

Assignment 1: Marks 35 marks

To be completed and submitted on LMS by Sep 14 2024

In the same groups

DSP task-list:

1. Perform the MAC operation $a*b + c$ through a behavioral code, by using a **DSP block or an in-built Vivado IP**. Call this design the **MAC-DSP**. Here, a,b and c are 8-bit integers each. Store these three input integers in an array in the Verilog code (no need to use a Block-RAM). Take the design till bitstream. Note the utilised resources after implementation and resources on to which the MAC operation was mapped. (5 marks)
2. **MAC-LUT** design: Now, use LUTs instead of DSPs to perform the same MAC. Observe differences in timing slack and resources utilised. (Enforce no-DSPs to be used during synthesis and implementation) (5 marks)
3. Instantiate 10 of the above **MAC-DSPs**. Now assume that you have an array a,b and c--> each contain ten 8-bit integers. Store each array in a separate **Block-RAM**. Each of the 10 MACs should now read a,b,c and perform $a*b+c$ at the “same time”, in parallel. Note the utilised resources after implementation and resources on to which the MAC operation was mapped. (20 marks)
 1. What is the maximum number of MACs you can instantiate in parallel on Basys3 FPGAs? You do not need the boards to perform this sub-task. Take the design till post-implementation, and estimate the maximum MACs that can be used. Make sure you get a positive timing slack.
 2. Calculate the throughput: number of MAC operations per second on the FPGA board
4. For task-3, observe the location of the block-RAMs that are being used for a,b,c, in the implemented layout. Note the connection between each MAC-DSP to the Block-RAM. What is the wire-delay? How can you reduce the wire-delay? Post screenshots of the block-RAMs in layout and wire-delays. (5 marks)

Document all the observations from the above tasks

Submit:

- The code (.v) and xdc, not the Vivado project
- Pdf (not doc) with your group members roll numbers and names + the observations and screenshots wherever needed from the above tasks
- The pdfs and codes will run through plagiarism check