



## **Graduate Certificate in Artificial Intelligence in Medicine**

This proposed certificate will provide opportunities for current graduate students in Biomedical Science, Engineering and Computer Science, and other disciplines to enhance their skills in the emerging field of Artificial intelligence (AI) in medicine.

### **Background**

The use of AI in medicine is poised to explode over the coming decades. AI has the potential to transform both the practice of medicine and the delivery of healthcare in the United States. AI applications in diagnostic assistance, personalized medicine, drug discovery, and prognostic and predictive analysis will increase efficiency, improve accuracy, enhance patient care, and reduce future medical costs. Driving the need for investment in AI in medicine is the growing amount of medical data generated by whole-genome and other types of next-generation sequencing technologies. Finding meaning and patterns from trillions of gigabytes of data will require AI. In addition, the combinations of global threats, such as an aging population and shortage in medical workers, mean that we need innovative solutions to address these problems, solutions that can be delivered with the aid of AI.

By exposing students with biomedical backgrounds to AI approaches and exposing engineering and computing science students to genetics, multi-omics, pharmacology, genomics, and predictive medicine concepts, we can train the next generation of specialists in AI in medicine. This certificate will ensure we have a population of graduates with the requisite skills to contribute to technologies that enhance healthcare delivery through integration of AI in all aspects of the medical industry.

### **Strengths at FAU**

The College of Medicine and College of Engineering and Computer Science currently have more than 40 faculty engaged in various areas of genetics, genomics, predictive health, AI, and machine learning. Faculty from both colleges have extensive experience teaching graduate students, and all courses that make up this certificate are already being taught to graduate students at present.

This program offering dual specialization is timely and will strengthen existing collaborations between the College of Medicine and College of Engineering and Computer Science, as well as create new opportunities for interaction and development of graduate education programs.

### **Market/Need**

Job demand for individuals with skills in AI in medicine is rapidly growing. According to the [towardshealthcare.com](https://towardshealthcare.com) website, the AI in medicine market is projected to reach \$674.19 billion by 2034, growing from \$37.98 billion in 2025. There is already a demand for machine learning engineers and data scientists among other specialties.

## **Resources**

All the required resources, including staff, faculty, courses, and infrastructure are currently in place in both colleges, and no new resources are needed to implement this certificate program.

## **Admission requirements**

Admission to and completion of this program will be overseen by the College of Medicine and College of Engineering and Computer Science. For admission, the applicant must satisfy the following criteria:

1. Enrollment in a master's or Ph.D. program in any FAU graduate program.
2. Approval of their graduate program to enroll.

## **Program Requirements**

The certificate program is designed to be tailored to the individual student, with previous coursework and future goals in mind. To complete the certificate, students must complete 12 credits in coursework, with six credits from the Department of Biomedical Sciences and six credits from the Department of Electrical Engineering and Computer Science (see below).

### **Complete 2 of the following courses in Biomedical Sciences (6 credits):**

#### **Human Genetics (PCB 6665) 3 credits**

*Prerequisite: Permission of instructor*

Designed to provide students with a functional understanding of the field of human genetics as it applies to progressive research and medicine. Emphasizes the integrated understanding and application of Genetic Analysis, Diagnosis and Mechanisms in human disease.

#### **Advanced Molecular and Cellular Biology (PCB 5532) 3 credits**

*Prerequisites: CHM 2210, PCB 4023, BCH 3033 and permission of instructor*

Course is designed to provide students with a basic background and advanced topics in cell and molecular biology. Emphasis is placed on human physiology and disease.

#### **Data Interpretation and Analysis in the Age of Precision Medicine – GMS 6860 - 3 credits**

Biomedical Science is a broad field comprising many applied sciences geared toward the development of new approaches in healthcare or public health. This unique College of Medicine course is designed for graduate students headed toward a broad array of postgraduate vocational opportunities in areas ranging from professional education, health care and scientific fields through business. Students are introduced to data interpretation, analysis and presentation approaches. Further, students are exposed to novel precision medicine concepts and database research.

#### **Integrating Genomics into Predictive Health (PCB 6667) 3 credits**

*Prerequisite: Permission of instructor*

The aim of this course is to introduce students to the emerging field of genomics, precision

medicine, and predictive health. Upon completion of the course students will gain a better understanding of the contribution of human genetic variation to pathogenic mechanisms and how technology helps us link the two.

### **Multi-omics in health and disease (PCB 6818) 3 credits**

*Prerequisite: Permission of instructor*

In the rapidly evolving fields of fundamental biology research and biomedicine, multi-omics studies combining genomics, transcriptomics, proteomics, and other modalities—are becoming increasingly prevalent. These integrative approaches, applied at both bulk and single-cell resolutions, have the power to identify novel biomarkers in disease and uncover the complex biological mechanisms within the context of health and disease.

### **Pharmacology (GMS 6513) 3 credits**

*Prerequisite: Permission of instructor*

This course introduces the study of the properties, effects and therapeutic value of the primary agents in major drug categories. Topics include cholinergic drugs, adrenergic drugs, hormones, diuretics, cardiovascular agents, respiratory drugs and gastrointestinal agents.

### **Advanced Cell Physiology (PCB 6207) 3 credits**

*Prerequisite: Permission of instructor*

Course describes in-depth membrane physiology, intracellular signaling pathways and cellular function, with an emphasis on neurons and human muscle cells (skeletal, smooth and cardiac muscle cells).

### **Molecular Basis of Human Cancer (PCB 6235) 3 credits**

*Prerequisites: Graduate standing and PCB 4023 or BCH 3033 or PCB 6207 with minimum grade of "B-"*

Course covers current concepts and knowledge of cancer, exploring the molecular and cellular mechanisms underlying cancer progression with an aim to understand the processes of tumorigenesis.

## **Complete 2 of the following courses in Electrical Engineering and Computer Science (6 credits):**

### **Computational Foundations of Artificial Intelligence (CAP 5625) 3 credits**

*Prerequisites: Graduate standing or senior standing*

This course covers the mathematical and programming foundations of artificial intelligence (AI) and machine learning (ML) using contemporary programming languages and tools. As a result, students develop familiarity with mathematical methods (and associated notation, software packages and libraries) that are widely used in AI and ML projects and literature. It is expected that students are proficient in a high level programming language.

### **Introduction to Data Science (CAP 5768) 3 credits**

*Prerequisite: Programming competency at the level of an online short course (e.g., Code*

*Academy)*

This course surveys foundational topics in data science and reinforces practical programming skills in the context of data analytics. Students learn fundamentals of computational data analysis using statistics and machine learning and gain experience working with data sets from a variety of domains. Students may not enroll in CAP 5768 if they have already taken CAP 4773.

**Computer Vision (CAP 6415) 3 credits**

*Prerequisite: Graduate standing*

Course covers fundamentals of computer vision and their applications in various areas such as medicine, homeland security, entertainment, and manufacturing.

**Applied Machine Learning (CAP 6610) 3 credits**

*Prerequisite: STA 2023*

This course covers theoretical foundations and tools for machine learning and data analytics. The class introduces major machine learning topics, such as supervised learning, unsupervised learning and numeric predictive models. Case studies include application of machine learning to different domains. Credit will not be given for both CAP 4612 and CAP 6610.

**Machine Learning for Computer Vision (CAP 6618) 3 credits**

*Prerequisite: CAP 5625*

Introduction to machine learning techniques and their application in computer vision problems. Discusses image processing principles, techniques and algorithms. Use of MATLAB for lab assignments and projects.

**Deep Learning (CAP 6619) 3 credits**

*Prerequisite: CAP 5625*

This course teaches students basic concepts of deep learning with applications in computer science, engineering, business and other areas. The class covers major topics including math preliminaries, machine learning basics, deep forward networks, convolution networks, autoencoders, representation learning networks and their implementations and applications.

**Reinforcement Learning (CAP 6629) 3 credits**

*Prerequisite: CAP 5625*

Students in this course study theoretical properties and practical applications of reinforcement learning. Course topics include Markov decision process, dynamic programming, temporal-difference learning, planning and learning with tabular methods, and deep reinforcement learning.

**Artificial Intelligence (CAP 6635) 3 credits**

The basic concepts, techniques, and applications of artificial intelligence: representations, search strategies, control, communication, deduction, agents, evolutionary computation and machine learning.

**Natural Language Processing (CAP 6640) 3 credits**

This course provides students with both theory and applications of natural language processing. It includes relevant background material in linguistics, mathematics, probability and computer science. Some of the topics covered in the class are text similarity, part-of-speech tagging, parsing, semantics, question answering, sentiment analysis and text summarization.

**Artificial Intelligence in Medicine and Healthcare (CAP 6683) 3 credits**

*Prerequisite: Graduate standing or permission of instructor*

This course introduces the underlying concepts, methods and potential of intelligent systems in medicine. It explores the application of artificial intelligence (AI) and machine learning methods, techniques and tools to specific areas in medicine and healthcare. As a research-and-project-based course, students have opportunities to identify and specialize in particular AI methods, clinical/healthcare applications and relevant tools.

## **CATALOG LANGUAGE**

**Graduate Certificate in Artificial Intelligence in Medicine**

The use of AI in medicine is poised to explode over the coming decades. AI has the potential to transform both the practice of medicine and the delivery of healthcare in the United States. AI applications in diagnostic assistance, personalized medicine, drug discovery, and prognostic and predictive analysis will increase efficiency, improve accuracy, enhance patient care, and reduce future medical costs. Driving the need for investment in AI in medicine is the growing amount of medical data generated by whole-genome and other types of next-generation sequencing technologies. Finding meaning and patterns from trillions of gigabytes of data will require AI. In addition, the combinations of global threats, such as an aging population and shortage in medical workers, mean that we need innovative solutions to address these problems, solutions that can be delivered with the aid of AI.

This certificate provides graduate students in all disciplines with advanced training in AI and medicine, preparing them for careers in research, healthcare, biotechnology, and industry.

**Admission requirements**

The graduate certificate in Artificial Intelligence in Medicine is open to all FAU graduate students. Admission to and completion of this program is overseen by the College of Medicine and College of Engineering and Computer Science. For admission, the applicant must satisfy the following criteria:

1. Enrollment in a master's or Ph.D. program in any FAU graduate program.
2. Approval of their graduate program to enroll.

## Curriculum

This certificate program is designed to be tailored to the individual student, with previous coursework and future goals in mind. To complete the certificate, students must complete 12 credits in coursework, with six credits from the Department of Biomedical Sciences and six credits from the Department of Electrical Engineering and Computer Science (see below).

Complete 2 of the following courses in Biomedical Sciences (6 credits total):

Course Title	Course Number	Credits
Pharmacology	GMS 6513	3
Data Interpretation and Analysis in the Age of Precision Medicine	GMS 6860	3
Advanced Molecular and Cellular Biology	PCB 5532	3
Advanced Cell Physiology	PCB 6207	3
Molecular Basis of Human Cancer	PCB 6235	3
Human Genetics	PCB 6665	3
Integrating Genomics into Predictive Health	PCB 6667	3
Multi-omics in health and disease	PCB 6818	3

Complete 2 of the following courses in Electrical Engineering and Computer Science (6 credits total):

Course Title	Course Number	Credits
Computational Foundations of Artificial Intelligence	CAP 5625	3
Introduction to Data Science	CAP 5768	3
Computer Vision	CAP 6415	3
Applied Machine Learning	CAP 6610	3
Machine Learning for Computer Vision	CAP 6618	3
Deep Learning	CAP 6619	3
Reinforcement Learning	CAP 6629	3
Artificial Intelligence	CAP 6635	3
Natural Language Processing	CAP 6640	3
Artificial Intelligence in Medicine and Healthcare	CAP 6683	3