EITF35: Introduction to Structured VLSI Design

Lab assignment 3
Arithmetic Logic Unit (ALU)

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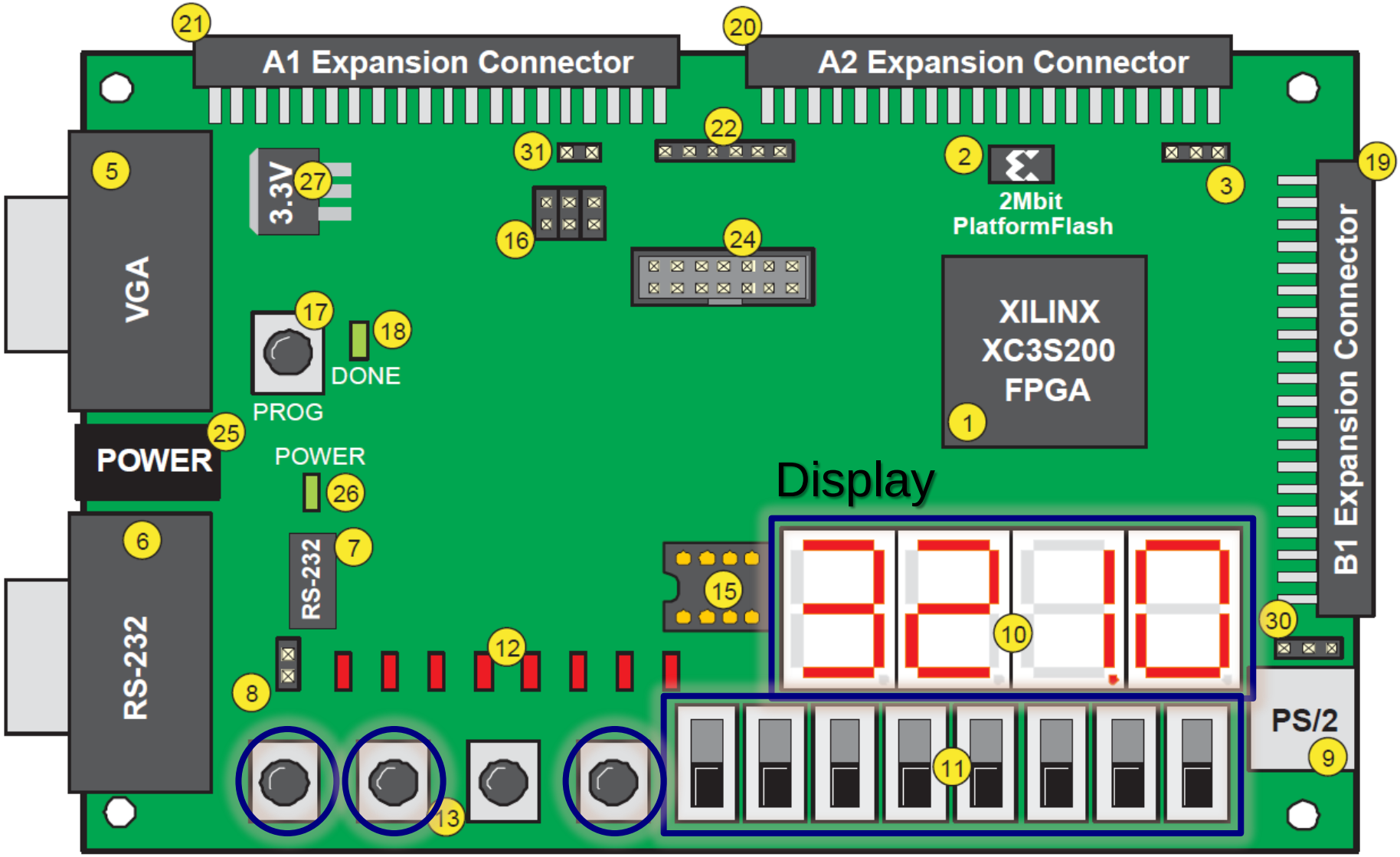
ALU is the heart of any computing

- Supercomputer (TOP500)
- Unveiled in 2007
- 250K processors
- Optical network
- petaFLOPS (10^{15})
- Low power

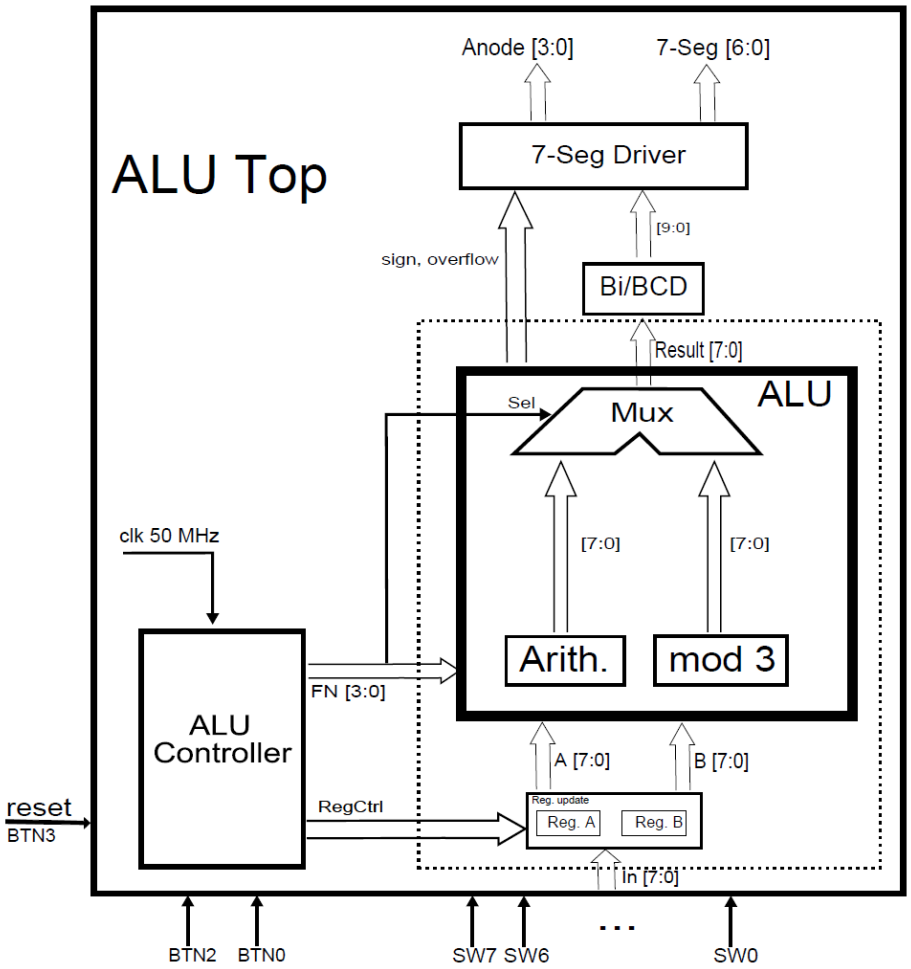
Every processor needs at least one ALU!

This assignment

- 8-bit calculator
- Sign/unsigned
- +/- and mod-3
- Overflow detection
- Switch inputs
- 7-segment display


21
A1 Expansion Connector
20
A2 Expansion Connector
22
31
2
2Mbit
PlatformFlash
3
19
B1 Expansion Connector
5
VGA
3.3V
27
16
24
XILINX
XC3S200
FPGA
1
17
18
DONE
PROG
25
POWER
POWER
26
Display
6
RS-232
RS-232
7
15
10
30
12
8
PS/2
9
11
13
Reset
Sign
Enter
Numeric keypad

ALU structure



- ALU
- Operand registers
- ALU controller
- Bi/BCD (Binary-Coded-Decimal) converter
- 7-segment driver (Lab 2)

Lab preparation

- Thoroughly read through the lab manual to understand all the detailed requirements.
- Draw a reasonably detailed FSM for ALU controller.
- Search on or come up with **HARDWARE-FRIENDLY** algorithms for:
  - Modulo-3 operation
  - Bi/BCD convertion

Modulo operation

- Definition: x mod n = x - n·floor(x/n)
- We only look at the case of **n = 3** in this assignment.
- e.g., 7 mod 3 = 7 - 3·floor(7/3) = 7 - 3·floor(2.33)
  = 7 - 3·2 = 7 – 6 = 1

- **IMPORTANT** to find a good algorithm to compute mod-3!
- **Be careful** with the signed modulo operations!

Some comments

- **Start early!**
- **Think before coding!**
- Thorough tests & **extensibility!**
- **Balanced workload!** Both group members should be able to do small changes individually during approval time.