a favorable opinion, he/she may re-apply in a subsequent semester. In other words, a student can go through the qualification process at most once per semester. If a student does not become qualified after two attempts, he/she will be eligible for suspension. Upon successful completion of the qualifying process, the qualified students are expected to register for at least 6 program applicable credits during each fall and spring term, with at least 3 dissertation credits. Students who successfully complete the qualification process must graduate within five academic years; else they will be eligible for suspension.

The Candidacy Process

Students may apply for candidacy with the supervisor's approval, after a committee has been assembled, after the qualifying process has been successfully completed, and after completing at least 6 dissertation research credits. The Graduate Director verifies the candidate's eligibility to apply for candidacy. The purpose of the PhD Candidacy process is to certify the scope and validity of the student's proposed research, and the student's ability to perform the work. The student submits a written Ph. D. proposal to his/her dissertation committee, and the committee schedules a presentation and discussion time. The student is given one or two questions by each committee member. Within a timeframe identified by the supervisor, the student will provide written answers to the questions. The committee members vote on the student's candidacy. The entire process is administrated by the supervisor. No later than two weeks after the beginning of the semester the graduate director is notified by the supervisor about the student's intention to seek candidacy that term. No later than one week before the end of the semester, the supervisor will notify the graduate director of the results of the candidacy vote. If the student's candidacy is denied, the student may apply for a second and final time in a future semester. The new application may involve a different committee composition. The student's dissertation committee will schedule an annual dissertation progress review meeting with the student upon successful completion of the candidacy process in order to ensure timely completion and final defense of the dissertation. Students who cannot pass the candidacy process after two attempts become eligible for suspension.

The Final Defense Examination

All PhD students are required to complete and defend a dissertation of publishable quality. This must be a product of an independent investigation, including a basic research component, that constitutes an original contribution to Computing. Projects that solely demonstrate an application of computer technology to a new problem area will not be acceptable. The format of the dissertation must conform to the requirements of the Graduate School. The dissertation must be submitted to the Graduate School in electronic form. Student must complete at least six dissertation credits after successful completion of the candidacy process before scheduling the defense of their dissertation research. The defense must occur after completion of research and all other work prescribed by the dissertation supervisor. The student must be registered for at least three hours of CIS7980 Dissertation Research during the term in which the defense is scheduled and the term in which the degree will be conferred. A draft of the dissertation must be submitted to all Dissertation Committee no later than 10 business days before the scheduled date of the defense. The dissertation title along with an abstract should be posted on electronic and standard bulletin boards at least two weeks in advance so that interested students and faculty may attend. A general-audience abstract along with an announcement must be submitted to the Graduate Director for posting. This information must be announced by the graduate director no later than 5 business days after receiving notification from the dissertation supervisor regarding the student's intent to defend.

The defense will consist of two parts: an open part and a closed part. During the open part, the student gives a one-hour presentation on the dissertation work. During this presentation, members of the audience may ask questions. Then the student's Dissertation Supervisor will ask the audience to leave the room to begin the closed section of the defense. The student's Dissertation Committee members and other faculty may ask the student more detailed questions during the closed section. The student will then leave the room while the Dissertation Committee prepares its decision. The dissertation must be approved by the committee, the School, and the graduate school. If the student's dissertation is not approved by the end of the semester in which he/she defends the dissertation, the student will be required to register for one credit hour of dissertation until the final submission of the dissertation or the time of graduation. The defense may be attempted at most two times.

Milestones
1. Transfer Credits
   Up to 30 credits from a prior master's degree in a Computing-related discipline taken either at UNF or from another accredited institution may be transferred and counted towards the PhD degree. Students must apply for the credit transfer during their first term of enrollment. An approval from the graduate school is necessary for the credit transfer.
2. Dissertation Committee
   The student must form a dissertation committee and identify a dissertation supervisor, who is a Graduate Faculty member and will chair this committee, by the completion of 30 credits in the program (post Bachelor).
3. Qualifying Process and Admission to Candidacy
   - A student becomes eligible for the qualification process upon completing 36 credits hours with an average GPA of at least 3.0, and a high-quality publication within the last 5 years preferably with a program faculty coauthor.
   - If a student does not become qualified after two attempts, he/she will be eligible for suspension.
   - Students may apply for candidacy with the supervisor's approval, after a committee has been assembled and after completing at least 6 dissertation research credits.
4. Dissertation Submission and Final Defense
   - Student must complete at least six dissertation credits after successful completion of the candidacy process before scheduling the defense of their dissertation research.
   - If the student's dissertation is not approved by the end of the semester in which he/she defends the dissertation, the student will be required to register for one credit hour of dissertation until the final submission of the dissertation or the time of graduation.
5. Time limitation
   - Completion within 5 calendar years after completion of the qualification process

For presenting a sequenced course of study, we consider three different scenarios: 1) a student admitted to the program has already obtained a master's degree in computing; 2) a student admitted to the program has obtained bachelor's degree in computing but not a master's degree; 3) a student admitted to the program has a bachelor's degree in a discipline outside of computing and has not fulfilled the undergraduate program prerequisites as listed on page 17 of this proposal.

In the best-case scenario 1), a student admitted to the program has already obtained a master's degree in computing, and has been approved to apply 30 credits worth of coursework from this master's degree to the PhD program. Such a student will be required take 18 credits of coursework at UNF, with the remaining 24 credits set aside for dissertation research. The sequenced course of study in the PhD program for both concentrations for this student would look like the one shown in Table A below.

TABLE A. Sequenced Course of Study for Student with a Master's Degree in Computing

	Fall	Spring	Summer
Year-1	9-credits coursework (including CIS6913)	3-credits coursework 3-credits DIS Qualification Process	
Year-2	3-credits DIS 6-credits CIS7980	6-credits CIS7980 Candidacy Process	
Year-3	6-credits CIS7980	6-credits CIS7980 Final Defense	

In case a student admitted to the program has completed a bachelor's degree in computing, they must complete a total of 72 credits, including 24 credits of dissertation research. The sequenced course of study in the PhD program for both concentrations for this student would look like the

one shown in TABLE B below.

TABLE B. Sequenced Course of Study for Student with a Bachelor's Degree in Computing

	Fall	Spring	Summer
Year-1	9-credits coursework (including CIS6913)	9-credits coursework	
Year-2	9-credits coursework	9-credits coursework	Qualification Process
Year-3	3-credits coursework 3-credits DIS 3-credits CIS7980	3-credits coursework 3-credits DIS 3-credits CIS7980	3-credits CIS7980 Candidacy Process
Year-4	6-credits CIS7980	6-credits CIS7980	3-credits CIS7980 Defense Examination

In case a student admitted to the program has completed a bachelor's degree in a non-computing discipline, they must complete the program prerequisites at the undergraduate level (listed on Page 17) prior to beginning with coursework related to the PhD program. The credits earned by taking the undergraduate prerequisites will not be applicable to the PhD program. The sequenced course of study in the PhD program for both concentrations for this student would look like the one shown in TABLE C below.

TABLE C. Sequenced Course of Study for Student with a Bachelor's Degree in Computing

	Fall	Spring	Summer
Year-1	COP3503 COT3100	COP3530 COP3703 CNT4504	
Year-2	9-credits coursework (including CIS6913)	9-credits coursework	
Year-3	9-credits coursework	9-credits coursework	Qualification Process
Year-4	3-credits coursework 3-credits DIS 3-credits CIS7980	3-credits coursework 3-credits DIS 3-credits CIS7980	3-credits CIS7980 Candidacy Process
Year-5	6-credits CIS7980	6-credits CIS7980	3-credits CIS7980 Defense Examination

Thus, the PhD program will require anywhere from 3 years to 5 years for completion, and for the purpose of enrollment projections and cost estimation, an average completion time is assumed as 4 years.

E. Provide a brief description for each course in the proposed curriculum.

CAP5605 Introduction to Artificial Intelligence
This course is intended for beginning graduate students lacking background in this area. Course topics include heuristic techniques for problem solving and decision making, control and search strategies, knowledge representation, logic, and AI languages and tools. Applications such as expert systems, natural language understanding, planning, and computer vision will be covered. Students will extend course topics via library assignments or other instructor-assigned requirements.

CAP6100 User Experience Design (3 credits)
This course covers user experience design concepts associated with the design, implementation, and evaluation of human/computer interfaces including interface devices, metaphors, and interaction styles. Topics covered include task analysis; dialog models and examples; design

thinking; contextual design and analysis; user-centered design including naive and expert user interfaces; interface development methodologies and implementation tools; interface testing and quality assessment.

CAP6610 Machine Learning (3 credits)
The course studies fundamental techniques and algorithms in machine learning. Introduces techniques like regression, classification, and clustering and describes the differences among them. The course also studies a variety of supervised and unsupervised learning algorithms including SVM, KNN, ANN, Q-Learning among others. The course also introduces the students to deep learning strategies. Evaluation techniques for any learning strategy are also discussed.

CAP6635 Advanced Artificial Intelligence (3 credits)
This course will provide in-depth coverage of uninformed and informed search strategies, thoughtful ways to represent knowledge, and incisive techniques that support rational decision making including under uncertainty. Application areas will include game playing, machine learning, natural language processing, and robotics.

CAP6768 Data Analytics (3 credits)
The aggressive rate of data growth has outpaced our ability to manually understand what data represents. Data is typically stored in database and files, and represented in different formats (structured, semi-structured, or no structure). Data analytics is the science of applying quantitative techniques to analyze data with the objective of discovering hidden knowledge and identifying interesting patterns. This course surveys a number of data preprocessing and sampling methods, data distributions and uncertainty, statistics, regression, time-series analysis, predictions and clustering. It introduces the characteristics and analytic challenges on dealing with clinical data from electronic health records. The course also covers emerging trends in Data Analytics and the applications of information technology in the healthcare. Statistical analyses and data mining techniques will be discussed along with methods for deploying these techniques using the open-source tools.

CAP6776 Information Retrieval and Text Mining (3 credits)
Information Retrieval (IR) and Text mining are increasingly important in this era where the use of textual data is growing in many different fields. This course will expose students to concepts and techniques of information retrieval and text mining including Retrieval models in IR, evaluation and language models, retrieval feedback, natural language processing, document representation, text classification, text clustering and labeling, document summarization, sentiment analysis, social network, and social media analysis, topic modeling, and text visualization. Students will also examine the applications and trends in text retrieval and mining.

CAP6777 Data Mining (3 credits)
This course is about mining knowledge from data in order to gain useful insights and predictions. The course will expose students to concepts and techniques of data mining, including data extraction, exploratory data analysis, visualization, association rules mining, classification and prediction, cluster analysis, and mining complex types of data. Students will also examine applications and trends in data mining. The course will include several coding projects in which students will implement mining algorithms.

CEN6001 Software Requirements Engineering (3 credits)
The course will examine the requirements phase of the Software Engineering lifecycle in detail. Topics will include requirements elicitation, requirements specification, requirements analysis and modeling, requirements prioritization, verification, and validation, requirements traceability, requirements management and requirements visualization.

CEN6016 Engineering of Software (3 credits)
This course will explore leading research in the field of software engineering (SE). Students will

acquire the knowledge needed to perform research or conduct practice in the field. Each class will cover research papers and topic presentations by the instructor and students. The majority of the course content will be drawn from the classic research papers and the current state-of-the-art in SE.

CEN6036 Software Architecture (3 credits)
This course addresses issues associated with large-scale Web application development including architectural design and documentation, and service-oriented computing technologies. In this course, students will gain an understanding of the concepts behind software architectures for large-scale Web-based systems as well as design, recognize, evaluate and document software architectures. The course would deepen students' understanding of service-oriented architecture. In particular, the course will focus on principles behind service-oriented software engineering, and approaches and methods for efficient service production in service ecosystems.

CEN6070 Software Quality Assurance and Testing (3 credits)
Topics covered in this course include: the quality of the software product; techniques with the stages of verification and validation; reliability; correctness, testing methods, coverage measures, testing specialized applications, formal verification, testing management techniques and support tools; team-oriented project used methods, techniques and practices learned.

CEN6079 Secure Software Development (3 credits)
This course provides an introduction and overview of security practices in software and systems engineering. Some of the topics covered are the characteristics of secure software, the role of security in the development lifecycle, designing secure software, risk analysis, threat modeling, defensive coding, penetration testing, static analysis, and best security programming practices.

CEN6086 Cloud Computing (3 credits)
This course investigates cloud computing models, techniques, and architectures. Cloud computing has evolved as a very important computing model, which enables information, software, and other shared resources to be provisioned over the network as services in an on-demand manner. Students will be exposed to the current practices in cloud computing. Topics may include distributed computing models and technologies, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), virtualization, security and privacy issues, performance and systems issues, capacity planning, challenges in implementing clouds, data centers, hypervisor CPU and memory management, Cloud OS, federated clouds, cloud hosted applications, and other advanced and research topics in cloud computing.

CEN6940 Computing Practicum (3 credits)
This practicum course allows students to gain valuable hands-on experience in the computing industry while earning credit towards their degree. This is a stand-alone, single-semester based course, which includes practical computing work under industrial supervision or instructor-guided exploration of a topic relevant to the industrial application of specific computing technology. Both instructor approval of a plan for the proposed work as well as a successful end-of-term presentation are required. Enrollment in more than one semester is allowed, but earned credit is applied in accordance with degree requirements.

CIS5930 Special Topics in Computer and Information Sciences (3 credits)
This course is reserved for beginning graduate students and advanced undergraduates. Topics are reflective of current faculty interests and advances in state-of-the-art computing not adequately addressed in current course offerings.
Repeatability: May be repeated up to 12 credits.

CIS5949 Experiential Studies in Computing (1 to 3 credits)
Students will participate in supervised work experiences related to computing. Up to 3 credits may be applied to the elective category for the Master of Science in Computing and Information

Sciences.
Repeatability: Students may receive repeat credit for this course.

CIS6371 Applied Cryptography (3 credits)
This course is about constructing practical cryptosystems for which we can argue security under plausible assumptions. The course covers many constructions for different tasks in cryptography. For each task, we define a precise security goal that we aim to achieve and then present constructions that achieve the required goal. A unified framework will be developed to analyze those constructions.

CIS6372 Information Assurance (3 credits)
An overview of techniques for ensuring and managing information security. Topics include administrative and technical security controls to prevent, detect, respond to, and recover from cyber-attacks; risk and vulnerability analysis to select security controls; security planning; security architecture; security evaluation and assessment; and legal, ethical, and privacy aspects of information assurance. The course also covers information security fundamentals, such as cryptography, authentication, and access control techniques, and their use in network, operating system, database, and application layers. Security issues of current importance are stressed.

CIS6900 Directed Individual Study (1 to 3 credits)
This course is reserved for advanced graduate students, on topics supportive of the student's overall program.
Repeatability: May be repeated with permission.

CIS6913 Research Methods in Computing (3 credits)
Students completing this course will be prepared to conduct research in the disciplines of computing and become better interpreters of research outcomes produced by others. The issues, concepts, methods, and techniques associated with scientific inquiry in general are covered, including qualitative and quantitative methods. An emphasis is placed on communication skills, creative thinking, problem-solving, and integration of knowledge. Students will select a research problem with the approval of the instructor, review the relevant literature, produce a pertinent prospectus draft, present the proposed work in an oral and/or poster presentation format, and review presentations of peers.

CIS6930 Special Topics in Computer and Information Sciences (3 credits)
This course is reserved for advanced graduate students. Topics are reflective of current faculty interests and advances in state-of-the-art computing not adequately addressed in current course offerings.
Repeatability: May be repeated up to 12 credits.

CNT5505 Computer Networks and Distributed Processing (3 credits)
This course is intended for beginning graduate students lacking background in this area. Topics include network architecture and protocols in computer communication networks, network elements and topology, switching and routing, and, data management and security in a distributed environment. Students will extend course topics via library assignments or other instructor assigned requirements.

CNT6167 Internet of Things
This course introduces the underlying network protocols for IoT communications, including rules regarding network architecture and design at the medium access and network layers. Short range wireless (e.g., Bluetooth, BLE, RFID, NFC, WiFi, LiFi), medium range wireless (e.g., IEEE 802.11ah HaLow), as well as, wired technologies (e.g., smart grid) are discussed. App development aspects of relevant technologies and their applications will be covered, as well.

CNT6407 Internet Security

This course provides an in-depth study of various techniques for network attacks and methods to defend against them. A number of threats and vulnerabilities of the Internet will be covered, including various vulnerabilities of TCP/IP protocols, denial of service (DOS), attacks on routing, attacks on DNS servers, TCP session hijacking, and so on. This course will also cover defense mechanisms, including intrusion detection, firewalls, tracing the source of attacks, anonymous communication, IPsec, virtual private network, and PKI.

CNT6519 Wireless Network Security
Wireless connectivity to servers and storage is becoming increasingly common these days. However, due to power, size and bandwidth limitations, the network and security management of wireless nodes have become fragile. As a starting point, wireless networks have adopted many security mechanisms from the wired world. But due to the inherent limitations, they are more vulnerable to attacks than the wired network. Threats like intercepting and unauthorized access to wireless traffic are real. More mature solutions to the security problems demand the need for understanding the current technologies and security flaws. (need to be changed to be consistent with other catalog course descriptions)

CNT6707 Network Architecture and Client/Server Computing
Topics covered in this course include: the technology and architecture of high-speed WANs and LANs including ATM, ATM-LANE, FDDI, fast and gigabit Ethernets; design and performance issues in high-speed networks; traffic analysis and queuing; resource allocation and congestion control; QoS parameters; RSVP and differentiated services; network security; wireless networks.

COP6284 Programming for Data Science
This course gives a broad overview of programming concepts for the data science field as well as a broad overview of the various aspects of data science process, methods, and techniques Students will gain an understanding on the data science lifecycle processes, and techniques and methods used for carrying out lifecycle activities. Students will learn how to manage and extract data from relational databases using SQL, how to write in programs in Python to conduct data science, and how to analyze data using R. This course provides a programming primer for working with and analyzing data. Students will be familiarized with essential programming tools used by practicing data scientists.

COP5615 Operating Systems
This course is intended for beginning graduate students lacking background in this area. Topics include process management, memory management, file management, input/output device management, and distributed systems issues. Students will extend course topics via library assignments or other instructor-assigned requirements.

COP6611 Advanced Operating Systems
For advanced graduate students. Advanced topics in operating systems such as network operating systems, distributed operating systems, distributed shared memory, object-based systems, distributed file access.

COP6616 Parallel Computing
In this course, topics covered include: parallel models and hardware architectures (shared-memory, message-passing, threads); basic communication operations; concurrency and synchronization techniques; parallel algorithms analysis and design; problem partitioning and mapping; parallel programming paradigms and environments; cluster-based computing; performance and scalability issues; parallel simulations; new trends in parallel computing.

COT6405 Design and Analysis of Algorithms
This graduate-level course in the design and analysis of algorithms will cover techniques for the design of algorithms and the theory of NP-completeness. The main topics covered in the course include dynamic programming; divide and conquer; union-find data structures; graph algorithms;

NP-completeness; and advanced topics.

COT6416 Computational Complexity
This is a course in structural complexity theory. The focus is on the models of computation and the structure and relationship among the important classes of computational problems such as P, BPP, NP, co-NP, and PSPACE. Results on the hardness of approximating optimization problems which follow from the PCP Theorem and the theory interactive proofs will be presented.

CIS7931 Computing Research Seminar (1 credit)
Topics reflect broader interests than covered in a standard course. Students will be expected to make presentations of material extracted from current trade publications. May be repeated up to 6 credits.

CIS7434 Emerging Topics in Intelligent Systems (3 credits)
This course is reserved for Ph. D. students, on topics from intelligent systems, reflective of current faculty research interests.
Repeatability: May be repeated up to 6 credits.

CIS7625 Emerging Topics in Cybersecurity (3 credits)
This course is reserved for Ph. D. students, on topics from cybersecurity, reflective of current faculty research interests.
Repeatability: May be repeated up to 6 credits.

CIS7980 Dissertation Research (1-6 credits)
Research for and writing of Ph. D. dissertation under direction of dissertation committee chair. May be repeated for credit.

F. For degree programs in medicine, nursing, and/or allied health sciences, identify the courses with the competencies necessary to meet the requirements in Section 1004.08, Florida Statutes. For teacher preparation programs, identify the courses with the competencies required in Section 1004.04, Florida Statutes.

> ☒ **Not applicable to this program because the program is not a medicine, nursing, allied health sciences, or teacher preparation program.**

G. Describe any potential impact on related academic programs or departments, such as an increased need for general education or common prerequisite courses or an increased need for required or elective courses outside of the proposed academic program. If the proposed program is a collaborative effort between multiple academic departments, colleges, or schools within the institution, provide letters of support or MOUs from each department, college, or school in Appendix D.

There is no anticipated impact on related academic programs or departments. Whenever needed, faculty members external to the School, College, or the University may serve on doctoral dissertation committees after a formal approval through the graduate school as it is currently practiced with the existing MS-CIS program.

H. Identify any established or planned educational sites where the program will be offered or administered. Provide a rationale if the proposed program will only be offered or administered at a site(s) other than the main campus.

The program will be offered and administered at the UNF main campus.

I. **Describe the anticipated mode of delivery for the proposed program (e.g., face-to-face, distance learning, hybrid). If the method(s) of delivery will require specialized services or additional financial support, describe the projected costs below and discuss how they are reflected in Appendix A – Table 3A or 3B.**

The delivery system for the program will be traditional delivery.

J. **Provide a narrative addressing the feasibility of delivering the proposed program through collaboration with other institutions, both public and private. Cite any specific queries of other institutions concerning shared courses, distance/distributed learning technologies, and joint-use facilities for research or internships.**

The proposed program is a research-based doctoral program and will be offered through faculty with expertise in intelligent systems and cybersecurity that are unique to UNF. Delivery of the program and/or specific courses through collaboration with other institutions is not anticipated.

K. **Describe any currently available sites for internship and/or practicum experiences. Describe any plans to seek additional sites in Years 1 through 5.**

☒ **Not applicable to this program because the program does not require internships or practicums.**

Students have the opportunity to earn academic credits for internships, but no internship is required for the program.

V. **Program Quality Indicators - Reviews and Accreditation**

A. **List all accreditation agencies and learned societies concerned with the proposed program. If the institution intends to seek specialized accreditation for the proposed program, as described in Board of Governors Regulation 3.006, provide a timeline for seeking specialized accreditation. If specialized accreditation will not be sought, please explain.**

ACM, IEEE, CSAB, and Computing Research Association (CRA) are relevant professional societies. There is currently no discipline-specific accreditation for graduate programs in Computing. However, the proposed program, like all programs at UNF, will be reviewed as part of the University's SACS accreditation process.

B. **Identify all internal or external academic program reviews and/or accreditation visits for any degree programs related to the proposed program at the institution, including but not limited to programs within the academic unit(s) associated with the proposed degree program. List all recommendations from the reviews and summarize the institution's progress in implementing those recommendations.**

ABET accredits BS level programs in Computing. UNF's BS programs in Computer Science, Information Systems, Information Science, Information Technology, and the BS-CIS program with concentration in Data Science are all ABET accredited, and the next review of these programs is anticipated in 2025. The most recent reviews of all these programs reported no deficiencies, weaknesses, or concerns.

The Master's degree program (MS-CIS), like all other programs at UNF, is reviewed as part of the University's SACS accreditation process. The most recent review of this program occurred in the summer of 2022. The observations and recommendations of the review are summarized below.

Observations:
- o The program is rooted in research but also helps students with industry jobs.
- o Need to create more incentives for faculty who mentor student projects and thesis.
- o Alumni are very proud of their affiliation.
- o The program is well balanced between research experience and hands-on practical skills.
- o The current concentrations are well selected to meet industry needs and allow interested students to pursue doctoral programs.
- o Program Strengths: 1) Faculty; 2) Alumni; 3) Curriculum
- o Excellent program in an area of growth and high demand for graduates.

Recommendations:
- ▪ The program can easily grow to attract more students with appropriate investment in faculty. However, it is also a competitive hiring market and although faculty are happy, faculty retention may be needed.
- ▪ Continue and increase support to leverage the current excellence and employer/alumni satisfaction.
- ▪ Additional support to faculty productivity can be achieved through more assistantships and better alignment of workload policies with research mentoring efforts.

The School will be filling three open positions next year. The School intends to leverage two endowments, namely the FIS Distinguished Professorship and the RF Smart Professorship, so that more competitive offers can be made to attract excellent candidates for the available faculty positions.

The School and the College are committed to continuous improvement, and maintain good relations and communication with alumni and receive feedback on industry needs. The College and the School also maintain good relationship with the local industry through advisory boards.

With UNF's recent classification as an R2 institution and its desire to expand research activity, it is anticipated support for enhancing faculty research productivity in terms of graduate assistantships will become increasingly available.

C. For appropriate degree programs, discuss how employer-driven or industry-driven competencies were identified and incorporated into the curriculum. Additionally, indicate whether an industry or employer advisory council exists to provide input for curriculum development, student assessment, and academic-force alignment. If an advisory council is not already in place, describe any plans to develop one or other plans to ensure academic-workforce alignment.

The School of Computing has a standing Computing Advisory Board (CAB) which meets at least twice a year to provide feedback on curriculum and performance of the graduates of the programs offered through the School. The CAB is populated by representatives of local companies. For the BS-level programs, the CAB periodically reviews Program Educational Objectives and makes recommendations for appropriate modifications based on industry-driven competencies. Such recommendations and the departmental action are documented and provided to the ABET review team at the time of the general review site visit. The CAB has been involved in discussions pertaining to the graduate programs as well, and the level of engagement can be expanded to include discussions on industry collaborations and discussions that could lead to potential research topics and additional faculty involvement with the PhD program as well.

VI. Faculty Participation

A. Use Appendix A – Table 2 to identify existing and anticipated full-time faculty who will participate in the proposed program through Year 5, excluding visiting or adjunct faculty. Include the following information for each faculty member or position in Appendix A – Table 2:

- **the faculty code associated with the source of funding for the position**
- **faculty member's name**
- **the highest degree held**
- **academic discipline or specialization**
- **anticipated participation start date in the proposed program**
- **contract status (e.g., tenure, tenure-earning, or multi-year annual [MYA])**
- **contract length in months**
- **percent of annual effort that will support the proposed program (e.g., instruction, advising, supervising)**

This information should be summarized below in narrative form. Additionally, provide the curriculum vitae (CV) for each identified faculty member in Appendix E. (All faculty CVs are included in Appendix I.)

The School of Computing will be comprised of the following faculty who will be contributing to the proposed PhD program.

- Sanjay Ahuja, Ph. D. Computer Science and Engineering, Professor
- Asai Asaithambi, Ph. D. Computer Sciences, Interim Director and Professor
- Mai Dahshan, Ph. D. Computer Science, Assistant Professor
- Ayan Dutta, Ph. D. Computer Science, Associate Professor
- Anirban Ghosh, Ph. D. Computer Science, Associate Professor
- Indika Kahanda, Ph. D. Computer Science, Assistant Professor
- Upulee Kanewala, Ph. D. Computer Science, Assistant Professor
- William Klostermeyer, Ph. D. Computer Science, CCEC Dean and Professor
- Xudong Liu, Ph. D. Computer Science, Associate Professor
- Kevin Pfeil, Ph. D. Computer Science, Assistant Professor
- Corey Pittman, Ph. D. Computer Science, Assistant Professor
- Zornitza Prodanoff, Ph. D. Computer Science and Engineering, Professor
- Sandeep Reddivari, Ph. D. Computer Science and Engineering, Associate Professor
- Swapnoneel Roy, Ph. D. Computer Science and Engineering, Associate Professor
- Karthikeyan Umapathy, Ph. D. Information Sciences and Technology, Associate Professor
- Iman Vakilinia, Ph. D. Computer Science and Engineering, Assistant Professor

In Table 2 provided in Appendix A, all faculty members listed above are coded as A – existing faculty on a regular line. A national search for filling two open faculty lines will be conducted during the academic year 2023-2024. Also, during the academic year 2023-2024, a national search for the School Director position will be conducted. These three participating faculty are coded as B – new hire on a vacant line.

B. Provide specific evidence demonstrating that the academic unit(s) associated with the proposed program has been productive in teaching, research, and service. Such evidence may include trends over time for average course load, FTE productivity, student HC in major or service courses, degrees granted, external funding attracted, and other qualitative indicators of excellence (e.g., thesis, dissertation, or research supervision).

The UNF School of Computing (School) is a department within the College of Computing, Engineering & Construction that has primary responsibility for all computing-related instruction at UNF at various levels. For undergraduate students, the School offers Bachelor of Science degrees in Computer Science, Information Systems, Information Science, Information Technology and Computing and Information Science-Data Science, and a minor in Computing. For graduate students, the School offers a research-focused Master of Science degree in Computing & Info Sciences with tracks in Computer Science, Cybersecurity, Data Science, and Information Systems. For graduate programs, students can select between a thesis option and a non-thesis option. All of the School's undergraduate programs are accredited by the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET), a non-governmental organization that accredits post-secondary education programs in applied and natural science, computing, engineering, and engineering technology. The School has 20 full-time faculty of which two also work as academic advisors, six part-time faculty, an office manager, and an administrative secretary. Summarized below as evidence of the School's productivity in teaching, research, and service, are some of the highlights of the School's accomplishments in recent years.

- The School's enrollments have been steadily increasing in both its undergraduate and graduate programs during the past three years. The following tables show the lower level, upper level, and graduate credit hours generated and the FTEs in the fall terms of 2020-2021 to 2023-2024 (the current year's data is not final yet).

Fall Credit Hours Generated

Year	Lower Level	Upper Level	Graduate
2020-2021	3003	4854	300
2021-2022	3147	5317	373
2022-2023	3516	5370	381
2023-2024	2952	5019	464

Fall FTEs

Year	Lower Level	Upper Level	Graduate
2020-2021	100.1	161.8	12.5
2021-2022	104.9	177.2	15.5
2022-2023	135.9	237.6	15.9
2023-2024	119.0	232.0	19.3

Also, the Fall undergraduate enrollment headcount has increased from 752 in Fall 2021 to 1010 in Fall 2022 (most recent available data). It is important to note that the graduate enrollments and FTEs have increased steadily during the past three years as well.

- The School awarded an average of 140 Bachelor's degrees and 20 Master's degrees in Computer and Information Sciences each year during the past five years.

- The School faculty have been diligently pursuing grant writing and securing research grants and contracts. For instance, during the past three years, the School faculty have attracted extramural funding at the level of $1,977,826 from federal programs and agencies, and at the level of $618,911 from institutional, state, and corporate funding sources and sponsors.

- In March 2023, Osprey Security, the student team representing the UNF School of Computing, won both first place and the "Best in Service" award at the 2023 Southeast Regional Cyber Defense Competition (SECCDC), as they competed against many other schools including Clemson University, Columbus State University, St. Petersburg College, the University of Central Florida, and the University of Southern Alabama. The teams were scored on their ability to detect and respond to outside threats, maintain the availability of existing services such as mail servers and web servers, respond to business requests such as the addition or

removal of additional services, and balance security needs against business needs.

- In May 2022, the School celebrated the opening of its new computer lab as part of the institution's ongoing partnership with local software company RF-SMART. The RF-SMART Intelligent Systems Lab, housed on the second floor of the John E. Mathews Jr. Computer Science Building (15), will provide 30 desktop computers and seat 49 students, an increase from the 22 seats previously available. RF-SMART Chairman Jorge Morales, along with CEO and President Michael Morales, spoke positively on the partnership UNF has made with their company, which has culminated into endowed scholarship and professorship programs, as well as job positions for graduates from the School.

- In 2020, the School received a $499,000 grant from the National Science Foundation for a research project focused on the use of autonomous robotics for agriculture in Northeast Florida. Led by Dr. Ayan Dutta of the School of Computing and Dr. Patrick Kreidl of the School of Engineering (with a courtesy appointment with the School of Computing), this project has Dr. Swapnoneel Roy of the School of Computing, and Dr. Ladislau Bölöni of the Computer Science Department at University of Central Florida as collaborators. This ongoing project investigates the use of a multi-robot system for efficient and secure agricultural information collection.

- During the period 2019-2021, Dr. Klostermeyer led an initiative entitled "Preparing Northeast Florida's Secondary Teachers to Foster Computational Thinking in Computer Science" under NSF's STEM+Computing program.

- In 2019, the National Security Agency and Department of Homeland Security designated the UNF School of Computing as a National Center of Academic Excellence in Cyber Defense Education. Institutions are selected for this designation based on their degree programs and alignment to specific cybersecurity-related curriculum knowledge units, validated by experts in the field.

- Since 2017, Dr. Karthikeyan Umapathy of the School of Computing and Dr. Dan Richard of the Psychology Department have been involved in organizing and running the Florida Data Science for Social Good (FL-DSSG) summer internship program. The mission of this program is to promote data-informed approaches and to partner with agencies in Florida to solve social problems by:
  o Working on data science projects in collaboration with agencies that serve a public good; and
  o Creating educational programs for aspiring data scientists to work on data science projects with social impact.
- During the past four years, the School faculty have collectively authored, co-authored with colleagues, or co-authored with students over 45 peer-reviewed journal publications, over 75 conference publications, and around 10 book chapters. A listing of selected faculty publications in each category since 2019 appears below.

Journal Articles
1. Ahuja, Sanjay, P., System Level Benchmarking of Public Clouds, *International Journal of Cloud Applications and Computing*, Volume 12, Issue 1, June 2023.
2. Krishnan, L. P., Vakilinia, I., Reddivari, S., & Ahuja, S. Scams and Solutions in Cryptocurrencies—A Survey Analyzing Existing Machine Learning Models, *Information*, 14(3), 171, March 2023.
3. Ahuja, Sanjay, P., and Wheeler, Nathan, An introduction to using blockchain for internet of things security, *International Journal of Blockchain and Cryptocurrencies*, Volume 2, no. 2, pp. 161-171. September 2021.
4. Ahuja, Sanjay, P., Czarnecki, E., and Willison, S., Multi-Factor Performance Comparison of Amazon Web Services Elastic Compute Cluster and Google Cloud Platform Compute

Engine, *International Journal of Cloud Applications and Computing, (IJCAC),* Volume 10, Issue 3, pp. 1-16, September 2020.

5. Ahuja, Sanjay, P., and Wheeler, N., Architecture of Fog-Enabled and Cloud-Enhanced Internet of Things Applications*, International Journal of Cloud Applications and Computing, (IJCAC*), Volume 10, Issue 1, October 2019.

6. A. Asaithambi. On Solving the Troesch Problem for Large Sensitivity Parameter Values Using Exact Derivative Evaluations. *International Journal of Applied and Computational Mathematics*, 8(202), 2022.

7. A. Asaithambi. On Solving the Nonlinear Falkner–Skan Boundary-Value Problem: A Review. *Fluids*, 6(4):153, 2021.

8. A. Asaithambi. Solution of Third Grade Thin Film Flow Using Algorithmic Differentiation. *International Journal of Applied and Computational Mathematics*, 6:74, 2020.

9. Dahshan, M. Youssef, Y., Poly, N, House, L., and Pollyea, R., Visual Exploration of High-Dimensional Spatialized Ensembles, In *Computers and GeoSciences*. (under review)

10. Dahshan, M., Poly, House, L., N., North, C., Pollyea, R., Turton, T. L., and Rogers, D. H., Human-Machine Partnerships at the Exascale: Exploring Simulation Ensembles Through Image Databases. (under review)

11. Mohamed, M.F., Dahshan, M., Li, K. and Salah, A., 2023. Virtual Machine Replica Placement Using a Multiobjective Genetic Algorithm. *International Journal of Intelligent Systems*, 2023.

12. Dahshan, M., Turton, T.L. and Polys, N., Exploration and Analysis of Image-based Simulation Ensembles, *EuroVis* (2022).

13. A. Dutta, E. Czarnecki, V. Ufimtsev, and A. Asaithambi. Correlation Clustering-Based Multi-Robot Task Allocation: A Tale of Two Graphs. *ACM SIGAPP Applied Computing Review*, 19(4):5–16, 2020.

14. A. Dutta, V. Ufimtsev, A. Asaithambi, and E. Czarnecki. Coalition Formation for Multi-Robot Task Allocation via Correlation Clustering. *Cybernetics and Systems*, 50(8):711–728, 2019.

15. J. Orr and A. Dutta. Multi-agent deep reinforcement learning for multi-robot applications: A survey. *Sensors*, 23(7):3625, 2023.

16. C. C. Escobar, S. Roy, O. P. Kreidl, A. Dutta, and L. Bölöni. Toward a green blockchain: Engineering merkle tree and proof of work for energy optimization. *IEEE Transactions on Network and Service Management*, 19(4):3847–3857, 2022.

17. A. Dutta, S. Roy, O. P. Kreidl, and L. Bölöni. Multi-robot information gathering for precision agriculture: Current state, scope, and challenges. *IEEE Access*, 9:161416–161430, 2021.

18. E. Czarnecki and A. Dutta. Scalable hedonic coalition formation for task allocation with heterogeneous robots. *Intelligent Service Robotics*, pages 1–17, 2021.

19. F. Anderson, A. Ghosh, M. Graham, L. Mougeot, D. Wisnosky, Bounded-degree plane geometric spanners in practice, accepted to the *ACM Journal of Experimental Algorithmics*, 2023.

20. A. Ghosh, R. Friederich, M. Graham, B. Hicks, R. Shevchenko, Experiments with Unit Disk Cover Algorithms for Covering Massive Pointsets. *Computational Geometry*, Elsevier, 2022. A preliminary version appeared in the proceedings of SEA 2019.

21. A. Dumitrescu, A. Ghosh, and C. D. Toth, Sparse Hop Spanners for Unit Disk Graphs, *Computational Geometry*, Elsevier, 2022. A preliminary version appeared in the proceedings of ISAAC 2020.

22. A. Dumitrescu, A. Ghosh, and C. D. T´oth, Online unit covering in Euclidean space, *Theoretical Computer Science*, Elsevier, 2020. Special issue with invited papers from the COCOA 2018 conference. A preliminary version appeared in the proceedings of COCOA 2018.

23. A. Bhattacharya, P. Dasgupta, A. Dutta, A. Ghosh, and O. P. Kreidl, Multi-robot informative path planning with continuous connectivity constraints, *International Journal of Advanced Robotic Systems*, 2020

24. I. Rupassara, J. Kindt, N. Kazi, and I. Kahanda, Challenges and Opportunities in Current Vaccine Technology and Administration: A Comprehensive Survey Examining Oral

Vaccine Potential in the United States, *Human Vaccines and Immunotherapeutics*, 2022. (journal h5-index: 62, Impact Factor: 4.526)

25. M. Pourreza Shahri and I. Kahanda, Deep semi-supervised learning ensemble framework for classifying co-mentions of human proteins and phenotypes. *BMC Bioinformatics*, 2021. (journal h5-index: 72, 5-year Impact Factor: 3.629)

26. N. Zhou, I. Kahanda and others, The CAFA challenge reports improved protein function prediction and new functional annotations for hundreds of genes through experimental screens. *Genome Biology*, 2019. (journal h5-index: 114, Impact Factor: 13.583)

27. Madhusudan Srinivasan, Mahadevan Subramaniam, Upulee Kanewala, Data Diversity based Metamorphic Relation Prioritization, Information and Software Technology, Under review.

28. Zedong Peng, Upulee Kanewala, Nan Niu, Metamorphic Relation Construction: How Do Scientific Software Developers Do It? IEEE Computing in Science and Engineering, Under review..

29. Kris Roker, Nan Niu, and Upulee Kanewala, Understanding Scientific Software Testing Process via GitHub Actions, IEEE Computing in Science and Engineering, Under review.

30. Madhusudan Srinivasan and Upulee Kanewala, Metamorphic Relation Prioritization for Effective Regression Testing, Software Testing, Verification and Reliability, 32(3), e1807, 2022.

31. W. Klostermeyer, M.E. Messinger, and A. Yeo. Dominating Vertex Covers: a searchlight problem, *Discussiones Mathematicae Graph Theory* 41(2021), 123-132.

32. Aiyin Jiang, Xudong Liu, Emily Czarnecki and Chengyi Zhang. Hourly Weather Data Projection due to Climate Change for Impact Assessment on Building and Infrastructure. *Sustainable Cities and Society* (SCS), 2019. Elsevier.

33. Xudong Liu and Miroslaw Truszczynski. Voting-based Ensemble Learning for Partial Lexicographic Preference Forests over Combinatorial Domains. *Annals of Mathematics and Artificial Intelligence (AMAI)*, 2019. Springer

34. W. D. Paredes, H. Kaushal, I. Vakilinia, Z. Prodanoff, LoRa Technology in Flying Ad Hoc Networks: A Survey of Challenges and Open Issues, *Sensors* 23 (5), 2403.

35. V. Lopez, H Kaushal, Z. Prodanoff, A. Jiang. Evaluation of communication delays in LoRaWAN networks for indoor emergency scenarios. *Journal of Communications Technology and Electronics*. 66 (Suppl 2), S149-S158

36. Zornitza Prodanoff, Cynthia White-Williams, and Hongmei Chi, "Standards Based Framework for Identifying and Recording m-Health App Vulnerabilities". *International Journal of E-Health and Medical Communications (IJEHMC),* 2021, vol. 12, issue 3, 1-16.

37. Genova, D., Hoogeboom, H.J. & Prodanoff, Z. Extracting reaction systems from function behavior. *J Membr Comput 2, 194–206 (2020).*

38. Reddivari, S., Bhowmik, T., & Hollis, C. (2019). Automated support to capture verbal just-in-time requirements via audio mining and cluster-based visualization. *Journal of Industrial Information Integration*, 14, 41-49.

39. S. Ariaeenejad, K. Kavousi, B. Zolfaghari, S. Roy, T. Koshiba, and S. G. Hosseini. Efficient bioconversion of lignocellulosic waste by a novel computationally screened hyperthermostable enzyme from a specialized microbiota. *Ecotoxicology and Environmental Safety*, 2023.

40. Richard, D., Rousseau, D., Umapathy, K., Pandya, H., Rousis, G., & Peeples, P. (Accepted for Publication). Exploring the Impact of a Trauma-informed Yoga and Mindfulness Curriculum for Multiple Populations: A Pilot Study. EXPLORE: The Journal of Science & Healing. https://doi.org/10.1016/j.explore.2023.05.007

41. Cheng, L., Umapathy, K., Rehman, M.S., Ritzhaupt, A.D., Antonyan, K., Shidfar, P., Nichols, P., Lee, M., and Abramowitz, B. (2023). Designing, Developing, and Validating a Measure of Undergraduate Students' Conceptions of Artificial Intelligence in Education. *Journal of Interactive Learning Research (JILR),* 34(2), 275-311.

42. Pascale, A.B., Richard, D., & Umapathy, K. (2021). Am I STEM? Broadening Participation by Transforming Students' Perceptions of Self and Others as STEM-Capable. Journal of Higher Education Theory and Practice, 21(7), 147-159.

43. Umapathy, K., Ritzhaupt, A.D., and Xu, Z. (2020). College Students' Conceptions of Learning of and Approaches to Learning Computer Science. *Journal of Educational Computing Research*, vol. 58 (3), pp.: 662 - 686.

44. Vakilinia, I., Wang, W., and Xin, J. "An incentive-compatible mechanism for decentralized storage network",
in *IEEE Transactions on Network Science and Engineering* 2023 IEEE.

45. Vakilinia, I., Faizian, P., and Khalili, M. M. "RewardRating: A Mechanism Design Approach to Improve Rating Systems", in *Games* 2022 MDPI.

46. Vakilinia, I. and Sengupta, S., "Vulnerability Market as a Public-Good Auction with Privacy Preservation", in *Computers & Security* 2020 Elsevier.

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<u>Book Chapters</u>
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VII. Estimate of Investment

A. Use Appendix A – Table 3A or 3B to provide projected costs and associated funding sources for Year 1 and Year 5 of program operation. In narrative form, describe all projected costs and funding sources for the proposed program(s). Data for Year 1 and Year 5 should reflect snapshots in time rather than cumulative costs.

The faculty effort needed to support the proposed PhD program will primarily consist of serving on students' committees for the qualification process, candidacy process, and supervision of dissertation research. The current teaching responsibilities of the faculty already include the teaching of graduate courses for the existing master's program that the PhD students might also take. The addition of a small number of PhD students in these courses will not increase the costs associated with faculty time. Current faculty members are already involved in supervising research for the master's students pursuing both the thesis and non-thesis options and offering special topics courses. The doctoral-level courses added to serve the PhD students are for dissertation research and emerging topics. Thus, the PhD program will continue to be staffed by existing UNF faculty as well as three new hires in the three currently vacant lines for which national searches will be conducted during the year 2023-2024. The program costs will not include costs associated with new faculty lines. However, three faculty members will contribute roughly 2% of their time to the PhD program in advising and mentoring the 3 PhD students admitted in Year 1. These costs are included under reallocation for Year 1. The number of faculty members involved will increase as the enrollment grows. For Year 5, 9 faculty members will be contributing 5% effort each in student support.

Additionally, as new recurring costs, two assistantships at the level of $12,500 each for each year, and programmatic costs (student travel, conference registration for students and other student support costs) at the level of $5,000 for each year, for a total of $30,000 in OPS costs will be included.

The increase from Year 1 to Year 5 in Faculty Salaries and Benefits due to compounded COLA

of 3% each year is used in the calculations. The cost of assistantships and student support will not be increased from one year to the next.

The E&G costs for the program, based on the % efforts indicated for each faculty in Appendix A, Table 2, and the new recurring programmatic costs including assistantships and student support costs included in OPS costs, have been estimated to be at the level of $36,279 in Year 1, equivalent to $16,124 per student FTE and $75,485 in Year 5, equivalent to $8,387 per student FTE in Year 5. A letter of support from the College Dean, indicating allocation of these new recurring programmatic costs, is included in Appendix M.

B. Use Appendix A – Table 4 to show how existing Education & General (E&G) funds will be reallocated to support the proposed program in Year 1. Describe each funding source identified in Appendix A – Table 4, and justify below the reallocation of resources. Describe the impact the reallocation of financial resources will have on existing programs, including any possible financial impact of a shift in faculty effort, reallocation of instructional resources, greater use of adjunct faculty and teaching assistants, and explain what steps will be taken to mitigate such impacts.

The proposed PhD program will leverage the existing inventory of computing graduate courses so that the PhD program may be immediately launched with no additional faculty time and effort required for the development of new courses. Also, the additional faculty effort needed to support the 3 students admitted in Year 1 will be distributed among 3 faculty members whose areas of expertise are in the concentrations proposed. The faculty effort will be needed to support the students in terms of onboarding, mentoring, and academic advising and estimated to be around 2% for each of the participating faculty members. Thus, the reallocation that will occur during Year 1 is based on 2% effort for 3 faculty members. This amounts to $6,279 based on their current salary and benefits. This information is presented in Appendix A – Table 4.

C. If the institution intends to operate the program as self-supporting, market tuition rate, or establish a differentiated graduate-level tuition, as described in [Board of Governors Regulation 8.002](), provide a rationale and a timeline for seeking Board of Governors' approval.

☒ **Not applicable to this program because the program will not operate as self-supporting, market tuition rate, or establish a differentiated graduate-level tuition**.

D. Provide the expected resident and non-resident tuition rate for the proposed program for both resident and non-resident students. The tuition rates should be reported per credit hour unless the institution has received approval for a different tuition structure. If the proposed program will operate as a continuing education program per [Board of Governors Regulation 8.002](), describe how the tuition amount was calculated and how it is reflected in Appendix A – Table 3B.

The program will charge its students the standard university graduate tuition and fees of $493.53 per credit hour ($408.10 in tuition and $85.43 in fees) for Florida residents and $1044.27 per credit hour ($408.10 in tuition, $524.51 in non-resident tuition, and $111.66 in fees) for nonresidents, based on the 2022/2023 UNF schedule of tuition and fees. The full breakdown of tuition and fees can be located [here.]()

E. Describe external financial and in-kind resources available to support the proposed program and explain how this amount is reflected in Appendix A –

Table 3A or 3B.

While securing external funding to support the operation of a Ph. D. program may present significant challenges in today's funding climate, several Computing faculty members have established a respectable track record of securing funding to support their research. The School has the Mathew Foundation support for specialized software and hardware purchase needs. Two additional endowed professorships, one from FIS and one from RF-SMART, are available on a competitive basis to support faculty in their research. More specifically, in addition to the assistantships included in the cost summary of this proposal, the startup packages offered to the new hires and the endowed professorship support may be used to provide full-time students with competitive assistantships and the space/equipment/software needed for them to pursue research on campus, as currently practiced in the School already. Finally, the School and the College engage actively with the industry in the region through Advisory Boards and work closely with the Office of Development to raise funds to establish scholarships and endowments, which in turn may be used to attract students and/or support faculty to advance their research.

At the present time, no external financial or in-kind resources that may be used to support this proposed program have been specifically identified and no specific amount is reflected in this category in Appendix A, Table 3A or 3B.

VIII. Self-Supporting and Market Tuition Rate Programs

Note: Skip this section If the proposed program will not operate as a self-supporting or market tuition rate program.

Proposed Program Type
☐ **Market Tuition Rate Program**
       ☐ **Online**
       ☐ **Continuing Education**
☐ **Self-Supporting Program**
☒ **N/A**

A. Provide supporting documentation in a separate attachment that serves as evidence that the new program will not supplant any existing similar or equivalent E&G degree offering. Describe the evidence in narrative form below. *Note that Board Regulation 8.002 considers a program similar if it is offered under the same CIP code as one funded under the E&G budget entity.*

B. If the proposed self-supporting or market tuition rate program will be a track under an existing E&G program or has a similar existing E&G program, provide a side-by-side tuition and fee comparison in the table below. Provide a link to the university's website that provides students with information about financial assistance and obligations for repayment of loans for these programs.

☐ **Not applicable because the program will not be a track under an existing E&G program or is not similar to an existing E&G program.**

Tuition and Fee Comparison

E&G Track or Program	Proposed Program

C. Explain whether the program leads to initial licensing or certification in occupational areas identified as a state critical workforce need. If so, which licenses and certifications will graduates receive upon completion, and explain why implementing the program as self-supporting or market tuition rate is the best strategy to increase the number of graduates in the state.

Note: Questions D – M pertain only to market tuition rate programs. If the proposed program will be self-supporting, skip to Section IX.

D. Explain the process used to determine the proposed market tuition rate and provide the tuition of similar programs offered by other SUS institutions and private institutions as appropriate so that the tuition of at least five similar programs is provided. If the proposed tuition rates differ for resident and non-resident students, explain why.

E. Explain how offering the proposed program at a market tuition rate is aligned with the university's mission. If the program qualifies as a Program of Strategic Emphasis, provide additional justification for charging higher tuition for the proposed program.

F. Provide a declaratory statement that offering the proposed program at the market tuition rate does not increase the state's fiscal liability or obligation.

G. Explain any proposed restrictions, limitations, or conditions to be placed on the program.

H. Explain how the university will ensure sufficient courses are available to meet student demand and facilitate program completion.

I. If applicable, provide a baseline of current enrollments, including a breakout of resident and non-resident enrollment in similar courses funded by the E&G budget entity.

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J. Describe any outcome measures that will be used to determine the program's success.

K. List the campuses and/or sites at which the proposed program will be offered. If the program is only offered online, indicate that, and provide the location from which the program will be managed.

L. Provide an estimate of the total and net annual revenue the university anticipates collecting for Years 1 and 5 if the proposal is approved. This information should be consistent with the data provided in Appendix A – Table 3B, which is required as a part of this proposal.

M. Describe how revenues will be spent, including whether private vendors will be utilized and for what purpose. Additionally, identify all budget entities used for the program.

IX. Non-Faculty Resources

A. Describe library resources currently available to implement and/or sustain the proposed program through Year 5 below, including but not limited to the following:
- the total number of volumes and serials available in the discipline and related disciplines
- all major journals that are available to the university's students

The Library Director must sign the additional signatures page to indicate they have reviewed Sections IX.A. and IX.B.

The UNF Thomas G. Carpenter Library Catalog has 7,978 volumes for the QA76 Call Number prefix, of which 1,680 items are available online. The library has electronic subscriptions to the ACM Digital Library and the IEEE Xplore Digital Library. UNF is also part of the Florida Academic Library Service Cooperative (FALSC), which makes the library collections of the other SUS universities and State Colleges available to faculty and students.

ACM Journals (both in-print and online, including an archive from 1950 forward)
Communications of the ACM
Computers in Entertainment*
Computing Reviews (print only)
Computing Surveys
Inroads
intelligence (archives only)
interactions
International Journal on Very Large Databases*
Journal of the ACM
Journal on Computing and Cultural Heritage

Journal on Data and Information Quality
Journal on Educational Resources in Computing (archives only - see Transactions on Computing
Education)
Journal of Emerging Technologies in Computing
Journal of Experimental Algorithmics*
Journal of Personal and Ubiquitous Computing
Linux Journal*

Transactions on
Accessible Computing
Algorithms
Applied Perception
Architecture and Code Optimization
Asian and Low-Resource Language Information Processing
Asian Language Information Processing (final issue December 2014)
Autonomous and Adaptive Systems
Computational Biology and Bio Informatics
Computational Logic
Computation Theory
Computer-Human Interaction
Computer Systems
Computing Education
Database Systems
Design Automation of Electronic Systems
Economics and Computation
Embedded Computing Systems
Graphics
Information and Systems Security
Information Systems
Intelligent Systems and Technology
Interactive Intelligent Systems
Internet Technology
Knowledge Discovery from Data
Management Information Systems
Mathematical Software
Modeling and Computer Simulation
Multimedia Computing, Communications, &
Applications
Networking
Parallel Computing
Programming Languages and Systems
Reconfigurable Technology and Systems
Sensor Networks
Software Engineering and Methodology
Storage
Web

IEEE Journals, Transactions, Letters, and Magazines
Access, IEEE
Aerospace and Electronics Systems Magazine, IEEE
Aerospace and Electronic Systems, IEEE Transactions on
Affective Computing, IEEE Transactions on
Annals of the History of Computing, IEEE
Antennas and Propagation, IEEE Transactions on

Antennas and Propagation Magazine, IEEE
Antennas and Wireless Propagation Letters, IEEE
Applied Superconductivity, IEEE Transactions on
Audio, Speech and Language Processing, IEEE Transactions on
Automatic Control, IEEE Transactions on
Automation Science and Engineering, IEEE Transactions on
Autonomous Mental Development, IEEE Transactions on
Bell Labs Technical Journal
Biomedical Circuits and Systems, IEEE Transactions on
Biomedical Engineering, IEEE Reviews in
Biomedical Engineering, IEEE Transactions on
Biomedical and Health Informatics, IEEE Journal of
Broadcasting, IEEE Transactions on
Circuits and Systems for Video Technology, IEEE Transactions on
Circuits and Systems I: Regular Papers, IEEE Transactions on
Circuits and Systems II: Express Briefs, IEEE Transactions on
Circuits and Systems Magazine, IEEE
Cloud Computing, IEEE Transactions on
Communications Letters, IEEE
Communications Magazine, IEEE
Communications Surveys and Tutorials, IEEE Communications Society
Communications, IEEE Transactions on
Components, Packaging and Manufacturing Technology, IEEE Transactions on
Computational Biology and Bioinformatics, IEEE/ACM Transactions on
Computer
Computer Graphics and Applications Magazine, IEEE
Computational Intelligence and AI in Games, IEEE Transactions on
Computational Intelligence Magazine, IEEE
Computational Social Systems, IEEE Transactions on
Computer Architecture Letters, IEEE
Computer-Aided Design of Integrated Circuits and Systems, IEEE Transactions on
Computers, IEEE Transactions on
Computer Graphics & Applications, IEEE
Computing in Science & Engineering Magazine, IEEE
Consumer Electronics Magazine, IEEE
Consumer Electronics, IEEE Transactions on
Control and Network Systems, IEEE Transactions on
Control Systems Technology, IEEE Transactions on
Control Systems Magazine, IEEE
Cybernetics, IEEE Transactions on
Dependable and Secure Computing, IEEE Transactions on
Design & Test of Computers, IEEE
Device and Materials Reliability, IEEE Transactions on
Dielectrics and Electrical Insulation, IEEE Transactions on
Display Technology, IEEE/OSA Journal of
Education, IEEE Transactions on
Electrical and Computer Engineering, Canadian Journal of
Electrification Magazine, IEEE
Electromagnetic Compatibility, IEEE Transactions on
Electromagnetic Compatibility Magazine, IEEE
Electron Device Letters, IEEE
Electron Devices, IEEE Transactions on
Electrical Insulation Magazine, IEEE
Electronic Materials, IEEE/TMS Journal of
Embedded Systems Letters, IEEE

Emerging and Selected Topics in Circuits and Systems, IEEE Journal of
Emerging Topics on Computing, IEEE Transactions on
Emerging and Selected Topics in Power Electronics, IEEE Journal of
Energy Conversion, IEEE Transactions on
Engineering Management, IEEE Transactions on
Engineering Management Review, IEEE
Evolutionary Computation, IEEE Transactions on
Fuzzy Systems, IEEE Transactions on
Geoscience and Remote Sensing Letters, IEEE
Geoscience and Remote Sensing Magazine, IEEE
Geoscience and Remote Sensing, IEEE Transactions on
Haptics, IEEE Transactions on
Human-Machine Systems, IEEE Transactions on
Image Processing, IEEE Transactions on
Industrial Electronics, IEEE Transactions on
Industrial Electronics Magazine, IEEE
Industrial Informatics, IEEE Transactions on
Industry Applications, IEEE Transactions on
Industry Applications Magazine, IEEE
Information Forensics and Security, IEEE Transactions on
Information Technology in Biomedicine, IEEE Transactions on
Information Theory, IEEE Transactions on
Instrumentation and Measurement, IEEE Transactions on
Instrumentation and Measurement Magazine, IEEE
Intelligent Systems, IEEE
Intelligent Transportation Systems, IEEE Transactions on
Intelligent Transportation Systems Magazine, IEEE
Internet Of Things Journal, IEEE
Internet Computing, IEEE
IT Professional
Knowledge and Data Engineering, IEEE Transactions on
Latin America Transactions, IEEE
Learning Technologies, IEEE Transactions on
Lightwave Technology, IEEE/OSA Journal of
Magnetics Letters, IEEE
Magnetics, IEEE Transactions on
Mechatronics, IEEE/ASME Transactions on
Medical Imaging, IEEE Transactions on
Micro, IEEE
Microelectromechanical Systems, IEEE/ASME Journal of
Microwave and Wireless Components Letters, IEEE
Microwave Magazine, IEEE
Microwave Theory and Techniques, IEEE Transactions on
Mobile Computing, IEEE Transactions on
MultiMedia, IEEE
Multimedia, IEEE Transactions on
NanoBioscience, IEEE Transactions on
Nanotechnology, IEEE Transactions on
Nanotechnology Magazine, IEEE
Network, IEEE
Network Science and Engineering, IEEE Transactions on
Network and Service Management, IEEE Transactions on
Networking, IEEE/ACM Transactions on
Neural Networks and Learning Systems, IEEE Transactions on
Neural Systems and Rehabilitation Engineering, IEEE Transactions on

Nuclear Science, IEEE Transactions on
Oceanic Engineering, IEEE Journal of
Optical Communications and Networking, IEEE/OSA Journal of
Parallel and Distributed Systems, IEEE Transactions on
Pattern Analysis and Machine Intelligence, IEEE Transactions on
Pervasive Computing, IEEE
Photonics Journal, IEEE
Photonics Technology Letters, IEEE
Photovoltaics, IEEE Journal of
Plasma Science, IEEE Transactions on
Potentials, IEEE
Power Delivery, IEEE Transactions on
Power & Energy Magazine, IEEE
Power Electronics Magazine, IEEE
Power Electronics, IEEE Transactions on
Power Systems, IEEE Transactions on
Proceedings of the IEEE
Professional Communication, IEEE Transactions on
Pulse, IEEE
Quantum Electronics, IEEE Journal of
Reliability, IEEE Transactions on
Robotics, IEEE Transactions on
Robotics & Automation Magazine, IEEE
Selected Areas in Communications, IEEE Journal on
Security and Privacy Magazine, IEEE
Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of
Selected Topics in Signal Processing, IEEE Journal of
Selected Topics in Quantum Electronics, IEEE Journal of
Semiconductor Manufacturing, IEEE Transactions on
Sensors Journal, IEEE
Services Computing, IEEE Transactions on
Signal Processing Letters, IEEE
Signal Processing, IEEE Transactions on
Signal Processing Magazine, IEEE
Smart Grid, IEEE Transactions on
Software Engineering, IEEE Transactions on
Solid-State Circuits, IEEE Journal of
Solid-State Circuits Magazine, IEEE
Software Magazine, IEEE
Spectrum, IEEE
Sustainable Energy, IEEE Transactions on
Systems Engineering and Electronics, Journal of
Systems Journal, IEEE
Systems, Man, and Cybernetics: Systems, IEEE Transactions on
Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on
Systems, Man and Cybernetics, Part B: Cybernetics, IEEE Transactions on
Systems, Man and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on
Technology and Society Magazine, IEEE
Terahertz Science and Technology, IEEE Transactions on
Translational Engineering in Health and Medicine, IEEE Journal of
Ultrasonics, Ferroelectrics and Frequency Control, IEEE Transactions on
Vehicular Technology, IEEE Transactions on
Vehicular Technology Magazine, IEEE
Very Large Scale Integration (VLSI) Systems, IEEE Transactions on
Visualization and Computer Graphics, IEEE Transactions on

Wireless Communications Letters, IEEE
Wireless Communications, IEEE Transactions on
Wireless Communications Magazine, IEEE
Women in Engineering Magazine, IEEE

B. Discuss any additional library resources needed to implement and/or sustain the program through Year 5. Describe how those costs are reflected in Appendix A – Table 3A or 3B.

☒ **Not applicable to this program because no additional library resources are needed to implement or sustain the proposed program.**

C. Describe any specialized equipment and space currently available to implement and/or sustain the proposed program through Year 5.

No specialized equipment and space are needed in order to implement or sustain the proposed program.

D. Describe any additional specialized equipment or space needed to implement and/or sustain the proposed program through Year 5. Include any projected Instruction and Research (I&R) costs of additional space in Appendix A – Table 3A or 3B. Costs for new construction should be provided in response to Section IX.E. below.

☒ **Not applicable to this program because no new I&R costs are needed to implement or sustain the program through Year 5**

E. If a new capital expenditure for instructional or research space is required, indicate where this item appears on the university's fixed capital outlay priority list. Appendix A – Table 3A or 3B includes only I&R costs. If non-I&R costs, such as indirect costs affecting libraries and student services, are expected to increase due to the program, describe and estimate those expenses in narrative form below. High enrollment programs, in particular, are expected to necessitate increased costs in non-I&R activities.

☒ **Not applicable to this program because no new capital expenditures are needed to implement or sustain the program through Year 5.**

F. Describe any additional special categories of resources needed to operate the proposed program through Year 5, such as access to proprietary research facilities, specialized services, or extended travel. Explain how those projected costs of special resources are reflected in Appendix A – Table 3A or 3B.

☒ **Not applicable to this program because no additional special categories of resources are needed to implement or sustain the program through Year 5.**

G. Describe fellowships, scholarships, and graduate assistantships to be allocated to the proposed program through Year 5 and explain how those are reflected in Appendix A – Table 3A or 3B.

☐ **Not applicable to this program because no fellowships, scholarships, and/or graduate assistantships will be allocated to the proposed program through**

Year 5.

Two graduate assistantships each year through Year 5 at the level of $ 12,500 each for a total of $ 25,000, and programmatic costs at the level of $5,000 each year through Year 5 will need to be allocated (as new recurring costs). These amounts are reflected in both Year 1 and Year 5 projected costs in Appendix, Table 3A.

X. Required Appendices

The appendices listed in tables 1 & 2 below are required for all proposed degree programs except where specifically noted. Institutions should check the appropriate box to indicate if a particular appendix is included to ensure all program-specific requirements are met. Institutions may provide additional appendices to supplement the information provided in the proposal and list them in Table 2 below.

Table 1. Required Appendices by Degree Level

Appendix	Appendix Title	Supplemental Instructions	Included Yes/No	Required for Degree Program Level		
				Bachelors	Masters/ Specialist	Doctoral/ Professional
A	Tables 1-4		Yes	X	X	X
B	Consultant's Report and Institutional Response		Yes			X
C	Academic Learning Compacts	Include a copy of the approved or proposed Academic Learning Compacts for the program	No, N/A	X		
D	Letters of Support or MOU from Other Academic Units	Required only for programs offered in collaboration with multiple academic units within the institution	No, N/A	X	X	X
E	Common Prerequisite Request Form	This form should also be emailed directly to the BOG Director of Articulation before submitting the program proposal to the Board office for review.	No, N/A	X		

F	Request for Exemption to the 120 Credit Hour Requirement	Required only for baccalaureate degree programs seeking approval to exceed the 120-credit hour requirement	No, N/A	X		
G	Request for Specialized Admissions Status	Required only for baccalaureate degree programs seeking approval for specialized admissions status	No, N/A	X		
H	Attestations for Self-Supporting and Market Tuition Rate Programs	Required only for self-supporting or market tuition rate programs	No, N/A		X	X
I	Faculty Curriculum Vitae		Yes	X	X	X

Table 2. Additional Appendices

Appendix	Appendix Title	Description
J	Letters of Support from outside of UNF	Support of Advisory Boards
K	Qualtrics Survey	Student/Alumni
L	Email inquiries/interests about PhD program	Students/Alumni
M	College Dean's Letter of Support	Programmatic Costs

Appendix A – Worksheet Tables 1-4

APPENDIX A
TABLE 3A
EROLLMENT AND GROWTH
PROJECTED COSTS AND FUNDING SOURCES

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Institutions should not edit the categories or budget lines in the table below. This table is specific to state-funded (E&G) programs, and institutions are expected to explain all costs and funding sources in Section VII.A. of the proposal. Detailed definitions for each funding category are located at the bottom of the table.															
2	Budget Line Item	Reallocated Base* (E&G) Year 1	Enrollment Growth (E&G) Year 1	New Recurring (E&G) Year 1	New Non-Recurring (E&G) Year 1	Contracts & Grants (C&G) Year 1	Philanthropy/ Endowments Year 1	Other Funding Year 1 - Please Explain in Section VII.A. of the Proposal	Subtotal Year 1	Continuing Base** (E&G) Year 5	New Enrollment Growth (E&G) Year 5	Other*** (E&G) Year 5	Contracts & Grants (C&G) Year 5	Philanthropy/ Endowments Year 5	Other Funding Year 5 - Please Explain in Section VII.A. of the Proposal	Subtotal Year 5
3	Salaries and Benefits (Faculty)	6,279	0	0	0	0	0	0	$6,279	45,485	0	0	0	0	0	$45,485
4	Salaries and Benefits (A&P and USPS)	0	0	0	0	0	0	0	$0	0	0	0	0	0	0	$0
5	OPS (including assistantships & fellowships)	0	0	25,000	0	0	0	0	$25,000	25,000	0	0	0	0	0	$25,000
6	Programmatic Expenses****	0	0	5,000	0	0	0	0	$5,000	5,000	0	0	0	0	0	$5,000
7	Total Costs	$6,279	$0	$30,000	$0	$0	$0	$0	$36,279	$75,485	$0	$0	$0	$0	$0	$75,485

8 *Identify reallocation sources in Table 4.
9 **Includes recurring E&G funded costs ("reallocated base," "enrollment growth," and "new recurring") from Years 1-4 that continue into Year 5.
10 ***Identify if non-recurring.
11 ****include library costs, expenses, OCO, special categories, etc.

Faculty and Staff Summary   **Calculated Cost per Student FTE**

Total Positions	Year 1	Year 5
Faculty (person-years)	0.045	0.3375
FTE (A&P and USPS)	0	0

	Year 1	Year 5
Total E&G Funding	$36,279	$75,485
Annual Student FTE	2.25	9
E&G Cost per FTE	16123.92444	8387.264444

18	**Table 3 Column Explanations**		
19	Reallocated Base* (E&G)	1	E&G funds that are already available in the university's budget and will be reallocated to support the new program. Please include these funds in the Table 4 – Anticipated reallocation of E&G funds and indicate their source.
20	Enrollment Growth (E&G)	2	Additional E&G funds allocated from the "Student and Other fees Tust Fund" contingent on enrollment increases.
21	New Recurring (E&G)	3	Recurring funds appropriated by the Legislature to support implementation of the program.
22	New Non-Recurring (C&G)	4	Non-recurring funds appropriated by the Legislature to support implementation of the program. Please provide an explanation of the source of these funds in the budget section (section VII.A.) of the proposal. These funds can include initial
23	Contracts & Grants (C&G)	5	Contracts and grants funding available for the program.
24	Philanthropy Endowments	6	Funds provided through the foundation or other Direct Support Organizations (DSO) to support the program.
25	Continuing Base** (E&G)	7	Includes the sum of columns 1, 2, and 3 over time.
26	New Enrollment Growth (E&G)	8	See explanation provided for column 2.
27	Other*** (E&G)	9	These are specific funds provided by the Legislature to support implementation of the program.
28	Contracts & Grants (C&G)	10	See explanation provided for column 5.
29	Philanthropy Endowments	11	See explanation provided for column 6.
30	Other Funding	12	Any funding sources not already covered in any other column of the table. Please provide an explanation for any funds listed in these columns in the narrative for Section VII.A. of the proposal.

APPENDIX A
TABLE 1-B
PROJECTED HEADCOUNT FROM POTENTIAL SOURCES
(Graduate Degree Program)

Source of Students (Non-duplicated headcount in any given year)*	Year 1 HC	Year 1 FTE	Year 2 HC	Year 2 FTE	Year 3 HC	Year 3 FTE	Year 4 HC	Year 4 FTE	Year 5 HC	Year 5 FTE
Individuals drawn from agencies/industries in your service area (e.g., older returning students)	1	0.75	2	1.5	3	2.25	4	3	4	3
Students who transfer from other graduate programs within the university**	0	0	0	0	0	0	0	0	0	0
Individuals who have recently graduated from preceding degree programs at this university	1	0.75	2	1.5	3	2.25	4	3	4	3
Individuals who graduated from preceding degree programs at other Florida public universities	0	0	0	0	0	0	0	0	0	0
Individuals who graduated from preceding degree programs at non-public Florida institutions	1	0.75	2	1.5	3	2.25	4	3	4	3
Additional in-state residents***	0	0	0	0	0	0	0	0	0	0
Additional out-of-state residents***	0	0	0	0	0	0	0	0	0	0
Additional foreign residents***	0	0	0	0	0	0	0	0	0	0
Other (Explain)***	0	0	0	0	0	0	0	0	0	0
Totals	3	2.25	6	4.5	9	6.75	12	9	12	9

*   List projected annual headcount of students enrolled in the degree program. List projected yearly cumulative ENROLLMENTS instead of admissions.

**   If numbers appear in this category, they should go DOWN in later years.

***   Do not include individuals counted in any PRIOR category in a given COLUMN.

APPENDIX A
Table 2
Anticipated Faculty Participation

Faculty Code	Faculty Name or "New Hire" Highest Degree Held Academic Discipline or Specialty	Rank	Contract Status	Initial Date for Participation in Program	Mos. Contract Year 1	FTE Year 1	% Effort for Prg. Year 1	PY Year 1	Mos. Contract Year 5	FTE Year 5	% Effort for Prg. Year 5	PY Year 5
A	Sanjay Ahuja, Ph. D. Engineering	Professor	Tenure	Fall 2025	9	0.75	0.00	0.00	9	0.75	0.00	0.00
A	Asai Asaithambi, Ph. D. Computer Science	Professor	Tenure	Fall 2025	9	0.75	0.00	0.00	9	0.75	0.00	0.00
A	Mai Dahshan, Ph. D. Computer Science	Assistant. Professor	Tenure Earning	Fall 2025	9	0.75	0.00	0.00	9	0.75	0.05	0.0375
A	Ayan Dutta, Ph. D. Computer Science	Associate Professor	Tenure	Fall 2024	9	0.75	0.02	0.015	9	0.75	0.05	0.0375
A	Anirban Ghosh, Ph. D. Engineering	Associate Professor	Tenure	Fall 2026	9	0.75	0.00	0.00	9	0.75	0.05	0.0375
A	Indika, Kahanda, Ph. D. Computer Science	Assistant. Professor	Tenure Earning	Fall 2025	9	0.75	0.00	0.00	9	0.75	0.05	0.0375
A	Upulee Kanewala, Ph. D. Computer Science	Assistant. Professor	Tenure Earning	Fall 2026	9	0.75	0.00	0.00	9	0.75	0.00	0.00
A	William Klostermeyer, Ph. D. Computing & Info Sciences	Professor	Tenure	Fall 2025	12	1.00	0.00	0.00	12	1.00	0.00	0.00
A	Xudong Liu, Ph. D. Computer Science	Associate Professor	Tenure	Fall 2024	9	0.75	0.02	0.015	9	0.75	0.05	0.0375
A	Kevin Pfeil, Ph. D. Computer Science	Assistant. Professor	Tenure Earning	Fall 2028	9	0.75	0.00	0.00	9	0.75	0.00	0.00
A	Corey Pittman, Ph. D. Computer Science	Assistant. Professor	Tenure Earning	Fall 2028	9	0.75	0.00	0.00	9	0.75	0.00	0.00
A	Zornitza Prodanoff, Ph. D. Computer Science and	Professor	Tenure	Fall 2027	9	0.75	0.00	0.00	9	0.75	0.00	0.00
A	Sandeep Reddivari, Ph. D. Computer Science	Associate. Professor	Tenure	Fall 2026	9	0.75	0.00	0.00	9	0.75	0.00	0.00
A	Swapnoneel Roy, Ph.D. Computer Science and Engineering	Associate Professor	Tenure	Fall 2024	9	0.75	0.02	0.015	9	0.75	0.05	0.0375
A	Karthikeyan Umapathy, Ph. D. Information Sciences and	Associate Professor	Tenure	Fall 2027	9	0.75	0.00	0.00	9	0.75	0.00	0.00

APPENDIX A
Table 2
Anticipated Faculty Participation

Code	Name / Department	Rank	Tenure Status	Term								
A	Iman Vakilinia, Ph.D. Computer Science and	Assistant. Professor	Tenure Earning	Fall 2027	9	0.75	0.00	0.00	9	0.75	0.05	0.0375
B	New Hire, Ph. D. Computer Science	Assistant Professor	Tenure Earning	Fall 2028	9	0.75	0.00	0.00	9	0.75	0.05	0.0375
B	New Hire, Ph. D. Computer Science	Assistant Professor	Tenure Earning	Fall 2028	9	0.75	0.00	0.00	9	0.75	0.05	0.0375
B	New Hire, Ph. D. Computer Science	Professor Director	Tenure	Fall 2028	12	1.00	0.00	0.00	12	1.00	0.00	0.00
	Total Person-Years (PY)							**0.045**				**0.3375**

Faculty Code	Code Description	Source of Funding	PY Workload by Budget Classification		
			Year 1		Year 5
A	Existing faculty on a regular line	Current Education & General Revenue	0.045		0.2625
B	New faculty to be hired on a vacant line	Current Education & General Revenue	0.00		0.075
C	New faculty to be hired on a new line	New Education & General Revenue	0.00		0.00
D	Existing faculty hired on contracts/grants	Contracts/Grants	0.00		0.00
E	New faculty to be hired on contracts/grants	Contracts/Grants	0.00		0.00
F	Existing faculty on endowed lines	Philanthropy & Endowments	0.00		0.00
G	New faculty on endowed lines	Philanthropy & Endowments	0.00		0.00
H	regular/tenure-track line course load	Enterprise Auxiliary Funds	0.00		0.00
		Overall Totals for	**0.045**		**0.3375**

APPENDIX A
TABLE 4
ANTICIPATED REALLOCATION OF EDUCATION GENERAL FUNDS*

Program and/or E&G account from which current funds will be reallocated during Year 1	Base before reallocation	Amount to be reallocated	Base after reallocation
Faculty Salaries and Benefits	2,971,829	6,279	$2,965,550
	0	0	$0
	0	0	$0
	0	0	$0
	0	0	$0
	0	0	$0
	0	0	$0
	0	0	$0
Totals	$2,971,829	$6,279	$2,965,550

* If not reallocating E&G funds, please submit a zeroed Table 4

Appendix B – External Consultant Report

STATE UNIVERSITY SYSTEM OF FLORIDA

Appendix B – Doctoral Program Proposal Consultant's Report and Response	

Instructions: Pursuant to Board of Governors Regulation 8.011, all institutions requesting Board of Governor's approval for a new doctoral-level program are required to submit a formal written review of the proposal by a qualified external academic consultant or for newly emergent fields where there are limited qualified experts, a cross-section of visiting experts. Institutions must submit a copy of the written review and a summary document describing how feedback was incorporated into the proposal or why feedback was not addressed. The format for the consultant's report and institutional response shall be determined by the individual institution submitting the proposal; however, both the review and the institutional response must be present and clearly identified.

Name of Consultant:	Dr. Donna S. Reese
Affiliation:	Mississippi State University
Qualification/Area of Expertise:	Professor Emerita – Department of Computer Science & Engineering
Date of Review:	September 26, 2023

In the space provided below, please list the recommendations provided by the external consultant and fully explain how those recommendations were or were not incorporated into the full proposal. For recommendations that were not incorporated, please provide an explanation.

External Consultant Comments/Suggestions and Institutional Response

The external consultant review points out several significant strengths of the proposal, including how: 1) individuals in the northeast Florida region who are interested in a PhD program would be well served by the proposed PhD program; 2) the program includes a meaningful set of prerequisite courses that will prepare candidates with no background in computing without unnecessarily delaying their entrance into the program; and 3) the proposed program should provide a strong economic payback for this region of the state in the emphasis areas of intelligent systems and cybersecurity which are both currently areas of national need.

The institutional responses to the external reviewer's suggestions to strengthen the proposal are provided below.

Consultant's Suggestion 1:
    A. Take into consideration that students might be entering the program with bachelor's degrees or master's degrees in computing when projecting the rate of degree production.
    B. Provide separately sequenced coursework details for students entering the program with different background preparation in computing.

Institutional Response 1: Revised tables describing sequenced coursework for the proposed program are now provided on Pages 22 and 23 of the proposal. These tables show that students entering with a master's degree in computing are expected to complete the program in 3 years; students entering the program with a bachelor's degree in computing but not a master's degree are expected to complete the program in 4 years; and students entering the program with a bachelor's or master's degrees in a discipline outside of computing are expected to complete the program in 5 years. For purposes of determining degree completion timelines and cost estimates, an average completion time of 4 years has been assumed.

Consultant's Suggestion 2: Clarify what is meant by "quality publication" in the qualification process.

Institutional Response 2: The following sentence is now added to the proposal on Page 20 of the proposal, after the first sentence under the paragraph titled "Qualification Process."

> More specifically, the publication could be an article that appeared in a School-approved peer-reviewed journal or in the proceedings of a School-approved conference in the subject area under the student's chosen concentration. The publication could have resulted from the candidate's previous research as the principal author or coauthor/researcher.

Consultant Suggestion 3: Add information on how student progress will be regularly reviewed once the student reaches candidacy status and starts working on the dissertation.

Institutional Response 3: The following sentence is now added to the proposal on Page 21 of the proposal, immediately preceding the last sentence under the paragraph titled "Candidacy Process."

> The student's dissertation committee will schedule an annual dissertation progress review meeting with the student upon successful completion of the candidacy process in order to ensure timely completion and final defense of the dissertation.

Consultant Suggestion 4: Include information on how the set-up for the current MS program can absorb the additional relatively small number of PhD students with no additional cost.

Institutional Response 4: The following text has been added to the proposal on Page 41 of the proposal (Section VII-A):

> The faculty effort needed to support the proposed PhD program will primarily consist of serving on students' committees for the qualification process, candidacy process, and supervision of dissertation research. The current teaching responsibilities of the faculty already include the teaching of graduate courses for the existing master's program that the PhD students might also take. The addition of a small number of PhD students in these courses will not increase faculty effort or the costs associated with the faculty time. Current faculty members are already involved in supervising research for the master's students pursuing both the thesis and non-thesis options, and offering special topics courses. The doctoral-level courses added to serve the PhD students are for dissertation research and emerging topics.

<u>Consultant Suggestion 5</u>:
    A. Include information on the current status and the institutional commitment to ensuring competitive stipends for full-time students to engage in the program and carry out research on campus.
    B. Include information on current status and the institutional commitment to ensuring the research space needed for full-time students to engage in the program and carry out research on campus.

<u>Institutional Response 5</u>: The following text has been added on Page 43 of the proposal (Section VII-E):

> The School has the Mathew Foundation support for specialized software and hardware purchase needs. Two additional endowed professorships, one from FIS and one from RF-SMART, are available on a competitive basis to support faculty in their research. More specifically, in addition to the assistantships included in the cost summary of this proposal, the startup packages offered to the new hires and the endowed professorship support may be used to provide full-time students with competitive assistantships and the space/equipment/software needed for them to pursue research on campus, as currently practiced in the School already.

September 26, 2023

Dr. Asai Asaithambi
Interim Director and Professor
School of Computing
University of North Florida
Jacksonville, FL 32224

Dr. Asaithambi:

This letter is to provide my review of the proposal for a Doctor of Philosophy in Computing program at the University of North Florida. This review is based on the draft proposal provided to me on August 31, 2023, and a follow-up hour-long zoom conference with you and Dean Chip Klostermeyer on September 21, 2023, where I received additional clarifications in answer to questions that I had when reviewing the proposal.

In reviewing this proposal, I find the following aspects to be particularly strong and to make a compelling argument for approval of this program:

- Although the state of Florida has other institutions that offer PhD programs in computing, the state is geographically large with a large population. The current PhD offerings, while geographically distributed in the state, do not cover the northeast part of the state where the University of North Florida is located. UNF already has a strong master's program in computing that is strongly supported by students from local industry. It seems natural that a percentage of these students would be interested in continuing their education in a doctoral program and would be well served by an offering in this geographic region. Indeed, the support letters from local industry as well as the survey results from current enrolled students and UNF alumni support this argument.

- The proposal recognizes the importance of providing access to this program for students who may not have an academic background in computing. In the two areas of emphasis of this proposed program, Intelligent Systems and Cybersecurity, it is not uncommon for students with a different educational background to find themselves needing additional knowledge and skills in these areas as they relate to their application area. The provision for a streamlined entry into this program for these students will make it attractive to a much larger population. The program has defined a meaningful set of prerequisite courses that will prepare these candidates for work in this area without unnecessarily delaying their entrance into the program.

- The two areas of emphasis of the proposed program are both currently areas of national need. The addition of this offering to help address this knowledge gap should provide a strong economic payback for this region of the state. The

665 George Perry Street | 300 Butler Hall | P.O. Box 9637 | Mississippi State, MS 39762 | P. 662.325.2756 | **cse.msstate.edu**
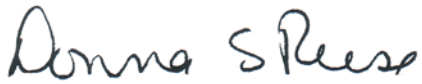
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program has strong faculty in this area and the PhD program should provide stronger links to local employers in these areas and enhance opportunities for collaborations between program faculty and local industry researchers.

I provide the following questions and comments to allow the program to consider ways that this proposal might be further strengthened.

- The proposal needs to consider that students entering the PhD without a prior MS degree will likely take longer than 4 years to complete the program and this will impact the pipeline of graduates. They may want to consider this aspect in their degree completion rate if a large percentage of the admitted students are expected to be admitted without a previous MS degree.

- The proposal may want to spell out more details in what is considered a "high-quality publication" for the qualification process. In particular, including additional information about whether or not publications that are co-authored, written as a result of previous research work and/or presented in quality conferences will satisfy this requirement. Since this requirement is before the beginning of the student's PhD research, these specifics will help students to better understand this requirement.

- The program may want to consider having a process for review of progress for students each year who have completed the candidacy process and are working towards their dissertation. This can help make sure that students do not get significantly side-tracked at that stage of the program and is common in other PhD programs.

- The program may want to clarify that the table on page 21 that shows the sequence of coursework is focused on students who have completed an MS before admission to the PhD. They may want to develop a similar sequence for students admitted without a previous MS as well if this is expected to be a common occurrence.

- The program makes an argument about the limited cost in terms of faculty workload for the addition of this program. That argument was strengthened by the discussion in our zoom call by additional information about the set-up for the current MS program and the capacity of those processes to absorb this relatively small number of students. You may want to include this information in the proposal.

- Adequately resourced assistantships will be necessary to attract quality students into this program. Since students currently working in local industry may not need this support, the level of support on average may be lower. However, the program will need to ensure that the stipends for those students pursuing full-time academic work is sufficient to be competitive. Start-up packages for new faculty could provide some of these resource requirements.

- Adequate space for full-time students conducting research on campus will be needed as well to allow for the high level of faculty/student interaction in research that is normally part of a PhD program. It seems that such space may already be available on campus, again as part of startup lab space allocated to faculty. The program may want to provide this information in the proposal as well.

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Overall, this is a strong proposal and I believe that the program will provide opportunities to the citizens and employers within the region supported by UNF. In addition, the approval of this program will strengthen the research opportunities for UNF faculty.

Sincerely yours,

Donna S. Reese
Professor Emerita

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Appendix J – Letters from Industry Partners

State University System of Florida   September 10, 2023
Attn: Board of Governors
325 West Gaines Street, Suite 1614
Tallahassee, Florida 32399

Subject: University of North Florida's Doctor of Philosophy in Computing

Dear Board of Governors,

The proposed Doctor of Philosophy in Computing at the School of Computing (School) at the University of North Florida (UNF) will provide advanced, research-based education and is of great importance to the business leaders and members of the Computing Advisory Board (CAB) of UNF's School of Computing.

The CAB members strongly support the School's proposal to offer the Doctorate degree in intelligent systems and cybersecurity.   This endorsement from the CAB includes support from the enclosed list of industry representatives from Jacksonville's technology industry and leading logistics, healthcare, financial technology, and advanced manufacturing businesses in Florida.

The CAB strongly believes that the proposed program will:
1) Empower the School's currently research-active faculty in the areas of cybersecurity and intelligent systems to attract competitive funding from federal agencies and corporations;
2) Enable UNF to achieve its goal of becoming an institution with very high research activity;
3) Provide a convenient, high-quality, viable option for industry professionals in Jacksonville area to pursue a research-based advanced degree without having to leave home; and
4) Contribute to the economic development of the Northeast Florida region.

The CAB has served as advisors to the School's academic programs and has been active participants in the accreditation and student educational activities for over two decades.   Therefore, we respectfully request your support and approval of the proposed program to fill critical unmet needs for both traditional students as well as working professionals seeking an advanced degree in computing in Northeast Florida.

We appreciate your support in this matter. Please contact me with any additional questions.

Sincerely,

James Simak
Chair, Computing Advisory Board
School of Computing
University of North Florida

Acosta
Chris Gay
6600 Corporate Center Pkwy
Jacksonville, FL 32216

AllState
John Foley
1776 American Heritage Life Dr.
Jacksonville, FL 32224

Black Diamond
Josh Bergen
9000 Southside Blvd #7500, Building 700
Jacksonville, FL 32256

CSI Companies
Melissa Fullmore-Hardwick
7720 Baymeadows Rd E
Jacksonville, FL 32256

Guidewell Source
Jon West
532 Riverside Avenue
Jacksonville, FL 32202

Harris Computer (Retired)
Dr. James Simak
8714 Ethans Glen Ter
Jacksonville, FL 32256

IBM
Khwaja Shaik
4601 Touchton Rd E Ste 4120
Jacksonville, FL 32246

Tokio Marine HCC
Joe Zemel

Interactive Resources
Mark Puskar
6420 Southpoint Parkway, Suite 110
Jacksonville, FL 32216

JEA
Bradley Krol
21 Church St W
Jacksonville, FL 32202

NLP Logix
Matt Berseth
4215 Southpoint Blvd #140
Jacksonville, FL 32216

Northeast Florida Regional STEM2 Hub
Kathleen Schofield

Pragmatic Works
Brian Knight
7175 Hwy 17 #2
Fleming Island, FL 32003

RF-SMART
John Marinatos
3563 Phillips Highway, Suite F-601
Jacksonville, FL 32207

SailPoint
Marilyn Thornton
11120 Four Points Drive, Suite 100
Austin, TX 78726

Vaco
David Reichard
10752 Deerwood Park Blvd #100
Jacksonville, FL 32256

Ventra Health
Craig Pichanick
4932 Sunbeam Rd Ste 100
Jacksonville, FL 32257

VyStar
Lisa Cochran
76 S. Laura St
Jacksonville, FL 32202

9/11/2023

State University System of Florida
Attn: Board of Governors
325 West Gaines Street, Suite 1614
Tallahassee, Florida 32399

Subject: University of North Florida's Doctor of Philosophy in Computing

To Whom it May Concern;

I am writing in my capacity as a member of the Computing Advisory Board (CAB), a committee comprised of distinguished professionals in the IT sector within Jacksonville, in strong endorsement of the School of Computing at the University of North Florida (UNF).

As a key player in Florida's technology and business sectors, I fully endorse the School's initiative to introduce a PhD degree program in Computing, focusing on intelligent systems and cybersecurity. I am convinced that the implementation of this program will:

- Amplify the existing capabilities of the faculty, particularly in cybersecurity and intelligent systems, thereby increasing the potential for competitive grants from governmental agencies and private corporations.
- Contribute to workforce development by producing highly skilled graduates who are prepared to assume leadership roles in the fast-evolving tech industry.
- Assist UNF in realizing its ambition to be recognized as a high-research-activity institution.
- Enhance the reputation and visibility of both the School and UNF on a national and international level, attracting top-tier talent and increasing enrollment rates.
- Offer local professionals in the Jacksonville area an accessible, top-tier opportunity to obtain a research-intensive advanced degree without the necessity of relocating.
- Positively influence the economic growth of the Northeast Florida region.

Thank you for your support and consideration in this matter.

Sincerely,

Matt Berseth
CAB Member
Co-founder & Chief Information Officer NLP Logix

PGIM Real Estate
Dale Johnston
655 Broad Street
Newark, NJ 07102
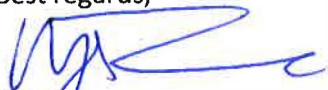pgimrealestate.com

September 1, 2023

To Whom It May Concern,

I am pleased to write this letter of support on behalf of many leaders of our community that are engaged as members of the Dean's Leadership Council for the College of Computing, Engineering, and Construction at the University of North Florida.

We fully support the proposal from the UNF School of Computing for the creation of a Ph.D. degree. We feel this program will benefit the School, the College, UNF, and the greater Jacksonville region. There is no doubt that we will benefit from many new opportunities in research, for our students, faculty, and community, and be a great step forward for the University of North Florida.

I have received written acknowledgements of support from the following:

Aarron Bowman, SVP, JAX-USA Partnership
Batey McGraw, VP, Dreamfinders Homes
Bernie Rice, CIO, Nemours
Dan Brown, Chairman, Miller Electric
Eric Wendell, Retired Head of Quality Management, Mercedes-Benz USA
Jim Horton, Senior Project Manager, WSP Global
John Marinatos, VP, RF-SMART
Len O'Neill, CIO, Suddath Companies
Mark Trednick, CIO, Haskell
Michael Manos, Chief Technology Officer, Dun & Bradstreet
Morgan County, VP, RS&H
Pete Sheridan, VP, VIA Consulting Services
Richard Lovelace, EVP, Stellar
Richard White, M.D., Medical Director - Center for Augmented Intelligence in Imaging, Mayo Clinic
Rob Blair, EVP of Payments, Ministry Brands
Ryan Schmitt, CEO, Petticoat Schmitt
Scott Parker, President, Elkins Construction
Shantih Spanton, Ph.D., Manager and Lead Senior Scientist, CSX
Shawn Barnett, Executive Vice President, England - Thims & Miller
Todd Renaud, CIO, Southeastern Grocers
Yolande Piazza, VP Financial Services, Google Cloud

Best regards,

Dale Johnston
Managing Director & Global Chief Information Officer
PGIM Real Estate
701 San Marco Blvd., 7th Floor, Jacksonville, FL 32207
E: dale.johnston@pgim.com M: 803-348-3113

Appendix K – Student Interest Survey

Default Question Block

Would you be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with concentration in Intelligent Systems/Artificial Intelligence at UNF sometime in the future?

○ Yes
○ Maybe
○ No

Do you know any non-UNF students who may be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with concentration in Intelligent Systems/Artificial Intelligence at UNF sometime in the future?

○ Yes
○ Maybe
○ No

Would you be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with concentration in Cybersecurity at UNF sometime in the future?

○ Yes
○ Maybe
○ No

Do you know any non-UNF students who may be interested in pursuing a PhD (Doctor of Philosophy) degree in Computing with concentration in Cybersecurity at UNF sometime in the future?

◯ Yes
◯ Maybe
◯ No

Would you like more information about this PhD program in Intelligent Systems/Artificial Intelligence and Cybersecurity concentrations?

◯ Yes
◯ Maybe
◯ No

If interested in UNF's new PhD in Computing degree program, please provide which concentration you will be most interested?

◯ Intelligent Systems/Artificial Intelligence
◯ Cybersecurity

If interested in UNF's new PhD in Computing degree program, please provide your email address

[   ]

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Appendix L – Student Interest Emails

From:	Amitabh Bhattacharya <a.bhattacharya.ml@gmail.com>
Sent:	Monday, August 28, 2023 10:34 AM
To:	Asaithambi, Asai
Subject:	Sincere interest in enrolling for newly planned Ph.D. program at SoC, UNF

Dear Dr. Asai Asaithambi,

I hope you are doing well. I want to thank you for working on a proposal to offer for the Ph.D. program in the School of Computing at the University of North Florida.

As a proud alumnus of UNF, I am writing to express my sincere and enthusiastic interest in this newly planned Ph.D. program. As I immensely benefited from the knowledge and guidance imparted by SoC during my master's, I am keen to re-engage here and pursue my Ph.D. program. The prospect of enrolling in advanced research under the mentorship of esteemed faculty members is something I find highly appealing. I am particularly intrigued by the program's plan to include thesis areas like cyber security and Intelligent systems.

As someone deeply passionate about cyber security, I have been actively involved in this field for several years. My academic journey, combined with hands-on experience in various roles, has solidified my desire to pursue advanced research and contribute significantly to the domain.

Furthermore, the faculty members at UNF, especially Dr. Swapnoneel Roy, renowned for their expertise and contributions to cybersecurity research, greatly inspire me. Their diverse backgrounds and active involvement in cutting-edge projects further motivate me to join your program. Moreover, the state-of-the-art facilities, research centers, and industry partnerships that UNF offers present an exceptional environment for academic growth and exploration. The opportunity to work alongside fellow passionate students and engage in practical research that addresses real-world cybersecurity challenges is exactly what I am seeking in a Ph.D. program.

I am confident that the rigorous curriculum, supportive academic community, and resources provided by UNF will provide me with the necessary foundation to excel in my academic pursuits and future career goals.

I am planning to register in Fall 2024 as a full-time student for the Ph.D. program. I would appreciate your guidance regarding the next steps for the application.

Thanks again!

Sincerely,
Amitabh Bhattacharya
Senior Data Scientist
Albertsons Companies, Inc.

Asaithambi, Asai

From:	Corbett, K-B
Sent:	Monday, August 28, 2023 9:54 AM
To:	Asaithambi, Asai
Subject:	Re: Would you be interested in pursuing a PhD in Computing degree offered at UNF

I am excited about this. Hopefully, a lot of people are interested in it.

From: Asaithambi, Asai <asai.asaithambi@unf.edu>
Sent: Monday, August 28, 2023 9:01 AM
To: Corbett, K-B <n00970482@unf.edu>
Subject: RE: Would you be interested in pursuing a PhD in Computing degree offered at UNF

Thank you.

From: Corbett, K-B <n00970482@unf.edu>
Sent: Sunday, August 27, 2023 10:14 AM
To: Asaithambi, Asai <asai.asaithambi@unf.edu>
Subject: Re: Would you be interested in pursuing a PhD in Computing degree offered at UNF

I completed the form.

From: Asaithambi, Asai <asai.asaithambi@unf.edu>
Sent: Saturday, August 26, 2023 2:54 AM
To: Corbett, K-B <n00970482@unf.edu>
Subject: Would you be interested in pursuing a PhD in Computing degree offered at UNF

UNF is proposing a PhD program in Computing with concentrations in Intelligent Systems/Artificial Intelligence and Cybersecurity. We are contacting you to determine the level of interest in such a program from the current Computing students at UNF. Please complete the brief qualtrix survey available here.
Thank you.

Appendix M – Dean's Support Letter

August 30, 2023

This letter expresses my strong support of the proposal for a Ph.D. program for the School of Computing at the University of North Florida. The proposed program will be able to launch with existing resources. No additional courses will need to be offered other than 7000-level research/dissertation courses.

In order for the program to reach its full potential, the College of Computing Engineering, and Construction has committed to provide additional graduate assistantships to the School of Computing to help establish a strong cohort of students. The College will seek external funds from donors and industry to support graduate assistants. If the program is approved, the College will also request funds from the UNF administration to fund three Ph.D. students.

We believe a Ph.D. program will strengthen our School of Computing by expanding research capabilities for faculty and students at all levels and by providing additional opportunities for collaborations, both with academic and industry partners.

Sincerely,

William F. Klostermeyer

William Klostermeyer
Dean
College of Computing, Engineering, and Construction
University of North Florida