Building, Evaluating, and Ethically Implementing AI Models: From Data Collection to Object Detection

Total Number of Lessons: 6
Total Estimated Time for Module: TBD

Section 1: Module Overview and Curricular Connections – Required

- **Module goal**:At the end of this module, students will be able to collect and interpret data, train machine learning models, evaluate model performance and bias, and critically assess the ethical implications of AI tools, including large language models (LLMs) used for code generation.

- **Connection to standards**:
  - Indiana Topics of CS Standards
    - **Domain 1: Data Science:** 7351.D1.1, 7351.D1.2, 7351.D1.3, 7351.D1.4, 7351.D1.5
    - **Domain 2: AI:** 7351.D2.1, 7351.D2.2, 7351.D2.3, 7351.D2.4, 7351.D2.5, 7351.D2.6
  - CSTA K-12 Computer Science Standards
    - 2-DA-08, 3A-DA-11, 3A-IC-26, 3B-IC-25

- **RET materials/ideas to be leveraged**: This module will incorporate object detection tools, dataset design concepts, and AI ethics discussions drawn from RET experiences with the NorthStar project's real-time object detection system, and extend those concepts into student-led experiments using Google Colab, MNIST, and CiFAR-10 image datasets. The unit will also include an ethics lesson on the use of LLMs for coding.

Section 2: Overview of Module Framework – Required

- **Real-world context**: From facial recognition in airports to AI-generated code in industry, machine learning is transforming how technology interacts with our daily lives. In this module, students will explore how AI models are trained, how bias and imbalance can affect outcomes, and the ethical implications of using AI tools, especially for code generation. Students will ultimately design and implement a simplified object detection task using their own collected data streams or adapted existing models.

- **Possible Lesson Ideas**:
  - Warm-up activity: AI in everyday life scavenger hunt
  - AI ethics debate: Should AI-generated code be trusted or credited?
  - News article discussion on real-world AI failures or bias incidents

- **Background STEM content**: Students will gain foundational knowledge about types of AI, how machine learning works, and how data quality affects model outcomes. They'll learn about supervised image classification, data visualization, and evaluation metrics such as accuracy, precision, recall, and confusion matrices. Background on neural networks and transfer learning will be simplified for student accessibility.
  - **Possible Lesson Ideas**:
    - Hands-on coding in Google Colab with MNIST and CiFAR-10 datasets
    - Small-group activity: Label and visualize your own classroom image dataset
    - Video explainer and discussion: How object detection works in computer vision

- **Description of Main Activity/Project**: Students will begin by experimenting with classic image classification datasets (MNIST and CiFAR-10), analyzing the data for imbalances and model performance. They will then collect their own images or use a pre-collected dataset from their school/classroom and train a basic object detection model using an AI platform (such as Roboflow or Google's Teachable Machine). Finally, students will reflect on AI ethics, focusing on the risks of bias in data and model outcomes, and discuss the growing role and ethical concerns of LLMs in code development.
  - **Possible Activity/Project Ideas**:
    - Data collection activity (images of objects in the classroom)
    - Data visualization project (class distribution, data imbalance)
    - ML training sessions with MNIST and CiFAR-10
    - Object detection demo with a live webcam feed
    - LLM code generation ethics debate and policy writing

SECTION 3: MODULE SEQUENCING AND ASSESSMENT – REQUIRED

- **Brief description of sequenced learning objectives**:

Lesson	Objective
1	Define types of AI, machine learning, and data. Discuss real-world applications and ethics concerns in AI.
2	Work with MNIST dataset; train, evaluate, and visualize model performance. Identify limitations and bias.
3	Use Ml4K to create and train a model, and implement with Python
4	Explore object detection concepts. Collect data or use existing webcam streams. Understand dataset labeling, size, and storage challenges.
5	Discuss ethical concerns with AI models and LLMs in code development. Review real-world cases and write an AI acceptable-use policy for the classroom.
6	Present final projects: data visualizations, model performance reports, and ethical reflections.

- **Brief description of formative and summative assessment approaches**:
  - **Formative:**
    - Daily exit slips (concept check questions)
    - Notebook or digital journal reflections on AI models and ethics

- Group discussions and polls (e.g., Kahoot, Padlet)
- Code notebook checks for data visualizations and model training steps

- **Summative:**

  - AI model performance report (accuracy, confusion matrix, data visualizations)
  - Class debate or written reflection on AI ethics and LLMs
  - Final presentation of object detection projects and ethical review

- **Recommendations for implementation**:
  - Ensure all students have access to devices with internet and a Google account for Colab
  - Preload datasets or prepare links in advance to avoid delays
  - Use simplified object detection tools (Teachable Machine, Roboflow) for ease of use
  - Scaffold students' coding tasks with provided starter notebooks
  - Build in extra time for debugging AI models
  - Establish clear classroom policies for appropriate AI tool usage, including code generation tools
  - Prerequisite Information:
    - What is data science?
    - Types of data and means of collection
      - Lookup vs. compute vs. relate
    - Jobs in data analytics
    - Data Science Life cycle
      - Ask - Consider - Analyze - Interpret
      - Types of Data- Qualitative (why, how, which one) vs. Quantitative (quantity)
        - Can you perform arithmetic operations? If not, qual, not quan
      - SciKit
      - Pandas
      - TensorFlow

Section 4: Module Files – Optional

- ☐ **List of attached files**: All lesson plans are here: RET Project Lesson Plans
  - ☐ Intro to AI and Ethics — Warm-up activity and AI ethics discussion guide
  - ☐ LLM Ethics Discussion — Slide deck for AI code generation ethics lesson
  - ☐ MNIST Lab (ipynb) — Google Colab notebook for MNIST model training
  - ☐ ML4K - Create and Train a model
    - ☐ OPTIONAL: CiFAR10 Analysis (ipynb) — Google Colab notebook for CiFAR-10 dataset exploration
  - ☐ Object Detection Project — Project instructions for object detection activit
    - ☐ Final Project Rubric — Grading rubric for final presentations