COMPUTER SCIENCE (BS/MS)

The BS/MS programs in Information Technology, Software Engineering, and Computer Science are five-year programs that give academically successful Loyola undergraduates the opportunity to pursue the MS degree in Information Technology, Software Engineering, or Computer Science while completing their BS degree. The applicant can be pursuing any of the BS degrees offered by the Department of Computer Science, including the joint majors with Mathematics or Physics or the interdisciplinary Bioinformatics.

These programs reduce the total number of courses needed and the total time needed for the combined degrees. Specifically, students in the BS/MS program are allowed to "double count" 9 credits (generally three 3-credit courses) of their Loyola COMP courses towards both their BS and MS degrees. Each double-counted course must be a 400-level course taken in the student's senior year in place of a corresponding 300-level course. This leaves a total of 21 credits (seven courses) to be taken after completion of the Bachelors' degree.

Students may not automatically enroll in the BS/MS program during Freshman admission. They must specifically apply to the Graduate School, generally in their Junior year by using The Graduate Application Form (https://gpem.luc.edu/apply/). See Application Requirements (https://academics.cs.luc.edu/undergraduate/bsmsprograms.html#application-requirements) and Application Information (https://academics.cs.luc.edu/undergraduate/bsmsprograms.html#application-information) for more details.

Related Programs

Major

- Computer Science (BS) (https://catalog.luc.edu/undergraduate/arts-sciences/computer-science/computer-science-bs/)

Master's

- Computer Science (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/arts-sciences/computer-science/computer-science-ms/)

Doctoral

- Computer Science (PhD) (https://catalog.luc.edu/graduate-professional/graduate-school/arts-sciences/computer-science/computer-science-phd/)

Curriculum

The MS program requires 30 credits of graduate courses. This generally takes one and a half years to complete. BS/MS students must also take 30 credits of courses at the 400 level or greater. The main advantages come from the fact that some of the MS courses may be double-counted, applying to the BS also, and there can be a shift in some of the required MS courses based on what students took in the BS portion. In particular students in the BS/MS program are allowed to "double count" 9 credits (generally three 3-credit courses) of their Loyola COMP courses for both their BS and MS degrees. Each must be a 400 level course taken in the student's senior year *in place* of a 300 level major course. Also, a student wishing to take 123 or more credits while an undergraduate, can have 3 of the extra credits be for a fourth 400 level COMP course, and count that toward the MS if the extra course is needed for *no* undergraduate requirement, from the university, college, core, major or minor. Hence a BS/MS student with 120 credits and 9 400-level COMP credits counted for the BS is required to take only 21 credits (instead of 30 credits) of additional 400-level courses. If a student takes a further 3-credit 400 level COMP course beyond the 120 credits needed for the BS, then only 18 further credits are needed. In either case, students can finish the program in five years.

Code	Title	Hours
Major Requirements		
MATH 131	Applied Calculus I [1]	3
or MATH 161	Calculus I	or 4
MATH 132	Applied Calculus II [1]	3
or MATH 162	Calculus II	or 4
COMP 141	Introduction to Computing Tools and Techniques	3
COMP 163	Discrete Structures	3
or MATH 201	Introduction to Discrete Mathematics & Number Theory	
COMP 170	Introduction to Object-Oriented Programming	3
COMP 264	Introduction to Computer Systems	3
COMP 271	Data Structures I	3
COMP 272	Data Structures II	3
COMP 310	Operating Systems	3
COMP 317	Social, Legal, and Ethical Issues in Computing	3
COMP 363	Design and Analysis Computer Algorithms	3
COMP 371	Programming Languages	3
STAT 203	Introduction to Probability & Statistics	3
COMP-BS Restricted Electives		
Select nine credit hours from the following:		9
COMP 301	Introduction to Computer Security	
COMP 313	Object-Oriented Design	
COMP 330	Software Engineering	
COMP 332	Requirements Engineering	
COMP 339	Distributed Systems	
COMP 341	Human-Computer Interaction	
COMP 343	Computer Networks	
COMP 353	Database Programming	
COMP 364	High Performance Computing	
COMP 370	Software Quality	
COMP 379	Machine Learning	
Practicum Capstone		
Select six credits taken from one or more of the following: [2]		6
COMP 312	Open Source Software Practicum	
COMP 390	Broadening Participation in STEM (Computing, Math & Science)	
COMP 391	Internship in Computer Science	
COMP 398	Independent Study	
Computer Science 300-Level Electives		
COMP 300-Level Course(s)		4
Computer Science Free Electives		
Select one of the following:		3
COMP 300-Level Course		

COMP 125	Visual Information Processing	
COMP 150	Introduction to Computing	
MS Requirements		
COMP 417	Social and Ethical Issues in Computing	3
COMP 460	Algorithms & Complexity	3
Track/Major Requirements (p. 2)		*12*
Four (4) COMP 400-Level Elective Courses		*12*
Total Hours		**82-84**

[1] By arrangement with the Undergraduate Program Director, the extra credits from MATH 161 Calculus I/MATH 162 Calculus II may be applied towards the "Computer Science Free Electives" category.

[2] See the details of registering for these courses in the Computer Science Department website resources. Students are encouraged to complete these credits during junior and senior years to draw on prior experience. Note:

- COMP 312 is a 3-credit course
- COMP 390 is limited to 3 total credits
- COMP 391 and COMP 398 will usually be limited to 6 total credits each, but permission may sometimes be granted for more.

Track/Major Requirements

No Concentration (Default)

Code	Title	Hours
Major Requirements		
COMP 413	Intermediate Object-Oriented Development	3
Select three of the following:		9
COMP 410	Operating Systems	
COMP 433	Web Services Programming	
COMP 436	Markup Languages	
COMP 439	Distributed Systems	
COMP 442	Server-Side Software Development	
COMP 443	Computer Networks	
COMP 453	Database Programming	
COMP 464	High-Performance Computing	
COMP 471	Theory of Programming Languages	
COMP 473	Advanced Object Oriented Programming	
COMP 474	Software Engineering	
Total Hours		**12**

Artificial Intelligence

Code	Title	Hours
Major Requirements		
COMP 479	Machine Learning	3
Select one of the following:		3
COMP 429	Natural Language Processing	
COMP 487	Deep Learning	
COMP 488	Computer Science Topics	
Select two of the following:		6
COMP 406	Data Mining	
COMP 429	Natural Language Processing	
COMP 458	Big Data Analytics	
COMP 487	Deep Learning	
COMP 488	Computer Science Topics	
Total Hours		**12**

Cybersecurity

Code	Title	Hours
Major Requirements		3
COMP 401	Computer Security	3
Select three of the following:		9
COMP 431	Cryptography	
COMP 440	Computer Forensics Investigations	
COMP 445	Internet of Things Device and Application Security	
COMP 447	Intrusion Detection and Computer Forensics	
COMP 448	Network Security	
COMP 449	Wireless Networking and Security	
COMP 452	Introduction to Computer Vulnerabilities	
COMP 488	Computer Science Topics	
Total Hours		**15**

Additional Rules of the BS/MS Program

1. All students need to take COMP 271 Data Structures I as part of their undergraduate major.
2. Students pursuing an MS in Software Engineering or Computer Science must take COMP 313 Object-Oriented Design by their senior year.
3. Students may take at most 6 credits total of internship at the undergraduate and graduate level, COMP 391 Internship in Computer Science plus COMP 499 Internship.
4. A student with credit for a 300 level COMP course that was taught in a combined class with a 400 level course may not take the 400 level course later for separate credit without permission from the Graduate Program Director. In particular for students with credit for COMP 317 Social, Legal, and Ethical Issues in Computing, the MS requirement for COMP 417 Social and Ethical Issues in Computing is waived, to be replaced by 3 MS elective credits. Similarly, in programs requiring COMP 413 Intermediate Object-Oriented Development, COMP 313 Object-Oriented Design will satisfy the requirement, but still, the course will need to be replaced by 3 MS elective credits.
5. In MS programs with restricted electives lists with two or more courses required from a larger explicit list, one of the courses may be waived if the corresponding 300 level undergraduate course was successfully completed at Loyola. The course must still be replaced by a 3-credit MS program elective.
6. All further individual MS program requirements must be met with the inclusion of the allowed 400 level courses taken as an undergraduate.

Requirements for Completion of the BS/MS Program

After admission to the BS/MS program, a student may request to be registered in their senior year for up to four 400 level COMP courses, with three of them replacing undergraduate major courses, and a fourth *if* the student will graduate with at least 123 credits and not need the fourth course as a part of *any* undergraduate requirement. Students generally take the remainder of their 30 credits of 400-level MS classes during their fifth year. This schedule can be modified for students with AP or transfer credit who desire to finish the combined program in less than five years. Students in the program are expected to consult regularly with the Graduate Program Director to ensure that they are on track for

completion of both the BS and MS degrees. The following are required to complete a BS/MS degree program:

- Successful completion of one of the BS degrees in the Department of Computer Science or Bioinformatics or a joint major with Mathematics or Physics
- The 400-level graduate courses, excluding those counted while an undergraduate, completed with a GPA of 3.0 or higher

Suggested Sequence of Courses

The below sequence of courses is meant to be used as a suggested path for completing coursework. An individual student's completion of requirements depends on course offerings in a given term as well as the start term for a major or graduate study. Students should consult their advisor for assistance with course selection.

Course	Title	Hours
Year 1		
Fall		
COMP 150	Introduction to Computing [1]	3
COMP 141	Introduction to Computing Tools and Techniques	3
MATH 131	Applied Calculus I [2]	3
CORE: Philosophical Knowledge Tier 1		3
CORE: College Writing Seminar		3
UNIV 101	First Year Seminar	1
	Hours	**16**
Spring		
COMP 170	Introduction to Object-Oriented Programming [3]	3
COMP 163	Discrete Structures	3
MATH 132	Applied Calculus II [4]	3
CORE: Historical Knowledge Tier 1		3
CORE: Ethics		3
	Hours	**15**
Year 2		
Fall		
COMP 271	Data Structures I	3
COMP 264	Introduction to Computer Systems	3
STAT 203	Introduction to Probability & Statistics [5]	3
CORE: Theology and Religious Studies Tier 1		3
CAS Language Requirement 101 level [6]		3
	Hours	**15**
Spring		
COMP 272	Data Structures II	3
COMP 317	Social, Legal, and Ethical Issues in Computing	3
CORE: Scientific Knowledge Tier 1		3
CORE: Societal & Cultural Knowledge Tier 1		3
CAS Language Requirement 102 level		3
	Hours	**15**
Year 3		
Fall		
COMP 363	Design and Analysis Computer Algorithms	3
COMP 310	Operating Systems	3
COMP Free Elective		1
CORE: Literary Knowledge & Experience Tier 1		3
CORE: Artistic Knowledge & Experience		3
CORE: Philosophical Knowledge Tier 2		3
	Hours	**16**
Spring		
COMP 371	Programming Languages	3
COMP-BS Restricted Elective		3
CORE: Theology and Religious Studies Tier 2		3
CORE: Scientific Knowledge Tier 2		3
CORE: Historical Knowledge Tier 2		3
	Hours	**15**
Year 4		
Fall		
COMP 400-Level Course		3
COMP Practicum		3
CORE: Literary Knowledge & Experience Tier 2		3
CORE: Societal & Cultural Knowledge Tier 2		3
CAS Elective		3
	Hours	**15**
Spring		
COMP-BS Restricted Elective		3
COMP Practicum		3
COMP 400-Level Course		3
COMP 400-Level Course		3
CAS Elective		3
	Hours	**15**
Year 5		
Students complete MS requirements in consultation with the Graduate Program Director.		21
	Hours	**21**
	Total Hours	**143**

Guidelines for Accelerated Bachelor's/ Master's Programs

Terms

- Accelerated Bachelor's/Master's programs: In this type of program, students share limited credits between their undergraduate and graduate degrees to facilitate completion of both degrees.
- Shared credits: Graduate level credit hours taken during the undergraduate program and then applied towards graduate program requirements will be referred to as shared credits.

Admission Requirements

Accelerated Bachelor's/Master's programs are designed to enhance opportunities for advanced training for Loyola's undergraduates. Admission to these programs must be competitive and will depend upon a positive review of credentials by the program's admissions committee. Accordingly, the admission requirements for these programs may be higher than those required if the master's degree were pursued entirely after the receipt of a bachelor's degree. That is, programs may choose to have more stringent admissions requirements in addition to those minimal requirements below.

Requirements:

- Declared appropriate undergraduate major,
- By the time students begin taking graduate courses as an undergraduate, the student has completed approximately 90 credit hours, or the credit hours required in a program that is accredited by a specialty organization,[1]
- A minimum cumulative GPA for coursework at Loyola that is at or above the program-specific requirements, a minimum major GPA that is at or above the program-specific requirements, and/or appropriate designated coursework for evaluation of student readiness in their discipline.[2]

Students not eligible for the Accelerated Bachelor's/Master's program (e.g., students who have not declared the appropriate undergraduate major) may apply to the master's program through the regular admissions process. Students enrolled in an Accelerated Bachelor's/Master's program who choose not to continue to the master's degree program upon completion of the bachelor's degree will face no consequences.[3]

Ideally, a student will apply for admission (or confirm interest in proceeding towards the graduate degree in opt-out programs) as they approach 90 credit hours. Programs are encouraged to begin advising students early in their major so that they are aware of the program and, if interested, can complete their bachelor's degree requirements in a way that facilitates completion of the program. Once admitted as an undergraduate, Program Directors should ensure that students are enrolled using the plan code associated with the Accelerated Bachelor's/Master's program. Using the plan code associated with the Accelerated Bachelor's/Master's program will ensure that students may be easily identified as they move through the program. Students will not officially matriculate into the master's degree program and be labeled as a graduate student by the university, with accompanying changes to tuition and Financial Aid (see below), until the undergraduate degree has been awarded. Once admitted to the graduate program, students must meet the academic standing requirements of their graduate program as they complete the program curriculum.

1 Programs that have specialized accreditation will adhere to the admissions criteria provided by, or approved by, their specialized accreditors.
2 The program will identify appropriate indicators of student readiness for graduate coursework (e.g., high-level performance in 300 level courses). Recognizing differences between how majors are designed, we do not specify a blanket requirement.
3 If students choose not to enroll in the Accelerated Bachelor's/Master's program, they still must complete all of the standard requirements associated with the undergraduate degree (e.g., a capstone).

For more information on Admissions requirements, visit here (https://gpem.luc.edu/portal/admission/?tab=home).

Curriculum

Level and progression of courses. The Accelerated Bachelor's/Master's programs are designed to be competitive and attractive to our most capable students. Students admitted to Accelerated Bachelor's/Master's programs should be capable of meeting graduate level learning outcomes. Following guidance from the Higher Learning Commission, only courses taken at the 400 level or higher (including 300/400 level courses taken at the 400 level) will count toward the graduate program.[1,2] Up to 50% of the total graduate level credit hours, required in the graduate program, may come from 300/400 level courses where the student is enrolled in the 400 level of the course. Further, at least 50% of the credit hours for the graduate program must come from courses that are designed for and restricted to graduate students who have been admitted to a graduate program at Loyola (e.g., enrolled in plan code that indicates the Accelerated Bachelor's/Master's program, typically ending with the letter "D").[3]

In general, graduate level coursework should not be taken prior to admission into the Accelerated Bachelor's/Master's program. Exceptions may be granted for professional programs where curriculum for the Accelerated Bachelor's/Master's program is designed to begin earlier. On the recommendation of the program's Graduate Director, students may take one of their graduate level courses before they are admitted to the Accelerated Bachelors/Master's program if they have advanced abilities in their discipline and course offerings warrant such an exception.[4] Undergraduate degree requirements outside of the major are in no way impacted by admission to an Accelerated Bachelor's/Master's program.[5]

Shared credits. Undergraduate courses (i.e., courses offered at the 300 level or below) cannot be counted as shared credits nor count towards the master's degree. Up to 50% of the total graduate level credit hours, required in the graduate program, may be counted in meeting both the undergraduate and graduate degree requirements. Of those shared credits, students in an Accelerated Bachelor's/Master's program should begin their graduate program with the standard introductory course(s) for the program whenever possible. So that students may progress through the Accelerated Bachelor's/Master's program in a timely manner, undergraduate programs are encouraged to design their curriculum such that a student can complete some required graduate credit hours while completing the undergraduate degree. For instance, some of the graduate curriculum should also satisfy electives for the undergraduate major.

The program's Graduate Director will designate credit hours to be shared through the advising form and master's degree conferral review process. Shared credit hours will not be marked on the undergraduate record as having a special status in the undergraduate program. They will be included in the student's undergraduate earned hours and GPA. Graduate credit hours taken during the undergraduate program will not be included in the graduate GPA calculation.

1 If students wish to transfer credits from another university to Loyola University Chicago, the program's Graduate director will review the relevant syllabus(es) to determine whether it meets the criteria for a 400 level course or higher.
2 Programs with specialized accreditation requirements that allow programs to offer graduate curriculum to undergraduate students will conform to those specialized accreditation requirements.
3 In rare cases, the Graduate Director may authorize enrollment in a 400-level course for a highly qualified and highly motivated undergraduate, ensuring that the undergraduate's exceptional participation in the graduate class will not diminish in any way the experience of the graduate students regularly enrolled.
4 For example, if a particular course is only offered once every 2-3 years, and a student has demonstrated the necessary ability to be successful, the Graduate Director may allow a student to take a graduate level course to be shared prior to the student being formally admitted to the graduate program. See, also, footnote 3.
5 Students should not, for example, attempt to negotiate themselves out of a writing intensive requirement on the basis of admission to a graduate program.

Graduation

Degrees are awarded sequentially. All details of undergraduate commencement are handled in the ordinary way as for all students in the School/College/Institute. Once in the graduate program, students abide by the graduation deadlines set forth by the graduate program. Students in these programs must be continuously enrolled from undergraduate to graduate degree program unless given explicit permission by their program for a gap year or approved leave of absence. In offering the option of an Accelerated Bachelor's/Master's program, the university is making possible the acceleration of a student's graduate degree completion. It should be understood that students may not request deferral of their matriculation into the Master's degree program. If students would like to delay their graduate studies after earning the undergraduate degree, they may apply for admission to the traditional master's degree program. Any application of graduate credit earned while in the undergraduate program is subject to the policies of the graduate degree granting school.

Learning Outcomes

- Students will gain a broad background in the practical and theoretical foundations of Computer Science.
- Students in a specific concentration will gain mastery in that area, which students who pursue the thesis option will gain deep expertise in their research area.