Computer Organisation COMP2008

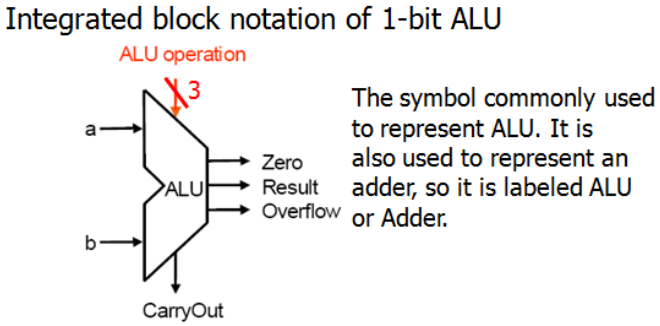
Lab Sheet 11 (starts session week 13, due in week 14)

Student Name and Number	
Date, Grade and Tutor signature, **max mark 3**	

Keep this cover sheet marked and signed by the tutor.

1. Preparation [Total max. mark: 1.5]

Understand how ALU (Arithmetic Logic Unit) is built from logic elements. You are to implement "Carry In Carry Out" block, which is a part of 1-bit ALU:



See lecture 10 slides for more details. You will do this by writing a MIPS program using logical instructions "AND" and "OR".

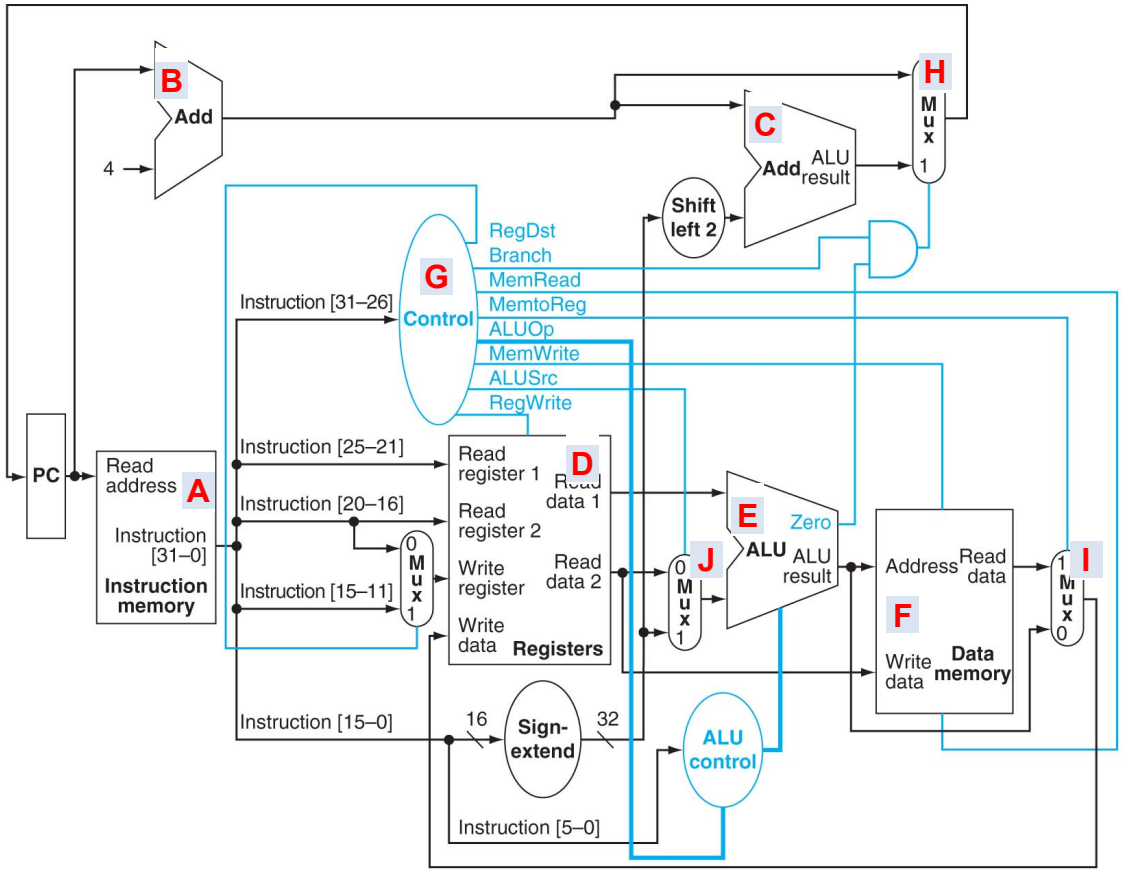
Understand the datapath assembling and control signals

To study ALU and datapath you can use the following resources:

1. the lecture notes
2. the textbook Ed 2: relevant parts of Appendix B and Chapter 4.5, Chapters 5.1-5.3.
3. the textbook Ed 3: relevant parts of Appendix B (included on CD which comes with the text) .
4. the textbook Ed 4: relevant parts of Appendix C (included on CD which comes with the text) and Chapters 4.1-4.4.
5. the textbook Ed 5: relevant parts of Appendix B and Chapters 4.1-4.4.
6. the textbook Ed 6: relevant parts of Appendix B and Chapters 4.1-4.4.

Question 1 [0.5 mark]: Describe below how ALU is **controlled** to perform one of the following functions: AND, OR, ADD, SUB. Illustrate your answer with hand drawing.

Question 2 [1 mark]: Consider the following simple MIPS datapath (Fig 4.17 from PH4), which supports the following instructions: add, sub, and, or, slt, beq, lw and sw.



- Refer to the labels **A** through **J** in the datapath diagram above, which components are required during the execution of **lw** instruction? To answer this question, please cross the components from the following table that are not used for executing a **lw** instruction. [0.5 mark]

A	B	C	D	E	F	G	H	I	J

- Refer to the labels **A** through **J** in the datapath diagram above, which components are required during the execution of **beq** instruction? To answer this question, please cross the components from the following table that are not used for executing **beq** instruction. [0.5 mark]

A	B	C	D	E	F	G	H	I	J

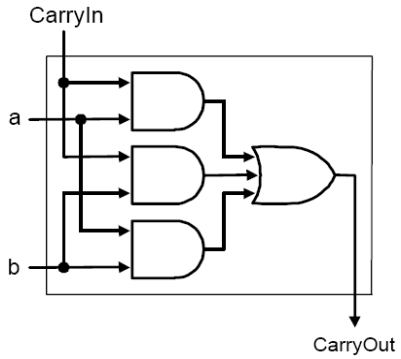
2. Workshop Task I [Total max. mark: 0.5]

- Run the provided program *and.s* , analyse the code, experiment with it to understand how it works. **Question 1 (0.3 mark):** which part of the program performs logical operation? Explain what happens if you enter digits other than 0 or 1 (use drawing with strings of 0s and 1s to illustrate).

- **Question 2 (0.2 mark):** improve *and.s* by adding code which checks that the keyboard input is 0 or 1. Any other numbers charactered should generate a message asking for correct input '0' or '1'.

3. Workshop Task II [Total max. mark: 1.0]

- Write new code to implement "CarryIn and CarryOut" logic as shown in the figure below: (you can also refer to lecture 10 slides for more details).



  The program should accept three inputs: a, b, CarryIn, and generate one output: CarryOut. As before, check that the keyboard input is 0 or 1. Remember, you are **not** implementing the complete 1-bit adder circuit, only the CarryIn / CarryOut part.

  Hints: To implement AND and OR logic gates, you can consider to use the logical instructions "and" and "or".

- Add code which terminates the program when "-1" is entered as any of the three inputs a, b or CarryIn.

Document your programs following the style of the programs discussed in the lectures, and demonstrated in the examples. Insufficient documentation and missing comments will detract from your mark.

Demonstration: Demonstrate to the tutor your running program, and be prepared to explain the code.

4. Assessment notice

When you ready, present to the tutor a printed copy of your program source code, with your name and student number included in the comments (#…), and typed or neatly written answers to questions, if there are any listed in the lab sheet. Your tutor may decide to keep the source code printout, but you should keep marked and signed cover sheet.

Warning: Any source code duplicated amongst students will result in a zero mark, and possible further action according to the WSU policy on plagiarism.

Week 14 is the last week. NO LAB WORK WILL BE ACCEPTED AFTER WEEK 14!