Informatics

Academic doctoral programs at MU in the area of Informatics are coordinated through the Institute for Data Science and Informatics.

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About the Institute for Data Science and Informatics (MUIDSI)

Building on a tradition of outstanding informatics education and research at Missouri, the MU Institute for Data Science and Informatics is comprised of 62 faculty from 27 different departments and 10 schools/colleges, including the Colleges of Agriculture, Food, and Natural Resources; Arts & Science; Education and Human Development; Engineering; Human and Environmental Science; Veterinary Medicine; School of Health Professions; Medicine; and Nursing. The Institute offers emphasis areas in bioinformatics and health informatics, along with a concentration area in geoinformatics. Each emphasis area and concentration area stress skill sets and research appropriate to the subfield within the broad area of informatics. A core curriculum provides all students with a foundation of knowledge and tools in biology, computer sciences, health systems, and statistics, after which they complete further coursework in their chosen area. The integrated program assures broad exposure to the field and fosters new insights and innovative research concepts.

Faculty

Professor D. Anderson**, S. Boren**, J. Bryan**, D. Burke**, S. Chen**, C. Davis-Stober**, C. Elsik**, R. Foraker**, Z.Gu**, R. Hammer**, H. He**, Ho Mai-Lan**, T. Lim**, A. L. Lin**, J. McClay**, J. Moore**, K. Palaniappan**, L. Popejoy**, M. Popescu**, C. R. Shyu**, E. Simoes**, R. K. Slotkin**, S. Van Doren**, X. Wan**, W. Warren**, D. Xu**, X. Zou**

Associate Professor F. Alahdab**, P. Calyam**, S. Chakraborty**, M. Csoba DeHass**, J. Decker**, G. DeSouza**, D. Fitch**, E. Hennes**, J. Kaiffi**, T. Kazic**, E. King**, T. Matisziw**, H. Qin**, R. Raghavan**, P. Rao**, B. Reeder**, S. Srinivas**
Assistant Professor N. Aloysius**, J. R. Bautista**, M. Becevic**, S. Behura**, K. Lee**, Q. Liu**, M. S. Kim**, S. X. Song**, C. Tong**
Associate Research Professor J. Jackson-Thompson**, I. Zachary**

For more information about each professor see: https://muidsi.missouri.edu/people/faculty/

* Graduate Faculty Member - membership is required to teach graduate-level courses, chair master's thesis committees, and serve on doctoral examination and dissertation committees.
** Doctoral Faculty Member - membership is required to chair doctoral examination or dissertation committees. Graduate faculty membership is a prerequisite for Doctoral faculty membership.

Undergraduate

While MU does not offer undergraduate degrees specifically in informatics, the University does offer baccalaureate opportunities in a number of related areas. Many successful informatics students have received bachelor's degrees in Biology, Biochemistry, Business, Data Science, Geography, Health Sciences, and Statistics before starting their doctorate. The catalog provides a complete list of these degree options (https://catalog.missouri.edu/degreesanddegreeprograms/).

In addition, MUIDSI offers several service courses designed for upper-level undergraduates and master's students to expose students to the fundamentals of bioinformatics and health analytics.

Graduate

- PhD in Informatics (https://catalog.missouri.edu/graduateschool/informatics/phd-informatics/)
  - with emphasis in Bioinformatics (https://catalog.missouri.edu/graduateschool/informatics/phd-informatics-emphasis-bioinformatics/)
  - with emphasis in Geospatial Informatics (https://catalog.missouri.edu/graduateschool/informatics/phd-informatics-emphasis-geospatial-informatics/)
  - with emphasis in Health Informatics (https://catalog.missouri.edu/graduateschool/informatics/phd-informatics-emphasis-health-informatics/)

Emphasis Areas & Concentration Areas

MUIDSI offers a doctoral degree (PhD) in two emphasis areas: bioinformatics and health informatics (https://muii.missouri.edu/). A Geospatial Informatics concentration area is also offered and is expected to be a fully approved emphasis area by Fall 2025.

Students with areas of interests outside of informatics may also wish to pursue a collaborative degree program between MUIDSI and other degree programs. The purpose of the collaborative degree program is to allow students the opportunity to obtain advanced degrees in fields that complement the study of informatics and expand the student's knowledge and applicability. The Institute also collaborates with the MD/PhD program, which allows exceptional medical students the opportunity to earn an MD and PhD in a structured environment that allows them to concentrate on each degree in an organized timeline.

Resources and Facilities

Instruction Cyberinfrastructure: For data science training, graduate students of MU Institute for Data Science and Informatics learn to utilize a rich collection of programming APIs, including cutting edge machine learning (TensorFlow, Scikit-Learn, SparkML, etc.) as well as cloud computing (boto3, etc.). Our education program invests significant resources for its internal Big Data infrastructure, including Hadoop/Spark clusters, Kubernetes and docker containers for scalable compute, and a variety of database technologies (relational, NoSQL, graph, geospatial, etc.). All of these technology interactions are facilitated from our customized JupyterHub environment, allowing students to conduct hands-on learning using Jupyter Notebooks.

Research Cyberinfrastructure: Students have priority access to the state-of-the-art high-performance and high-throughput computing environment for their computationally-intensive and secured informatics research for all emphasis areas. This infrastructure, built on a National Science Foundation Major Research Instrumentation (MRI) grant ($880,000), supports the Big Data research and training programs of the Institute for Data Science and Informatics.

As the 40th IBM Quantum Innovation Center worldwide, our faculty and students have access to state-of-the-art quantum computing resources. Through the Mizzou Quantum Innovation Center, the Institute benefits from exclusive access to IBM Quantum Systems not available to the public, as well as early beta releases of the Qiskit quantum SDK. Trainees can evaluate, explore, and execute quantum computing tasks via an API that enables runtime-level access to IBM's quantum computers through the Qiskit Runtime environment—supporting learning and research in bioinformatics, biomedical informatics, and geospatial informatics applications.

The Institute also continues to invest resources to partner with the campus research computing service group to provide an excellent cyberinfrastructure for both instruction and research for the Informatics PhD program.

National Research Platform (NRP):

MU provides six state-of-the-art, FP64, high-GPU-RAM, high-GPU memory bandwidth, advanced multi-GPU artificial intelligence (AI) accelerator nodes for the National Science Foundation (NSF) National Research Platform's Nautilus hyper-converged distributed cluster. These nodes contribute over 1-TB of GPU memory through 24 Nvidia A100 GPUs, as well as over 5 TB of CPU RAM, and 1280 CPU cores to the Nautilus community. These nodes are connected to the Science DMZ, through MU by dual 25 Gbps connectivity. Additionally, MU hosts the first, and only, publicly available Grace Hopper AI Superchip (GH200) on Nautilus.

Faculty Areas of Research Interest

Faculty research covers a wide range of interests including Artificial Intelligence, big data analytics, structural bioinformatics, systems biology, cancer informatics, chemical informatics, epigenomics, phenomics, text mining & understanding, electronic health records, personalized medicine, human-computer interactions in health care, consumer informatics, patient safety, public health informatics, geospatial informatics, information retrievals, biomedical data mining & knowledge discovery, biomedical imaging informatics, and machine learning. For a list of faculty members and their research areas, please visit our web page. (https://muidsi.missouri.edu/people/faculty/)

Internal Funding

The Institute and faculty are funded by federal training grants for students who meet residency and citizenship requirements. Fellowships and research/teaching assistantships are available for highly qualified applicants. Application information is available on the Institute's website (https://muidsi.missouri.edu/academic-programs/phd-program/financial-support/).

INFOINST 7002: Introduction to Informatics
This course provides an overview to informatics foundations in addition to introducing topics regarding the current informatics-driven areas of science. Topics to include: recent trends in informatics; database management and Big Data analytics; data visualization, bioinformatics, health informatics, geoinformatics, nursing informatics, social informatics, and legal informatics. Graded on A-F only.

Credit Hours: 3
Prerequisites: Instructor's consent

INFOINST 7010: Computational Methods in Bioinformatics
(same as CMP_SC 7010). Fundamental concepts and basic computational techniques for mainstream bioinformatics problems. Emphasis placed on computational aspect of bioinformatics including formulation of a biological problem, design of algorithms, confidence assessment of software development. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: CMP_SC 4050 and STAT 4710

INFOINST 7430: Introduction to Health Informatics
Introduction to the use of clinical information systems in healthcare. Topics include clinical data, standards, electronic medical records, computerized provider order entry, decision support, telemedicine, and consumer applications. Graded on A-F basis only

Credit Hours: 3
Prerequisites: departmental consent required

INFOINST 8001: Topics in Informatics
Organized study of selected topics. Subjects and earned credit may vary from semester to semester. Repeatable upon consent of department. Graded A-F basis only.

Credit Hours: 3

INFOINST 8005: Applications of Bioinformatics Tools in Biological Research
This service course is designed for bioinformatics non-major students from life sciences, biological sciences, plant sciences, animal sciences, biochemistry, medicine fields and others. This course will provide an introduction to the current state of the art topics in bioinformatics and the computational tools available to the research community for application to biological research questions. Students will learn how to effectively utilize the tools and software packages to analyze data and visualize the results. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: Instructor's consent
Recommended: Graduate students are expected to have basic knowledge in algorithms, databases, and molecular biology

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INFOINST 8085: Problems in Informatics
Independent, directed study on a topic in the area of informatics. Some sections may be graded A-F or S/U.

Credit Hour: 1-6
Prerequisites: Instructor's consent required

INFOINST 8087: Seminar in Informatics
Students attend and/or present at informatics seminars approved by the institute. Graded on S/U basis only.

Credit Hour: 0.5-1
Prerequisites: instructor's consent required

INFOINST 8088: Lab Rotations in Informatics
This course is designed to train students in both computational/ informatics and life science/hospital laboratories to foster critical research collaborations in biomedical informatics. Students are expected to write reports with their advisors and the mentor of the rotation. Graded on S/U basis only.

Credit Hour: 1-3

INFOINST 8090: Dissertation (pre-candidacy) Research in Informatics
Research leading to dissertation before comprehensive examination. Graded on S/U basis only.

Credit Hour: 1-99

INFOINST 8150: Integrative Methods in Bioinformatics
(same as CMP_SC 8150). With biology entering the Big Data era, scientists are overwhelmed with the amount and the diversity of the experimental, statistical, and omics data about the biological objects they study. As a result, the frontier bioinformatics and computational genomics methods have started to utilize a so-called integrative approach, where the computational and informatics methods are used to combine the high-throughput and low-throughput data. The main objective of this course is to teach students how to utilize bioinformatics and programming techniques for such multi-omics data integration. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: INFOINST 8005 or instructor's permission

INFOINST 8190: Computational Systems Biology
(same as CMP_SC 8190). This course covers current theories and methods in the modeling and analysis of high-throughput experiments such as microarrays, proteomics, and metabolomics. Topics include the inference of causal relations from experimental data and reverse engineering of cellular systems. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: INFOINST 7010 or CMP_SC 7010; INFOINST 8010

INFOINST 8310: Computational Genomics
(same as CMP_SC 8130). This course introduces computational concepts and methods of genomics to students. The course covers genome structure, database, sequencing, assembly, annotation, gene and RNA finding, motif and repeats identification, single nucleotide polymorphism, and epigenomics. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: INFOINST 7010 or CMP_SC 7010

INFOINST 8350: Integrative Methods in Bioinformatics
Course objective is to introduce the most popular experimental methods from the point of view of the information sources that can be used in. Students will learn to use data obtained directly from biological experiments and how to suggest new experiments to improve results. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: INFOINST 7010 or CMP_SC 7010

INFOINST 8390: Computational Systems Biology
This course covers current theories and methods in the modeling and analysis of high-throughput experiments such as microarrays, proteomics, and metabolomics. Topics include the inference of casual relations from experimental data and reverse engineering of cellular systems. Graded A-F basis only.

Credit Hours: 3
Prerequisites: INFOINST 7010 or CMP_SC 7010; INFOINST 8010 or instructors consent

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INFOINST 8450: Precision Medicine Informatics
(same as PTH_AS 7450). This course will introduce students with the theoretical and practical aspects of precision medicine informatics. Topics include: complex diseases, computational genomics/proteomics, informatics of molecular interactions and biological pathways, somatic mutations, signal transduction and cancer, biomarker discovery, machine learning and data mining for PMI, networks methods for PMI, knowledge representation and reasoning for PMI. The course will consist of a set of didactic lectures, computational assignments, in-class demonstrations of PMI methods and discussions of recent publications.

Credit Hours: 3
Prerequisites: INFOINST 8005 with C or better or INFOINST 7010 with C or better or instructor's consent

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INFOINST 8810: Research Methods in Informatics
Research Methods in Health and Bioinformatics is a writing intensive course that provides students with an understanding of research proposal development, literature searching, research synthesis, research designs, evaluation methods, and ethics. Graded A-F basis only.

Credit Hours: 3
Prerequisites: Second semester or later in PhD program or instructor's consent

INFOINST 8870: Knowledge Representation in Biology and Medicine
The main topics presented in the course are: logic systems, knowledge representation methods, production systems and representation of statistical and uncertain knowledge. Graded A-F basis only.

Credit Hours: 3
Prerequisites: BBME 7430 and BBME 7440

INFOINST 8880: Machine Learning Methods for Biomedical Informatics
(same as CMP_SC 8180) This course teaches statistical machine learning methods and their applications in biomedical informatics. The course covers theories of advanced statistical machine learning methods and teaches how to develop machine learning methods to solve biomedical problems. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: CMP_SC 7050 and INFOINST 7010 or CMP_SC 7010 or INFOINST 8005

INFOINST 9090: Dissertation (post-candidacy) Research in Informatics
Research leading to Ph.D. dissertation after comprehensive examination. Graded on S/U basis only.

Credit Hour: 1-99