

Building a RISC-V CPU Core (LFD111x)

Course Overview

Building a RISC-V CPU Core (LFD111x) is designed for anyone with a technical inclination who is interested in learning more about hardware. Whether you are new to digital logic or are a seasoned veteran, students will take away new skills that can be applied immediately. No prior knowledge of digital logic design is required.

This is a crash course in digital logic design and basic CPU microarchitecture. Using the Makerchip online integrated development environment (IDE), you will implement everything from logic gates to a simple, but complete, RISC-V CPU core. You will be amazed by what you can do using freely-available online tools for open source development. You will familiarize yourself with a number of emerging technologies supporting an open-source hardware ecosystem, including RISC-V, Transaction-Level Verilog, and the online Makerchip IDE.

LFD111x is a hands-on experience with RISC-V and modern circuit design tools. You will walk away with fundamental skills for a career in logic design, and you will position yourself on the forefront by learning to use the emerging Transaction-Level Verilog language extension (even if you don't already know Verilog).

Course Learning Objectives

By the end of this course, you will learn about:

- Digital logic design (combinational and sequential logic)
- RISC-V (RV32I) instruction set architecture
- Basic CPU microarchitecture
- Transaction-Level Verilog basics
- Makerchip online IDE

Knowledge/Skills Prerequisites

Anyone with a technical inclination can successfully complete the workshop. No prior knowledge of digital logic design is required.

You may want to consider first taking [Introduction to RISC-V \(LFD110x\)](#) prior to this course, though this is not a prerequisite.

Exercises/System Prerequisites

The lab environment (Makerchip) is entirely online. The only system requirement is a web browser.

Audience

This course is designed for anyone with a technical inclination who is interested in learning more about hardware.

Course Instructors



As founder of Redwood EDA, Steve Hoover is fostering an open-source silicon ecosystem through numerous technologies including the WARP-V CPU core generator with support for RISC-V. His main focus is design methodology and tools enabled by Transaction-Level Verilog (TL-Verilog), available to all at makerchip.com. He is also the lead developer of the 1st CLaaS open-source framework for cloud FPGAs. Steve holds a BS in electrical engineering summa cum laude from Rensselaer Polytechnic Institute and an MS in computer science from the University of Illinois. He has designed numerous components for high-performance server CPUs and network architectures for DEC, Compaq, and Intel.

Course Length

4-6 hours

Course Outline

Welcome!

Chapter 1: Learning Platform

Chapter 2: Digital Logic

Chapter 3: The Role of RISC-V
Chapter 4: RISC-V-Subset CPU
Chapter 5: Completing Your RISC-V CPU
Final Exam (Verified Certificate track only)

edX Platform

If you are using edX for the first time, we strongly encourage you to start by taking a free 'how to use edX' course that the team at edX has made available. In this course, you will learn how to navigate the edX platform, how to connect with other edX learners, how to answer problems on the edX platform, how grades work in edX courses, and how to complete your first course.

Click [here](#) to register for “*DemoX*” and you will be on your way. You will find the edX platform simple and intuitive.

Getting Help

For any **technical issues** with the edX platform (including login problems and issues with the Verified Certificate), please use the **Help** icon located on the upper right side of your screen.

One great way to interact with peers taking this course and resolving any **content-related issues** is via the **Discussion Forums**. These forums can be used in the following ways:

- To discuss concepts, tools, and technologies presented in this course, or related to the topics discussed in the course material.
- To ask questions about course content.
- To share resources and ideas related to RISC-V.

We strongly encourage you to not only ask questions, but to share with your peers opinions about the course content, as well as valuable related resources. The Discussion Forums will be reviewed periodically by the Linux Foundation staff, but it is primarily a community resource, not an 'ask the instructor' service.

Course Timing

This course is entirely self-paced; there is no fixed schedule for going through the material. You can go through the course at your own pace, and you will always be returned to exactly where you left off when you come back to start a new session. However, we still suggest you avoid long breaks in between periods of work, as learning will be faster and content retention improved.

The chapters in the course have been designed to build on one another. It is probably best to work through them in sequence; if you skip or only skim some chapters quickly, you may find

there are topics being discussed you have not been exposed to yet. But this is all self-paced and you can always go back, so you can thread your own path through the material.

Learning Aids

Besides simple exposition through text and figures, this course uses additional methods to present the learning material including demo videos and knowledge check questions (Verified Certificate track only).

Audit and Verified Tracks

You can enroll into an audit or a verified track. In an audit track, you will have access to all ungraded course content: course readings, videos, and learning aids, but no certificates are awarded when auditing. You will not be able to access any graded content (knowledge check questions at the end of each chapter, and the final exam).

In order to receive a certificate, you will need to obtain a passing grade (please refer to the “Grading” section below), verify your identity with edX, and pay a fee. Once all edX requirements have been met, you can download your certificate from the Progress tab.

To learn more about audit and verified tracks, visit [edX Help Center > Certificates](#).

Grading (Verified Certificate track only)

At the end of each chapter, you will have a set of graded **knowledge check questions**, that are meant to further check your understanding of the material presented. The grades obtained by answering these knowledge check questions will represent **20%** of your final grade.

The remaining **80%** of your final grade is represented by the score obtained in the **final exam**. The final exam is located at the end of the course and it consists of 10 questions.

You will have a maximum of two attempts to answer each knowledge check and final exam question (other than True/False questions, in which case, you have only one attempt). You are free to reference your notes, screens from the course, etc., and there is no time limit on how long you can spend on a question. You can always skip a question and come back to it later.

In order to complete this course with a passing grade, you must obtain a passing score (knowledge check and final exam) of minimum 70%.

Course Progress and Completion (Verified Certificate track only)

Once you complete the course (including knowledge check questions and final exam), you will want to know if you have passed. You will be able to see your completion status using the **Progress** tab at the top of your screen, which will clearly indicate whether or not you have achieved a passing score.

About The Linux Foundation

The Linux Foundation is the world's leading home for collaboration on open source software, hardware, standards, and data. Linux Foundation projects are critical to the world's infrastructure, including Linux, Kubernetes, Node.js, ONAP, PyTorch, RISC-V, SPDX, OpenChain, and more. The Linux Foundation focuses on leveraging best practices and addressing the needs of contributors, users, and solution providers to create sustainable models for open collaboration. For more information, please visit us at linuxfoundation.org. The Linux Foundation has registered trademarks and uses trademarks. For a list of trademarks of The Linux Foundation, please see its trademark usage page:

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The Linux Foundation Events

The Linux Foundation hosts an increasing number of events each year, including:

- Open Source Summit North America, Europe, Japan and China
- Embedded Linux Conference + OpenIoT Summit North America and Europe
- Open Source Leadership Summit
- Open Networking Summit North America and Europe
- KubeCon + CloudNativeCon North America, Europe and China
- Automotive Linux Summit
- KVM Forum
- Linux Storage Filesystem and Memory Management Summit
- Linux Security Summit North America and Europe
- Cloud Foundry Summit
- Hyperledger Global Forum
- And many more.

To learn more about The Linux Foundation events and to register, click [here](#).

The Linux Foundation Training

The Linux Foundation offers several types of training:

- Classroom
- Online
- On-site
- Events-based.

To get more information about specific courses offered by The Linux Foundation, click [here](#).

The Linux Foundation Certifications

The Linux Foundation certifications give you a way to differentiate yourself in a job market that's hungry for your skills. We've taken a new, innovative approach to open source certification that allows you to showcase your skills in a way that other peers will respect and employers will trust:

- You can take your certification from any computer, anywhere, at any time
- The certification exams are either performance-based or multiple choice
- The exams are distribution-flexible
- The exams are up-to-date, testing knowledge and skills that actually matter in today's IT environment.

For a list of currently offered certifications, click [here](#).

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