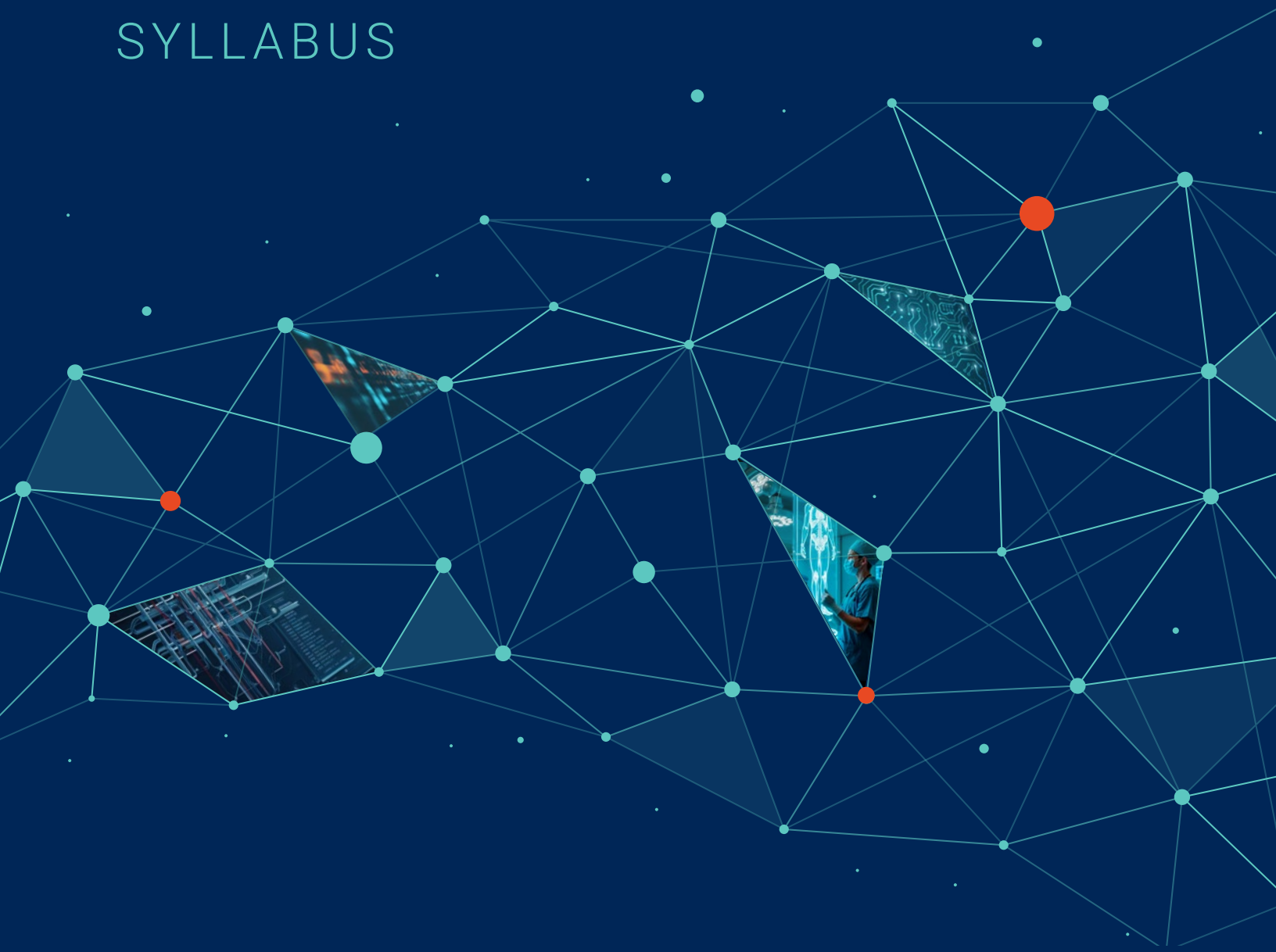
AI Passport
FOR BIOMEDICAL AND CLINICAL RESEARCH

AI Passport for Biomedical and Clinical Research

SYLLABUS



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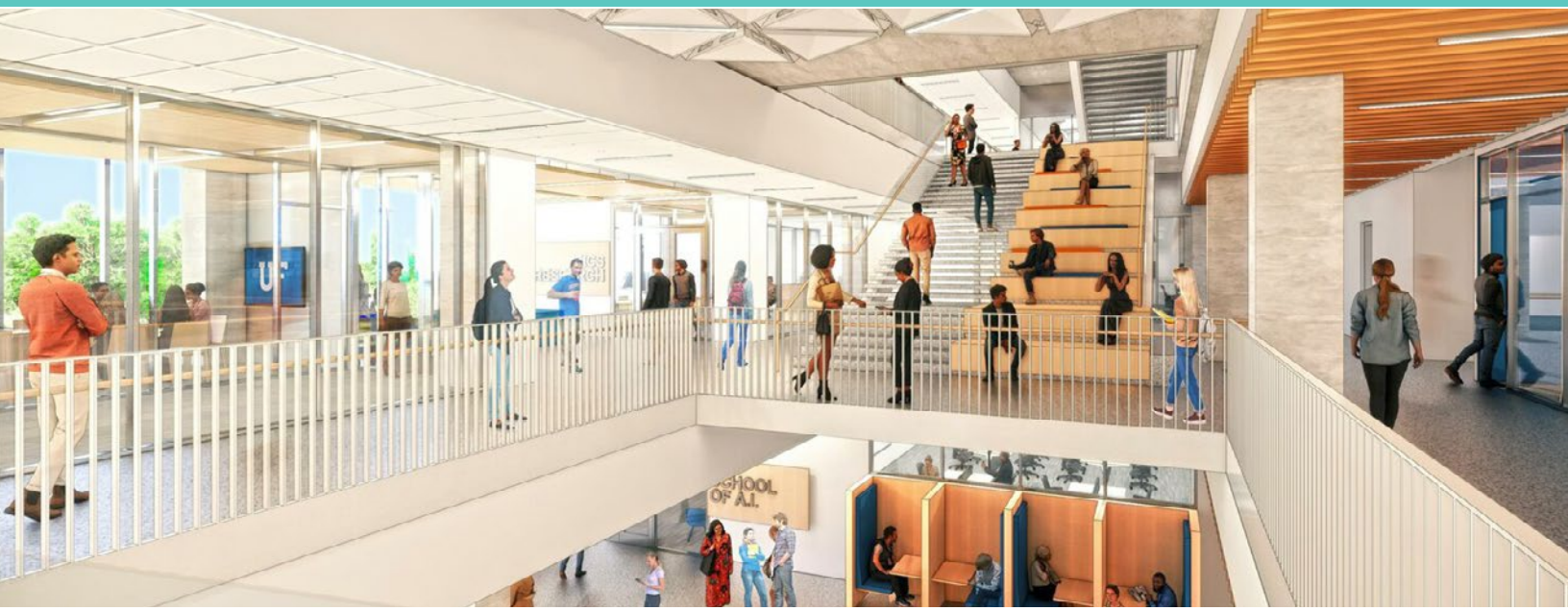
Your Learning Journey



INTRO

LESSONS PLANS

Funded by the **NIH IPERT program**, the AI Passport is a national initiative to rapidly upskill healthcare providers and biomedical and clinical researchers with the foundations of artificial intelligence.

Across this 16-week program, you will build a shared vocabulary of AI, explore the ethical and regulatory landscape, strengthen your ability to design and evaluate experiments, and gain hands-on experience with biomedical data, imaging, machine learning, deep learning, and generative AI. Through peer collaboration, expert mentorship, and a culminating impact project, you will practice applying these skills to real-world healthcare challenges—equipping you to responsibly integrate AI into your own research and clinical practice.

From fundamentals to real-world projects, this program equips you to integrate AI into biomedical research and healthcare practice.

We are the last generation of doctors who trained without AI — and the first to imagine what comes next.

Welcome to the AI Passport.

We designed this program to prepare the biomedical and clinical research community for the era of AI. Alongside my colleagues, I'm excited to guide you in building the skills, practices, and perspectives that will help you lead in this transformation.

Azra Bihorac, MD, MS, is the Senior Associate Dean for Research Affairs at the University of Florida College of Medicine and Director of the Intelligent Clinical Care Center. A physician, researcher, and educator, she is internationally recognized for advancing biomedical AI and reimagining how the next generation of clinicians and scientists will train in the AI era.

What's Inside

- **7 modules** covering wide range of AI domains
- **49** video lessons
- Hands-on practice with real biomedical data
- No coding required
- "Reveal" recorded demos walk you through solutions

Learn with Peers, Guided by Experts

Expert Facilitators

Our AI Expert Coaches guide discussions, foster peer connections, and provide feedback on your assignments. They'll help you apply concepts, answer questions, and make sure you get the most out of each week's learning experience.

Course Community

You'll learn alongside a cohort of healthcare professionals, researchers, and peers who share your interest in biomedical AI. Through discussions, peer reviews, and live calls, you'll build valuable connections, share insights, and support each other's growth throughout the course.

What Others Are Saying

Very pertinent for today's clinicians.

Healthcare professional

The program will help me make better use of AI in my work.

Clinical researcher

This course showed me how AI can support healthcare management tasks I face every day.

Healthcare administrator

With the program, I can already see how patient outcomes will be improved.

Physician participant

Learning Experience

Each module follows the SPACER framework — a cycle of seeing, practicing, sharing, and reflecting that turns concepts into real skills

See

Watch short videos and interactive sessions that introduce AI concepts with real-world biomedical examples.

Practice

Work through guided notebooks and projects using real datasets — no coding required.

Reflect

Capture your insights in digital journals and tie your learning back to your own research and career.

Share

Connect with peers and AI coaches in live community calls and peer reviews to exchange ideas and feedback.

This approach is based on Kolb's experiential learning theory and adapted for biomedical AI education

Fundamentals of **Biomedical AI Research**

After this course, you'll be able to…

Explain and apply the foundations of biomedical AI, including core methods in data, machine learning, imaging, and generative AI, while recognizing opportunities, limitations, and ethical responsibilities.

Design and evaluate biomedical AI experiments that ensure rigor, reproducibility, fairness, and generalizability across diverse populations and healthcare settings.

Practice responsible data stewardship by sourcing, annotating, protecting, and sharing biomedical data ethically and securely across institutions.

Collaborate and communicate effectively in multidisciplinary teams, engaging in mentorship, peer review, and community feedback to advance sustainable AI research.

Translate knowledge into impact by developing and presenting a real-world biomedical AI project that demonstrates innovation, responsibility, and clinical relevance.

MODULE **01**

Fundamentals of **Biomedical AI Research**

Outcomes & Lesson Plan

2 WEEKS

5.5 HOURS PER WEEK

VIEW COURSE

Meet the Faculty Behind Module 1

This module was created by University of Florida faculty across medicine, engineering, and data science. Together they designed the videos, notebooks, and exercises you'll use to build your AI skills.

Ashish Aggarwal, MS

Guides you through demystifying AI and exploring how biomedical AI projects are designed, from defining clinical problems to building research frameworks.

Benjamin Shickel, PhD

Introduces the fundamentals of artificial intelligence and the AI lifecycle, showing how problems become solutions through data, modeling, and MLOps.

Rhonda Bacher, PhD

Teaches how to design experiments and evaluate models through training, validation, and generalizability, helping you understand what makes results reliable.

Tezcan Ozrazgat-Baslanti, PhD

Explains the principles of scientific rigor and reproducibility, sharing strategies for planning, analyzing, and interpreting studies with confidence.

Tyler Loftus, MD PhD

Shows how diverse teams work best together, highlighting the value of communication, collaboration, and multidisciplinary strengths in biomedical AI research.

Elizabeth Palmer, PhD

Helps you navigate mentorship and peer review in AI research, offering practical guidance for building ethical, supportive professional relationships.

5.5 HRS

Week 1
Core Concepts

Learn how to build a shared vocabulary for biomedical AI, explore the AI lifecycle, and design and evaluate AI experiments.

Lesson 1:
Foundations of Biomedical AI

Build a shared vocabulary for biomedical AI, recognize its opportunities and limitations, and understand the full AI project lifecycle—from defining clinical problems to developing and deploying models.

Lesson 2:
Designing Biomedical AI Experiments

Understand how to design biomedical AI experiments, from identifying datasets and research questions to planning controls and data management. Learn how to train, validate, and assess generalizability of models.

4 Videos

Demystifying AI
Learn what artificial intelligence really is, how it works, and where it succeeds or fails in biomedical contexts.

The AI Lifecycle
Follow the journey of an AI project from problem definition through deployment and understand how MLOps supports sustainable systems in healthcare.

Designing Biomedical AI Experiments
Explore how biomedical AI experiments are set up, from choosing datasets to managing data quality and ethics.

Training, Validation, and Generalizability
Discover how AI models are trained and validated, and why generalizability across populations and settings is essential.

1 Assignment

Practice notebooks – AI in action

Notebook 1: Demystifying AI Vision
(image recognition and model confidence)

Notebook 2: AI Decision Systems
(games, predictions, and tradeoffs)

Notebook 3: Text-to-Insight
(Natural language processing applied to clinical text)

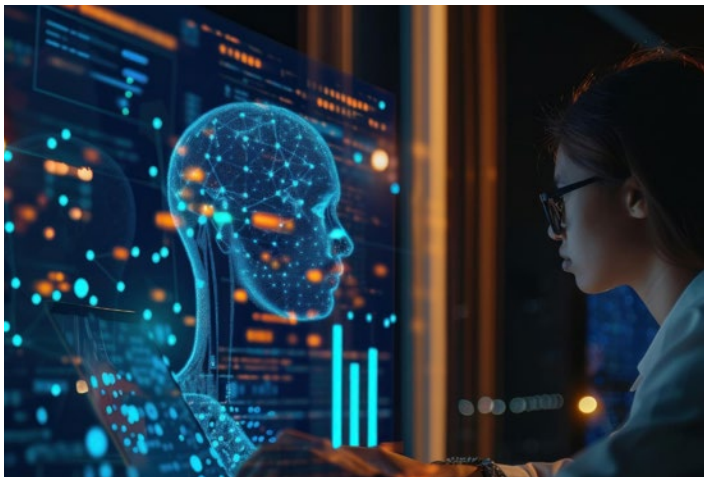
Notebook 4: Statistical Power Visualizer
(study design, power, and sample size)

1 Office Hour with AI expert coaches

Engage with expert coaches to clarify course concepts and explore topics of interest in greater depth.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.



5.5 HRS

Week 2
Responsible and Collaborative AI Research

Learn how to work effectively in interdisciplinary teams, apply principles of rigor and reproducibility, and navigate ethical responsibilities in mentorship and peer review.

Lesson 3:
Collaboration and Team Science in Biomedical AI

Recognize the value of interdisciplinary collaboration, practice strategies for leveraging team strengths, and apply principles of scientific rigor and reproducibility to ensure reliable and generalizable research outcomes.

Lesson 4:
Ethics, Mentorship, and Peer Review in Biomedical AI

Explore the ethical dimensions of AI in healthcare, strengthen your ability to navigate mentor–mentee relationships, and practice fair, constructive, and confidential peer review to support high-quality biomedical AI research.

3 Videos

Leveraging Multidisciplinary Team Strengths
Learn how diverse expertise strengthens biomedical AI teams and how to foster inclusive, collaborative practices.

Scientific Rigor and Reproducibility
Understand the principles of rigorous study design, reproducibility, and transparency in biomedical AI.

Mentorship and Peer Review
Learn how to navigate mentor–mentee relationships and conduct ethical, constructive peer review.

1 Assignment

Practice notebooks – Responsible AI in practice

Notebook 5: Outlier Detection Explorer
(clustering and anomaly detection in biomedical data)

Notebook 6: Moral Machine
(ethical dilemmas in automated decision-making)

Notebook 7: Mentorship & Peer Review Scenarios
(evaluating integrity in biomedical AI research)

5 Reflection questions

Use these questions to guide your reflection journal. Focus on connecting course concepts to your own research, clinical work, or professional goals.

1. When defining an AI problem in your field, what assumptions or biases might shape your approach?
2. Where in the AI lifecycle do you see your greatest opportunity for growth as a researcher?
3. How would you test whether your work is truly rigorous and reproducible?
4. What ethical dilemmas could arise in applying your AI ideas to real patients or data?
5. How has feedback from peers or mentors changed the way you think about responsible AI research?

1 Community Call with AI expert coaches

Participate in live sessions to reflect on your learning progress, engage in guided discussions, and contribute to the community of peer learners.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

MODULE **02**

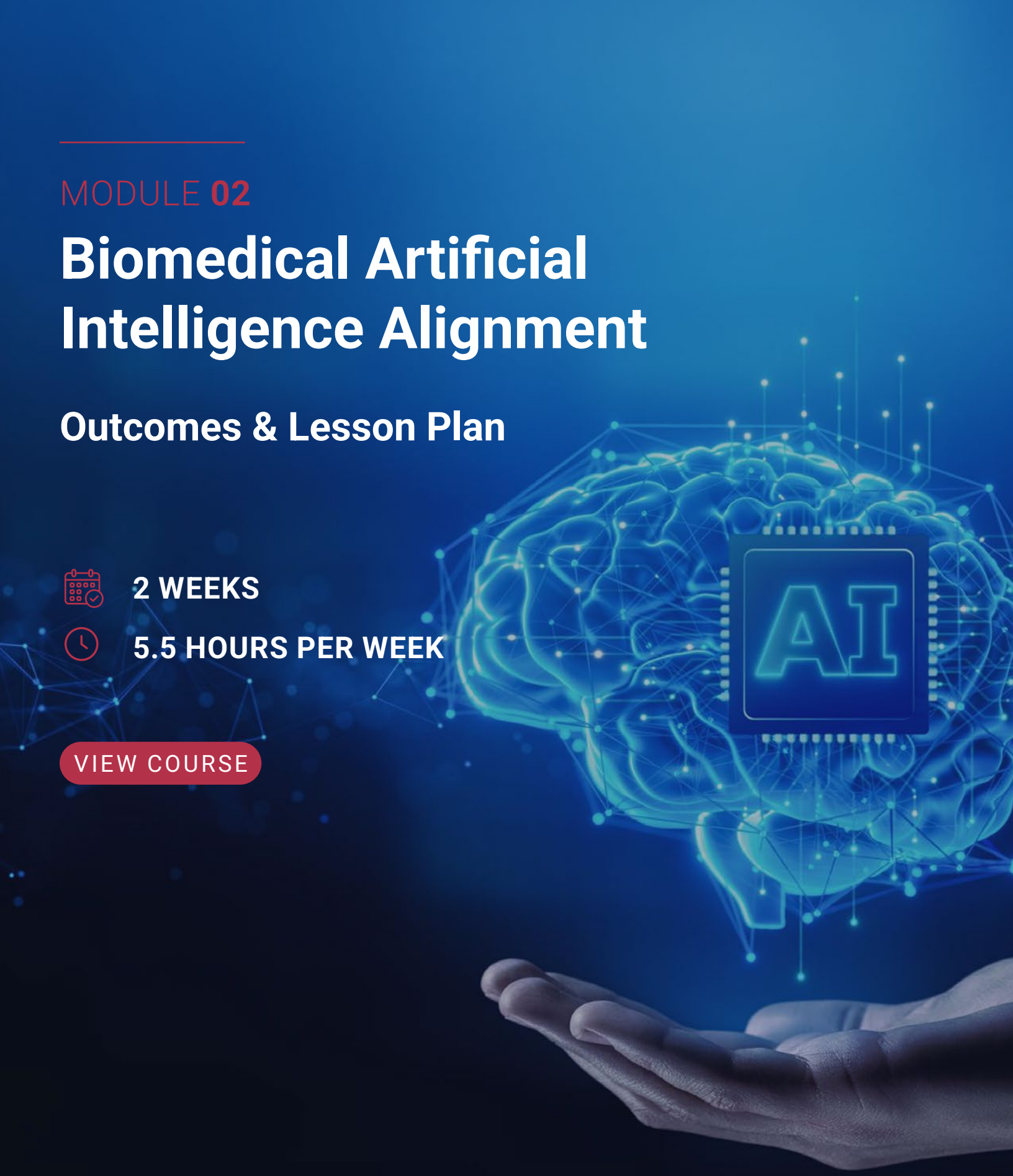
Biomedical Artificial Intelligence Alignment

Outcomes & Lesson Plan

2 WEEKS

5.5 HOURS PER WEEK

VIEW COURSE



Meet the Faculty Behind Module 2

This module was created by University of Florida faculty with expertise in medicine, law, engineering, and communication. Learners explore how ethics, fairness, and regulation guide responsible biomedical artificial intelligence.

Elizabeth Palmer, PhD

Helps learners apply core bioethical principles and safety standards to ensure biomedical artificial intelligence is trustworthy, patient-centered, and responsibly designed.

Barbara Evans, JD, LLM, PhD

Equips learners to navigate legal and regulatory frameworks that govern biomedical artificial intelligence, from FDA oversight to liability and ethical compliance.

Jasmine McNealy, PhD, JD

Guides learners in identifying and mitigating bias in biomedical artificial intelligence to support fairness, transparency, and social responsibility.

Jeremy Balch, MD

Introduces methods for validating and monitoring biomedical artificial intelligence systems to ensure ongoing safety and clinical reliability.

Tezcan Ozrazgat-Baslanti, PhD

Demonstrates how inclusive data practices can reduce bias and improve the accuracy of biomedical artificial intelligence across diverse populations.

5.5 HRS

Week 1
Biomedical AI Alignment

Learn how ethics, regulation, fairness, privacy, and human–AI collaboration shape trustworthy biomedical AI systems.

Lesson 1:
Bioethics and Regulation in Biomedical AI

Examine how the core principles of bioethics and evolving regulatory frameworks shape the safe and fair use of AI in healthcare.

Lesson 2:
Bias, Fairness, and Privacy in Biomedical AI

Understand how bias, fairness, and privacy shape the societal impact of biomedical AI, and learn strategies to ensure trustworthy systems.

4 Videos

The Fundamental Principles of Bioethics
Learn how autonomy, beneficence, nonmaleficence, and justice guide the ethical design and use of biomedical AI.

The Regulatory Landscape of Biomedical AI
Discover how regulatory frameworks such as FDA approval and liability policies shape the safe and responsible deployment of biomedical AI systems.

Bias, Fairness, and Societal Impact
Explore how bias impacts biomedical AI, how fairness metrics and mitigation strategies are applied, and the societal consequences of misaligned systems.

Privacy in Biomedical AI
Understand the importance of protecting patient privacy, implementing data standards, and applying post-market surveillance to safeguard trust in AI systems.

1 Assignment

Practice notebooks –
Ethics, Regulation, and Fairness in AI

Notebook 1: Bioethics in Action
(bioethics in AI)

Notebook 2: Regulatory Checkpoint
(AI ethics in healthcare)

Notebook 3: Bias and Fairness Explorer
(AI bias and fairness)

Notebook 4: Privacy and Data Protection Lab
(biomedical data regulation)

1 Office Hour with AI expert coaches

Engage with expert coaches to clarify course concepts and explore topics of interest in greater depth.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

5.5 HRS

Week 2
Quality, Safety, and Collaboration in Biomedical AI

Learn how to evaluate biomedical AI for safety and reliability, strengthen collaboration between humans and AI systems, and account for biological and social variables that shape fairness and effectiveness.

Lesson 3:
Biomedical AI Quality and Safety

Understand how quality and safety metrics, continuous validation, and monitoring for adverse AI events ensure reliable and trustworthy biomedical systems.

Lesson 4:
Human–AI Collaboration and Biological Variables in Biomedicine

Explore how trusted human–AI teaming strategies support fairness, reliability, and effective outcomes in biomedical AI.

3 Videos

Biomedical AI Quality and Safety
Learn how continuous validation, monitoring, and safety metrics ensure reliable and trustworthy biomedical AI systems.

Human-AI Collaboration in Biomedicine
Discover how human-in-the-loop strategies, trusted teaming, and AI-augmented education enhance decision-making and accountability in healthcare.

Biological Variables in AI
Understand why variability in data acquisition are essential for fairness, generalizability, and reliability in biomedical AI outcomes.

1 Assignment

Practice notebooks – Responsible AI in practice

Notebook 5: Safety Metrics Lab
(data drift and model monitoring)

Notebook 6: Human–AI Teaming Explorer
(human-AI collaboration)

Notebook 7: Fairness Analyzer
(AI fairness analysis)

5 Reflection questions

Use these questions to guide your reflection journal. Focus on connecting course concepts to your own research, clinical work, or professional goals.

1. How do ethical or regulatory principles shape the way you approach AI in your field?
2. Where might bias or privacy concerns emerge in your own data or models?
3. What does “trustworthy AI” mean in the context of patient care?
4. How can you balance human judgment and AI input in decision-making?
5. What steps could you take to make your AI research or applications safer and more transparent?

1 Community call with AI expert coaches

Participate in live sessions to reflect on your learning progress, engage in guided discussions, and contribute to the community of peer learners.

2 Peer feedback moments

Provide feedback on two peers’ notebooks to strengthen their reasoning and application of course concepts.

MODULE **03**

Data-Centric Biomedical Artificial Intelligence

Outcomes & Lesson Plan

2 WEEKS

5.5 HOURS PER WEEK

VIEW COURSE

Meet the Faculty Behind Module 3

This module was created by University of Florida faculty to strengthen learner fluency in biomedical data quality, ethics, and preprocessing. Through videos, exercises, and peer reflections, learners build trustworthy, high-performance datasets.

Jie Xu, PhD

Helps learners apply core bioethical principles and safety standards to ensure biomedical artificial intelligence is trustworthy, patient-centered, and responsibly designed.

Tyler Loftus, MD, PhD

Explains how to ethically acquire biomedical datasets and navigate complex multi-institutional data sharing. Helps learners address privacy, autonomy, and collaboration through real-world implementation strategies.

Muxuan Liang, PhD

Teaches the role of human annotation and dataset readiness for machine learning. Supports learners in building reliable AI datasets through annotation consistency, inter-rater agreement, and bias reduction.

Elizabeth Palmer, PhD

Outlines best practices for secure and ethical data use, including deidentification and regulatory compliance. Helps learners strengthen trust in biomedical AI systems through transparent, ethical data handling.

5.5 HRS

Week 1

Biomedical Data for AI

Learn how data quality, sourcing, annotation, and governance shape the reliability of biomedical AI, and explore principles and practices that ensure secure use of datasets across institutions.

Lesson 1:
Data Foundations for Reliable & Ethical Biomedical AI

Understand how the quality and ethical sourcing of data are fundamental to building accurate biomedical AI models, impacting model performance and patient well-being.

Lesson 2:
FAIR Annotation: Enhancing Biomedical Data for AI

Explore how adhering to FAIR data principles and employing reliable human annotation techniques are crucial for maximizing the usability, interoperability, and performance of AI models in biomedical research.

4 Videos

The Importance of Data for Developing Biomedical AI
Understand how data issues like overfitting and underfitting affect model accuracy and reliability.

Acquiring Ethically Sourced Biomedical Data
Learn strategies to source data ethically, while respecting autonomy, justice, and beneficence.

Understanding the Role of Human Annotation
Explore annotation tools, rater reliability, and their impact on model performance.

Promoting FAIR Biomedical Data Principles
Define FAIR data principles, and understand how standards improve data sharing, integration, and management.

1 Assignment

Practice notebooks –
Foundations of Responsible Biomedical Data

Notebook 1: The importance of data for developing biomedical AI (AI data development)

Notebook 2: Acquiring ethically sourced biomedical data (ethical data sourcing)

Notebook 3: Understanding the role of human annotation (human annotation)

Notebook 4: Promoting FAIR biomedical data principles (FAIR data principles)

1 Office Hour with AI expert coaches

Engage with expert coaches to clarify course concepts and explore topics of interest in greater depth.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

5.5 HRS

Week 2

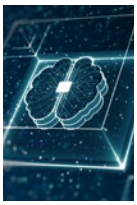
Biomedical Data Engineering for AI/ML

Learn to transform raw biomedical data into high-quality datasets ready for AI/ML applications, while navigating the complexities of data preprocessing, secure multi-institutional sharing, and patient privacy regulations.

Lesson 3:
Preparing Biomedical Data for AI/ML

Recognize the essential steps in data preprocessing and standardization – including outlier detection and imputation techniques – to create high-quality, AI/ML-ready biomedical datasets.

Lesson 4:
Collaborative & Secure Biomedical Data Sharing



Explore strategies and regulations surrounding the secure, ethical sharing of biomedical data and AI/ML models across institutions, balancing collaboration with robust patient privacy protections.

3 Videos

Developing AI/ML-Ready Biomedical Datasets
Learn to handle outliers, preprocessing, and imputation for clean biomedical datasets.

Developing AI/ML-Ready Biomedical Datasets
Explore secure methods for sharing data and models across institutions while protecting privacy.

Secure and Ethical Use of Biomedical Data
Understand informed consent, deidentification, and key privacy regulations in biomedical data.

1 Assignment

Practice notebooks –
Advancing Ethical Data Practices

Notebook 5: Developing AI/ML-ready biomedical datasets (AI/ML dataset development)

Notebook 6: Navigating multi-institutional data sharing challenges (Navigating multi-institutional data challenges)

Notebook 7: Secure and ethical use of biomedical data (Data protection ethics)

5 Reflection questions

Use these questions to guide your reflection journal. Focus on connecting course concepts to your own research, clinical work, or professional goals.

1. How do you decide whether your data are reliable and ethically sourced?
2. What steps can you take to improve data quality and reduce bias in your work?
3. How do you balance patient privacy with the need for open, collaborative data sharing?
4. What would trustworthy data governance look like in your setting?
5. How could you explain your use of biomedical data and AI clearly to patients or collaborators?

1 Community Call with AI expert coaches

Participate in live sessions to reflect on your learning progress, engage in guided discussions, and contribute to the community of peer learners.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

MODULE **04**

Fundamentals of Biomedical Machine Learning (ML)

Outcomes & Lesson Plan

2 WEEKS

5.5 HOURS PER WEEK

VIEW COURSE

Meet the Faculty Behind Module 4

This module was created by University of Florida faculty with expertise in statistics, biomedical engineering, and informatics. Through videos and applied activities, learners build and evaluate machine learning models for biomedical use.

Guoshuai Cai, PhD

Teaches fundamental machine learning and deep learning techniques for biomedical data. Helps learners apply classification, regression, clustering, and feature transformation to real-world problems.

Feifei Xiao, PhD

Introduces the shared vocabulary of machine learning and biostatistics, guiding learners through key concepts like supervised learning, unsupervised learning, features, and labels. Helps build a common foundation for cross-disciplinary collaboration.

Li Chen, PhD

Explains how to choose the right biomedical machine learning and deep learning models. Supports learners in selecting appropriate algorithms like decision trees, support vector machines, or neural networks based on task requirements.

Zhe He, PhD

Covers model evaluation metrics such as accuracy, sensitivity, and calibration, and explores the ethical implications of black-box models. Guides learners in using explainability tools like SHapley Additive exPlanations (SHAP) and Local Interpretable Model-agnostic Explanations (LIME) to foster trust in AI systems.

Tezcan Ozrazgat-Baslanti, PhD

Demonstrates how to assess and improve generalizability in biomedical AI. Helps learners identify overfitting, apply cross-validation, and design models that perform reliably across diverse datasets and populations.

5.5 HRS

Week 1

Machine Learning and Deep Learning Foundations

Learn key machine learning/deep learning (ML/DL) concepts, apply supervised and unsupervised learning, and identify models for biomedical AI problems.

Lesson 1:
Foundations of Biomedical Machine Learning

Learn core ML concepts and apply basics like classification, clustering, training, and feature extraction.

Lesson 2:
Selecting Biomedical Machine Learning and Deep Learning Models

Compare ML models (e.g., logistic regression, decision trees) and DL models (e.g., CNNs, RNNs, transformers) to choose the right fit for biomedical problems.

4 Videos.

Shared Biomedical AI Vocabulary
Learn how supervised and unsupervised learning, features, and labels create a shared foundation for biomedical AI.

Applied Fundamentals of Machine Learning and Deep Learning
Discover how classification, regression, clustering, and feature extraction shape the core processes of ML/DL.

Choosing the Right Biomedical Machine Learning Model
Learn how to compare models to select the right method for specific biomedical tasks.

Choosing the Right Biomedical Deep Learning Model
Explore how and when to effectively apply neural networks, convolutional neural networks, recurrent neural networks, and transformers to biomedical challenges.

1 Assignment

Practice notebooks – ML/DL Vocabulary, Fundamentals, and Model Selection

Notebook 1: Shared Biomedical AI Vocabulary (biomedical AI basics)

Notebook 2: Applied Fundamentals of ML and DL (biomedical ML techniques)

Notebook 3: Choosing ML Models (ML model comparison)

Notebook 4: Choosing DL Models (deep learning in biomedical research)

1 Office Hour with AI expert coaches

Engage with expert coaches to clarify course concepts and explore topics of interest in greater depth.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

5.5 HRS

Week 2

Evaluating, Generalizing, and Explaining AI Models

Learn how to evaluate model performance, ensure generalizability, and address fairness, accountability, and explainability in biomedical AI.

Lesson 3:
Evaluating Biomedical Machine Learning Models

Learn how to assess biomedical ML models using accuracy, sensitivity, specificity, area under the curve, and calibration, while exploring approaches to improve explainability.

Lesson 4:
Generalizability and Ethics of Black-Box AI

Learn how to test model generalizability and examine the challenges of black-box algorithms, including fairness, accountability, and explainability.

3 Videos

Evaluating Biomedical Machine Learning Models
Learn to assess models using accuracy, sensitivity, specificity, calibration, and explainability tools like SHapley Additive exPlanations (SHAP) and Local Interpretable Model-agnostic Explanations (LIME).

Model Generalizability
Understand how to design and validate models that generalize across datasets and populations.

Ethics of Black-Box Algorithms
Explore ethical concerns around fairness, accountability, and interpretability, and apply strategies for transparent AI models.

1 Assignment

Practice notebooks –
Advancing Ethical Data Practices

Notebook 5: Evaluating ML Models (model performance metric)

Notebook 6: Model Generalizability (model validation techniques)

Notebook 7: Ethics of Black-Box Algorithms (algorithmic fairness and accountability)

5 Reflection questions

Use these questions to guide your reflection journal. Focus on connecting course concepts to your own research, clinical work, or professional goals.

1. How would you choose an AI or ML approach to explore a question in your research or practice?
2. How would you decide whether a simpler or more complex model fits your goals best?
3. How would you test if your model works well across different patient groups or data sources?
4. How would you identify and address potential ethical or fairness concerns in your model?
5. How would you explain your model's insights and limitations to collaborators, clinicians, or patients?

1 Community Call with AI expert coaches

Participate in live sessions to reflect on your learning progress, engage in guided discussions, and contribute to the community of peer learners.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

MODULE **05**

Biomedical Image Analysis

Outcomes & Lesson Plan

2 WEEKS

5.5 HOURS PER WEEK

VIEW COURSE

Meet the Faculty Behind Module 5

This module was created by University of Florida faculty with expertise in statistics, biomedical engineering, and informatics. Through videos and applied activities, learners build and evaluate machine learning models for biomedical use.

Ruogu Fang, PhD

Introduces biomedical imaging modalities and traditional analysis methods, helping learners understand how to extract clinical insights from X-rays, MRIs, and other image types.

Pinaki Sarder, PhD

Explains core preprocessing and advanced image transformation techniques, including data augmentation and multimodal fusion, to improve image quality and prepare data for deep learning.

Wei Shao, PhD

Teaches traditional and AI-powered image analysis, including segmentation, classification, and object detection. Guides learners to build reproducible workflows for consistent analysis across datasets.

Ashish Aggarwal, MS

Covers ethical and privacy concerns in medical imaging, from deidentification to responsible data sharing. Supports learners in building compliant and secure imaging AI practices.

5.5 HRS

Week 1

Biomedical Imaging: From Modalities to Deep Learning

Explore biomedical imaging from core modalities and preprocessing to traditional analysis and deep learning methods for clinical and biomedical research.

Lesson 1:
Foundations of Biomedical Imaging: Modalities & Preprocessing

Understand key imaging modalities and learn preprocessing techniques to enhance image quality and prepare datasets for analysis.

Lesson 2:
Advanced Biomedical Image Analysis: Traditional Methods & Deep Learning

Compare traditional image analysis with deep learning approaches and evaluate their impact on biomedical research and clinical outcomes.

4 Videos.

Landscape of Biomedical Imaging
Describe the key biomedical imaging modalities and their roles in clinical diagnosis and research.

Biomedical Image Preprocessing and Transformation
Apply techniques like normalization, augmentation, and filtering to boost data quality and improve analysis accuracy.

Traditional Biomedical Image Analysis
Use methods like edge detection, segmentation, and feature extraction to identify patterns in imaging data.

Biomedical Computer Vision Applications
Apply techniques like object detection, classification, and segmentation to solve clinical and research imaging problems.

1 Assignment

Practice notebooks – Biomedical image analysis foundations

Notebook 1: Imaging Modalities Explorer (medical imaging basics)

Notebook 2: Preprocessing Lab (image preprocessing in biomedicine)

Notebook 3: Segmentation & Feature Extraction (image analysis methods)

Notebook 4: CNN Classifier (deep learning for images)

1 Office Hour with AI expert coaches

Engage with expert coaches to clarify course concepts and explore topics of interest in greater depth.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

5.5 HRS

Week 2

Next-Generation Biomedical Imaging: Ethics, Consistency, & Innovation

Understand biomedical image analysis for clinical and research applications: from advanced deep learning techniques and federated learning to reproducibility and ethical data handling practices.

Lesson 3:
Frontiers in Biomedical Image Analysis

Explore advancements in biomedical image analysis, including novel deep learning architectures, self-supervised learning, and federated learning, while critically evaluating their potential in clinical and research applications.

Lesson 4:
Generalizability and Ethics of Black-Box AI

Learn to establish consistency and reliability in biomedical image analysis through the implementation of standardized workflows, reproducible pipelines, and robust validation strategies across diverse datasets.

3 Videos

Advanced and Emerging Topics
Explore advanced biomedical imaging techniques: deep learning architectures, self-supervised learning, and federated learning.

Consistency in Biomedical Image Analysis
Apply standardized workflows and validation strategies for consistent, reproducible image analysis.

Ethical and Privacy Implications of Biomedical Imaging
Understand how to protect patient privacy using de-identification tools, ethical guidelines, and secure data-sharing practices.

1 Assignment

Practice notebooks –
Building Ethical and Reproducible AI

Notebook 5: Multimodal Fusion & AI Model Innovation Lab (advanced AI techniques)

Notebook 6: Reproducibility Workflow Builder (workflow validation)

Notebook 7: Ethical Data Handling & Secure Sharing Simulation (secure data handling)

5 Reflection questions

Use these questions to guide your reflection journal. Focus on connecting course concepts to your own research, clinical work, or professional goals.

1. How would you decide which imaging modality best fits your research or clinical question?
2. How would you use preprocessing or feature extraction to improve image quality in your data?
3. How would you compare traditional image analysis methods with deep learning for your area of work?
4. How would you apply reproducible and ethical workflows when working with biomedical images?
5. How would you balance AI innovation in imaging with the need for patient privacy and data integrity?

1 Community Call with AI expert coaches

Participate in live sessions to reflect on your learning progress, engage in guided discussions, and contribute to the community of peer learners.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

MODULE **06**

Generative AI in Biomedicine

Outcomes & Lesson Plan

2 WEEKS

5.5 HOURS PER WEEK

VIEW COURSE

Meet the Faculty Behind Module 6

This module was created by University of Florida faculty with expertise in computer science, engineering, informatics, and medicine. Learners explore how generative artificial intelligence supports biomedical innovation while upholding ethical and reproducible practices.

Ashish Aggarwal, MS

Outlines techniques to evaluate generative AI outputs for consistency and reproducibility. Supports learners in building transparent and reliable workflows.

Benjamin Shickel, PhD

Explains the structure and function of large language models. Guides learners in applying transformer-based models to biomedical natural language processing tasks.

Akshith Ullal, PhD

Addresses ethical considerations in AI-generated biomedical content and teaches prompt-engineering strategies, helping learners manage risks and design effective, context-aware prompts.

Scott Siegel, PhD

Demonstrates the use of generative models and large language models in healthcare, including synthetic data generation, medical text and image reporting, and the automation of literature reviews and hypothesis generation to accelerate biomedical research.

5.5 HRS

Week 1

Foundations of Generative AI and Large Language Models

Learn how generative AI and large language models (LLMs) are used in biomedicine, build prompt design skills, and understand their potential and limits in healthcare.

Lesson 1:
Foundations of Generative AI and Large Language Models

Learn how generative adversarial networks, variational autoencoders, and transformers can power generative AI, and how they compare to traditional methods in biomedicine.

Lesson 2:
Applying and Optimizing Large Language Models in Biomedicine

Apply large language models (LLMs) for biomedical tasks like report generation and summarization and enhance performance with tailored prompt strategies.

4 Videos.

Fundamentals of Generative Biomedical AI
Learn how generative adversarial networks and variational autoencoders help synthesize data and empower new uses in healthcare.

Fundamentals of Large Language Models
Discover how transformers and self-supervised learning power LLMs and compare their performance to traditional methods.

Large Language Models in Biomedicine
Explore how LLMs support biomedical tasks, such as medical image report generation, text summarization, and information retrieval.

Prompt Engineering for Biomedical Applications
Learn how to design effective prompts using zero-shot, few-shot, chain-of-thought, and automated prompting techniques to optimize biomedical LLM performance.

1 Assignment

Practice notebooks – Generative AI Foundations

Notebook 1: Fundamentals of Generative Biomedical AI (generative AI basics)

Notebook 2: Fundamentals of Large Language Models (advanced LLM models)

Notebook 3: LLMs in Biomedicine (Biomedical text summarization)

Notebook 4: Prompt Engineering for Biomedical Applications (effective prompt crafting)

1 Office Hour with AI expert coaches

Engage with expert coaches to clarify course concepts and explore topics of interest in greater depth.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

5.5 HRS

Week 2
Large Language Modules and Reproducibility in Biomedicine

Learn how to apply LLMs to accelerate biomedical research, evaluate the reproducibility of AI-generated data, and navigate the ethical responsibilities of disseminating AI-generated biomedical content.

Lesson 3:
Utilizing Large Language Models for Accelerating Biomedical Research

Recognize how LLMs can accelerate biomedical discovery, practice strategies for automating literature review and hypothesis generation, and apply them to support efficient knowledge synthesis.

Lesson 4:
Evaluation and Reproducibility of AI-Generated Data

Explore methods for evaluating the reliability of AI-generated biomedical outputs, strengthen your ability to apply benchmarks and reproducibility standards, and practice strategies for ensuring transparency and consistency in generative AI research.

3 Videos

Utilizing LLMs for Accelerating Biomedical Research
Understand how LLMs can be applied to automate literature reviews, hypothesis generation, and disseminate contextual information to advance research workflows.

Evaluation and Reproducibility of AI-Generated Data
Learn how to evaluate AI-generated data with benchmarks, ensure transparent and consistent generation, and manage variability through reproducibility checks.

Ethical Dissemination of Generated Biomedical Content
Examine the ethical challenges of synthetic data, including bias, transparency, and responsible disclosure when sharing generative AI outputs in biomedical contexts.

1 Assignment

Practice notebooks – Responsible Generative AI

Notebook 5: Utilizing LLMs for Accelerating Biomedical Research (biomedical data interpretation)

Notebook 6: Evaluation and Reproducibility of AI-Generated Data (AI data reproducibility)

Notebook 7: Ethical Dissemination of Generated Biomedical Content (responsible AI dissemination)

5 Reflection questions

Use these questions to guide your reflection journal. Focus on connecting course concepts to your own research, clinical work, or professional goals.

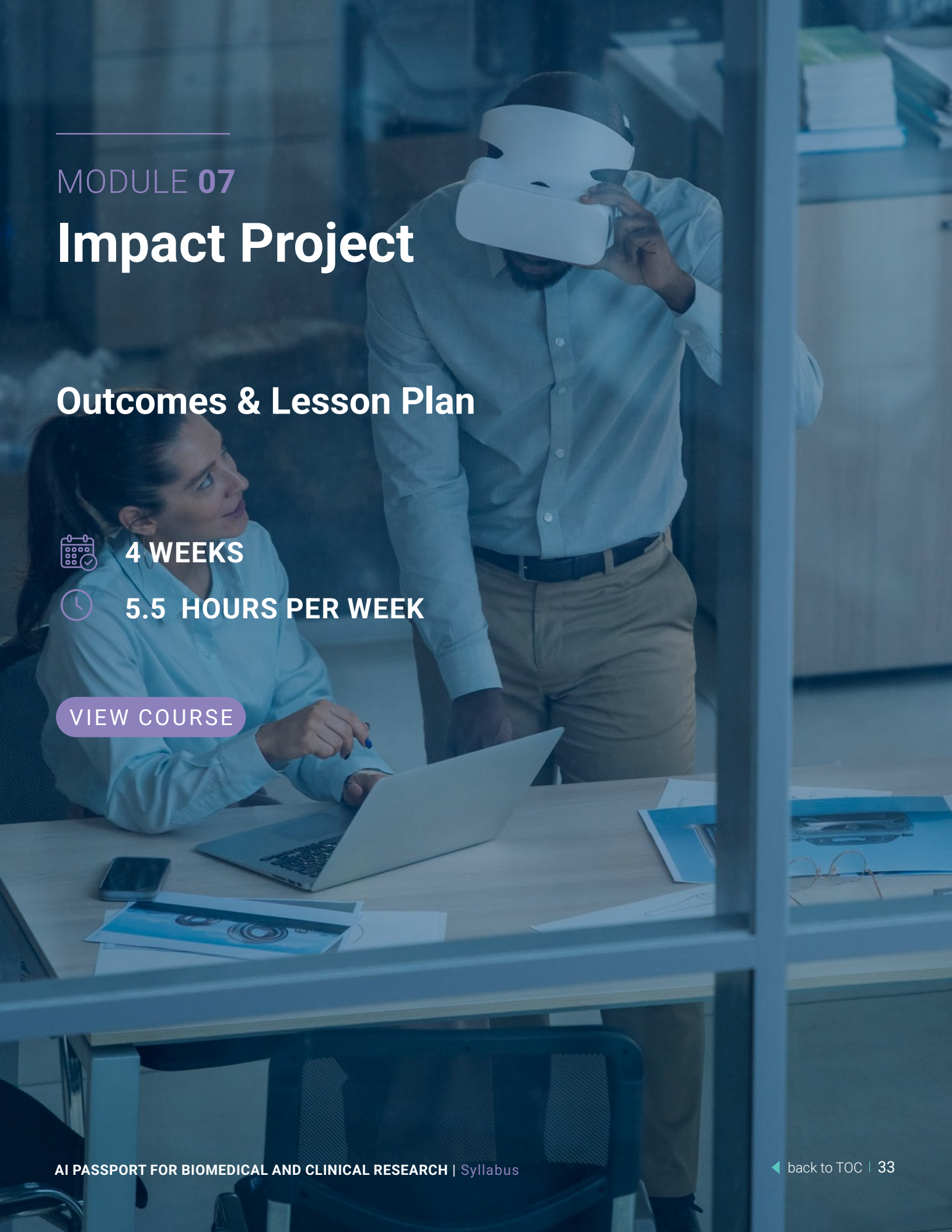
1. How would you use generative AI or large language models to support your research or clinical work?
2. How would you identify where generative AI could be most useful—or most risky—in your field?
3. How would you check whether AI-generated content or results are reliable and reproducible?
4. How would you address ethical issues such as bias, privacy, or misinformation when using generative AI?
5. How would you explain the role and limits of generative AI to your collaborators or patients?

1 Community Call with AI expert coaches

Participate in live sessions to reflect on your learning progress, engage in guided discussions, and contribute to the community of peer learners.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.



MODULE **07**

Impact Project

Outcomes & Lesson Plan

4 WEEKS

5.5 HOURS PER WEEK

VIEW COURSE

Meet the Faculty Behind Module 7

This module empowers learners to design, evaluate, and communicate their own biomedical artificial intelligence research project. Through hands-on assignments, peer feedback, and faculty guidance, learners practice applying AI methods responsibly and rigorously.

Benjamin Shickel, PhD

Guides learners in designing biomedical artificial intelligence experiments, helping them define research questions, align methods, and evaluate feasibility.

Yulia Levites Strekalova, PhD

Teaches how to write compelling AI research proposals and deliver effective feedback. Helps learners refine their ideas through collaborative review and scientific communication.

Azra Bihorac, MD, MS

Demonstrates strategies for clear and impactful scientific communication. Supports learners in crafting abstracts, presentations, and elevator pitches that resonate with diverse audiences.

Ashish Aggarwal, MS

Explores the intersection of traditional research and biomedical artificial intelligence. Helps learners confidently integrate AI tools into their domain expertise.

Tezcan Ozrazgat-Baslanti, PhD

Introduces techniques for designing reproducible and trustworthy AI research. Guides learners in documenting data, methods, and models to improve transparency and replicability.

Elizabeth Palmer, PhD

Covers ethical research practices, responsible conduct, and collaboration. Helps learners build a culture of integrity and accountability in biomedical artificial intelligence.

5.5 HRS

Week 1

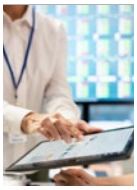
Project Definition & Foundation

Formulate a strong research question, identify relevant AI techniques, understand ethical considerations, and begin crafting a project proposal.

Lesson 1:
Designing Biomedical AI Experiments

Establish clear hypotheses, select appropriate AI techniques, and design experiments to evaluate feasibility.

Lesson 2:
Writing Successful Biomedical AI Proposals



Recognize and articulate AI innovation, address ethical concerns, and structure a compelling research proposal.

4 Videos.

Designing Biomedical AI Experiments
Establish clear hypotheses, select AI techniques based on goals and datasets, design appropriate baseline evaluations, and appraise AI feasibility.

Writing Successful Biomedical AI Proposals
Recognize and contextualize AI innovation, address AI-centric ethical concerns, and develop an effective NIH proposal.

Effective Scientific Communication
Learn how to distill complex findings and effectively communicate scientific abstracts, elevator pitches, and oral presentations while engaging audiences.

Bridging Traditional Research With AI Innovation
Identify AI-ready scientific domains, collaborate with AI experts, navigate skepticism, and integrate AI tools into existing research.

1 Assignment

Practice notebooks – AI in action

Notebook 1: Designing biomedical AI experiments (initial project design)

Notebook 2: Writing successful biomedical AI proposals (literature review & innovation identification)

Notebook 3: Effective scientific communication (project summarization & refinement)

Notebook 4: Bridging traditional research with AI innovation (LLM-powered feedback)

1 Office Hour with AI expert coaches

Engage with expert coaches to clarify course concepts and explore topics of interest in greater depth.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

5.5 HRS

Week 2

Advancing Responsible & Robust Biomedical AI Research

Learn to critically evaluate biomedical AI research, design reproducible experiments, and uphold the highest standards of research integrity and responsible conduct.

Lesson 3:

Critical Evaluation & Collaborative Review in Biomedical AI

Learn to assess the strengths and weaknesses, potential biases, and limitations of published AI research.

Lesson 4:

Designing for Trustworthiness: Reproducibility & Responsibility in Biomedical AI

Understand the principles of reproducible research and learn to implement practices that ensure your work can be independently verified.

3 Videos

Peer Review and Feedback Mechanisms
Explore best practices for constructive peer review and fostering collaborative research environments.

Robust Biomedical AI Research Design
A deep dive into creating reproducible workflows, documenting model details, and ensuring data transparency.

Responsible Biomedical AI Research
Navigating ethical considerations, research integrity, and safe research practices in the context of biomedical AI.

1 Assignment

Practice notebooks – Responsible AI in practice

Notebook 5: Peer review and feedback mechanisms (reproducibility & transparency)

Notebook 6: Robust biomedical AI research design (ethics & integrity)

Notebook 7: Responsible biomedical AI research (accountability & responsible conduct)

5 Reflection questions

Use these questions to guide your reflection journal. Focus on connecting course concepts to your own research, clinical work, or professional goals.

1. How would you design an AI project to address a key challenge in your own research area?
2. How would you ensure your project is transparent, reproducible, and ethically sound?
3. How would you communicate your project's purpose and impact to collaborators or reviewers?
4. How would you respond if you discovered bias or errors in your AI model or data?
5. How would you apply explainability or privacy-preserving tools, like XAI or federated learning, in your work?

1 Community Call with AI expert coaches

Participate in live sessions to reflect on your learning progress, engage in guided discussions, and contribute to the community of peer learners.

2 Peer feedback moments

Provide feedback on two peers' notebooks to strengthen their reasoning and application of course concepts.

5.5 HRS

Week 3
Hackathon: Biomedical AI Project Development

Work on your individual or team project, applying the skills and knowledge learned in the first two weeks to develop a biomedical AI project.

Lesson 5:
Introduction to Federated Learning

Understand the principles and benefits of federated learning for privacy-preserving AI. (Federated learning allows for training models across decentralized datasets without exchanging them, preserving data privacy.)

Lesson 6:
Explainable AI (XAI) Techniques

Learn methods for interpreting AI model predictions and building trust. (XAI aims to make AI decision-making more transparent and understandable to humans.)

Project Development

- Work on your project proposal, refining your research question, identifying relevant AI techniques, and designing experiments to evaluate feasibility.
- Begin building your project, using datasets, models, and experimentation to develop a working prototype.

1 Community Call with AI expert coaches

Join a community call with mentors to discuss your project, receive feedback, and get guidance on any challenges you're facing.

1 Project Review

Submit your project for review by mentors and peers, receiving feedback on your progress and suggestions for improvement.

5.5 HRS

Week 4

Hackathon: Biomedical AI Project Finalization

Finalize your project, refining your prototype, and preparing to present your work to the community.

Lesson 7:
Introduction to Federated Learning

Understand the principles and benefits of federated learning for privacy-preserving AI. (Federated learning allows for training models across decentralized datasets without exchanging them, preserving data privacy.)

Lesson 8:
Explainable AI (XAI) Techniques

Learn methods for interpreting AI model predictions and building trust. (XAI aims to make AI decision-making more transparent and understandable to humans.)

Project Finalization

- Refine your project, addressing any feedback or challenges you've encountered.
- Prepare a final presentation of your project, including a summary of your research question, methods, results, and conclusions.

1 Community Call with AI expert coaches

Join a community call with mentors to discuss your project, receive feedback, and get guidance on any challenges you're facing.

1 Project Presentation

Present your project to the community, receiving feedback and recognition for your work.

AI Passport

FOR BIOMEDICAL AND CLINICAL RESEARCH

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