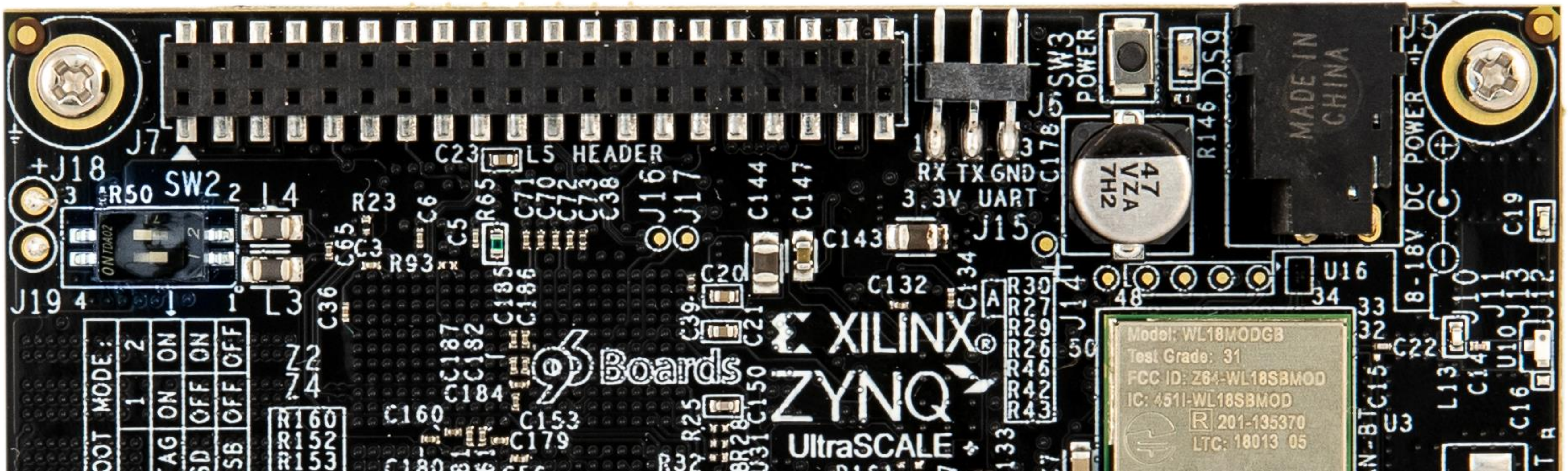
Linux Application Development on Ultra96

Xilinx Developer Forum – San Jose – October, 2018

AVNET®
Reach Further™



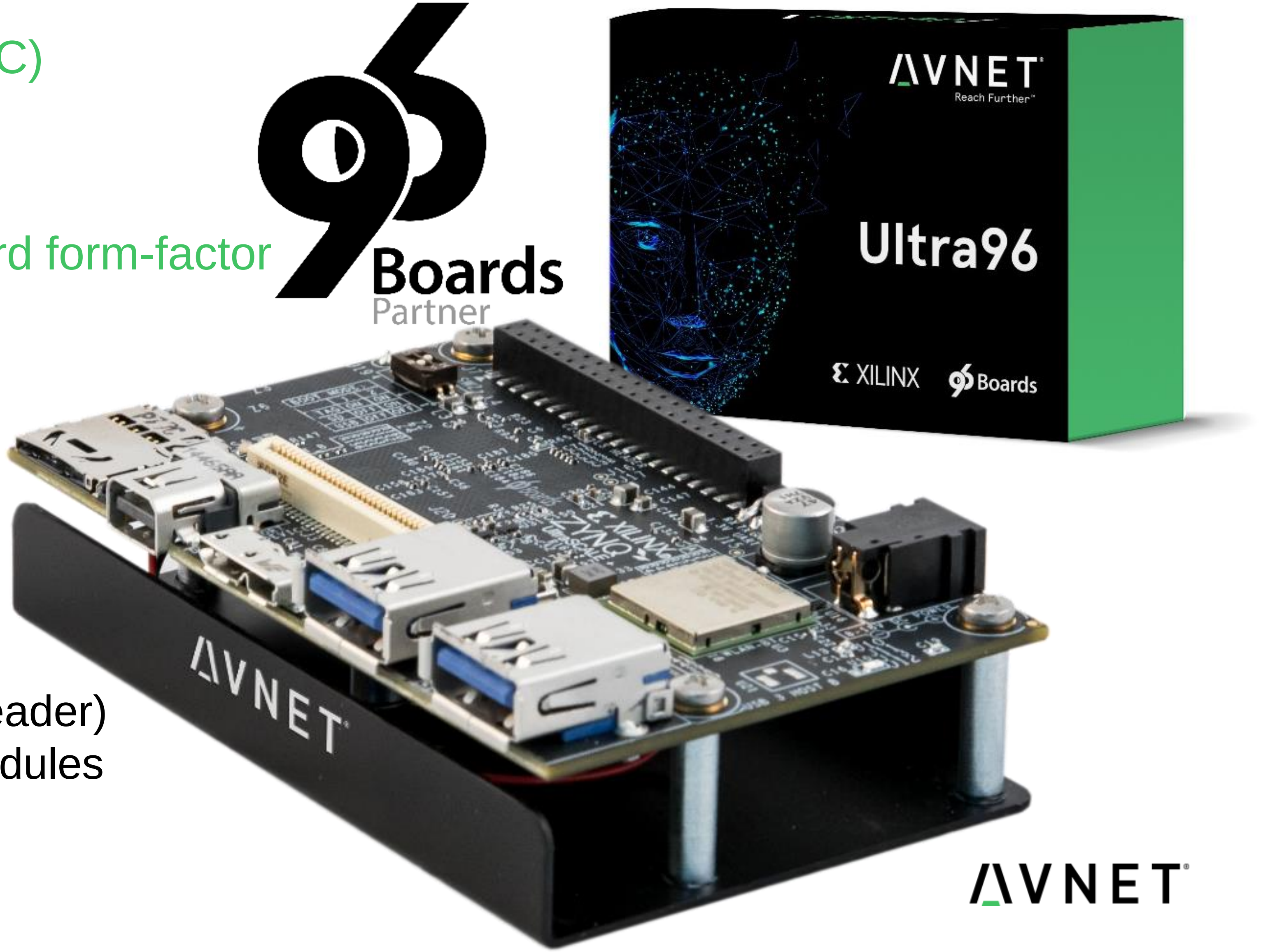
Course Objectives

- When you have completed this lab you will know how to do the following
  - Set up an SDK software application project for debugging
  - Use the many features of the Xilinx SDK
    - Code editor
    - TCF agent for remote execution
    - Debugger
    - Profiler

What is / ULTRA96

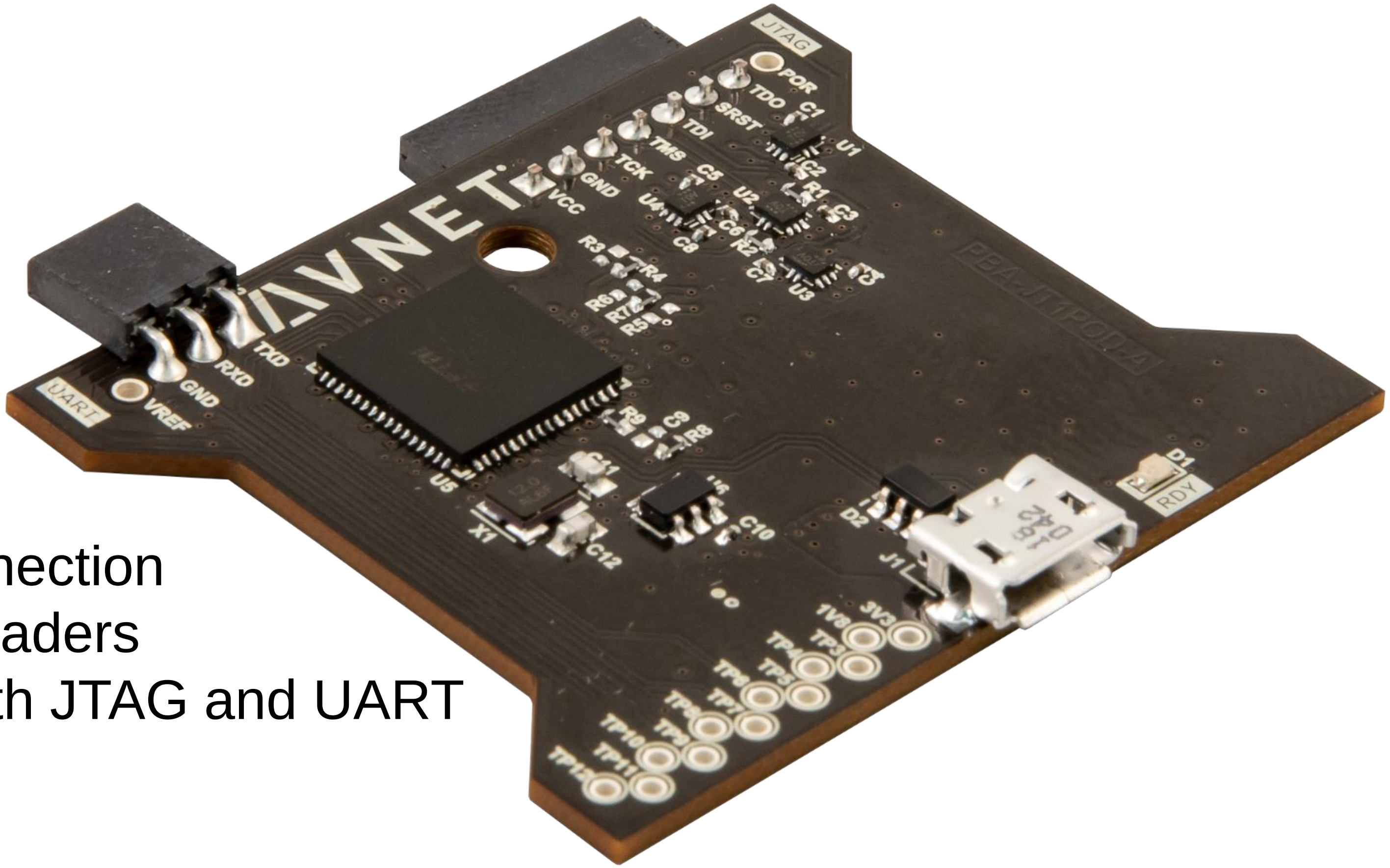
- $249 Single Board Computer (SBC)
  - Based on Zynq UltraScale+
  - https://avnet.me/Ultra96
- Designed to 96boards.org standard form-factor
  - Consumer edition
- Features
  - 2 GB (512M x32) LPDDR4 RAM
  - 16 GB MicroSD card
  - Wi-Fi / Bluetooth
  - Mini DisplayPort
  - 3x USB 3.0 (2x host, 1x gadget)
  - 1x USB 2.0 host (on expansion header)
  - Expansion headers for add-on modules
  - User LEDs & PB switch

96 Boards Partner



JTAG / UART Adapter for Ultra96

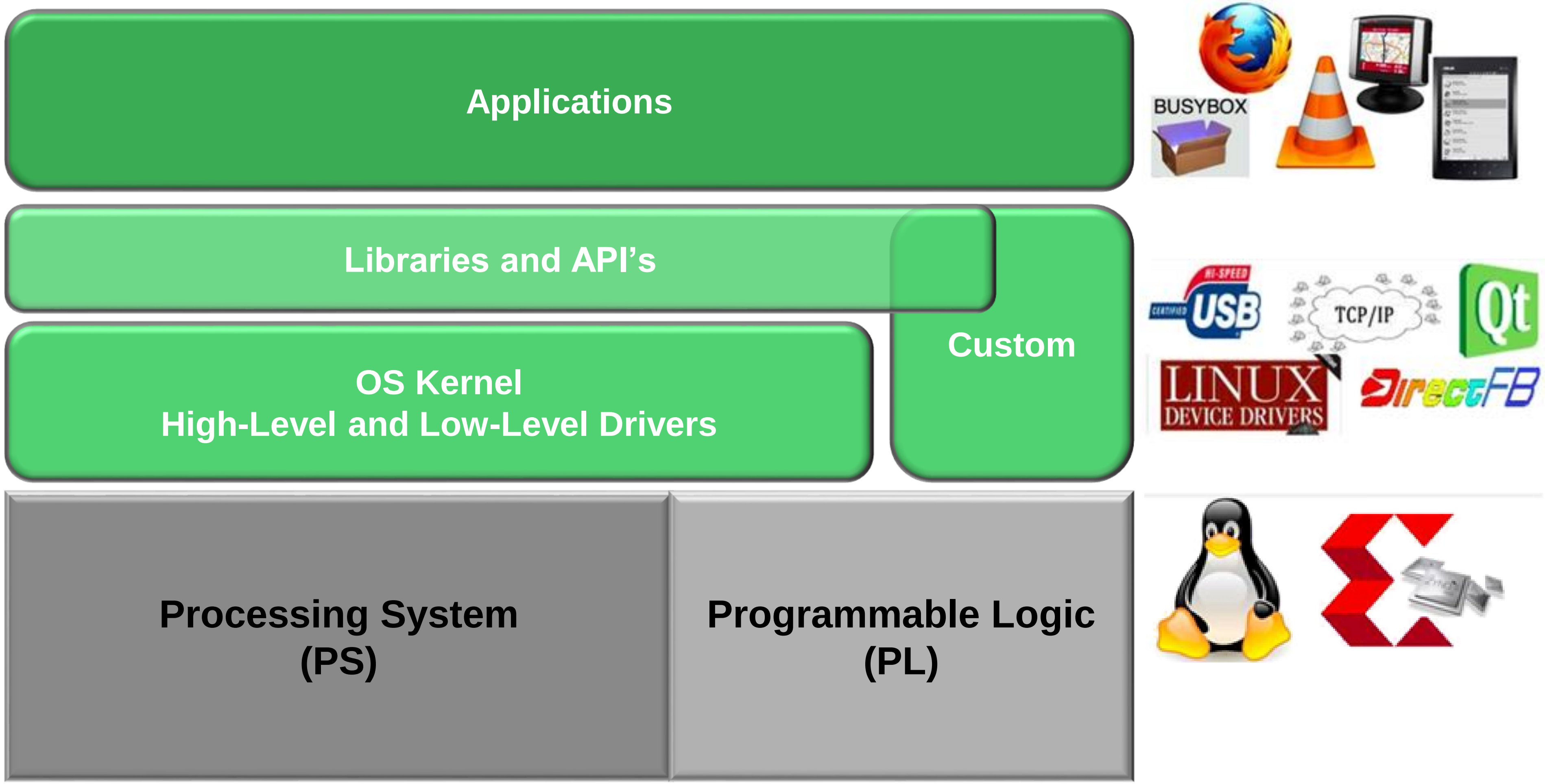
- $38.99 adapter board for the Ultra96
  - https://avnet.me/ultra96jtag



- Features
  - microUSB high-speed USB 2.0 connection
  - UART and JTAG mate to Ultra96 headers
  - Single connection to host PC for both JTAG and UART

- Support
  - Tutorials at https://avnet.me/Ultra96tutorials

Zynq MPSoC Linux Software Platform



Applications

Libraries and API's

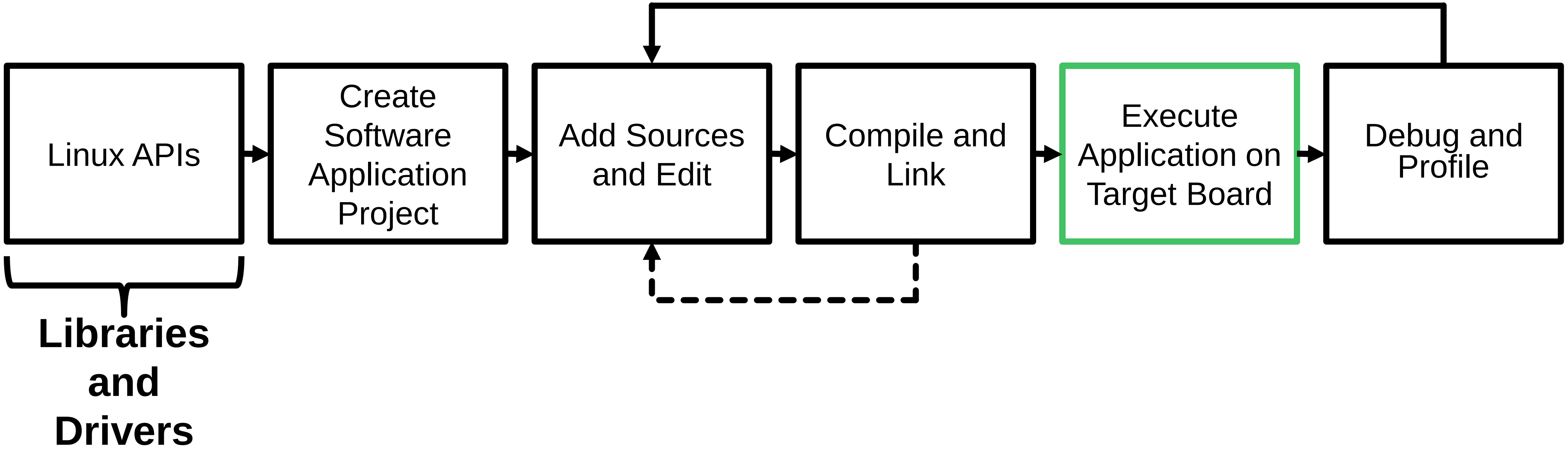
OS Kernel
High-Level and Low-Level Drivers

Custom

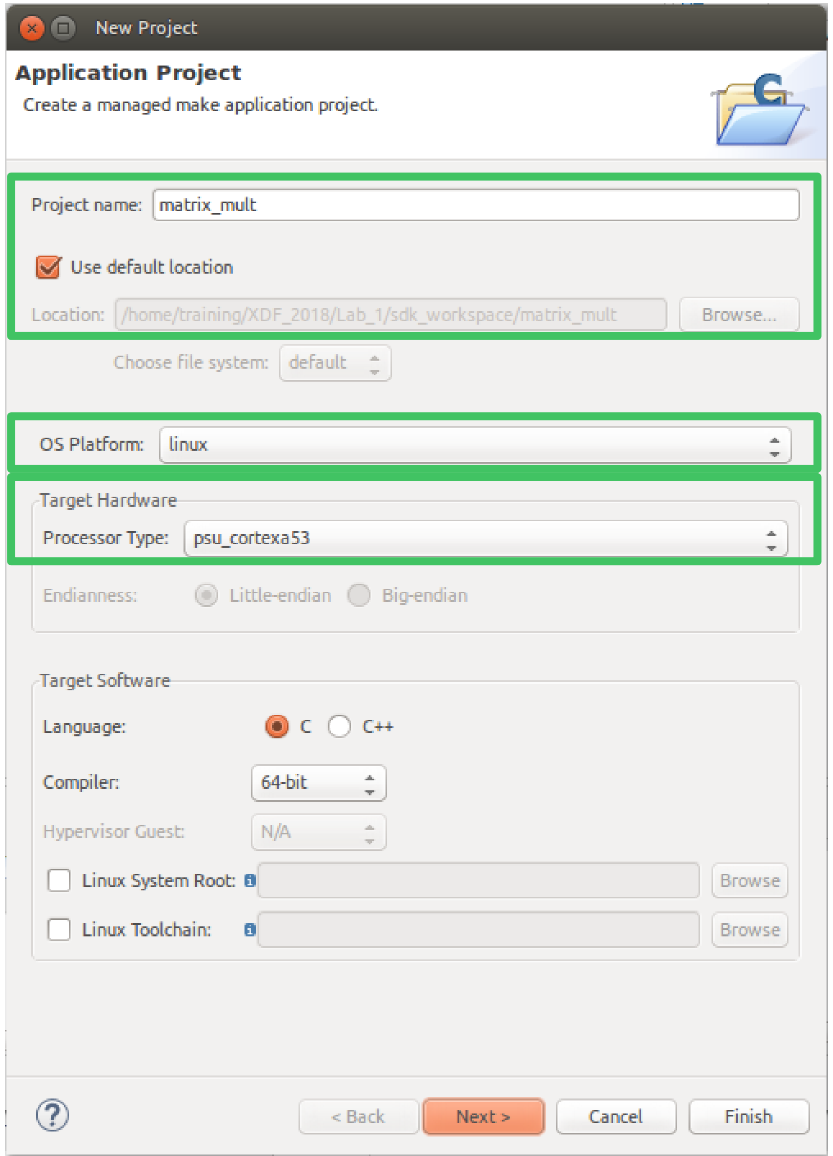
Processing System
(PS)

Programmable Logic
(PL)

Linux Application Development Flow



New Application Project Wizard


New Project

Application Project

Create a managed make application project.

Project name: matrix_mult

☑ Use default location

Location: /home/training/XDF_2018/Lab_1/sdk_workspace/matrix_mult

Choose file system: default

OS Platform: linux

Target Hardware

Processor Type: psu_cortexa53

Endianness: ○ Little-endian ○ Big-endian

Target Software

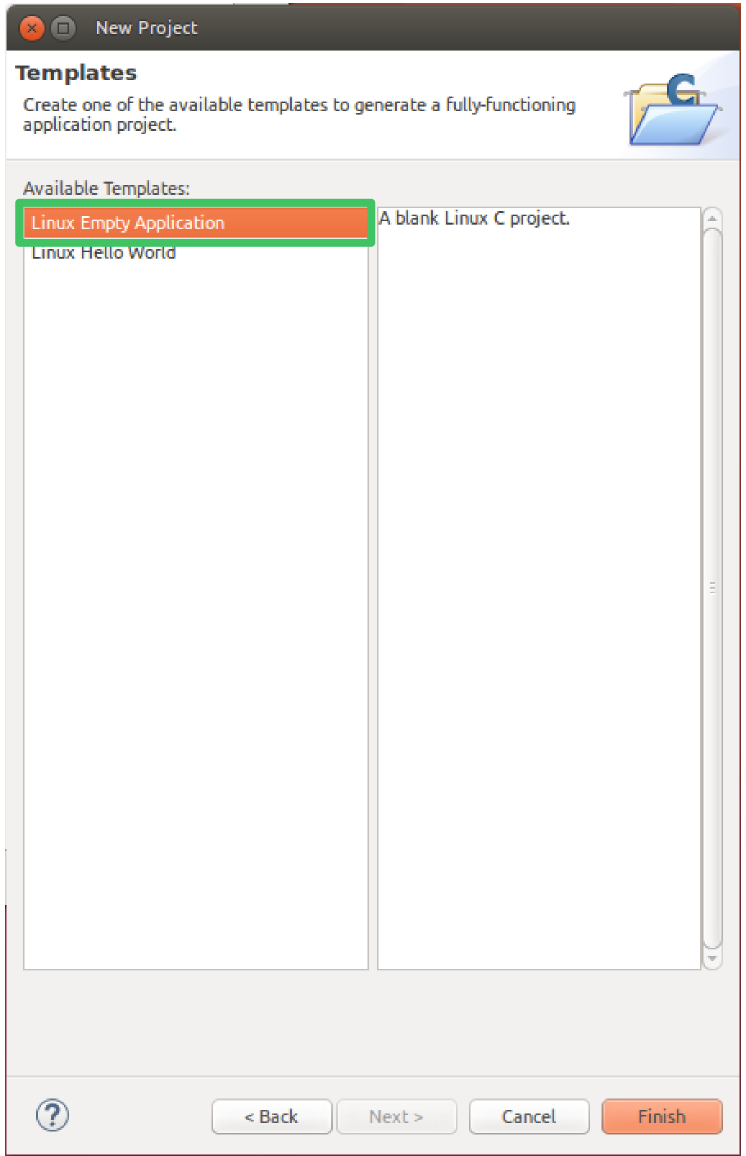
Language: ● C ○ C++

Compiler: 64-bit

Hypervisor Guest: N/A

□ Linux System Root:

□ Linux Toolchain:


New Project

Templates

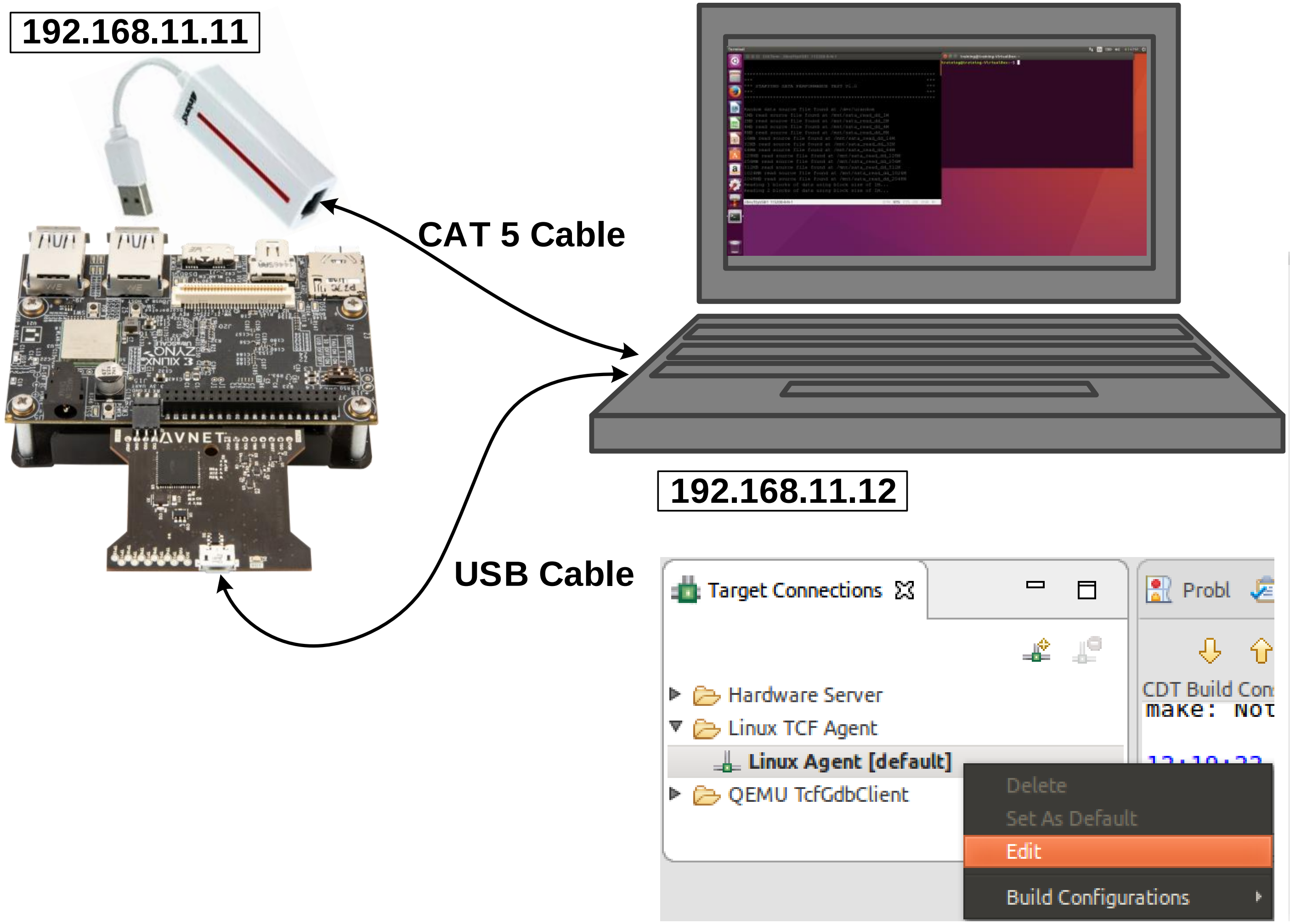
Create one of the available templates to generate a fully-functioning application project.

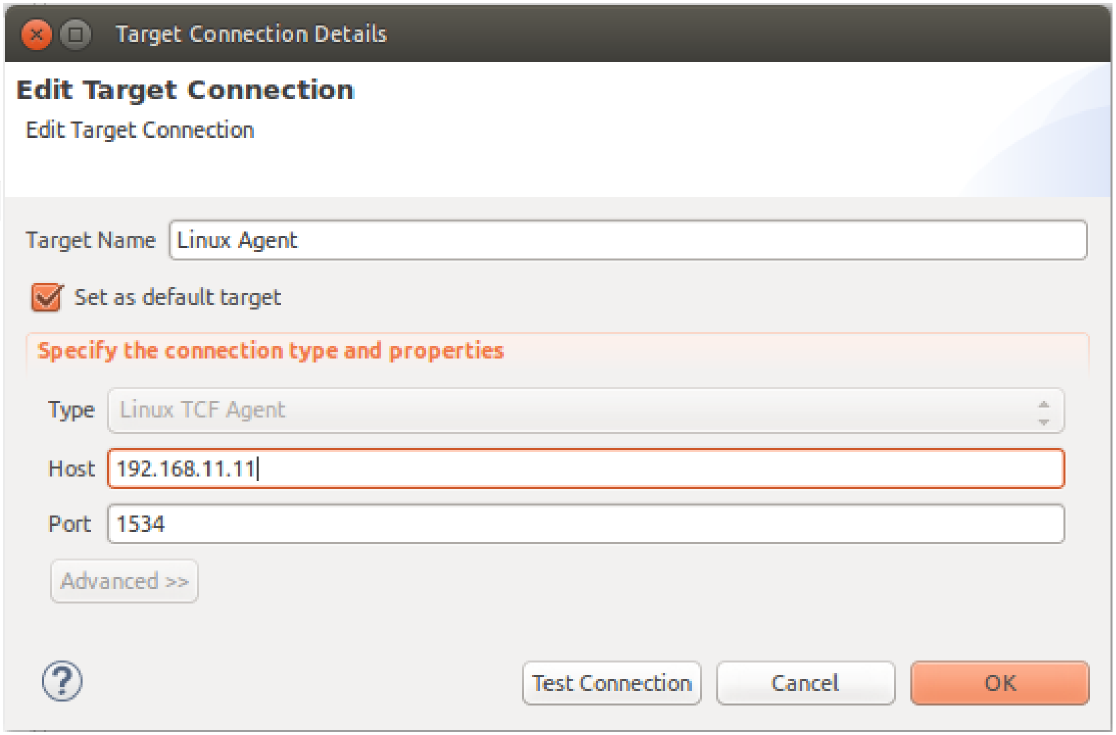
Available Templates:

- Linux Empty Application
- Linux Hello World

A blank Linux C project.

Linux TCF Agent




Target Connection Details

Edit Target Connection

Edit Target Connection

Target Name: Linux Agent

☑ Set as default target

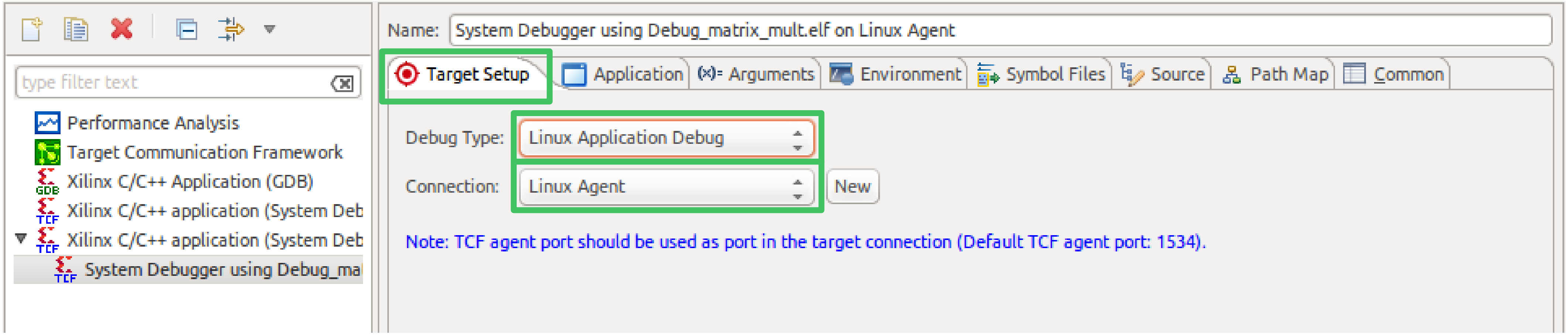
Specify the connection type and properties

Type: Linux TCF Agent

Host: 192.168.11.11

Port: 1534

Run Configuration



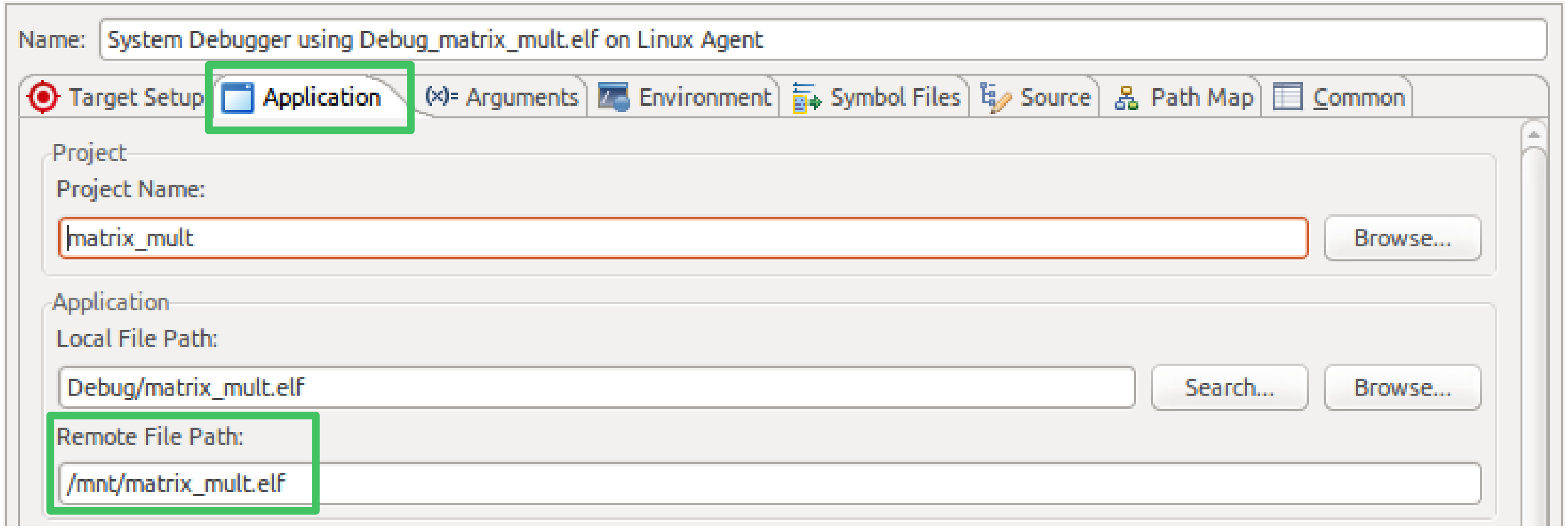
- Performance Analysis
- Target Communication Framework
- Xilinx C/C++ Application (GDB)
- Xilinx C/C++ application (System Deb
- Xilinx C/C++ application (System Deb
  - System Debugger using Debug_ma

Name: System Debugger using Debug_matrix_mult.elf on Linux Agent

Debug Type: Linux Application Debug

Connection: Linux Agent

Note: TCF agent port should be used as port in the target connection (Default TCF agent port: 1534).



Name: System Debugger using Debug_matrix_mult.elf on Linux Agent

Project

Project Name: matrix_mult

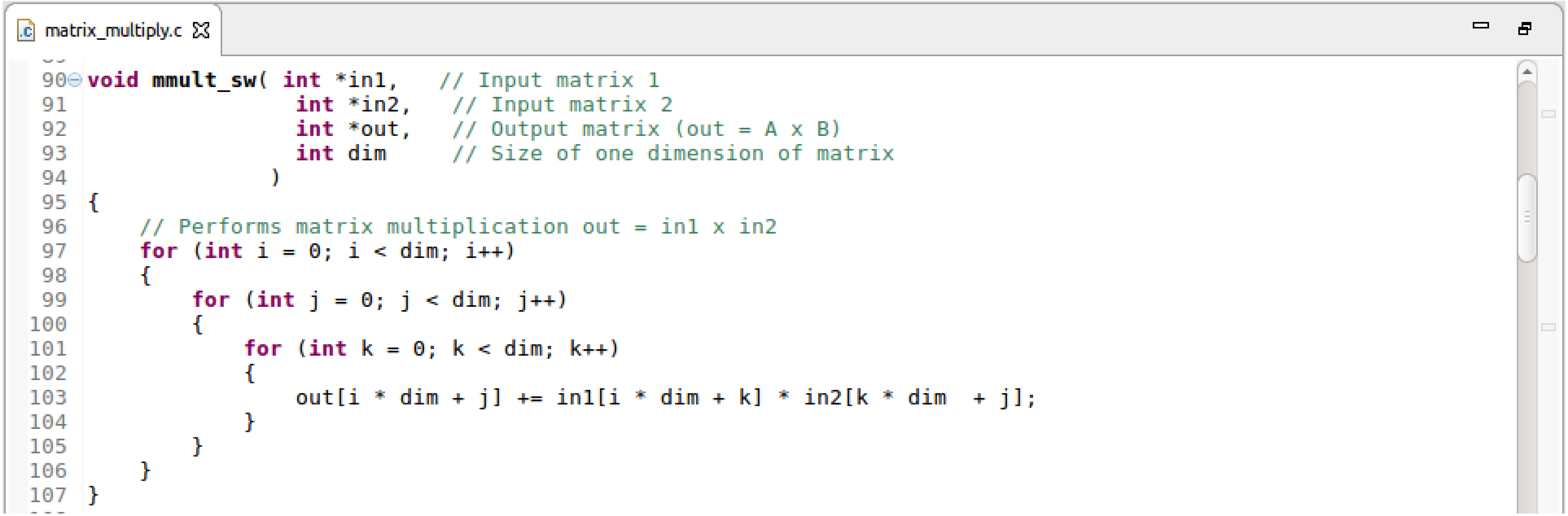
Application

Local File Path: Debug/matrix_mult.elf

Remote File Path: /mnt/matrix_mult.elf

Matrix Multiply Code Excerpt

- Standard *ijk*-form matrix multiply algorithm
- Matrices filled with random elements
- Loop of 1024 matrix multiplies is performed 20 times



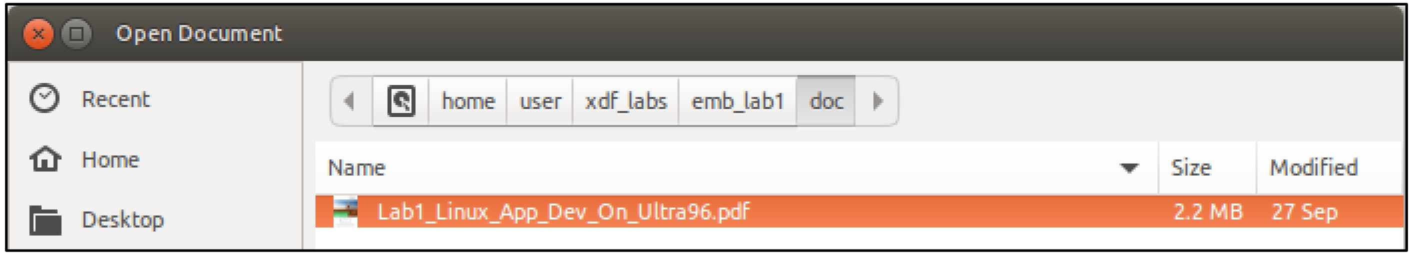
```c
void mmult_sw( int *in1,   // Input matrix 1
                int *in2,   // Input matrix 2
                int *out,   // Output matrix (out = A x B)
                int dim     // Size of one dimension of matrix
              )
{
    // Performs matrix multiplication out = in1 x in2
    for (int i = 0; i < dim; i++)
    {
        for (int j = 0; j < dim; j++)
        {
            for (int k = 0; k < dim; k++)
            {
                out[i * dim + j] += in1[i * dim + k] * in2[k * dim  + j];
            }
        }
    }
}
```

Lab Exercise

- Using SDK for Linux application development
  - Create an application which interacts with Ultra96 hardware
  - Utilize push button using Linux event subsystem
  - Perform 32x32 matrix multiply
  - Control LEDs to visually show rate of loop of performing matrix multiplies
  - Debug, find, and correct error in software
  - Profile the running software to examine CPU load

Lab Instructions

- Login to the Ubuntu laptop
  - User = user, password = password
- Open the PDF reader on the Ubuntu tool bar
- Click on the icon and navigate to the /home/user/xdf_labs/emb_lab1/doc folder
- Double-click to open the Lab1_Linux_App_Dev_On_Ultra96.pdf lab instructions file



Name	Size	Modified
Lab1_Linux_App_Dev_On_Ultra96.pdf	2.2 MB	27 Sep

Thank you!