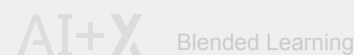


Artificial Intelligence: Problem Solving with Machine Learning



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Why This Program?

As new technological breakthroughs in machine learning and artificial intelligence continue, the students of tomorrow will need to be equipped with the tools to take part in the academic world that is quickly approaching. In order to be equipped with these tools, students will need to develop a deep understanding of both the theory and practice of machine learning. In addition, it will be necessary to have experience with how those theories are applied to many different fields that can utilize its tools.

This program, utilizing the best that Massachusetts Institute of Technology (MIT) has to offer in a **Blended Learning** format, will give students these tools, both providing high-quality information about what machine learning is and how it can be utilized. The program will also expose students to the many different academic fields that will be radically changed as machine learning becomes a main component of research and development. With the tools and experience gained in this program, students will be well-equipped to be competitive in the new world that machine learning is creating.

Who should attend?

This program is aimed at high-level undergraduate students who are driven to learn as much as they can about the future of technology. Students with a background in mathematics and computer science who are looking to learn about how these fields are being utilized in the creation of cutting-edge technologies will find this program to be ideal for them. In addition, this program is for anyone interested in learning about the international community of machine learning specialists and experiencing high-level education at one of the top universities in the world.

How Blended Learning Works?

With fast improvements in the field of machine learning and AI made by institutes such as MIT, education must improve along with it. While online lecture-based education offers students the convenience of learning at their own pace, it is also important to give students real hands-on projects that test their understanding and give them the chance to apply what they have learned to real-world problems.

To find the perfect combination of both lecture-based and project-based education, this program will take a Blended Learning approach, beginning with an **Small Private Online Course (SPOC)** that will introduce students to the material, allow them to learn at their own pace, and combining it with a **Project-based Learning (PBL)** program that applies what the students learned in the SPOC to the real world. With this mixture of SPOC and PBL, students can have all the benefits of both online and onsite learning, helping them prepare to make their mark on the technological advances of the future.

Artificial Intelligence: Problem Solving with Machine Learning

“AI+X” Blended Learning

What is this “AI + X” Program?

While knowledge of machine learning and artificial intelligence is important in a vacuum, it is also important for students to understand how these technologies are applied to various associated fields. Because of this importance, this course will focus not only on AI, but “AI + X”, where ‘X’ stands in for these associated fields.

We focus on Blended Learning academic programs that consist of a Small Private Online Course (SPOC) Module and Project-based Learning (PBL) Module .

The first part of this program will consist of a **SPOC module** led by MIT Professors. The module will last 6 weeks and will consist of pre-recorded lectures and exercises along with live sessions with MIT Professors. These live sessions will answer student questions and present further interactive lectures for students, giving the module a face-to-face aspect. Topics to be covered in this SPOC will include, but are not limited to:

- Ordinary and Partial Differential Equations
- Optimization
- Classification and regression
- Probabilistic methods
- Case studies in the real world

In addition to the SPOC module, this program will also offer a **PBL module** for all students who have completed the SPOC. This module will focus on applications of machine learning and will be led by MIT Professors along with many guest faculty members. Topics covered will include, but not be limited to:

- Computational Materials Discovery
- Li-ion Battery Life Prediction
- Computational Imaging
- Composite Design
- Neural Net Usage To Generate Missing Data

This module will also offer projects applying the knowledge students gained in the SPOC module and will conclude with either a research paper or project report.

The PBL module will offer students the following 8 project tracks. Students will choose one of the tracks and complete a project to complete the PBL module.

- Accelerating Computational Materials Discovery
- Feature Engineering and Selection in Li-Ion Battery Life Prediction
- Computational Imaging
- Quantifying Risk in Complex Systems
- Prediction in Oil and Gas Production
- Creating a Machine Learning Program
- Machine Learning in Composite Design
- Using Neural Nets to Generate Missing Data

Blended Learning	Length	Timing	Content	Price
SPOC	6 weeks	Sep 12th - Oct 23th, 2020	Digital online content and additional live sessions with the teaching professors	\$1,550 USD
Online PBL	12 weeks	Nov 1st - Jan 30th, 2020	Hands-on projects based on SPOC learning. Outcome of research paper and project report guided by teaching team. Advanced digital online content and additional live sessions with the teaching faculty.	\$5,950 USD

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“AI+X” Blended Learning

Program Outcome

SPOC Outcome

During the SPOC module of the Blended Learning program, students will:

- Simulate physical processes using numerical discretization methods
- Describe canonical machine learning problems from a statistical perspective
- Assess cost-accuracy trade-offs in numerical simulation
- Learn powerful optimization techniques and understand their fundamental role in machine learning
- Practice real-world forecasting and risk assessment problems using Monte Carlo simulation.

At the end of SPOC module, all students will receive:

- A **learning analytics report** showing that the student, upon completing the program, has mastered the material taught in the course
- An **official certificate** by Massachusetts Institute of Technology
- Opportunity to interview for an **internship or full-time position** at AI companies

PBL Outcome

During the PBL module of the Blended Learning program, students will:

- Understand why and how machine learning methods may improve engineering problem-solving
- Quantify risk and clarify salient features from data in complex systems
- Learn how researchers make better predictions with missing or sparse data
- Transfer machine learning approaches developed in one industry to another industry
- Assess conditions when a machine learning approach may not be helpful or worth the extra effort

Students will also apply this learning to do the following:

- Build Internet of Things devices that can sense, connect, infer, and act
- Understand trends in AI, deep learning, Internet of Things, pervasive sensing, and blockchain solutions
- Learn the latest innovations in automated vehicles

In addition to the academic materials students will master, students will also complete an **academic paper** of the program that can be published.

Teaching Faculty for this Program

1. Director of the MIT Center of Computational Engineering, Associate Professor of Aeronautics, and Director of the Aerospace Computational Design Laboratory at MIT
2. Associate Professor of Chemical Engineering at MIT
3. Professor of Chemical Engineering at MIT
4. Professor of Mechanical Engineering at MIT
5. Associate Professor of Mechanical and Ocean Engineering at MIT
6. Associate Professor of Electrical Engineering and Computer Science at MIT
7. Professor of Civil and Environmental Engineering at MIT
8. Professor of Engineering and Head of the Department of Civil and Environmental Engineering at MIT
9. Professor of Applied Mathematics and Director of MIT's Earth Resources Laboratory at MIT

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“AI+X” Blended Learning

SPOC Syllabus

Week	Type	Module Name	Module Description
1	Live session	Academic Orientation	This orientation will offer students an initial look into the SPOC, both introducing the faculty and teaching team that will be working with them as well as introductory information about the content that will be taught during the SPOC.
	Recorded Lecture	Introduction, Review of Linear Algebra and Matrix Operations, and Modeling Fundamentals	Will offer a refresher course in the linear algebra and matrix operations needed for the modeling, optimization, and machine learning that will be introduced later in the course. Will also introduce Ordinary Differential Equations, as well as the Forward Euler Method and other Higher-Order and Implicit Methods for utilizing ODEs.
2	Recorded Lecture	More Modeling and Simulation	Will introduce Partial Differential Equations (PDEs), explicit and implicit solutions for PDEs, Boundary Conditions, and Linear and Nonlinear Systems.
	Live session	Supplementary Topics in Ordinary and Partial Differential Equations	This live module will allow students to ask any questions about the introduction to Modeling and ODE's, as well as serve as a bridge to begin covering PDEs in the next module.
3	Recorded Lecture	Optimization and Data-Driven Modeling	Will introduce the topic of Optimization, as well as Least Square Problems, Gradient Descent, Newton's Method, and Parameter Estimations.
4	Recorded Lecture	From Optimization to Machine Learning	Will introduce Regression and Classification, as well as methods for each and Assessing Model Fit.
	Live session	Supplementary Topics in Optimization and Machine Learning	This live module will allow students to ask questions about PDEs and optimization, as well as serve as a bridge to begin discussing Machine Learning in earnest in the next module.
5	Recorded Lecture	Probabilistic Methods	Will introduce Probabilistic Methods generally, as well as Monte Carlo Simulation, Probabilistic Forecasting, and Sensitivity Analysis.
6	Recorded Lecture	Case Studies and Summary	Will apply all the previous learning with real-world examples and give students the chance to see how what they learned can be applied. Will also wrap up the SPOC and give the students a sense of where they can go next.
	Live session	Supplementary Topics in Probabilistic Methods, Additional Case Studies, and Conclusions	This live module will allow students to ask questions about the introduction to machine learning and probabilistic methods as well as bridge the gap into the case studies and conclusions that make up the rest of the SPOC

This SPOC will also include 3 live sessions led by teaching assistants, which will serve as the SPOC's office hours.

During these live sessions, the teaching assistants will answer student questions and supplement the material presented by Professor Marzouk.

In addition to lectures, the SPOC will also test students through the following assignments:

- The SIR epidemiology disease model solver and step-size assignment
- Designing a PDE to model the spread of a contaminant, with 1% or less relative error and low computational cost
- A short multiple choice quiz, with an additional aircraft wing design optimization problem
- Building two predictive models for piston engines: Predicting the piston's position in a cylinder and Predicting the piston's cycle time
- Using Monte Carlo simulation to model the load of a polycarbonate beam in the wind for design purposes

Event	Sessions	Hours
Recorded Lectures	12	16
Live Session	4	8
Office Hours	3	6
Assignments and Readings		18
Total Hours		48 total 8 per week

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Prerequisites

SPOC Prerequisites

Technical Requirements

In order to participate in the SPOC module of the Blended Learning program, it is recommended that you use the latest version of Chrome or Firefox. Web browsers on mobile devices might not allow you to access all the necessary features of the SPOC, so using a laptop or desktop is preferred.

Academic Background and Programming Skills

Advanced Mathematics background (Linear Algebra and Calculus) is necessary for taking this course. While the ability to code in Python is not strictly necessary, it is recommended that students have at least some familiarity with Python or other similar programming languages.

Language Skills

This course will be conducted in English, so being able to converse naturally in English will also be required to take part in this program.

PBL Prerequisites

In order to take part in the PBL module of the Blended Learning program, students must first successfully pass the SPOC module.

Application

Please scan the QR code below to submit your application.

Once your application is submitted, "AI+X Blended Learning", admission team will review your information and get back to you as soon as possible.

Thank you for your interest.



("AI+X" Blended Learning Candidate Registration Form)

Application Deadline

Final Deadline: July 15th, 2020

Positions will be available until fully filled. Late applications will be considered but not guaranteed.