REVIEW OF THE B.S. IN COMPUTER SCIENCE

Classification of Instruction Programs (CIP) Code: 11.0701
Computer Science

OVERVIEW

The **B.S. in Computer Science** program at Illinois State University is housed in the School of Information Technology within the College of Applied Science and Technology. The School of Information Technology houses six degree programs: a B.S. in Computer Science, B.S. in Cybersecurity, a B.S. in Information Systems, a B.S. in Network and Telecommunications Management, an M.S. in Computer Sciences, and an M.S in Information Systems. In addition, the school offers a minor in Information Systems and Graduate certificates in Data Science: Computer Science, Enterprise Computing Systems, Information Assurance and Security, Internet Application Development, Network and Telecommunications Management, and Systems Analyst. The last review of the B.S. in Computer Science program occurred in 2013-2014.

The B.S. in Computer Science program provides a foundation for students who will enter a variety computer science careers. This degree is designed for students who wish to pursue a comprehensive study of computer science that blends theory, abstraction, and design in a variety of traditional and current areas. The computer science major prepares students to solve modern computing problems by providing a strong background in theory, design, hardware, and systems along with significant software development experience in multiple languages on multiple operating systems. It also prepares students to pursue graduate studies in computer science. Course work focuses on both theory and hands on experience that will prepare students as software programmers and developers with strong skill sets in math, logic, and science. Students enrolling in the B.S. in Computer Science select either the General Computer Science sequence or the Web Computing sequence. The Enterprise Computer Engineer sequence was discontinued in 2014.

Enrollment by Plan of Study, Fall Census Day, 2014-2021
B.S. in Computer Science, Illinois State University
First Majors Only

	2014	2015	2016	2017	2018	2019	2020	2021
Enterprise Computer Engineer sequence	4	1						
General Computer Science sequence	242	286	289	309	328	319	382	381
Web Computing sequence				2	8	11	16	15
No subplan		3	6	3	2	1		
Total	**246**	**290**	**295**	**314**	**338**	**331**	**398**	**396**

Table notes: The Enterprise Computer Engineer sequence was deleted effective Fall 2014. The Web Computing sequence began in Fall 2017.

Degrees Conferred by Plan of Study, 2014-2021
B.S. in Computer Science, Illinois State University
First Majors Only

	2014	2015	2016	2017	2018	2019	2020	2021
Enterprise Computer Engineer sequence	1							
General Computer Science sequence	32		27	38	41	56	53	49
Web Computing sequence						1		1
No subplan			1					
Total	**33**	**30**	**28**	**38**	**41**	**56**	**53**	**50**

Table notes: Graduating Fiscal Year consists of summer, fall, and spring terms, in that order. For example, Graduating Fiscal Year 2018 consists of the following terms: summer 2017, fall 2017, and spring 2018. The Enterprise Computer Engineer sequence was deleted effective Fall 2014. The Web Computing sequence began in Fall 2017.

EXECUTIVE SUMMARY
PROGRAM REVIEW SELF-STUDY REPORT

Program goals

Program Educational Objectives are statements that describe the expected accomplishments and professional status of graduates 3-5 years beyond the baccalaureate degree. The School of Information Technology at Illinois State University is dedicated to graduating people who will:

- Be successfully employed in a computer science related field or accepted into a graduate program.
- Design and develop creative and effective solutions to practical computing problems.
- Exhibit teamwork and effective communication skills.
- Be characterized by effective leadership skills and high standards of ethics.
- Engage in lifelong learning to adapt to an ever-changing professional environment.

Student learning outcomes

At the time of graduation, a student in our computer science program must attain the following outcomes:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired standards
- An ability to function effectively on teams to accomplish a common goal
- An understanding of professional, ethical, legal, security and social issues and responsibilities
- An ability to communicate effectively with a wide range of audience
- An ability to analyze the local and global impact of computing on individuals, organizations, and society
- Recognition of the need for and an ability to engage in continuing professional development
- An ability to use current techniques, skills, and tools necessary for computing practice
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices

- An ability to apply design and development principles in the construction of software systems of varying complexity

Program curriculum (2021-2022)

Graduation requirements (General Computer Science sequence):
122 credit hours including 83 credit hours for the degree program and 39 credit hours for General Education. The 83 credit hours for the degree program include 54 credit hours of business courses and 29-30 credit hours of courses external to the School of Information Technology.

Graduation requirements (Web Computing Science sequence):
122 credit hours including 78 credit hours for the degree program and 39 credit hours for General Education. The 78 credit hours for the degree program include 54 credit hours of business courses and 29-30 credit hours of courses external to the School of Information Technology.

Program delivery

The program is offered on the Normal campus.
The program is delivered primarily through face-to-face or blended face-to-face/online instruction.

Department faculty (Fall 2021)

21 tenure track faculty members (8 Professors, 5 Associate Professors, and 8 Assistant Professors)
16 non-tenure track faculty members (3 full-time, 13 part-time, totaling 7.2 FTE)
Undergraduate student to faculty ratio: 30 to 1
Undergraduate student to tenure-line faculty ratio: 41 to 1

Specialized accreditation

The B.S. in computer science program is accredited by the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET) through September 2027. The program was reaccredited in 2021.

Changes in the academic discipline, field, societal need, and program demand

Since the last program review, the demand for computer science graduates has grown dramatically, resulting in a large increase in program demand by prospective students. The current Bureau of Labor Statistics projects that demand for software developers (the most common job for computer science graduates) will grow by 22 percent in 2020-2030, which is much faster than average growth. Growth for web developers is less strong at 13 percent, but still faster than average. This increased demand is reflected in the growth in the program (and the similar growth in many computer science programs state-wide). This national trend has made it more challenging to hire program faculty, both because of increased national demand for faculty in the discipline and because a smaller percentage of computer science graduates are going on to graduate school, presumably due to the availability of positions and the increases in starting pay in the field due to the increased demand. This phenomenon has directly impacted the program, since one of two computer science tenure-track searches failed in FY20.

Curricular expectations for computer science graduates have changed somewhat, which is reflected in the 2018 changes to the ABET accreditation curricular requirements which added several required topics to the curriculum such as parallel and distributed computing, security, data management. All of these topics were part of the curriculum, but some were only available in electives. To address the added requirements, program faculty had to increase the number of required IT courses in the program, though the faculty were able to reduce the total hours in the program because of reduced expectations in math and science. As students under the new curriculum work their way through the program, this is increasing the number of computer science course sections required each semester

Responses to previous program review recommendations

1. *Continue multi-faceted efforts to recruit highly qualified students, including, but not limited to, outreach to high school counselors and sponsorship of camps for middle and high school students, with an emphasis on improving gender diversity.* The school has engaged in a variety of outreach efforts including sending letters to high school seniors, follow-up with applicants, focus on recruitment scholarships, events for high school and community college counselors, summer camps and other events for high school students, and participation in community STEM events. Program faculty found direct outreach to high school counselors to be ineffective and have discontinued that and the summer camps. However, the program has found efforts to be highly effective in growing the program and increasing the number of highly qualified students. The program has been less successful in recruiting women into the program, though there has been some increase in the percentage of women in Computer Science even as the program as a whole has grown dramatically. The recruitment and retention of women (as well as under-represented groups in general) will continue to be a focus of the program in coming years.

2. *Continue efforts to address gender diversity among faculty members as hiring opportunities arise.* The program has successfully hired two tenure-track women for the computer science program since our last program review, so the program have three women out of the eight faculty whose focus is the computer science program. There have been three other hires of female tenure-track faculty in the school. While women are still in the minority, matching national trends in Information Technology, the program and the school as a whole now have a substantial percentage of women in tenure-track roles to serve as role models and mentors for the students.

3. *Design and implement a systematic program of regular communication with program alumni to collect and maintain data on alumni perceptions of the program and on alumni successes in employment and graduate studies.* The School of Information Technology instituted a program of collecting data from graduates at commencement receptions, including a non-ISU email and information about employment. Program faculty have also made some attempts to collect the same information from students who do not attend the receptions but have been less successful in getting data from those graduates. Faculty have also improved the communication outward to alumni and have increased opportunities for alumni to be engaged with current students. However, the program still needs to improve data collection methods to include a larger percentage of the alumni and faculty also need to work on developing a more systematic program of data collection from those alumni.

4. *Complete revisions to the student learning outcomes assessment plan to more closely align the plan with standards of the Accreditation Board for Engineering and Technology (ABET) and to further integrate program and learning assessment; implement the revised plan; utilize assessment results to make program improvements; and document how this has been addressed.* Revisions of the program assessment plan were completed following the last program review, and systematic data collection has been done. An additional significant revision was accomplished recently due to changes in program accreditation requirements that were adopted by ABET in 2018. In addition to regular data collection and some curricular changes that were based on assessment data, the School of Information Technology has implemented a process in which the faculty for each program in the school meet each semester to discuss the assessment data that was collected in the previous semester. This process encourages the faculty to consider both curricular and pedagogical changes that would enhance student learning. Minutes are taken at each program faculty meeting regarding assessment data. The assessment committee then reviews the minutes from the program faculty meetings. The program faculty are pleased that the very recent program accreditation visit report noted no weaknesses or concerns in the areas of assessment and continuous improvement.

5. *Regularly monitor and adjust the curriculum to ensure its currency and relevance in light of changes in information technology and student needs; curricular issues to be consider include, but are not limited to, changes in program requirements and elective options, including the five-course sequence and its impact on time-to-degree, and summer online course offerings.* The program faculty has made significant curricular changes in light of changes in the field and accreditation standards. The faculty are also working on expanding elective options for students in the coming years. Some of those new electives are in areas that are increasingly important in the current world, such as machine learning and data visualization. Faculty have evaluated the five-course prerequisite sequence in required courses but have determined that to reduce prerequisites would harm students' success in the later courses, which would be of greater concern than the length of the chain. The length of the chain is not typically an

issue for FTIC students, though it is an issue for transfer students. However, most community colleges in Illinois do have courses that articulate to the first two courses in that five-course sequence. Therefore, the program has focused our efforts on communicating the importance of taking those courses while completing an associate's degree to community college counselors and prospective transfer students. Faculty have also adjusted summer course offerings to increase the number of computer science courses offered in the summers.

Major findings

Overall, the program faculty believe that the computer science program is doing well, though there are opportunities for improvement. There are many aspects of the program that are working well.

- The program continues to be accredited by ABET.
- The curriculum has been routinely updated.
- The assessment plan has also been updated, and faculty have become more involved in the assessment process and especially in the process of considering assessment results and looking at pedagogical and curricular adjustments that may be suggested by the assessment process.
- The program remains popular with both prospective students and employers, as evidenced by the dramatic and sustained growth of the program's enrollment. Over 70 percent of graduates have completed internships, and the evidence that the program has regarding employment suggests that most students find jobs in their field or enroll in graduate school within 12 months, with a significant percentage having job offers in hand at graduation.
- The program's percentage of underrepresented ethnic minorities generally mirrors or is slightly higher than the percent in the university.
- The program has been successful in hiring multiple female faculty members and has also seen slight growth in the percent of female students, even as the overall number of students has grown.
- The program has also seen an increase the number of highly qualified students in the program, as evidenced by significant increases in participate in the honors program. Again, that has been an increase in terms of percent of the growing student population, not just an increase in number.

The program does have a few areas that would benefit from improvement.

- Although the female student population has increased, numbers are still below the national average. Program faculty need to work to find ways to recruit women into the program as well as continuing to focus on retaining the women the program has.
- Program faculty need to work on maintaining connections with our graduates. Since the last review, the program has started regular collection of data from graduating seniors but have obtained data from less than half of any graduating class. The program has also significantly increased its communication outward to alumni but has been less effective at consistently getting feedback from our alumni.
- The program administration will continue to advocate for faculty in order to maintain our distinctiveness as a computer science program focused on individual attention to students. This is made more urgent by the curricular changes necessary to comply with the latest changes to our accreditation requirements, since the program wase forced to shift six hours of each student's program from outside the school to be required IT courses. The first First-time-in-college students impacted by this change are now reaching their junior year, so the increased need for seats stemming from this change in addition to the enrollment growth will become ever more apparent. The Director and Dean advocated for and were approved an additional faculty member, authorized in FY23. With a successful search, the faculty member will support the identified program improvements.

Initiatives and plans

Based on major findings of this program review self-study, the Computer Science faculty plan to do the following during the next program review cycle to improve the program:

1. Continue to improve our assessment plan and activities. Creating a consolidated schedule for all majors within the School of Information Technology will help streamline our processes which likely will both improve efficiency and effectiveness.
2. Continue to monitor changes in the field and accreditation and update curriculum as appropriate.

3. Implement our new strategic plan. The plan includes efforts to increase diversity among our students and efforts to internationalize the student experience.
4. Develop an accelerated master's degree opportunities for students. A plan is almost complete for an accelerated opportunity between the Computer Science undergraduate program and the new Computer Science graduate program.
5. Highlight and grow opportunities for undergraduate research.
6. Improve the program's data collection from and communication with program alumni.

PROGRAM REVIEW OUTCOME AND RECOMMENDATIONS FROM THE ACADEMIC PLANNING COMMITTEE

Review Outcome: The Academic Planning Committee, as a result of this review process, finds the B.S. in Computer Science program in the School of Information Technology to be in Good Standing.

The Academic Planning Committee recognizes that many of the efforts and activities that led to the development of the self-report were accomplished during the time period coinciding with the COVID-19 pandemic. The committee thanks the program for a comprehensive and critical self-study report that included input from multiple stakeholders including from one advisory board.

The committee commends faculty efforts to grow the program's enrollment during the period covering the program review cycle that has resulted in significant growth (from 246 in 2014 to 398 in 2020). The program indicates that, with current resources, this enrollment level is at their ideal target of 400 students. The program faculty see an opportunity for controlled growth of the program (with continued student interest and opportunities for graduates), but only with the support of additional faculty positions.

The committee commends the School faculty for efforts to increase the gender and racial/ethnic diversity among its students. The percentage of students identifying as female has increased from 6.6 percent in fall 2015 to 10.6 percent in fall 2020. The percentage of undergraduate students from groups traditionally underrepresented in the discipline has remained relatively constant near 30 percent (ranging between 25 and 33 percent), at or near the University average during the period of review. The committee commends the program for the use of three endowed scholarship funds for incoming FTIC and transfer students.

The committee commends the program faculty for their efforts to support the success of their students. We commend the program on its ability to continue to limit enrollments in many of its courses, which is in keeping with the University's commitment to fostering a small-college atmosphere with large-university opportunities. The committee commends the program for the creative and varied co-curricular options it provides its students to meet their education and career goals. These include three student organizations, a lifestyle floor in Manchester Hall, collaboration with State Farm on an annual mobile application development competition, and opportunities to participate in other competitions and hackathons. These opportunities help the School prepare students for employment and build a strong student community in the program. The School provides some opportunities for student participation in research opportunities, including the new Next STEM Scholars program (supported through an NSF grant). Furthermore, students participating in the honors program has nearly doubled, from 7.6 percent to 14.8 percent between 2016 and 2020. The committee also notes that the School has excellent laboratory facilities and works to incorporate significant hands-on experiences into the curricula of the various programs.

The committee commends the program for the creative and varied curricular options it provides students to meet their educational and career goals. The committee commends the faculty's work to revise the curriculum during the period of review. This included revisions to align with the new Accreditation Board for Engineering and Technology (ABET) computer science curricular requirements, providing more flexibility to students by reducing the overall required number of credit hours, the addition of a course that focuses on social, legal, and ethical issues in the discipline (IT 214), and revision and expansion of elective options. We note that all undergraduate programs in the School include a professional practice requirement, usually in the form of a paid internship in the field. The

committee also commends the program for their collaborations that support other programs and departments and provide opportunities for students who want to double major.

The committee commends the program faculty on the development, implementation, and revision of their plan for the assessment of student learning outcomes. During the current review cycle, faculty have used the evidence gathered through the student learning outcomes assessment plan to inform program changes, and this includes the incorporation of rubrics as tools for assessing student coursework regarding the program's learning outcomes. The committee acknowledges the use of such rubrics as one method to provide consistent reviews of student learning that can provide potential areas for improvement. The information gathered through these measures has been used to make program changes, and several examples of these changes were specified.

The committee commends the School faculty on their success at hiring and retaining a higher number of female faculty members. We recognize the faculty members of the program for their scholarly contributions to the B.S. in Computer Science program. Faculty members are active researchers who publish peer-reviewed journals articles, and present at national and international professional conferences.

The committee appreciates the in-depth analysis of comparator and aspirational programs. As part of this analysis, the program faculty identified multiple institutions with similar programs that excel in ways that our program may aspire to. The committee also recognizes that faculty developed specific action plans to implement similar initiatives as those to improve the program at Illinois State University.

The committee commends the program faculty for being accredited by the Accreditation Board for Engineering and Technology (ABET) and also for being one of the first departments in the nation to have ABET accreditation for both a computer science program and an information systems program. Furthermore, Illinois State University continues to be the only university in Illinois to hold both accreditations.

Follow-up Reports.
The self-study report identifies a number of potential initiatives related to the program curriculum, time-to-degree, and credit hours. The committee asks that the program faculty consider these as part of a comprehensive review and evaluation of the curricula across all sequences, and develop a plan for necessary revisions. This analysis should include examining the role of the articulation of transfer courses and how they impact time-to-degree, identify any courses that are potential bottlenecks due to high DFW rates (e.g., in the required mathematics courses and IT 168), the impact of limited offerings (e.g., required courses that are only offered every other year), and the availability and timing of the required internships. We ask that these discussions involve both internal and external stakeholders (e.g., alumni and the Advisory Board) as well as comparisons with the curricula of programs at comparator institutions. Accordingly, the committee asks the faculty to engage in discussions of this plan and to summarize the findings of those discussions in a report submitted to the Office of the Provost by May 15, 2023.

Recommendations.
The Academic Planning Committee thanks faculty and staff members of the School of Information Technology for the opportunity to provide input regarding the B.S. in Computer Science program at Illinois State University through consideration of the self-study report submitted by faculty. The following committee recommendations to be addressed within the next regularly scheduled review cycle are provided in a spirit of collaboration with School faculty members. In the next program review self-study report, tentatively due October 1, 2030, the committee asks the program to describe actions taken and results achieved for each recommendation.

Develop a plan for controlled enrollment growth. The committee notes that demand for the program has been strong, resulting in steady growth in enrollments. The committee acknowledges the work faculty have completed regarding their recruitment efforts, and that this work has been successful in enrolling both first-time-in-college students and external transfer students in the program. Given the time and energy that must be devoted to such recruitment activities, the committee suggests that faculty target external locations and internal programs with likely transfers in a strategic way. The committee also suggests that the program work with the Office of Admissions to gather data regarding the reasons that many accepted students chose to go elsewhere (particularly women accepted into the program).

Continue to focus on equity, diversity, and inclusion. While the committee recognizes the efforts to increase the gender and ethnic diversity of faculty and students within the program, the committee encourages the program to continue to pursue its goals related to further developing an equitable, diverse, and inclusive environment that effectively supports students, faculty, and staff from diverse backgrounds. We encourage the program to continue refining and implementing their plans for recruiting students from groups who are traditionally underrepresented in the program and discipline. We note that many of the recruitment strategies are described at the School level, and we recommend that the program faculty explore the use of program-specific recruitment strategies (e.g., program-specific scholarships). Furthermore, we encourage the program faculty to continue to examine ways to infuse diversity, equity, and inclusion into the curriculum.

Continue to focus on student success and retention. The committee recommends that the program faculty develop a plan for student success. The plan should be used to increase transparency and communication around "student success" by defining the program's goals for, assessment of, and actions towards supporting students enrolled in the program. The plan may provide an overarching structure for other plans (e.g., retention, curriculum, alumni engagement). The committee recognizes substantial work by former and current faculty members to review and update the program and its curriculum. The committee recommends continued periodic review of the program structure and content to remain current with changes in the field and to maintain program retention and graduation rates (including the percentage of graduates completing the program within four years and trying to reduce the numbers of curricular exceptions needed). The committee recommends that the program continue monitoring student retention, particularly of students from traditionally underrepresented groups. The committee suggests that faculty members investigate student interest and participation in the Honors program to ensure that students desiring to complete the program with honors have sufficient opportunities to do so.

Continue to review and revise the curriculum. The committee recognizes substantial work by faculty members to review and update the program and its curriculum, especially with respect to responding to accreditation standards. The committee recommends continued periodic review of the program structure and content to remain current with changes in the field. Continue to develop and expand the internship program for majors, perhaps through input from the Advisory Board in creating additional opportunities for interaction among students, alumni, practitioners, and prospective employers. The committee encourages the program to clarify the research components in the curriculum (e.g., are there potential discrepancies in required hours between professional practice and independent study) and to continue developing opportunities for student research and creative activities.

Continue implementing and refining the student learning outcomes assessment plan. The committee encourages faculty to continue its implementation of the student learning outcomes assessment plan for the program during the next program review cycle, to continue to utilize information gathered through plan implementation to make program revisions as necessary, and to document how that has been done. The committee encourages faculty to periodically evaluate the effectiveness of the plan in assessing student learning to identify any modifications to the plan faculty may deem necessary.

Continue the collaborative work with Milner Library. The committee recommends that the program work with the subject liaison librarian to examine and evaluate the library's journals and monograph collection related to computer science to aid in both the selection and deselection process of these sources. Given recent journal cancellations and expected increases in distance and hybrid courses, we encourage the School and the Library to further collaborate to increase awareness of alternative access to resources, such as Interlibrary Loan and I-Share lending, among faculty and students. We also recommend that the program work with the subject liaison librarian to develop a tiered approach for information fluency learning outcomes for the School, align those outcomes to the curricula, and integrate those outcomes into the student learning outcomes assessment plan for the program.

Continue to refine a plan for alumni tracking and engagement. While program faculty have been successful at increasing scholarships through donations from alumni, the committee encourages the program faculty to continue to refine their plan for tracking program alumni and use this system to enhance alumni networking and engagement. These activities may become even more important in the years ahead as the program's alumni become more diverse. The program could benefit from increased involvement of its alumni, employers, and other external stakeholders in

providing input regarding the program and in mentoring students and providing employment opportunities for program graduates.