THE OHIO STATE UNIVERSITY

College of Engineering

Undergraduate Education & Student Services

122 Hitchcock Hall
2070 Neil Avenue
Columbus, OH 43210-1278

614-292-2651 Phone
614-292-9379 Fax

engineering.osu.edu

Memo

To: Randy Smith, Vice Provost for Academic Programs
From: Rosie Quinzon-Bonello, Assistant Dean for Curriculum and Assessment
Date: May 25, 2023
Re: Proposal for Machine Learning and Artificial Intelligence (AI) MicroBootcamp

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On May 24, 2023, Associate Dean David Tomasko, on behalf of the College of Engineering Committee for Academic Affairs, approved the proposal for a Non-credit, 10-week Online Program *Machine Learning and Artificial Intelligence (AI) MicroBootcamp.*

Attached is the proposal for consideration as an informational item for CAA.

Thank you,

Rosie Quinzon-Bonello

College of Engineering

Proposal for a Non-credit, 10-week Online Program

"Machine Learning and Artificial Intelligence (AI) MicroBootcamp"

May 22, 2023

OAA Certificate Program Category: (4) Workforce Development Certificate of Completion Programs

Description

The online Machine Learning and Artificial Intelligence (AI) MicroBootcamp is a practical, hands-on learning experience for building foundational technical skills for machine learning and AI, including unsupervised and supervised learning, ML optimization, neural networks, natural language processing, and emerging AI topics. Designed and taught by industry experts, this project-based course contains text, graphics, and videos paired with live instructor support, expert grading feedback, and real time tutoring support. Learners will build and develop new skills while building a portfolio of example work. Additionally, learners will practice hands-on machine learning and AI activities and learn about emerging technologies in the AI space.

This microbootcamp is designed for those with prior coding experience seeking to develop in-demand, salary-premium skills. It's a good fit for students who have completed the Coding or Data Analytics bootcamps.

The curriculum and instruction include self-guided asynchronous coursework with weekly guideposts and augmented by weekly, 1.5-hour, live sessions or "office hours" with instructors. Personalized support is also provided through a dedicated student success manager, 24/7 learning assistant support, tech support, tutoring, personalized grading and feedback, and career engagement network resources.

Participants must complete the 10-week program to obtain the certificate of completion. The bootcamp will be delivered online. The bootcamp is a partnership with the College of Engineering, edX, a 2U brand, and the Computer Science and Engineering department and administered through the Professional and Distance Education Programs Office.

This bootcamp is very similar to the Coding, Cybersecurity, Data Analytics, and UX/UI bootcamps already approved and offered through a partnership with edX/2U and the Computer Science and Engineering and Electrical and Computer Engineering departments.

Outcomes-based

Upon completion of the course participants will:

1. Apply machine learning techniques to gain knowledge and solve problems.
2. Use unsupervised machine learning models to categorize unlabeled data.
3. Use supervised machine learning models trained on labeled data to make predictions about data.
4. Evaluate machine learning models by using test data and metrics.
5. Improve the performance of machine learning models by using optimization techniques.
6. Identify neural networks and deep learning models.
7. Use neural networks and deep learning models to make predictions about data.
8. Determine the sentiment of vector-encoded text using NLP and transformers.

9. Describe recent innovations in AI and their impact on the field of AI.
10. Hypothesize how AI could be applied in the future.

Curriculum

There are eight modules of content and two "challenge" assignments structured around specific AI topics and skills for students to accomplish. Students should plan to spend at least five hours on each module and five hours on each "challenge" assignment. The online lessons are designed to teach concepts and skills through real-world context with readings and interactive skills-based activities with provided solutions. Throughout the course, students apply the skills learned to a "challenge" with human-graded feedback.

The bootcamp curriculum will include these topics:

Module 1 - Introduction to AI and Machine Learning

This module will introduce learners to the concepts of AI and Machine Learning. Students will learn the fundamentals of what AI and machine learning are but also how they have been interacting with AI for years. Learners will learn about recent technological advances and how they are split between "general" and "narrow" AI.

Topics Covered:

- What is AI
- Ethics of AI
- Narrow vs General AI
- Impact of Machine Learning
- Course Tools and Technologies

Learning Objectives

1. Understand an overview of the machine learning models that will be taught in this course.
2. Define the key concepts of the course including unsupervised learning, supervised learning, machine learning optimization, neural networks, natural language processing, and deep learning.
3. Describe how computers comprehend data and how it differs from how humans comprehend data.

Module 2 - Unsupervised Learning

In this module, learners will learn how to identify hidden patterns, relationships, and structure within data that reveal interesting insights used to make predictions. Learners will learn how unsupervised learning is used to find hidden patterns and similarities in data.

Topics Covered:

- Unsupervised Machine Learning
- Clustering
- K-Means Algorithm

- PCA and reducing dimensionality in data

Learning Objectives

1. Describe the purpose and importance of unsupervised learning in artificial intelligence.
2. Define clustering and how it is used in machine learning.
3. Apply the K-means algorithm to identify clusters in a given dataset.
4. Determine the optimal number of clusters for a dataset using the elbow method.
5. Practice scaling and transforming categorical variables into a numerical representation.
6. Explain PCA and how it can be used to reduce dimensionality in data.
7. Use PCA to reduce the number of features in a dataset.
8. Apply the K-means algorithm after PCA dimensionality reduction.

Module 3- Supervised Learning - Linear Regression

In this module, learners will build on the knowledge of the previous module and learn how supervised learning differs from unsupervised learning. Learners will further refine and improve the results of algorithms using balanced data to train AI models more accurately.

Topics Covered:

- Supervised Learning Models
- Regression
- Linear Regression

Learning Objectives

1. Recognize the difference between supervised and unsupervised learning.
2. Define the key concepts of supervised learning.
3. Determine when a regression or classification model is appropriate.
4. Apply the model-fit-predict process.
5. Make predictions with linear regression models of supervised learning.

Module 4 - Supervised Learning - Classification

Learners will continue with supervised learning but now focus on classification, logistic regression, and then go further into applying other models with complex data. Learners will then be introduced to linear vs. nonlinear data and ensemble learning with random forests.

Topics Covered:

- Classification
- Logistic Regression
- Model-Fit-Predict Process
- Linear vs. Nonlinear Models
- Ensemble Learning

Learning Objectives

1. Determine when to use a classification model.

2. Explain the difference between logistic regression, support vector machines (SVMs), and decision trees.
3. Identify linear and non-linear data.
4. Apply the model-fit-predict process for logistic regression, SVM, decision trees, and random forests.
5. Articulate how ensemble learning works and why it improves accuracy and model performance.

Module 5 - Machine Learning Optimization

In this module, learners will learn how to manipulate data in preprocessing, test multiple models, and fine tune hyperparameters to achieve better results with machine learning. Learners will build upon the previous two modules and take their knowledge a step further by learning techniques that optimize performance in models.

Topics Covered:

- Evaluating Model Performance
- Imbalanced Data
- Model Selection for Success Metrics
- Limitations of Traditional Models

Learning Objectives

1. Communicate how datasets and end goals can guide metric selection.
2. Streamline datasets for ingestion by a machine learning model.
3. Effectively select a working model for a dataset given a particular success metric.
4. Describe the limitations of traditional machine learning models and the value of more complex algorithms.

Module 6 - Neural Networks and Deep Learning

In this module, learners will be introduced to neural networks, a type of machine learning model that was designed to work like the human brain. Then they will learn about deep learning models, which are more advanced types of neural networks. Learners will use both types of models to make predictions about data, and they will learn optimization techniques for these models.

Topics Covered:

- Neural Networks
- Compare and Contrast Neural Networks with Deep Learning
- TensorFlow
- Keras

Learning Objectives

1. Explain what a neural network is.

2. Compare the advantages and disadvantages of using neural network models with other types of machine learning models.
3. Compare and contrast neural network models and deep neural network models.
4. Preprocess data for neural network models.
5. Implement neural network models using TensorFlow and Keras.
6. Save trained TensorFlow neural network models for later use.
7. Implement deep neural network models using TensorFlow and Keras.

Module 7 - Natural Language Processing

In this module, learners will learn how natural language processing (NLP) and transformers help computers understand, interpret, and predict human language. Learners will learn how to solve NLP tasks with pre-trained transformer models and how to build AI applications via user-friendly web interfaces.

Topics Covered

- Natural Language Processing
- Transformers
- Tokenization

Learning Objectives

1. Describe the purpose and importance of NLP in artificial intelligence.
2. Describe what text is to a computer.
3. Describe what a language model is and its role in NLP.
4. Describe the tokenization process and how it is used in NLP.
5. Explain the process of converting a sentence into tokens.
6. Explain the benefits of Hugging Face Tokenizers.
7. Convert a sentence into tokens and numerical values.
8. Explain similarity measures and what they do.
9. Determine the similarity between sentences.
10. Create a search engine using a transformer neural network.
11. Determine the sentiment of text.
12. Describe the importance of transformers and what they do.
13. Become familiar with the different pre-trained transformer
14. models.
15. Define NLP Tasks such as text summarization, text
16. generation, etc.
17. Apply a pre-trained transformer model for a specific task.

Module 8 - Emerging Topics in AI

In this module, learners will be introduced to several topics related to cutting edge AI research areas and technologies. They will learn about these topics at a high-level, with a focus on key concepts rather than technical applications.

Topics Covered:

- Generative AI
- AI Applications Outside the Computer
- Active Research Areas

- Ethics and Regulation

Learning Objectives

1. Describe how pretrained transformers are driving innovation, such as in computer vision and large language models.
2. Summarize key concepts behind additional areas of active research in AI, for example: one-shot algorithms, improving speed, direct deployment on mobile, etc.

Admission

No college degree is required, although students should have a fundamental understanding of the Python programming language including variables, conditionals, functions, data structures, and loops; and experience using Pandas for exploratory data analysis. Student should have experience coding in Python including:

- Can create software scripts in Python using programming fundamentals such as variables, lists, conditionals, loops, and functions.
- Can read and write files in Python.
- Can install, import, and use external libraries in Python.
- Experience applying essential coding skills including syntax recollection, pseudocode, problem decomposition, and debugging.

Students should have completed coursework in linear algebra, statistics, and multivariable calculus. It's recommended they have work experience in a field that requires programming skills.

Stand-alone Program and Maximum Credit Overlap between Academic Certificate and Other Academic Programs
This is a non-credit, online course and will be a stand-alone program.

Maximum Credit Overlap with Degree Program
N/A

Minimum Acceptable Grade to Apply
N/A

Transfer Credit
N/A

EM Credit
N/A

Arranged/Individual Study Courses
None.

Minimum Grades and GPA to Complete Program
Students must obtain a passing grade on all quizzes, assessments and projects to receive the certificate of completion.

Recorded in the Student Information System (SIS)
No

Regular OSU Tuition and Fee Assessment
No, this is a non-credit program. Fee will be $3,499 per person.

Eligibility for Federal Pell Grant and Direct Student Loans
No

Diploma Issued
No.

Type of Completion Document Issued
A certificate of completion is awarded after a participant successfully completes the 10-week program.

Proposal Contact Information

Bob Mick
Director
Professional & Distance Education Program
Mick.15@osu.edu
614-292-0393

Dr. Tom Bihari
Professor
Computer Science and Engineering
Bihari.5@osu.edu