ARTIFICIAL INTELLIGENCE IN HEALTH CARE (AIHC)

AIHC 5000 AIHC Seminar Series (1 Credit)
K. Schultz, D. Holmes (Fall, Winter, Spring, Summer) - The seminar sessions are organized by the Department of Artificial Intelligence & Informatics and Center for Digital Health to bring together Mayo Clinic audiences and invited speakers to meet and learn about Artificial Intelligence in healthcare. Students will independently attend 12 sessions over 12 months, reflecting and synthesizing their learning. The goal of this course is to enable students to describe research, clinical and business use cases for Artificial Intelligence in health care at Mayo Clinic and in the industry. Students will also be able to communicate with a wide range of audiences on the complex topics of Artificial Intelligence and reflect on the collaboration opportunities at Mayo Clinic. Students can register for this course in any quarter. They will have 12 months from the quarter of registration to complete the course. This course is completed asynchronously and does not have any course meetings. However, students are required to attend 4 AI&I Lunch and Learn sessions and 2 AI Speaker Series sessions of their choice synchronously.
Grading: Sat / Unsat

AIHC 5010 Introduction to Machine Learning (3 Credits)
T. Kline (Winter) – Prerequisite: Basic understanding of probability theory and statistics, college algebra and calculus, or permission of instructor. Machine learning is an exciting and fast-changing subfield of artificial intelligence (AI) with many recent innovative applications in healthcare. This course offers a broad introduction to both the theoretical and practical aspects of the design and implementation of modern machine learning techniques. On the theory side, the course will focus on understanding key concepts of the algorithms and the relationships between them. On the applied side, the course will focus on effectively using machine learning methods to solve real-world problems. We will learn these machine learning concepts without going deeply into the mathematics and gain practical experience by applying them to healthcare related problems. Assuming no prior knowledge in machine learning, this course will cast such problems under the two major paradigms of machine learning: supervised (generative/discriminative learning, parametric/non-parametric learning, neural networks, causal learning) and/or unsupervised (clustering, association rule mining, dimensionality reduction, kernel methods) frameworks. The course will consist of a combination of lectures, assignments, quizzes, a final exam, and a final group/team project.
Grading: Standard Letter

AIHC 5020 Introduction to Data (3 Credits)
L. Bernard (Summer, Winter) – Data is the foundation of knowledge generation and the raw material by which machine learning and artificial intelligence are fueled. The use of machine learning and artificial intelligence for the betterment of patient care and healthcare delivery is now coming into its own. An in-depth understanding of the nature of data is a crucial aspect for understanding and leveraging machine learning and artificial intelligence to its fullest. This foundation course will delve into the many attributes of data with a particular focus on the clinical data generated in the medical evaluation and treatment of patients along with the additional regulatory, privacy/confidentiality, and security issues involved with use of clinical data sets. Data summarization and statistical testing, Programming skills in Python of R is preferred.
Grading: Standard Letter

AIHC 5030 Introduction to Deployment, Adoption & Maintenance of Artificial Intelligence Models/Algorithms (2 Credits)
L. Rost (Spring) – This course will provide a high-level overview with multiple concrete examples of how to vet artificial intelligence for health care. Creating a model or algorithm is just one step in the journey to real-world artificial intelligence (AI). Deploying means turning your model/algorithm into a useable service that is integrated into an existing production environment where it can take in an input, return an output and deliver value. You will learn to assess whether and when an AI algorithm should be used, and the steps required in AI translation and project execution. You will learn how to define an algorithm's business model, perform a business and financial effects assessment plan, and ensure that your AI solution meets ethical and regulatory requirements.
Prerequisites: (CTSC 5300, and AIHC 5010, and AIHC 5615, and AIHC 5020)
Grading: Standard Letter

AIHC 5045 Healthcare Software & AI Management: Quality, Safety, & Implementation (1 Credit)
M. Lifson (Spring) – This course bridges the gap between clinical innovation and regulatory compliance in healthcare AI and software. You'll learn how to bring innovative clinical software tools from ideas to FDA cleared medical devices. Through a practical case study approach, you'll understand the key considerations for ensuring patient safety, maintaining clinical efficacy, and meeting regulatory requirements. The course is specifically designed for healthcare professionals who want to understand how to effectively participate in or lead the development of AI enabled clinical tools.
Grading: Standard Letter

AIHC 5100 AI Fundamentals for Healthcare Professionals (2 Credits)
A. Foong (Fall) - This survey course introduces clinicians to the core concepts and inner workings of modern artificial intelligence, with a focus on deep learning. Designed for healthcare professionals with no prior background in AI, the course explains essential building blocks such as gradient descent, linear regression, activation functions, and neural network architectures in a clear and accessible manner. Participants will explore how deep learning is applied in imaging tasks, including how images are represented numerically and how convolutional neural networks extract meaningful features. The course also demystifies large language models like ChatGPT by unpacking how they process text, predict words, and generate responses. Practical strategies for interacting with models through prompting and retrieval-augmented generation (RAG) are also discussed. While some basic mathematical concepts are introduced where necessary, the emphasis is on intuitive understanding and conceptual clarity, and no mathematics beyond high-school level is assumed. Clinical examples are used throughout to illustrate key ideas, but the primary focus is on equipping participants to truly understand how AI works and to think critically about its capabilities and limitations in medicine.
Grading: Sat / Unsat

AIHC 5200 AI Math Foundations (2 Credits)
N. Hugenberg (Summer, Winter) – This course will provide a mathematical foundation for the study of machine learning and artificial intelligence applications, with examples emphasizing best practices for biomedical and clinical research. Primary topics are calculus, linear algebra, probability and statistics, and computer programming in MATLAB. Students are expected to have some background in these topics already, but this course will establish a common ground for all AIHC students to work from.
Grading: Standard Letter

AIHC 5300 Introduction to Mayo Clinic Cloud (1 Credit)
K. Schultz, D. Holmes (Fall, Winter, Spring, Summer) – This course will provide an overview of the Mayo Clinic Cloud (MCC) environment, enabling learners to get started in MCC and use AI Factory 2.0 and Cloud App Factory.
Grading: Sat / Unsat

AIHC 5500 Artificial Intelligence and Machine Learning Journal Club (1 Credit)
H. Liang, K. Peterson, J. Reed (Spring) – The goal of this course is to enable students to become thought leaders in the domain of AI in health care. This is achieved through exposure to a broad range of AI topics and methodologies via weekly seminars. Each student will give two seminar presentations about notable AI-related publications. Seminars will also include presentations from guest speakers (from inside and outside of Mayo Clinic) about AI-related projects, tools, and methodologies.
Grading: Sat / Unsat

AIHC 5600 Foundations of Artificial Neural Networks (2 Credits)
H. Tizhoosh (Winter) - The course explores the foundational principles of Artificial Neural Networks (ANNs) comprehensively to provide a solid understanding of the key concepts shaping modern machine learning. The course investigates the core elements that form the basis of ANNs, ranging from the natural neuron, artificial neurons, Perceptron, Gradient Descent, Multi-Layer Perceptron, Convolutional Neural Networks, Autoencoders, and advanced architectures like transformers.
Grading: Standard Letter

AIHC 5615 Fundamentals of Statistics for Artificial Intelligence (2 Credits)
D. Harris (Fall) – This course will review basic concepts in statistics, specifically with regards to hypothesis testing for a variety of experimental designs regression techniques as useful statistical modeling approach, practical examples using the selected concept, and presentation of findings. The focus of this course will be in the implementation of software code to complete the model development, assessment of the statistical model utility, and visualization of the performance.
Grading: Standard Letter

AIHC 5960 Introduction to Medical Informatics (2 Credits)
V. Herasevich, B. Pickering (Fall) – This course is intended to provide an introduction to the principles of medical and clinical informatics. Information science (IS) and Information Technology (IT) is now playing a major role in clinical medicine and research studies, from managing data to integration of data, information, and knowledge. Information infrastructure, guided by appropriate principles and expertise, could determine the success or failure of a study.
Grading: Standard Letter

AIHC 5961 Health Information Technology Evaluation: Clinical Informatics Methods (1 Credit)
V. Herasevich, B. Pickering (Winter) – Governments and clinical providers are investing in health information technologies with little evidence as to their ultimate value. For years, health information technology (HIT) has been implemented with the goals of improving clinical care processes, health care quality, and patient safety. A systematic approach to the evaluation and testing allows for comparison of different HIT interventions with the goal of promoting those which improve clinical care and outcomes. In addition, structured evaluations of a projects impact are an essential element of the justification for investment in HIT. The question of the day is no longer "why perform evaluations," but "how to perform evaluations." This course will present basic concepts, theory, and methods associated with HIT evaluation. Special topics include structure of studies, measurement fundamentals, design of demonstration studies, analyzing results of evaluation, proposing and communication results of evaluation studies, guidelines and reference standards.
Grading: Standard Letter

AIHC 5962 Clinical Surveillance, Alerting, and Data Representation (1 Credit)
V. Herasevich, B. Pickering, A. Bhattacharyya (Winter) – Electronic Health Records are designed to improve patient health care and information management. Traditionally organized as databases, modern EMRs still lack deep integration with related workflows and decision support system available in other industries rather than healthcare. Clinical systems divert attention to serious medical situations by delivering notifications to the right place, at the right time, and to right person. However, further development is needed. On other hand, clinical data representation in current EMR solutions utilized standard controls and frameworks with 30+ years legacy. This course is designed to provide fundamental knowledge for understanding clinical surveillance and alerting systems, as well as modern clinical data visualization approaches.
Grading: Standard Letter

AIHC 5963 Health Information Security (1 Credit)
V. Herasevich, P. Zummo (Spring) – Increased access to advances in information technology enhances healthcare opportunities. However, it also presents significant threats to personal information and confidential data. Improved access, along with developing and implementing new technology, has made cybersecurity one of the most emerging industries and disciplines. A cyberattack on a hospital could not only compromise operations, but also endanger patient care which has become increasingly dependent on information technology. This course will provide introductory knowledge, theory, and methods associated with Information Security including policy, procedures, architectures, and risk assessment and focuses on strategical thinking to address cybersecurity challenges in healthcare context.
Grading: Standard Letter

AIHC 5964 AI & HIT Implementation (1 Credit)
V. Herasevich, B. Pickering (Spring) – Improved healthcare delivery and patient outcomes are the ultimate goals of software applications in healthcare. However, beside evaluation of impact that applications appropriate translation to clinical practice is critical task. This course is designed for people that are new to project management and give a solid foundation of implementation process.
Grading: Standard Letter

AIHC 6000 Independent Study in Artificial Intelligence in Healthcare (1-3 Credits)
D. Holmes (Fall, Winter, Spring, Summer) – Independent studies are arranged on an individual basis in selected advanced topics in artificial intelligence in healthcare. Learners are expected to define a topic area and parameters in consultation with a member of the teaching faculty and/or the program director. Specific assessments may vary but are required to demonstrate mastery of the topic. Independent studies are intended to emphasize laboratory/project-based learning (augmented with lecture/book content); this is in comparison to Tutorials which are intended to be primarily theoretical discussions on a topic (augmented with homework/labs). In addition to individual assignments for the course, students will be expected to submit a summary of their learning experience as a final assignment for review by the AIHC Executive Committee.
Grading: Sat / Unsat

AIHC 6020 Data Curation in Healthcare (2 Credits)
N. Braun (Summer, Winter) – Data is required by all applications big and small. Data in Healthcare has been generated inside of departments and other organizations, often in unique and unrelated data models. This has resulted in data silos that have prevented that data from achieving full value to patients, providers, administrators, payers, and researchers. This course introduces the concept of data in all of its representations with emphasis on data models and the various Databases in contemporary usage and includes the curation and governance of that data. Data supports Healthcare applications for patient care, administration, public health reporting, research, utilization reporting and planning, and claims management. Healthcare data has a need to be cataloged, curated and governed to ensure that it is accurate, useful, and protected. Processes involved in the curation of data include data collection, validation, cleansing, transformed, translated, secure, reliable, and understood by all parties. Over the course of twelve lectures and labs, we will explore data and databases, the importance of data curation, the different methods for achieving curated information, the security of that information, and the techniques used to curate the data used in Healthcare today. This course will utilize labs for hands-on experiences related to the merging, transforming, filtering, and protecting data that makes up the healthcare environments for today and tomorrow.
Grading: Standard Letter

AIHC 6150 Special Topics: Generative AI Advanced Solutions Lab (2 Credits)
K Schultz, S Reddy, D Holmes (Fall) - Gen AI is a fast-evolving field in ML with many applications in healthcare. The objective of this course is to deliver the following skills: • Understanding of the key concepts of Generative AI • Google Cloud Generative AI Products • Methods to build and tune Large Language Models (LLMs) and Image Generative Models This Advanced Solutions Lab (ASL) course will be offered to those who already have advanced competency in machine learning concepts and want to advance their knowledge in Generative AI. This offering will explain some fundamental concepts in Generative AI, and introduce Google Cloud to build Generative AI based applications. NOTE: This course requires instructor approval and enrollment is limited. The course is not being offered in the standard format. The course is offered over a short time window. Synchronous participation is required. No exceptions will be given and students are responsible for managing their time accordingly.
Grading: Sat / Unsat

AIHC 6300 Certificate Capstone Project (1 Credit)
D. Holmes (Fall, Winter, Spring, Summer) – For artificial intelligence in health care (AIHC) certificate students only. Registration typically occurs for the spring quarter. Completion of the capstone project is required for successful completion of the certificate program. The topic is chosen by students and is based on their specific interest with appropriate guidance from the assigned mentor and/or program director. This course may only be taken once for credit.
Grading: Sat / Unsat

AIHC 6500 Tutorial in Artificial Intelligence in Healthcare (1-3 Credits)
D. Holmes (Fall, Winter, Spring, Summer) – Tutorials are arranged on an individual basis in selected advanced topics in artificial intelligence in healthcare. Learners are expected to define a topic area and parameters in consultation with a member of the teaching faculty and/or the program director. Specific assessments may vary but are required to demonstrate mastery of the topic. Tutorials are courses which are intended to be primarily theoretical discussions on a topic (augmented with homework/labs); this is in comparison to Independent Studies are intended to emphasize laboratory/project-based learning (augmented with lecture/book content). In addition to individual assignments for the course, students will be expected to submit a summary of their learning experience as a final assignment for review by the AIHC Executive Committee.
Grading: Sat / Unsat