BIOMEDICAL DATA SCIENCE, MS

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

ADMISSIONS

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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	December 15
Spring Deadline	The program does not admit in the spring.
Summer Deadline	The program does not admit in the summer.
GRE (Graduate Record Examinations)	Not required.
English Proficiency Test	Refer to the Graduate School: Minimum Requirements for Admission policy: https://policy.wisc.edu/library/UW-1241 (https://policy.wisc.edu/library/UW-1241/).
Other Test(s) (e.g., GMAT, MCAT)	n/a
Letters of Recommendation Required	3

Applicants 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., MD's, PharmD's, RN's). It is expected that admitted applicants 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. The program will consider applicants 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
- Unofficial transcripts from each higher-education institution attended
- A statement of purpose
- International degree-seeking applicants must prove English proficiency
- 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 COMP SCI 200 -COMP SCI 300) or courses in programming and data structures

For additional information about admission to the program, see MS Program in Biomedical Data Science (https://biostat.wiscweb.wisc.edu/education/prospective-students/) on the department website.

FUNDING

FUNDING

GRADUATE SCHOOL RESOURCES

The Bursar's Office provides information about tuition and fees associated with being a graduate student**.** Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information 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 degree requirements (https://guide.wisc.edu/graduate/#requirementstext) and policies (https://guide.wisc.edu/graduate/#policiestext), 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 typically take enough credits aimed at completing the program in a year or two.

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

Requirement	Detail
Minimum Credit Requirement	30 credits
Minimum Residence Credit Requirement	16 credits
Minimum Graduate Coursework Requirement	15 credits must be graduate-level coursework. Refer to the Graduate School: Minimum Graduate Coursework (50%) Requirement policy: https://policy.wisc.edu/library/UW-1244 (https://policy.wisc.edu/library/UW-1244/).
Overall Graduate GPA Requirement	3.00 GPA required. Refer to the Graduate School: Grade Point Average (GPA) Requirement policy: https://policy.wisc.edu/library/UW-1203 (https://policy.wisc.edu/library/UW-1203/).
Other Grade Requirements	Students must earn a B or above in all core curriculum coursework.
Assessments and Examinations	No formal examination required.
Language Requirements	No language requirements.

REQUIRED COURSES

Code	Title	Credits
Concentration Electives		
In consultation with their faculty advisor, students will select electives in an area of concentration within biomedical data science. Examples include but are not limited to:		12
I SY E 517	Decision Making in Health Care	
B M I/STAT 541	Introduction to Biostatistics	
or B M I/ POP HLTH 551	Introduction to Biostatistics for Population Health	
or STAT/ F&W ECOL 571	Statistical Methods for Bioscience I	
B M I/ POP HLTH 552	Regression Methods for Population Health	
B M I/ COMP SCI 567	Biomedical Image Analysis	
STAT/ F&W ECOL 572	Statistical Methods for Bioscience II	
B M I 573	Foundations of Data-Driven Healthcare	
B M I/ COMP SCI 576	Introduction to Bioinformatics	
B M I/BIOCHEM/ BMOLCHEM/ MATH 609	Mathematical Methods for Systems Biology	
B M I/STAT 620	Statistics in Human Genetics	
B M I/STAT 641	Statistical Methods for Clinical Trials	
B M I/STAT 642	Statistical Methods for Epidemiology	
B M I/ POP HLTH 651	Advanced Regression Methods for Population Health	
B M I/STAT 741	Survival Analysis Theory and Methods	
B M I/ COMP SCI 767	Computational Methods for Medical Image Analysis	
B M I/STAT 768	Statistical Methods for Medical Image Analysis	
B M I 773	Clinical Research Informatics	
B M I/ COMP SCI 775	Computational Network Biology	
B M I/ COMP SCI 776	Advanced Bioinformatics	
B M I/STAT 877	Statistical Methods for Molecular Biology	
Data Science Electives		
In consultation with their faculty advisor, students will select electives in computer science and/or statistics. Examples include but are not limited to:		12
STAT 609	Mathematical Statistics I	
STAT 610	Introduction to Statistical Inference	
STAT 627	Professional Skills in Data Science	
STAT 771	Computational Statistics	
STAT 849	Advanced Statistical Methods	
STAT 850		
COMP SCI/ E C E 766	Computer Vision	
COMP SCI/E C E/ I SY E 524	Introduction to Optimization	
COMP SCI/E C E/ M E 532	Matrix Methods in Machine Learning	
COMP SCI 544	Introduction to Big Data Systems	
COMP SCI 571	Building User Interfaces	
COMP SCI/I SY E/ MATH/STAT 726	Nonlinear Optimization I	
COMP SCI 744	Big Data Systems	
COMP SCI 762	Advanced Deep Learning	
COMP SCI 765	Data Visualization	
COMP SCI 784	Foundations of Data Management	
COMP SCI 564	Database Management Systems: Design and Implementation	
COMP SCI 764	Topics in Database Management Systems	
COMP SCI 570	Introduction to Human-Computer Interaction	

COMP SCI/ ED PSYCH/ PSYCH 770	Human-Computer Interaction	
COMP SCI 540	Introduction to Artificial Intelligence	
COMP SCI/ E C E 760	Machine Learning	
COMP SCI/ E C E 761	Mathematical Foundations of Machine Learning	
COMP SCI 769	Advanced Natural Language Processing	
COMP SCI/I SY E/ MATH 425	Introduction to Combinatorial Optimization	
COMP SCI/I SY E/ MATH/STAT 525	Linear Optimization	
COMP SCI 642	Introduction to Information Security	
Research Ethics Course		
The following is recommended:		1-2
B M I 738	Ethics for Data Scientists	
If a student is unable to take B M I 738, one of the following courses may be substituted.		
ONCOLOGY 715	Ethics in Science	
BIOCHEM 729	Advanced Topics (Topic: Responsible Conduct of Research)	
NURSING 802	Ethics and the Responsible Conduct of Research	
PATH-BIO/ COMP BIO 812	Research Ethics and Career Development	
OBS&GYN 955	Responsible Conduct of Research for Biomedical Graduate Students	
OBS&GYN 956	Advanced Responsible Conduct of Research for Biomedical Students	
Professional Development Elective		
B M I 800	Becoming a Biomedical Data Scientist	1
Research		
Complete 4 credits of following:		4
B M I 699	Independent Study	
Total Credits		**30**

Electives

Between the Concentration Electives and Data Science Electives, students must complete at least 6 credits of computer sciences-oriented courses and 6 credits of statistics-oriented courses. Computer sciences-oriented courses include those in the Department of Computer Sciences course listing (COMP SCI (https://guide.wisc.edu/courses/comp_sci/)). Statistics-oriented courses include those in the Department of Statistics course listing (STAT (https://guide.wisc.edu/courses/stat/)), in addition to B M I/POP HLTH 552 Regression Methods for Population Health **and** B M I/POP HLTH 651 Advanced Regression Methods for Population Health . A specific section of B M I 826 Special Topics in Biostatistics and Biomedical Informatics can satisfy as either a computer sciences-oriented course or a statistics-oriented course at the discretion of the MS Program Steering Committee.

POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School's Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy/) serve as the official document of record for Graduate School academic and administrative policies and procedures and are updated continuously. Note some policies redirect to entries in the official UW-Madison Policy Library (https://policy.wisc.edu/). Programs may set more stringent policies than the Graduate School. Policies set by the academic degree program can be found below.

MAJOR-SPECIFIC POLICIES

PRIOR COURSEWORK

Graduate Credits Earned at Other Institutions

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

Undergraduate Credits Earned at Other Institutions or UW-Madison

Refer to the Graduate School: Transfer Credits for Prior Coursework (https://policy.wisc.edu/library/UW-1216/) policy.

Credits Earned as a Professional Student at UW-Madison (Law, Medicine, Pharmacy, and Veterinary careers)

Refer to the Graduate School: Transfer Credits for Prior Coursework (https://policy.wisc.edu/library/UW-1216/) policy.

Credits Earned as a University Special Student at UW–Madison

With program approval, students are allowed to transfer no more than 9 credits of course work numbered 300 or above taken as a UW–Madison University Special student. However, these credits are not allowed to count toward the 50% graduate coursework minimum unless numbered 700 or above or are taken to meet the requirements of a capstone certificate and has the "Grad 50%" attribute. Coursework earned ten or more years prior to admission to a master's degree is not allowed to satisfy requirements.

PROBATION

Refer to the Graduate School: Probation (https://policy.wisc.edu/library/UW-1217/) policy.

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.

CREDITS PER TERM ALLOWED

15 credit maximum. Refer to the Graduate School: Maximum Credit Loads and Overload Requests (https://policy.wisc.edu/library/UW-1228/) policy.

TIME LIMITS

Refer to the Graduate School: Time Limits (https://policy.wisc.edu/library/UW-1221/) policy.

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/)
- 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://employeedisabilities.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 Student Assistance and Support (OSAS) (https://osas.wisc.edu/) (for all students to seek grievance assistance and support)
- 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)

Grievance Policy for Graduate Programs in the School of Medicine and Public Health

Any student in a School of Medicine and Public Health graduate program who feels that they have been treated unfairly in regards to educational decisions and/or outcomes or issues specific to the graduate program, including academic standing, progress to degree, professional activities, appropriate advising, and a program's community standards by a faculty member, staff member, postdoc, or student has the right to complain about the treatment and to receive a prompt hearing of the grievance following these grievance procedures. Any student who discusses, inquiries about, or participates in the grievance procedure may do so openly and shall not be subject to intimidation, discipline, or retaliation because of such activity. Each program's grievance advisor is listed on the "Research" tab of the SMPH intranet (https://intranet.med.wisc.edu/).

Exclusions

This policy does not apply to employment-related issues for Graduate Assistants in TA, PA and/or RA appointments. Graduate Assistants will utilize the Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/) (GAPP) grievance process to resolve employment-related issues.

This policy does not apply to instances when a graduate student wishes to report research misconduct. For such reports refer to the UW-Madison Policy for Reporting Research Misconduct for Graduate Students and Postdoctoral Research Associates (https://research.wisc.edu/kb-article/?id=84924).

Requirements for Programs

The School of Medicine and Public Health Office of Basic Research, Biotechnology and Graduate Studies requires that each graduate program designate a grievance advisor, who should be a tenured faculty member, and will request the name of the grievance advisor annually. The program director will serve as the alternate grievance advisor in the event that the grievance advisor is named in the grievance. The program must notify students of the grievance advisor, including posting the grievance advisor's name on the program's Guide page and handbook.

The grievance advisor or program director may be approached for possible grievances of all types. They will spearhead the grievance response process described below for issues specific to the graduate program, including but not limited to academic standing, progress to degree, professional activities, appropriate advising, and a program's community standards. They will ensure students are advised on reporting procedures for other types of possible grievances and are supported throughout the reporting process. Resources (https://grad.wisc.edu/current-students/#reporting-incidents) on identifying and reporting other issues have been compiled by the Graduate School.

Procedures

1. The student is advised to initiate a written record containing dates, times, persons, and description of activities, and to update this record while completing the procedures described below.
2. If the student is comfortable doing so, efforts should be made to resolve complaints informally between individuals before pursuing a formal grievance.
3. Should a satisfactory resolution not be achieved, the student should contact the program's grievance advisor or program director to discuss the complaint. The student may approach the grievance advisor or program director alone or with a UW-Madison faculty or staff member. The grievance advisor or program director should keep a record of contacts with regards to possible grievances. The first attempt is to help the student informally address the complaint prior to pursuing a formal grievance. The student is also encouraged to talk with their faculty advisor regarding concerns or difficulties.
4. If the issue is not resolved to the student's satisfaction, the student may submit a formal grievance to the grievance advisor or program director in writing, within 60 calendar days from the date the grievant first became aware of, or should have become aware of with the exercise of reasonable diligence, the cause of the grievance. To the fullest extent possible, a grievance shall contain a clear and concise statement of the grievance and indicate the issue(s) involved, the relief sought, the date(s) the incident or violation took place, and any specific policy involved.
5. On receipt of a written grievance, the following steps will occur. The final step must be completed within 30 business days from the date the grievance was received. The program must store documentation of the grievance for seven years. Significant grievances that set a precedent may be stored indefinitely.
   a. The grievance advisor or program director will convene a faculty committee composed of at least three members to manage the grievance. Any faculty member involved in the grievance or who feels that they cannot be impartial may not participate in the committee. Committee composition should reflect diverse viewpoints within the program.

b. The faculty committee, through the grievance advisor or program director, will obtain a written response from the person or persons toward whom the grievance is directed. The grievance advisor or program director will inform this person that their response will be shared with the student filing the grievance.
c. The grievance advisor or program director will share the response with the student filing the grievance.
d. The faculty committee will make a decision regarding the grievance. The committee's review shall be fair, impartial, and timely. The grievance advisor or program director will report on the action taken by the committee in writing to both the student and the person toward whom the grievance was directed.

6. If either party (the student or the person or persons toward whom the grievance is directed) is unsatisfied with the decision of the program's faculty committee, the party may file a written appeal to the SMPH senior associate dean for basic research, biotechnology and graduate studies within 10 business days from the date of notification of the program's faculty committee. The following steps will occur:
    a. The grievant will be notified in writing, within 5 business days of the written appeal, acknowledging receipt of the formal appeal and establishing a timeline for the review to be completed.
    b. The senior associate dean or their designee may request additional materials and/or arrange meetings with the grievant and/or others. If meetings occur, the senior associate dean or their designee will meet with both the grievant and the person or persons toward whom the grievance is directed.
    c. The senior associate dean or their designee will assemble an ad hoc committee of faculty from outside of the student's graduate program and ask them to prepare a written recommendation on whether to uphold or reverse the decision of the program on the student's initial grievance. The committee may request additional materials and/or arrange meetings with the grievant and/or others. If meetings occur, the committee will meet with both the grievant and the person or persons toward whom the grievance is directed.
    d. The senior associate dean or their designee will make a final decision within 20 business days of receipt of the committee's recommendation.
    e. The SMPH Office of Basic Research, Biotechnology, and Graduate Studies must store documentation of the grievance for seven years. Grievances that set a precedent may be stored indefinitely.
7. The student may file an appeal of the School of Medicine and Public Health decision with the Graduate School. See the Grievances and Appeals section of the Graduate School's Academic Policies and Procedures (https://grad.wisc.edu/documents/grievances-and-appeals/).

Time Limits

Steps in the grievance procedures must be initiated and completed within the designated time periods except when modified by mutual consent. If the student fails to initiate the next step in the grievance procedure within the designated time period, the grievance will be considered resolved by the decision at the last completed step.

OTHER

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

PROFESSIONAL DEVELOPMENT

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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

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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.