Unit 7: Introduction to Machine Learning

Content Area: **Mathematics**
Course(s):
Time Period: **March**
Length: **5 weeks**
Status: **Published**

Unit Overview:

In this unit, students will be introduced to the big ideas behind machine learning. They will build two different machine learning algorithms to make predictions on whether they will like a song. In this process they will learn about using vectors and matrices as data structures as well as applying conditional probability and exercising their basic programming abilities. Students will also consider how machine learning impacts their lives and others' lives and will share their newly gained understandings of machine learning with a member of their community. During the unit, students will work in Colab and Edublocks.

Essential Questions:

How can I build machine learning algorithms that will make predictions on whether I like a song?

Enduring Understandings:

- Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon.
- Identify, analyze, and synthesize relevant external resources to pose or solve problems.

Standards/Indicators/Student Learning Objectives (SLOs):

MATH.9-12.A.CED.A.1	Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
MATH.9-12.A.CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MATH.9-12.S.IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
MATH.9-12.S.IC.A.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
MATH.9-12.F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
MATH.9-12.F.IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

MATH.9-12.N.VM.A.1	Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\lvert\boldsymbol{v}\rvert$, $\lVert\boldsymbol{v}\rVert$, v).
MATH.9-12.S.CP.A.3	Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
MATH.9-12.F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
MATH.9-12.S.CP.A.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
MATH.9-12.S.CP.B.6	Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.
MATH.9-12.A.REI.D.10	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
MATH.9-12.N.VM.C.6	Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

Lesson Titles:

- 7.1 Predictive Modeling
- 7.2 Machine Learning
- 7.3 Basic Programming
- 7.4 Linear Algebra
- 7.5 Conditional Probability

Career Readiness, Life Literacies, & Key Skills:

WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.7	Plan education and career paths aligned to personal goals.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

CS.9-12.8.1.12.DA.1	Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
CS.9-12.8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
TECH.8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.

TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.

Equity Considerations

Holocaust Mandate

Topic:

Materials Used:

Addresses the Following Component of the Mandate:

- Bias
- Bigotry
- Bullying
- Holocaust Studies
- Prejudice

LGBTQ and Disabilities Mandate

Topic (Person and Contribution Addresses):

Materials Used:

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

Climate Change

Asian American Pacific Islander Mandate

Topic (Person and Contribution Addresses):

Fei-Fei Li - leading innovator in artificial intelligence (AI)

Materials Used:

Discussion on contributions to the AI world and innovation.

Addresses the Following Component of the Mandate:

AAPI

- Economic
- Political
- Social

Summative Assessment:

Students consider the basic ideas behind machine learning. They explore and adapt algorithms to predict song ratings based on song attributes and their peers' ratings. As part of their work in these algorithms, students explore the concepts of train/test split of datasets, complexity of modeling functions, conditional probability as a measure of similarity, and weighted averages. Students use their knowledge of basic programming to work in EduBlocks and Google Colab. Additionally, they consider the ethical implications of the use of machine learning in the context of music recommendations and beyond. The assignment concludes with students sharing their knowledge of machine learning and how it impacts their lives with a member of their community.

- Build a Portfolio - Unit 6 City Ranking Project

Benchmark Assessments

- Project-Based Assessment
- Skills Based Assessment

Alternative Assessment

- Journal Reflections
- Performance tasks
- Portfolios

- Presentations
- Project-based assignments

Formative Assessment:

- Data Talks/ Class Discussions
- Individual. Partner & Group Exploration Activities
- Jigsaw Assignments
- Math Journals

Resources & Materials:

This curriculum will introduce students to the main ideas in data science through free tools such as Google Sheets, Python, Data Commons and Tableau. Students will learn to be data explorers in project-based units, through which they will develop their understanding of data analysis, sampling, correlation/causation, bias and uncertainty, probability, modeling with data, making and evaluating data-based arguments, the power of data in society, and more! At the end of the course students will have a portfolio of their data science work to showcase their newly developed abilities.

- Data Sets & Visuals
- YouCubed High School Data Science Curriculum

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Analyze and interpret predictive models and their outputs.
- Apply conditional probability within a modeling situation
- Communicate relevant information about machine learning to a target audience
- Introductory understanding of vectors and matricies as data structures
- Recognize and explain the need to have training and testing datasets and the potential problems of over- or underfitting the training data in predictive models.
- Understand and explain the concept of content-based and collaborative filtering machine learning models
- Use basic programming skills to run and edit code for a reccomender system.
- Use polynomials (up to degree 8) to fit data in order to create predictive models

Modifications

ELL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Vary test formats

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking

- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

Technology Materials and Standards

- Chromebooks

- CODAP
- Edublocks
- Google Colab
- Google Jamboard
- Google Sheets
- Google Slides
- Promethean Board
- Tableau

Computer Science and Design Thinking Standards

CS.6-8.DA	Data & Analysis