

Course Description

This course outlines the architecture of AMD Versal™ AI Engine ML v2 (AIE-ML v2), a part of AMD Versal AI Edge Series Gen 2 devices, and explores the features and key architectural enhancements with this iteration of AI Engines.

This course provides an overview of both native and supported data types and highlights how to program the AI Engine and migrate older AI Engine designs. The enhancements included in AIE-ML v2, utilizing the DSP libraries, along with the compute capabilities and how to analyze performance, will also be demonstrated.

The emphasis of this course is on:

- Providing an overview of the new AI Engine (AIE-ML v2) architecture
- Describing the system design planning and application partitioning methodology
- Describing the AMD Vitis™ and AI Engine tool flow
- Providing an overview of the native and supported data types for functional implementation in AIE-ML v2
- Illustrating the programming model and the usage of memory tiles (shared buffers) for AIE-ML v2
- Utilizing the Vitis DSP library for AI Engines in implementing a matrix multiplication with multiple tiles
- Analyzing reports using the Vitis Analysis view and reviewing throughput and performance of different AI Engine architectures

What's New for 2025.2

- All labs have been updated to the latest software versions

Level – VER 1

Course Details

- 1 day ILT or 2 sessions/9

Course Part Number – AIE-MLV2-ARCH

Who Should Attend? – DSP users, software developers, system architects, and anyone who needs to accelerate their software applications using our devices

Prerequisites

- Familiarity with the C/C++ programming language
- Vitis tool for acceleration development flow
- Familiarity with basic signal processing concepts

Software Tools

- Vitis Unified IDE 2025.2
- Optional: MATLAB® tool (any latest version)

Hardware

- Architecture: Versal adaptive SoCs

After completing this comprehensive training, you will have the necessary skills to:

- Describe the AMD Versal AI Engine AIE-ML v2 architecture
- Follow the system partitioning and system mapping methodology
- Describe the AI Engine tool flow and utilize the supported data types for AIE-ML v2
- Program the AI Engines with the help of the programming model and describe the utilization of memory tiles

- Utilize the AI Engine DSP library and test a matrix multiplication design with multiple tiles for parallelization
- Analyze AI Engine designs using the Analysis view (Vitis Analyzer utility) and analyze the throughput and performance of different AI Engine architectures

Course Outline

- **AMD Versal Adaptive SoC: Architecture Overview**
Provides a high-level overview of the Versal architecture, illustrating the various compute resources available in the Versal architecture. {Lecture}
- **Introduction to the AIE-ML v2 Architecture**
Discusses the AI Engine AIE-ML v2 array architecture and its tiles. Also lists the key differences between the AIE, AIE-ML, and AIE-ML v2 architectures. {Lecture}
- **Versal AI Edge Series Gen 2: Application Partitioning**
Covers the system design planning and partitioning methodology. Also explains what application partitioning is and how an application can be accelerated by using various compute domains in the Versal device. {Lecture}
- **Versal AI Edge Series Gen 2: AIE-ML v2 Tool Flow**
Reviews the Vitis tool flow for the AI Engine and demonstrates the full application acceleration flow for the Vitis platform. {Lecture, Lab}
- **Supported Data Types for AIE-ML v2**
Provides an AI Engine functional overview and identifies the supported vector data types and high-width registers for allowing single-instruction multiple-data (SIMD) instructions. Covers the vector-based floating-point data types and block floating-point data types. {Lecture}
- **The Programming Model and AIE-ML v2 Memory Tiles**
Highlights the basics of AI Engine kernels and graph code as well as the data flow graph model. Also describes the memory tiles in the AIE-ML v2 architecture and illustrates AI Engine-ML v2 programming using both shared buffers and external buffers with the AIE-ML v2. {Lecture, Lab}
- **Overview of the AI Engine DSP Library with AIE-ML v2**
Provides an overview of the AI Engine DSP library, which enables faster development and comes with ready-to-use example designs that help with using the library and tools. Also describes how to use and configure the library functions. {Lecture, Lab}
- **Analyzing the AI Engine Design Reports and Performance**
Covers the different reports generated by the Analysis View in the Vitis Unified IDE and how to use these reports to optimize AI Engine designs. Also shows how to migrate a design to the new architecture as well as compare performance improvements after migration. {Lecture, Lab}