SAM HOUSTON STATE UNIVERSITY

Master of Science in Computing and Information Science

PROGRAM REVIEW SUMMARY REPORT

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INTRODUCTION

The CIS program started in 1990 as the first graduate program offered in the Department of Computer Science. Enrollment in the program has fallen in the last seven years from 32 students in 2013 to 14 in the Fall of 2019. This decrease in student enrollment is partially due to the addition of M.S. degrees in digital forensics and information assurance and security in 2006 and 2008, respectively. Those programs have seen considerable growth in the same time frame. Average class size in the program is 8 with a maximum of 18 students in a class.

The program is currently managed by two graduate advisors: one responsible for admissions and the second responsible for programs of study. Faculty to student ratio in the program currently ranges from 3 to 10.

APPROPRIATENESS OF SHORT AND LONG-TERM GOALS

The program has stated their goals to be the following:

- Faculty engages in research to create and disseminate new knowledge, develop quality-teaching skills, maintain high professional standards, and actively serve the University and Community.

- Graduates with a master's degree will have a strong technical foundation, that is, to develop and demonstrate knowledge of theoretical materials, as well as computational and technical skills relevant to their corresponding concentration.

The educational objectives of the IAS M.S. degree are:

- To promote critical thinking skills and enhance decision-making abilities, which help students to define computing requirements for a given task.
- To promote excellence in communication, professionalism, and ethical responsibility.
- To promote professional development and acquisition of skills to remain relevant in the field of computing.
- To provide professionally relevant computer scientists that are ready to accept the responsibilities that they will hold in business, industry, and governmental positions.
- To provide a strong academic foundation that is needed to pursue doctoral level programs.
- Graduates with a master's degree will have a strong technical foundation, that is, to develop and demonstrate knowledge of theoretical materials, as well as computational and technical skills relevant to their corresponding concentration.

These goals are appropriate for the degree program. All faculty need to continually engage in research and life-long learning to ensure that students are provided with the most up to date education possible during their academic career. Research activity by faculty members serves to keep their knowledge relevant and appropriate for the current state of practice in the field. Students benefit by being exposed to state of the practice material and technologies that will help them transition into the workplace ready to work, without a lot of on the job training required. Additionally, providing students with a strong technical foundation with both theoretical and practical applications provides for a more capable graduate with both the ability to perform immediately and the ability to engage in life-long learning.

CURRICULUM

The rich curriculum is composed of 36 units of coursework. Curriculum is composed of 18 units in the core courses and 18 units of electives. Out of the 18 units of core courses, 3 units are covered by the capstone design course. The full-time student load is 9 units per semester with a maximum allowable completion time of 6 years. A full-time student is expected to graduate in 2 years with a full load of 9 units per semester. The program admits students with a wide spectrum of B.S. degrees in addition to computer science graduates. Students who do not have a computer science background are expected to complete two mandatory courses that do not count towards the master's degree. Students can complete up to 6 units of special topics and 6 hours of thesis research or 3 units of directed project. Until 2020, the directed project course was spread over two semesters with only 3 credits allocated to it. In 2020, the curriculum committee decided to keep the two-semester structure, but to increase the number of units allocated to this requirement to 3 units per semester (a total of 6 units).

As part of the directed project, graduation requirements include a substantial report, IEEE format paper, presentation slides and a formal presentation. We believe that it would be beneficial to add the possibility of a thesis by letting the student choose a research problem and increasing the writing component to reflect a more research-oriented effort.

Students who do not earn a grade of A in a class have to take the comprehensive exam in that area. The comprehensive exam is not a requirement for those choosing a thesis or a project.

The curriculum is adequate with a good set of courses in the areas of computer science, computer security, artificial intelligence, and digital forensic science. Students have expressed a desire for more advanced computer science related courses, outside of cyber security to be offered in the regular semesters. This is difficult with the growth of cyber security and digital forensics and the negative growth of the computing and information science program.

The thesis option is not chosen by many students but is well established and managed effectively by the advisors in the department.

The project assignment and management are well structured. Having the project proposal and final presentation reviewed by a committee will make sure that the quality is maintained. The advisor being assigned by the department will ensure equitable workload and opportunity to supervise among faculty.

The assessment of the program is done by the IDEA center. The committee plans to use these assessment reports for improving quality of instruction and appear to have a mechanism for doing that effectively.

FACULTY

The program is supported by 4 core faculty members and two support faculty members, each devoted to the success of the program. The faculty is diverse with 50% of the core faculty being female, and 1/3 of the total faculty being female. Faculty also has a very diverse cultural (if not ethnic) background connecting the faculty to 3 different countries of origin.

Faculty also have very diverse research interests. Despite having a heavy teaching load, faculty have been very productive with an average of 4 peer reviewed manuscripts per faculty per year. Multiple faculty members received awards and recognition. Dr. Qingzhong Liu was the recipient of the Excellence in Scholarly and Creative Accomplishments Award at SHSU in 2017. Dr. Bing Zhou and Dr. Qingzhong Liu's publication on imbalanced text classification received the best paper award from the International Joint Conference on Rough Sets. Dr. Cihan Varol's paper, entitled, "Enhancement of Lempel-Ziv Algorithm to Estimate Randomness in a Dataset" also received the best paper award from the International Conference on Machine Learning and Data Analysis (ICMLDA'16). These awards are a testimony to the quality of research conducted by program faculty.

Normal teaching load for faculty is 3 courses per semester which limits faculty research. Funded research by program faculty is historically limited, however in recent years the number of applications submitted has increased considerably. The college may consider giving release time to faculty for developing research proposals perhaps on a rotation to provide equitable opportunity for development. It is very challenging to grow research and hold qualified faculty at the university unless research grants increase, and faculty can supplement the salary of their research assistants as well their own salary from extramural grants.

The program faculty also have a record of publishing with students. In the past 6 years, more than 17 CIS graduate students have presented and published 22+ papers at international conferences or in peer-reviewed journals. This is commendable.

STUDENTS

The program has a diverse student body with approximately 18% female students. Students in this program are primarily full-time students who until recent years have come predominantly

from international countries. During the last several years, the percentage of students in the program from international sources has decreased, probably because fewer students are coming from internationally to study in the U.S. Those that are coming are going to bigger, more financially prosperous institutions because the opportunities are better.

DEGREE LEARNING OUTCOMES AND STUDENT LEARNING OUTCOMES

Sufficient evidence is provided in the report to show that students in this program are achieving the desired outcomes of the program. Since Fall 2015, 16 students took 25 comprehensive examinations, with 17 of those resulting in a passing grade of 70 or higher and 8 resulting in a high pass grade of 85 or higher.

In addition, exit survey data suggests that students are getting what they need to be competent the field upon graduation.

PROSPECTS FOR PROGRAM TO ACHIEVE ITS OBJECTIVES

This program is well positioned to provide an exceptionally well qualified set of graduates to move into the job market with sufficient technical capability to perform immediately with little on the job training. More opportunity for research-based education might provide for more graduates entering doctoral programs at SHSU or other universities to add to the growing need for faculty with these skillsets. Incentivizing thesis participation is one way to grow the number of research-based students. Perhaps, considering a reduction in the number of credit hours overall for thesis students is one way to provide incentive to choose this option. A vast majority of institutions nationally only require 30 hours of graduate credit, including 6 hours of thesis research for a M.S. degree.

FACTORS IMPACTING THE DEPARTMENT'S FUTURE DEVELOPMENT OR EFFECTIVENESS

- Effectiveness of instructional programs as evidenced by student learning outcomes:
    - While most evidence points to a very effective curriculum and body of instruction provided to students, some student feedback indicated a desire for more practical application of materials to guide students in learning how to solve real-world problems. Perhaps a more stringent use of available virtual machine resources and a more disciplined approach to online course development by all faculty will provide this needed capability.
- Appropriateness of the level of research, professional and/or other creative activity of the faculty:
    - The level of research productivity exhibited by the faculty in this program is more than appropriate, especially considering their extensive teaching and advising load, and the lack of more extensive graduate teaching assistants.
- Opportunities for development, and weaknesses/deficiencies in the program:
    - The program is highly satisfactory in software, networking, machine learning, and digital forensics areas. We believe the program could benefit from a hardware-

oriented faculty member with research interests in real time systems, network processing, Internet of Things (IOT) and inline security solutions. Although there are machine learning courses in the program, machine learning in the context of information security could be improved.
    - Funded research can be improved. If the university supports development of areas of expertise, program faculty is well positioned to cooperate with medical school and business school faculty in research. Perhaps this is worth exploring in the future.
    - Graduation rate is varied with 2-year graduation rate anywhere from 25% to 100%. The average is approximately 57% and 3-year graduation is approximately 77%
    - Retention rate is pretty good with 1-year retention at 75%. This number is always volatile with the total number of students so small.
    - Starting salaries averaging $81K and startup funding of $20,000 is not a lot of money. With these numbers for salary and startup funding, recruiting talented faculty will be a challenge. Specifically, startup funding and release time for the first year or so for new faculty can be an effective factor in attracting research active faculty.
    - Although there is limited support for teaching assistantships, the fact that tuition cannot be waived, makes getting talented graduate students more challenging. Other universities have more well-established funding mechanisms for offering graduate students better incentives to join their programs.

- Quality of the support from the library and other support external to the department
    - Department support for travel $5000 per faculty /year to conferences is commendable. This will help faculty establish social contacts with their peers and establish cooperation with faculty from other institutions.
    - College provides support for 8 TAs. Although we believe the number of the TAs and support level is not adequate, we also understand the constraints. We recommend that management look into this resource pool to try and increase the support level.
    - Faculty computer support: SHSU's IT@Sam provides faculty with a PC and a mobile device (a laptop or tablet). Most of the CS Faculty request computer equipment with better specifications than the university offers, so the typical startup cost for a new computer is $5,000. Additionally, we have been reassured that desktop computers are replaced every five years and mobile devices replaced every three years.

- Quality of facilities
    - Adequate classroom and laboratory facilities are provided for lectures in the case of face to face classes. Two research labs in the Cyber Forensic Intelligence Center. A virtual server farm is maintained by the program and is a great resource for faculty research and laboratories. The CS VM farm is paid for and maintained by the CS department at a cost of $40,000 to $50,000 per year. Students pay a technology fee and a Lab fee for each class. The technology fee goes to IT@Sam for all the campus IT needs. The lab fee is divided up by the college and goes to the departments.