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I. Executive Summary

We have prepared this academic program review document with input from the Chair, Associate Chair for Academic Affairs, Graduate Program Directors, the Undergraduate Program Director, and various faculty members within the department of Information Systems (IS). This document has been prepared in accordance with the guidelines provided by the Office of the Provost using data provided by the Office of Institutional Research Analysis and Decision Support as well as data gathered by the College of Engineering and Information Technology and the IS Department.

In keeping with the mission of UMBC, the goal of the IS Department is to establish itself as a center of excellence in undergraduate and graduate education as well as research. Some of the notable achievements of the IS Department include the success of our alumni in holding significant positions such as University President (at Clemson University), CIO (at Johns Hopkins University), Vice President (Amazon) and various leadership positions in the IT industry. The IS Department has established a successful and the largest on-line MS program in the university. In online degree rankings announced January 10, 2017, *U.S. News* recognized the online master's degree in information systems among the top 25 in the nation. The online MS degree program appears on US News Best Online Computer Information Technology Programs list in 2017. The IS Department launched a new Masters in Professional Studies program in Health Information Technology in 2014, which is the fourth Masters program in the department.

Students in the IS Department constitute among the largest student body in the College of Engineering and IT in terms of participation in internship opportunities. The IS Department offers two undergraduate, four masters, and two PhD programs with a total enrollment of over 1,700 students. Our goal is to develop the technical, problem solving, and communication abilities of our undergraduate and graduate students, through well thought out state of the art curricula. Through this process, we prepare our graduates to enter the workforce as IT professionals in a competitive environment that also has one of the highest prospects for job growths in the future, even in the current challenging economy. In addition, we provide our PhD students with the necessary training to perform rigorous research so as to be able to make significant and novel contributions in their fields of specialization. In order to achieve these goals, we continuously monitor, update, and assess our curricula, reach out to our students, alumni and employers for feedback, and incorporate changes as necessary.

The faculty of the IS Department is committed to the conduct of high quality research and dissemination of research results through peer-reviewed publications in various national and international conferences, journals, books, and book chapters. Most research within the IS Department fit within five core areas: Artificial Intelligence/Knowledge Management, Database/Data Science, Health IT, Human-Centered Computing, and Software Engineering. Most of our research support comes from the National Science Foundation (NSF), while we also receive funding from other government agencies such as the US Department of Education, The National Institutes of Health, Office of Naval Research, National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR), corporations such as Google, IBM, GE, and CISCO, and foundations including the Verizon Foundation and Alzheimer's Association. We involve our graduate and undergraduate students in state of the art research conducted and supervised by our faculty. Our goal is to increase our research visibility by continuing to publish in top quality journals, increasing our external funding, and hiring tenure-track faculty from high quality doctoral programs to fill vacant positions.

II. Description of the Programs

Provide a narrative description of the program and its history, including mission, organization, specializations, and relationship to UMBC mission. Attach as appendices copies of administrative structure and operative committees. (Use data from Table 2.)

A. Mission

Information Systems (IS) is a multidisciplinary field, which addresses the application of information technologies to achieve the goals of individuals or organizations. The IS Department at UMBC is affiliated with the College of Engineering and Information Technology. The mission of the IS Department is to provide a state of the art educational experience to students at the undergraduate and graduate levels, including an on-line Masters program in Information Systems, which has been an important and successful part of the IS department and UMBC. Many of our students engage in research to produce significant and novel results that are of value to the discipline. In addition to teaching the key areas in IS, we seek to make our students problem solvers, so that they are positioned to be ideal employees for public and private sector organizations with significant IT requirements. In addition, in our PhD programs we seek to produce students who will make significant and novel research contributions in Information Systems and Human-Centered Computing (HCC). The faculty is committed to conducting state of the art research, publishing results in high quality outlets, and competing for external funding to help grow our graduate and undergraduate programs. The dual goals of providing high quality undergraduate education and producing state of the art research is in line with UMBC's mission of being a research-intensive university with a focus on undergraduate education.

B. Organization and operative committees

The administrative structure of the IS Department consists of the department chair, an associate chair for academic affairs, three graduate programs directors for the IS, HCC programs respectively, and one undergraduate programs director. The department's operations are supported by six full-time staff including a IT systems administrator, program management specialist, graduate program manager, marketing manager, and an administrative assistant. The department has eight standing committee including an undergraduate programs committee, three graduate programs committees, an assessment committee, a research committee, a library committee, and an awards committee. In addition, an ad hoc committee is formed each year for merit review. Other ad hoc committees are formed when necessary such as committees for faculty recruitment and faculty promotion and tenure. The organization chart is shown in Figure 1.

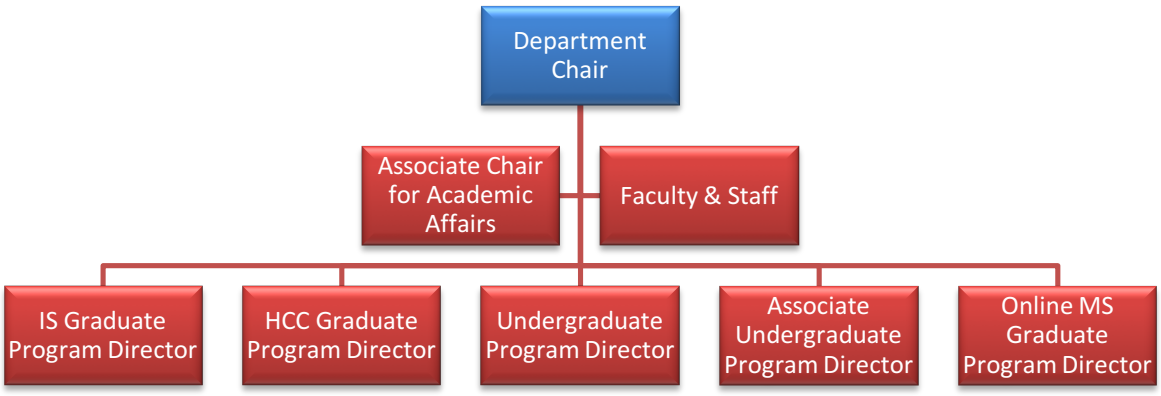

Figure 1. Organization Chart

C. Specializations

The specializations in the academic programs are described in Section VI. There are five primary research areas of the faculty including Human-Centered Computing (HCC), Data Science (DS),

Artificial Intelligence and Knowledge Management (AI/KM), Software Engineering (SE), and Health Information Technology (HITs). Some faculty members have secondary and overlapping areas of research interests.

D. History and specializations within the academic programs offered

Historically, the School of Business at the University of Maryland (located in College Park) was organized as a school with degree programs but without departments. In the late 1960's the first department within the Business School was created: the Department of Information Systems Management. This department focused on the use of computers and information systems within the business environment and offered a BS degree, but it was small in terms of faculty and student enrollment.

Through a mandated reorganization of the University of Maryland, the campus at College Park was renamed the University of Maryland College Park (UMCP); and the University of Maryland Baltimore County (UMBC) was established within the University of Maryland System as a research oriented university in the Baltimore region. As part of this reorganization, the Department of Information Systems Management and its BS program were transferred in the Fall of 1980 from the School of Business at UMCP to UMBC. Since UMBC had no schools or colleges at that time, the Department of Information Systems Management became an independent department within UMBC as was the case for all other departments at that time. However, no faculty members from UMCP moved to UMBC. Since the program had very few students, one full-time program director was hired to administer the BS program along with a cadre of part-time instructors.

In 1982, UMBC graduated its first two students from this new BS program. Since the program was beginning to grow, a second full-time instructor was hired. Within a few years the undergraduate program was growing rapidly. Consequently, a third full-time instructor was hired in 1984; two more were hired in 1985. For the 2017-2018 academic year the department has 7 lecturers, 10 assistant professors, 12 tenured associate professors, and 4 tenured professors. Classroom instruction is increasingly dependent upon the use of part-time instructors as the increase in the number of full-time faculty has not kept pace with the growth in enrollments. The student population that resulted in two BS graduates in 1982 has now grown to over 1250 undergraduate majors. The department routinely graduates over 200 undergraduates each year. In fact, each year the department graduates the largest number of information systems professionals in the State of Maryland and is one of the largest academic programs in Information Systems within the mid-Atlantic region.

In 1985, approval was granted to establish MS and PhD programs with the first students enrolling in 1986. By 1988, the department had 20 MS students and 8 doctoral students. The first MS students graduated in 1990; and the first PhD student graduated in 1992. Between 2011 and 2017, the department graduated 1028 MS students and 51 PhD students.

The continued demand for advanced university education in Information Systems led the department to seek approval for the establishment of an on-line version of its existing MS program. Approval was granted in 2000 and the first students were admitted to this program in January 2001. The department graduated 391 students from the on-line version of the MS program between 2011 to 2017.

Due to faculty research interests and student demand the department started a new Master of Professional Studies (MPS) program in Health Information Technology in 2014. As of Fall 2017, there are 52 students enrolled in this program and it has graduated 30 students.

As of Fall 2017, there are 206 students in the on-campus MS program, 145 enrolled in the on-line version of the same program, 34 MS in in Human Centered Computing, and 52 in HIT MPS program. In addition, there are 58 IS PhD and 15 HCC PhD students in the IS department. Altogether there are 1257 undergraduate students and 448 graduate students in the IS department as of Fall 2017.

With the rapid growth of students and faculty, the teaching and research interests of the department's scope broadened well beyond business and management perspectives of computing and information. The department and its faculty have evolved, taking a multi-disciplinary and technical approach to information systems. As a result, two developments occurred. First, in 1991, approval was granted to establish a BA program. The purpose of this program was to offer information system education at the university level in those areas of the disciplines that are

decidedly less technical. Second, also in 1991, the university officially changed the name of the Department of Information Systems Management by removing the term "management" from its official designation. At that point, the department's official name became the Department of Information Systems. The official designation of the undergraduate BS program was accordingly changed. The official names of the MS and PhD programs were also subsequently changed to reflect the department's new name. This name change of all the degree programs was necessary to reflect the inclusive and multi-disciplinary nature of the discipline of Information Systems as well as to reflect the character and orientation of these degrees.

Fall 1980	Department of IS Management, BS program transferred from UMCP to UMBC
1985	MS and PhD Programs in IS established
1991	Name changed to Department of Information Systems BA Program established
2000	Online MS Program established
2014	Master of Professor Students (MPS) program in Health IT established

III. Educational Goals and Learning Outcomes

A. Overview and Process

This document provides an outline of the student learning assessment plan that is carried out at the Information Systems (IS) department at UMBC. Its purpose is to identify the student learning assessment activities that are followed in the IS department for each program the department offers.

Consistent with the UMBC mission of "… an Honors University, the campus offers academically talented students a strong undergraduate liberal arts foundation that prepares them for graduate and professional study, entry into the workforce, and community service and leadership. UMBC emphasizes science, engineering, information technology, human services and public policy at the graduate level..." [1] the IS department offers 8 different degree programs (2 undergraduate, and 6 graduate) to over 1700 students majoring in one of them.

The Middle States Commission on Higher Education has accredited UMBC and based on the 2009 UMBC Assessment Plan "UMBC uses assessment results to improve student learning and to advance the institution" [2]. In addition, "Student learning outcomes are an essential component of the assessment of institutional effectiveness" [2]. Therefore, the IS department uses student learning assessment to improve student learning by identifying learning outcomes, offering courses with these outcomes, assessing the learning achievement by the students, and improve teaching and learning by providing a feedback to the next offering of each assessed course, thus closing the loop (see Figure 1) [3].

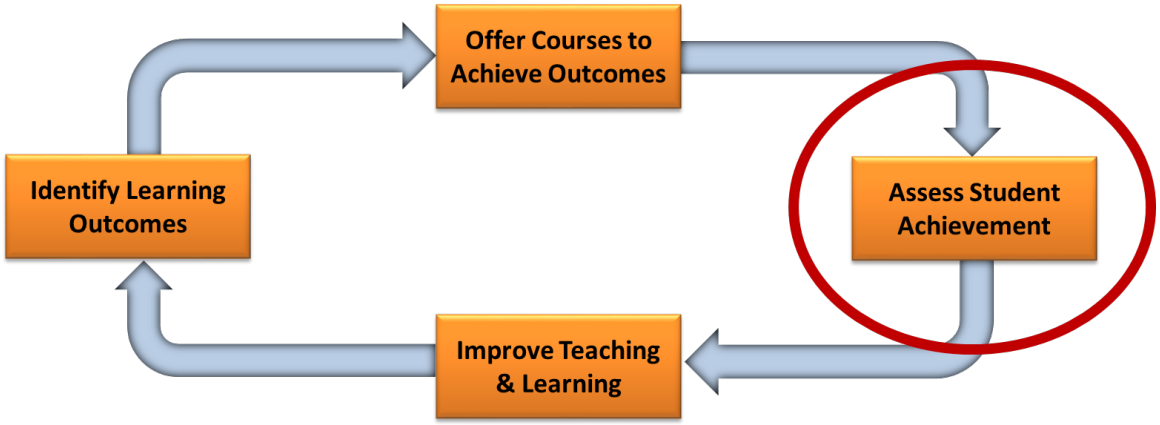

Figure 2. The cycle of student Learning outcomes

The IS department considers the Assessment of Student Achievement (depicted within a red circle in Figure 1) as a crucial component in support of the UMBC's mission for the IS students. After receiving assistance from the UMBC Faculty Development Center (FDC) both in person, and in electronic means via the numerous resources that have been made available through the FDC [4], the IS department designed a process to assess student achievement (the circle in Figure 1).

If we are to expand that circle we can identify the assessment process that the IS department has planned to assess student learning in several courses for each program offered. Figure 3 illustrates this process for any course that has been selected for assessment.

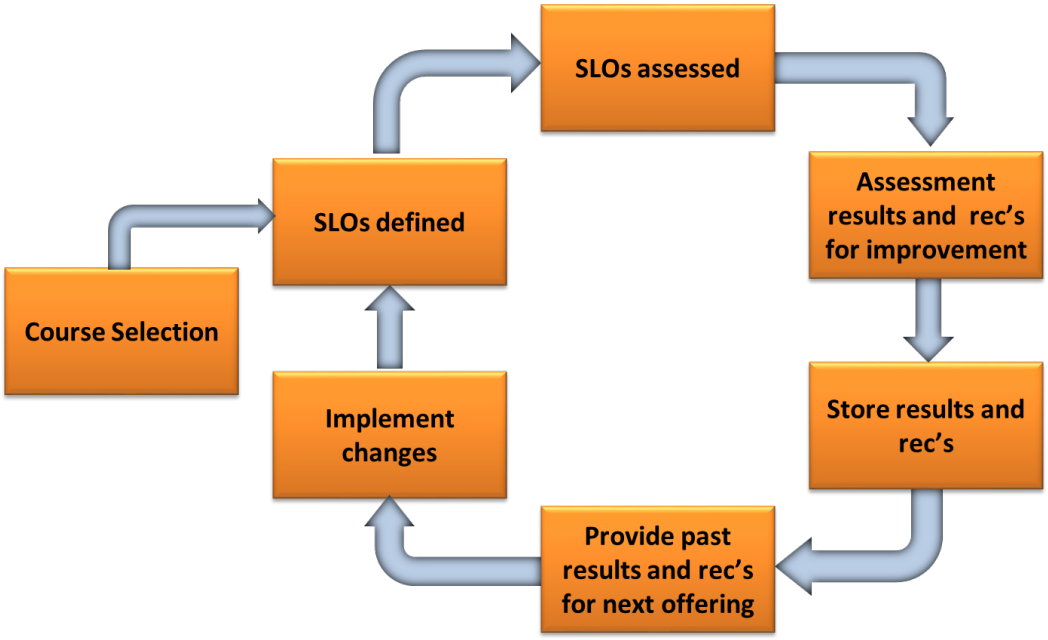

Figure 3. Process of student assessment for a single course in the IS department

This process is briefly explained below (start on the left part of Figure 2 and follow the arrows):

1. A course is selected for assessment
2. The course instructor identifies the student learning outcomes (SLO).
3. The SLOs are assessed during and/or soon after the end of the semester
4. The assessment results and recommendations for improvement are generated by the instructor
5. The results and recommendations are submitted and stored electronically in the IS department repositories on the IS department's internal Blackboard site

6. The next time the same course is offered, previous results and recommendations are provided to the course instructor
7. The course instructor implements changes (if needed) and may update/edit the SLOs based on the past recommendations, thus closing the loop and getting ready for the new assessment cycle

The above process is repeated for representative courses that have been identified for student assessment in each program offered by the IS department. The progress is maintained at the IS department repositories. The SLOs may not necessarily change, however, the instructor is expected to implement the changes recommended during the last assessment of the course.

B. Student Learning Outcomes (SLOs)

The IS department has identified several Student Learning Outcomes (SLOs) for each program that is offered. Students who are enrolled in each program are expected to acquire the skills and competences that are offered by their degree program. Therefore, the IS department has defined the SLOs for each program and the courses or activities that students take, which provide a measurable metric in one or more of the program SLOs. Below is a list of the different programs and SLOs for each program offered by the IS department.

1. BS in Information Systems program

Program SLOs for the BS in IS
1. Develop oral and written skills 2. Develop teamwork and leadership skills 3. Demonstrate application development using programming languages 4. Demonstrate knowledge of hardware infrastructure and integration 5. Demonstrate networking skills 6. Demonstrate capability of database design and development 7. Demonstrate capability for analyzing and designing information systems

The courses that have been chosen to assess the BS in IS program are: **IS247, IS300, IS420, IS436, IS451.**

2. BA in Business Technology Administration program

Program SLOs for the BA in BTA program
1. Develop oral and written skills 2. Demonstrate ability to solve problems in technical/managerial environments 3. Demonstrate use of database applications 4. Demonstrate use of business models and management in the workplace

The courses chosen to assess the BA in BTA program are: **IS125, IS300, IS320, IS350, MGMT210.**

3. MS in Human-Centered Computing program

Program SLOs for the MS in HCC program
1. Demonstrate design of a quality user interface 2. Demonstrate use of human-centered computer models and theories 3. Demonstrate capability to design process and evaluation in individual and group environments 4. Demonstrate capability for analyzing and designing information systems

The courses chosen to assess the MS in HCC program are: **HCC613, HCC629, HCC636, HCC710.**

4. MS in Information Systems program

Program SLOs in the MS in IS programs (both on-campus and online)
1. Demonstrate decision making techniques for the workplace 2. Demonstrate development of complex database applications 3. Demonstrate knowledge of distributed systems and their applications 4. Demonstrate knowledge for structured analysis and design in information systems

The courses chosen to assess the MS in IS program are: **IS603, IS620, IS651, IS636** (and the corresponding courses for the online MS in IS). These courses cover the defined program SLOs.

5. PhD in Human-Centered Computing and PhD in Information Systems programs

Program SLOs in the PhD programs (both HCC and IS)
1. Demonstrate capability for research in a topic area 2. Demonstrate formulation of a research problem, its methodology, and preliminary results 3. Demonstrate how to conduct and publish research in outlets such as peer-reviewed journals or conferences

The SLOs for the Ph.D. programs are not assessed through coursework. Instead, as appropriate for PhD the learning outcomes are different and they are measured as follows:

1. Comprehensive exam (average grade from each committee member)
2. Proposal defense (overall Pass/Fail rate)
3. Dissertation defense (defense rate – Pass, Cond Pass, Fail- and/or existing published papers)

NOTE: The comprehensive exams in both HCC and IS programs can be directly measured based on the grade that the student earns. Regarding the proposal defense and dissertation defense we are aware of a defense assessment form (thanks to Faculty Development Center) [6] that can be used, however, this would require approval for adoption by the entire IS department faculty before it is implemented.

C. Measuring Student Learning Outcomes

The SLOs are measured when a representative and selected course of the corresponding program (except for the PhD) is assessed. The measures are of two types:

1. Direct Measures: Examples are homework, quizzes, reports, term papers, grades based on explicit criteria, etc.
2. Indirect Measures: Examples are surveys that students take (e.g. surveymonkey.com or CATME.org), number of student hours spent on homework, etc.

By combining direct and indirect measures the IS department can identify what the students have (have not) learned [direct measures]; and also provide an explanation on why they did or not [indirect measures].

D. Direct Assessment - Student Learning Outcomes (SLOs)

The IS department developed the SLOs for all academic programs. A number of core courses have been selected from each program and the course level SLOs are defined and measured with direct assessments by selected instructors teaching these courses. Some of these courses have multiple sections

Assessment period: Assessing a course is a repetitive process and not a one-time activity, to ensure that the IS department is assessing learning of students and is taking appropriate action based on the results of the assessment. A selected course will be assessed on a 2 year periodic timeframe. As shown in Figure 2, each time a course is assessed, there should be an improvement recommendation for the next time it is offered; during the following assessment there should be a

follow-up implementation of the last recommendation. A course does not have to be assessed every single semester it is offered, but on a periodic basis.

E. Indirect Assessment – Surveys

In addition to the direct assessment of selected courses the IS department is also conducting indirect assessment on the opinion of the students regarding their own learning. The main instrument for indirect assessment is the results of a set of surveys from www.CATME.org if the instructor has deemed it feasible for the course taught. Each instructor reads these comments and reports a summary of students' opinion about their learning during the course. Major emphasis is given to the comments section along with other student ratings related to the knowledge they acquired by taking the course.

The IS department follows the template shown in Table 1 below to report both Direct and Indirect measures, along with the recommendations of the instructor and follow up for the next offering.

Table 1. Template for reporting direct/indirect measures and recommendations

Source, Date, SLO(s)	***Evidence from Original Assessment***	***Recommendation from that Assessment***	***Follow-Up Implementation***	***Results from Implementation***
(For Example) Intro to Q Fall 2013-Spring 2014 SLO1	*(For Example)* Final exam, Fall 2013, 10 questions mapped to SLO1, of X students tested, __% demonstrated competence, which was below program expectations.	*(For Example)* Students need additional practice on SLO1.	*(For Example)* Tutorials added to address SLO1 in Spring 2014.	*(For Example)* Final exam, Spring 2014, 10 similar questions mapped to SLO1; __% of students demonstrated competence in SLO1. *(Results will be used to inform future plans.)*
(For Example) Capstone Course Spring 2012-14 All SLOs	*(For Example)* Capstone paper, Spring 2012, scored by multiple readers with rubric aligned to all SLOs; sample of X students out of Y total. Only __% of students demonstrated competence in SLO3.	*(For Example)* Reviewed curriculum map to pinpoint where SLO3 is addressed. Identified need for additional learning opportunity in 2 courses.	*(For Example)* Added class activity addressing SLO3 in 2 courses.	*(For Example)* Capstone review, Spring 2014, sample of X students out of Y total. __% of students competent in SLO3. *(Results will be used to inform future plans.)*
(For Example) Senior Survey Spring 2013 SLO2	*(For Example)* Spring 2013 data indicated __% students felt competent in oral communication (SLO2); increase of __% over Spring 2012 survey.	*(For Example)* Discussed faculty efforts linked to improvement, including shared rubric for oral presentations.	*(For Example)* Created similar components in other courses.	*(For Example)* Spring 2013 satisfaction data remained steady. *(Results will be used to inform future plans.)*

F. Mapping to Program and Institutional Outcomes

Following the specific reports for course assessment, the next step is to link the individual course SLOs to the program SLOs and furthermore, to the institutional SLOs in support of UMBC's mission [1]. For example, how a specific course SLO maps to any of the previously mentioned program SLOs? Also how do these SLOs support the institutional SLOs?

UMBC Institutional SLOs (a.k.a UMBC Functional Competencies): UMBC has five major Functional Competencies for undergraduate students [5]. Table 2 identifies these SLOs:

Table 2. UMBC Institutional SLOs

UMBC Undergraduate Functional Competencies

1. Oral and Written Communication
2. Scientific and Quantitative Reasoning
3. Critical Analysis and Reasoning
4. Technological Competence
5. Information Literacy

The following table identifies the mapping between the undergraduate program SLOs and the UMBC Functional Competencies

Table 3. Mapping between undergraduate program SLOs and UMBC FCs

BS in Information Systems	BA in Business Tech. Adm'n	UMBC Functional Competencies
SLO1	SLO1	FC1
SLO3, SLO4, SLO5, SLO6, SLO7	SLO2, SLO3, SLO4	FC2
SLO1, SLO3, SLO4, SLO5, SLO6, SLO7	SLO2, SLO3, SLO4	FC3
SLO1, SLO2, SLO3, SLO4, SLO5, SLO6, SLO7	SLO2, SLO3, SLO4	FC4
SLO1, SLO2, SLO3, SLO4, SLO5, SLO6, SLO7	SLO1, SLO2, SLO3, SLO4	FC5

In general, there are more course SLOs, compared to program SLOs, and there are more program SLOs compared to the five institutional SLOs. The process of mapping course SLOs to program SLOs is best to be carried out at the same time the instructor assesses the course SLOs. Instructors are cognizant of their own course SLOs better than anyone else, therefore, they are the most capable to identify the most relevant SLOs of the program the course belongs to, thus implementing the best mapping from course SLOs to program SLOs. The use of spreadsheets is currently employed to consolidate assessment results across the different granularities of SLOs (course, program, institution). The IS department is currently in the process of defining the logistics of this step in the assessment process.

G. Implementation of Assessment Activities in the IS department

The Information Systems department has enacted a departmental committee to deal with course assessment issues. The Assessment Committee oversees all assessment activities of the department. The Associate Chair for Academic Affairs chairs this committee which consists of faculty appointed by the IS department Chair. The duties of the assessment committee are the following:

Assessment Committee duties

- Identifies selected courses to be assessed in every semester
- Notifies the instructors, who provide a course assessment plan (SLOs and assessment methods for each SLO) for the given semester
- Receives and reviews from each instructor who has performed an assessment on a course:
    - the results of the assessment
    - possible recommendations for improvement based on the assessment

- Stores the assessment results and the recommendations electronically in a secure place, such as the IS department Resources site on Blackboard
- Communicates to the instructors the previous recommendations of the same course to enable a feedback loop for each assessed course
- Keeps track of the assessment progress being made for repeated cycles on a per course basis. These progress reports are also kept in electronic form at the IS department Resources site on Blackboard
- Provides a report to the Chair of the assessment activities for each semester, containing a summary with:
    - The selected courses that were assessed
    - A summary of the recommendations for each course
    - The cycle with marked progress on a per course basis

H. Assessment Activities

The assessment committee is tasked to assess the following programs:

I. During the Fall 2017 semester the following assessment activities are planned:

1. Programs with courses offered in SPRING 2017 semester
    - BA in BTA program courses
    - PhD in HCC program assessment
    - PhD in IS program assessment
    - Reflection and changes on the assessment plan

2. During the Spring 2017 semester the following assessment activities are planned:

Programs with courses offered in FALL 2017 semester:

- MS in HCC program courses
- MS in IS program courses
- BS in IS program courses
- Reflection and changes on the assessment plan

Assessment summary 2016-2017:

The Assessment Committee of the Department of Information Systems chaired by the Associate Chair for Academic Affairs oversees the assessment activities of all programs offered by the department. Committee members had meetings with the Faculty Development Office (Linda Hodges and Jennifer Harrison) to change the assessment activities to include mostly direct measures for measuring student learning for course assessments. The committee identified and generated student learning outcomes (SLOs) for all programs offered by the department. The committee designed a new plan for assessment based on these new SLOs. The committee started collecting data for the undergraduate and graduate programs based on these new SLOs. Undergraduate programs were assessed in Fall and Graduate programs in Spring semester. New courses at the graduate and undergraduate level were introduced during this year including:

- Special Topics in IS: Cloud Computing
- Special Topics in IS: Smart Home Health Analytics

Assessment summary 2017-2018:

The Assessment committee continued collecting assessment data for courses taught in the SP2017 and FA2017 semesters, based on the newly created Assessment plan of the department. The committee assessed undergraduate programs in Fall and Graduate programs in Spring semester. In addition, Committee members serving in other IS department committees cross-referenced

assessment data and student input to relevant committees (such as the UGC, and GC) to update courses. As a result recently updated courses include:

- IS420: In FA2017 the IS420 course content was updated to include new material to modernize the course and keep it current with technology advances and improve the marketable skills of students. New content material on NoSQL databases replaces old material on Web forms. The change was influenced by indirect student and industry feedback. New texbook, new project and new home works reflect this change.
- IS295: In SP2018 the IS295 course content was updated towards a different direction. Instead of MS Office related material the course is being re-oriented towards Introductory Decision Making for organizations with supporting exercises based on spreadsheet macros. This change was due to periodic assessment evaluation of courses as they relate to market trends and curriculum alignment with the ACM/AIS recommendations for I curricula.

New graduate courses are being offered in SP 2018:

- Special Topics in IS: Introduction to Affective Computing
- Special Topics in IS: Big Data + HPC + Atmospheric Science
- Special Topics in IS: Information Extraction

IV. Curriculum

The Department of Information Systems offers two undergraduate degree programs: Bachelor of Arts in Business Technology Administration and Bachelor of Science in Information Systems. At the graduate level the IS department offers two MS, one MPS and two PhD programs. The MS programs include two traditional face-to-face masters programs including one in Information Systems and the other in Human Centered Computing. In addition, an online MS in Information Systems can be completed entirely on-line. Doctoral programs are offered in Information Systems and Human Centered Computing.

A. Undergraduate Curricula

a. Are students introduced early to the modes of inquiry and methodology of the discipline? In what ways? Are these modes utilized in assignments for subsequent courses?

The first course taken by students in the BA curriculum (which is recommended as the first course in the BS program as well) introduces students to computer hardware, software, procedures, systems and human resources, and it explores their integration and application in business and other segments of society. Fundamental IS approaches to computer problem-solving and programming are discussed and demonstrated. These basic analytical skills are revisited, expanded upon, and reinforced in all subsequent IS courses.

b. Is there a common core of courses taken by all students in the program? If so, please describe.

As noted above, the Department offers both the BS and the BA degree. The BS is a highly structured program, with 89 semester hours of specific courses required of all students. The BA is less structured, with 52 semester hours of specific courses required of all students. However, BA students are also required to complete a second major, a minor, or a certificate program.

All BS students must complete the following courses:

Information Systems

IS 147 Introduction to Computer Programming

IS 247 Computer Programming II

IS 300 Management Information Systems

IS 310 Software and Hardware Concepts

IS 410 Introduction to Database Design

IS 420 Database Application Development

IS 425 Decision Support Systems

IS 436 Structured Systems Analysis & Design

IS 450 Data Communications and Networks

IS 451 Network Design and Management

One additional semester of an approved programming language

One upper-level IS elective (excluding internship or individual study credits)

Mathematics and Statistics

MATH 155 Applied Calculus

MATH 215 Finite Mathematics for Information Sciences

STAT 351 Applied Statistics for Business and Economics

Management/Economics/Technical Communications

MGMT 210 The Practice of Management

ECON 101 Principles of Microeconomics

ECON 102 Principles of Macroeconomics

ECON 121 Principles of Accounting I

ECON 122 Principles of Accounting II

ENGL 393 Technical Writing

All BA students are required to complete the following courses:

Information Systems

IS 101 Introduction to Computer-Based Systems

IS 125 Information Systems Logic & Structured Design

IS 202 Systems Analysis Methods

IS 295 Introduction to Applications Programming

IS 300 Management Information Systems

IS 303 Human Factors in Computer System Design

IS 350 Business Communications Systems

IS 440 Office Automation

One upper-level IS elective (excluding internship or individual study credits)

Mathematics and Statistics

MATH 115 Finite Mathematics

MATH 155 Applied Calculus

STAT 121 Introduction to Statistics for Social Sciences

OR

MATH 155 Applied Calculus

STAT 351 Applied Statistics for Business and Economics

Management/Economics/Technical Communications

MGMT 210 The Practice of Management

ECON 101 Principles of Microeconomics

ECON 102 Principles of Macroeconomics

ECON 121 Principles of Accounting I

ECON 122 Principles of Accounting II

ENGL 393 Technical Writing

There have been several fairly minor changes to the core curriculum of both degree programs since the last Academic Program Review (APR):

- IS 202 has been removed from the core of the BS degree. Over time, the content of that course has evolved to the extent that it is too duplicative with IS 436, which is also part of the core. So it has been dropped, although it remains part of the core for the BA degree.
- The credits from removing IS 202 from the BS core have been replaced by a new requirement that BS students take one additional upper-level IS elective. Adding more elective options to the core curriculum has been a goal for some time, but the size of the faculty, and correspondingly limited course offerings, have precluded this option until recent years. The upper-level IS course offerings have significantly expanded since the last APR, and our students now have many choices for electives. The requirement for an additional elective has also been added to the BA core as well.
- The Mathematics and Statistics department has created a new course, MATH 155, Applied Calculus, which is very well suited to the calculus needs of our majors, both BS and BA, therefore this course is now required instead of the previous calculus requirements.
- We developed our own two-course programming sequence: IS 147 and IS 247. This sequence is required for our BS majors instead of the previously-required sequence of CMSC 201 CMSC 202. Students may still use CMSC 201 and 202 to satisfy the two-course programming sequence requirement, which is an advantage for students transferring into the IS major from Computer Science or other majors.
- BA students are now allowed to substitute a higher-level statistics course (STAT 351) for the finite math and statistics combination (MATH 115 and STAT 121). This meets the needs of our program while providing more flexibility for students who are required to take STAT 351 for their chosen certificate program.

There have also been two changes to the overall core curriculum structure of the BS degree effective 2006. The first is the elimination of tracks, which gives BS students more flexibility in completing their degrees. Specialization in a particular area can be achieved through undergraduate certificates. Second, a gateway mechanism has been put into place that establishes a set of criteria based on the student's grades in IS 310 and 300, in calculus and the first programming course. Students not meeting these criteria cannot progress in the major. There have been no substantive structural changes to the BA degree. The content of all individual courses is continually revised to keep up with changes in the discipline.

c. Is there a capstone experience (such as a senior seminar, a senior project, a thesis, comprehensive examination) that provides students with an opportunity to integrate what they have learned? If so, please specify.

The BS curriculum has a course which serves to provide a capstone experience: IS 436 Structured Systems Analysis and Design. This course is intended to allow students to integrate the knowledge and skills learned in earlier courses that focus on particular system components. Students work in groups and complete the entire systems analysis and design process as part of this course. At this time, there is no comparable capstone experience as part of the BA program.

d. What opportunities for student development other than courses (lectures, colloquia, workshops, publications, etc.) does the department provide?

The Department's Council of Majors sponsors programs with speakers from the industry, panels of alumni focusing on developments in technology, and events focusing on IT career and networking opportunities. The Department participates with the Office of Institutional Advancement and other departments to support the IT Visionaries Forums featuring speakers from industry and government with both faculty and students being encouraged to attend along with representatives from the IT industry. The department sponsors several invited speakers each semester, with talks (primarily research-oriented) being open to the entire department. Undergraduates are also encouraged to engage in research with faculty members, and often participate in URCAD (Undergraduate Research & Creative Achievement Day). Undergraduates are often successful in receiving funds from the campus undergraduate research grant program to support their involvement in research.

e. Which of your courses are cross-listed with courses from another department? Which other major programs require courses in your discipline? How many hours from your discipline are required by other programs?

- IS 202 is required for the IS option of the Human Context of Science and Technology undergraduate certificate, and IS 125 and all 200-level or higher IS courses are electives for this option and certificate.
- IS 101 and 295 are required for the BA in Health Administration and Policy
- IS 387 Web Content Development is cross-listed as ENGL 387
- IS 404 The History of Computers and Computing is cross-listed as HIST 404 and CMSC 404
- IS 352 Women Gender and Information Technology is cross-listed as GWST 352 and CMSC 352.
- MGMT 220 Introduction to Entrepreneurship is cross-listed with ENTR 200.
- MGMT 385 Business Ethics is part of the General Core for BS in Financial Economics.

There are a number of programs that list IS and MGMT courses as alternatives that satisfy program requirements. Examples include the BS in Bioinformatics and Computational Biology and the BS in Financial Economics.

f. How does the program curriculum interconnect with the general education curriculum?

None of our required courses carry a general education designation. Two electives, IS 304 Ethical Issues in Information Systems and IS 352 Women Gender and Information Technology are designated as arts and humanities and social sciences general education courses, respectively. Our core includes courses in economics, mathematics, and statistics, which satisfy general education requirements for our majors.

g. How does the program address the technology fluency of its students?

We find that most of the students in our BS curriculum have at least basic technology fluency learned in high school or at a community college. Those BS students who do not have basic technology fluency when they arrive can take IS 101 Introduction to Computer-Based Systems, part of which teaches the use of Microsoft Office. BA students, who generally have had less exposure to computers, are required to take IS 101. Students must be fluent with appropriate technologies to complete either of our undergraduate programs.

B. Master of Science in Information Systems

The MS program offered by the Department of Information Systems is designed for people with, and without, an educational background in an IT field. The fundamental courses may, or may not, be required based on a student's educational history. The program is offered both as a traditional face-to-face degree, but the degree can also be completed entirely on-line. We begin by describing the face-to-face offering.

Traditional on-campus program

Students may be admitted to the program in either the Fall or Spring semesters. The MS program requires satisfactorily completing 30-39 credits (10-13 three credit hour courses) at the graduate level. One or more of the three fundamental courses may be waived at the time of admission based on prior academic experience. As a result students entering this program complete between 30 and 39 credit hours of graduate studies depending on their background. All MS students are required to take five core courses and five electives from the department's course offerings.

Fundamentals courses

IS 600 Introduction to Object-Oriented Programming Concepts

IS 610 Database Program Development

IS 650 *Data Communications and Networks*

Core courses

IS 601 *Foundations of Information Systems*

IS 603 *Decision Technology Systems*

IS 620 *Advanced Database Project*

IS 636 *Structured Systems Analysis and Design*

IS 651 *Network Design and Management*

Elective courses/MS Thesis

A student may elect to do a Masters Thesis, or pursue a course-only Masters degree. For course-only degree a student must successfully complete five elective courses. If a student chooses to complete a Masters Thesis, two electives may be used for thesis research credits and the student must choose a thesis advisor from the department and form a three member committee that oversees and accepts the thesis. An MS thesis must be pre-approved by the advisor and submitted to the thesis committee at least four weeks prior to the proposal or final defense.

On-line program

Students may be admitted to the program in either the Fall or Spring semesters. The on-line MS program requires satisfactorily completing 30-34 credits (10 three-credit hour courses plus one four-credit Fundamentals course) at the graduate level. The fundamental courses may be waived at the time of admission based on prior academic experience. As a result students entering this program complete between 30 and 34 credit hours of graduate studies depending on their background. All on-line MS students are required to take four core courses and six electives. Many of the courses in the on-line program have different course numbers but the same title as their face-to-face counterparts. This is designed for administrative purposes such as tracking enrollment.

Fundamentals course

IS 607 Introduction to Information Systems

Core courses

IS 631 Management Information Systems

IS 632 Networks

IS 633 Database Management Systems

IS 634 Structured Systems Analysis and Design

Elective courses

IS 667 Interaction Design

IS 668 Enterprise-Wide Computing

IS 669 Project Management Operations

IS 670 Health Informatics

IS 671 Electronic Commerce

IS 672 Computer and Network Security

IS 673 Readings in Human-Centered Computing Research

IS 675 Introduction to Data Mining

IS 701 Independent Study

Given different financial models for the face-to-face and on-line courses and programs, there are limits to the number of on-line courses students can take when enrolled in the face-to-face program. Students enrolled in the face-to-face program can take up to two courses through the on-line program while paying standard on-campus tuition. Students in the on-line MS program can take as many on-campus courses as they would like while paying on-campus tuition.

C. Master of Science in Human-Centered Computing

The new HCC MS program was implemented in 2007 with five students enrolling. Currently 41 students are enrolled in the program. This program was started in response to changes in the industry including the growing need for usability and user interaction design professionals in the Washington, DC – Baltimore metropolitan area and nationwide. Rapidly increasing enrollments highlight the demand for this new degree.

The requirements for this program have changed since it was first introduced. The following outlines the current requirements for this program. More details can be found at the following website: http://www.is.umbc.edu/programs/graduate/HCC_MS_program.asp. The most recent significant changes to this program were implemented during the Spring 2010 semester, but additional changes are being discussed as students complete the degree and feedback is received from both students and employers. The program is comprised of ten graduate courses (30 credits) with the option of replacing two courses (six credits) with a thesis. Students are required to take five core courses:

HCC/IS 613 Graphical User Interface Design & Implementation

HCC 629 Fundamentals of Human-Centered Computing

HCC 636 Structured Systems Analysis and Design

HCC 710 Graphic Design for Interactive Systems

HCC 729 Human-Centered Design

Five additional elective courses can be taken from among HCC and IS electives, including on-line electives. A few examples of recommended electives are:

HCC/IS 698 Special Topics

HCC 700 Independent Study in Information Systems

HCC 706 Interfaces for Information Visualization and Retrieval

HCC 727 Computer-Supported Cooperative Work

HCC 728 On-line Communities

IS 731 Electronic Commerce

HCC 760 Human-Computer Interaction

HCC 761 Information Systems in Human Behavior

IS 765 Project Management

HCC 710 Graphic Design for Interactive Systems

SOCY 616 Cyberspace, Culture and Society

D. MPS in Health IT Program

Students may be admitted to the program in either the Fall or Spring semesters. The MPS program requires satisfactorily completing 30 credits at the graduate level. All MPS students are required to take six core courses and four electives. Students may take up to (2) of the required four electives in a discipline outside of HIT. Courses are offered either on campus, hybrid, or online. Summer courses are also available for credit, including the Health Informatics Capstone course. Students are eligible for the Health Informatics Capstone course after successful completion of 21 credits. Students may enroll part-time or full-time for this program.

Core courses

HIT 658 Health Informatics I

HIT759 Health Informatics II

HIT 663 Health IT Policy & Administration

HIT 664 Health IT Law & Ethics

HIT 750 Data Analytics

HIT 760 Health Informatics Capstone

Elective courses

HIT 764: Health Information Privacy & Security

HIT 723: Public Health Informatics

HIT 674: Process & Quality Improvement with HIT

HIT 724: Educational Technologies in Healthcare

HIT 751: Introduction to Healthcare Databases

IS 610: Database Program Development

ENGM 652: Management, Leadership, and Communication

SOCY 618: SAS for the Social Sciences

Other Graduate courses approved by Health IT Graduate Program Director

E. Doctor of Philosophy in Information Systems

The Ph.D. program in Information Systems is a research degree program. The program is designed for students with a bachelor's or master's degree from a variety of disciplines. However, additional courses may be required based on the student's educational history. The doctoral program is intended for serious students who desire to make significant scientific research contributions to the field of Information Systems. Students are admitted to the Ph.D. degree program in the Fall and Spring semesters.

A doctoral candidate is required to produce a publishable doctoral dissertation based upon the candidate's original research. The dissertation must necessarily advance the body of scientific knowledge that underlies the discipline of Information Systems.

A critical component of a doctoral candidate's development is the dissemination of scientific information. Doctoral candidates are routinely expected to author by themselves or co-author with their professors and fellow students scholarly papers for submission to scientific journals and conference proceedings. Doctoral candidates should also be prepared to present these research results at various national and international conferences.

Program Requirements and Milestones

1. First year dossier
2. Completion of course requirements
3. Comprehensive examination
4. Dissertation proposal
5. Dissertation research
6. Dissertation defense

Program Requirements

An admitted doctoral student is strongly encouraged to identify a mentor by the end of the first semester in the program. All doctoral students must have a mentor and a tentative committee by the end of their second semester in the program. Doctoral students are also expected to attend all research seminars, doctoral proposals and dissertation defenses, and any colloquia with guest speakers as part of their learning experience.

First Year Dossier

At the end of the doctoral student's first year, a dossier must be prepared which includes all significant work/papers written that year, a statement of learning specific to the program of doctoral study and a statement describing future plans: areas needing more course work and preliminary dissertation areas, if available. The dossier should include a list of all courses taken, grades received, and the name of the student's advisor who may or may not chair ultimately the student's dissertation committee. The dossier should be submitted electronically to the Graduate Program Director. The dossier will be evaluated by the Graduate Program Director. The purpose of the review is to assess the student's progress in the program, and to determine if the student should proceed into the second year of doctoral study. The student will be informed by email if their progress is satisfactory, not satisfactory and needs specific improvement, or is not satisfactory to continue.

Course Requirements

1. Doctoral students must participate in an introductory Gateway seminar (I and II) during their first year in the program.
2. Doctoral students must complete the required two (2) methodology courses during their first year of study.
3. Doctoral students must take 5 area courses (details below).
4. All doctoral students must take four (4) Independent Studies during their second year of course work.
5. Doctoral students with previously earned Masters degrees may be excused from a maximum of six (6) courses, but must complete at least two courses at the 700/800 level at the Information Systems department. The student's mentor must approve the course waivers.

Gateway Seminar

This seminar is an introduction to the active research areas in the department and will provide the doctoral student with a well-rounded orientation to information systems theory and practice.

IS 803 *Gateway Seminar for Doctoral Students I*

IS 802 *Gateway Seminar for Doctoral Students II*

NOTE: Gateway Seminar I must be taken before Gateway Seminar II (both are required)

Methodology Courses

IS 804 Advanced Experimental Design Methodology

IS 805 Advanced Field Research Methods

IS 809 Computational Methods for Information Systems Research

Two methodology courses are required

Area Courses

Doctoral students must take five (5) courses, called "area courses" from the research areas of the IS department (AI/KM, DB/DM, DSS, HCC, SE) according to the following rules:

- Two courses must be taken from the student-selected primary research area
- Two courses must be taken from the student-selected secondary research area
- The fifth course can be any graduate level course offered by the IS department (it could be taken from the primary, secondary or any third area); however, IS 600, 610, 613, 650, 651 and 652 are not to be taken for credit in the Ph.D. Program
- In two of the three areas, at least one of the courses taken must be at the 700 or 800 level

Artificial Intelligence / Knowledge Management Courses:

IS 707 Applications of Intelligent Technologies

IS 708 Knowledge Management and Knowledge Organizations

IS 755 Advanced Artificial Intelligence

Database / Data Mining Courses:

IS 620 Advanced Database Project

IS 720 Mobile Database Management

IS 721 Semi-structured Data Management

IS 722 Information and Systems Integration

IS 733 Data Mining

Decision Support Systems Courses:

IS 601 Foundations of Information Systems

IS 603 Decision Technology Systems

IS 625 Decision Support Systems

IS 731 Electronic Commerce

Human-Centered Computing Courses:

HCC 629 Human Factors in Information Systems

IS/HCC 706 Interfaces For Info. Visualization & Retrieval

HCC 710 Graphic Design for Interactive Systems

IS/HCC 727 Computer-Supported Cooperative Work

IS/HCC 728 On-line Communities

HCC 729 Human-Centered Design

HCC 760 Human-Computer Interaction

HCC 761 Information Systems in Human Behavior

Software Engineering Courses:

IS 636 Structured Systems Analysis and Design

IS 740 Fundamentals of Software Testing

IS 764 Advanced Systems Design

IS 765 Project Management

Other Advanced Level Courses: (NOTE: This is not a research area – however students may use one of the courses below as their 5th course)

IS 651x LAN Management Using …

IS 654 Survey of Telecommunications

IS 660 Health Care Informatics I

IS 661 Health Care Informatics II

Independent Studies:

Doctoral students must take four (4) Independent Study courses; two of them are to be taken with their mentor. The student's mentor must approve each independent study.

MS degree: Ph.D. students who have successfully completed 30 credits are awarded a MS degree

Comprehensive Exam:

The Comprehensive Examination is an integral component of the PhD Program. Through this examination a doctoral student demonstrates the requisite breadth and depth knowledge of the discipline as well as the competencies that are necessary to continue doctoral studies by conducting original research.

Areas to be Examined:

The concentration areas covered in the comprehensive exam include two selected course areas as well as Methodology Analysis. The student must identify the two concentration areas from the following list of concentration areas:

- Artificial Intelligence/Knowledge Management
- Database/Data Mining
- Decision Making Support Systems
- Human-Centered Computing
- Software Engineering

The department publishes reading lists for each of these concentration areas and for the areas of Methodology Analysis and for General Information System knowledge. Students are expected to be very familiar with the articles on the two selected concentration areas and may be asked questions on the research methodology courses they have taken.

Integrative Question

All students taking the exam are given the same integrative question. This question is intentionally broad in order to allow each student a degree of latitude in answering the question. Along with the answer to the integrative question, each examinee must also submit at the same time a dossier that includes:

1. List of courses taken: students must complete all but the last two independent studies before taking the exam. Using a departmental form the student will list the five area courses and two methodology courses he/she has taken. This form must be filled out and included in the dossier;
2. Self-assessment including strengths and weaknesses;
3. Copies of all papers (published as well as unpublished course papers)

Oral Examination

Following the submission of the answer to the integrative question, each student is given an Oral Examination. This must be taken in the same semester when the student answered the integrative question. The oral exam is approximately a two-hour closed exam. The student may bring notes, papers, and any other materials to the oral examination.

The comprehensive exam committee for each student consists of two faculty members from each of the two concentration areas selected by the student. The student is to ask faculty members from these areas to serve on the examining committee. The examinee's mentor is also one of these four committee members. The Graduate Program Director appoints the fifth committee member from members of the Graduate Committee.

The Oral Examination begins with the student giving a 30-minute presentation on the answer to the integrative question. Following the presentation, the comprehensive exam committee

examines the student on the answer to the integrative question, the papers from the two selected areas and methodological analysis.

Comprehensive Exam Results

The examination committee notifies the examinee within 24 hours concerning the outcome of the Comprehensive Examination. Students who fail the examination may attempt the exam a second time. Failing the examination a second time results in dismissal from the PhD program.

Comprehensive Examination Time Table

Fall Semester:

- **June 1:** Reading lists for the following Fall semester are announced.
- **September 15:** Integrative question is emailed to the examinees. (**N.B.** After this date the student cannot withdraw from the examination.)
- **October 15:** Answer to integrative question and dossier are submitted.
- **November 1:** Oral examinations to be scheduled after this date.

Spring Semester:

- **September 1:** Reading lists for the following Spring semester are announced.
- **February 15:** Integrative question is emailed to the examinees. (**N.B.** After this date the student cannot withdraw from the examination.)
- **March 15:** Answer to integrative question and dossier are submitted.
- **April 1:** Oral examinations to be scheduled after this date.

Dissertation Proposal Defense

After a doctoral student passes the comprehensive exam can prepare the dissertation proposal defense, and can register in IS 898 courses.

Dissertation Research

Following a successful proposal defense, the doctoral student becomes doctoral candidate and can register for dissertation courses (IS 899).

Dissertation Defense

Students who have completed their dissertation will publicly defend it. The examination committee votes on the pass/fail of the exam and the results are submitted to the Graduate School.

F. Doctor of Philosophy in Human-Centered Computing program

The new HCC PhD program was implemented in 2007 enrolling three students. Currently 10 students are enrolled in the program. Similar to the HCC MS program, this program has been started in response to changes in industry and academic research and the growing need for research and higher education in HCC. Steadily increasing enrollments are encouraging, especially when one considers the institutions that serve as the primary competition for PhD students in this field (i.e., CMU and Georgia Tech).

The specific requirements for this program have changed since it was first introduced. The following outlines the current requirements for this program. More details can be found at http://www.is.umbc.edu/programs/graduate/HCC_PhD_program.asp. The program is comprised of 48 credits of graduate courses and dissertation research, as follows:

Required Foundation Courses (9 credit hours):

* HCC 810 Reading Seminar: completed as a series of three (3) one-credit seminars during the first three semesters of the student's doctoral studies.

* Two (2) Methodology Courses: Most students would take IS 804 (Advanced Experimental Design Methodology) and IS 805 (Advanced Field Research Methods), but other courses may be approved by their advisor as appropriate.

Required Core courses (15 credit hours):

IS 629 Human Factors in Information Systems

IS 729 Human-Centered Computing

IS 760 Human-Computer Interaction

HCC 761 Information Systems in Human Behavior

HCC 710 Graphic Design for Interactive Systems

Advanced Required Core courses (24 credit hours):

HCC 801 Independent Study

Three (3) Electives (9 credits total. At most one of these electives can be satisfied by taking another offering of HCC 801 in addition to the one listed above. At most one of these electives can be an additional methodology course. All courses must be approved by the student's advisor.)

HCC 899 Doctoral Dissertation Research

At the end of the doctoral student's first year, a dossier must be prepared which includes all significant work/papers written that year, a statement of learning specific to the program of doctoral study and a statement describing future plans: areas needing more course work and preliminary dissertation areas, if available. The dossier should include a list of all courses, grades received, and the name of the student's advisor who may or may not chair ultimately the student's dissertation committee. The dossier should be submitted electronically to the Graduate Program Director. The purpose of the review is to assess the student's progress in the program, and to determine if the student should proceed into the second year of doctoral study.

After completing three offerings of the HCC 810 reading seminar but before the end of the student's sixth semester of studies, the student completes the Comprehensive Review. As part of the review, the student has to take a written exam and prepare a comprehensive dossier. The dossier includes a statement that details the student's intellectual and scholarly growth as well the student's research directions and intentions, all papers written to satisfy course requirements, including the independent study courses and all papers published in conference proceedings and scholarly journals, a list of all courses and grades, and the name of the student's advisor. A three-member committee evaluates the student's dossier and overall progress, and determines whether the student should continue toward the doctorate. For the written exam, the students have to prepare from three readings lists. One is identical to the IS PhD program's HCC reading list. The students select the other two reading lists from the following four lists: Accessibility, Human-Information Interaction, Social Computing, Other Important Readings in HCC. These areas reflect the research areas of the HCC faculty of the Department.

After passing the comprehensive review, the students focus on their dissertation research. First they present their research in the dissertation proposal defense and then the final defense.

V. Faculty Profile

A. Faculty Profile and Productivity

1. Curriculum Vitae

Each faculty member provides a professional curriculum vita that includes peer reviewed journal and conference publications, presentations at national and international societies and

meetings, interdisciplinary associations, positions held in professional organizations, service, editorials, review and committee activities, honors and awards, and research grants and fellowships. This data is included as part of this report.

2. Five-Year Faculty Profile

Please review and correct the information in Table 4, "Five-Year Faculty Profile," listing department faculty by rank, full-time and part-time status, highest degree attained, rank, race, gender, and age. Please comment on the faculty profile of your department and indicate any areas of under-representation. What changes in faculty membership and specialties have taken place within the past five years, and what has been the impact on your program(s)?

In the past five years, the IS Department hired twelve tenure-track faculty and two lecturers. Most of the hires were in existing positions that were vacated as a result of turnovers. In 2011 two tenured full professors left UMBC. This includes the then Department Chair who joined another institution as Dean. Subsequently, two additional tenured faculty members (one Associate Professor and one Professor) retired in 2014. In the past five years four Assistant Professors resigned and left UMBC. Out of the four three left UMBC to join industry positions and one joined an academic department at another university. Out of the two lecturer hires one was made primarily to teach COMP 101, a course designed for freshmen in the computing majors including Computer Engineering, Computer Science, Information Systems, and Business Technology Administration. In 2013 one of our lecturers left because of family reasons. This has resulted in a net increase of four tenure track faculty members and one lecturer. In addition, the MPS in Health IT position has a full-time lecturer, who is also the graduate program director.

The Department had made significant progress in the number of women in tenured/tenure-track faculty positions. Women are well represented among the full-time, tenure-track faculty (42%) and among the lecturers (62%). There are no underrepresented minorities in tenured/tenure-track or full-time lecturer positions. Since few minorities receive PhD degrees in IS-related disciplines each year, recruiting minority faculty to tenure-track positions has been a challenge. Each time the IS Department has had an opportunity to recruit new faculty, there has been significant effort invested in diversifying our pool of applicants. While one minority tenure track faculty member was hired in the past five years, he left the university to pursue an industry career. The department will continue working to diversify the faculty.

3. Needs

What does the department perceive as its needs for new faculty over the next seven years? Identify the areas of specialization needed and provide a brief statement of justification.

The department needs 4-5 new tenure track positions and 4-5 new lecturer positions in order to maintain the growth in our research expenditure and continue to provide quality instructions to undergraduate and graduate students. The department is currently under-staffed with respect to our teaching needs. This trend is likely to grow with an upward trending enrollment projection. Even with the recent faculty hires the student to faculty ratio in the IS department is one of the largest in the university and significantly larger than those at other peer institutions. Currently, the department is heavily dependent on adjunct faculty to staff mostly undergraduate but increasingly some courses. To put this in perspective, the department has 45 adjunct faculty and 34 full-time faculty. The overdependence on adjunct faculty results, in many cases, in compromising the quality of instruction. While we want to maintain a cohort of adjunct faculty, a better parity will be achieved with the faculty hiring plan mentioned above. PhD production in the department has also increased from 5-6 to 10-12 per year in the past five to seven years.

In terms of the areas of specialization, the areas discussed below can have high positive impact for the department both in terms of research enterprise as well as student demand. These areas are health IT, data science, cybersecurity, and human centered computing. The grant expenditure in the department has increased substantially since the last APR. This has been achieved by a combination of new faculty hires as well as increased productivity among existing faculty. In the past five years, two faculty members have received the NSF CAREER awards, one of which is at the intersection of human centered computing and health IT and the other is an intersection of data science and health IT. The major funding in the department currently are also in the four areas mentioned above. There is also substantial amount of collaborative research with other departments and centers including Computer Science and Electrical Engineering (CSEE), Center for Cybersecurity, and Accelerated Cognitive Cybersecurity lab. The two main research areas in the department are AI/Knowledge Management and Software Engineering. Much of the funded research in AI/KM overlaps with data science, mobile health, and human centered computing, while other areas such as machine learning and natural language processing are also areas of interest. In

software engineering there is growing interest in privacy and security issues, in addition to empirical software engineering.

Faculty Development

Has the department undertaken any faculty development activities in the past five years (seminars, colloquia, department or university workshops in teaching or advising, etc.)? If so, please specify.

Faculty development is important for the success of the Department's academic and research activities. When new faculty are hired, a Faculty Development Plan is developed in collaboration with the Chair and the new faculty member. This plan discusses issues that are important as one moves through the tenure process and is formally submitted to the Dean upon completion. New faculty also meet with the Chair periodically to discuss their progress, and they are encouraged to take advantage of the Faculty Development Center and other resources available on campus. Start-up packages are developed when faculty are hired to ensure they have adequate resources to support the development of a robust research program, and as part of this process teaching loads are adjusted as appropriate to allow new faculty time to develop course materials, become familiar with teaching classes, develop proposals for research funding, and more generally to settle into their new roles as faculty. The Department's Eminent Scholar Mentor Program, which has been adopted by the university in recent years, provides an opportunity for junior faculty to identify a well-established member of the community at another university who they believe would be a good external mentor. Once an appropriate match is identified, the Dean's office initiates contact with the potential mentor to discuss the program and our expectations. Assuming a mentoring relationship is established, the department provides limited funds to facilitate face-to-face meetings at UMBC, the mentor's institution, or at a conference both individuals would normally attend. In addition, the department organizes meetings every spring between tenured and tenure-track faculty where the tenured faculty outline their expectations for tenure.

The Department has a history of encouraging tenured/tenure-track faculty to engage in professional interactions with faculty at other institutions through support for travel to conferences. As discussed in the budget section, faculty can supplement these funds in various ways including teaching in the on-line MS program, obtaining external funding (a portion of the department's anticipated indirect cost returns are distributed to faculty when grants are first received).

In the past, the department invited two or three well-established scholars from other universities to give a presentation in the department every semester. In an effort to reduce the impact of this change, the department has attempted to leverage our location to invite scholars who will be nearby for other reasons to visit UMBC, give presentations, and meet with faculty and students.

The Department has attempted to initiate a monthly research seminar series several times in recent years. While UMBC graduate students and faculty make up the majority of presentations, visiting researchers were invited to present whenever possible. These seminars were intended to cover a variety of areas of Information Systems. Given the diverse interests of our faculty, it has proven difficult to sustain these seminars. Another factor that has likely contributed to the lack of success with these seminar series has been the significant recruiting that has occurred within the Department in recent years and the numerous talks given by faculty candidates. While we would like a department-wide seminar series, the challenges we have experienced making this happen are unlikely to change in the near future, so we anticipate that we will continue to experience a number of smaller, more focused seminars based on the various areas of research within the department.

VI. Faculty Research and Scholarly Productivity

Describe primary areas of faculty research and scholarship, level of external grants submitted and funded, and notable scholarly achievements. (Use data from Table 6.)

A. Research areas

The following are brief descriptions of the five primary research areas represented within the department. While longer descriptions could be provided, these descriptions are intended to highlight the general research directions taken in the department as part of these defined areas. The names of the faculty who identify each area as their primary research focus are presented. All of the areas, with the exception of DSS, have three or more faculty members who identify the area

as their primary research focus. The Data Science area has one faculty member (with one additional member on terminal leave this year).

a) Artificial Intelligence / Knowledge Management

Faculty in the AI area primarily focus on applying AI techniques such as natural language processing, machine learning, and text mining to a variety of real-world problems and applications, including knowledge discovery and management, mobile computing, social media analytics (e.g., online consumer review and blog analysis), cybersecurity, smart homes/city, computational social science, digital humanities, and user modeling. At present, we have six faculty members who identify AI/KM as their primary research area: Drs. Foulds, Joshi, Pan, Roy, Zhang, and Zhou.

b) Data Science

The area includes both fundamental and applied research in data science, data mining, and data management. Faculty research includes big data, cloud computing, semantic web, anomaly detection, spatial and temporal data mining, intrusion detection, workflow, data analytics in distributed systems and cyber physical systems, adversarial learning, privacy preserving data mining, and data integration. Research has been conducted in application areas such as cyber security, healthcare, smart grid, GIS, and digital government. At present, we have six faculty members who identify data science as their primary research area: Drs. Chen, Duan, Gangopadhyay, Janeja, Karabatis and Wang.

c) Health Information Technology

Health Information Technology (HIT) is the interdisciplinary study of the design, development, adoption and application of IT-based innovations for clinical settings, health informatics, health services delivery, management and planning. HIT plays a crucial role in terms of improving the quality of care, reducing health care costs, and enabling better health outcomes. The HIT research in the department explores interdisciplinary research questions by using quantitative, qualitative, and mixed methodologies. The research activities often involve our colleagues who hold positions in health care related companies, hospitals, and other research institutions. At present, we have four faculty members who identify Health IT as their primary research area: Drs. Koru, Gong, Norcio, and Yesha. In addition, several other faculty members have a strong secondary interest in this area including Dr. Gangopadhyay, Mentis and Zhang.

d) Human-Centered Computing

A number of our faculty conduct research in the area of Human-Centered Computing. The IS department investigates HCC from a broad variety of perspectives. As a result, HCC research within the Department addresses a diverse collection of interrelated research questions centered on the design, implementation, and evaluation of highly-usable interactive systems. We also employ a variety of methodologies in our research including both quantitative and qualitative approaches, lab and field based data collection, and usability engineering approaches including user-centered design, participatory design, and other related techniques.

The three core areas are:

i) Accessible Computing — broadly defined to include issues associated with disabilities, age, culture, as well as context-aware computing, among others.

ii) Human-Information Interaction — studies information behavior and the design of user interaction methods to support that behavior.

iii) Social Computing — studies social behavior as it relates to computational systems and evaluating the various environments therein.

At present, we have seven faculty members who identify HCC as their primary research area: Drs. Branham, Hurst, Kleinsmith, Komlodi, Kuber, Lutters, and Mentis.

e) Software Engineering

Systems and Software Group analyzes and studies real life systems, and the processes of adopting, designing, developing, testing, and maintaining software solutions to improve organizational productivity, efficiency, and outcomes. The importance of aligning the organizational missions and goals with those of software projects is well recognized which prompts

a research focus on the people and organizational issues on both systems and software sides in addition to the technical ones. At present, six faculty members identify Systems and Software as their primary research area: Drs. Koru, Massey, Norcio, Sampath, Seaman, and Ozok.

B. Level of external grants submitted and funded

Compared to the period covered by the previous assessment, the level of external grants submitted and funded has significantly increased in most of the years in the current period (see Table 6). For example, in 2017 the total dollar amount of funded external grants was $2.1 million. The only exception was 2016 when a few major grants expired. The number of faculty members awarded external grants also increased in most years, indicating broader involvement of grant activity by the faculty. In 2010 fewer than 20% faculty members were awarded external grants, while in 2017, more than 80% of the faculty members (without counting the hires made in 2017) are either PIs or co-PIs on at least one externally funded grant. The grant expenditure increase by over four times between 2010 and 2017 and in mot years the growth has been 30-40% over previous years. The number of submitted external grants significantly increased over the time period in the past five years. This indicates that some of our faculty members have spent significant efforts seeking external grants, but there is considerable room for additional growth with regard to the pursuit of external funding. The potential areas to seek additional funding are in cybersecurity, health IT, data science including AI, and human centered computing, as reflected in our most recent hires. Given UMBC's vicinity to federal government agencies, there is great funding and educational potential in this area. The department is also in search of a new faculty in Health IT, which will boost funding efforts in this area. Most of the relevant research areas in the IS department where federal funding is available are multi-disciplinary. In this respect the research conducted by the IS faculty are not core computational or algorithmic but more suited to identify and solve problems with major societal impacts. Examples include security and privacy in healthcare, imaging interaction in surgery, machine learning for health monitoring of patients with Dementia and Alzheimer's disease, biomedical software engineering, cloud computing for healthcare, game mechanics for stem cell transplant survivors, intrusion detection through semantics and context, accessibility and assistive technologies, cognitive accelerated cybersecurity, and scientific workflow. All of the above research areas are currently supported by external grants. In addition to research grants there are some innovative teaching grants. Examples include augmenting cybersecurity analytics in undergraduate IT programs and "big data+HPC+atmospheric sciences", which is a joint grant between IS (lead), Math, and physics. Between 2016-2018 two faculty members in the IS department have received an NSF CAREER awards. Most of the current funding are from NSF but there are current funding from other government agencies such as NIH, NIDILRR, DHMH, and DOE. In addition there are funding from Alzheimer's Association, CISCO, GE, IBM, Toyota, ONR, and MITRE.

C. Notable scholarly achievements

The IS faculty members maintain a steady rate of productivity in terms of publications of books and refereed works, presentations at international/national conferences (see Table 6). IS faculty members have made many individual achievements such as receiving scholarly awards, publishing books, editing journals, serving on editorial boards, and chairing conferences (details of the number of scholarly awards and published books can be found in Table 6). For example, Dr. Janeja has obtained the American Association of Advancement of Science (AAAS) fellowship at the NSF Computer & Information Science & Engineering (CISE), Dr. Mentis is the Executive Vice President of Association for Computing Machinery (ACM) Special Interest Groupon Computer-Human Interaction (SIGCHI). IS faculty members have served as editor/associate editor/editorial board members of journals such as Smart Homecare and Telehealth, iConference, Computer Supported Cooperative Work, International Journal of Human Computer Studies, Elsevier Pervasive and Mobile Computing Journal, IEEE Transactions of Software Engineering, and the Journal of Electronic Commerce Research. Faculty members have also been involved in organizing and being on the program committee of conferences such as IEEE International Conference on Data Mining, IEEE International Conference on Service Computing, IEEE/ACM International Conference on Big Data Computing, ACM Digital Health, SMARTCOMP, ACM SIGCHI, ACM Computer-Supported Cooperative Work (CSCW), ACM ASSETS, NSF Data Corps, and American Medical Informatics Association (AMIA). Faculty members have also published a number of books such as "Methods, Models, and Computation for Medical Informatics", "Innovations in Data Methodologies and Computational Algorithms for Medical Applications", and E-Life: Web-Enabled Convergence of Commerce, Work, and Social Life.

VII. Teaching Quality

The Department considers high quality and effective teaching at all levels to be an important component of faculty development. In the approved departmental workload policy, 40% of a tenured/tenure-track faculty member's time is allocated to instruction and related matters and quality teaching is considered each year at faculty annual review. Tenured faculty serve as valuable resources for new faculty, passing on successful strategies, techniques, and teaching materials. Newly hired faculty are also encouraged to take advantage of the UMBC Faculty Development Center and the English Language Center and the programs these centers offer. Since Spring 2006, the department has been contracting with an external firm for conducting on-line teaching evaluation as opposed to using the standard Student Course Evaluation Questionnaire (SCEQ) that was in use prior to that. Since 2016, the department has been using the Student Evaluation of Educational Quality (SEEQ) an online survey adopted university wide.

While part-time instructors have taught for the Department for many years, our heavy reliance on part-time instructors results in the need to continuously recruit new part-time instructors. Given the large number of classes taught by part-time instructors, it is critical that we carefully monitor the teaching effectiveness of this group of faculty. However, as noted below, limited resources make this difficult. Currently, we run a one hour orientation for our part-time instructors every year, with a special emphasis on new instructors. These seminars could also prove useful for our less experienced full-time faculty. Unfortunately, our excessive dependence on part-time instructors, combined with extremely limited resources, force us to avoid changes that may cause too many experienced part-time instructors to discontinue teaching for the Department.

At present, we rely entirely on the on-line evaluations for evaluating the teaching of both the full-time and part-time faculty. We are careful to consider more than the single summative question when evaluating teaching effectiveness, but reliance on these course evaluations is not optimal. A more comprehensive mechanism for evaluating teaching effectiveness is desired, but significant barriers include (1) excessive demands on our existing full-time faculty, (2) additional demands that may be placed on the Faculty Development Center, (3) excessive dependence on part-time instructors, and (4) inadequate stipends we currently offer part-time instructors.

VIII. Service

This section describes the service contributions by the faculty to the department, the University, the USM system, the public, and the profession over the five-year period of review.

Within the university, which encompasses service to the department, UMBC, and the USM system, faculty showed days of participation on departmental committees (range: 65 – 88), University committees (range: 45 – 51), and system committees (range: 3- 7). There was an upward trend in participation on departmental committees, attributable to the formation of new committees to handle the growth and expansion of the department's programs. For example, the Student Recruiting Committee was established to develop specific strategies that can be implemented to increase the number of first year undergraduates, on-campus MS students, and PhD students in areas that match those identified in our program review as existing or desired strengths (in proportion to the number of faculty in those areas). This charge has been refined in recent years to include issues affecting recruiting of undergraduate and graduate students. The Assessment Committee was established since our last review and was created to address issues affecting the assessment of the department's academic programs. The committee is also responsible for executing assessment related activities. The Honors and Awards Committee was also created and is charged with identifying undergraduate and graduate students to receive various honors and awards each year including, but not limited to, the following: Outstanding Senior in Information Systems, Outstanding Senior in Business Technology Administration, the John B. Schwartz Scholarship, the Vijay Jose Scholarship, and Legg Mason Book Scholarships. Additionally, at the departmental level, faculty are actively engaged in advising undergraduates (range: 722- 950). The notable figure in CY09 (950) was attributable to rising enrollments in the program.

With respect to professional service to the field of information systems, faculty contributed to journals as editors and editorial board members. Faculty actively participated as reviewers of journal and international conferences as mentioned above. Faculty also held offices in national and international organizations such as ACM SIGCHI, AMIA, and ACM and SMARTCOMP with a contribution to regional and local organizations. Finally, with respect to service to the public, which includes both paid and unpaid contributions, faculty spent days of effort involved with school systems, government agencies, non-profit agencies, and businesses.

IX. Student Profile

A. Undergraduate student profile

As of Fall 2017 there are 1257 undergraduate students in the IS department, which is 11% of the university's undergraduate student population. Since the precipitous drop in 2007, the undergraduate student numbers have been increasing steadily along with the full-time equivalents. The average age of the undergraduate students in the IS department is 22.2 with 74% men and 26% women. The largest ethnic cohort is Asian (34%), followed by white (31%), black (17%) Hispanic (5%), and international (4%). There are 5 American Indians and one Hawaiian/Pacific islander. Thus 61% of the students are minority with 26% under-represented minorities. 83% of the undergraduate students are full-time and 95% are in state. As of Fall 2017, there are 140 freshmen, 246 sophomores. 388 juniors, and 483 seniors. As most IS programs are offered at the graduate level there is little understanding of IS as a discipline among high school counselors. As a result most high school students enroll in the "Computer Science" track and subsequently apply for Computer Science programs as they enter college. However, many of the CS majors switch to IS programs within the first two years. As discussed before COMP 101 was started as a way to enable freshmen students to select the appropriate major at the outset rather than at a later point in time. As of Fall 2017, 543 students started as freshmen in the IS department, 664 are transfer students, and 50 have another undergraduate degree. The average cumulative UMBC GPA is 2.8, average highschool GPA is 3.5, and average transfer GPA is 2.9. The average SAT score is 1199 out of 1600. The undergraduate student profile is shown in Figure 3.

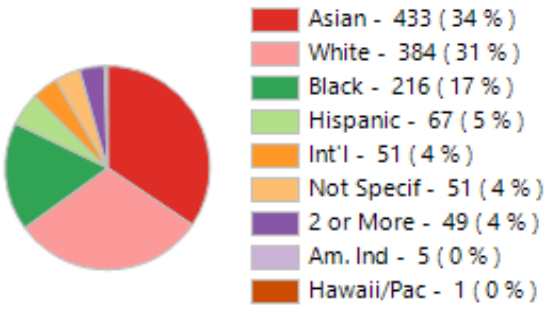

Figure 4. Undergraduate student demographics

B. Graduate Student Profile

As of Fall 2017 there are 448 graduate students in the IS department, which constitutes 18% of the graduate student population in the university. The gender distribution is 55% male and 44% female and 1% unknown. The racial/ethnic distribution, shown in Figure 4, is as follows: 40% international, 24% white, 17% black, 11% Asian, 2% Hispanic, and 4% unknown and one American Indian. Hence, 32% are minority and 23% are under-represented minorities. Around 43% of the graduate students are fulltime and 65% are out of state. The average age of the graduate students is 31. The average number of credits taken by the graduate students is 19 per year. The average cumulative GPA is 3.6.

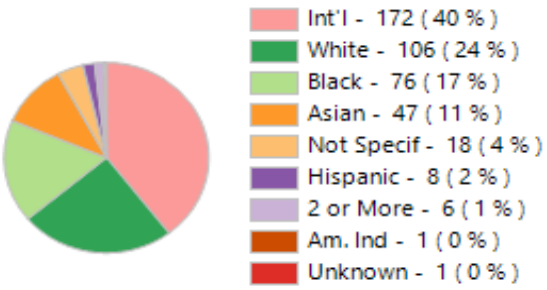

Figure 5. Graduate student demographics

X. Student advising

A. Undergraduate Advising

Most of the undergraduate advising is done by the full-time lecturers and the Undergraduate Program Director and Associate UPD. This resulted in a very large advising load on the lecturers, necessitating a number of course releases so that they could attend to their advising students. To help ameliorate this situation, beginning in the Fall semester of 2010, the tenured and tenure-track faculty began to assume some of the advising load. Most of the tenure track faculty advise some undergraduate students. However considering other responsibilities including graduate advising the number of undergraduate advisees has been kept small for most tenure track faculty. As the number of undergraduate students increases it will be important to hire new full-time lecturers to handle the advising load. While centralizing advising is a partial solution, there will be still considerable amount of advising load in the department as the undergraduate population is top heavy on the side of upper classmen.The remaining undergraduates will continue to be spread among a subset of faculty who advise larger numbers of students in exchange for course releases. To date, this group has been comprised entirely of full-time lecturers. Prior to starting undergraduate advising, tenured and tenure-track faculty are receiving training, both in the on-line Student Administration system (from DOIT) and in department-specific advising requirements (from the current Undergraduate Program Director and the full-time lecturers). They are also able to rely on the experienced advisors/lecturers for support and consulting. Currently, each full-time lecturer advises approximately 140 undergraduates, five of the tenured and tenure-track faculty each advise six students, and the Undergraduate Program Director advises about 100 students.

B. Graduate advising

MS Advising

Advising MS students is a process performed by faculty members who have been assigned as academic advisors of MS students. Primarily it is based on two items:

- Interaction between advisor and student
- Departmental course policies regarding courses that students should take

Interacting with academic advisor: Students are expected to create and discuss their academic plan with their designated academic advisor. The IS website provides guidelines for courses that are needed for graduation, and students are expected to consult with their academic advisor at least once every semester in order to select courses appropriate for their plan.

Students may elect to consult with their faculty advisor either on a face-to-face meeting or electronically over email. Students select courses that are interested in, and forward them to their advisor who in turn reviews the student's request and after viewing the student's academic history, decides to approve or deny the request. Approved requests are being sent to the graduate program manager who enters permissions for the students who can register for the approved courses.

Courses that students take: All IS courses are specified as "permission required" so that students take courses after consulting and receiving permission from their academic advisor. This policy has a dual benefit to the student and the department:

- Students cannot arbitrarily register for any number of courses without approval from advisors
- The department has a better handle on enrollment numbers since students must have approvals before registration

Advising MS Thesis students: Students who elect to write an MS Thesis have an additional faculty member as their "mentor". In addition, a three-member MS committee is formed with the mentor as chair and two additional faculty members. The student interacts closely with the mentor who guides the student on research topics and supervises their thesis and the courses that they take. The student also consults the MS committee member on Thesis progress.

Advising On-line MS students: On-line MS students receive advising on course selection in a slightly different way from on campus students. Since the on-line MS program offers a smaller number of courses, on-line MS students follow a pre-specified plan with fundamentals, core, and elective courses. Therefore, course selection is simpler and students request courses based on availability for a current semester.

The Graduate Program Director acts as an academic advisor for the on-line MS students and for the students whose advisor is on sabbatical.

PhD Advising

PhD students must identify a mentor who will guide them in their doctoral studies based on their research interests and the areas of expertise of faculty members. During the student's first year of doctoral work, if they have not already identified a mentor, all course scheduling must be approved by the Director of the Graduate Program to ensure compliance with the program. The Director of the Graduate Program will function as the advisor to first year doctoral students unless they have already designated a faculty mentor.

The faculty mentor discusses with the student all aspects of the program to make sure that the student follows all milestones of the program. In summary, the mentor performs the following duties with a mentee:

- Guides the student on course selection
- Approves courses to be taken
- Offers two independent study courses to the student and coordinates with other faculty members for the remaining two independent studies
- Discusses issues related to research area and choice of topic
- Participates as a member in the Comprehensive examination committee of the student
- Assists the student in identifying a research topic that will evolve into a dissertation and supervises the student in conducting preliminary research
- Oversees the student in the preparation of the dissertation proposal defense
- Guides the student in disseminating research results through external publications in conferences and journals
- Serves in the dissertation committee
- Supervises the student until completion of the dissertation research

XI. Financial support for graduate students

At this time, we are funding over 30 graduate students with either a Teaching Assistantship or a Research Assistantship. Our goal is to increase external funding in the future, which will results in an increase in Research Assistantships. However, additional university funding for Graduate Assistantships is necessary for the Department to continue effectively serving our majors. Additional funding will also provide stability for our PhD programs, help ensure a consistent flow of PhD graduates from the Department, and help the university retain its current classification as a public doctoral research extensive university.

XII. Student Research

Discuss undergraduate research and the number of graduate theses and dissertations for the last five years; student publications, exhibitions, and professional presentations. Include list of graduate and undergraduate student research projects for the past three years in appendix

A. Undergraduate Research

The major avenue currently for undergraduate students to gain research experience is through independent studies (IS 400) and senior projects (IS 469). In both cases, the student works individually with a faculty member on a project and topic of mutual interest. Many, but not all, independent studies and senior projects are research-oriented. The activities associated with these classes include conducting a literature review in a particular area, assisting in the collection of data for a larger research project, analyzing data, and helping with experimental design and research planning. Some of these opportunities have led to published papers, with undergraduate students as co-authors. The list of graduate and undergraduate student research projects for the past three years is shown in Appendix A.

The department has also set aside funds to support undergraduate and MS-level research. The department research awards require a proposal to be submitted from the student outlining the research plan and how the funds will be used. These funds cannot be used for stipends, but are often used for experimental materials, paying subjects, travel, and other research-related expenses. Some faculty also support undergraduate students through externally funded research projects such as National Science Foundation and State Highway Administration or internal funding such as Special Research Assistantship/Initiative Support (SRAIS), Undergraduate Research Awards (URA), and start-up funds. Typically, this level of support results in more extensive involvement in research activities as well as co-authored publications. Some of the undergraduates present their research at UMBC's Undergraduate Research and Creative Achievement Day.

Several undergraduate courses also teach research skills. Our two core systems analysis courses (IS 202 and 436) teach strategies for information gathering, an important activity in systems analysis. Techniques such as interviewing, surveying, and observation are taught and applied in the students' group projects. IS 403 also includes information-gathering skills. At least one undergraduate course (IS 413) also involves an in-depth review of selected academic and scholarly papers. Thus, all of our undergraduates are taught basic research skills as components of their core courses while more extensive exposure to research skills come through individual work with faculty members.

B. Graduate Theses and Dissertations

As a PhD granting department, we require doctoral students to complete a dissertation as part of fulfillment of their program requirement. There are 44 doctoral students who successfully completed their dissertation research in the past five years, which is a considerable increase from 26 which was the number at the time of the last APR. The topics of the dissertations cover all of the five research areas of the department. The list of doctoral students graduated in the past five years is shown in Appendix B. Since a second PhD program, Human-Centered Computing, was introduced two years ago, the number of dissertations is expected to increase in a few years.

For the IS program our doctoral students' exposure to research begins quickly with all incoming doctoral students being required to attend a PhD day, and take the gateway seminar course. In addition, all PhD students are reminded of and are encouraged to attend departmental seminars including presentations by internal and external speakers, proposal and final dissertation defenses. While many of these assistantships involve teaching responsibilities, some of the funded PhD students are funded by research grants of faculty members. Often, this results in immediate involvement with that faculty member's research activities. In addition, in their first semester, PhD students take the Department's Gateway Seminar, in which a different faculty member leads a discussion on their area of research each week. The course had been restructured into a two-semester course for the past two years. In addition to the introduction of faculty members' research, doctoral students are also required to work with a faculty member in the area of their interests on a research project to complete the course. PhD students are also required to take a minimum of two methodology courses, which range from field methods to statistics to experimental design. Our department has offered three more methodology courses (IS804, IS805, and IS809) since the last program review as regular courses.

A doctoral student's exposure to research continues after their initial semesters. Often, this is accompanied by the student being hired as a research assistant by a faculty member. In this case, the student becomes an integral part of an ongoing research project, including co-authoring publications. A number of our graduate-level courses, especially the Special Topics courses (IS 698/800), include a research component, ranging from review and study of the literature, to participation as a subject in an ongoing study, to experimental design and data analysis.

Probably the most important preparation our doctoral students receive, prior to beginning their dissertation work, is through the four required semester-long independent studies they must complete with multiple faculty members. These independent studies provide students with four one-on-one opportunities to conduct significant research. Normally, several of these independent studies result in published papers, with the student as a co-author

PhD students in the HCC program are required to take 9 credit hours of foundation courses including a reading seminar and two methodology courses including IS 804 and IS 805 and any other course approved by the advisor. In addition, they have to take five required core courses and eight advanced required courses including one independent study and a minimum of 12 dissertation credits. Both doctoral programs (IS and HCC) incorporate research into the program long before the students are formally admitted into candidacy. PhD students in both programs are also encouraged to identify and start working with a faculty mentor within a year of their starting the program. Similarly both programs require submission of a dossier after the first year so as to ensure that students are on track with their programs. Incorporating these additional structures in the process have ensured that the doctoral students are able to identify their research goals and start preparing for the actual research as early as possible

The research opportunities for graduate students are not limited to doctoral students. An increasing number of Masters students have opted for the thesis option in the past few years. Thus, our MS students also benefit from a significant exposure to research methods and issues. Most of the graduate level courses with research components (in particular IS 698) are also available to MS students. MS students also take independent studies and some of our MS students also have assistantships through which they assist faculty members with research.

C. Student Publications and Professional Presentations

Given the opportunities the department has offered for students to work with faculty on research projects as well as receiving training on research methodology, many students' work has led to publishable results. Students from all levels have been involved in research publications. In the past five years, our students have co-authored 21 journal articles, 48 conference papers, 4 invited talks, and 25 presentations. Details are provided in Appendix C. Some of the journals are of top quality in specific areas such *as IEEE Transactions on Knowledge and Data Engineering* and *ACM Transactions on Computer Human Interaction*. Some of the conference papers were selected as the Best Student Award.

XIII. Facilities

The following table indicates the need for improvement in the facilities of the IS department. These are based on the current faculty, staff, and student numbers. As the department continues to grow there will be additional space requirements because we are at almost 100% utilization.

	Very Adequate	Adequate	Inadequate	Very Inadequate
Facility				
1. Office Space				
a. Faculty Space		X		
b. Administrative Space		X		
c. Graduate Student Space			X	
2. Library				
a. Periodical Holdings		X		
b. Book Holdings		X		
c. Department-based Holdings				
3. Computing Facilities				
a. Central Computer Server(s)				
1. Hardware		X		
2. Software		X		
b. Department-Based				
1. Hardware			X	
2. Software		X		
4. Other Research Facilities				
a. Laboratories				
1. Space		X		
2. Electric Power		X		
3. Water and Sewer		X		
4. Lighting, Heat		X		
5. Ventilation		X		
b. Equipment				
1. Faculty Research		X		
2. Teaching		X		
3. Student Research			X	

The University library budget has been reduced over the past several years. The faculty has had to make decisions on removing journals from the library subscription list. While this is not ideal, the university library does provide support services such as acquiring journal articles requested by the faculty.

The remaining categories of the Facility Review are determined to be Adequate or Very Adequate. The ITE building has appropriate space for offices and research. With the increase in external funding and new hires the demand on research space is also increasing. The department had to convert some space previously allocated for graduate students into research lab space for the faculty. We also converted an open lab space for all IS students into a research lab. This was not ideal for the students and after meeting with the student leadership it was decided that we would make the teaching labs available for student use when not in use. The faculty in the IS department discussed this issue in our faculty meeting.

The department maintains four teaching labs with 25 computers in each. There is no budget line item for upgrading these computers. However, computers need to be upgraded or replaced every 4-5 years. Electric power, heat, and ventilation could have been rated higher, but there are periodic problems with the HVAC causing rooms to be inappropriately hot or cold and we have had occasional power problems especially with regard to the power for our servers.

XIV. Climate

Given the nature of this section, especially the fact that this section would be the most logical place for concerns of individual faculty or groups of faculty to appear, faculty were invited to provide feedback individually. We also arranged for faculty to meet by rank with the goal of allowing faculty to provide feedback as a group, thereby increasing the opportunity for anonymity if desired. The information provided below represents a summary of the issues raised by all groups.

We have a mixed group of faculty from varying backgrounds. The department maintains a high level of scholarly productivity. Research collaboration within and across groups is a common practice in all five research areas.

There is considerable support provided by the senior faculty in terms of mentoring junior faculty. Some of the activities that promote support are meetings held every spring between tenured and tenure-track faculty where the tenured faculty outline their expectations for tenure. Throughout the year, the department sponsors lunches where the tenure-track faculty get together and discuss issues relating to promotion and tenure. In terms of university support, the WISE group (Women in Science and Engineering) and the Provost's office conduct meetings where specific issues relating to tenured/tenure track faculty are discussed.

Research mentoring occurs at different levels in the department. Annual reviews are conducted where the Chair of the department compiles and conveys the feedback from all tenured faculty members on the performance of the tenure-track faculty member. The chair and dean also enable research opportunities with the industry by connecting individual faculty members with industry contacts. The department offers a proposal reviewing service performed by colleagues and also maintains a repository of successful proposals that faculty members can use as guides when preparing proposals. The department also enables paid editing services for proposals and papers.

To promote a collegial environment where research ideas can be discussed and exchanged freely, the department organizes brown bag lunch speaker series where local speakers and speakers within the department are encouraged to present their research. In addition, the department organizes a distinguished lecture series every semester. The visiting speakers give a unique opportunity to discuss research conducted within the department and to explore collaborations. Monthly faculty/staff meetings and also provide venues for discussion with other faculty/staff, and provide a forum to discuss department-wide issues. The assistant professors observed that it would be nice to receive more financial support from the department to attend conferences to enable building strong ties with the professional community. At present, financial support is included in start-up packages (typically covering the first three years). Beyond start-up packages, financial support is determined based on the merit performance of the faculty member, but the amount allotted is no longer sufficient for all conference-related expenses due to recent budget cuts.

To assist faculty with teaching, several department and university level facilities are available. The Faculty Development Center Director meets with individual faculty members, video tapes of their classes, conducts student group evaluations, and also meets with the faculty member individually and suggests avenues for improvement. Additionally, the Faculty Development Center runs training workshops to support teaching (e.g., supporting writing intensive courses, experiences from second year faculty, etc). Further, colleagues in the department are willing to help each other with courses that they have taught previously, by providing course materials, or giving feedback on how to improve the course.

Several internal funding mechanisms are made available to faculty members with the eventual goal of encouraging external funding support. Currently, the department will provide some funding to further research outlined in proposals that received positive reviews from external funding agencies (but were not funded). Course releases are available for faculty with sufficient external funding who are using this funding to engage students in their research. The university also provides opportunities such as the summer faculty fellowship and the SRAIS (Special Research Assistantship/Initiative Support) program to support faculty members with giving seed money to pursue efforts to secure external funding.

Co-curricular activities for students include participation in the IT Visionaries seminar series and a new IS seminar series instituted this year. All of our undergraduate students are welcomed to participate in their own IS Council of Majors where an IS Faculty advisor supports their peer efforts to develop meaningful program choices. Graduate students have their own student organization

and are also encouraged to participate in the university-wide graduate students association.

Mentoring for our students is done through both a structured advising session multiple times per year as well as an open door policy for mentoring according to discipline by all IS and HCC faculty.

Racial diversity within the graduate and undergraduate student populations is very good and a number of faculty also participate in student recruiting events targeted at minority populations. Though the Department has an active relationship with the CWIT program and tries to promote the inclusion of women in the IS major, there has been a definite drop in female undergraduate students since the last reporting period. Conversely, the Department's hiring has resulted in a relatively high percentage of women in faculty positions while the racial diversity issue remains only partially addressed.

There are some significant differences of opinion among the senior faculty with regard to the importance of obtaining external funding. There are on-going discussions among the tenured faculty about how to address these differences and find common ground that would satisfy the individual differences while being consistent with the research goals and missions of the university and the college.

XV. Profile of graduates

For the past five years, indicate the number of graduates and survey 25 of them for information on job placements, and continued contributions to the field or profession. Include list of job placements in appendix. (Use data from Tables 13 and 14)

A. Undergraduate

The number of degrees awarded by the Department of Information Systems steadily rose from 50 in the BTA program and 150 in the IS program in 2012 to 75 (BTA) and 175 (IS) in 2017. Given the student demand in Health IT and cybersecurity the department started two certificate programs in these areas in 2017. The cybersecurity analytics certificate program already has 20 students enrolled in it. The courses in both areas are in high demand. The results of our departmental on-line surveys show that in the past five years (between 2010-2016) the average starting salary of our graduates from the BTA program was $38,000 per year and that of our graduates from the BS program was $46,000 per year. Most of the respondents reported that their job search time was between zero to three months, the numbers being equally distributed between "less than one month" and "one to three months". Most of the students from the undergraduate degree programs work as computer programmers/analysts. Most (74%) of the graduates have full-time positions. About 18% enroll directly in graduate programs. Some of the employers include Lockheed Martin, GE, Legg Mason, and Microsoft.

B. Graduate

The number of PhD degrees awarded in the past 5 years was an average of 10 per year. The number of degrees granted in the face-to-face Masters program in the past 5 years was an average of 100 per year. The number of graduates from the on-line MS program ranged from 60 with an average of around 50 per year. It is noteworthy that the traditional on-campus MS program has produced more graduates in each of the last three years as compared to the on-line program, which is a reverse trend than in the years of our previous APR. The average salary reported by respondents who graduated from our MS program was $59,000, while that of our PhD program was $72,000. Some of the employers of our graduate students include Lockheed Martin, Verizon, and State Highway Administration. Students graduating from our PhD programs often take positions in academia including University of Massachusetts Boston, Towson University, University of South Carolina, Illinois State University, as well as international universities such as Kuwait University, Imam Saud University, and Jordan University of Science and Technology. A significant portion of our PhD graduates also take government and industry positions including Google, Facebook,

MITRE, and MedStar. Some international students are increasingly returning to their country of origin.

XVI. Budget

Given recent economic conditions and the resulting reductions in UMBC's budget, the IS Department has experienced some reduction in its core budget in recent years as have other departments across campus. In addition, the department returns a significant amount of money from its on-line program earnings. Together, these reductions have impacted the department in terms of providing teaching support to the faculty including teaching releases. The average teaching load for a research active tenured faculty is 2 courses per semester, which is higher than any of the other departments in the college or other peer institutions with similar research expectations. In order to grow our research productivity it will be beneficial to reduce the teaching load to 3 per year for tenured faculty and two per year pre-tenure.

Another area of concern is the cost overruns in our adjunct faculty budget that has to be covered from departmental resources. At the same time the Dean and the Provost have provided significant help with the startup costs of the hiring of the new faculty. As we recruit faculty members with strong research interest and potential the startup funds and teaching load need to be competitive with our peer institutions.

The department has limited state funds to support PhD students which has remained stagnant for many years. This has implications for the department's PhD production, the ability of faculty to recruit students to work on new grants, and how we address instructional needs at the undergraduate level. Increased support for graduate assistantships would allow the department to address its instructional mission more effectively and would increase research productivity. However, this has been offset by the increase in the number of grant funded PhD students as compared to the time of the previous APR.

This was one significant factor in the revisions to our undergraduate advising model since the last APR. Ultimately, this revised advising model should result in increased interactions between tenured/tenure-track faculty and our undergraduate students. We believe the support mechanisms we have established for this new advising mechanism, combined with the support provided through PeopleSoft, will allow these students to be effectively advised. While the end result of this change should be positive from the perspective of our undergraduate programs, it does add an additional task for our faculty.

Budget cuts have had a significant impact on the resources available to support the department's operations, leaving minimal funds for basic necessities such as copying, replacing equipment, and buying office supplies. Reductions in state funding have also resulted in a significant reduction in support for faculty travel. While some funds are still made available to all faculty, the amount allocated to each faculty member has decreased to the extent where these funds are no longer adequate to cover the expenses associated with a single trip. Obtaining external funding (a portion of the department's anticipated indirect cost returns are distributed to faculty when grants are first received) has helped the faculty to some extent.

Given changes in staffing and enrollments, the department has experienced an increase in the number of courses being offered as well as an increase in the number of sections that must be staffed with part-time instructors. However, there has not been a corresponding increase in the department's budget for hiring part-time instructors. To address this situation, the vast majority of departmentally-funded PhD students supervise labs or teach classes. At present, it is estimated that the department's part-time staffing budget is approximately $70,000 less than what is required. Recent requests for supplemental funding for courses taught by part-time instructors did reduce this shortfall slightly, but these funds have not been added to the department's base budget at this time. To address this significant shortfall, the department must rely on salary savings associated with vacant positions and sabbaticals as well as retained earnings from the on-line MS program. The use of retained earnings from the on-line MS program is noteworthy since, from its inception, the intent was for these funds to be used to support and build the department's research activities.

Given the current budget situation, the department is only able to support full-year sabbatical requests since this generates some salary savings even after part-time instructors are hired to cover the resulting unstaffed courses. In recent years, the department has had numerous requests to develop family support plans (with corresponding reductions in teaching loads). All such requests have been supported, but it is important to note that this creates financial challenges for the

department since faculty are typically excused from teaching for a semester with no reduction in salary and no additional funds are provided to the department to address the corresponding increase in part-time staffing.

The on-line MS program has become an integral part of the department and central to its financial operations. This program provides support for 2 of the department's five full-time staff. The instructional staffing budget of the on-line MS program also provides support for approximately one-half of the department-supported PhD students with all of these students being directly involved in instructional activities. The success of this program provides additional resources to the department in the form of a fraction of the retained earnings after all expenses are covered. Faculty who support student involvement in research via external funding also receive some funds in recognition of their contribution to enhancing the department's research activities. Additional funds are used for departmental administration such as the Associate Chair, GPDs and UPDs, faculty hiring including advertising and campus visit, and startup costs for the new faculty.

Overall, the primary budget-related challenge for the IS Department is our part-time staffing budget. This shortfall, combined with the fact that we must offer these unfunded courses if our students are going to continue to make progress toward completing their degrees, forces the department to reallocate funds which would otherwise be used to support and build the department's research programs to address these demands. An additional budget-related challenge would be the limited funding provided by the university for graduate assistants. Since graduate assistants not only supervise labs associated with some of our larger classes but also teach some undergraduate courses, additional funding for graduate assistants would also help reduce our reliance on part-time instructors for these courses.

XVII. Evaluation

The Department of Information Systems has many challenging tasks such as providing quality education to undergraduate and graduate students, developing new academic programs while continuously assessing and improving the quality of existing programs, increasing research productivity and competing for external funding to maintain and increase graduate student support, retaining and hiring faculty to drive the aspirations of the department. The challenging economic times have inevitably put additional pressures to maintain all of our academic programs to minimize the effect on students by offering required and elective courses in a timely manner without affecting instructional quality, and being able to operate with reduced staff support and funding for graduate students. The department has so far been able to meet all of these challenges and, in addition, has been able to create new programs such as undergraduate certificates, MS and PhD in HCC, MPS in Health IT, and a successful on-line MS program.

As we move forward the faculty has to continue the strive for excellence in providing quality undergraduate education, promote cutting edge research, increase collaborations with private and public industries to grow the state's economy, and serve the communities it lives in. It will be critical for us to continue to hire new high quality faculty who will help us to grow our research programs and educate students at all levels.

XVIII. Future directions

The faculty met to discuss the future directions of the department and several ideas emerged as a result. The major directions are listed below:

1. Undergraduate hybrid courses: To date, all of our undergraduate courses are classroom based. However, there are discussions at the university level regarding offering hybrid courses at various levels. The department's undergraduate committee, the department chair and the associate chair for academic programs are actively discussing the policies and procedures to introduce hybrid courses in the undergraduate curriculum.
2. BTA program: There are ongoing discussions regarding the BTA program, its goals, and the nature of this program moving forward. There are concerns regarding how well prepared students are to enter the workforce upon completion of the degree and the nature of the positions students can attain. One of the strengths of the program – the requirement to complete a second major – is also viewed as a potential difficulty since this gives students a degree of flexibility that is not always effectively exercised. A number of changes have been discussed including strengthening the technical content of the program; placing new restrictions on the second major that students complete

(e.g., providing a list of pre-approved options and requiring a written statement from students outlining their long-term plans if they wish to pursue an option not on this list). Discussions will continue with the goal of strengthening the program such that students are well prepared to enter the workforce upon completion.

3. Importance of external funding: As stated elsewhere in this document, the faculty is divided on this issue and its ramifications on faculty productivity and the department's research mission. By and large the faculty believe that increasing external funding is critical as it can help strengthen and grow the department's PhD programs while enhancing the department's status within the community and contributing to UMBC's goal of enhancing its status as a research university. As we move forward, we will continue to encourage faculty to identify funding sources, develop, submit, and resubmit revised and improved proposals, and to leverage external funding to enhance their research programs and engage students at all levels in research activities.
4. Research areas: Currently, there are five research areas in the department. As the department moves forward it will be important to identify areas where strong research programs can be built in terms of retention of faculty, hiring high-quality faculty, supporting additional PhD students through external funding, and increasing the visibility of the research in the department.
5. Graduate certificates: Currently the department does not offer graduate certificates. We are actively discussing the possibility of introducing graduate certificates as a way of providing new options for students and recruiting new students to our graduate degrees. Issues that need to be resolved include identification of the areas, number of courses required to complete a certificate, and relationship between these certificates and our existing graduate programs.

Appendix A: List of graduate and undergraduate student research projects for the past three years

1. Target-Based, Privacy Preserving, and Incremental Association Rule Mining
2. A smart segmentation technique towards improved infrequent non-speech gestural activity recognition model
3. SenseBox: A low-cost smart home system
4. Analyzing Social Media Texts and Images to Assess the Impact of Flash Floods in Cities
5. STenSr: Spatio-temporal tensor streams for anomaly detection and pattern discovery
6. A Graph-Based Method for Analyzing Electronic Medical Records
7. Mining trajectories of moving dynamic spatio-temporal regions in sensor datasets
8.
9. Analyzing Attack Strategies Against Rule-Based Intrusion Detection Systems
10. Network Analysis towards Drug Repositioning using the PIM Substrates
11. Tracking the Evolution of Physical Events from Social Media using Signal Processing
12. Detecting Domain Generation Algorithms using Convolutional Neural Networks
13. Password Meters for Mobile Authentication
14. Mobile Authentication Methods
15. Ethics of BCI
16. Authentication using BCI
17. Enhancing Mobile Users' Levels of Situational Awareness Using Tactile Feedback
18. Developing Technologies for Individuals with Intellectual Disabilities
19. Technologies to Support Individuals who are Blind
20. Evaluation of Physical and Web Interfaces
21. Determining the Accessibility of Social Networking Sites
22. Telerehabilitation study
23. Telestration in laparoscopic surgery study
24. Parkinson's movement assessment study
25. Narratives in Gaming
26. Hierarchical Bayesian Models of Species Distributions in High-Dimensional Microbial Data
27. Emotion Perception from Body Expressions
28. Affective Body Expression Recognition Systems of Paramedics in Simulation Training
29. Development of Physiological Sensing Event Tagging Application
30. Clustering User Session Data to Detect Malicious Bot Traffic
31. Web Testing Infrastructure
32. Cyberstudy of the Federal Government

33. Smart Home in a Retail Box: Modifying Inexpensive, Off-The-Shelf Hardware to Aid Cutting-Edge Research
34. A Microphone Sensor based System for Green Building Applications
35. A Survey of Embedded Power Line Communications Solutions for Sensor Network Applications
36. Ensuring Secure Cloud Services Using Policy-Based Approaches
37. Reputation Scoring System & Score Based Correlation
38. Unstructured Data Knowledge Extraction
39. Automated Legal Analytics Using Deep Learning
40. Accelerated Cognitive Computing Lab projects
41. Data Protection Using Blockchains
42. Implicit One-handed Mobile User Authentication by Induced Thumb Biometrics on Touch-screen Handheld Devices
43. Using game mechanics to improve outcomes among stem cell transplant survivors
44. Behavioral Control of Deceivers in Online Attacks
45. Using game mechanics to improve outcomes among stem cell transplant survivors
46. Toward a User-centered, Inclusive, and Personalized Approach to Mobile Web Adaptation
47. Hybrid learning for imbalanced stream classification
48. Intrusion detection from large-scale streaming data
49. Wearable Sensor based Human Posture Recognition
50. A Comparison of Big Data Application Programming Approaches: A Travel Companion Case Study
51. Examining the challenges faced by individuals with diverse needs (e.g. vision loss, situational impairments) when accessing both web and mobile-based interfaces
52. Examining tactile, auditory and graphical authentication for desktop and mobile interfaces
53. Brain-Computer Interfaces (BCI) and gestural interaction to support communication
54. Developing haptic feedback to support GUI exploration for individuals who are blind, and tactile feedback to support mobile interactions
55. Participatory design (PD) with disabled communities
56. Enhancing mobile device users' levels of situational awareness through tactile feedback
57. Supporting physical activity in slow walking conditions
58. Developing Authentication Mechanisms to Support Situational Impairments
59. Credibility of Information for Individuals who are Blind
60. Supporting Social Networking Among Students
61. Authentication using Smartwatch Technologies
62. Supporting Communication through Tactile and Gestural Signals
63. Hand Signal Recognition
64. Web Credibility for Individuals who are Blind
65. Haptic and Gestural Authentication
66. Haptic Authentication Methods
67. Mobile Solution to Support Individuals with Cognitive and Physical Disabilities
68. Haptic Automotive Interfaces
69. Enhancing Mobile Users' Levels of Situational Awareness Using Tactile Feedback
70. Supporting Dementia Care in the Home
71. Activism in Live Streaming
72. Social Media Break
73. Traumatic Brain Injury Movement Assessment
74. Heads Up Display for Instruction
75. Distribution of Imaging Use in Surgery
76. Software Process Improvement through the Removal of Project-level Knowledge Flow Obstacles: The Perceptions of Software Engineers
77. A Validated Checklist for Planning Experiments in Software Engineering
78. Qualitative Synthesis in Software Engineering Research
79. Measuring and Monitoring Technical Debt
80. Awareness of Technical Debt in Agile Software Teams
81. Insight Moments in the Learning of Programming Languages
82. Decision Making with Technical Debt Information
83. Accelerated Cognitive Computing Lab (ACCL)
84. Efficient and scalable RDF store with support for federated search and reasoning
85. Nonverbal behavior recognition with paramedic trainees in simulation training
86. Physiological sensing of public speaking anxiety in ESL students
87. International medical graduates' information behaviors
88. Searching for information in English as a foreign language

89. Interruptive Notifications in Support of Task Management
90. Enhancing Embodied Conversation Agents with Initial Inventories
91. Credibility decisions of foreign-language searchers
92. Foreign-language search behaviors of Arabic speakers
93. Code-switching in online searching
94. Supporting children's online identity in international communities
95. Collaborative sensemaking in virtual reality environments
96. Work practices of cybersecurity advocates
97. Virtual reality UX for language acquisition
98. Understanding group polarization in social media, design interventions
99. Citizen acceptance model for technology mediated social participation systems, value sensitive social media design for Arabic culture
100. Examination of synthetic knowledge production processes in land system science, creation of scientific cyberinfrastructure
101. Updating faultline models for group dynamics on distributed teams, more carefully understanding the norms of technology use
102. Understanding authorship and audience in the design of team-based online and hybrid courses
103. User's perception of privacy and security implications of Android's app permission system
104. Fault Seeding of SQL Injection Faults in Web Applications
105. Examining static analysis tool use among Android developers
106. Mutating Click-stream data to detect code injection vulnerabilities in web applications
107. Understanding MVC architecture and fault seeding
108. Identifying malicious values to use in SQL injection attacks
109. Load testing of web applications

Appendix B: List of Doctoral Students Graduated in the Past Five years

Doctoral Student	Date of Degree	Organization	Title
Patrick Carrington	2017	Carnegie Mellon	Charitable Computing
Mohammed Arif Ul Alam	2017	IBM, Cambridge, Mass.	Context-Aware Multi-Inhabitant Functional and Physiological Health Assessment in Smart Home Environments
Song Chen	2017	MITRE Corp.	Fraud Detection in Healthcare
Peng Chu	2017	Honeywell Intelligrated	Information Seeking and Retrieval in English as a Non-Native Language
Cailing Dong	2017	Intelligent Fusion Technology	Linking Online and Offline Social World: Opportunities and Threats
John Hebler, Jr	2017	Lockheed Martin	Convergence-Directed, Semantic Model for Integrating Large-Scale, Dynamic, and Heterogeneous Databases
Ibrahim Toure	2017	CoStar Group	Real Time Big Data Analytics for Predicting Terrorist Incidents
Shaikha Al-Duaij	2017	Kuwait University	A Data Mining Approach to Compare Privacy Policies
Hseien-Ming Chou	2017	Chung Yuan Christian University, Taiwan	Context-Aware Call Management for Mobile Phones
Yin Kang	2017	Samsung	A Hierarchical Framework for Online Product Review Helpfulness Assessment
Gloria Abena Opoku-Boateng	2017	Northrup Grumman	Computerized and Non-Computerized Approaches to Brain Games for Maintaining and Enhancing Mental Acuity in Health Older Adults: An Investigation of Performance Enhancement
Kirsten Richards	2017	Loyola College, MD	Risk Analysis of the Discoverability of Personal Data Used for Primary and Secondary Authentication
Timothy Richards	2017	USNA	Young Adult Preferences for Campaign Website Personalization and Privacy: A Data-Driven Instrument for Design
Fahed Alayed	2016	Imam Muhammad Ibn Saud University	Citizen Acceptance Model for Technology-Mediated Social Particiopation
Yupeu Guo	2016		Measuring and Monitoring Technical Debt

Jianwei Lai	2016	Illinois State University	Thumb-Based Approaches to Target Acquisition, Zooming, and Text Entry in Single-Handed Interaction with Mobile Phones
Rand Obeidat	2016	University of Minn. Duluth	Technological Disruptive Change Within Healthcare Environment: An Examination of Change Management Factors that Influence Nurses' Attitude Towards Implementing Disruptive Change
Kelly Gurley	2016	MedStar, Boston	The Accuracy of Self Reported Data of an Aging Population Using a Telehealth System in a Retirement Community Setting Based on the User's Age, Gender, Employment, Status and Computer Experience.
Dari Alhuwail	2016	Kuwait University	Leveraging Health Information Technology Effectively for Performance Improvement in Home Health Care
Ali Azari	2016	CVS	Multiclass Imbalanced Learning through Selective Sampling
Brantd Braunschweig	2016		Measuring Shared Understanding in Software Design Teams
Gohar Mukhtar	2016	IRS	Resuscitating Service Oriented Architecture (SOA): Honing SOA Adoption by Measuring Maturity at the Service Architecture Level
Rose Yesha	2016	UMBC	An Automated Method for Analyzing Unstructured Health Data
Josephine Namayanja	2015	University of Mass, Boston	Change Detection in Temporally Evolving Networks
Yanan Sun	2015	Towson University	Tensor-Based Spatio-Temporal Outlier Detection in Large Datasets
Michele Williams	2015	Perason	Answering Subjective and Open-Ended Visual Questions from People with Vision IMpairments
Alyson Young	2015	Indiana University, Indianapolis (IUPUI)	From Local Data to Global Knowledge: Understanding Meta-Study Practice in Land Change Science
Ahmad Alaiad	2015	Jordan University of Science and Technology	A Model of Adoption of Emerging Home Healthcare Information Technology
Amir Karami	2015	University of South Carolina	Fuzzy Topic Modeling for Medical Corpora
Hsien-ming Chou			
Huimin Qian	2014		Improving Access to Mobile Technologies Using Tactile Feedback
Shaojian Zhu	2014	Google	A Quantitative Quality Control Model for Parallel and Distributed Crowdsourcing

			tasks
Lei Shi	2014	Facebook	Multivariate Spatial Anomalous Window Discovery
Rahayu Ahmad	2014	Universiti Utara (Malaysia)	Perceived Faultline Impact in temporary Distributed teams: Examining the Role of Norms in technology Use
Kathleen Weaver	2014	University of Maryland	Using an Intelligent Interviewer to Conduct Cognitive Assessments
John Piorkowski	2014	JHU /Applied Physics Laboratory	Trust Discovery in Online Communities
Ahmed Aleroud	2014	Yarmouk University	Contextual Information Fusion for the Detection of Cyber-Attacks
Jinie Pak	2014	Towson University	Detecting Deception in Computer Mediated Communication: A Social Structural Perspective
Hayden Wimmer	2013	Georgia Southern University	Knowledge-Guided Evolutionary Algorithms for Financial Investing
Kelly Engle	2013	HACC	Data Mining and Domain Knowledge: An Exploration of Methods to Advance Medical Research
Lisa Vizer	2013	UNC Chapel Hill	Detecting Cognitive Stress and Impairment Using keystroke and Linguistic Features of Typed Text: Toward a Method for Continuous Monitoring of Cognitive Status
Zhenxue Zhang	2013	Facebook	urCF: An Approach to Integrating User Reviews to Memory-Based Collaborative Filtering
Celeste Paul	2013	Department of Defense	A model for Contextual Factors and their Effects in the Interruptive Notification User Experience
Zelalem Bachore	2012	Cabrini University	
Susan Mitchell	2012	University of Maryland, Baltimore County	
Matthew Dinmore	2012		
Jie Du	2012		Memetic Algorithms, Domain knowledge and Financial Investing
Thomas Narock	2012	Notre Dame of Maryland University	Provenance-Based Approaches to Semantic Web Discovery and Usage

Appendix C: List of Student Publications

A. Journal Publications, Peer Reviewed

1. Julie M. Haney and Wayne G. Lutters. 2017. The Work of Cybersecurity Advocates. In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems.
2. Frey, B., Southern, C., & Romero, M. (2011). Brailletouch: mobile texting for the visually impaired. Universal Access in Human-Computer Interaction. Context Diversity, 19-25.
3. Southern, C., Clawson, J., Frey, B., Abowd, G., & Romero, M. (2012, September). Braille Touch: mobile touchscreen text entry for the visually impaired. In Proceedings of the 14th international conference on Human-computer interaction with mobile devices and services companion (pp. 155-156). ACM.
4. Romero, M., Frey, B., Southern, C., & Abowd, G. D. (2011, August). BrailleTouch: designing a mobile eyes-free soft keyboard. In Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services (pp. 707-709). ACM.
5. Frey, B., Rosier, K., Southern, C., & Romero, M. (2012, May). From texting app to braille literacy. In CHI'12 Extended Abstracts on Human Factors in Computing Systems (pp. 2495-2500). ACM.
6. Kane, S. K., Frey, B., & Wobbrock, J. O. (2013, April). Access lens: a gesture-based screen reader for real-world documents. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 347-350). ACM.
7. Wong, C.K., Mentis, H.M., Kuber, R. (to appear in 2017). The Bit Doesn't Fit: Evaluation of a Commercial Activity-Tracker at Slower Walking Speeds. Gait & Posture, 59, 177-181.
8. Feng, Y, Wong, C.K., Janeja, V., Kuber, R., Mentis, H.M. (2017). Comparison of tri-axial accelerometers step-count accuracy in slow walking conditions. Gait & Posture, 53, 11-16.
9. Feng, Y., Wong, C., Park, A., & Mentis, H. (2016). Taxonomy of instructions given to residents in laparoscopic cholecystectomy. Surgical endoscopy, 30(3), 1073-1077.
10. Mentis, H.M., Shewbridge, R., Powell, S., Armstrong, M., Fishman, P., & Shulman, L. (2016). Co-Interpreting Movement with Sensors: Assessing Parkinson's Patients' Deep Brain Stimulation Programming. Human–Computer Interaction, 31(3-4), 227-260.
11. Madjaroff, G. & Mentis, H.M. (2017). Narratives of Older Adults with Mild Cognitive Impairment and Their Caregivers. Proceedings of the ACM SIGACCESS conference on Computers and accessibility (ASSETS), Baltimore, MD (pp. 140-149), New York: ACM.
12. Carrington, P., Chang, K., Mentis, H., & Hurst, A. (2015). "But, I don't take steps": Examining the Inaccessibility of Fitness Trackers for Wheelchair Athletes. Proceedings of the ACM SIGACCESS conference on Computers and accessibility (ASSETS), Lisbon, Portugal (pp. 193-201), New York:ACM.
13. Susan M. Mitchell, Carolyn B. Seaman. "Could removal of project-level knowledge flow obstacles contribute to software process improvement? A study of software engineer perceptions", Information and Software Technology. Volume 72, pp. 151-170. April 2016. doi:10.1016/j.infsof.2015.12.007
14. Mentis, H., Shewbridge, R., Powell, S., Fishman, P., & Shulman, L. (2015). Being seen: Co-Interpreting Parkinson's Patient's Movement Ability in Deep Brain Stimulation Programming. Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems (CHI), Seoul, South Korea (pp. 511-520), New York:ACM.
15. Yuepu Guo, Rodrigo Oliveira Spínola, Carolyn Seaman. "Exploring the costs of technical debt management – a case study", Empirical Software Engineering. 21(1):159-182, February 2016.
16. Erin Lim, Nitin Taksande, and Carolyn Seaman. "A Balancing Act: What Software Practitioners Have to Say about Technical Debt." IEEE Software, 29(6):22-27, DOI: 10.1109/MS.2012.130, 2012.
17. Carlton A. Crabtree, Anthony F. Norcio, and Carolyn B. Seaman. "An empirical study of process knowledge: coherence as a static process property," Journal of Software Evolution and Process, DOI: 10.1002/smr.1567, August 2012.
18. Carolyn Seaman, Yuepu Guo, Clemente Izurieta, Yuanfang Cai, Nico Zazworka, Forrest Shull, and Antonio Vetro'. "Using technical debt data in decision making: Potential decision approaches." Third International Workshop on Managing Technical Debt (MTD), pp. 45-48, DOI: 10.1109/MTD.2012.6225999, 2012.
19. Will Snipes, Brian Robinson, Yuepu Guo, and Carolyn Seaman. "Defining the decision factors for managing defects: A technical debt perspective." Third International Workshop on Managing Technical Debt (MTD), pp. 54-60, DOI: 10.1109/MTD.2012.6226001 , 2012.
20. Susan M. Mitchell and Carolyn B. Seaman. "Software Process Improvement through the Identification and Removal of Project-level Knowledge Flow Obstacles". International Conference on Software Engineering (ICSE), Track on New Insights and Emerging Results (NIER), pp. 1265-68, DOI: 10.1109/ICSE.2012.6227103, 2012.

21. Young, Alyson L., and Wayne G. Lutters, “Infrastructuring for Cross-Disciplinary Synthetic Science: Meta-Study Research in Land System Science,” Computer Supported Cooperative Work, Springer, 26(1), 2017, 165-203.
22. Haney, Julie M., and Wayne G. Lutters, “It’s Scary, It’s Confusing, It’s Dull”: How Cybersecurity Advocates Overcome Negative Perceptions of Security,” Proceedings of the Symposium on Usable Privacy and Security (SOUPS), USENIX, 2017, article 7, 1-6.
23. Pointek, J., Shull, F., & Tesoriero, R. “NetDyn Revisited: A Replicated Study of Network Dynamics,” Computer Networks and ISDN Systems 29.7 (1997): 831-840.
24. Saulynas, S., Lechner, C. and Kuber, R. 2017: Towards the Use of Brain-Computer Interface Technologies as a Potential Alternative to PIN Authentication. International Journal of Human-Computer Interaction. DOI: http://dx.doi.org/10.1080/10447318.2017.1357905
25. Wolf, F. & Kuber, R. 2017: Developing a Head-Mounted Tactile Prototype to Support Situational Awareness. International Journal of Human-Computer Studies. DOI: http://dx.doi.org/10.1016/j.ijhcs.2017.08.002.
26. Easley, W., Kuber, R. & Ozok, A.A. 2017: An Empirical Study Examining Medication Management among Individuals with Visual Impairments. Universal Access in the Information Society, 16 (2), 483-495.
27. Krishnaswamy, K., Kuber, R. & Oates, T. 2016: Developing a Limb Repositioning Interface for Individuals with Severe Physical Disabilities. Universal Access in the Information Society, 15 (4), 609–627.
28. Said, K., Kuber, R. & Murphy, E. 2015: AudioAuth: Exploring the Design and Usability of a Sound-Based Authentication System. International Journal of Mobile Human-Computer Interaction, 7(4), 16-34.
29. Qian, H., Kuber, R., Sears, A. & Stanwyck, E. 2014: Determining the Efficacy of Multi-Parameter Tactons in the Presence of Real-world and Simulated Audio Distractors. Interacting with Computers, Interacting with Computers, 26 (6), 572-594 .
30. Kuber, R. & Wright, F.P. 2013: Augmenting the Instant Messaging Experience Through the Use of Brain–Computer Interface and Gestural Technologies. International Journal of Human Computer Interaction, 29 (3), 178-191.
31. *Scheuerman, M., *Easley, W., *Abdolrahmani, A., Hurst, A., Branham, S.M. “Learning the Language: The Importance of Studying Written Directions in Designing Navigational Technologies for the Blind.” In Extended Abstracts, ACM SIGCHI Conference on Human Factors in Computer Systems (CHI EA ’17), Denver, CO, May 6-11, 2017. 7 pages.
32. Abdolrahmani, A., *Easley, W., Williams, M., **Ronquillo, E., Branham, S.M., Chen, T., Hurst, A. “Not All Errors are Created Equal: Factors that Impact Acceptance of an Indoor Navigation Aid for the Blind.” In Extended Abstracts, ACM SIGACCESS Conference on Computers & Accessibility (ASSETS EA ’16), Reno, NV, Oct 24-26, 2016. 2 pages.
33. Easley, W., Williams, M., *Abdolrahmani, A., **Galbraith, C., Branham, S.M., Hurst, A., Kane, S. “Let’s Get Lost: Exploring Social Norms In Predominately Blind Environments.” In Extended Abstracts, ACM SIGCHI Conference on Human Factors in Computing Systems (CHI EA ’16), San Jose, CA, May 7-12, 2016. 8 pages.
34. Buehler, E., Branham, S.M., *Ali, A., **Chang, J., **Hofmann, M., Hurst, A., Kane, S. “Sharing is Caring: Assistive Technology Designs on Thingiverse.” In Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems (CHI ’15), Seoul, Korea, April 18-23, 2015. 10 pages. (acceptance rate: 23%, Best Paper Award - top 1%)
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36. Branham, S.M., *Abdolrahmani, A., *Easley, W., *Scheuerman, M., **Ronquillo, E., Hurst, A. “‘Is Someone There? Do They Have a Gun?’: How Visual Information About Others Can Improve Personal Safety Management for Blind Individuals.” In Proceedings of the ACM SIGACCESS Conference on Computers & Accessibility (ASSETS ’17), Baltimore, MD, October 30 - November 1, 2017. 10 pages. (acceptance rate: 26%)
37. Hamidi, F., *Scheuerman, M., Branham, S.M. “Gender Recognition or Gender Reductionism? The Social Implications of Automatic Gender Recognition Systems.” In Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems (CHI ’18), Montéal, Quebec, April 21-26, 2018. 10 pages. Forthcoming
38. Oh, U., Branham, S.M., Findlater, L., Kane, S. “Audio-Based Feedback Techniques for Teaching Touchscreen Gestures.” In Transactions on Accessible Computing (TACCESS), 7(3), November 2015.
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Preserving, and Incremental Association Rule Mining, IEEE Transactions on Services Computing, 10(4),
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40. Shaikha Al-Duaij, Zhiyuan Chen, and Aryya Gangopadhyay. Using Crowd Sourcing to Analyze Consumers' Response to Privacy Policies of Online Social Network and Financial Institutions at Micro
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59. Md Abdullah Al Hafiz Khan and Nirmalya Roy, “TransAct: Transfer learning Enabled Activity Recognition”, in Proceedings of the 1st IEEE PerCom International Workshop on Pervasive Smart Living Spaces (PerLS), co-located with PerCom, pp. 545-550, March 2017.
60. David Welsh and Nirmalya Roy, “Smartphone-based Mobile Gunshot Detection”, In Proceedings of the 13th Workshop on Context and Activity Modeling and Recognition (CoMoRea'17), co-located with PerCom, pp. 244-249, March 2017.
61. Joseph Taylor, H M Sajjad Hossain, Mohammad Arif Ul Alam, Md Abdullah Al Hafiz Khan, Nirmalya Roy, Elizabeth Galik, and Aryya Gangopadhyay. “Demo: SenseBox: A Low-Cost Smart Home System”, in Proceedings of the IEEE International Conference on Pervasive Computing and Communications Demonstrations (PerCom), March 2017.
62. Mohammad Arif Ul Alam, Nirmalya Roy, Michelle Petruska, and Andrea Zemp, “Smart-Energy Group Anomaly Based Behavioral Abnormality Detection”, in Proceedings of the IEEE Wireless Health 2016, pp. 1-8, Washington D.C. October 2016.
63. Mohammad Arif Ul Alam, Nirmalya Roy, Archan Misra, Joseph Taylor, “CACE: Exploiting Behavioral Interactions for Improved Activity Recognition in Multi-Inhabitant Smart Homes”, in Proc. 36th IEEE International Conference on Distributed Computing Systems (ICDCS) Nara, Japan, pp. 539-548, June 2016. (17% acceptance rate)
64. Mohammad Arif Ul Alam, Nirmalya Roy, Sarah Holmes, Aryya Gangopadhyay, Elizabeth Galik, “Automated Functional and Behavioral Health Assessment of Older Adults with Dementia”, in Proc. First IEEE Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE), pp. 140-149, Washington D.C. June 2016.
65. Md Abdullah Al Hafiz Khan, Ruthvik Kukkapalli, Piyush Waradpande, Sekar Kulandaivel, Nilanjan Banerjee, Nirmalya Roy, Ryan Robucci, “RAM: Radar based Activity Monitor”, in Proc. IEEE International Conference on Computer Communications (INFOCOM), pp. 1-9, April 2016. (18% acceptance rate)
66. H M Sajjad Hossain, Nirmalya Roy, Md Abdullah Al Hafiz Khan, “Active Learning Enabled Activity Recognition”, in Proceedings of the IEEE International Conference on Pervasive Computing and Communications (PerCom), pp. 1-9, March 2016. (15% acceptance rate)
67. Nilavra Pathak, Nirmalya Roy, and Animikh Biswas “Iterative Signal Separation Assisted Energy Disaggregation”, in Proceedings of the IEEE 6th International Green and Sustainable Computing Conference (IGSC 2015), pp. 1-8, Dec 2015. Las Vegas, USA (27% acceptance rate)
68. Mohammad Arif Ul Alam, Nilavra Pathak, Nirmalya Roy, “Mobeacon: An iBeacon-Assisted Smartphone-based Real Time Activity Recognition Framework”, in Proceedings of the 12th International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services (MobiQuitous), Pages 130-139, July 2015. (27% acceptance rate)
69. Md. Abdullah Al Hafiz Khan, Sajjad Hossain, and Nirmalya Roy “Infrastructure-less Occupancy Detection and Semantic Localization in Smart Environments”, in Proceedings of the 12th International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services (MobiQuitous), Pages 51-60, July 2015. (27%acceptance rate)
70. Nilavra Pathak, Md. Abdullah Al Hafiz Khan, and Nirmalya Roy, “Acoustic based appliance state identifications for fine grained energy analytics”, in Proceedings of the IEEE International Conference on Pervasive Computing and Communications (PerCom), pp. 63-70, March 2015. (15% acceptance rate)
71. Nirmalya Roy, Nilavra Pathak, and Archan Misra, “AARPA: Combining Mobile and Power-line Sensing for Fine-grained Appliance Usage and Energy Monitoring”, in Proceedings of the IEEE International

Conference on Mobile Data Management (MDM), pp. 213-218, May 2015. (25% acceptance rate)
72. Md. Abdullah Al Hafiz Khan, Sajjad Hossain, and Nirmalya Roy, “SensePresence: Infrastructure-less Occupancy Detection for Opportunistic Sensing Applications”, in Proc. International Workshop on Human Mobility Computing and Privacy (HuMoComP), co-located with MDM, pp. 56-61, May 2015.
73. Sajjad Hossain, Nirmalya Roy, and Hafiz Khan, “Sleep Well: A Sound Sleep Monitoring Framework for Community Scaling”, in Proceedings of the IEEE International Conference on Mobile Data Management, (MDM), pp. 44-53, June 2015. (25% acceptance rate)
74. Nirmalya Roy and Christine Julien, “Immersive physiotherapy: Challenges for smart living environments and inclusive communities”, in Proceedings of the 12th International Conference on Smart Homes and Health Telematics (ICOST), pp 242-248, Denver, USA, June 2014.
75. Nirmalya Roy and Brooks Reed Kindle, “Monitoring patient recovery using wireless physiotherapy devices”, in Proceedings of the 12th International Conference on Smart Homes and Health Telematics (ICOST), pp 71-79, Denver, USA, June 2014.
76. Mohammad Arif Ul Alam and Nirmalya Roy, “Gesmart: A gestural activity recognition model for predicting behavioral health”, in Proceedings of the IEEE International Conference on Smart Computing (SmartComp), pp. 193-200, Hong Kong, China, November 2014.
77. Nirmalya Roy, David Kleinschmidt, Joseph Taylor and Behrooz Shirazi, “Performance of the Latest Generation Powerline Networking for Green Building Applications,” in Proceedings of the 5th ACM Workshop on Embedded Systems for Energy-Efficient Buildings, (BuildSys), Pages 1-8, Rome, Italy, 2013
78. Nirmalya Roy, Archan Misra, and Diane Cook, “Infrastructure-Assisted Smartphone-based ADL Recognition in Multi-Inhabitant Smart Environments”, in Proceedings of the IEEE International Conference on Pervasive Computing (PerCom), pp. 38-46, March 2013. (11% acceptance rate)

C. Poster Presentations, Peer Reviewed

1. Julie M. Haney and Wayne G. Lutters. 2017. "It's Scary, It's Confusing, It's Dull": How Cybersecurity Advocates Overcome Negative Perceptions of Security. Poster session at Symposium on Usable Privacy and Security (SOUPS)."
2. Julie M. Haney. 2016. Barriers to Adoption of the Top 10 Information Assurance Mitigations and Beyond: A Human-Centered Perspective. Presentation at Information Assurance Symposium.
3. Stoney Trent, Robert Hoffman, and Julie Haney. 2016. Measures of Operational Fit for Cyber Mission Forces. Poster session at National Defense Industrial Association Human Systems Conference.
4. Yili Zhang, Pratik Tamakuwala, and Güneş Koru. Toward High-Quality Big Data to Support Population Health: Identifying the Data Quality Problems with Medicaid Datasets. SINI2017, 27th Summer Institute in Nursing Informatics. (People's choice of best poster presentation award)
5. Brandt Braunschweig and Carolyn Seaman. "Measuring Shared Understanding in Software Project Teams using Pathfinder Networks", IEEE/ACM International Symposium on Empirical Software Engineering and Measurement (ESEM 2014), Torino, Italy, September 2014.
6. Julie M. Haney and Celeste L. Paul. 2016. Toward Integrated Operations Between Red/Blue Network Defense Teams. IEEE Military Communications (MILCOM).
7. Frey, B., & Seaman, C. (2015, October). Scientists tell stories: About seeking help with programming. In Visual Languages and Human-Centric Computing (VL/HCC), 2015 IEEE Symposium on (pp. 47-51). IEEE.
8. Frey, B., Doddridge, J & Seaman, C. (2017, October). Chasing the AHA! Moment: Exploring Initial Learnability of Programming Languages. In Visual Languages and Human-Centric Computing (VL/HCC), 2017 IEEE Symposium on (to appear). IEEE.
9. Frey, B. (2017, October). Moving from the Known to the Unknown to Measure the Initial Learnability of Programming Languages. In Visual Languages and Human-Centric Computing (VL/HCC), 2017 IEEE Symposium on (to appear). IEEE.
10. Yili Zhang, Pratik Tamakuwala, and Güneş Koru. Towards Improving the Quality of Medicaid Data: Identifying Data Defects in a Large Healthcare Administration System. AMIA 2017 Annual Symposium.
11. Yili Zhang, Pratik Tamakuwala, and Güneş Koru. Understanding and Detecting Data Defects in Medicaid Datasets: Towards Higher Data Quality for Better Decision Support. CHITA 2017, Conference on Health IT and Analytics.
12. Graziela Simone Tonin, Alfredo Goldman, Carolyn Seaman, Diogo Pina. "Effects of Technical Debt Awareness: A Classroom Study", 18th International Conference on Agile Software Development (XP 2017), May 2017, Cologne, Germany, forthcoming.
13. Haney, Julie M., and Wayne G. Lutters, "Skills and Characteristics of Successful Cybersecurity Advocates," Proceedings of the Workshop on Security Information Workers (WSIW), Symposium on Usable Privacy and Security (SOUPS), USENIX, 2017, paper 3, 1-7
14. Wolf, F., Kuber, R. & Aviv, A.J. Addressing Observational Attacks through the Design of a Tactile Aid for Mobile User Authentication. In 33rd Annual Computer Security Applications Conference - ACSAC'17, Orlando, FL.
15. Saulynas, S. & Kuber, R., 2017: Towards BCI and Gestural-Based Authentication for Individuals who are Blind. In Proceedings of the 19th International ACM Conference on Computers and Accessibility – ASSETS'17, Baltimore, MD, 403-404.
16. Wolf, F., Kuber, R. & Aviv, A.J., 2017: Perceptions of Mobile Device Authentication Mechanisms by Individuals who are Blind. In Proceedings of the 19th International ACM Conference on Computers and Accessibility – ASSETS'17, Baltimore, MD, 385-386.
17. Wolf, F., Kuber, R., Pawluk, D. & Turnage, B., 2017: Towards Supporting Individuals with Situational Impairments in Inhospitable Environments. In Proceedings of the 19th International ACM Conference on Computers and Accessibility – ASSETS'17, Baltimore, MD, 349-350.
18. Davin, J., Aviv, A.J., Kuber, R. & Wolf, F., 2017: Baseline Measurements of Shoulder Surfing Analysis and Comparability for Smartphone Unlock Authentication. In Extended Abstracts on Human Factors in Computing Systems - CHI'17, Denver, CO, 2496-2503.
19. Wolf, F., Kuber, R., and Aviv, A.J., 2016: Towards Non-Observable Authentication for Mobile Devices. In Proceedings of the Twelfth Symposium on Usable Privacy and Security – SOUPS'16, Denver, CO.

20. Abdolrahmani, A., Kuber, R. & Easley, W., 2015: Web Search Credibility Assessment for Individuals who are Blind. In Proceedings of the 17th International ACM Conference on Computers and Accessibility – ASSETS'15, Lisbon, Portugal, 369-370.
21. Saulynas, S., Albar, L., Kuber, R. & Felzer, T., 2015: Using OnScreenDualScribe to Support Text Entry and Targeting among Individuals with Physical Disabilities. In Proceedings of the 17th International ACM Conference on Computers and Accessibility – ASSETS'15, Lisbon, Portugal, 303-304.
22. Ali, A., Kuber, R. & Aviv, A.J., 2015: H4Plock: Supporting Mobile User Authentication through Gestural Input and Tactile Output. In Proceedings of the Eleventh Symposium on Usable Privacy and Security - SOUPS'15, Ottawa, Canada.
23. Saulynas, S. & Kuber, R., 2015: Going Beyond "Beyond Being There": An Inquiry into the Use of Brain-Computer Interface Technologies and Intelligent Machine Agents to Facilitate Inconspicuous Communication. In Proceedings of the International Conference on Collaboration Technologies and Systems – CTS'15, Atlanta, GA, 454-459 (Best Poster Paper Nominee).
24. Feldman, P. & Kuber, R., 2015: Tangibly Augmenting Haptics. In Extended Abstracts of the International Conference on Tangible, Embedded and Embodied Interaction – TEI'15, Stanford, CA, 563-568 .
25. Wolf, F. & Kuber, R. 2014: Developing Tactile Feedback for Wearable Presentation: Observations from using a Participatory Approach. In Extended Abstracts of the International Conference on Human Computer Interaction with Mobile Devices and Services - Mobile HCI'14, Toronto, Canada, 543-548.
26. Qian, H., Kuber, R. & Sears, A. 2014: Supporting the Mobile Notification Process through Tactile Cues Selected using a Paired Comparison Task. In Extended Abstracts on Human Factors in Computing Systems - CHI'14, Toronto, Canada, 1741-1746.
27. Wolf, F., Feldman, P. & Kuber, R. 2014: Towards Supporting Situational Awareness using Tactile Feedback. In proceedings of the IEEE Symposium on 3DUI, Minneapolis, USA, 131-132.
28. Norman, K., Arber, Y. & Kuber, R. 2013: How Accessible is the Process of Web Interface Design? In proceedings of the 15th International ACM Conference on Computers and Accessibility – ASSETS'13, Bellevue, USA, Article No: 51.
29. Qian, H., Kuber, R. & Sears, A. 2013: Designing Tactile Feedback to Support Mobile Users when Situationally Impaired. In proceedings of the 15th International ACM Conference on Computers and Accessibility – ASSETS'13, Bellevue, USA, Article No: 47.
30. Wheeler, M., Wolf, F. & Kuber, R. 2013: Supporting Augmented and Alternative Communication using a Low-Cost Gestural Device. In proceedings of the 15th International ACM Conference on Computers and Accessibility – ASSETS'13, Bellevue, USA, Article No: 67.
31. Qian, H., Kuber, R. & Sears, A. 2013: Tactile Notifications for Ambulatory Users. In Extended Abstracts of on Human Factors in Computing Systems - CHI'13, Paris, France, 1569-1574.

D. Panels & Workshops Conducted

1. Julie M. Haney and Wayne G. Lutters. 2017. Skills and Characteristics of Cybersecurity Advocates. Workshop on Security Information Workers, Symposium on Usable Privacy and Security (SOUPS).
2. Brandt Braunschweig and Carolyn Seaman. “An Examination of Shared Understanding in Free/Libre Open Source Project Maintenance”, 6th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE 2013). San Francisco, USA, May 2013.
3. 2017, IEEE Workshop on The IEEE International Workshop on Benchmarking, Performance Tuning and Optimization for Big Data Applications (BPOD 2017).
4. Brantley, K., Chen, J., Ganesan, A., & Pan, S. (2015). LDAExplore: Visualizing Topic Models Generated Using Latent Dirichlet Allocation. CoRR, abs/1507.06593.