

COEN 317 Lab 2 (UJ-X)

by

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Performed on

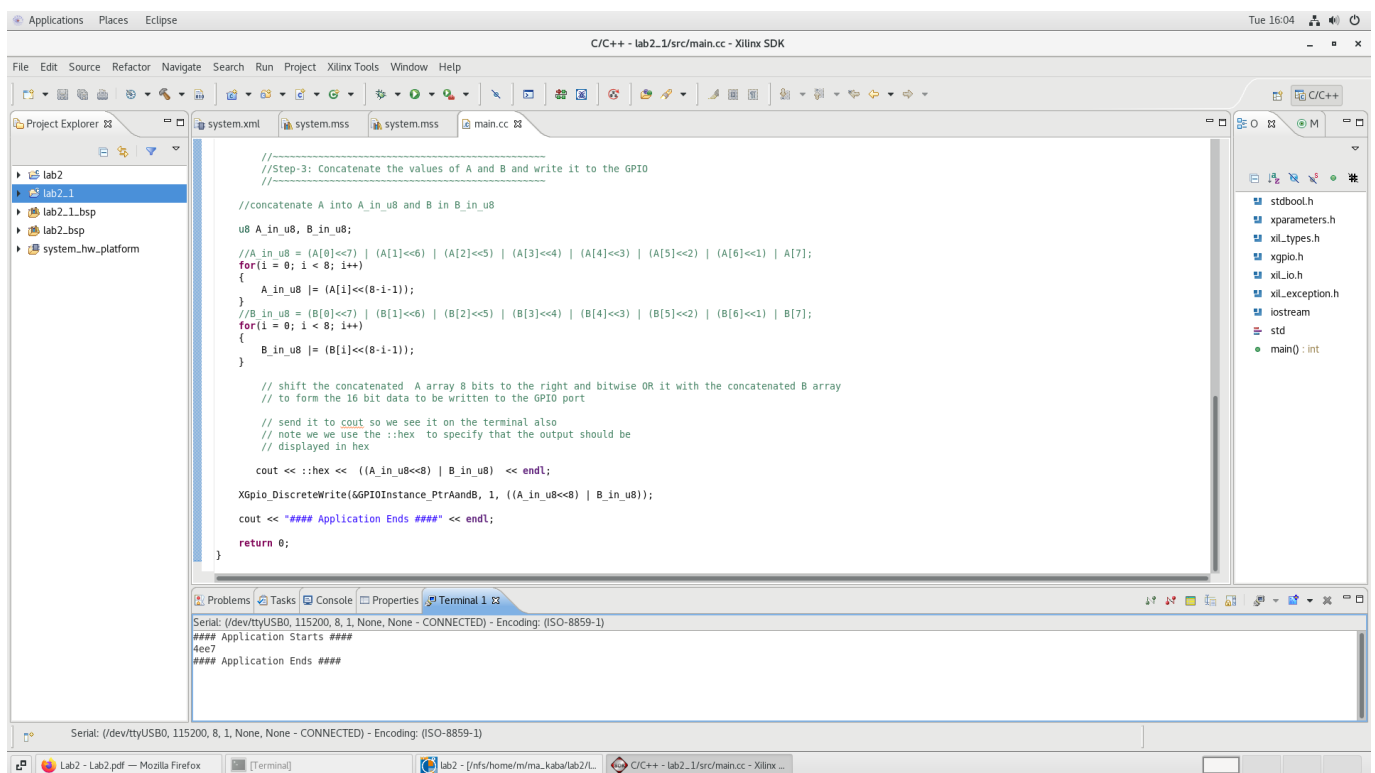
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"I certify that this submission is my original work and meets the Faculty's  
Expectations of Originality."

# Introduction

This lab experiment aims to explore the utilization of programmable logic within the XC7020 chip. Specifically, we will implement a two-input AND gate, with each input spanning 8 bits. The processor will supply data to the AND gate via a 16-bit wide General Purpose Input/Output (GPIO). The resulting 8 outputs from the AND gate will be visually displayed using LEDs.

# Results



The screenshot shows the Eclipse IDE with the following components:

- Project Explorer:** Shows a project named 'lab2' with sub-projects 'lab2\_1', 'lab2\_1.bsp', 'lab2.bsp', and 'system\_hw\_platform'.
- Editor:** Displays the file 'main.cc' with the following code:

```
//Step-3: Concatenate the values of A and B and write it to the GPIO
//
//concatenate A into A_in_u8 and B in B_in_u8
u8 A_in_u8, B_in_u8;
//A in u8 = {A[0]<<7 | (A[1]<<6) | (A[2]<<5) | (A[3]<<4) | (A[4]<<3) | (A[5]<<2) | (A[6]<<1) | A[7];
for(i = 0; i < 8; i++)
{
    A_in_u8 |= (A[i]<<(8-1-i));
}
//B in u8 = {B[0]<<7 | (B[1]<<6) | (B[2]<<5) | (B[3]<<4) | (B[4]<<3) | (B[5]<<2) | (B[6]<<1) | B[7];
for(i = 0; i < 8; i++)
{
    B_in_u8 |= (B[i]<<(8-1-i));
}

// shift the concatenated A array 8 bits to the right and bitwise OR it with the concatenated B array
// to form the 16 bit data to be written to the GPIO port

// send it to cout so we see it on the terminal also
// note we use the ::hex to specify that the output should be
// displayed in hex

cout << "::hex << ((A_in_u8<<8) | B_in_u8) << endl;
XGpio_DiscreteWrite(&GPIOInstance_PtrAandB, 1, ((A_in_u8<<8) | B_in_u8));
cout << "### Application Ends ###" << endl;

return 0;
}
```
- Terminal:** Shows the output of the program:

```
Serial: (/dev/ttyUSB0, 115200, 8, 1, None, None - CONNECTED) - Encoding: (ISO-8859-1)
### Application Starts ###
4ee7
### Application Ends ###
```

In the main.cc program, we made modifications to the initial values of two boolean arrays, A and B, updating them from their original setups to new initial values. After implementing these changes, we recompiled the code and subsequently downloaded it to the board to observe the behavior of the 8 LEDs. Following these adjustments, the program proceeds to configure the GPIO port for output. It initializes the two boolean arrays, A and B, each

containing eight values. These values are then combined into two 8-bit numbers, which are further merged into a single 16-bit number. This concatenated 16-bit number is then transmitted to the GPIO port, influencing the state of the connected LEDs based on the newly assigned values.

## **Conclusion**

In conclusion, the second lab experiment on the XC7020 chip successfully demonstrated the implementation of a two-input AND gate with visual output through LEDs, highlighting the chip's programmable logic capabilities. By adjusting the initial values of Boolean arrays and observing the LED responses, we effectively showcased the AND gate's operation via a 16-bit wide GPIO input. This hands-on approach not only validated the programmable logic's functionality but also emphasized the importance of precise input configuration. The experiment serves as a foundational step towards deeper exploration of digital logic circuits in programmable devices.