# Yocto Project and OpenEmbedded training

## 3-day session

<table>
<thead>
<tr>
<th>Title</th>
<th>Yocto Project and OpenEmbedded development training</th>
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</thead>
</table>
| **Overview** | Understanding the Yocto Project  
Using it to build a root filesystem and run it on your target  
Writing and extending recipes  
Creating layers  
Integrating your board in a BSP  
Creating custom images  
Application development with the Yocto Project SDK |
| **Materials** | Check that the course contents correspond to your needs:  
| **Duration** | Three days - 24 hours (8 hours per day).  
40% of lectures, 60% of practical labs. |
| **Trainer** | One of the engineers listed on  
https://bootlin.com/training/trainers/ |
| **Language** | Oral lectures: English, French.  
Materials: English. |
| **Audience** | Companies and engineers interested in using the Yocto Project to build their embedded Linux system. |
| **Prerequisites** | **Knowledge of embedded Linux** as covered in our embedded Linux training (https://bootlin.com/training/embedded-linux/)  
**Knowledge and practice of UNIX or GNU/Linux commands**  
People lacking experience on this topic should get trained by themselves, for example with our freely available on-line slides: https://bootlin.com/blog/command-line/ |
### Required equipment

For on-site sessions only.

Everything is supplied by Bootlin in public sessions.

- Video projector
- PC computers with at least 8 GB of RAM, a CPU at least equivalent to an Intel Core i5 and Ubuntu Linux installed in a **free partition of at least 50 GB**. **Using Linux in a virtual machine is not supported**, because of issues connecting to real hardware.
- We need Ubuntu Desktop 20.04 (Xubuntu and other variants are fine). We don’t support other distributions, because we can’t test all possible package versions.
- **High Speed Connection to the Internet** (direct or through the company proxy).
- **PC computers with valuable data must be backed up** before being used in our sessions. Some people have already made mistakes during our sessions and damaged work data.

### Materials

Electronic copies of presentations and labs.

Electronic copy of lab files.

### 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

STMicroelectronics STM32MP157D-DK1 Discovery board
- STM32MP157D (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
### Day 1 - Morning

**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 - Overview of the Yocto Project and the Poky reference system**

- Organization of the project source tree
- Building a root filesystem image using the Yocto Project

**Lab - First Yocto Project build**

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

### Day 1 - Afternoon

**Lecture - Using Yocto Project - basics**

- Organization of the build output
- Flashing and installing the system image

**Lab - Flashing and booting**

- Flashing and booting the image on the board

**Lecture - Using Yocto Project - advanced usage**

- Configuring the build system
- Customizing the package selection

**Lab - Using NFS and configuring the build**

- Configuring the board to boot over NFS
- Learn how to use the PREFERRED_PROVIDER mechanism
## Day 2 - Morning

### Lecture - Writing recipes - basics
- Writing a minimal recipe
- Adding dependencies
- Development workflow with *bitbake*

### Lab - Adding an application to the build
- Writing a recipe for *nInvaders*
- Adding *nInvaders* to the final image

### Lecture - Writing recipes - advanced features
- Extending and overriding recipes
- Adding steps to the build process
- Learn about classes
- Analysis of examples
- Logging
- Debugging dependencies

## Day 2 - Afternoon

### Lab - Learning how to configure packages
- Extending a recipe to add configuration files
- Using `ROOTFS_POSTPROCESS_COMMAND` to modify the final rootfs
- Studying package dependencies

### Lecture - Layers
- What layers are
- Where to find layers
- Creating a layer

### Lab - Writing a layer
- Learn how to write a layer
- Add the layer to the build
- Move *nInvaders* to the new layer
### Day 3 - Morning

<table>
<thead>
<tr>
<th>Lecture - Writing a BSP</th>
<th>Lab - Implementing the kernel changes</th>
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<tbody>
<tr>
<td>• Extending an existing BSP</td>
<td></td>
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<tr>
<td>• Adding a new machine</td>
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<tr>
<td>• Bootloaders</td>
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<tr>
<td>• Linux and the linux-yocto recipe</td>
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<tr>
<td>• Adding a custom image type</td>
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<tr>
<td>• Extend the kernel recipe to add the nunchuk driver</td>
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<tr>
<td>• Configure the kernel to compile the nunchuk driver</td>
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<tr>
<td>• Play <em>nInvaders</em></td>
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### Day 3 - Afternoon

<table>
<thead>
<tr>
<th>Lecture - Creating a custom image</th>
<th>Lab - Creating a custom image</th>
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<tbody>
<tr>
<td>• Writing an image recipe</td>
<td></td>
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<tr>
<td>• Adding users/groups</td>
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<tr>
<td>• Adding custom configuration</td>
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<tr>
<td>• Writing and using package groups recipes</td>
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<tr>
<td>• Writing a custom image recipe</td>
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<tr>
<td>• Adding <em>nInvaders</em> to the custom image</td>
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<th>Lecture - Creating and using an SDK</th>
<th>Lab - Experimenting with the SDK</th>
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<tr>
<td>• Understanding the purpose of an SDK for the application developer</td>
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<td>• Building an SDK for the custom image</td>
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<tr>
<td>• Building an SDK</td>
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<tr>
<td>• Using the Yocto Project SDK</td>
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