**Enhancing AI Literacy Through Interactive Fruit Ripeness Classification: A Machine Learning Game for K-12 Education**

**1. Abstract**

This project introduces an interactive fruit ripeness classification game leveraging machine learning to enhance AI literacy in K-12 education. The system enables users to train a model using labeled images of ripe and unripe fruit, then test its predictions. By providing hands-on experience with supervised learning through an intuitive user interface and real-time feedback, the game makes machine learning concepts more accessible to students. Additionally, the system incorporates Explainable AI (XAI) techniques to provide transparent explanations for its predictions, further enhancing students' understanding of AI decision-making processes.

**2. Introduction and Motivation**

As machine learning increasingly permeates everyday applications, understanding its principles remains challenging for K-12 students. This project bridges the gap between theoretical AI concepts and practical applications in education through an engaging, interactive learning activity. By allowing students to train a model and observe its predictions, the project enhances their understanding of AI, classification algorithms, and data-driven decision-making. The integration of XAI techniques ensures that students gain insights into how the model makes decisions, fostering a deeper understanding of AI systems.

**3. Related Work**

A comprehensive literature review explored previous work in AI education and image classification. Key papers include:

1. Chen et al. (2020) "Artificial Intelligence in Education: A Review."
2. Latif et al. (2023) "Machine Learning in Higher Education: Students' Performance Assessment Considering Online Activity Logs."
3. Pesek et al. (2022) "The Role of AI in the Education and for the Education."
4. Mon et al. (2023) "A Study on Role of Artificial Intelligence in Education."
5. Wu (2020) "Machine Learning in Education."
6. Jotsov et al. (2022) "Using Machine Learning Algorithms to Improve Education Process."  
   These studies underscore the importance of hands-on AI education and support the integration of interactive classification tools in classrooms. Recent trends also highlight the need for Explainable AI in educational contexts to enhance transparency and trust in AI systems.

**4. Design**

The project features an intuitive user interface implemented using Tkinter, including:

* A training interface for uploading labeled fruit images
* A testing interface for classifying new images
* A results section displaying model predictions with visual feedback
* Graphical representations of classification accuracy using pie and bar charts
* Explainable AI Features: The system provides explanations for its predictions, allowing students to understand which features of the fruit images influence the model's decisions.

Curriculum Alignment  
The project aligns with AI4K12's Five Big Ideas:

1. Perception: Fruit image analysis as sensor input simulation
2. Representation: Comparing human vs. AI feature detection
3. Learning: Model accuracy progression tracking
4. Natural Interaction: UI design journaling activity
5. Societal Impact: Food waste reduction and speed up processes

Cross-Disciplinary Connections

* Biology: Fruit ripening processes
* Math: Statistical analysis of accuracy metrics
* Ethics: Discussion on agricultural AI impacts

**5. Technical Implementation**

The system is implemented in Python, incorporating:

* Image feature extraction using OpenCV
* Tkinter for GUI development
* Matplotlib for data visualization
* A dataset of fruit images labeled as "ripe" and "not ripe"
* Explainable AI Techniques: The model uses techniques like LIME to provide transparent explanations for its predictions, enhancing students' understanding of AI decision-making processes.

**6. Research Questions, Data Collection Methods, and Learning Activities**

Research Questions

* How does the interactive fruit ripeness classification game enhance students' understanding of machine learning and classification algorithms?
* What is the impact of providing real-time feedback on students' learning about supervised learning techniques?
* How do students perceive the transparency of AI decisions when Explainable AI (XAI) techniques are incorporated into the game?
* Does the game's interactive nature increase student engagement in learning about AI and machine learning?

Data Collection Methods

* Pre-survey to assess students' prior knowledge of AI
* Post-survey to evaluate learning outcomes and engagement levels

Learning Activities

* Model training using a dataset of fruit images
* Model testing and prediction accuracy analysis
* Discussions on AI bias and dataset selection