Introduction / Ramp-Up Workshop

Lab 01

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01

Introduction to Course.

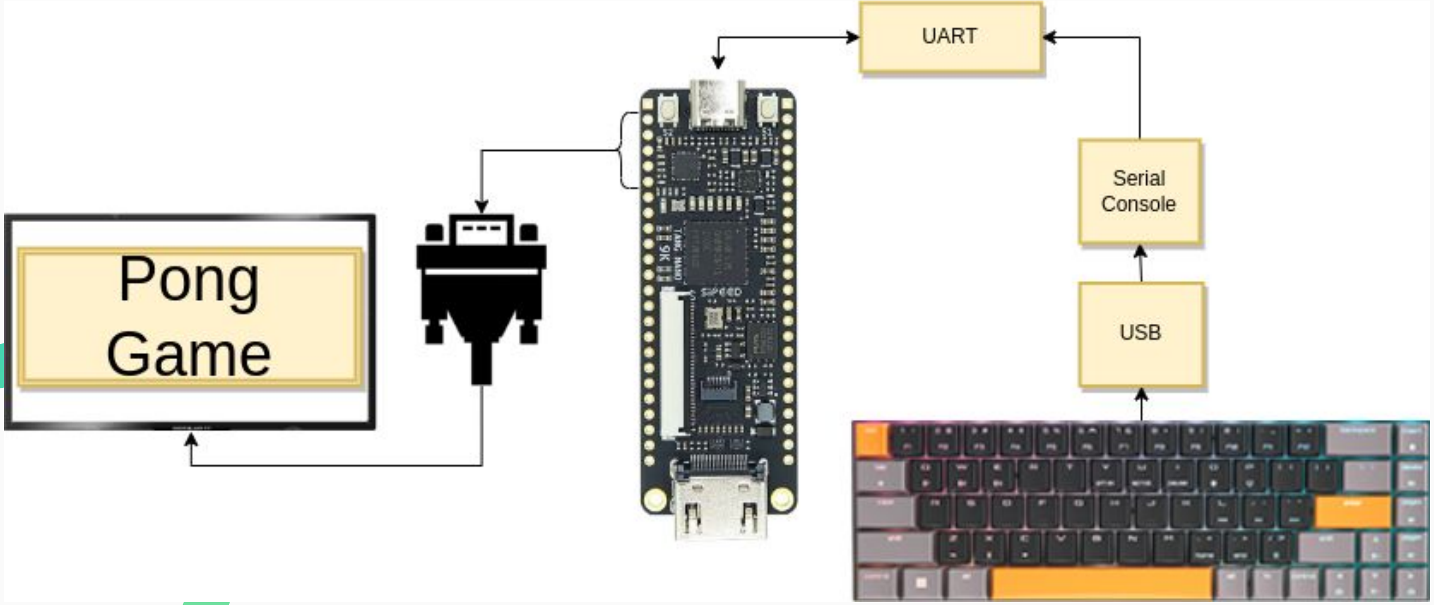
Big Picture Overview Of the Course

Introduction

Welcome to our beginner-friendly course on hardware design and FPGA programming! This program is tailored for those eager to learn the essentials of creating hardware designs and effectively porting them onto FPGA (Field Programmable Gate Array) platforms. Central to this learning experience is the indispensable role of Lushy Lab, providing a user-friendly VS Code extension that facilitates seamless hardware design and FPGA testing.

Throughout this course, participants will embark on a comprehensive learning journey. Starting with the setup of the Lushy Lab extension, learners will progress through the fundamentals of Digital Logic Design (DLD), gaining a solid foundation for the subsequent exploration of Verilog, a hardware descriptive language crucial for expressing complex hardware designs. Moving beyond theory, students will engage in practical hands-on experiences, crafting their own games from scratch, including popular titles like Pong. The curriculum also encompasses interfacing with peripherals like VGA (Video Graphic Array) for screen display and keyboards for user control.

System Context Of Project



02
Getting Setup For Lushay Lab

Getting Setup Of Lushy Lab Extension On VS Code.

Setup Guide

Step 01: OSS-CAD-Suite

- OSS-CAD-Suite is a project managed by the yosys
- enabling users to visually set up and execute the operating system toolchain.

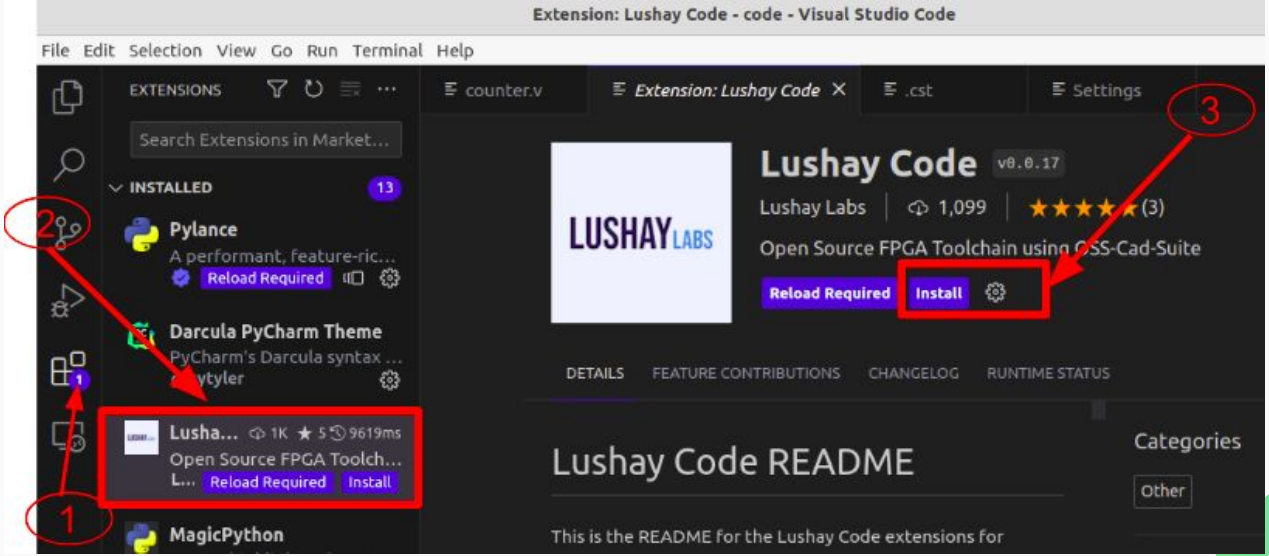
OSS-CAD-Suite Installation Link:
https://github.com/YosysHQ/oss-cad-suite-build/releases/download/2023-04-06/oss-cad-suite-linux-x64-20230406.tgz

- You can use the above link for OSS-CAD-Suite installation.

Setup Guide

Step 02: Lushay Lab Extension Installation In VS Code

- Second step is to open up the VSCode and go to the Extensions tab and install the Lushay code.



Extension: Lushay Code - code - Visual Studio Code

Lushay Code v0.0.17

Lushay Labs | 1,099 | ★★★★★ (3)

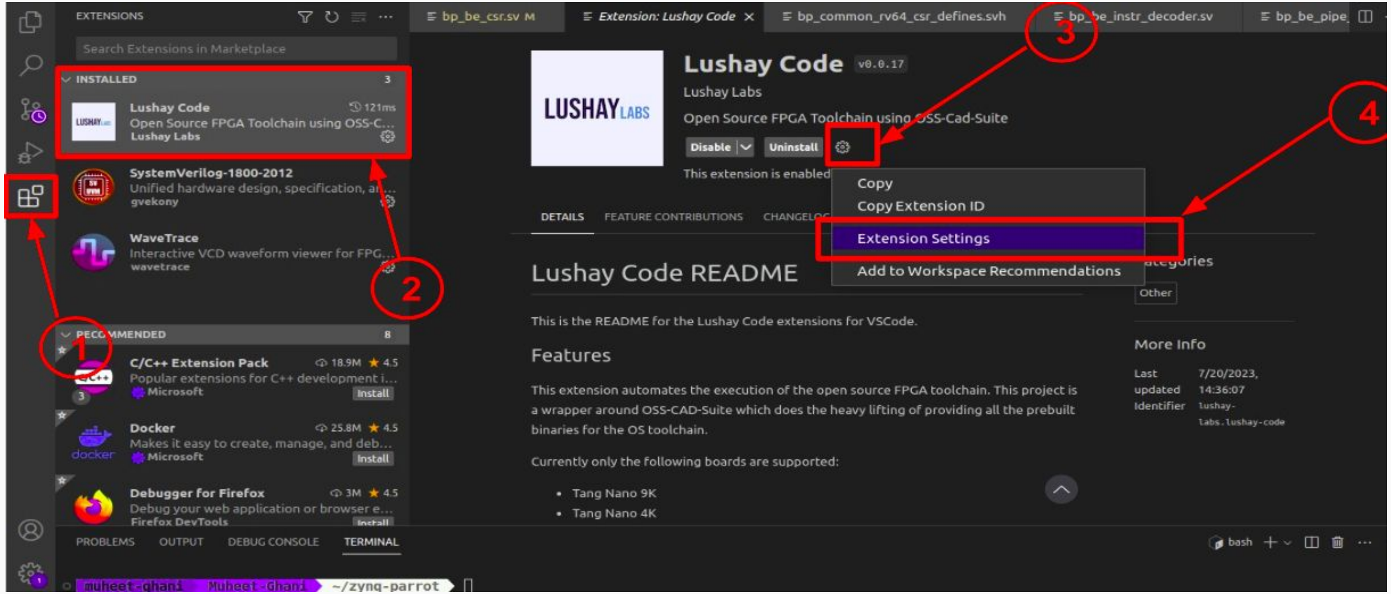
Open Source FPGA Toolchain using OSS-Cad-Suite

Lushay Code README

This is the README for the Lushay Code extensions for

Setup Guide

Choose the recently extracted OSS-CAD-Suite folder specifically, the folder named ”oss-cad-suite” containing the ”bin” subfolder.


EXTENSIONS
Search Extensions in Marketplace
INSTALLED 3
Lushay Code 121ms
Open Source FPGA Toolchain using OSS-C...
Lushay Labs
SystemVerilog-1800-2012
Unified hardware design, specification, a...
gvekony
WaveTrace
Interactive VCD waveform viewer for FPG...
wavetrace
RECOMMENDED 8
C/C++ Extension Pack 18.9M 4.5
Popular extensions for C++ development i...
Microsoft Install
Docker 25.8M 4.5
Makes it easy to create, manage, and deb...
Microsoft Install
Debugger for Firefox 3M 4.5
Debug your web application or browser e...
Firefox DevTools Install
bp_be_csr.sv M
Extension: Lushay Code
bp_common_rv64_csr_defines.svh
bp_be_instr_decoder.sv
bp_be_pipe_
Lushay Code v0.0.17
LUSHAY LABS
Lushay Labs
Open Source FPGA Toolchain using OSS-Cad-Suite
Disable
Uninstall
This extension is enabled
Copy
Copy Extension ID
Extension Settings
Add to Workspace Recommendations
DETAILS
FEATURE CONTRIBUTIONS
CHANGELOG
Categories
Other
More Info
Last updated 7/20/2023, 14:36:07
Identifier lushay-labs.lushay-code
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
bash
1
2
3
4

Lushay Code README

This is the README for the Lushay Code extensions for VSCode.

Features

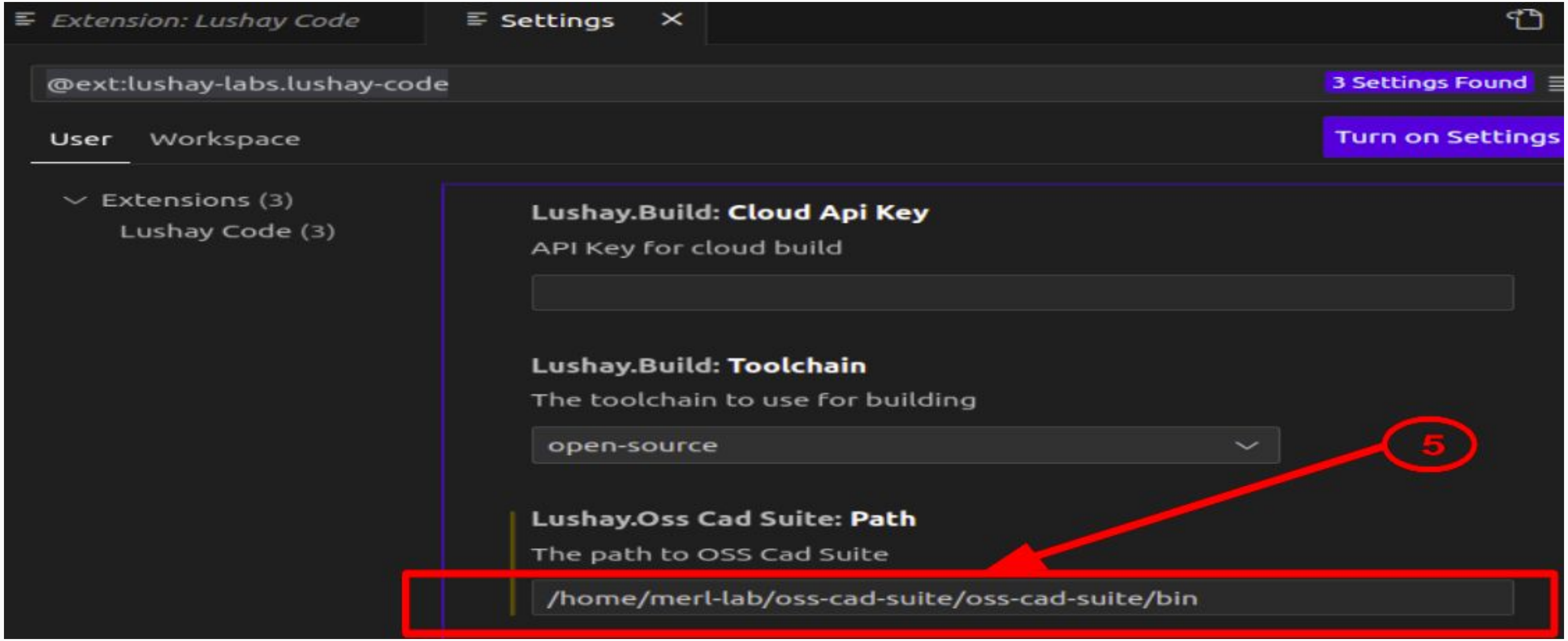
This extension automates the execution of the open source FPGA toolchain. This project is a wrapper around OSS-CAD-Suite which does the heavy lifting of providing all the prebuilt binaries for the OS toolchain.

Currently only the following boards are supported:

- Tang Nano 9K
- Tang Nano 4K

```
muheet-ghani  Muheet-Ghani  ~/zynq-parrot
```

Setup Guide



Lushay.Build: **Cloud Api Key**
API Key for cloud build

Lushay.Build: **Toolchain**
The toolchain to use for building
open-source

Lushay.Oss Cad Suite: **Path**
The path to OSS Cad Suite
/home/merl-lab/oss-cad-suite/oss-cad-suite/bin

03

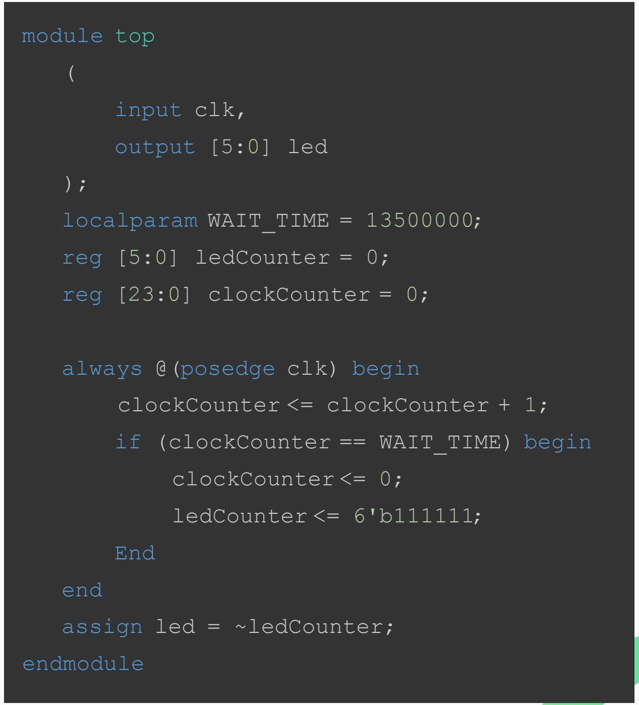
FPGA Porting.

Implement Logic with VS code Lushy lab Extension and Ported on FPGA

FPGA Porting

Step 01: Write Verilog Code

Make the folder i.e Counter and create verilog file i.e counter.v. and copy the below just for the reference.



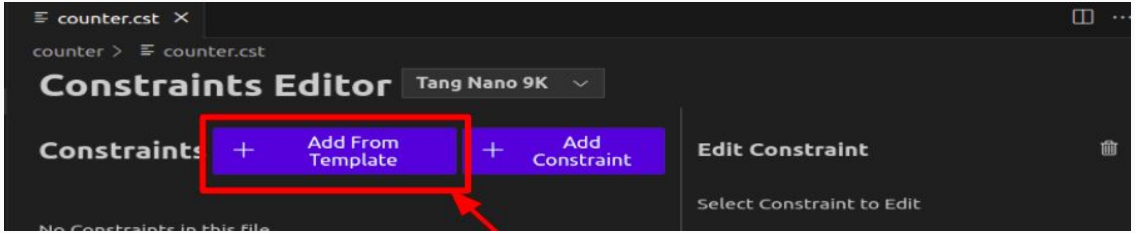
```
module top
    (
        input clk,
        output [5:0] led
    );
    localparam WAIT_TIME = 13500000;
    reg [5:0] ledCounter = 0;
    reg [23:0] clockCounter = 0;

    always @(posedge clk) begin
        clockCounter <= clockCounter + 1;
        if (clockCounter == WAIT_TIME) begin
            clockCounter <= 0;
            ledCounter <= 6'b111111;
        End
    end
    assign led = ~ledCounter;
endmodule
```

FPGA Porting.

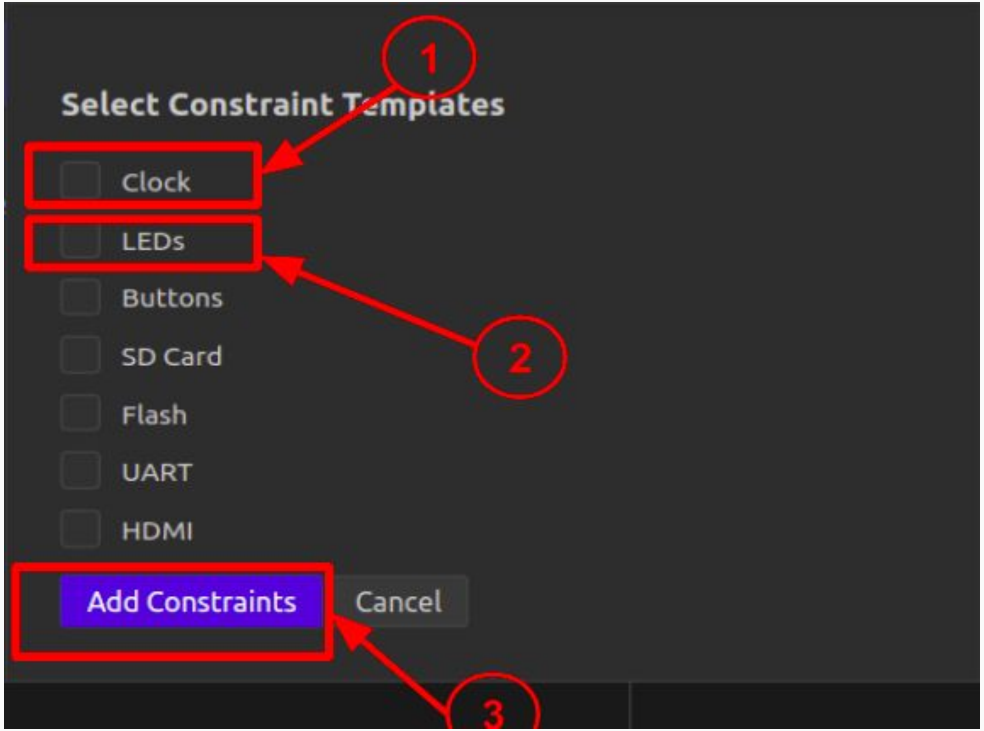
Step 02: Create .cst file

When .cst is created on VS Code. this type of interface will be open for constraints. Now click on “Add From Template”.



FPGA Porting

Next you have to select clk, and led and then click “add constraint”.



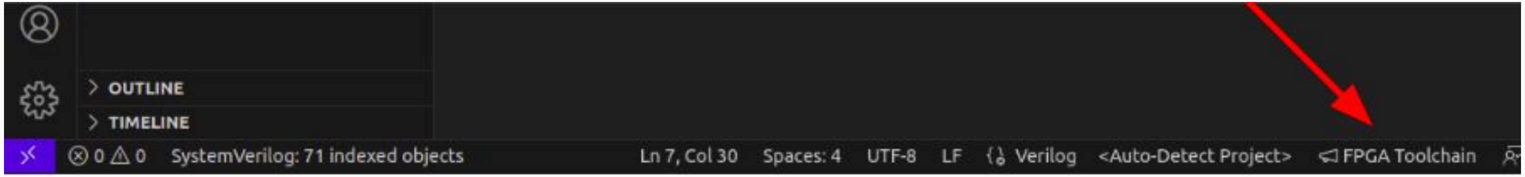
Select Constraint Templates

- ☐ Clock
- ☐ LEDs
- ☐ Buttons
- ☐ SD Card
- ☐ Flash
- ☐ UART
- ☐ HDMI

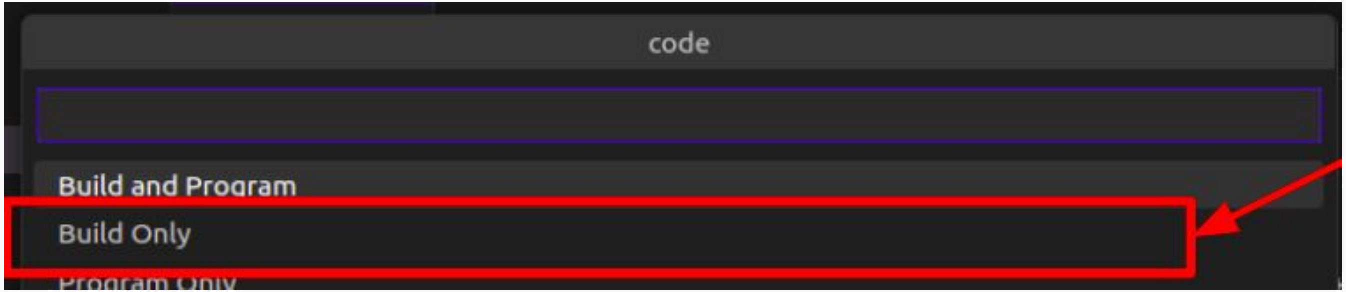
FPGA Porting.

Step 03: Synthesis And PNR

Now click on the bottom right hand side called “fpga toolchain”



Now click on “build only” which starts synthesis and pnr

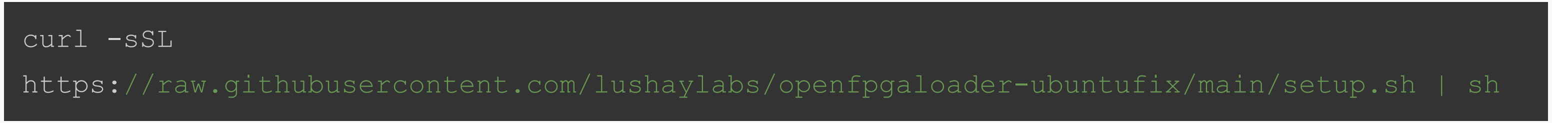


FPGA Porting.

Step 04: Program FPGA

Now After completing the “build only” step successfully bitstream have generated with .fs extension file now it’s time to program onto the FPAG. Now again click on the bottom right side “FPGA toolchain” button and hit the “program only” option just below the “build only” option.

If it show’s the error message of the “FTDI port not found” then run this command on terminal.



```
curl -sSL
https://raw.githubusercontent.com/lushaylabs/openfpgaloader-ubuntufix/main/setup.sh | sh
```

04

Exercise.

Exercise Task.

Exercise.

Now Add button on the counter logic and make the counter which depend on the button.

Testimonial

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Under The Supervision Of:

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Sajjad Ahmed: Research Associate.

Thanks: Lushay Lab, Slidesgo.

Future Work

This is version 1.0 of our course. We will continue this training and very soon release further versions. For any questions or to stay connected with us

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Gmail: Dr.Ali Ahmed. Sajjad Ahmed. Abdul Muheet Ghani.