# MATHEMATICS AND COMPUTER SCIENCE (BS) (COLLEGE OF SCIENCE & HEALTH)

The BS in Math and Computer Science is a joint degree between the College of Computing and Digital Media and the Department of Mathematics in the College of Science and Health. It provides challenging opportunities to exceptional students with an interest in the highly theoretical nexus of math and computer science. Mathematics is a key element to the theory and practice of computer science and technology:

- Number theory forms the basis for encryption algorithms for messages sent over the Internet.
- Facts from projective geometry and multivariable calculus underlie the computer algorithms that control computer animation.
- Properties of abstract groups are instrumental in correcting transmission errors that occur when information is sent from one computer to another.
- Graph theory and combinatorics are used to create algorithms for Internet search engines and analyze Internet routing protocols.

This program is intended to appeal to academically talented students. It is designed to prepare them for graduate study in various areas of computer science such as theoretical computer science, graphics, data analysis, artificial intelligence, and computational methods and in areas in applied mathematics such as numerical analysis or discrete mathematics. The program is also designed to prepare students to compete for the more theoretically complex jobs found in computer software development.

Students in the program will explore a broad range of fields including:

- Theory of computation
- Computational mathematics
- Artificial intelligence
- Data analysis
- Graphics
- Computer vision
- Research

It is highly recommended that students concentrate on one or two areas for their advanced classes to achieve depth, but they are not required to do so. Faculty advisors are available to assist students in their selection.

| Program Requirements | Quarter Hours |
| --- | --- |
| Liberal Studies Requirements | 80 |
| Major Requirements | 56 - 62 |
| Major Concentration Requirements | 28 |
| Open Electives | 22 - 28 |
| **Total hours required** | **192** |

## Learning Outcomes
Students will be able to:

- Construct valid, logical arguments and analyze the reasoning of others.
- Model a computation problem, select appropriate algorithms and data structures for a solution, justify the correctness of the algorithm, and implement an application solving the problem.
- Use discrete and continuous mathematical structures to model problems and then solve them using appropriate techniques.
- Analyze the efficiency of a computational solution mathematically, and validate the analysis experimentally.

## College Core Requirements
### Modern Language Requirements
Students who intend to graduate with the Bachelor of Arts (BA) degree will be required to demonstrate competence in a modern language equivalent to the proficiency attained from one year of college-level language study. Such competence may be demonstrated in one of several ways:

- completing the last course in the fourth-year high school sequence of any language
- completing the last course in the first-year college sequence of any language
- completing a college course beyond the first-year level in any language
- achieving a satisfactory score on any of the Modern Language placement examinations administered at DePaul
- achieving a satisfactory rating in a proficiency examination accepted by DePaul
- achieving a score of 3 or higher on the Advance Placement (AP) test for any language
- achieving a score of 5 or higher in the Language B assessment from a Standard or Higher Level International Baccalaureate (IB) program
- achieving a satisfactory score on the CLEP examination

Please note: Modern Languages courses with an E-designation are taught in English and may not be applied to the Modern Language Requirement.

For further information regarding satisfactory scores and possible credit from the DePaul placement, AP, CLEP, or IB examinations, please contact Student Records.

Students who complete an Inter-College Transfer (ICT) to the College of Science and Health will abide by the College of Science and Health Modern Language Requirement in place on the effective date of the ICT.

BA students who meet College requirements and wish to pursue further work in the language may elect the Language for Liberal Studies Option (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-program-guidelines/language-for-liberal-studies-option/) of the Liberal Studies Program. While Bachelor of Science (BS) students are not required to demonstrate competency in a modern language, the Language for Liberal Studies Option is available to them for language study at any level. Modern Languages courses with an E-designation are taught in English and may not be applied to the Language for Liberal Studies Option.

## Major Declaration Requirements
All students in the College are required to declare a major field prior to beginning their junior year. After researching College programs, the student should declare a major field by visiting Campus Connection and

using the Declarations and Inter-College Transfer tool. The student will then be assigned a faculty advisor or staff advisor in the department or program and should make an appointment to see that advisor at his or her earliest convenience.

To change major fields, or to declare a minor or concentration, the student must use the Declarations and Inter-College Transfer tool described above. However, for the purpose of exploring the possibility of changing a major field, the student should consult an academic advisor in the College or an academic advisor in the Office for Academic Advising Support.

# Liberal Studies Requirements

Honors program requirements can be found in the individual Colleges & Schools section of the University Catalog. Select the appropriate college or school, followed by Undergraduate Academics and scroll down.

| First Year Program | | Hours |
|---|---|---|
| **Chicago Quarter** | | |
| LSP 110 or LSP 111 | DISCOVER CHICAGO or EXPLORE CHICAGO | 4 |
| **Focal Point** | | |
| LSP 112 | FOCAL POINT SEMINAR | 4 |
| **Writing** | | |
| WRD 103 | COMPOSITION AND RHETORIC I [1] | 4 |
| WRD 104 | COMPOSITION AND RHETORIC II [1] | 4 |
| **Quantitative Reasoning** | | |
| Not Required | | |
| **Sophomore Year** | | |
| **Race, Power, and Resistance** | | |
| LSP 200 | SEMINAR ON RACE, POWER, AND RESISTANCE | 4 |
| **Junior Year** | | |
| **Experiential Learning** | | |
| Required | | 4 |
| **Senior Year** | | |
| **Capstone** | | |
| Select one of the following: | | |
| CSC 394 | SOFTWARE PROJECTS [1] | 4 |
| MAT 398 | SENIOR CAPSTONE SEMINAR [1] | 4 |

[1] Students must earn a C- or better in this course.

## Learning Domains

**Arts and Literature (AL) (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-learning-domains/arts-and-literature/)**
- 3 Courses Required

**Historical Inquiry (HI) (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-learning-domains/historical-inquiry/)**
- 2 Courses Required

**Math and Computing (MC) (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-learning-domains/math-and-computing/)**
- Not Required

**Philosophical Inquiry (PI) (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-learning-domains/philosophical-inquiry/)**
- 2 Courses Required (See note below)

**Religious Dimensions (RD) (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-learning-domains/religious-dimensions/)**
- 2 Courses Required (See note below)

**Scientific Inquiry (SI) (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-learning-domains/scientific-inquiry/)**
- 1 Lab Course Required

**Social, Cultural, and Behavioral Inquiry (SCBI)  (https://catalog.depaul.edu/undergraduate-core/liberal-studies-program/liberal-studies-learning-domains/social-cultural-and-behavioral-inquiry/)**
- 3 Courses Required

## Notes

Students must take one of the following ethics courses:

| Course | Title | Quarter Hours |
|---|---|---|
| *Select one of the following:* | | |
| CSC 208 | ETHICS IN TECHNOLOGY (PI) | 4 |
| PHL/MGT 248 | BUSINESS ETHICS (PI) | 4 |
| REL/MGT 228 | BUSINESS, ETHICS AND SOCIETY (RD) | 4 |

Specified required courses within Liberal Studies may have grade minimums (e.g. C- or better). Please consult your advisor or your college and major requirements.

Students with a primary major in Mathematics and Computer Science (joint degree) are required to complete one of the following Capstone courses: CSC 394 or MAT 398. Students double majoring or pursuing dual degrees with the primary major or primary degree in Mathematics and Computer Science (joint degree) are also required to complete one of these courses. Mathematics and Computer Science (joint degree) students in the University Honors Program shall take the University Honors Capstone. They are not expected to take both the Honors Capstone and the primary major or primary degree Capstone.

Courses offered in the student's primary major cannot be taken to fulfill LSP Domain requirements. If students double major, LSP Domain courses may double count for both LSP credit and the second major. Students who choose to take an experiential learning course offered by the major may count it either as a general elective or the Experiential Learning requirement.

In meeting learning domain requirements, no more than one course that is outside the student's major and is cross-listed with a course within the student's major, can be applied to count for LSP domain credit. This policy does not apply to those who are pursuing a double major or earning BFA or BM degrees.

# Major Requirements
## Course Requirements

| Course | Title | Quarter Hours |
|---|---|---|
| Choose one (1) sequence: | | 8 |
| CSC 241 & CSC 242 | INTRODUCTION TO COMPUTER SCIENCE I and INTRODUCTION TO COMPUTER SCIENCE II | |
| OR | | |
| CSC 243 | INTRODUCTION TO COMPUTER SCIENCE FOR PROGRAMMERS (and one (1) major elective) | |
| Remaining Requirements: | | |
| CSC 300 | DATA STRUCTURES I | 4 |
| CSC 301 | DATA STRUCTURES II | 4 |
| CSC 321 | DESIGN AND ANALYSIS OF ALGORITHMS | 4 |
| CSC 373 | COMPUTER SYSTEMS I | 4 |
| CSC 374 | COMPUTER SYSTEMS II | 4 |
| MAT 140 | DISCRETE MATHEMATICS I | 4 |
| MAT 141 | DISCRETE MATHEMATICS II | 4 |
| or MAT 215 | INTRODUCTION TO MATHEMATICAL REASONING | |
| MAT 260 | MULTIVARIABLE CALCULUS I | 4 |
| MAT 262 | LINEAR ALGEBRA | 4 |
| Select one of the following calculus sequences: | | 12 - 18 |
| Calculus Sequence (option 1) | | |
| MAT 147 | CALCULUS WITH INTEGRATED PRECALCULUS I | |
| MAT 148 | CALCULUS WITH INTEGRATED PRECALCULUS II | |
| MAT 149 | CALCULUS WITH INTEGRATED PRECALCULUS III | |
| Calculus Sequence (option 2) | | |
| MAT 150 | CALCULUS I | |
| MAT 151 | CALCULUS II | |
| MAT 152 | CALCULUS III | |
| Summer Calculus Sequence (option 3) | | |
| MAT 155 | SUMMER CALCULUS I | |
| MAT 156 | SUMMER CALCULUS II | |
| Select One of the Following (Capstone) | | 4 |
| CSC 394 | SOFTWARE PROJECTS | |
| DSC 394 | DATA SCIENCE PROJECT | |
| MAT 398 | SENIOR CAPSTONE SEMINAR | |
| Select twelve (12) credit hours of CDM Major Electives | | 12 |
| Select twelve (12) credit hours of MAT Major Electives | | 12 |
| Select four (4) credit hours of CDM or MAT Major Elective | | 4 |
| Select twenty-eight (28) credit hours of Open Electives | | 28 |

Note: Students may take CSC 243 and one (1) Additional Major Elective in lieu of CSC 241 and CSC 242.

## Major Electives

Students must earn a grade of C- or higher in all major requirements and major elective courses.

For the major electives, it is recommended that students concentrate on one or two areas to achieve depth, but they are not required to do so. Students are strongly encouraged to discuss course selection with an advisor. Students may wish to arrange with a professor to take an independent study or a research experience (MAT 399 (https://catalog.depaul.edu/search/?P=MAT%20399) or CSC 399 (https://catalog.depaul.edu/search/?P=CSC%20399) or IT 300 (https://catalog.depaul.edu/search/?P=IT%20300)) in order to explore a subject more deeply than is possible in a scheduled course.

### Theory of Computation

The courses in the theory of computation area explore the mathematical and logical foundations of computer science.

| Course | Title | Quarter Hours |
|---|---|---|
| CSC 235 | PROBLEM SOLVING | |
| CSC 327 | PROBLEM SOLVING FOR CONTESTS | |
| CSC 333 | CRYPTOLOGY | |
| CSC 344 | AUTOMATA THEORY AND FORMAL GRAMMARS | |
| CSC 347 | CONCEPTS OF PROGRAMMING LANGUAGES | |
| CSC 348 | INTRODUCTION TO COMPILER DESIGN | |
| CSC 358 | SYMBOLIC PROGRAMMING | |
| CSC 376 | DISTRIBUTED SYSTEMS | |
| CSC 389 | THEORY OF COMPUTATION | |
| MAT 216 | FOUNDATIONS OF ADVANCED MATHEMATICS | |
| MAT 302 | COMBINATORICS | |
| MAT 303 | THEORY OF NUMBERS | |
| MAT 305 | GRAPH THEORY | |
| MAT 310 | ABSTRACT ALGEBRA I | |
| MAT 335 | REAL ANALYSIS I | |
| MAT 336 | REAL ANALYSIS II | |
| MAT 349 | APPLIED PROBABILITY | |
| or MAT 351 | PROBABILITY AND STATISTICS I | |
| MAT 370 | ADVANCED LINEAR ALGEBRA | |

### Computational Methods

The computational methods area investigates quantitative and computational methods in computer science.

| Course | Title | Quarter Hours |
|---|---|---|
| CSC 331 | SCIENTIFIC COMPUTING | |
| MAT 304 | DIFFERENTIAL EQUATIONS | |
| MAT 359 | SIMULATION MODELS AND MONTE CARLO METHOD | |
| MAT 384 | MATHEMATICAL MODELING | |
| MAT 385 | NUMERICAL ANALYSIS I | |
| MAT 386 | NUMERICAL ANALYSIS II | |

### Artificial Intelligence

For students with an interest in the computational relations between syntax and semantics.

| Course | Title | Quarter Hours |
|---|---|---|
| CSC 357 | EXPERT SYSTEMS | |
| CSC 358 | SYMBOLIC PROGRAMMING | |
| CSE 375 | INTRODUCTION TO ROBOTICS | |
| CSC 380 | FOUNDATIONS OF ARTIFICIAL INTELLIGENCE | |

### Data Science Area

For students who are interested in statistical and computational analysis of data. Many of the courses in this area require the student to take MAT 351-MAT 353.

| Course | Title | Quarter Hours |
|---|---|---|
| DSC 323 | DATA ANALYSIS AND REGRESSION | |
| or MAT 356 | APPLIED REGRESSION ANALYSIS | |
| DSC 324 | ADVANCED DATA ANALYSIS | |
| DSC 333 | INTRODUCTION TO BIG DATA PROCESSING | |
| DSC 341 | FOUNDATIONS OF DATA SCIENCE | |
| DSC 345 | MACHINE LEARNING | |
| DSC 365 | DATA VISUALIZATION | |
| MAT 341 | STATISTICAL METHODS USING SAS | |
| MAT 349 | APPLIED PROBABILITY | |
| or MAT 351 | PROBABILITY AND STATISTICS I | |
| MAT 352 | PROBABILITY AND STATISTICS II | |
| MAT 353 | PROBABILITY AND STATISTICS III | |
| MAT 355 | STOCHASTIC PROCESSES | |
| MAT 357 | NONPARAMETRIC STATISTICS | |
| MAT 358 | APPLIED TIME SERIES AND FORECASTING | |
| MAT 359 | SIMULATION MODELS AND MONTE CARLO METHOD | |
| MAT 360 | GENERALIZED LINEAR MODELS | |

### Computer Vision

Computer vision studies the mathematical and algorithmic underpinnings of image analysis and image processing.

| Course | Title | Quarter Hours |
|---|---|---|
| MAT 261 | MULTIVARIABLE CALCULUS II | |
| MAT 335 | REAL ANALYSIS I | |
| MAT 370 | ADVANCED LINEAR ALGEBRA | |
| MAT 381 | FOURIER ANALYSIS AND SPECIAL FUNCTIONS | |
| MAT 384 | MATHEMATICAL MODELING | |
| MAT 387 | OPERATIONS RESEARCH: LINEAR PROGRAMMING | |
| MAT 388 | OPERATIONS RESEARCH: OPTIMIZATION THEORY | |
| CSC 381 | INTRODUCTION TO DIGITAL IMAGE PROCESSING | |
| CSC 382 | APPLIED IMAGE ANALYSIS | |

### Research

| Course | Title | Quarter Hours |
|---|---|---|
| CSC 395 | RESEARCH COLLOQUIUM | |
| CSC 399 | INDEPENDENT STUDY | |
| MAT 390 | MATHEMATICS READING AND RESEARCH | |
| MAT 396 | SENIOR THESIS RESEARCH | |

## Finance

| Course | Title | Quarter Hours |
|---|---|---|
| MAT 349 | APPLIED PROBABILITY | |
| MAT 368 | MATHEMATICS FOR FINANCE | |
| MAT 387 | OPERATIONS RESEARCH: LINEAR PROGRAMMING | |
| MAT 388 | OPERATIONS RESEARCH: OPTIMIZATION THEORY | |

## Open Electives

Open Elective credit hours are required to meet the minimum graduation requirements of 192 hours. Open Electives may be taken from any unit at DePaul.

*See* www.cdm.depaul.edu *(*http://www.cdm.depaul.edu*) to see sample schedule of course requirements on a year-by-year basis.*

## Degree Requirements

Students in this degree must meet the following requirements:

- Complete a minimum of 192 credit hours (generally 48 courses)
- Earn a grade of C- or higher in WRD 103, WRD 104, and all Major and Minor courses
- Earn a grade of D or higher in all other Liberal Studies and Open Elective courses
- Maintain a cumulative GPA of 2.0 or higher