MASTER OF HEALTHCARE DATA SCIENCE (MHDS)

MHDS 401-DL Foundation of Healthcare Programming with Python and R (1 Unit)
This course introduces students to the foundational programming and data management skills required for modern health data analytics using both Python and R. Students will learn how to acquire, clean, transform, and manage healthcare and biomedical datasets while developing confidence in writing, reading, and interpreting code for real-world health applications. In practice, healthcare data teams often use both Python and R. Python is commonly used in modern data engineering and AI/ML workflows, while R is widely used in research and statistical analysis environments. This course builds foundational skills in both so students can work across a wider range of healthcare, research, and industry settings. Emphasis is placed on data cleaning, wrangling, and reproducible workflows—the core building blocks of any analytics pipeline. While basic exposure to visualization and statistical concepts may be included, the primary focus will be on applied programming, data quality, and interpretation rather than advanced analytics. The course introduces the responsible use of Generative AI to support programming, debugging, and documentation tasks.

MHDS 403-DL Introduction to U.S. Healthcare, Digital Health & Analytics (1 Unit)
This course will provide an introduction to the current structure and emerging trends shaping the US Healthcare System. Students will learn what it means to navigate the confusing, bottom-up, and variously incentivized entities in the American health care system. Additionally, we will cover foundational healthcare data sources for the 3Ps (Providers, Patients, and Payers) and fundamentals of Health Information Technology including electronic health records, health information exchanges, clinical decision support, consumerism, and the impact of big data and predictive analytics. Topics center on how information technology and analytics enables patient care and fuels modern health care organizations.

MHDS 405-DL Data Literacy and Analytics in Healthcare (1 Unit)
Students will learn about data literacy, unique aspects of working with healthcare data, relational databases, healthcare data standards, and the basics of utilizing SQL for data and analytics. Students will leave this course with a strong understanding of how to approach working with healthcare data, how the healthcare system shapes data, terminologies (i.e., RxNorm, SNOMED) and exchange standards (i.e. SMART on FHIR), relational databases, and how to retrieve, analyze, and aggregate relational data for analytics purposes using SQL.

MHDS 407-DL Data Governance, AI Ethics & Cybersecurity (1 Unit)
This course provides a working knowledge of the specific considerations for health data and the appropriate application of privacy laws to protect personal health information and maintain confidentiality. This will include oversight of technical, administrative, and physical safeguards needed to maintain a secure environment and minimize the risk of a data breach. Additionally, the course will address ethical concerns and dilemmas in the use and disclosure of health data, such as use in public safety and medical research. Topics include: ensuring system specifications and configurations meet regulatory requirements; ensuring cybersecurity risks are mitigated; addressing European Union Privacy Laws for international systems; and managing organizational & technical governance.

MHDS 409-DL Foundations of Health Statistics and Data Exploration (1 Unit)
This course introduces considerations in the use of statistics in health research, descriptive statistics, probability concepts and distributions, statistical inference, data wrangling, exploratory techniques, visualization, modeling and foundational applications of artificial intelligence (AI) in data analysis. The course will use R and Python as the primary software tools, alongside selected AI-assisted analytical methods, with a focus on healthcare and clinical use cases and hands-on exercises.
Prerequisite: MSHA 401-DL or MHDS 401-DL.

MHDS 410-DL Predictive Modeling and Statistical Inference in Healthcare (1 Unit)
This course builds on MHDS 409 and develops the foundations of predictive modeling by: introducing the conceptual foundations of regression and multivariate analysis; developing statistical modeling as a process that includes exploratory health data analysis, model identification, and model validation; and discussing the difference between the uses of statistical models for statistical inference versus predictive modeling. The high level topics covered in the course include: exploratory data analysis, statistical graphics, linear regression, automated variable selection, principal components analysis, exploratory factor analysis, and cluster analysis.
Prerequisite: MHDS 409-DL or MSHA 409-DL.

MHDS 412-DL Feature Engineering and Unstructured Data (1 Unit)
This course will provide students with the skills to develop analytical features from health datasets. Students will develop an understanding of healthcare data, particularly electronic health record (EHR) data, and use R & SQL to build features for analytical modeling. In addition to working with continuous and categorical health data, students will understand and develop skills for natural language processing to extract discrete data elements from free-text clinical documentation, such as physician notes, for the development of analytical features.
Prerequisite: MHDS 405-DL or MSHA 405-DL.

MHDS 422-DL Practical Machine Learning and AI in Healthcare (1 Unit)
The use of machine learning and AI methods is having large and important impacts on many aspects of health care. They are being used to improve clinical care, to discover new drugs, to design new devices, to support clinical decision-making, and to improve operational efficiency. Students in this course do hands on work using R and Python to solve prediction problems using statistical methods, deep learning models, and large language models. This course emphasizes reproducibility of results, predictive accuracy and precision, using structured and unstructured healthcare data, multimodal data, and workflow management. Students complete four main applied projects and participate in online discussions that ask them to do research, to complete tasks, and discuss their findings. Required reading is minimized as much as possible. Suggested additional content is provided throughout the course.
Prerequisite: MHDS 401-DL or MSHA 401-DL, and MHDS 409-DL or MSHA 409-DL.

MHDS 426-DL Applications of AI in Healthcare (1 Unit)
This course provides a practical, interdisciplinary exploration of applied artificial intelligence (AI) in healthcare, with a focus on high-impact use cases using traditional AI, Natural Language Processing (NLP), and generative AI to demonstrate pragmatic applications of AI across the healthcare ecosystem. Students will examine real-world implementations ranging from automated clinical documentation and radiology image analysis to predictive risk modeling and AI-assisted care delivery. Designed for healthcare and analytics professionals, this course emphasizes how to evaluate, implement, and lead AI-driven solutions, rather than build them from scratch. Through hands-on case studies

and interactive scenario planning, students will learn how to assess data readiness, address model limitations, and communicate the value of AI tools to clinical and operational stakeholders. Key topics include AI adoption frameworks, handling messy healthcare data, evaluating vendor tools, understanding ethical and regulatory considerations (e.g., HIPAA, bias mitigation, FDA guidance), and aligning AI innovation with organizational goals. By the end of the course, students will be equipped to bridge the gap between advanced AI technologies and responsible, outcome-driven implementation in healthcare settings.

MHDS 427-DL Enabling AI: Cloud Platforms, Data Architecture, and Scalable Systems (1 Unit)
As artificial intelligence (AI) becomes foundational to modern healthcare and biomedical research, scalable infrastructure and cloud computing environments are critical to support real-time analytics, machine learning pipelines, and growing healthcare datasets. This course introduces the key concepts, tools, and architectures that underpin AI-readiness at scale, with a focus on practical applications in health systems, research institutions, and AI innovation hubs. Students will gain hands-on exposure to core components of modern data infrastructure, including cloud service models (IaaS, PaaS, SaaS), containerization (Docker, Kubernetes), data pipelines, and storage strategies optimized for protected health information (PHI). The course also explores the role of distributed computing, high-performance environments, and MLOps practices for deploying AI models into production. Through real-world case studies and guided design exercises, students will assess trade-offs in cost, compliance, scalability, and performance, developing a systems-thinking approach to supporting AI and data science initiatives in clinical, operational, and research settings.

MHDS 428-DL Digital Twin Intelligence in Healthcare: Foundations, Agents, and Strategy (1 Unit)
In this course, you will be introduced to the design and adoption of AI-enabled digital twinning, the aim of which is to curate dynamic, continuously learning service-oriented solutions that mirror a person's physiology, behavior, and contextual care. Students will integrate multimodal sensing, machine-learning, and Agentic AI to (1) model functional states such as activity, emotion, and circadian rhythm; (2) generate holistic, outcomes-based care plans; (3) develop prescriptive "clinical sandboxes" that predict risk and compare treatment pathways (i.e., sepsis, mortality, and outcomes) inclusive of social determinants of health; and (4) address data-governance challenges of consent, provenance, and portability. By the end of the course, learners build a functioning Digital Twin Agentic AI Agent service that uses a blend of language and/or vision models based on a digital-twin dataset of their choice.

MHDS 455-DL Data Visualization and Storytelling (1 Unit)
This course will build upon the analytical tools learned during the previous courses in the MSHA sequence to enable students to visually convey their findings to both technical and non-technical audiences. In this course, students will learn how to identify and explain the layers of the grammar of graphics, select effective static data visualizations, write R code to manipulate data visualizations, and construct their own compelling visualizations from scratch using health data. Course goals will be achieved using the ggplot2 package in R. In addition this course will utilize Tableau and Power BI for multistakeholder communications. By the end of the course, students should be effective visual communicators of their findings and will be proficient in producing impactful visualizations using ggplot2.
Prerequisite: MHDS 401-DL or MSHA 401-DL, and MHDS 409-DL or MSHA 409-DL.

MHDS 480-DL Healthcare Strategy, Operations, and AI Leadership (1 Unit)
This interdisciplinary course provides students with the knowledge and leadership skills to drive operational excellence and digital transformation in healthcare organizations. Integrating perspectives from both Healthcare Data Science and Health Informatics, the course examines healthcare system strategy and operations to strengthen operational workflows and improve outcomes. Students will practically apply analytics and informatics to help with some of the most foundational aspects of healthcare operations, including the application of AI. Students will learn how to lead cross-functional teams, apply project and change management tools, and translate complex data into actionable insights.

MHDS 498-DL Capstone (1 Unit)
By the end of this course, students will be able to: apply tools learned during MHDS coursework to define a problem in health care; define the data needed to resolve the problem; perform the analysis, and communicate the results and conclusion of the analysis in written form; present their project to a leadership team with a convincing proposal and recommendations.
Prerequisite: Capstone must be taken in the final quarter of the MHDS program. Note: Registration for this course will close one week prior to the start of the term.