Yocto Project and OpenEmbedded development training

On-line seminar, 4 sessions of 4 hours

Latest update: May 20, 2024

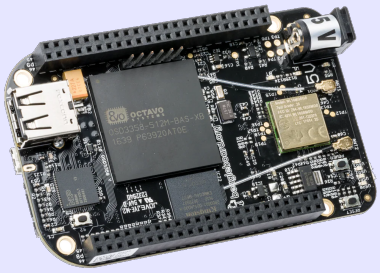
Title	**Yocto Project and OpenEmbedded development training**
Training objectives	• Be able to understand the role and principle of an embedded Linux build system, and compare Yocto Project/OpenEmbedded to other tools offering similar functionality. • Be able to configure and build basic embedded Linux system with Yocto, and install the result on an embedded platform. • Be able to write and extend recipes, for your own packages or customizations. • Be able to use existing layers of recipes, and create your own new layers. • Be able to integrate support for your own embedded board into a BSP layer. • Be able to create custom images. • Be able to use the Yocto Project SDK to develop applications. • Be able to use devtool to generate and modify recipes.
Duration	**Four** half days - 16 hours (4 hours per half day)
Pedagogics	• Lectures delivered by the trainer, over video-conference. Participants can ask questions at any time. • Practical demonstrations done by the trainer, based on practical labs, over video-conference. Participants can ask questions at any time. Optionally, participants who have access to the hardware accessories can reproduce the practical labs by themselves. • Instant messaging for questions between sessions (replies under 24h, outside of week-ends and bank holidays). • Electronic copies of presentations, lab instructions and data files. They are freely available at https://bootlin.com/doc/training/yocto.
Trainer	One of the engineers listed on: `https://bootlin.com/training/trainers/`
Language	Oral lectures: English, French, Italian. Materials: English.

Audience	Companies and engineers interested in using the Yocto Project to build their embedded Linux system.
Prerequisites	• **Knowledge and practice of UNIX or GNU/Linux commands**: participants must be familiar with the Linux command line. Participants lacking experience on this topic should get trained by themselves, for example with our freely available on-line slides at bootlin.com/blog/command-line/. • **Minimal experience in embedded Linux development**: participants should have a minimal understanding of the architecture of embedded Linux systems: role of the Linux kernel vs. user-space, development of Linux user-space applications in C. Following Bootlin's *Embedded Linux* course at bootlin.com/training/embedded-linux/ allows to fulfill this pre-requisite. • **Minimal English language level: B1**, according to the *Common European Framework of References for Languages*, for our sessions in English. See bootlin.com/pub/training/cefr-grid.pdf for self-evaluation.
Required equipment	• Computer with the operating system of your choice, with the Google Chrome or Chromium browser for videoconferencing. • Webcam and microphone (preferably from an audio headset) • High speed access to the Internet
Certificate	Only the participants who have attended all training sessions, and who have scored over 50% of correct answers at the final evaluation will receive a training certificate from Bootlin.
Disabilities	Participants with disabilities who have special needs are invited to contact us at *training@bootlin.com* to discuss adaptations to the training course.

Hardware, first option

BeagleBone Black board

- An ARM AM335x processor from Texas Instruments (Cortex-A8 based), 3D acceleration, etc.
- 512 MB of RAM
- 2 GB of on-board eMMC storage (4 GB in Rev C)
- USB host and device
- HDMI output
- 2 x 46 pins headers, to access UARTs, SPI buses, I2C buses and more.



Hardware, second option

One of these Discovery Kits from STMicroelectronics: **STM32MP157A-DK1**, **STM32MP157D-DK1**, **STM32MP157C-DK2** or **STM32MP157F-DK2**

- STM32MP157 (dual Cortex-A7) CPU from STMicroelectronics
- USB powered
- 512 MB DDR3L RAM
- Gigabit Ethernet port
- 4 USB 2.0 host ports
- 1 USB-C OTG port
- 1 Micro SD slot
- On-board ST-LINK/V2-1 debugger
- Arduino Uno v3-compatible headers
- Audio codec
- Misc: buttons, LEDs
- LCD touchscreen (DK2 kits only)

Half day 1

Lecture - Introduction to embedded Linux build systems

- Overview of an embedded Linux system architecture
- Methods to build a root filesystem image
- Usefulness of build systems

Lecture - Yocto Project and Poky reference system overview

- Introduction to the Yocto / OpenEmbedded build system and its lexicon
- Overview of the Poky reference system

Lecture - Using Yocto Project - basics

- Setting up the build directory and environment
- Configuring the build system
- Building a root filesystem image

Demo 1 - First Yocto Project build

- Downloading the Poky reference build system
- Configuring the build system
- Building a system image

Lecture - Using Yocto Project - basics

- Organization of the build output

Demo 1 - Flashing and booting

- Flashing and booting the image on the board

Half day 2

Lecture - Using Yocto Project - advanced usage

- Variable assignment, operators and overrides
- Package variants and package selection
- bitbake command line options

Demo 2 - Using NFS and configuring the build

- Configuring the board to boot over NFS
- Add a package to the root filesystem
- Learn how to use the `PREFERRED_PROVIDER` mechanism
- Get familiar with the bitbake command line options

Lecture - Writing recipes - basics

- Recipes: overview
- Recipe file organization
- Applying patches
- Recipe examples

Demo 3 - Adding an application to the build

- Writing a recipe for *nInvaders*
- Troubleshooting the recipe
- Troubleshooting cross-compilation issues
- Adding *ninvaders* to the final image

Lecture - Writing recipes - advanced features

- Extending and overriding recipes
- Virtual packages
- Learn about classes
- BitBake file inclusions
- Debugging recipes
- Configuring BitBake network usage

Half day 3

Lecture - Layers

- What layers are
- Where to find layers
- Creating a layer

Demo 4 - Writing a layer

- Learn how to write a layer
- Add the layer to the build
- Move *ninvaders* to the new layer

Demo 5 - Extend a recipe

- Extend the kernel recipe to add patches
- Configure the kernel to compile the nunchuk driver
- Edit the ninvaders recipe to add patches
- Play *nInvaders*

Lecture - Writing a BSP

- Introduction to BSP layers
- Adding a new machine
- Bootloader configuration
- Linux: the kernel bbclass and the linux-yocto recipe

Demo 6 - Create a custom machine configuration

- Create a new machine configuration
- Build an image for the new machine

Lecture - Distro layers

- Distro configuration
- Distro layers

Lecture - Images	Demo 7 - Create a custom image
• Writing an image recipe • Image types • Writing and using package groups recipes	• Add a basic image recipe • Select the image capabilities and packages • Add a custom package group • Add an image variant for debugging

Half day 4

Lecture - Writing recipes - going further	Lecture - Licensing
• The per-recipe sysroot • Using Python code in metadata • Variable flags • Packages features and PACKAGECONFIG • Conditional features • Package splitting • Dependencies in detail	• Managing open source licenses

Lecture - The Yocto Project SDK	Demo 8 - Develop your application in the Poky SDK
• Goals of the SDK • Building and customizing an SDK • Using the Yocto Project SDK	• Building an SDK • Using the Yocto Project SDK

Lecture - Devtool	Demo 9 - Using devtool
• About devtool • Devtool use cases	• Generate a new recipe • Modify a recipe to add a new patch • Upgrade a recipe to a newer version

Lecture - Automating layer management	Lecture - Runtime Package Management
• Automating layer management	• Introduction to runtime package management • Build configuration • Package server configuration • Target configuration

Questions and Answers
• Questions and answers with the audience about the course topics • Extra presentations if time is left, according what most participants are interested in.

Possible extra time

Extra time (up to 4 hours) may be proposed if the agenda didn't fit in 4 half days, according to the time spent answering questions from participants.