Quick Start Guide

Renesas RUHMI Framework

Quick Start Guide

Renesas RA Family
RA8P1 Series

Rev.1.01 October 2025

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Corporate Headquarters
TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact information
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Precautions

This Evaluation Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area, or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.
The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:
• Ensure attached cables do not lie across the equipment.
• Reorient the receiving antenna.
• Increase the distance between the equipment and the receiver.
• Connect the equipment into an outlet on a circuit different from that which the receiver is connected.
• Power down the equipment when not in use.
• Consult the dealer or an experienced radio/TV technician for help.
Note: It is recommended that wherever possible shielded interface cables are used.
The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:
• The user is advised that mobile phones should not be used within 10 m of the product when in use.
• The user is advised to take ESD precautions when handling the equipment.
The Evaluation Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1.Precaution against Electrostatic Discharge (ESD)
A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2.Processing at power-on
The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3.Input of signal during power-off state
Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4.Handling of unused pins
Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5.Clock signals
After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6.Voltage application waveform at input pin
Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7.Prohibition of access to reserved addresses
Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8.Differences between products
Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

Renesas RUHMI Framework

EK-RA8P1 - Quick Start Guide

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1. Introduction

This Quick Start Guide (QSG) provides a practical introduction to the Renesas RUHMI (Robust Unified Heterogeneous Model Integration) framework, in which AI compiler is by powered by EdgeCortix® MERA™. and it is optimized for Renesas RA microcontrollers.

The guide covers:

- An overview of RUHMI Framework's key features, including model quantization, compilation, and C source code generation.
- Step-by-step instructions for installing and running RUHMI Framework in both Linux and Windows environments.
- Usage of AI application example for deploying TensorFlow Lite, ONNX, and PyTorch/ExecuTorch models with optional acceleration using Arm® Ethos-U55.
- Usage of RHUMI framework with your AI model and your project.

1.1 Assumptions and Advisory Notes

To use RUHMI Framework effectively, the following conditions and knowledge are assumed:

1. **Tool experience:** Users are expected to have prior experience with embedded development and AI model training using frameworks such as TensorFlow or PyTorch/ExecuTorch.
2. **Model access:** It is assumed that users already possess or have access to pre-trained models in TensorFlow Lite (.tflite), ONNX (.onnx) , PyTorch/ExecuTorch(.pte) format.
3. **Subject knowledge:** Familiarity with microcontroller-based systems, C programming, and Renesas Smart Configurator tools are required.
4. **Supported platforms:** RUHMI Framework targets Renesas RA family MCUs. Optional support for the Arm® Ethos-U55 NPU is available through the Arm Vela compiler. Verify hardware compatibility before use.
5. **Software versioning:** Always use the latest version of RUHMI Framework to ensure compatibility with supported models, libraries, and runtime tools.
6. **Screen references:** Figures and UI examples in this guide are for reference only. Actual screen layouts or paths may differ depending on the software version.

2. RUHMI Framework Overview

RUHMI (Robust Unified Heterogeneous Model Integration) Framework is a model deployment toolchain developed to enable AI model deployment on embedded processors. It enables efficient and scalable deployment of machine learning models on edge devices with limited memory and power budgets. RUHMI Framework's first backend iteration has been optimized to support Renesas RA8 series of microcontrollers by leveraging a modified version of MERA™2.0 from Renesas partner EdgeCortix®.

RUHMI Framework supports widely used model formats including TensorFlow Lite, ONNX, and PyTorch/ExecuTorch. It is also capable of deploying models to both CPU-only and CPU+NPU (Arm® Ethos-U55) configurations.

RUHMI Framework is ideal for real-time applications such as:

- Object detection
- Speech recognition
- Industrial and consumer edge AI use cases

It is designed to minimize hardware-specific complexity while offering developers a flexible, framework-agnostic toolchain.

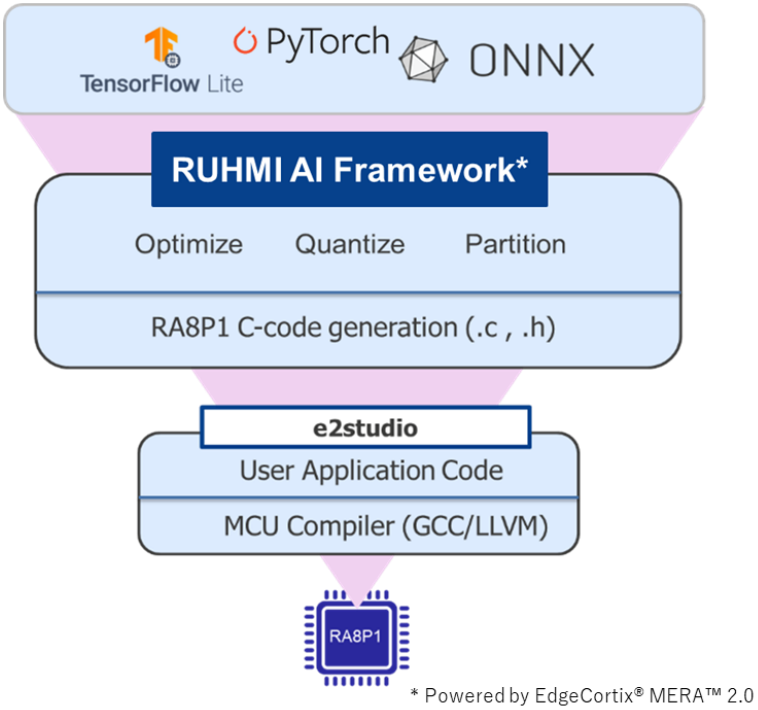

Figure 2.1 RUHMI Framework Overview

Key Features of RUHMI Framework

- Supports FP32 (floating-point) and INT8 (quantized) inference
- Automatically partitions operators between CPU and NPU based on hardware constraints
- Generates optimized C/C++ source code for integration into e² studio projects
- Uses CMSIS-NN and soft-float libraries for portable MCU inference
- Supports external memory for large models beyond SRAM size
- Built-in quantizer with PSNR-based validation for post-training quantization
- Integrated utilities for reference data generation, runtime testing, and MCU verification
- Seamless integration with **TensorFlow Lite (.tflite), ONNX (.onnx) , PyTorch/ExecuTorch(.pte) format.**
- Compatible with both Linux CLI and Windows CLI / GUI(AI Navigator) environments

The project example included in this guide demonstrates the following:

(1) Import of a pre-trained AI model in the supported format
(2) Post-training quantization using RUHMI Framework's built-in quantizer
(3) Compilation into optimized C source code for Renesas RA8P1 platform
(4) Generation of input/output reference data for validation
(5) Deployment and execution on an evaluation board via Renesas e² studio

You can get the software, the technical documentation and the application example project from GitHub repository, renesas/ruhmi-framework-mcu: Renesas RUHMI Framework supports AI model optimization and deployment, and is powered by EdgeCortix® MERA™

3. Running RUHMI Framework with Windows GUI: AI Navigator

RUHMI Framework supports a GUI-based model deployment workflow via the AI Navigator in Renesas e² studio. This section explains how to import and convert an AI model (e.g. TFLite) using the GUI, and how to integrate it into your Renesas RA8P1 project.

Hardware Requirements

- EK-RA8P1 Evaluation Kit
- USB-C to USB-C cable
- A PC with at least one available USB port

Software Requirements

- Windows® 10 or 11 operating system. Renesas e² studio version: 2025-10
- Flexible Software Package (FSP): 6.1.0 or later.
  - Refer to the webpage (RA Flexible Software Package Documentation) for the details.
- AI Navigator v2.1.0 for GUI
  - Visit the AI Navigator web page (AI Navigator: IDE for AI Applications | Renesas) and download the release note. It includes the features, changes, additional notes, and more.

3.1 Introduction

AI Navigator is a set of plugins for e² studio that makes it easy to develop the edge AI application with Renesas devices. One of the plugins, AI Model Conversion Tool Plugin uses RUHMI Framework to provide AI model conversion feature.
The development steps using AI Navigator are shown below. All steps can be controlled by the AI Navigator.

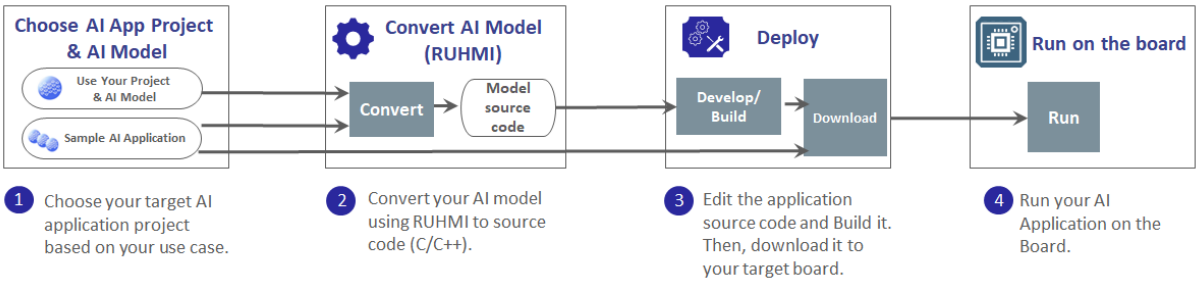

Figure 3.1 AI Navigator development flow

3.2 Installation

- **New e² studio users**

Download e² studio 2025-10 from the following link:
e² studio 2025-10 installer for Windows After downloading, install e² studio.
Select the following each item when installing.
- Device Family: RA
- Additional Software: Renesas AI Navigator, AI Model Conversion Tool Plugin, and Renesas FSP v6.1.0

- **e² studio users**

Download and install FSP v6.1.0 or later.
Then, add the necessary plugins by following the steps below.:
1. Launch e² studio.
2. Click **[Help]** > **[Install Renesas IDE Features...]**.

(Refere to Figure 3.2 Install IDE feature (1))
3. Select **[Renesas AI Navigator]** and **[AI Model Conversion Tool Plugin]**.
4. Click **[Finish]**.

(Refere to Figure 3.3 Install IDE feature (2))
5. Confirm that these plugins are selected in the "install" dialog box and click **[Next]**.
6. Confirm these plugins are selected as the installation target and click **[Next]**.
7. Read the license agreements and select **"I accept the terms of the license agreement"** if you agree. Then, click **[Finish]** to start the plugins installation.
8. If the dialog of the trust certificate dialog appears during the installation, check the certificate and click **[OK]**.
9. After the installation is finished, e² studio will prompt you to restart.
10. Click **[Restart Now]**.

Note: If [Install Renesas IDE Features...] is not listed in [Help], please follow the steps below instead.
1. Click [Help] > [Install New Software...].
2. Click "Add..." and enter the following URLs in Location.
   - AI Navigator Plugin: https://tool-support.renesas.com/e2studio/ai/ai-navi
   - AI Model Conversion Tool Plugin: https://tool-support.renesas.com/e2studio/ai/rz_tvm

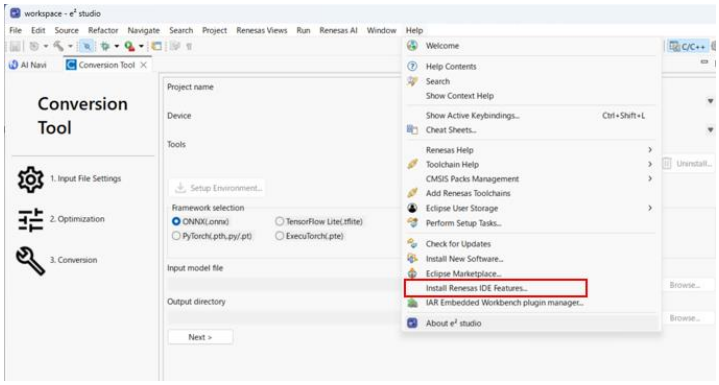

Figure 3.2 Install IDE feature (1)

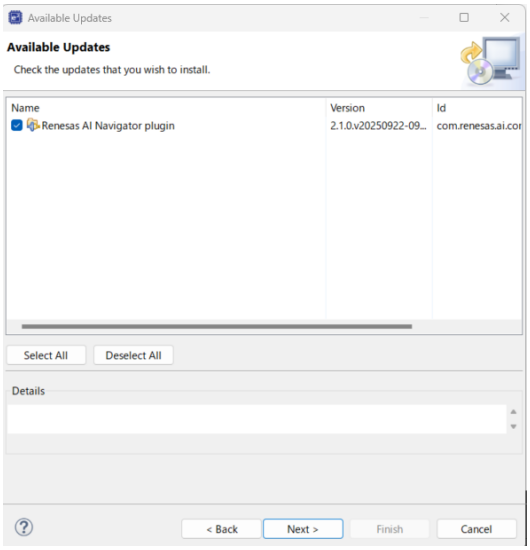

Figure 3.3 Install IDE feature (2)

3.2.1 RUHMI update from Conversion Tool

You can confirm the installation status in Conversion Tool. Open Conversion Tool from Renesas AI in the menu.

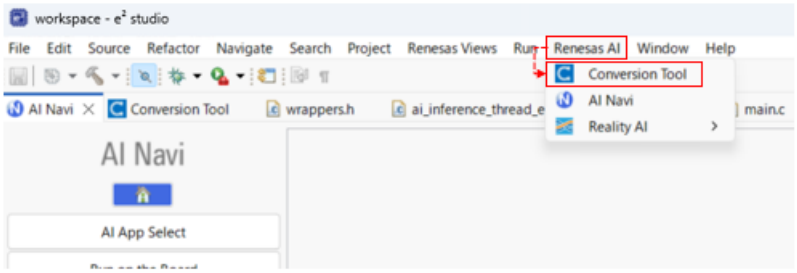

Figure 3.4 Renesas AI menu

Conversion Tool supports the auto installation feature for RUHMI.
When RUHMI is not ready in the environment, AI Navigator will notify you RUHMI to be installed. By clicking the button of setup Environment, RUHMI will be installed automatically.

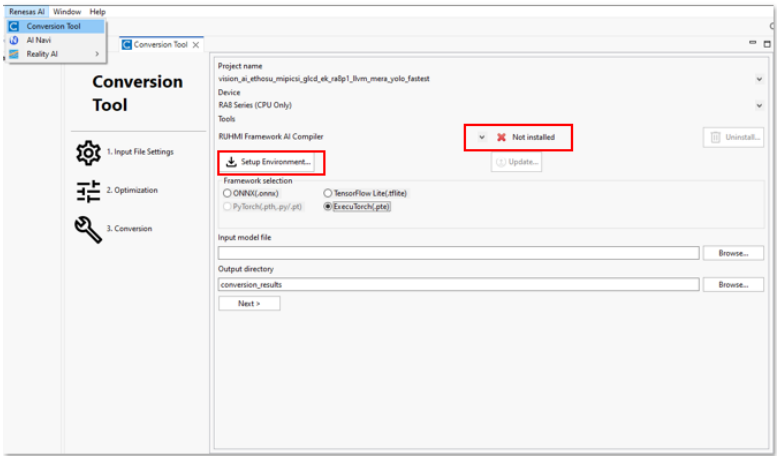

Figure 3.5 Auto installation

Conversion Tool also supports the auto update feature for RUHMI. If the latest package of RUHMI has been available in the GitHub repository, Conversion Tool will notify the ready-ness. (Figure3.6 Update feature)
Get RUHMI updated by clicking the update button. The update procedure will start automatically.

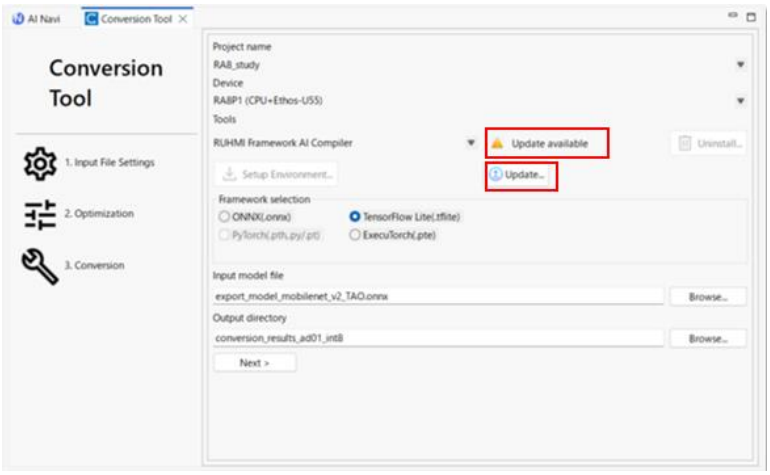

Figure 3.6 Update feature

In case no longer RUHMI is needed, you can uninstall RUHMI AI compiler by clicking the Uninstallation button. (Figure 3.7 RUHMI Uninstallation)

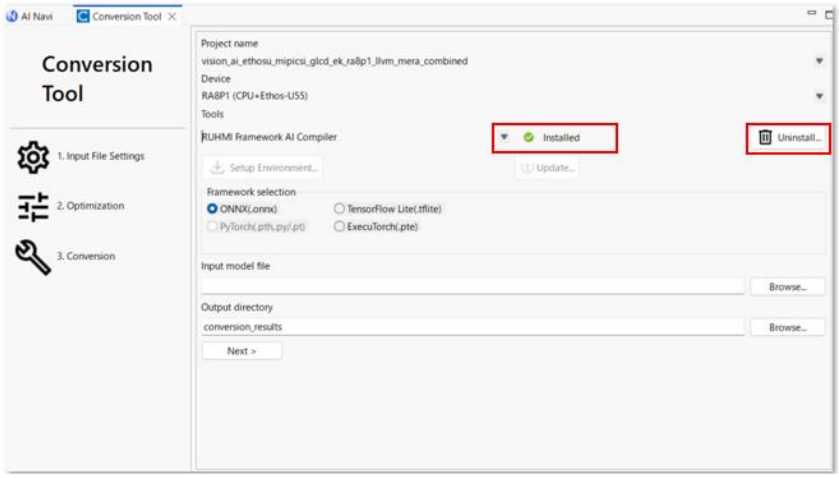

Figure 3.7 RUHMI Uninstallation

3.2.2 How to confirm the version of AI Navigator

You can confirm the version of AI Navigator installed in your host by following steps. Open the dialog providing detailed information for e2Studio from HELP menu in e2Studio.

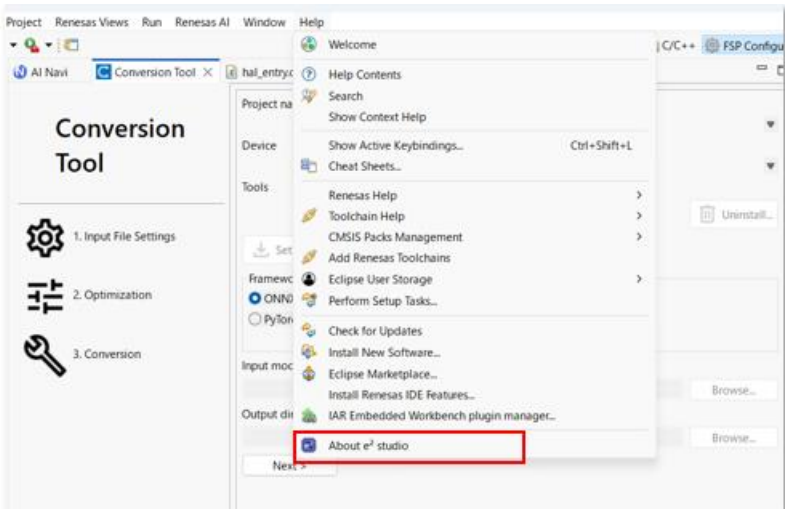

Figure 3.8 Help menu

Click the button of Installation Detail. Figure 3.9 Check the installation detail.

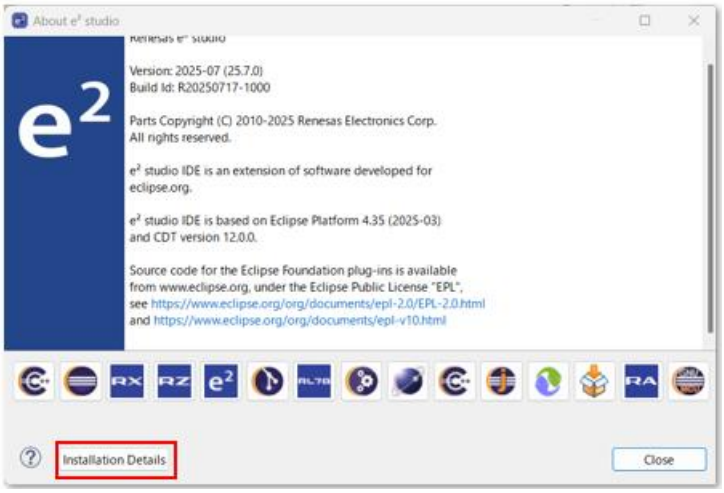

Figure 3.9 Check the installation detail

You can see the version information of AI Navigator installed in your host as below.

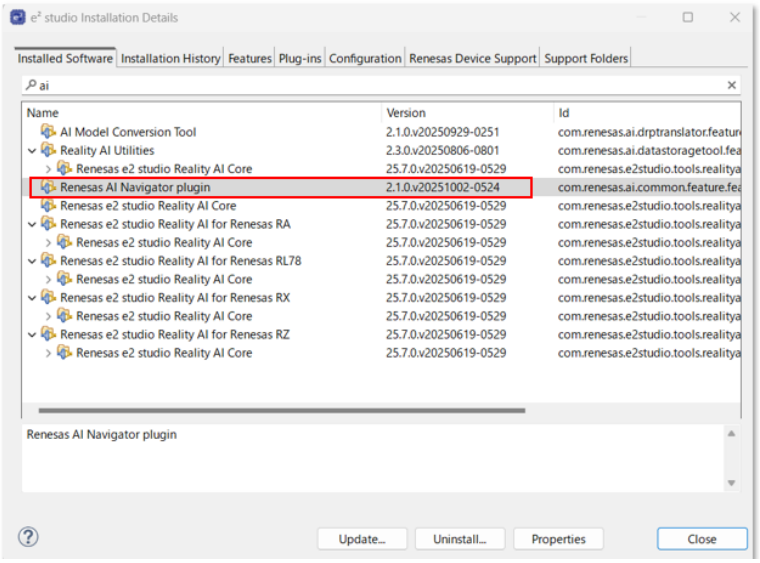

Figure 3.10 AV Navigator version

3.3 Getting Started

This section explains how to integrate an AI model into your project with AI Navigator, including model conversion using RUHMI Framework on GUI.
The following figure shows the workflow from opening to running on the board. It includes AI model conversion using RUHMI Framework.

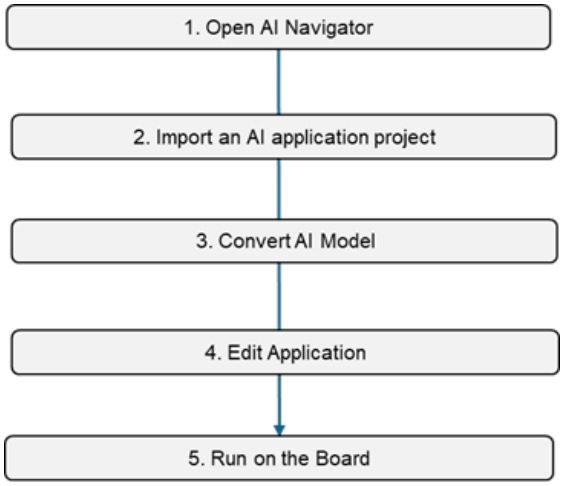

Figure 3.11 AI Navigator Workflow

3.3.1 Open AI Navigator

Open e² studio and your workspace.

Click **[Renesas AI]** as shown in the figure below to launch **AI Navigator** and **Conversion Tool**.

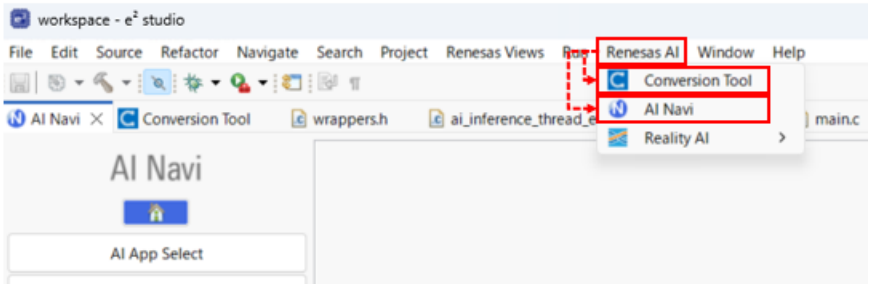

Figure 3.12 Opening AI Navigator

AI Navigator
This application provides you with selecting either sample application (AI application example) run and your project with your own converted model.

Conversion Tool:
This application provides the model conversion function with your own model input.

A dialog box may appear asking you to switch perspectives. If you accept, click **"Switch"** to continue.

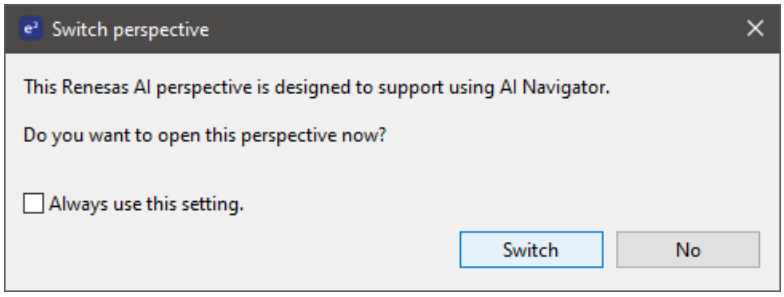

Figure 3.13 Switch perspective dialog box

AI Navigator will open.

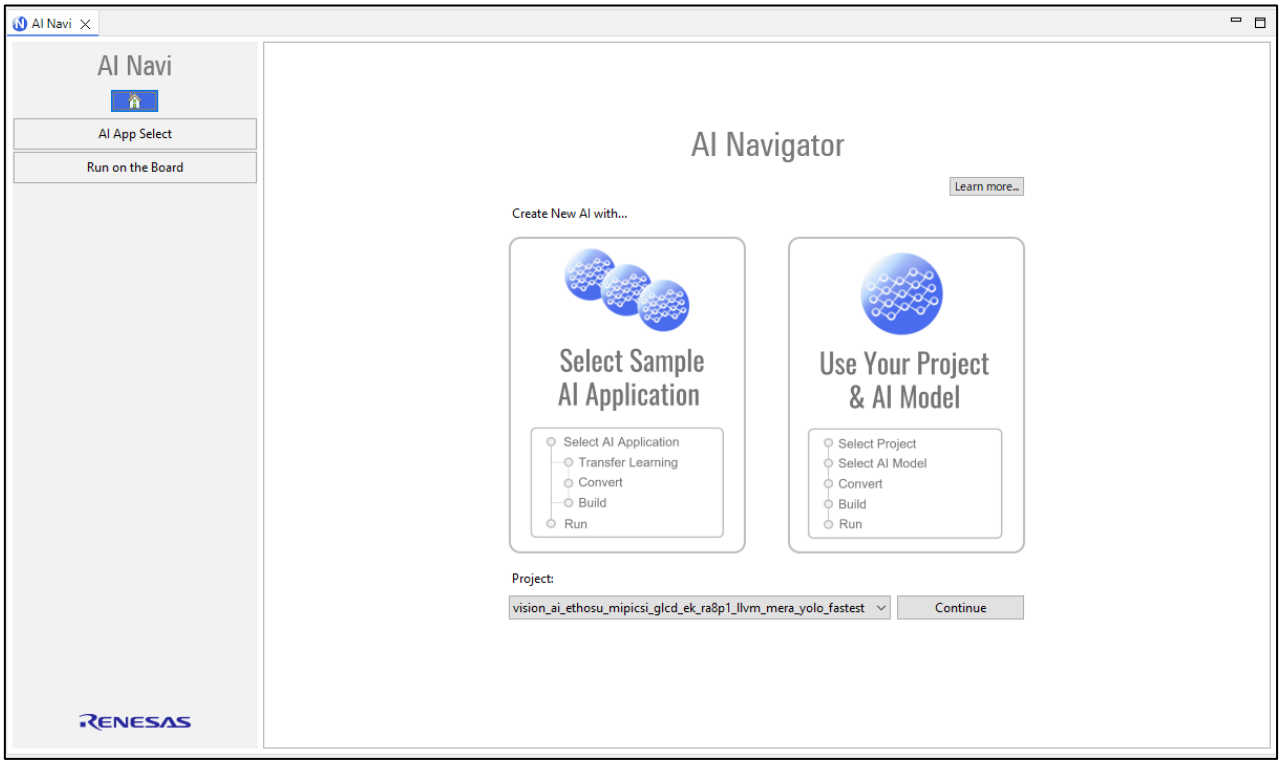

Figure 3.14 AI Navigator Welcome View

Note: If the Appearance Theme is set to "Light (Preview)", some GUI components such as buttons may not be displayed correctly.
Please change Theme to "**Light**" or "**Dark**" from **[Window]** -> **[Preferences] -> [General]** -> **[Appearance]**.

3.3.2 Import AI application Example

There are two ways to import a project.

- Select Sample AI Application (AI application Example)
- Use Your Project & AI Model

3.3.2.1 Select Sample AI Application (AI application Example)

With EK-RA8P1, it can run the following two AI application examples.

- Image classification
- Face detection

Using AI Navigator, you can import them into your workspace and run them onto the target board.
Follow the instructions below to import.

1. Click **[Select Sample AI Application]**.
2. Select a category of sample AI application (AI application Example) based on your case.
3. Choose sample AI application (AI application Example).
4. Click **[Import]**.
5. The Project and AI information view like below will appear if the import is successful.

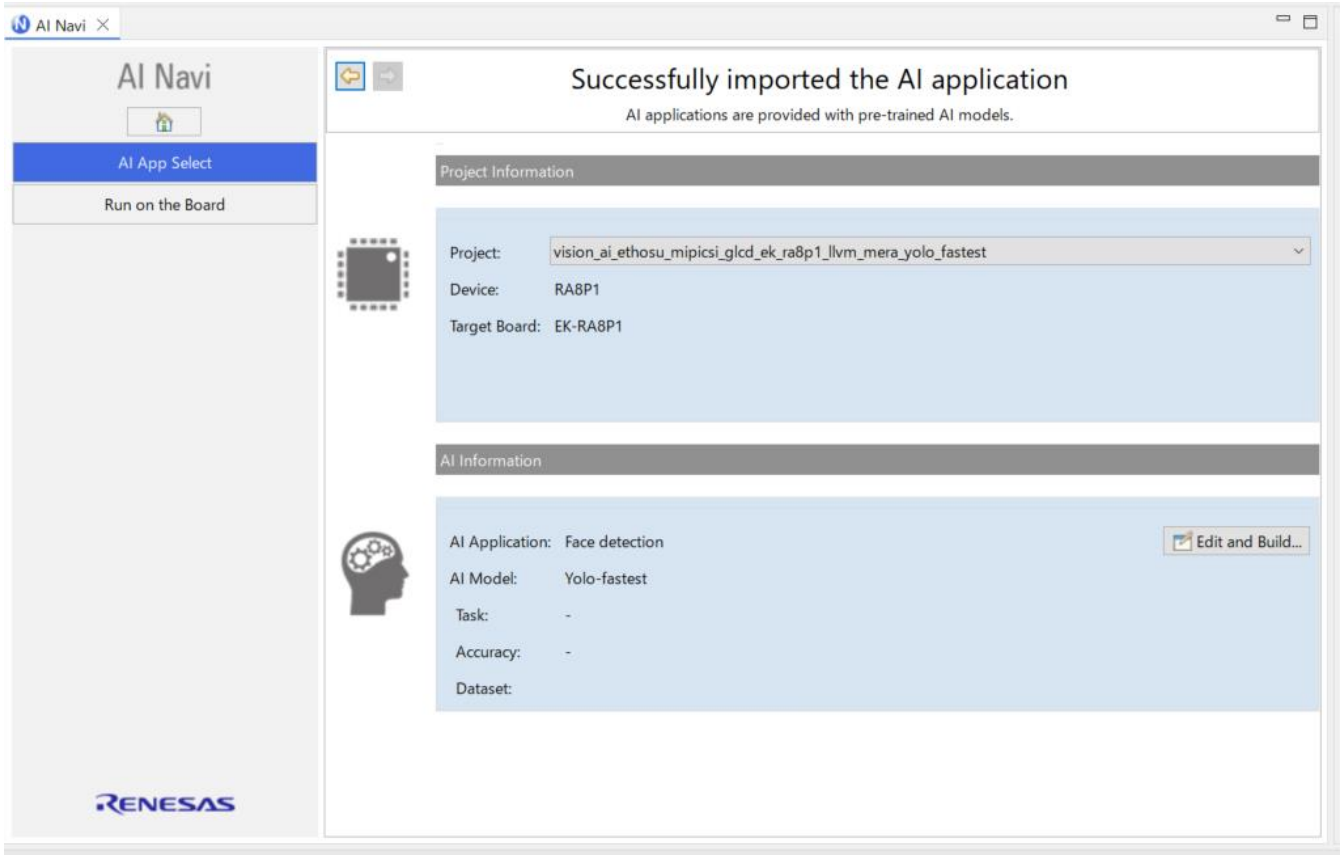

Figure 3.15 Project and AI information view

In case you just want to run the AI application example, click **[Run on the Board]** in the AI Navigator menu. (See 3.3.5 Run on the Board)
If you want to convert an AI model, click **[Edit and Build…]** in AI information to appear **[Convert AI Model]** in the menu.

3.3.2.2 Use Your Project & AI Model

AI Navigator also provides the user project feature that allows users to develop AI Applications using your own projects, including own AI model. Follow the instructions below to prepare and import your project and AI model.

1. Create or import an RA8P1 e^2 studio project into your work space.
   Note: Refer to RA Flexible Software Package Documentation for information about FSP project.
   Note: Add the following stacks if you use Ethos:
   - Google TFLM Core Lib
   - Google TFLM CMSIS-NN Kernel

   Once added, the required dependent stacks (such as ARM Ethos-U Core Driver, ARM CMSIS NN Library Source, ARM CMSIS DPS Library Source) will be included automatically. You can refer Using the Ethos-U NPU with RA8 MCUs to get more information.

2. Click **[Use Your Project & AI Model]** in the AI Navigator Welcome View.
3. Select your project prepared in 1. and click **[Finish]**.

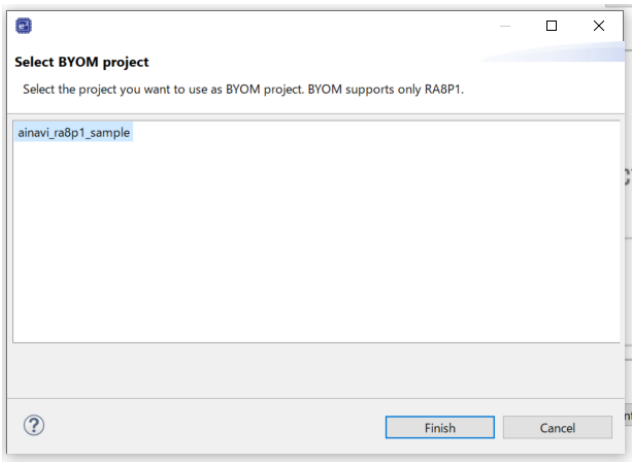

Figure 3.16 Select your project window

4. Click **[Use AI Model on Your PC]**.

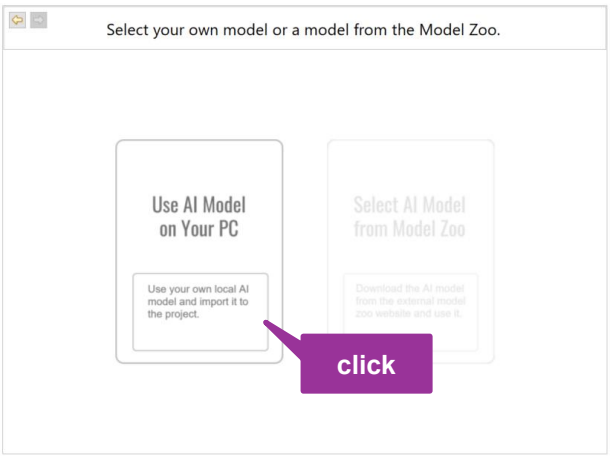

Figure 3.17 Use AI Model on Your PC

5. Select your AI model (*.tflite / *.onnx / *.pte).

Note: Please avoid using spaces in your AI model name. The AI model conversion may not succeed.

6. The Project and AI information view will appear when the project and AI model are imported successfully.

Figure 3.18 Project and AI information view (Use your project & AI model)

3.3.3 Conversion

After the setup, click **[Convert…]** and Conversion Tool will open.
Follow below three steps to convert AI model once Conversion Tool opens. These steps are also shown in the left-side menu in the figure (Figure 3.19 Conversion Tool).

(1) Input file settings
(2) Optimization
(3) Conversion

(1) Input file settings

With reference to Figure 3.19 Conversion Tool, please set the following settings in this view. After setting, click **[Next]**.

- **Project name**: Select your project.
- **Device**: Set your device
  You can see two options in the pull-down menu as Figure 3.20 Device setting.
  - RA8P1 (CPU+Ethos-U55): Using RA8P1
  - RA8 series (CPU only): RA8 series MCU without Ethos-U55
- **Tools**: RUHMI Framwork AI Compiler
- **Framework selection**: Select your mode framework.
  ONNX (.onnx), TensorFlow Lite (.tflite), PyTorch(.pth/.py), ExcuTorch(.pte)
- **Input model file**: Click **[Browse]** and select your target AI model.
  You can select the model file of the your selected framework type.
- **Output directory**: Specify the output directory for the conversion result.
  You cannot put any space in the folder name.

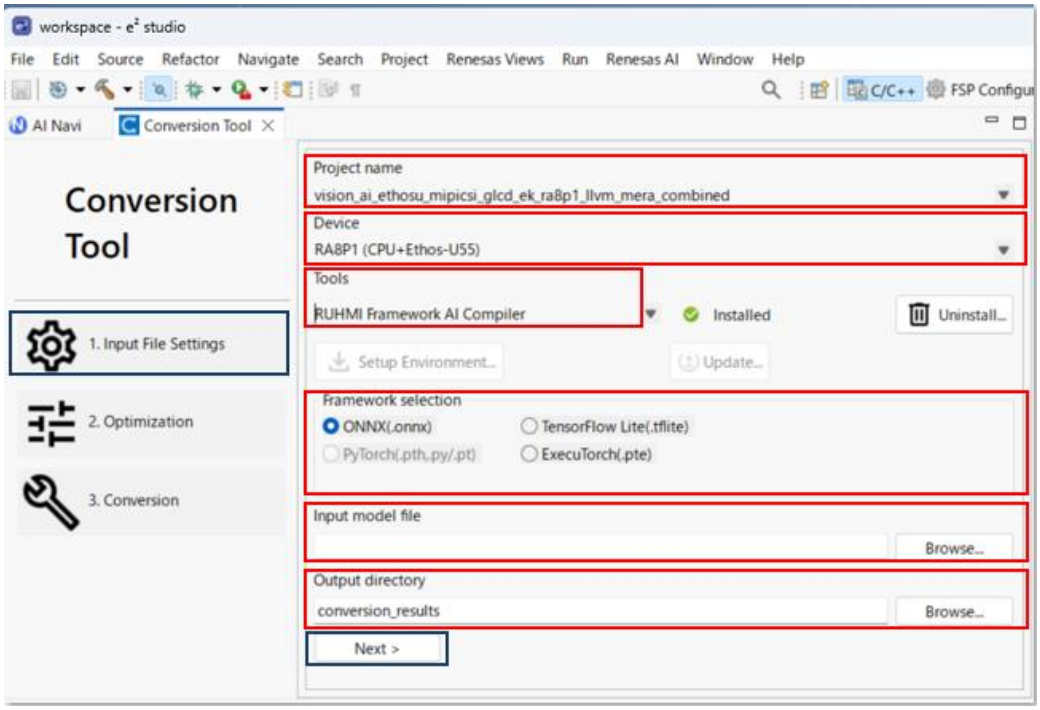

Figure 3.19 Conversion Tool

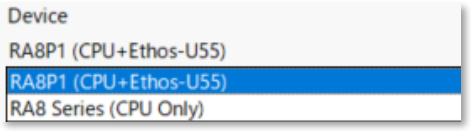

Figure 3.20 Device setting

(2) Optimization

In this view, you can perform quantization as needed to prepare your AI model into an optimized format.
If you select a quantized model as the input model file in the previous view, confirm that the message indicating a quantized AI model was loaded in Quantization result, and click **[Next]**. (Optimization (input file: a non-quantized model))

If you select a non-quantized model, perform quantization in this view. Set each parameter and click **[Start quantization]**. If quantization is successful, a message as shown in Figure 3.22 Optimization (input file: a non-quantized model) will appear. Click [Next] to continue.

Note: Click **[Learn more]** in this view and open AI Model Conversion Tool Help.
Refer to View 2: Optimization (Quantization) for the details about quantization.

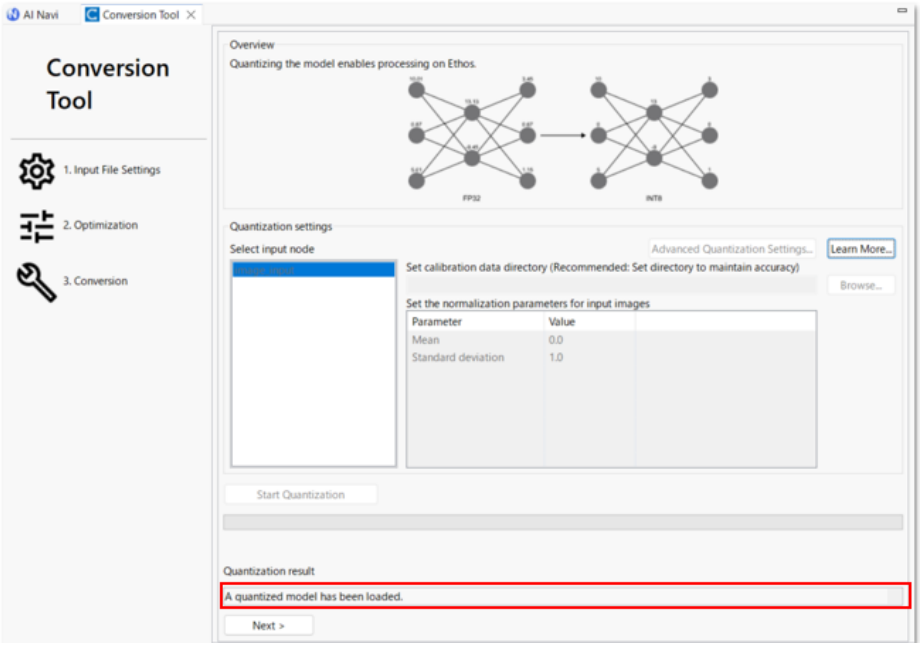

Figure 3.21 Optimization (input file: a quantized model)

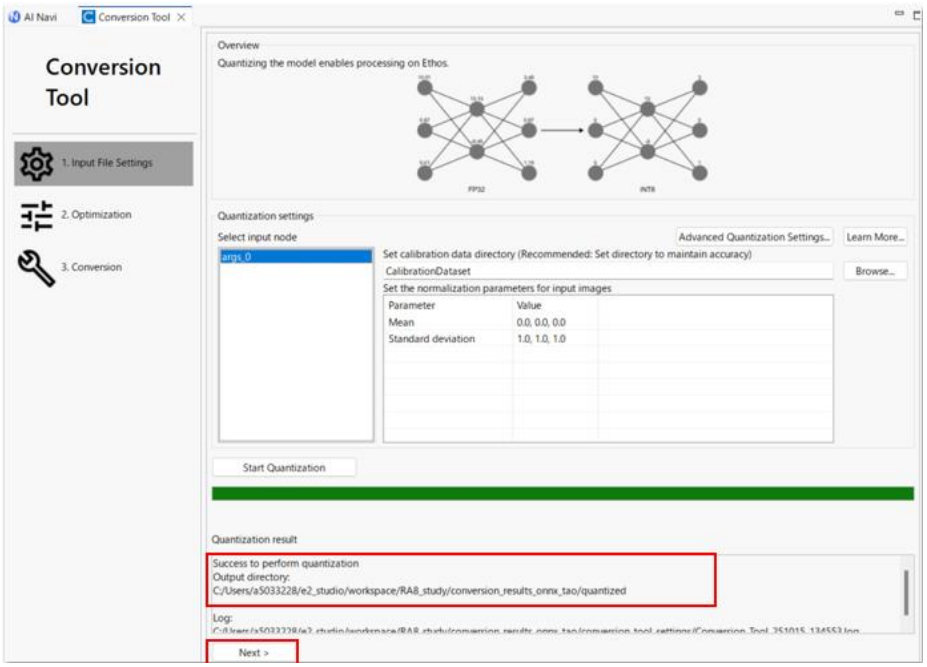

Figure 3.22 Optimization (input file: a non-quantized model)

(3) Conversion

Configure the following options as needed before conversion.

The optimization options depends on the conversion mode.

Case 1) Use CPU+ Ethos-U55

- **Optimize mode**:
  - **Performance**: (default) Optimize for maximum performance.
  - **Size**: Optimized for minimal RAM usage.
- **Memory mode**:
  - **Sram_Only**: (default) Specify when placing weights in the internal ROM.
  - **Shared_Sram**: Specify when placing weights in the external ROM.

Case 2) Use CPU only

- **Weight location (*for using CPU only)** :
  - **ROM**: (default) Neural network weight data is stored in ROM.
  - **RAM**: Neural network weight data is stored in RAM.

Additional options:

Click **[Browse]** and select your target AI model.

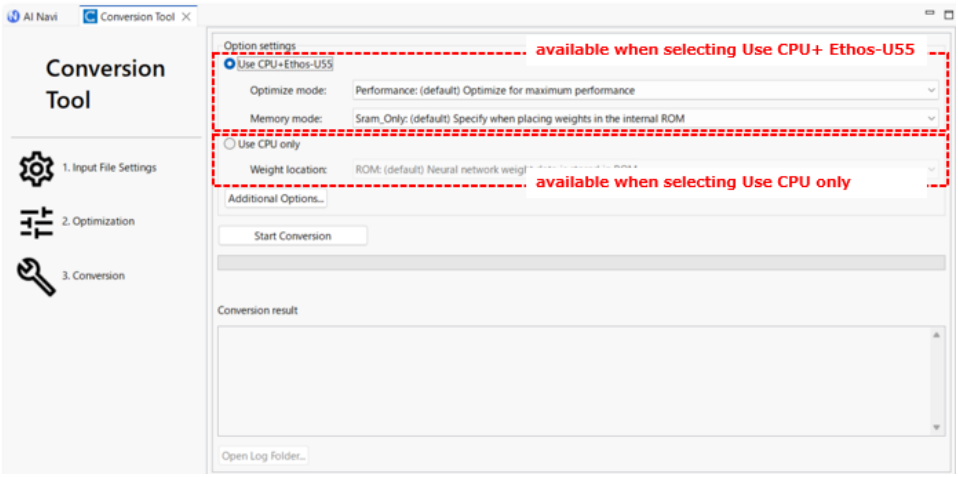

Figure 3.23 Conversion options

After setting options, click **[Start conversion]**. If the conversion is successful, a message indicating success will appear in the Conversion Result section, as shown in the figure below.

You can see the conversion log in the folder which you can open by clicking the button. The log file there should be helpful to get the support from Renesas.

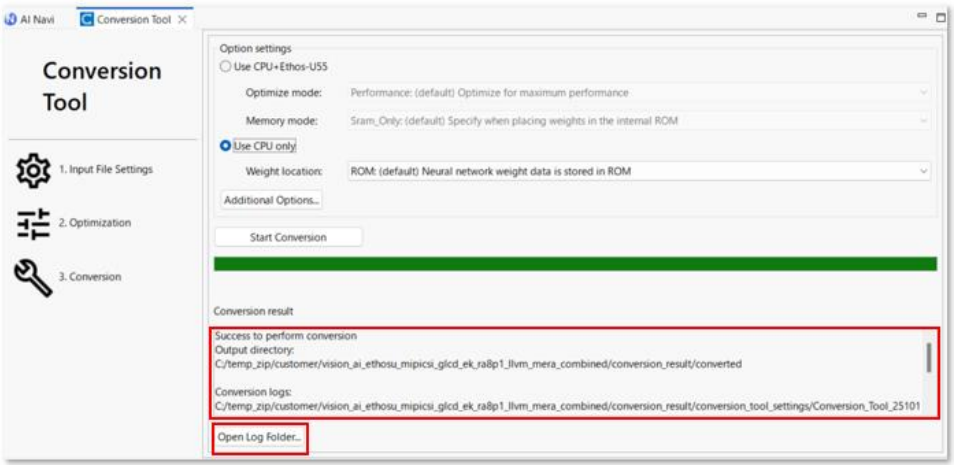

Figure 3.24 Conversion completed

3.3.4 Edit your application

After conversion, edit your application source code including the implementation of AI model (C/C++), and build your project.

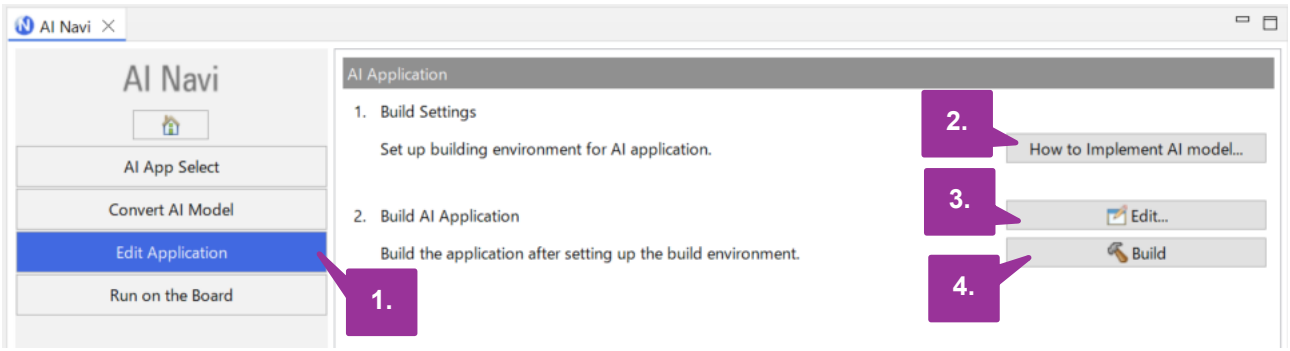

Figure 3.25 Edit Application

1. Click **[Edit Application]** in the AI Navigator menu.
2. Click **[How to Implement AI Model…]** to open “How to Implement AI model”. This document describes the steps from integrating the converted output code via RUHMI Framework to executing AI inference.
3. Modify the source code. When clicking **[Edit…]**, hal_entry.c will open. Integrate the AI model.
4. Click **[Build]**. The build result will be shown in the console.

3.3.5 Run on the Board

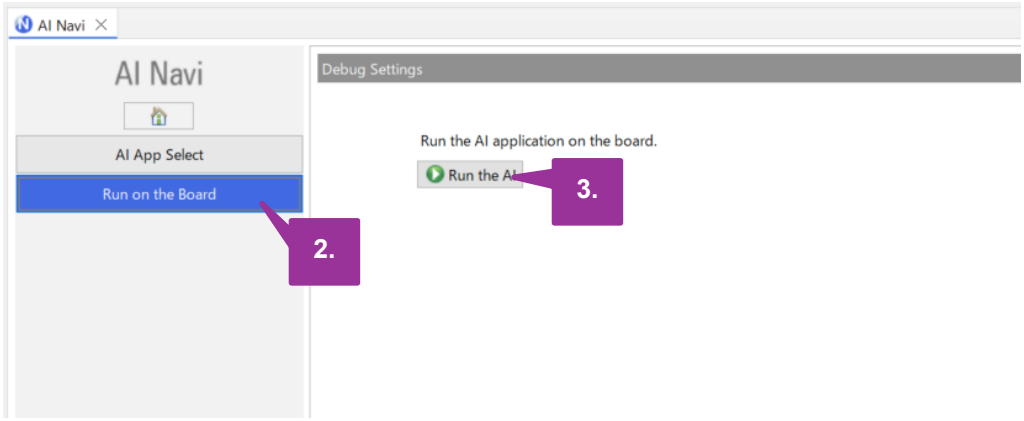

Figure 3.26 Run on the AI

To run your AI Application on the target board,

1. Connect EK-RA8P1.
2. Click **[Run on the Board]** in the AI Navigator menu.
3. In the Debug AI view, click **[Run the AI]** to start inference.

Note: When you try to run an RA8P1 AI application example via the [Run the AI] button, the build process will start automatically before debugging. To skip this auto build:

1. Open Debug Configurations.
2. Select your project in Renesas GDB Hardware Debugging.
3. Go to Main tab.
4. Choose “Disable auto build” or “Use workspace settings” in Build (if required) before launching.

4. Running the sample script by CLI interface

Without GUI interface provided by AI navigator, you can use RUHMI framework to convert AI model with CLI interface from the GitHub repository. You can install RUHMI with CLI interface supported by manual insulation following the coming section.

renesas/ruhmi-framework-mcu: Renesas RUHMI Framework supports AI model optimization and deployment, and is powered by EdgeCortix® MERA™

4.1 Software Requirements

- Windows® 10 or 11 operating system or Ubuntu 22.04 LTS.
- Flexible Software Package (FSP): 6.1.0

4.2 Downloading and Installing Software and Development Tools

Before modifying or running the sample scripts, it is necessary to download and install the required software and development tools on the host PC. RUHMI Framework supports installation and usage in the following environments:

Platform	Interface Type	Description
Linux (Ubuntu 22.04)	CLI	Full-featured environment. Recommended for advanced users and automation.
Windows	CLI	Suitable for scripting and model testing. Requires Python + VC Redistributable.
Windows	GUI	Integrated into e² studio. Ideal for beginners and visual, step-by-step setup.

4.2.1 Linux CLI Installation

Get the installation file from GitHub and place it in your PC.
GitHub repository: ruhmi-framework-mcu/install at main · renesas/ruhmi-framework-mcu
Installation files for Linux: mera-x.y.z+pkg.nnnn-cp310-cp310-manylinux_2_27_x86_64.whl

NOTE: x, y, z and nnnn mean the version number.
(e.g. mera-2.4.0+pkg.1756-cp310-cp310-manylinux_2_27_x86_64.whl)

Update the package index to ensure your system has the latest information about available software packages. and installs essential development tools such as GCC, and Make (build-essential), along with CMake, which is a tool used to manage build processes for compiling source code. Run the following commands:

```
sudo apt update
sudo apt install build-essential cmake python3-venv python3-pip
```

Recommended: use the default Python installation
Because MERA™ software stack is compatible by default with the base system Python version provided by Ubuntu 22.04 we can create a virtual environment as follows:

```
sudo add-apt-repository -yu ppa:ubuntu-toolchain-r/test
sudo add-apt-repository ppa:deadsnakes/ppa
sudo apt update && sudo apt upgrade
sudo apt-get install -q -y --only-upgrade libstdc++6 libgcc-s1
sudo apt update && sudo apt upgrade
sudo apt build-essential gcc-13 g++-13
sudo apt-get install python3.10 python3.10-venv python3.10-dev python3-pip
python3.10 -m venv mera-env
source mera-env/bin/activate
pip install --upgrade pip && pip install decorator typing_extensions psutil attrs pybind11 cmake
```

Your prompt should now show that you are under a virtual environment mera-env: **(mera-env) user@compute:~$**

Install MERA
Finally install MERA on the virtual environment mera-env:

```
pip install ./mera-2.4.0+pkg.1756-cp310-cp310-manylinux_2_27_x86_64.whl
```

NOTE: In this case, the installation file is “mera-2.4.0+pkg.1756-cp310-cp310-manylinux_2_27_x86_64.whl”. The suffix number of the file depends on the package version.

At this point MERA should be ready to use. You can confirm with the following example:

```
python -c "import mera; print(mera.__version__)″
```

4.2.1.1

Download the Microsoft Visual C++ Redistributable

Note: You must download vc_redist.x64.exe since RUHMI Framework's MERA™2.0 backend only supports X64 architecture PCs

- Run the download exe file to install Redistributable package.

Microsoft Visual C++ Redistributable latest supported download

Install Python 3.10.5
Download Python installer, Windows installer (64-bit), from Python Release Python 3.10.5 | Python.org.
Then install it on your PC.

Open **PowerShell** from the windows start menu. Create and move it to the working folder. Assuming **C:\work** is the current folder in the following process. You can confirm python is ready with the intended version.

```
PS <current directory>> cd C:\work
PS C:\work> python --version
Python 3.10.5
```

Prepare the virtual environment.
Build the virtual environment under the working directory.

```
py -3.10 -m venv .venv
```

Before activating the virtual environment, you may need to change the execution policy for shell execution.

```
Set-ExecutionPolicy -ExecutionPolicy RemoteSigned -Scope Process
.venv\Scripts\Activate.ps1
```

Your prompt should now show that you are under a virtual environment mera-env: **(.venv) PS C:\work>**

Install MERA backend and dependencies
Get the installation file from GitHub and place it on your PC.

GitHub repository: ruhmi-framework-mcu/install at main · renesas/ruhmi-framework-mcu
Installation files for Windows: mera-x.y.z+pkg.nnn-cp310-cp310-win_amd64.whl

NOTE: The file name may vary depending on the release version. x, y, z and nnn mean the version number.
(e.g. mera-2.4.0+pkg.179-cp310-cp310-win_amd64.whl)

To configure the environment variables for e2studio, the following command is needed.

```
[Environment]::SetEnvironmentVariable('CONVERSION_TOOL_E2STUDIO_PLUGIN_PYTHON_VENV_
LOC', "$(Get-Location)", 'User')
```

Put the installation file in the working directory.
In PowerShell, run the following commands to install MERA. The file name should be as the actual name in your place. The suffix of the installation file may vary depending on the release version.

```
python -m pip install .\mera-x.y.z+pkg.nnn-cp310-cp310-win_amd64.whl
python -m pip install onnx==1.17.0 tflite==2.18.0
```

You can confirm the installed RUHMI release version, vera version and all your path settings of your environment by the following commands.

```
python -c "import mera; print(mera.__version__)”
2.4.0+pkg.179

vela --version
4.2.0
```

4.3 Using Sample script for Linux and Windows CLI

RUHMI Framework provides Python-based command-line tools to help users deploy AI models on Renesas RA8 MCUs with or without acceleration by Arm® Ethos-U55. The sample scripts are:

- mcu_deploy.py: for deploying non-quantized (FP32) models
- mcu_quantize.py: for quantizing models and deploying optimized C code

Both scripts support additional options for reference data generation and memory configurations.
You can get the sample scripts from [ruhmi-framework-mcu/scripts at main · renesas/ruhmi-framework-mcu].

4.3.1 Compiling Non-Quantized Models

To deploy a pre-trained **model** without quantization:

```
python scripts/mcu_deploy.py --ethos --ref_data models/ output_dir/
```

Option	Description
--ethos	Enables code generation for Arm Ethos-U55
--ref_data	Generates input/output .npy files for testing
models/	Directory containing .tflite model files
output_dir/	Output folder where C code and test data are saved

4.3.2 Quantizing and Compiling Models

To quantize a TFLite, ONNX, or Executorch (.pte) model and compile it for MCU:.
Example command:

```
python scripts/mcu_quantize.py models_fp32/ compiled_models/ -c 5 --ethos --ref_data
```

Option	Description
-c, --calib_num	Number of random samples used for calibration (default: 5)
--ethos	Target Arm Ethos-U55 for accelerated subgraphs
--ref_data	Generate C99-format reference input/output for validation
models_fp32/	Input folder with FP32 models (.tflite, .onnx, .pte)
compiled_models/	Output folder for quantized and compiled results

4.4 Deployment Output Structure

After running the scripts, the following folder and file structure will be generated for each model. These represent the C source code, headers, and supporting files necessary to integrate the model into an MCU project.

```
deploy/
├── person-det_no_ospi
│   ├── build
│   │   └── MCU
│   │       ├── compilation
│   │       │   ├── mera.plan
│   │       │   └── src
│   │       │       ├── compute_sub_0000.c     [Copy onto your source folder]
│   │       │       ├── compute_sub_0000.h     [Copy onto your source folder]
│   │       │       ├── ethosu_common.h        [Copy onto your source folder]
│   │       │       ├── hal_entry.c            [NOTE] This is just a reference and NOT needed copied.
│   │       │       ├── kernel_library_int.c   [Copy onto your source folder]
│   │       │       ├── model.c                [Copy onto your source folder]
│   │       │       ├── model.h                [Copy onto your source folder]
│   │       │       ├── model_io_data.c        [Copy onto your source folder]
│   │       │       └── model_io_data.h        [Copy onto your source folder]
```

```
│   │   │   │   ├── sub_0001_command_stream.c      [Copy onto your source folder]
│   │   │   │   ├── sub_0001_command_stream.h      [Copy onto your source folder]
│   │   │   │   ├── sub_0001_invoke.c          [Copy onto your source folder]
│   │   │   │   ├── sub_0001_invoke.h          [Copy onto your source folder]
│   │   │   ├── deploy_cfg.json
│   │   │   ├── ir_dumps
│   │   │   │   ├── person-det_can.dot
│   │   │   │   ├── ...
│   │   │   ├── person-det_after_canonicalization.dot
│   │   │   └── person-det_subgraphs.dot
│   │   ├── logs
│   │   ├── model
│   │   │   └── input_desc.json
│   │   └── project.mdp
```

You will copy all files under the folder of **<deployment_directory>/build/MCU/compilation/src.** other than hal_entry.c onto your source folder.
Please note that the file names and the number of files depend on the input model and the conversion mode.

4.5 Generated inference API (Ethos-U Enabled)

If Ethos-U support is enabled during conversion into source code with the compiler then an arbitrary **number** of subgraphs for either CPU or Ethos-U will be generated. Each of these subgraphs will correspond to generated C functions to run the corresponding section of the model on CPU or Ethos. Each function call will get its input from previous outputs of other subgraphs and write its outputs on buffers that are designated to **become** again inputs to other functions and so on. To make easier for the user to invoke these models where CPU and NPU are involved, the generated code will automate this process and provide a single function that will orchestrate the calls to the different computation units named void **RunModel(bool clean_outputs)** and helpers to access to each of the input and output areas at model level not per subgraph level. The runtime API header where Ethos-U is enabled can be found on a file named **model.h** under the same directory **<deployment_directory>/build/MCU/compilation/src.**

Example 1: Definition of input/output buffers (in the file of model.h)

```
void RunModel(bool clean_outputs);

  // Model input pointers
float* GetModelInputPtr_input_1();

  // Model output pointers
float* GetModelOutputPtr_Identity_70029();
```

Example 2: Source code

```
memcpy(GetModelInputPtr_input_1(), model_input0, model_input_SIZE0);
                                  //Set the input model to the pointer for the compiler
                                  //Will be set the output data to the GetModelOutputPtr_Identity_70029()
RunModel();  //Execution
```

4.6 Generated inference API (CPU-Only)

When a model is converted into source code with RUHMI framework without Ethos-U support, all the operators in the model are mapped to run on CPU only. In this case, the generated code will refer to a single subgraph compute_sub_0000, by default, when no suffix is provided, the name of the header to be included on your application entry point is defined in compute_sub_0000.h.

This header, model.h, provides the declaration of a C function that if called will run the model with the provided inputs and write the results on the output buffers provided.

Example 3: Definition of input/output buffers (in the file of model.h)

```
enum BufferSize_sub_0000 {
  kBufferSize_sub_0000 = <intermediate_buffers_size>
};

void compute_sub_0000(
  // buffer for intermediate results
  uint8_t* main_storage, // should provide at least <intermediate_buffers_size> bytes of storage

  // inputs
  const int8_t <input_name>[xxx], // 1,224,224,3

  // outputs
  int8_t <output_name>[xxx]  // 1,1000
);
```

Example 4: source code

```
int8_t output_buffer[1000];    //StatefulPartitionedCall_0_70016;

compute_sub_0000(compute_buffer, input_buffer, output_buffer);
```

5. Website and Support

Visit the following URLs to learn about the kit and the RA family of microcontrollers, download tools and documentation, and get support.

Renesas Artificial Intelligence (AI)	renesas.com/ai
AI Navigator	renesas.com/software-tools/ai-navigator
RA Product Information	renesas.com/ra
MCU Evaluation Kit	renesas.com/ra-kits
RA Product Support Forum	renesas.com/ra/forum
Renesas Support	renesas.com/support

Provide Feedback/ Request a Feature

Renesas aims to provide the best microcontroller kit experience to help jumpstart customer innovation with RA, RX & RL78 family of microcontrollers and take products to market faster. The Renesas microcontroller kits have been designed with a lot of attention-to-detail and customer-centric thinking in every aspect of design. Renesas aims to exceed customer expectations.

Renesas looks forward to hearing your feedback and knowing how we can enhance your experience. Please share your feedback at renesas.com/ra/kitfeedback & renesas.com/rx/kitfeedback.

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jul. 01 2025	-	Initial release
1.01	Oct. 31 2025	-	Reorganized the section structure
		7	1.1Assumptions and Advisory Notes Expanded the supported farmwork.
		9	3.1 Introduction In Software Requirements, FSP version updated.
		11	3.2.1 RUHMI update from Conversion Tool Added RUHMI installation and update feature from GUI.
		14	3.3.1 Open AI Navigator Improved GUI interface design.
		19	3.3.3 Conversion Improved GUI interface design.
		24	4.2 Downloading and Installing Software and Development Tools Improved the description to meet the instruction in the GitHub repository.
		28	4.5 Generated inference API (Ethos-U Enabled) In Software Requirements, FSP version updated.
		28	4.6 Generated inference API (CPU-Only) In Software Requirements, FSP version updated.

Renesas RUHMI Framework – Quick Start Guide with EK-RA8P1

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