Programming with Machine Learning and AI | Course Overview

Year-Long Course Outline with CTE Competencies

Pre-requisite – Intro to Robotics Programming

Equipment Requirements – XRP Red Vision Kit or Husky Lens, *FIRST* Tech Challenge Kit with Camera, *FIRST* Robotics Competition Robot with Camera

Course Description

This advanced course challenges students to move beyond scripted responses toward autonomous intelligence. Students will focus on high-speed data processing, advanced path planning, and computer vision. The course emphasizes Industry 4.0 standards, requiring students to build robust, fault-tolerant systems ready for *FIRST* Robotics Competition championship-level play and professional technical careers.

Course Outcomes

COMPETENCY	STUDENT OUTCOMES
Develop Computer Vision Pipelines	Students will program robots to identify, track, and calculate 3D coordinates of objects using Limelight or OpenCV.
Architect Modular Command-Based Code	Students will use Design Patterns (like Command-Based programming) to create reusable, decoupled software subsystems.
Optimize Motion Profiling & Path Planning	Students will implement trajectories and S-curve motion profiling to achieve smooth, high-speed autonomous navigation.
Integrate Edge AI & Machine Learning	Students will deploy pre-trained AI models onto the robot to perform complex classification or decision-making tasks in real-time.
Implement Real-Time Telemetry Dashboards	Students will build custom dashboards to monitor robot health, heat maps, and "black box" diagnostic data during operation.
Apply Industry Standard Version Control	Students will utilize GitHub for collaborative coding, managing branches and merging code within a team environment.
Communicate Using Technical Documentation	Students will produce flowcharts, pseudocode, and Engineering Notebook entries that follow software industry standards for clarity.
Collaborate Effectively in Programming Teams	Students will demonstrate teamwork skills including code reviews, shared responsibility, and modular software design in group tasks.

Industry Certifications

- **Python Institute:** PCAP – Certified Associate in Python Programming
- **Certiport:** IT Specialist – Software Development / Java / JavaScript
- **OpenCV University:** Official OpenCV Certification (Foundational to Professional levels)

FIRST Training learning content that can be used to implement this course.

XRP	FIRST Robotics Competition	FIRST Tech Challenge
XRP Sparkfun Red Vision Kit	Module 9: Electrical and Programming	FIRST Tech Challenge Docs
	FIRST Robotics Competition WPIlib	

Standards Alignments

Organization	Aligned Standards
NGSS	HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4, HS-PS2-1, HS-PS2-2, HS-PS4-5
ISTE	1.1.a, 1.1.c, 1.2.a, 1.2.b, 1.4.a, 1.4.b, 1.5.a, 1.5.b, 1.5.c, 1.6.a, 1.6.b, 1.7.a, 1.7.b
ITEEA (STEL)	1M, 2P, 3J, 4I, 5H, 6F, 7J, 8J, 9K, 10L
NIMS	Measurement Materials & Safety (MMS), Quality & Continuous Improvement, Industrial Technology Maintenance Awareness, Electrical Systems (Fundamentals), CNC Operations (Intro), Workforce Readiness
NBEA	Information Technology II.A, Information Technology III.A, Communication III.A, Management III.A, Career Development I.B
ACTE-CRP	CRP1, CRP2, CRP4, CRP6, CRP7, CRP8, CRP9, CRP10, CRP11, CRP12