

BIOMEDICAL DATA SCIENCE, M.S.

The current explosion of biomedical data provides an awesome opportunity to improve understanding of the mechanisms of disease and ultimately to improve human health care. However, fully harnessing the power of high-dimensional, heterogeneous data requires a new blend of skills including programming, data management, data analysis, and machine learning.

The M.S. degree program in biomedical data science covers core concepts and allows for concentrated coursework, in both methodology and application.

ADMISSIONS

Please consult the table below for key information about this degree program's admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program's website. Graduate admissions is a two-step process between academic programs and the Graduate School. **Applicants must meet** the minimum requirements (<https://grad.wisc.edu/apply/requirements/>) **of the Graduate School as well as the program(s).**

Once you have researched the graduate program(s) you are interested in, apply online (<https://grad.wisc.edu/apply/>).

Requirements	Detail
Fall Deadline	January 12
Spring Deadline	The program does not admit in the spring.
Summer Deadline	The program does not admit in the summer.
GRE (Graduate Record Examinations)	Required.
English Proficiency Test	Every applicant whose native language is not English or whose undergraduate instruction was not in English must provide an English proficiency test score and meet the Graduate School minimum requirements (https://grad.wisc.edu/apply/requirements/#english-proficiency).
Other Test(s) (e.g., GMAT, MCAT)	The MCAT may be accepted as an alternate to the GRE.
Letters of Recommendation Required	3

Potential students include both those with bachelor's degrees in an area of data-science (e.g., computer science, statistics), as well as health professionals and clinicians (e.g., M.D.'s, Pharm.D.'s, R.N.'s). It is expected that admitted candidates will have demonstrated an aptitude for computer science and math, fundamental programming skills, knowledge of data structures and algorithms, and at least two semesters of college calculus. We will however consider candidates who have a wide range of undergraduate backgrounds; providing opportunities to develop necessary skills immediately upon entering the program.

Applying to the Program:

- A formal online application (<https://grad.wisc.edu/apply/>) with required fee through the UW–Madison Graduate School
- Three letters of recommendation
- Transcripts from each higher-education institution attended
- A statement of purpose
- GRE or MCAT scores
- Applicants whose native language is not English, or whose undergraduate instruction was not in English, must provide an English proficiency test score (TOEFL, MELAB, or IELTS)
- Evidence of quantitative preparation, including at least two semesters of college calculus (similar to MATH 221 - MATH 222) and either a course in linear algebra (similar to MATH 340) or courses in programming and data structures

Application Deadline: January 12

For additional information about admission to the program, see MS Program in Biomedical Data Science (https://www.biostat.wisc.edu/content/ms_program_in_biomedical_data_science/) on the department website.

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (<https://grad.wisc.edu/funding/>) is available from the Graduate School. Be sure to check with your program for individual policies and restrictions related to funding.

PROGRAM RESOURCES

Funding guarantees are not provided for students in this program. Students are encouraged to explore funding options available across campus.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (<http://guide.wisc.edu/graduate/#policiesandrequirementstext>), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students are able to complete a program with minimal disruptions to careers and other commitments.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the

advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW-Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirements Detail

Minimum 30 credits

Credit

Requirement

Minimum 16 credits

Residence

Credit

Requirement

Minimum Half of the coursework (15 out of 30 total credits) must be completed in graduate-level coursework; courses with Graduate be completed in graduate-level coursework; courses with Coursework the Graduate Level Coursework attribute are identified and Requirement searchable in the university's Course Guide.

Overall 3.00 GPA required.

Graduate GPA

Requirement

Other Grade Students must earn a B or above in all core curriculum Requirements coursework.

Assessments No formal examination required. The research track and requires a research project of 3–6 credits.

Examinations

Language No language requirements.

Requirements

REQUIRED COURSES

Code	Title	Credits
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Core Courses Required

B M I/STAT 541	Introduction to Biostatistics	3
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or B M I/ POP HLTH 551	Introduction to Biostatistics for Population Health	
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or STAT/ F&W ECOL/ HORT 571	Statistical Methods for Bioscience I	
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B M I/COMP SCI 567	Medical Image Analysis	3
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B M I 573	Foundations of Data-Driven Healthcare	3
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B M I/COMP SCI 576	Introduction to Bioinformatics	3
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Concentration Electives

In consultation with their faculty advisor, students will select electives in an area of concentration within biomedical informatics. Examples include but are not limited to:

B M I/STAT 641	Statistical Methods for Clinical Trials
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B M I/STAT 642	Statistical Methods for Epidemiology
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B M I/ COMP SCI 776	Advanced Bioinformatics
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B M I/STAT 877	Statistical Methods for Molecular Biology
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I SY E 417	Health Systems Engineering
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I SY E/B M I 617	Health Information Systems
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Data Science Electives

6-7

In consultation with their faculty advisor, students will select two courses as electives in computer science and/or statistics. Coursework of high relevance includes the following areas:

B M I/ COMP SCI 767	Computational Methods for Medical Image Analysis
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B M I/STAT 768	Statistical Methods for Medical Image Analysis
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STAT 601	Statistical Methods I
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STAT 602	Statistical Methods II
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STAT 609	Mathematical Statistics I
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STAT 610	Introduction to Statistical Inference
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STAT 627	Professional Skills in Data Science
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STAT 771	Statistical Computing
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STAT 849	Theory and Application of Regression and Analysis of Variance I
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STAT 850	Theory and Application of Regression and Analysis of Variance II
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COMP SCI 577	Introduction to Algorithms
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COMP SCI 787	Advanced Algorithms
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COMP SCI 766	Computer Vision
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COMP SCI 564	Database Management Systems: Design and Implementation
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COMP SCI 764	Topics in Database Management Systems
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COMP SCI 570	Introduction to Human-Computer Interaction
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COMP SCI/ ED PSYCH/ PSYCH 770	Human-Computer Interaction
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COMP SCI 540	Introduction to Artificial Intelligence
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COMP SCI 760	Machine Learning
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COMP SCI/ E C E 761	Mathematical Foundations of Machine Learning
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COMP SCI 545	Natural Language and Computing
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COMP SCI 769	Advanced Natural Language Processing
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COMP SCI/I SY E/ MATH 425	Introduction to Combinatorial Optimization
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COMP SCI/I SY E/ MATH/STAT 525	Linear Optimization
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COMP SCI/ I SY E 635	Tools and Environments for Optimization
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COMP SCI 642	Introduction to Information Security
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POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School's Academic Policies and Procedures (<https://grad.wisc.edu/acadpolicy/>) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

MAJOR-SPECIFIC POLICIES

PRIOR COURSEWORK

Graduate Work from Other Institutions

With program approval, students are allowed to count no more than 9 credits of graduate coursework from other institutions. Coursework earned five or more years prior to admission to a master's degree is not allowed to satisfy requirements.

UW–Madison Undergraduate

With program approval, students are allowed up to 7 credits numbered 300 or above from a UW–Madison undergraduate degree to count toward the degree. Coursework earned five or more years prior to admission to a master's degree is not allowed to satisfy requirements.

UW–Madison University Special

With program approval, students are allowed to count no more than 9 credits of course work numbered 300 or above taken as a UW–Madison Special student. Coursework earned five or more years prior to admission to a master's degree is not allowed to satisfy requirements.

PROBATION

The status of a student can be one of three options:

1. Good standing (progressing according to standards; any funding guarantee remains in place).
2. Probation (not progressing according to standards but permitted to enroll; loss of funding guarantee; specific plan with dates and deadlines in place in regard to removal of probationary status).
3. Unsatisfactory progress (not progressing according to standards; not permitted to enroll, dismissal, leave of absence or change of advisor or program).

ADVISOR / COMMITTEE

All students are required to conduct a yearly progress report meeting with their advisor, scheduled by December 17 and completed by April 30. Failure to do so will result in a hold being placed on the student's registration.

CREDITS PER TERM ALLOWED

15 credits

TIME CONSTRAINTS

If students have been absent for five or more years, they must file a new Graduate School application for admission and submit it with a new application fee. Master's degree students who have been absent for five or more consecutive years lose all credits that they have earned before their absence. Students may count the coursework completed before their absence for meeting graduate degree-credit requirements; the

Graduate School will not count that work toward the Graduate School's minimum residence credit requirement.

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (<https://doso.students.wisc.edu/bias-or-hate-reporting/>)
- Graduate Assistantship Policies and Procedures (<https://hr.wisc.edu/policies/gapp/#grievance-procedure>)
- Hostile and Intimidating Behavior Policies and Procedures (<https://hr.wisc.edu/hib/>)
 - Office of the Provost for Faculty and Staff Affairs (<https://facstaff.provost.wisc.edu/>)
- Dean of Students Office (<https://doso.students.wisc.edu/>) (for all students to seek grievance assistance and support)
- Employee Assistance (<http://www.eao.wisc.edu/>) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
- Employee Disability Resource Office (<https://employee disabilities.wisc.edu/>) (for qualified employees or applicants with disabilities to have equal employment opportunities)
- Graduate School (<https://grad.wisc.edu/>) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
- Office of Compliance (<https://compliance.wisc.edu/>) (for class harassment and discrimination, including sexual harassment and sexual violence)
- Office of Student Conduct and Community Standards (<https://conduct.students.wisc.edu/>) (for conflicts involving students)
- Ombuds Office for Faculty and Staff (<http://www.ombuds.wisc.edu/>) (for employed graduate students and post-docs, as well as faculty and staff)
- Title IX (<https://compliance.wisc.edu/titleix/>) (for concerns about discrimination)

Students should contact the program director with questions about grievances.

OTHER

Funding guarantees are not provided for students in this program. Students are encouraged to explore funding options available across campus.

PROFESSIONAL DEVELOPMENT

GRADUATE SCHOOL RESOURCES

Take advantage of the Graduate School's professional development resources (<https://grad.wisc.edu/pd/>) to build skills, thrive academically, and launch your career.

LEARNING OUTCOMES

1. Understand, apply, and evaluate common informatics theories, methods, and tools related to biological and biomedical problems, health care and public health.

2. Apply, adapt, and validate an existing approach to a specific biomedical and health problem.
3. Produce solutions that address academic or industrial needs using informatics tools and knowledge.
4. Evaluate the impact of biomedical informatics applications and interventions.
5. Understand the challenges and limitations of technological solutions.
6. Demonstrate scholarly oral and written presentations.
7. Adhere to the professional and legal standards of conduct in Biomedical Data Science.

PEOPLE

Faculty: Broman, Buchanan, Burnside, Chappell, Chen, Chung, Craven, Dewey, Doan, Dyer, Elwert, Gangnon, Gianola, Gitter, Keles, Kendziorski, Kim, Lu, Mao, Mumford, Newton (chair), Ong, Palta, Patel, Peissig, Rosa, Rosenberg, Roy, Singh, Sorkness, Tang, Yandell, Velten, Wang, Yu, Zhang, Zhu