Toronto AI School

Master Program in AI for Healthcare & Bioinformatics

Week 1 – Foundations of AI in Healthcare

Session	Topics Covered
Day 1 – Healthcare AI Landscape	- Introduction to AI in healthcare systems - Overview of hospitals, pharmacies, and clinical data systems - Electronic Health Records (EHR) fundamentals - Medical data types (clinical, imaging, genomics) - Healthcare AI opportunities in North America - Case Study: Mayo Clinic AI diagnostics systems - Case Study: Cleveland Clinic AI patient monitoring
Day 2 – Healthcare Data Engineering	- Healthcare data pipelines - Clinical data integration - Medical data cleaning and preprocessing - Healthcare interoperability standards (HL7, FHIR) - Data privacy regulations in healthcare - Case Study: Epic hospital EHR data systems - Case Study: Kaiser Permanente data infrastructure
Day 3 – AI Use Cases in Healthcare	- AI-powered disease prediction - Medical decision support systems - AI triage assistants - Remote patient monitoring - AI-powered hospital operations - Case Study: AI stroke detection systems - Case Study: hospital readmission prediction models

Week 2 – Machine Learning for Medical Data

Session	Topics Covered
Day 1 – Clinical Machine Learning	- Predictive models for patient risk - Clinical outcome prediction - Hospital resource prediction - Medical classification models - Healthcare anomaly detection - Case Study: hospital ICU prediction systems - Case Study: AI sepsis detection systems
Day 2 – Medical Data Analytics	- Clinical data analysis pipelines - Healthcare dashboards - Population health analytics - Clinical research analytics - Health insurance risk models - Case Study: UnitedHealth predictive analytics - Case Study: CDC disease trend analysis

Day 3 – Medical AI Tools	- Python libraries for healthcare AI - Healthcare machine learning pipelines - Clinical NLP systems - Medical data visualization - Healthcare AI experimentation - Case Study: NIH research AI systems - Case Study: AI models for patient outcome prediction

Week 3 – AI for Medical Imaging

Session	Topics Covered
Day 1 – Computer Vision in Healthcare	- Medical imaging fundamentals - AI for X-ray analysis - AI for CT scan interpretation - AI for MRI diagnostics - Image segmentation techniques - Case Study: Google DeepMind eye disease detection - Case Study: AI breast cancer detection models
Day 2 – Diagnostic AI Systems	- Automated radiology analysis - AI pathology systems - Medical image classification - AI-assisted surgical planning - Clinical decision support - Case Study: FDA approved diagnostic AI systems - Case Study: AI lung cancer screening tools
Day 3 – Medical Imaging Pipelines	- Imaging dataset preparation - Model training for imaging systems - Medical annotation workflows - Healthcare model evaluation - Deployment of imaging AI systems - Case Study: Stanford radiology AI systems - Case Study: AI skin cancer detection

Week 4 – AI for Drug Discovery & Bioinformatics

Session	Topics Covered
Day 1 – Bioinformatics Foundations	- Genomics data analysis - DNA sequencing technologies - Protein structure prediction - Biological data pipelines - Genomics databases - Case Study: Human Genome Project data systems - Case Study: 23andMe genetic data analysis
Day 2 – AI in Drug Discovery	- Drug discovery pipelines - AI molecule prediction - Protein-ligand interaction modeling - Pharmaceutical data analysis - AI drug candidate discovery - Case Study: Pfizer drug discovery AI - Case Study: Moderna vaccine development analytics

Day 3 – Computational Biology	- AI for genomics research - AI for protein folding - AI molecular simulations - Bioinformatics workflow automation - Biomedical data integration - Case Study: AlphaFold protein prediction - Case Study: cancer genomics research AI

Week 5 – AI in Hospitals

Session	Topics Covered
Day 1 – Clinical Decision Systems	- AI clinical support tools - Hospital triage systems - Patient diagnosis assistance - Medical recommendation engines - Clinical workflow automation - Case Study: IBM Watson healthcare systems - Case Study: Mayo Clinic AI diagnosis platform
Day 2 – Hospital Operations AI	- Hospital resource optimization - Bed management prediction - Emergency room prediction models - Patient flow optimization - Staff scheduling prediction - Case Study: hospital ER demand prediction - Case Study: healthcare logistics optimization
Day 3 – Remote Patient Monitoring	- AI patient monitoring systems - Wearable health data analytics - Chronic disease prediction - AI alert systems for clinicians - Remote care infrastructure - Case Study: Apple Health monitoring - Case Study: Fitbit health analytics

Week 6 – AI for Pharmacies

Session	Topics Covered
Day 1 – Pharmacy AI Systems	- AI prescription analysis - Drug interaction detection - Medication adherence monitoring - Pharmacy inventory prediction - Drug demand forecasting - Case Study: CVS pharmacy analytics systems - Case Study: Walgreens prescription prediction
Day 2 – Pharmaceutical Analytics	- Drug sales prediction models - Pharmacy supply chain analytics - Patient medication risk prediction - Drug recommendation systems - Pharmacy AI dashboards - Case Study: pharmaceutical logistics AI - Case Study: retail pharmacy demand forecasting

Day 3 – Medication Safety AI	- AI drug error detection - Prescription fraud detection - Pharmacy fraud monitoring - Drug safety prediction - Pharmacy compliance analytics - Case Study: insurance medication fraud detection - Case Study: healthcare billing analytics

Week 7 – Natural Language Processing in Healthcare

Session	Topics Covered
Day 1 – Clinical NLP	- NLP for clinical notes - Medical text classification - Healthcare document summarization - Patient record analysis - Clinical language models - Case Study: AI medical transcription systems - Case Study: hospital documentation automation
Day 2 – AI Assistants for Doctors	- AI doctor copilots - Clinical question answering systems - AI diagnosis assistants - Patient communication assistants - Medical chatbot systems - Case Study: Microsoft healthcare copilots - Case Study: hospital patient support chatbots
Day 3 – Medical Knowledge Systems	- Medical knowledge graphs - Clinical decision knowledge bases - AI medical search systems - Healthcare knowledge retrieval systems - Medical RAG architectures - Case Study: clinical knowledge assistants - Case Study: hospital AI documentation search

Week 8 – Healthcare AI Compliance

Session	Topics Covered
Day 1 – Healthcare Regulations	- HIPAA compliance requirements - Patient privacy protection - Medical data security - Healthcare governance frameworks - Ethical AI in healthcare - Case Study: HIPAA data breach investigations - Case Study: hospital data governance systems
Day 2 – Responsible Medical AI	- Bias in healthcare AI - Clinical model validation - Healthcare AI audit frameworks - Regulatory approval processes - Medical AI risk assessment - Case Study: FDA approval for AI diagnostics - Case Study: clinical AI validation studies

Day 3 – AI Security in Healthcare	- Securing medical AI systems - Healthcare cyber threats - Medical data encryption - Secure hospital AI deployment - Healthcare infrastructure security - Case Study: hospital ransomware attack - Case Study: healthcare cybersecurity defense

Week 9 – AI Product Development for Healthcare

Session	Topics Covered
Day 1 – Healthcare AI Platforms	- Designing AI healthcare platforms - Healthcare SaaS products - Clinical AI APIs - Medical data platforms - AI healthcare startups - Case Study: telemedicine AI platforms - Case Study: AI health analytics startups
Day 2 – Healthcare AI Infrastructure	- Cloud AI for healthcare systems - Healthcare data architecture - Medical ML pipelines - AI system scalability - Healthcare platform monitoring - Case Study: Google Health AI systems - Case Study: Amazon healthcare analytics
Day 3 – Healthcare Innovation	- AI startups in healthcare - AI hospital transformation - Future of AI medicine - Digital health innovation - AI research opportunities - Case Study: AI radiology startups - Case Study: biotech AI platforms

Week 10 – Capstone Healthcare AI Projects

Session	Topics Covered
Day 1 – Clinical AI System	- Build disease prediction model - Design patient risk prediction system - Create clinical decision support tool - Build healthcare NLP assistant - Deploy healthcare ML pipeline - Project: hospital readmission prediction - Project: AI patient triage system
Day 2 – Bioinformatics AI	- Build genomics analysis pipeline - Design protein prediction model - Develop drug discovery analytics - Create genomics visualization dashboard - Build bioinformatics data pipelines - Project: cancer genomics analysis - Project: drug discovery ML system

Day 3 – Healthcare AI Startup	- Build healthcare AI SaaS product - Design telemedicine AI assistant - Create pharmacy analytics platform - Deploy healthcare API system - Present healthcare AI innovation - Project: pharmacy demand prediction AI - Project: medical chatbot assistant