October 31, 2022

Dr. James D. Fielder, Jr., Secretary
Maryland Higher Education Commission
6 North Liberty Street, 10th Floor
Baltimore, MD 21201

Dear Secretary Fielder,

Hood College is submitting for your review a high demand Master of Science in Health Informatics, which will be offered by our ABET-accredited Deapartment of Computer Science and Information Technology. Health Informatics is a emerging multi-domain field that connects people, technology, and data to better improve healthcare outcomes and safety by supporting operational and technological advancements globally.

There is a growing demand for qualified Health Informatics professionals with relevant healthcare, data science, and machine learning skill sets. This Masters program will provide student not only with a working knowledge of the structure and polices of the Healthcare systems and the Informatics profession but also a practical skill set of data science and data analysis to effect real change in healthcare outcomes. Utilizing our faculty's expertise in health, computer science, management and statistics, we have repackaged existing courses into a comprehensive master's program that will appeal to working professionals in the fields of nursing, clincal health, public and population health, data science and education. This program would entail 15 hours of core courses covering the fundamentals of Health Systems and Informatics and 15 hours of electives focusing on data science, healthcare industry and public and population health. The proposed master's degree would be unique among our competitors in Maryland.

Recent events both domestically and internationally have increased the demand for trained Health Informatics professionals who can provide knowledge and insight into the ever increasing volume of healthcare data. Pending the Commission's concurrence, the College wishes to begin offering the proposed certificate during the 2023-24 academic year. Therefore, we formally request your review and approval of this program.

Sincerely,

Deborah D. Ricker, Ph.D.
Provost and Vice President of Academic Affairs

Enclosure

Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	

Each underline action below requires a separate proposal and cover sheet.

New Academic Program	Substantial Change to a Degree Program
New Area of Concentration	Substantial Change to an Area of Concentration
New Degree Level Approval	Substantial Change to a Certificate Program
New Stand-Alone Certificate	Cooperative Degree Program
Off Campus Program	Offer Program at Regional Higher Education Center

Payment Submitted:	Yes No	Payment Type:	R*STARS # Check #	Payment Amount:	Date Submitted:

Department Proposing Program		
Degree Level and Degree Type		
Title of Proposed Program		
Total Number of Credits		
Suggested Codes	HEGIS:	CIP:
Program Modality	On-campus	Distance Education (*fully online*)
Program Resources	Using Existing Resources	Requiring New Resources
Projected Implementation Date	Fall Spring	Summer Year:
Provide Link to Most Recent Academic Catalog	URL:	

Preferred Contact for this Proposal	Name:
	Title:
	Phone:
	Email:

President/Chief Executive	Type Name:
	Signature: *Andrea E. Chapelen* Date:
	Date of Approval/Endorsement by Governing Board:

Revised 1/2021

HOOD COLLEGE

PROPOSAL
M.S. in Health Informatics
October 31, 2022

A. Centrality to institutional mission statement and planning priorities

I. Hood College as a Top Tier Institution for Educating and Preparing Professional Health Informaticists

> *Through an integration of the liberal arts and the professions, Hood College provides an education that empowers students to use their hearts, minds and hands to meet personal, professional and global challenges and to lead purposeful lives of responsibility, leadership, service and civic engagement.*
>
> -Hood College Mission Statement

For more than 125 years, Hood College has prepared students for successful careers and the responsibilities of citizenship. Located in Frederick, Maryland, the College is widely recognized for its graduate and undergraduate degree programs, opportunities for high-caliber research in the natural, behavioral, and social sciences, and its industry and community partnerships. Hood College offers 33 undergraduate majors, master's degrees in 21 professional areas, 13 post-baccalaureate certificate programs, certification programs in education, and a doctoral program in organizational leadership or business administration. More than 1,100 undergraduates and nearly 1,000 graduate students from across the globe are currently enrolled at Hood.

Hood College is proposing the M.S. in Health Informatics (HIFX) degree, because it will play a leadership role in Maryland's economic and social development by preparing HIFX graduates to join a high-quality educated workforce in an area of national need. The HIFX master's degree program will contribute to the mission of Hood College by serving the citizens of Maryland, the United States, and the world through dissemination of knowledge which prepares our graduates to succeed as leaders, professionals, informed consumers, responsible citizens, and lifelong learners. The creation of graduate degrees in Health Informatics will contribute to meeting the strategic goals of the College by providing affordable, accessible and structured content and research options. The formalized degree program will provide vital transformative STEM

education and fill an industry need.

The program builds upon the strengths of Hood College by leveraging resources and space from established units such as Bioinformatics, Nursing, Computer Science, Information Technology, and Organization Leadership at Hood College. Current Hood College graduate programs have some connections to Health Informatics, thus potential synergy and collaborations exist with the HIFX graduate degree program. At present, graduate level degrees in Health Informatics represent a gap within the Hood College system. However, several graduate programs may be considered as being synergistic to the proposed graduate degree programs. The traditional areas of Health Informatics are closely linked to programs in Bioinformatics, Biological Sciences, Computer Science, Information Technology, and Management Information Systems, whereas the emerging areas such as Machine Learning, Artificial Intelligence and Advanced Data Analytics are related to computer science and mathematical disciplines. Faculty membership in HIFX is inherently multi-disciplinary as reflected in HIFX teaching andresearch collaborations with other departments to include Bioinformatics, Biological Sciences, Computer Science, Information technology, Management Information Science, Mathematics, Nursing, and Public Health at Hood College.

II. Detailed Description of the Master's Degree in Health Informatics
Hood College is proposing the creation of a Master of Science (M.S.) in Health Informatics (HIFX). This program will provide a leadership role in Maryland's economic and social development by preparing HIFX graduates to join a high-quality educated workforce in an area of national need. The creation of graduate degrees in Health Informatics will contribute to meeting the strategic goals of the College by providing affordable, accessible, and pedagogically-structured education and research programs. The formalized degree program will provide vital transformative STEM education and world changing research opportunities for graduate students. Currently, there are no accredited graduate degree programs in Health Informatics at Hood College or at any institution in the state of Maryland, yet the labor market demand for HIFX graduates is strong.

The demand for health informatics workers is projected to grow at twice the rate of employment overall, but there is strong evidence that the nation already faces a shortage of qualified workers in this field, according to a new report from research firm Burning Glass.[1] A shortage of talent qualified to undertake these jobs can impede key improvements to America's healthcare system – let alone the basic ability of the system to pay bills, the report concludes, and it highlights the need for educators, training organizations and workforce policymakers to develop more opportunities for students and job seekers to cross-train between healthcare and IT specialties. Based on data from the US Bureau of Labor Statistics the national growth rate of employment in this field is projected to be greater than 32%.[2] For undergraduates in information technology and nursing, an accessible 4 + 1 Master's degree can be integrated with the BS allowing students to earn a graduate credential in only two additional semesters.

The name "Health Informatics" highlights an innovative approach to managing complex problems with an integrated perspective that considers healthcare issues, data analytics, and

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[1] "Health Informatics | Healthcare Informatics."
[2] "Medical and Health Services Managers."

information technology. The HIFX curriculum will train students to apply their technical understanding of systems engineering, data analytics, healthcare to develop strategies to protect humans and help healthcare professionals achieve better health outcomes. HIFX seeks to lead in the education of all disciplines in how to incorporate design, practices and processes that are more harmonious with the healthcare ecosystem. Our meta-disciplinary team-oriented coursework will provide master's students with options for research, employer projects and/or industry content, based on their career goals.

The program builds upon the strengths of Hood College by leveraging resources and space from established units such as Bioinformatics, Nursing, Computer Science, Information Technology, and Organizational Leadership at Hood College. Current Hood College graduate programs have some connections to Health Informatics, thus potential synergy and collaborations exist with the HIFX graduate degree program. At present, graduate level degrees in Health Informatics represent a gap within the Hood College system. However, several graduate programs may be considered as being synergistic to the proposed graduate degree programs. The traditional areas of Health Informatics are closely linked to programs in Bioinformatics, Biological Sciences, Computer Science, Information Technology, and Management Information Systems, whereas the emerging areas such as Machine Learning, Artificial Intelligence and Advanced Data Analytics are related to computer science and mathematical disciplines. The proposed M.S. in Health Informatics requires the successful completion of 30 hours of coursework.

M.S. HIFX - Example Plan of Study (30 Credit Hours Required)

SEMESTER 1		
Course No.	**Credits**	**Course Title**
HIFX 500	3	Fundamentals of Health Informatics - Core
HIFX 501	3	Introduction to HIS & Data Standards - Core
HIFX 502	3	US Health Policy, Standards & Ethics - Core
TOTAL	9	
SEMESTER 2		
Course No.	**Credits**	**Course Title**
BIFX 551	3	Advanced Data Analytics in R
MATH 500	3	Statistical Methods for Health Science Research
	3	Elective 1 (see list below)
TOTAL	9	
SEMESTER 3		
Course No.	**Credits**	**Course Title**
BIFX 530	3	Introduction to Database Management Systems
	3	Elective 2 (see list below)
	3	Elective 3 (see list below)
TOTAL	9	

SEMESTER 4		
Course No.	Credits	Course Title
HIFX 595	3	Research, Internship, Capstone
TOTAL	3	

Additional Electives
- BIFX 546 Machine Learning in Bioinformatics
- BIFX 548 Data Visualization
- CS 527 Data Science
- CS 552 Deep Learning
- ITMG 525 Applied Data Analysis
- BIFX 545 Leading Reproducible Research

III. Descriptions of courses

Following is a list of existing courses that have been offered one or more times at Hood College, along with three new courses that will be created for the proposed program. Existing courses are highly appropriate for graduate study in Health Informatics.

Existing courses:

BIFX 502 Foundations in Computer Science
This course provides students with an introduction to programming concepts and techniques used in problem solving. Students will study general programming concepts for the purpose of data analysis. These concepts are demonstrated through the use of a modern programming language. Students will design, implement and test programs to solve analytical problems. Students will develop the ability to logically plan and develop programs, and learn to write, test, and debug programs. Topics include file I/O, expressions, types, variables, branching, loops, data access, data profiling, and data manipulation. Students will apply their knowledge through hands-on programming projects.

BIFX 503 Biostatistics in R
After a brief introduction to working in R, this course will focus on the statistical concepts that are used in biology and medicine to analyze and validate data. Topics will include probability, hypothesis testing, tests for variables (e.g. chi-square, Fisher's test), t-test, linear and multivariate regression, covariance and Bayesian statistic.

BIFX 530 Applied Database Systems
Prerequisite: A minimum grade of "B-" in BIFX 502 or CSIT 512 and BIFX 551 or permission of the instructor. Not open to students who have completed CS 530. A study of the design and implementation of databases from a real-world applications point of view. The course will explore the enterprise perspective of managing data needs of an organization. Topics include data integrity, database models, logical database design, the integration of databases, security, and database administration issues. The course will also address topics such as assessing end user needs, developing specifications, and designing functionally equivalent solutions. The

student will be introduced to query processing within a database environment.

BIFX 546 Machine Learning in Bioinformatics
Prerequisites: BIFX 501 or BIFX 502 or CSIT 512 and BIFX 503 This course on machine learning will provide students with more advanced methods to analyze data using both R and Python, allowing them to computationally represent biological data that can then be used to solve complex problems. Topics that will be covered include regression, classification (nearest neighbor methods, decision-tree based methods) and clustering. A large section of the class will be devoted to modern approaches of neural networks and deep learning including convolutional neural networks and reinforcement learning. Approaches for developing expert systems will also be covered based on formal logic, ontologies and technologies for the semantic web.

BIFX 548 Data Visualization
Prerequisite: BIFX 551 or permission of the instructor. Basic knowledge of programming in R is required. Data visualization is a sub-area of Human-Computer Interaction (HCI). Students will learn the theories and tools of data visualization. This course covers the basic theories of data visualization, such as data types, chart types, visual variables, visualization techniques, structure of data visualization, navigation in data visualization, color theory, cognitive theory, and visualization evaluation. Various frameworks for data visualization will be used such in R and Tableau.

BIFX 551 Advanced Data Analytics in R
Prerequisites: A minimum grade of B- in IT 518 or MGMT 566 or BIFX 502 or CSIT 512, or Permission of Instructor This class introduces programming for bioinformatics, with a focus on programming in R and tools to communicate and develop your code. Emphasis will be placed on good development practices and reproducible research. Significant time will be spent learning to program within an integrated development environment, cleaning, visualizing, and analyzing data. (Different name - same course)

BIFX 552 Bioinformatics Data Skills
Prerequisites: A minimum grade of "B-" in BIFX 551 or permission of the instructor. This class introduces applied data science skills needed by bioinformatics professionals. A focus will be placed on reproducible bioinformatics research and will include the following topics and tools: beginning to intermediate use of the Unix command line, working with remote computing resources, version tracking, R and Bioconductor, tools for manipulating sequence data, and creation of pipelines.

BIFX 553 Applied Data Science for Bioinformatics
Prerequisites: A minimum grade of "B-" in BIFX 552 or permission of the instructor. Students will continue to develop the data science skills learned in BIFX 552 while gaining a deeper understanding of statistics and machine learning by performing real-world analyses of biological data. A deeper understanding will be gained of what can go wrong in data analyses, and principles of reproducible research will be emphasized. Students will use the high performance-computing cluster using R as well as important application programs for processing sequencing data. A large portion of the class will be devoted to processing high-throughput sequencing data (RNA-Seq, whole genome sequencing, whole exome sequencing, variant analysis,

metagenomics). Additional possible topics are genome-wide association studies (GWAS), phylogenetics, and the analysis of protein motifs and protein domains.

BMS 537 Introduction to Bioinformatics
Prerequisites: BMS 511 and BMS 524 or permission of the instructor. Lab fee. This is a hands-on, applied course that will introduce students to the use of computer software and Web servers in the analysis of biological sequence data (DNA and protein). Topics include: Pairwise and multiple sequence alignment, BLAST, scoring matrices, phylogenetic analysis, DNA sequence analysis and prediction of 2-D and 3-D molecular structures.

BMS 542 Ethics in Science
The course considers the ethical dilemmas one could face in a career in science, including how information gained in the research lab is conveyed to the wider scientific audience. Topics included are the peer review process, the patent process, the Recombinant DNA Advisory Committee, the FDA's role in drug approval, the funding of research and the national research prioritization process.

CS 519 Advanced Data Structures
Prerequisites: A minimum grade of "B-" in CSIT 512 Intensive introduction to object-oriented programming and advanced data structures. Topics include heaps, priority queues, hash tables, B+, B* trees and graphs. Emphasizing advantages and disadvantages of design and implementation choices, and the way these choices affect software quality. Instruction will be in the C++ programming language.

CS 522 Data Mining
Prerequisites: MATH 500 and CS 519 Introduces basic principles and methods for data analysis and knowledge discovery to computer science students. Topics include preprocessing, association, classification and anomaly detection. Students develop basic skills for modeling and performance evaluation.

CS 527 Data Science
Prerequisites: CS 530 or Permission of the instructor This course provides an overview of Data Science, covering a broad selection of challenges and methodologies for working with big data. Topics to be covered include data collection, integration, management, modeling, analysis, visualization, prediction, and informed decision making. Students work on hands-on projects and case studies using real data sets from a variety of domains including science, business, engineering, social sciences, and life sciences.

CS 528 Artificial Intelligence
Prerequisite: A minimum grade of "B-" in CSIT 512 or permission of the instructor. History, fundamental principles, and future directions of A.I. Topics include state-space searching, knowledge representation, logic and deduction, natural language processing, neural networks, learning, vision, robotics, and cognitive science. Topics will be treated at a level of depth and detail appropriate for a first course in AI.

CS 530 Intro to Database Management Systems

Prerequisite: A minimum grade of B- in CSIT 512 or permission of the instructor. Not open to students who have completed IT 530. Design and implementation of databases from a real world applications point of view. The course includes database concepts such as basic architectural issues, the relational model, query processing, logical database design and normalization theory and data protection issues.

CS 543 Machine Learning
Prerequisites: CSIT 512 and CS 528 Introduction to the field of modeling learning with computers. Topics included are explorations of inductive learning, learning decision trees, ensemble learning, computational learning theory, and statistical learning methods.

CS 552 Deep Learning
Prerequisite: CS 519 or Permission from Instructor This course introduces the field of deep neural network-enabled machine learning with applications in computer vision and natural language processing. Deep learning is behind many recent advances in artificial intelligence, including speech recognition and self-driving cars. Students will work on big data projects using cloud resources from fastest supercomputers in the world.

CSIT 565 Advanced Database Management Systems
Prerequisites: CS 519 and CS 530 or CSIT 512 and IT 530 This course examines advanced data management concepts and technologies. Topics include indexing structures, query processing, transaction management, data security, data warehousing, object-oriented extensions, XML, distributed data management, and recent advances and alternate architectures for Big Data management and processing.

IT 514: Info Tech & Cloud Business Intelligence
Prerequisites: A minimum grade of "B-" in IT 510 and CSIT 512 or concurrent enrollment or permission of the instructor. Current issues in the use of information technology (IT) and the exploration of trends such as Cloud computing and business intelligence. The primary purpose of this course is to provide a set of technical tools to understand the role of information technology in Cloud computing business intelligence.

ITMG 516 Introduction to Data Analytics and Business Data Mining
Prerequisites: CSIT512 for IT and MGMT 566 for MIT and MBA This course examines techniques for discovering patterns in data. Topics will cover various data mining algorithms and statistical techniques, such as correlation analysis, text mining, decision trees, clustering, and association rules. The course will use data mining and analytical software to build on traditional statistical concepts. Project management techniques unique to exploratory projects will be used throughout the course. In addition to teaching students to organize, manipulate, and convert data into meaningful information for managerial decision-making, the course prepares them to effectively communicate such information with different stakeholders. In addition, students are expected to have competency in statistics.

ITMG 524 - Advanced Data Analytics Programming with R
Prerequisites: A minimum grade of B- in IT 518 or MGMT 566 or BIFX 502 or CSIT 512, or Permission of Instructor This class introduces the R programming language and advanced

concepts and techniques to discover patterns in data. Students will explore datasets by identifying variables with the most predictive power, and developing and assessing predictive models in R. Discussion topics include exploratory data analysis, visualization, and data transformation. Students will implement the following data mining techniques: regression, neural networks, classification, clustering, principal component analysis, and survival analysis. Advanced techniques such as bagging, boosting, and random forests will also be explored. Significant time will be spent learning to program within an integrated development environment and implementing version tracking.

ITMG 525 Applied Data Analytics
Prerequisites: A minimum grade of B- in CSIT 512 (or waived), ITMG 516 and ITMG 524 or permission of instructor. This course provides a hands-on approach to data analytics methods and techniques, such as data acquisition and management, data preparation and modelling, and visualization schemas to deduce information in the fields of Business, Healthcare, Social Media, and Bioinformatics.

MATH 500 Statistics
Basic statistical methods as they apply to education and other fields. Topics include frequency distributions and their representations, measures of central tendency and dispersion, elementary probability, statistical sampling theory, testing hypotheses, non-parametric methods, linear regression, correlation, and analysis of variance.

BIFX 579 (to be cross-listed with HIFX 579)
Prerequisites: Completion of 18 BIFX credits including a minimum grade of B- in BIFX 504 and in BIFX 552, or permission of the instructor. This course provides a practical, hands-on experiential learning opportunity for Bioinformatics MS students and emphasizes experimental design and biological interpretation of results. Students will utilize a wide variety of concepts and skills that they have learned throughout previous courses to complete an original research project from start to finish. Over the course of the semester, students will share their questions and insights during frequent "lab meeting" style presentations, and will work both independently and collaboratively to complete their projects. They will present their work in the form of a well annotated script that contains all of the code necessary to complete the project, a brief paper describing the project in paragraph form, and a final poster presentation of their results. Students are encouraged to collaborate with their employer or an outside laboratory to propose a project to the course instructor during the first week of class. Alternatively, project ideas and data will be provided by the instructor. Computational resources will be provided via the Bioinformatics program's High-Performance Computing Cluster.

Courses to be developed:

HIFX 500 Fundamentals of Health Informatics
Prerequisites: None. This course will provide knowledge information technology in healthcare. We consider a wide range of technology applications – from enterprise application systems to EHR (Electronic Health Records), to current trends in information technology and related regulatory initiatives. We examine how these technologies enable the healthcare industry to manage information and knowledge resources most effectively and deliver superior services to

its customers. ide an introduction to the design, structure and political implications of healthcare systems and payer-provider relationships with respect to patient and populations health.

HIFX 501 Introduction to Health Information Systems & Data Standards
Prerequisites: None. This course will provide an overview of Health Information Systems and the standard vocabularies, ontologies terminologies, and data standards in the US Healthcare systems.

HIFX 502 US Health Systems & Economics
Prerequisites: None. This course will introduce the design, structure and political implications of healthcare systems and payer-provider relationships with respect to patient and populations health.

IV. Expected Student Learning Outcomes

The student learning outcomes (SLOs) for the M.S. in Health Informatics are adapted from the Health Informatics Body of Knowledge developed under the auspices of the American Health Information Management Association:
1. Demonstrate an understanding of how information system technologies and health informatics tools support healthcare delivery, clinical decision-making, care management, and population health goals
2. Understand health information systems design and management including planning, implementation, and evaluation methods
3. Show a working knowledge of the healthcare delivery environment and policies that influence adoption and use of health information technologies, including standards and requirements (e.g., Meaningful Use, quality metrics)
4. Understand privacy and confidentiality of health information, information security practices, and how these requirements influence system design, usage, and business continuity and disaster recovery planning
5. Gain practical knowledge of various health informatics tools and methods such as electronic medical records, workflow redesign, data visualization/dashboards, data analysis
6. Gain exposure to principles and methods of data mining, natural language processing, and information exchange

V. Program Funding and Institutional Commitment to the Program
Hood College remains committed to ongoing administrative, financial, and technical support of this program. The majority of the courses used to construct this new master's degree have already been developed and offered at least once by the hosting Department of Computer Science and Information Technology (CSIT) allowing the College to offer the proposed program with minimal additional cost. Furthermore, the institution, and more specifically the Graduate School, already supports both a bioinformatics (BIFX) post-baccalaureate certificate and master's degree, whose faculty, staff and infrastructure resources will contribute to the health informatics (HIFX) program proposed herein. The HIFX program will share some courses with the BIFX program, but will provide the opportunity to specialize in healthcare data systems.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

I. Regional & Statewide Needs

In a recent IDC study of healthcare worker demand through 2025, researchers found that healthcare data is projected to grow faster than in manufacturing, financial services, or media. Healthcare data will experience a compound annual growth rate (CAGR) of 36 percent through 2025. IDC also found that more than 40 percent of healthcare organizations still struggle to hire employees with the necessary data skill sets. Butler-Henderson et al. published *The Health Information Workforce: Current and Future Developments* in 2021. Butler states that ISCO-08 has only three categories for HIDDIN (Health Informatics, Digital, Data, Information, and Knowledge) occupations: Health Information Technicians (ISCO-08: 3252); Filing and Copying Clerks (ISCO-08: 4415); and Librarians and Related Information Professionals (ISCO-08: 2622).

This is a very limited representation of HIDDIN-related occupations. Consequently, many national classifications also lack representation of HIDDIN-related occupations. Therefore, utilizing Department of Labor job statistics are not effective in categorizing and qualifying the job market. According to a 2020 HIMSS survey on informatics, training and education continues to be a priority for informaticists, and 2020 saw a significant rise in formal education. The percentage of respondents who have a master's degree or Ph.D. in informatics is 37% as compared with 31% in 2017.

In a new question for 2020, survey respondents selected enhanced credibility and marketability (49%) and personal satisfaction (45%) as top reasons to pursue certification. These answers also topped the list when asked about perceived value of certification, although personal satisfaction (81%) edged out over enhanced credibility and marketability (78%). Certification was again found to have a high impact on respondents' career paths. The average rating for the impact certification has on career was 5.14 out of seven as compared with 4.96 in 2017.

II. Critical and Compelling Need as Identified in the State Plan
The proposed HIFX master's degree will support the following strategies of the 2017-2021 Maryland State Plan for Postsecondary Education:
  a. Under Strategy 8: Develop new partnerships between colleges and businesses to support workforce development and improve workforce readiness (p. 85).
  • Identify and create preferred partnerships in Maryland.
  • Support business-driven credentials.
  • Include long-term graduate education opportunities when considering a student's career trajectory.
Hood College works closely with the local and regional community and is well-integrated with local practices, agencies, and hospitals that will benefits from health informatics.
b. Under Strategy 3 and Strategy 5, respectively:
Strategy 3: Strategy 3: Expand efforts to cultivate student readiness, financial literacy, and financial aid for individuals outside traditional K-12 school channels.
  • Develop initiatives to identify and address obstacles that students face in preventing

them from continued enrollment and completion.

- Strategy 5: Ensure that statutes, regulations, policies, and practices that support students and encourage their success are designed to serve the respective needs of both traditional and nontraditional students (p. 83).
- Systematically review policies and practices to ensure they are student-focused and are implemented with the goal of student success.
- Improve policies regarding academic program review that meet the State's needs – e.g., workforce shortages, do not duplicate, do not saturate, allow for responsiveness, do not sacrifice student growth and development, and allow for career exploration and goal setting.
- Ensure academic policies and campus practices support all students, including non-traditional students.

The HIFX program will be hybrid, with 50-75% of instruction available online, depending on the student's course selections. Faculty have designed the program this way so that students can benefit from experiential, in-person education where most useful, while enjoying the convenience of remote learning where practical. This unique mix of modalities may be a key draw for students across a wide geographic area, including not only Maryland and Washington, D.C., but also nearby parts of Pennsylvania, Virginia, and West Virginia. Coursework that is synchronous will also be scheduled in the evenings and/or weekends to accommodate nontraditional students who work during the daytime hours. Therefore, health care professionals can continue their regular employment while pursuing the HIFX degree.

Additionally, there are no accredited programs currently being offered in the region. See Table 1.

c. Under Strategy 7: Enhance career advising and planning services and integrate them explicitly into academic advising and planning.

• Find ways to incorporate career advising into academic advising.

The curriculum of the HIFX program proposed herein is geared toward students with a clear path to starting or continuing their careers. There are foundation courses built into the program for those students interested in entering the field or for current healthcare practitioners who need the computing/programming background to pursue a career in this specialized field. We are building on a previous success in our bioinformatics program, namely a capstone experience at the end of the program that will link our HIFX students to professionals and real HIFX projects in the industry.

Health informaticists are employed in government service, consulting service, industry, and education. The basic skills required in each sector are similar. Frequently HIFX practitioners are responsible for large and complex projects and supervise or coordinate with professionals from other disciplines. A broadtechnical background provided by advanced education and experience is essential for this responsibility. As HIFX students approach graduation there will be numerous opportunities for guidance and mentoring for job procurement. Students will have a faculty advisor, and Hood College faculty have a strong network among professional practitioners. The faculty who are collaborating to launch the HIFX graduate program have a substantial record of mentoring graduate students in the Health Informatics discipline.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State:

The demand for health informatics workers is projected to grow at twice the rate of employment overall, but there is strong evidence that the nation already faces a shortage of qualified workers in this field," according to a new report from research firm Burning Glass.[3] A shortage of talent qualified to undertake these jobs can impede key improvements to America's healthcare system – let alone the basic ability of the system to pay bills, the report concludes, and it highlights the need for educators, training organizations and workforce policymakers to develop more opportunities for students and job seekers to cross-train between healthcare and IT specialties. Two Major findings of the Burning Glass report support the creation of this program:

1. *Many of these new jobs are hybrids, requiring skill sets from different disciplines. Clinical Analysts, for example, assist clinical staff with IT systems, health data analysis, interpret data, and manage patient records. That requires some of the skills both of a registered nurse and of an IT technician—at present, an uncommon combination. As a result, Clinical Analyst positions stay open 15% longer than the national average.*
2. *The talent pipeline for these workers seems to be leaking. According to federal statistics, there are 125,000 workers currently in these jobs. All of them could compete for the roughly 45,000 open postings and while another 34,000 graduates enter the field every year only 68 percent of graduates pass the required certification exams.*

AVERAGE SALARY BY GEOGRAPHIC REGION

Average Salary by Region

Region	Salary
AR, LA, OK, TX	$78,090
AZ, CO, ID, MT, NM, NV, UT, WY	$76,670
CT, NH, RI, VT, MA, ME	$84,410
DC, DE, FL, GA, MD, NC, SC, VA, WV	$78,170
HI, CA, AK, OR, WA	$87,680
IL, IN, MI, OH, WI	$72,400
MS, KY, AL, TN	$69,940
ND, SD, MN, IA, KS, MO, NE	$71,220
NY, NJ, PA	$83,120
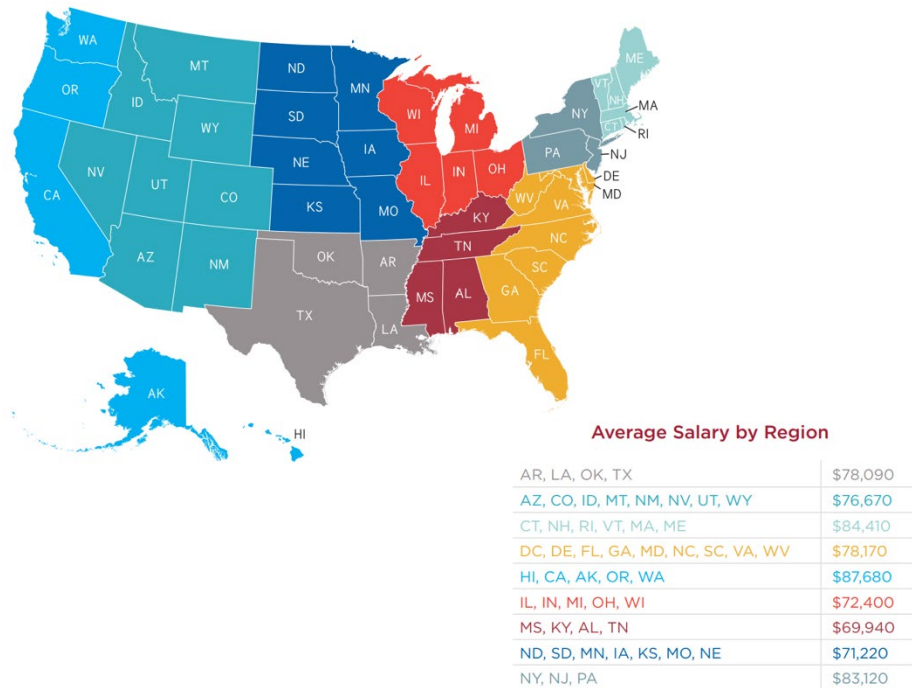
AHIMA: US Salary Survey Report: HIM Professionals in 2019

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[3] "Health Informatics | Healthcare Informatics."

The best students earning a master's degree in HIFX will be
prepared and qualified to enter a Health Informatics Ph.D. program at any top institution.

Based on data from the US Bureau of Labor Statistics the national growth rate of employment in this field is projected to be greater than 32%.[4] According to the 2020 HIMSS workforce survey, the number of respondents earning more than $150,000 a year stayed the same (11%) since 2017. Figure 1 below provides detailed salary data for all levels of employment in the HIFX field. The number of respondents making $131,000 to $150,000 rose by four percentage points in the same time period, and those making $116,000 to $130,000 increased by three percentage points.[5] As with previous years, the majority of respondents (63%) stated they earn a base salary between $61,000 and $115,000 The need for the HIFX labor force in Maryland is projected to achieve growth rates higher than the international growth rate. According to BLS, Maryland is in the top five states for "highest employment level for Health Information Technologists."[6]

Maryland, Salary Detail for Health Informaticians

Occupation code	Occupation title (click on the occupation title to view its profile)	Employment	Employment per 1,000 jobs	Median hourly wage	Mean hourly wage	Annual mean wage
9-0000	Healthcare Practitioners and Technical Occupations	161,220	63.898	$37.79	$45.46	$94,550
9098	Health Information Technologists, Medical Registrars, Surgical Assistants, and Healthcare Practitioners and Technical Workers, All Other	3,150	1.25	$36.48	$40.95	$85,180

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[4] "Medical and Health Services Managers."
[5] HIMSS Nursing Informatics Workforce Survey | May 2020
[6] "Health Information Technologists, Medical Registrars, Surgical Assistants, and Healthcare Practitioners and Technical Workers, All Other."

Clinical Informatics Coordinator

Salary	Benefits	Job Description	Compare Jobs	Similar Jobs

Salary	**Salary + Bonus**	Benefits

Based on HR-reported data: a national average with a geographic differential ⓘ

Paid Annually ⌄

View as table

10%	25%	**50%(Median)**	75%	90%
$71,739	$81,820	**$92,893**	$105,592	$117,154

●Your Salary
???

Didn't find your job? **Click** ?

Employers: Find Surveys For This Job →

Health Informatics Manager

Salary	Benefits	Job Description	Compare Jobs	Similar Jobs	Job Openings	Resume Critique

Salary	**Salary + Bonus**	Benefits	How To Become

Based on HR-reported data: a national average with a geographic differential ⓘ

Paid Annually ⌄

View as table

10%	25%	**50%(Median)**	75%	90%
$120,202	$136,536	**$154,476**	$174,978	$193,644

lower level job

●Your Salary
???

Didn't find your job? **Click** ?

Employers: Find Surveys For This Job →

upper level job
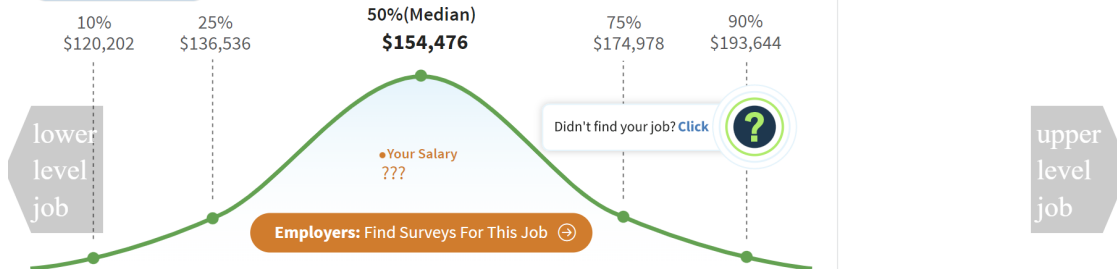
Health Informatics Director

$	$	📄	▤	💼
Salary	Benefits	Job Description	Compare Jobs	Similar Jobs

Salary	**Salary + Bonus**	Benefits	How To Become

Based on HR-reported data: a national average with a geographic differential ⓘ

Paid Annually ⌄   View as table

10%	25%	50%(Median)	75%	90%
$147,718	$171,593	**$197,816**	$234,512	$267,923

lower level job

●Your Salary
???

Didn't find your job? **Click** ❓

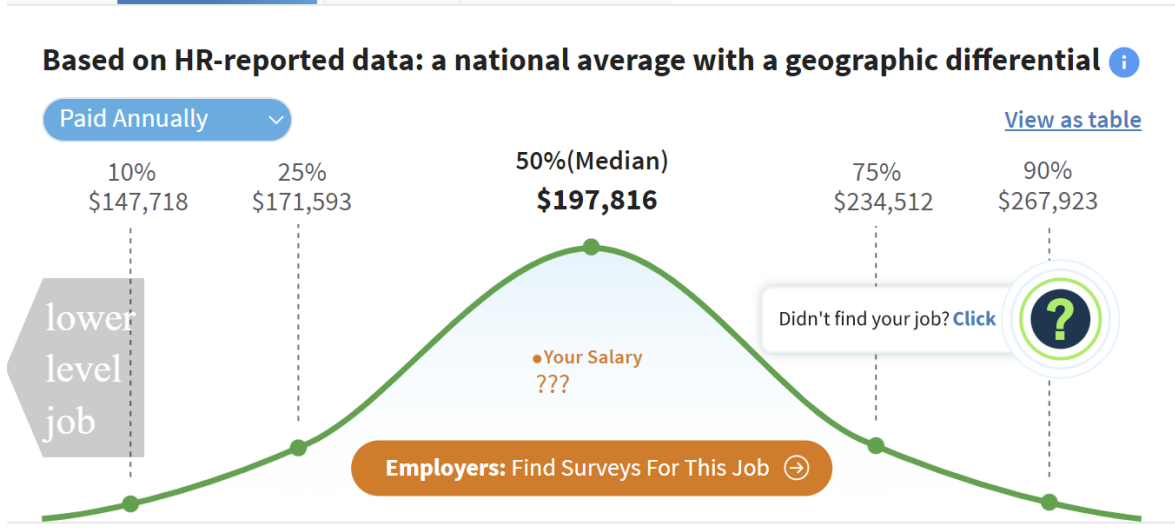**Employers:** Find Surveys For This Job →

Figure 1. Examples of Health Informatics career progression
The above figures demonstrate increasing levels of responsibility in the health informatics field. According to Salary.com, the clinical informatics coordinator is an example of the entry in to the informatics community. The national average salary with bonus for this type of position is $92,893. This position typically requires a bachelor's degree in an area of specialty and may requires a certification such as registered nurse (RN).   The health informatics manager oversees a health informatics team. The national average salary with bonus for this type of position is $154,476. This position typically requires a master's degree or Ph.D. The health Informatics Director directs a health informatics team. The national average salary with bonus for this type of position is $197,816.   This position requires a master's degree or Ph.D.

D. Reasonableness of Program Duplication:
Currently, there are no accredited master's programs available to students seeking an advanced degree in Health Informatics in Maryland. UMBC offers a health informatics program that is not certified by AHIMA. These are several online programs that offer post-baccalaureate certificates and master's level programs—but none are accredited, nor certified, by HIFX agencies. Table 1 below shows accredited programs.

Institution	State	Content Delivery	Credit Hours Cert/MS Degree

15

Boston University	MA	Campus Based and Online	16/32
Drexel University	PA	Online	9/45
East Carolina University	NC	Campus Based and Online	15/39
Florida International University	FL	Online	15/39+
George Mason University Health Informatics	VA	Campus Based and Online	18/30-36
Indiana University	IN	Campus Based and Online	15/36
Louisiana Tech University	LA	Online	0/45
Marshall University	WV	Campus Based	0/33
Medical University of South Carolina	SC	Campus Based and Online	0/36
Nova Southeastern University	FL	Online	18/43
Oregon Health & Science University	OR	Online	24/49 or 55
Southern Illinois University Edwardsville	IL	Online	0/36
The College of St. Scholastica	MN	Online	18/42
University of Alabama at Birmingham	AL	Online	15/45
University of Central Florida	FL	Online	0/38
University of Illinois at Chicago	IL	Online	12-13/38
University of Mississippi Medical Center	MS	Online	10/36
University of Scranton	PA	Online	12/33
University of South Carolina -Columbia	SC	Campus Based and Online	0/36
University of Texas – Houston	TX	Campus Based and Online	15/36
University of Washington	WA	Campus Based	0/54

Table 1. According to AMIA, there are 22 universities across the US offering accredited Health Informatics Masters programs.

There are also no graduate-level degrees in Health Informatics at Hood College. Several Hood

College graduate programs have some connection to Health Informatics, and thus may be considered as being synergistic to the proposed graduate degree programs. The traditional areas of Health Informatics are closely linked to programs in Bioinformatics and Nursing.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs)

Not applicable. The four HBIs in Maryland do not currently offer accredited programs in health informatics.

F. Relevance to the identity of Historically Black Institutions (HBIs)
Not applicable.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes (as outlined in COMAR 13B.02.03.10):

I., Describe how the proposed program was proposed program was established and also describe the faculty who will oversee the program.

The Hood College Department of Computer Science and Information Technology has a well-established suite of graduate degrees both online and on-campus offerings. The department currently hosts the following graduate programs—the majority of which will contribute multiple courses to the proposed degree: bioinformatics (both cert. & M.S.), computer science (M.S.), information technology (M.S.), cybersecurity (both cert. & M.S.), and management information systems (M.S.). Students will have on-campus and online course options based on personal preference, flexibility and geographic location.

Thus, a health informatics program was a natural outgrowth of existing expertise in the department. The below subset of CSIT faculty will lead and oversee the health informatics program, and we plan to hire a new faculty program director with HIFX expertise should the program gain MHEC approval:
- Ahmed Salem, Ph.D., IT specialist and CSIT Department Chair
- Miranda Darby, Ph.D., bioinformaticist, former director of the bioinformatics M.S. program
- Bill Pierce, M.S., health informaticist
- Daniel Sierra Sosa Ph.D., programmer, director of the bioinformatics M.S. program
- TBD, Health Informatics Program Director

II. Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.
The student learning outcomes (SLOs) for the M.S. in Health Informatics are adapted from the Health Informatics Body of Knowledge developed under the auspices of the American Health Information Management Association:
1. Demonstrate an understanding of how information system technologies and health

informatics tools support healthcare delivery, clinical decision-making, care management, and population health goals

2. Understand health information systems design and management including planning, implementation, and evaluation methods
3. Show a working knowledge of the healthcare delivery environment and policies that influence adoption and use of health information technologies, including standards and requirements (e.g., Meaningful Use, quality metrics)
4. Understand privacy and confidentiality of health information, information security practices, and how these requirements influence system design, usage, and business continuity and disaster recovery planning
5. Gain practical knowledge of various health informatics tools and methods such as electronic medical records, workflow redesign, data visualization/dashboards, data analysis
6. Gain exposure to principles and methods of data mining, natural language processing, and information exchange

III. Explain how the institution will provide for assessment of student achievement of learning outcomes in the program and document student achievement of learning outcomes in the program.

The HIFX program's evaluation plan is based on the current evaluation for the bioinformatics program, but will also include mapping to the CAHIIM-accreditation learning outcomes (detailed in Appendix A). Briefly, each student learning outcome (SLO) is mapped to at least two required courses in the proposed program. Within each of those courses, there is at least one key assignment that measures that particular SLO. The Office of Institutional Research at Hood College assists programs with their evaluation procedures. All assignments linked to a program's evaluation plan are tracked in Chalk & Wire, the online assessment program used by Hood College. Students will be required to maintain an average of 3.0/4.0 ("Meets Expectations") on all key assignments. Upon approval of the proposed program, the College will forward the SLOs and evaluation map to Nathan Reese, Assistant Director of Institutional Assessment, for entry into Chalk & Wire.

The level of achievement for mastering learning outcomes becomes greater as students advance through the HIFX program. The level of achievement continues to grow through professional practice. In order to assess whether students master learning outcomes appropriate for their degree, course content will be mapped to the program learning outcomes. An advisory committee composed of the Graduate Faculty will review the Plan of Study of each student to ensure that program learning outcomes are achieved at the appropriate level.

IV. Provide a list of courses with title, semester credit hours and course descriptions, along with a description of program requirements.

The program will be available for both full- or part-time enrollment. Full-time status requires enrollment in 9 credit hours per semester. Part-time graduate students enroll in 3-6 credit hours per semester. The M.S. could be completed in two years by full-time students

and in 3-4 years by part-time students. The program builds upon the strengths of Hood College by leveraging resources and space from established units such as Bioinformatics, Nursing, Computer Science, Information Technology, and Organizational Leadership at Hood College. Current Hood College graduate programs have some connections to Health Informatics, thus potential synergy and collaborations exist with the HIFX graduate degree program. The proposed M.S. in Health Informatics requires the successful completion of 30 hours of coursework.

M.S. in HIFX - Example Plan of Study (30 Credit Hours Required)

SEMESTER 1		
Course No.	**Credits**	**Course Title**
HIFX 500	3	Fundamentals of Health Informatics - Core
HIFX 501	3	Introduction to HIS & Data Standards - Core
HIFX 502	3	US Health Policy, Standards & Ethics - Core
TOTAL	9	
SEMESTER 2		
Course No.	**Credits**	**Course Title**
BIFX 551	3	Advanced Data Analytics in R
MATH 500	3	Statistical Methods for Health Science Research
	3	Elective 1 (see list below)
TOTAL	9	
SEMESTER 3		
Course No.	**Credits**	**Course Title**
BIFX 530	3	Introduction to Database Management Systems
	3	Elective 2 (see list below)
	3	Elective 3 (see list below)
TOTAL	9	
SEMESTER 4		
Course No.	**Credits**	**Course Title**
HIFX 595	3	Research, Internship, Capstone
TOTAL	3	

Additional Electives
- BIFX 546 Machine Learning in Bioinformatics
- BIFX 548 Data Visualization
- CS 527 Data Science
- CS 552 Deep Learning
- ITMG 525 Applied Data Analysis

- BIFX 545 Leading Reproducible Research

Existing courses:

BIFX 502 Foundations in Computer Science
This course provides students with an introduction to programming concepts and techniques used in problem solving. Students will study general programming concepts for the purpose of data analysis. These concepts are demonstrated through the use of a modern programming language. Students will design, implement and test programs to solve analytical problems. Students will develop the ability to logically plan and develop programs, and learn to write, test, and debug programs. Topics include file I/O, expressions, types, variables, branching, loops, data access, data profiling, and data manipulation. Students will apply their knowledge through hands-on programming projects.

BIFX 503 Biostatistics in R
After a brief introduction to working in R, this course will focus on the statistical concepts that are used in biology and medicine to analyze and validate data. Topics will include probability, hypothesis testing, tests for variables (e.g. chi-square, Fisher's test), t-test, linear and multivariate regression, covariance and Bayesian statistic.

BIFX 530 Applied Database Systems
Prerequisite: A minimum grade of "B-" in BIFX 502 or CSIT 512 and BIFX 551 or permission of the instructor. Not open to students who have completed CS 530. A study of the design and implementation of databases from a real-world applications point of view. The course will explore the enterprise perspective of managing data needs of an organization. Topics include data integrity, database models, logical database design, the integration of databases, security, and database administration issues. The course will also address topics such as assessing end user needs, developing specifications, and designing functionally equivalent solutions. The student will be introduced to query processing within a database environment.

BIFX 546 Machine Learning in Bioinformatics
Prerequisites: BIFX 501 or BIFX 502 or CSIT 512 and BIFX 503 This course on machine learning will provide students with more advanced methods to analyze data using both R and Python, allowing them to computationally represent biological data that can then be used to solve complex problems. Topics that will be covered include regression, classification (nearest neighbor methods, decision-tree based methods) and clustering. A large section of the class will be devoted to modern approaches of neural networks and deep learning including convolutional neural networks and reinforcement learning. Approaches for developing expert systems will also be covered based on formal logic, ontologies and technologies for the semantic web.

BIFX 548 Data Visualization
Prerequisite: BIFX 551 or permission of the instructor. Basic knowledge of programming in R is required. Data visualization is a sub-area of Human-Computer Interaction (HCI). Students will learn the theories and tools of data visualization. This course covers the basic theories of data visualization, such as data types, chart types, visual variables, visualization techniques, structure of data visualization, navigation in data visualization, color theory, cognitive theory, and

visualization evaluation. Various frameworks for data visualization will be used such in R and Tableau.

BIFX 551 Advanced Data Analytics in R

Prerequisites: A minimum grade of B- in IT 518 or MGMT 566 or BIFX 502 or CSIT 512, or Permission of Instructor This class introduces programming for bioinformatics, with a focus on programming in R and tools to communicate and develop your code. Emphasis will be placed on good development practices and reproducible research. Significant time will be spent learning to program within an integrated development environment, cleaning, visualizing, and analyzing data. (Different name - same course)

BIFX 552 Bioinformatics Data Skills

Prerequisites: A minimum grade of "B-" in BIFX 551 or permission of the instructor. This class introduces applied data science skills needed by bioinformatics professionals. A focus will be placed on reproducible bioinformatics research and will include the following topics and tools: beginning to intermediate use of the Unix command line, working with remote computing resources, version tracking, R and Bioconductor, tools for manipulating sequence data, and creation of pipelines.

BIFX 553 Applied Data Science for Bioinformatics

Prerequisites: A minimum grade of "B-" in BIFX 552 or permission of the instructor. Students will continue to develop the data science skills learned in BIFX 552 while gaining a deeper understanding of statistics and machine learning by performing real-world analyses of biological data. A deeper understanding will be gained of what can go wrong in data analyses, and principles of reproducible research will be emphasized. Students will use the high performance-computing cluster using R as well as important application programs for processing sequencing data. A large portion of the class will be devoted to processing high-throughput sequencing data (RNA-Seq, whole genome sequencing, whole exome sequencing, variant analysis, metagenomics). Additional possible topics are genome-wide association studies (GWAS), phylogenetics, and the analysis of protein motifs and protein domains.

BMS 537 Introduction to Bioinformatics

Prerequisites: BMS 511 and BMS 524 or permission of the instructor. Lab fee. This is a hands-on, applied course that will introduce students to the use of computer software and Web servers in the analysis of biological sequence data (DNA and protein). Topics include: Pairwise and multiple sequence alignment, BLAST, scoring matrices, phylogenetic analysis, DNA sequence analysis and prediction of 2-D and 3-D molecular structures.

BMS 542 Ethics in Science

The course considers the ethical dilemmas one could face in a career in science, including how information gained in the research lab is conveyed to the wider scientific audience. Topics included are the peer review process, the patent process, the Recombinant DNA Advisory Committee, the FDA's role in drug approval, the funding of research and the national research prioritization process.

CS 519 Advanced Data Structures

Prerequisites: A minimum grade of "B-" in CSIT 512 Intensive introduction to object-oriented programming and advanced data structures. Topics include heaps, priority queues, hash tables, B+, B* trees and graphs. Emphasizing advantages and disadvantages of design and implementation choices, and the way these choices affect software quality. Instruction will be in the C++ programming language.

CS 522 Data Mining
Prerequisites: MATH 500 and CS 519 Introduces basic principles and methods for data analysis and knowledge discovery to computer science students. Topics include preprocessing, association, classification and anomaly detection. Students develop basic skills for modeling and performance evaluation.

CS 527 Data Science
Prerequisites: CS 530 or Permission of the instructor This course provides an overview of Data Science, covering a broad selection of challenges and methodologies for working with big data. Topics to be covered include data collection, integration, management, modeling, analysis, visualization, prediction, and informed decision making. Students work on hands-on projects and case studies using real data sets from a variety of domains including science, business, engineering, social sciences, and life sciences.

CS 528 Artificial Intelligence
Prerequisite: A minimum grade of "B-" in CSIT 512 or permission of the instructor. History, fundamental principles, and future directions of A.I. Topics include state-space searching, knowledge representation, logic and deduction, natural language processing, neural networks, learning, vision, robotics, and cognitive science. Topics will be treated at a level of depth and detail appropriate for a first course in AI.

CS 530 Intro to Database Management Systems
Prerequisite: A minimum grade of B- in CSIT 512 or permission of the instructor. Not open to students who have completed IT 530. Design and implementation of databases from a real world applications point of view. The course includes database concepts such as basic architectural issues, the relational model, query processing, logical database design and normalization theory and data protection issues.

CS 543 Machine Learning
Prerequisites: CSIT 512 and CS 528 Introduction to the field of modeling learning with computers. Topics included are explorations of inductive learning, learning decision trees, ensemble learning, computational learning theory, and statistical learning methods.

CS 552 Deep Learning
Prerequisite: CS 519 or Permission from Instructor This course introduces the field of deep neural network-enabled machine learning with applications in computer vision and natural language processing. Deep learning is behind many recent advances in artificial intelligence, including speech recognition and self-driving cars. Students will work on big data projects using cloud resources from fastest supercomputers in the world.

CSIT 565 Advanced Database Management Systems
Prerequisites: CS 519 and CS 530 or CSIT 512 and IT 530 This course examines advanced data management concepts and technologies. Topics include indexing structures, query processing, transaction management, data security, data warehousing, object-oriented extensions, XML, distributed data management, and recent advances and alternate architectures for Big Data management and processing.

IT 514: Info Tech & Cloud Business Intelligence
Prerequisites: A minimum grade of "B-" in IT 510 and CSIT 512 or concurrent enrollment or permission of the instructor. Current issues in the use of information technology (IT) and the exploration of trends such as Cloud computing and business intelligence. The primary purpose of this course is to provide a set of technical tools to understand the role of information technology in Cloud computing business intelligence.

ITMG 516 Introduction to Data Analytics and Business Data Mining
Prerequisites: CSIT512 for IT and MGMT 566 for MIT and MBA This course examines techniques for discovering patterns in data. Topics will cover various data mining algorithms and statistical techniques, such as correlation analysis, text mining, decision trees, clustering, and association rules. The course will use data mining and analytical software to build on traditional statistical concepts. Project management techniques unique to exploratory projects will be used throughout the course. In addition to teaching students to organize, manipulate, and convert data into meaningful information for managerial decision-making, the course prepares them to effectively communicate such information with different stakeholders. In addition, students are expected to have competency in statistics.

ITMG 524 - Advanced Data Analytics Programming with R
Prerequisites: A minimum grade of B- in IT 518 or MGMT 566 or BIFX 502 or CSIT 512, or Permission of Instructor This class introduces the R programming language and advanced concepts and techniques to discover patterns in data. Students will explore datasets by identifying variables with the most predictive power, and developing and assessing predictive models in R. Discussion topics include exploratory data analysis, visualization, and data transformation. Students will implement the following data mining techniques: regression, neural networks, classification, clustering, principal component analysis, and survival analysis. Advanced techniques such as bagging, boosting, and random forests will also be explored. Significant time will be spent learning to program within an integrated development environment and implementing version tracking.

ITMG 525 Applied Data Analytics
Prerequisites: A minimum grade of B- in CSIT 512 (or waived), ITMG 516 and ITMG 524 or permission of instructor. This course provides a hands-on approach to data analytics methods and techniques, such as data acquisition and management, data preparation and modelling, and visualization schemas to deduce information in the fields of Business, Healthcare, Social Media, and Bioinformatics.

MATH 500 Statistics
Basic statistical methods as they apply to education and other fields. Topics include frequency

distributions and their representations, measures of central tendency and dispersion, elementary probability, statistical sampling theory, testing hypotheses, non-parametric methods, linear regression, correlation, and analysis of variance.

BIFX 579 (to be cross-listed with HIFX 579)
Prerequisites: Completion of 18 BIFX credits including a minimum grade of B- in BIFX 504 and in BIFX 552, or permission of the instructor. This course provides a practical, hands-on experiential learning opportunity for Bioinformatics MS students and emphasizes experimental design and biological interpretation of results. Students will utilize a wide variety of concepts and skills that they have learned throughout previous courses to complete an original research project from start to finish. Over the course of the semester, students will share their questions and insights during frequent "lab meeting" style presentations, and will work both independently and collaboratively to complete their projects. They will present their work in the form of a well annotated script that contains all of the code necessary to complete the project, a brief paper describing the project in paragraph form, and a final poster presentation of their results. Students are encouraged to collaborate with their employer or an outside laboratory to propose a project to the course instructor during the first week of class. Alternatively, project ideas and data will be provided by the instructor. Computational resources will be provided via the Bioinformatics program's High-Performance Computing Cluster.

Courses to be developed:

HIFX 500 Fundamentals of Health Informatics

Prerequisites: None. This course will provide knowledge information technology in healthcare. We consider a wide range of technology applications – from enterprise application systems to EHR (Electronic Health Records), to current trends in information technology and related regulatory initiatives. We examine how these technologies enable the healthcare industry to manage information and knowledge resources most effectively and deliver superior services to its customers. ide an introduction to the design, structure and political implications of healthcare systems and payer-provider relationships with respect to patient and populations health.

HIFX 501 Introduction to Health Information Systems & Data Standards

Prerequisites: None. This course will provide an overview of Health Information Systems and the standard vocabularies, ontologies terminologies, and data standards in the US Healthcare systems.

HIFX 502 US Health Systems & Economics

Prerequisites: None. This course will introduce the design, structure and political implications of healthcare systems and payer-provider relationships with respect to patient and populations health.

V. Discuss how general education requirements will be met, if applicable.
Not applicable.

VI. Identify any specialized accreditation or graduate certification requirements for this program and its students.
Not applicable.

VII. If contracting with another institution or non-collegiate organization, provide a copy of the written contract.
Not applicable.

VIII. Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management system, availability of academic support services and financial aid resources, and costs and payment policies.

A description of Hood College admission and registration requirements for graduate students is available on the college website:

We welcome students with an interest in Health Informatics regardless of their previous background. Because of the diversity of topics within Health Informatics, no one kind of undergraduate preparation is recommended. However, if deficiencies in math, statistics, computer science, or specific Health Informatics or science topics are identified by the program director, they may be required to be completed during the first one or two semesters of a student's plan of study. See the table below for prerequisite classes required for admission.

Before a candidate will be considered for admission, an application package for admission must be completed and received by The Graduate School. In addition to the application form, a number of supplementary documents must be submitted. Applicants must submit a Statement of Purpose essay of approximately 300-500 words stating clearly and succinctly the reason for seeking graduate study in Health Informatics at Hood College, the applicant's career goals, and research interests. The applicant may include information about any unique circumstances, special abilities, awards, achievements, scholarly publications, or professional history that are relevant to the admission decision. Depending on the strength of the applicant's submission, recommendations may be requested. Official original transcripts from each college or university at which the applicant hascompleted course work must be on file before an application can be processed.

The foundation courses represent background knowledge and skills necessary for successful completion of degree requirements. Some or all of the foundation courses may be waived by the program director, based upon an analysis of the student's previous work. A student holding a baccalaureate degree in computer science will normally be granted exemption from, but not graduate credit for, the foundation course. Any foundation courses required are in addition to the 30 credits required for program

completion, such as BIFX 502 (Foundations in Computer Science) or CSIT 512 (Elements of Computer programming).

All incoming graduate students receive a comprehensive new-student orientation at the beginning of their first semester, which covers all the categories listed above. New students spend an hour with the graduate dean learning about the myriad of support services at the College before they move into the program-specific orientations with faculty directors. The Hood College Graduate School website provides a comprehensive guide for graduate students. Each program has a detailed landing page where curriculum, course, and degree requirements are clearly described. The HIFX program will have a page akin to the existing programs linked below. Curriculum, course, and degree requirements: https://www.hood.edu/graduate/academics/programs/bioinformatics-c

The division of IT support at Hood College has developed an Online Success Toolkit for hybrid and online courses. This page provides detailed information about our learning management system, Blackboard, as well as Zoom video conferencing and other key technology for success in the HIFX program. Information Technology Resources: https://www.hood.edu/offices-services/information-technology. The Graduate School has developed an Online Success Toolkit from a pedagogical perspective: https://www.hood.edu/academics/josephine-steiner-student-success-center/online-success-toolkit

In addition, the Graduate School has many resources available to help students understand the cost, payment plans, and financial aid resources associated with our degree programs. Representatives from the Office of Financial Aid are present at all Graduate School Admissions Café Events, as well as New Student Orientation.
Funding Your Education:
https://www.hood.edu/graduate/admission/funding-your-education?utm_medium=Google&utm_source=display&utm_campaign=HoodGraduate

IX. Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.

Hood College follows a model of centralized recruitment and admissions under the direction of The Graduate School, led by the Dean of the Graduate School. Program information for all programs at Hood College are readily available on the College's website. The information is presented in a user-friendly format. The HIFX program, if approved, will be posted in a similar manner. Recruitment and advertising materials for the program will also be posted on the website and distributed at academic fairs and professional conferences. The program will have a webpage on the website with detailed program information that will include learning and student outcomes. The website will be monitored and updated as needed. The application form will be easily accessible to prospective students on the College's website.

H. Adequacy of Articulation
I. If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.

Not applicable.

II. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11).

Over ninety percent (90%) of the CSIT faculty who will teach in the proposed program hold doctoral or terminal degrees. With a low student to faculty ratio (13:1), students are given high-quality, personalized attention, which fosters their academic and professional success. See Table 2 for a complete listing of academically qualified faculty who will teach and advise HIFX students.

Faculty	New/Existing	Rank/Status	Degree/Credentials
Ahmed Salem	Existing	Associate Professor	Department Chair, PhD, MS, BS
Miranda Darby	Existing	Assistant Professor	PhD, BA
George Dimitoglou	Existing	Associate Professor	PhD, ACM, IEEE
Aijuan Dong	Existing	Associate Professor	PhD, MS
Carol Jim	Existing	Assistant Professor	PhD, MS, BA
Jiang Li	Existing	Assistant Professor	PhD, MS, MS, BS
Xinlian Liu	Existing	Associate Professor	PhD, BS
Bill Pierce	Existing	Assistant Professor	BME, MS, AAS
Daniel Sierra Sosa	Existing	Assistant Professor	PhD
Elizabeth Chang	Existing	Faculty Emeriti	PhD
TBD (HIFX Director)	New	TBD	TBD

Table 2: Academically Qualified Faculty

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.03.12)

The Beneficial-Hodson Library supports graduate and undergraduate programs. Books, eBooks, government publications, journals, audiovisuals, databases, historical collections, and more are available to students and faculty. The library adds to its collection of monographic and subject-specific materials, based upon the recommendations of faculty. As a participant in MIC, the Beneficial-Hodson Library can obtain almost any book held by those partner libraries within 24 hours through our shared courier service, Interlibrary Loan (ILL). ILL is available as an alternative for materials not held within the Consortium, and the ILL manager is able to fill approximately 85% of all ILL requests.

Hood students and faculty have access to nearly 150 academic databases and HIFX-related journals. These include:

- Academic Search Ultimate (Scholarly journal and other articles covering all subject areas. Full text.)
- ProQuest (Scholarly journal and other articles covering all subject areas. Full text.)
- Ex Libris Group (Scholarly journal and other articles covering all subject areas. Full text.)
- Evolutionary bioinformatics
- Briefings in bioinformatics

- Journal of integrative bioinformatics
- IEE/ACM transactions on computational biology and bioinformatics

K. Adequacy of Physical Facilities, Infrastructure and Instructional Equipment (as outlined in COMAR 13B.02.03.13)

The proposed curriculum will be taught using existing resources such as the campus library and standard classroom facilities. Additionally, some of the courses will be taught in hybrid or online modalities, depending on an individual student's course selections. During the COVID-19 pandemic, Hood College significantly expanded its capability to offer hybrid and online instruction, incorporating programs like Panopto and Zoom, as well as webcams in every classroom.

L. Adequacy of Financial Resources with Documentation (as outlined in COMAR 13B.02.03.14)

See Table 3: Revenues and Table 4: Expenditures.

We anticipate a consistent increase of students enrolled each year as the program gains visibility and prominence.

REVENUES					
Resource Categories	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
1. Reallocated Funds	0	0	0	0	0
2. Tuition/Fee Revenue (d+g)					
a. Number of F/T Students	3	5	7	9	11
b. Annual Credit Hour Generation	54	90	126	162	198
c. Credit Hour Rate	$610	$630	$650	$670	$690
d. Total F/T Revenue (b x c)	$32,940	$56,700	$81,900	$108,540	$136,620
e. Number of P/T Students	8	12	16	18	18
f. Annual Credit Hour Generation for 2e	96	144	192	216	216
g. Credit Hour Rate	$610	$630	$650	$670	$690
h. Total P/T Revenue (f x g)	$58,560	$90,720	$124,800	$144,720	$149,040

i. Total Tuition Revenue (d + h)	$91,500	$147,420	$206,700	$253,260	$285,660
3. Grants, Contracts & Other Ext. Sources	0	0	0	0	0
4. Other Sources	0	0	0	0	0
Total (Add 1-4)	**$91,500**	**$147,420**	**$206,700**	**$253,260**	**$285,660**

Table 3: Revenues

Line 2c, 2g and 2k: Assumes ~3% (or ~$20) increase per credit per year.

Line 2e: Students not enrolled in other Hood programs.

Line 2f: Assumes students will take 12 credits/year.

Line 2i: Includes credits generated by students upgrading from the Certificate (also currently being reviewed by MHEC). We assume each student will take 12 credits/year.

EXPENDITURES					
Expenditure Categories	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**FY 2028**
1. Faculty (b + c)					
a. AC (full-time)	1	1	1	1	1
b. Total Salary (assume 3% salary increase)	$75,000	$77,250	$79,568	$81,955	$84,413
c. Total Benefits (est. 30% of salary)	$22,500	$23,175	$23,870	$24,586	$25,324
d. Additional Adjunct Faculty	0	0	0	0	0
e. Additional Adjunct Faculty for F/T course buyout	0	0	0	0	0
f. Total Adjunct Faculty Salary	$0	$0	$0	$0	$0
2. Administrative Staff (b + c)					
a. FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff					
a. FTE	0	0	0	0	0
b. Total Salary (assume 3% salary increase)	0	0	0	0	0
c. Total Benefits (est. 30%)	0	0	0	0	0
4. Equipment	$0	$3,000	$3,000	$3,000	$3,000
5. Library	$0	$0	$0	$0	$0
6. Software	$0	$2,000	$2,000	$2,000	$2,000
7. Marketing	$4,000	$4,000	$4,000	$2,500	$2,500
8. Professional development	$0	$0	$0	$0	$0
9. Other Expenses	$0	$0	$0	$0	$0
Total Expenditures (Add 1-7)	**$101,500**	**$109,425**	**$112,438**	**$114,041**	**$117,237**
Net Surplus/Deficit (Revenues-Expenditures)	**-$10,000**	**$37,995**	**$94,262**	**$139,219**	**$168,423**

Table 4: Expenditures
Line 4. Hardware (routers, switches etc.).
Line 6. Software, licensing, maintenance costs.
Line 7. Marketing expenses, outreach.

M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15).

The HIFX program's evaluation plan is based on the current evaluation for the bioinformatics program. Each student learning outcome (SLO) is mapped to at least two required courses in the master's program. The Office of Institutional Research at Hood College assists programs with their evaluation procedures. All assignments linked to a program's evaluation plan are tracked in Chalk & Wire. Upon approval of the HIFX master's degree, the College will forward the SLOs and evaluation map to Nathan Reese, Assistant Director of Institutional Assessment, for entry into Chalk & Wire.

N. Consistency with the State's Minority Student Achievement Goals (as outlined in COMAR 13B.02.03.05).

Thirty-eight percent (38%) of the student body are from under-represented racial or ethnic populations—one of the highest percentages across colleges/universities in the state of Maryland—which demonstrates Hood College's commitment to a diverse student population. The program will reserve 20% of its available spots for students who are attending or attended Historically Black Colleges and Universities (HBCU) and Minority Serving Institutions (MSI), who have met the program's admission requirements. There are several offices within the divisions of academic and graduate student life that promote inclusion and cultural sensitivity. The Division of Inclusivity and Community provides programs for students and supports activities for African-American, Hispanic, Asian, Native American and international students and organizations such as the International Club, Black Student Union and La Comunidad. To meet the needs of the growing number of students from other countries, the Director of International Student Services assists these students in making the adjustment to a new country and in achieving their educational objectives. Additional graduate programming on inclusivity is supported by both The Graduate School and student-led groups, like the Graduate Student Association (GSA). The college also has a strong track record for supporting our students of color from a variety of successful grant initiates (e.g., HRSA[7] and CGS-JED[8][9])

O. Relationship to Low Productivity Programs Identified by the Commission:

This program is not directly related to an identified low productivity program.

P. Adequacy of Distance Education Programs (as outlined in COMAR 13B.02.03.22)

Modes of delivery for the proposed HIFX program will include traditional face–to-face, hybrid, synchronous and/or asynchronous online instruction. Hood College has several fully online programs, which we are approved to offer by both MSCHE and MHEC. Thus, we have demonstrated through multiple reporting requirements that we adhere to all C-RAC guidelines in order to deliver content effectively online. Faculty will also be required to complete the college's trainings in hybrid and online instruction, offered through the Center for Teaching and Learning.

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7 https://www.hood.edu/news/hood-college-receives-22-million-grant-hrsa

8 https://cgsnet.org/new-initiative-support-graduate-student-mental-health-and-wellness
9 https://www.hood.edu/news/dean-grad-school-joins-national-mental-health-committee

Additional faculty support of online course development is provided by an instructional designer as needed

Appendix A

Course map for future CAHIIM or AMIA certification

Course Number	Course Name	Core/Elec	CAHIIM Domain Mapping	AMIA Domain Mapping
HIFX 500	Fundamentals of Health Informatics	C	F1-10	1
HIFX 501	Introduction to Health Information Systems & Data Standards	C	F1-2,F4-8	2
HIFX 502	US Health Systems & Economics	C	F1-2,F4-8,F10	4, 5
BIFX 530	Healthcare Databases	C	F1-3,F7-8	3-4
BMS 500	Statistical Methods for Social Science: Design and Analysis	C	F1,F3,F5-8,F9	2, 3, 4
HIFX 595	Research/Intern Capstone	C	F1-F10	1-5
BIFX 546 CS 552	Machine Learning for Bioinformatics Deep Learning	E (Min 1)	F1-4,F7	1-4
BIFX 551, BIFX 548	Advanced Data Analytics in R Data Visualization	C E	F1-F7	1-4
BIFX/CS 530	Intro to Database Management Systems	C	F1-3,F7,F10	1-5

For the purposes of CAHIIM Accreditation, students in the health informatics discipline should have working knowledge and competency of these foundational domains as they define and affect the practice of health informatics. The program graduate is expected to demonstrate the knowledge, skills, and attitudes that exist in the following domains:[10]
1.   Health
2.   Information Science and Technology
3.   Social and Behavioral Science
4.   Health Information Science and Technology
5.   Human Factors and Socio-technical Systems
6.   Social and Behavioral Aspects of Health
7.   Social, Behavioral, and Information Science and Technology Applied to Health
8.   Professionalism
9.   Interprofessional Collaborative Practice
10.   Leadership

For purposes of AMIA certification, students in Health informatics discipline should have a working knowledge of the following domain competencies:

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[10] https://www.cahiim.org/accreditation/health-informatics/curriculum-requirements

1. **Foundation Knowledg**e: Provides fundamental knowledge and skills that provide health informaticians with a common vocabulary, basic knowledge across all health informatics domains, and understanding of the environment in which they function.

2. **Enhancing Health Decision Making, Processes and Outcomes:** Focuses on how to support and enhance decision-making by clinicians, patients, and public health professionals; analyze existing health processes and identify ways that health data and HIS can enable improved outcomes; evaluate the impact of HIS on practice; pursue discovery and innovation in HIS and informatics practice.

3. **Health Information Systems (HIS)**: Focuses on how to plan, develop or acquire, implement, maintain, and evaluate health information systems that are integrated with existing information technology systems across the continuum of care, including clinical, consumer, and public health domains, while addressing security, privacy, and safety considerations.

4. **Data Governance, Management, and Analytics**: Focuses on how to establish and maintain data governance structures, policies, and processes; acquire and manage health-related data to ensure its quality and meaning across settings; -and utilize it for analysis that supports individual and population health and drives innovation.

5. **Leadership, Professionalism, Strategy, and Transformation:** Focuses on how to build support and create alignment for informatics best practices and lead health informatics initiatives and innovation through collaboration and stakeholder engagement across organizations and systems.

Following is a list of courses that have been offered one or more times at Hood College. These courses are highly appropriate for graduate study in Health Informatics:

BIFX 502 Foundations in Computer Science
BIFX 503 Biostatistics in R
BIFX 530 Applied Database Systems
BIFX 546 Machine Learning in Bioinformatics
BIFX 548 Data Visualization
BIFX 551 Advanced Data Analytics in R
BIFX 552 Bioinformatics Data Skills
BIFX 553 Applied Data Science for Bioinformatics
BMS 537 Introduction to Bioinformatics
BMS 542 Ethics in Science
CS 512 Elements of Computer Programming
CS 519 Advanced Data Structures
CS 522 Data Mining
CS 527 Data Science
CS 528 Artificial Intelligence
CS 530 Intro to Database Management Systems
CS 543 Machine Learning
CS 552 Deep Learning

CSIT 565 Advanced Database Management Systems
IT 514 Contemporary issue in Information technology
ITMG 516 Introduction to Data Analytics and Business Data Mining
ITMG 524 Advanced Data Analytics Programming with R
ITMG 525 Applied Data Analytics
ITMG 527 Management Issues in Information Systems
IT 530 Applied Database Systems
MATH 500 Statistics

Courses to be added

- HIFX 500   Fundamentals of Health Informatics (Appendix B)
- HIFX 501   Introduction to Health Information Systems & Data Standards (Appendix C)
- HIFX 502   US Health Systems & Economics (Appendix D)
- HIFX 578   Capstone (to be cross-listed with BIFX Capstone)