

## CSE4117 Microprocessors Second Project

Due date: 23. 01. 2021 9:00

Demo date: Will be announced later.

### Question 1: Verilog Part

In the website;

<http://www.marmaralectures.com/reference-for-second-project/>

There is code for the Bird CPU, the keypad, 7-segment display, the main module, and the assembler with some missing sections (marked with the remark "to be added").

- Complete the missing sections in the all code given,
- Load it into the FPGA kit,
- Connect the keypad and the 7-segment monitor to FPGA.

Write an assembly program in Bird which will turn your hardware into a pocket calculator which is capable of adding and multiplying numbers.

- # key will act as sum (ie, +)
- \* key will act as multiplication (ie, \*)

There will be no "privilege" in calculations, ie, if you enter 3#2\*10 the result will be 50, not 23. Or, in other words, + and \* will have the same privilege.

In your code, you must have at least two function calls, "call addit" and "call mult", to perform addition and multiplication after you finish entering a number and press \* or #.

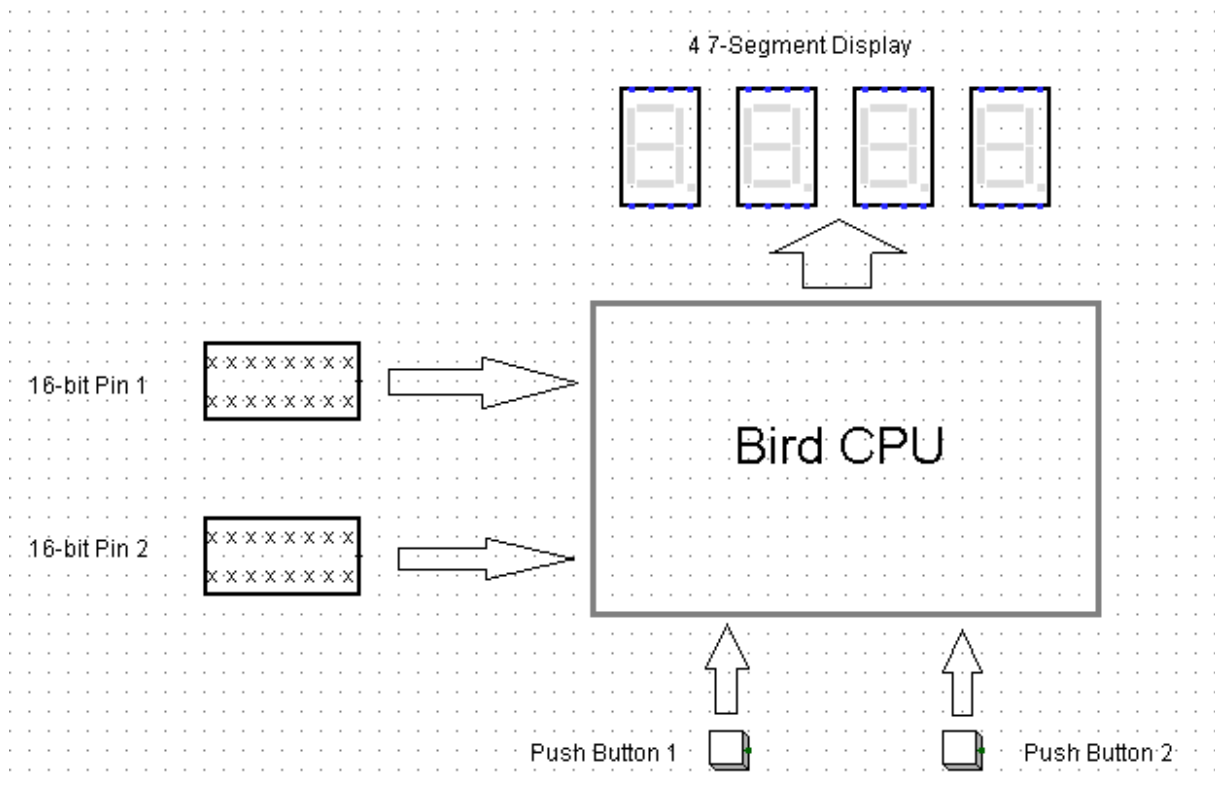
Your calculator must read the numbers from the keypad and display them in **decimal** on seven segment display. To display your result in decimal, you must write an additional piece of code (**Assembly code not in Verilog**) to convert your hexadecimal result into decimal (or binary coded decimal, BCD). You must do this in software and **NOT** in hardware. Some hints on how this can be done is described in the following link:

<https://my.eng.utah.edu/~nmcdonal/Tutorials/BCDTutorial/BCDConversion.html>

**Disregard "BCD conversion in hardware" part.**

There is an accompanying video which shows how the system you will build should work. (Note that in this video numbers are hexadecimal but you will implement as decimal)

Question 2: Logisim Part  
You will implement Bird in Logisim.



You have;

- Bird CPU
- Two 16-bit switchboards, switchboards 1 and 2
- Two Push Button, PB1 and PB2
- One 4\*7-segment display

Your assembly program will have a variable sum, which is initialized to  $\text{sum}=0$  at the start. Then your code will continuously poll the 16-bit switchboards (16-bit pins).

- If PB1 is pressed, you will read the number from switchboard 1, calculate  $\text{sum}=\text{sum}+(\text{entered number})$ , display new sum on 4\*7-segment register.
- If PB2 is pressed, you will read the number from switchboard 2, calculate  $\text{sum}=\text{sum}+(\text{entered number})^*(\text{entered number})$ , display new sum on 4\*7-segment register.

The numbers must be converted to decimal before displaying. The conversion process must be done in software in a function.