

Teaching AI/Machine Learning



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ETP Type: PD

Subject/Grade: Computer
Artificial Technology-Machine
Learning/ 11th-12th

NOTE: Lesson 1 of this ETP
was updated in Summer 2023
([addendum](#))

Abstract

A learning path for high school students into the study of Artificial intelligence (hereafter AI)/Machine Learning (hereafter ML). For my summer assignment I am working for Professor Tengyu Ma's Artificial Intelligence lab. My assignment is to develop 1 or 2 lessons to teach high school students about machine language. This is an important subject to introduce to high school students because ML and AI are permeating everywhere in our lives today. My ETP is written with the focus of giving middle school or high school teachers basic steps and resources to help them teach their students specifically about ML. This Professional Development plan will be for Computer Science or Engineering/STEM and Math teachers.

Focal Content & Supporting Practices

- 9-12S.DA.8 Use data analysis tools and techniques to identify patterns in data representing complex systems
- Software and System Development
 - Information and communication Technologies
- California standards for teaching profession
 - Engaging and Supporting All Students in Learning
 - 1.1 Using knowledge of students to engage them in learning
 - 1.2 Connecting learning to students' prior knowledge, backgrounds, life experiences, and interests
 - 1.3 Connecting subject matter to meaningful, real-life contexts

21st Century Skills and Applications

- Information Literacy
- Critical thinking
- Communication and collaboration

Measurable Objective(s)

The teacher should :

1. Understand AI/ML enough to be able to explain and provide examples, based on the ETP steps.
 - a. Describe how machine learning works
2. Know how machine learning could affect day to day life, employment and education
3. Understand how machine learning and Artificial Intelligence relate to one another.
4. Be Able to show how we train machines to think like humans when completing a task which they could not historically do before.
5. The curriculum will consist of 3 components
 1. We will discuss many of the ways humans learn in the introduction lesson which will also include a subset of the specific vocabulary needed to understand ML.
 2. Hands on activity where students can understand ML from a computer's prospective
 3. Finally the student will design a program, scratch, looking at how data is used in AI/ML

Formative Assessment(s)

1. The first activity will be used to make sure teachers and students understand the vocabulary associated with Machine Learning and Artificial intelligence.
2. Teachers will be asked if they have questions as the PD is being conducted.

Summative Assessment(s)

Lesson 2 can be used as a summative assessment via a hands-on activity to get an understanding of what the students and teachers have learned. The key will be producing 2 sets of vocabulary for Happy and Sad.

- a. One set is for training data
- b. One set is for testing data, some of the vocabulary must include some of the training data. But must also include new terms related to the labels Happy and Sad as well.
- c. There is a rubric that can be used. Test word on the rubric = Training data in the assignment, Test data = Testing data.

Fellowship Description

My fellowship is to learn what Artificial Intelligence/Machine Learning are and then develop lessons so high school students can understand the concepts specifically of ML. ML is a subset of AI, AI is a subset of computer science which focuses on the use of data and algorithms to imitate the way that humans learn. Humans learn in many different ways.

My curriculum is developed under the guidance of assistant professor Tengyu Ma. Tengyu's work brings together techniques from theoretical computer science, applied mathematics, statistics, probability, and information theory to answer the twin questions of how to design successful nonlinear models and efficiently optimize nonconvex training functions for those models. Several of his publications develop mathematical tools to characterize the optimization landscape of various machine learning problems including dictionary learning, matrix completion, tensor decomposition, and linearized (recurrent) neural nets; some of these results have been published in *Transactions of the Association for Computational Linguistics* and the *Journal of Machine Learning Research*. Tengyu has also worked on sum-of-squares algorithms and statistical and communication trade-offs in machine learning, both areas having technical and conceptual open problems that he intends to continue

Fellowship Connection to School/Classroom

In our academy we try to introduce students to not only real world problems, hands-on activities,, various engineering and career opportunities. They meet engineers, they meet people in various occupations. This assignment will introduce students to Artificial Intelligence and machine learning . Students will get a deeper understanding of AI by focusing on ML. Many students know AI from watching movies like I-Robot, Odyssey 2000 (Hal), and self-driving cars, but ML is more than that. Also students will learn what technology actually is used to produce a product when using AI. I also hope students will consider going into the study of AI. What teachers should know is that students' future depends on their AI fluency. They must be able to show students how to manipulate data.

Instructional Plan

1. This is a training module to help you teach your students the basics of Machine Learning. Within this plan there are resources, activities, warm-ups, Goals, questions and quizzes that an educator can use. Each lesson can be taught independently however it is suggested that you teach them in the order given.
2. Objective
 - a. Lesson 1 can be taught in 1-2 days depending on whether your classes are 50 min or block. The activity allows the students, through a hands-on activity, to work in specific roles which will help them understand what machine learning consists of. At the end of the lesson the student should be able to understand how the machine plays a part in machine learning.
 - b. Lesson 2 can also be taught in 1-2 days. The activity is primarily the entire lesson. The instructor should prepare documentation before the course is started. At the end of the lesson students should understand what role data and evaluating data plays in machine learning.
3. Focus Learning (I do)
 - i. Instructor should spend time going over the vocabulary. Although there are 3 categories to Machine Learning. I suggest that you focus on one. The lessons in this ETP focus on Supervised Learning, which is the first step in Machine

Learning. Note each category has its advantages and disadvantages. This plan does not focus on evaluating these advantages and disadvantages, just on learning the basic concepts relating to Machine Learning. Below find links to where you can find more information on the categories. There is also sub-vocabulary necessary to learn for each category. For instance with Supervised learning you must learn what Labels, Input, Output and Classification means.

4. Day 1

a. Goal of Day 1:

- i. To learn about Machine Learning by doing.
 1. The students will be placed in groups with specific roles:
 - a. The “Data Collector”
 - b. The Machine
 - c. The Quality Engineers
 2. They will learn the vocabulary through an activity
 - a. There are specific short videos which can be used to help with learning the vocabulary
 3. Finally there will be a quiz/formative assessment that the instructor can use to understand what their students have learned.

b. [Introduction Artificial Intelligence Lesson video](#) - Time required: 5 min

- i. Goal: to give students a quick and simple presentation on AI/ML
- ii. Ask students if they can give you examples of AI in the real world.
- iii. Let students know they are about to not just understand products developed using AI today but how the developer must think prior to developing a product. How do we get a machine to perform tasks humans do, this is what we will explore over the next week or so.

c. Activity: What is a label and how do we use it? Time required : 35 min

- i. Step by Step instructions and handouts :
 1. Goal: You never know anyone until you walk in their shoes.
 2. Instructions:
 - a. Before presenting
 - i. Put students in groups, assume class size has 30 students, break them into groups of 6. Time: 5 min
 1. Roles:
 - a. 2 students Machine = Duties:
 - i. Responsible for describing what are the specific features of the images. This is the training mode.
 - b. 2 students “Data Collector”= Duties:
 - i. Organize the raw data, remove any duplicates.
 - c. 2 students Quality Engineers = Duties:

- i. Timekeeper, ensures since the machine does not use prior knowledge when outlining features. Also, when comparing features with test images.
 - 2. Make copies of the following slides to handout:
 - a. Give all students a copy of Slide 3 or have them write it in their notebook
 - b. "Data Collectors" have slide 6.
 - c. Machines get a copy of the feature sheet after activity gets started.
 - b. Once the students have the copies open the slide deck and follow the instructions: [Machine Learning Lesson 1](#) time 30 mins
 - ii. Basic Vocabulary lecture videos/reading material -
 - 1. [Supervised Learning](#) (Review this information with students) - 15 min
 - a. a stylization of Machine Learning directed (supervised) by a human being. With supervised learning, the desired goal or *target variable* is already known, and our job is to train the *Machine Learning model* to be able to predict that target variable with a high degree of *confidence*.
 - i. Have students discuss applications they see in the real world using ML.
 - b. [Algorithm](#) - 10 min
 - i. Have students define what an Algorithm is in their own words.
 - c. [Top 10 algorithms](#) - 5 mins
 - i. Have students discuss what they have learned from both lessons.
 - d. Not necessary to review this material, it is just additional information.
 - i. [Unsupervised Learning](#)
 - 1. utilizes data that is unstructured, not labeled, and not classified to produce outputs and insights. Exact opposite to supervised learning.
 - ii. [Pattern Recognition](#)
 - iii. [Reinforcement Learning](#)
 - a. an environment that rewards its actions with positive or negative results.
 - e. Note depending on your teaching periods this presentation can be delivered in 2 to 3 days
5. Day 2/Lesson 2
 - a. Goal - Students will learn how important it is to prepare and use the correct data
 - b. Warm up -
 - i. Review the flow chart slide 2
 - c. Instructions
 - i. Follow the steps in the slides

1. [Sample Supervised Learning Lesson 2](#) Required Time 40 mins
- ii. Discuss what the students learned from this activity. How different is this activity from lesson 1? 10 minutes.

Additional Supports

The images used in the presentation are good for distance learning, ELL and SPED students because these are universal images,

Materials

Links: [Machine Learning Lesson 1](#), [feature sheet](#), [Sample Supervised Learning Lesson 2](#),

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Keywords (2-4)

Machine Learning, Artificial Intelligence, Supervised Learning, Pattern