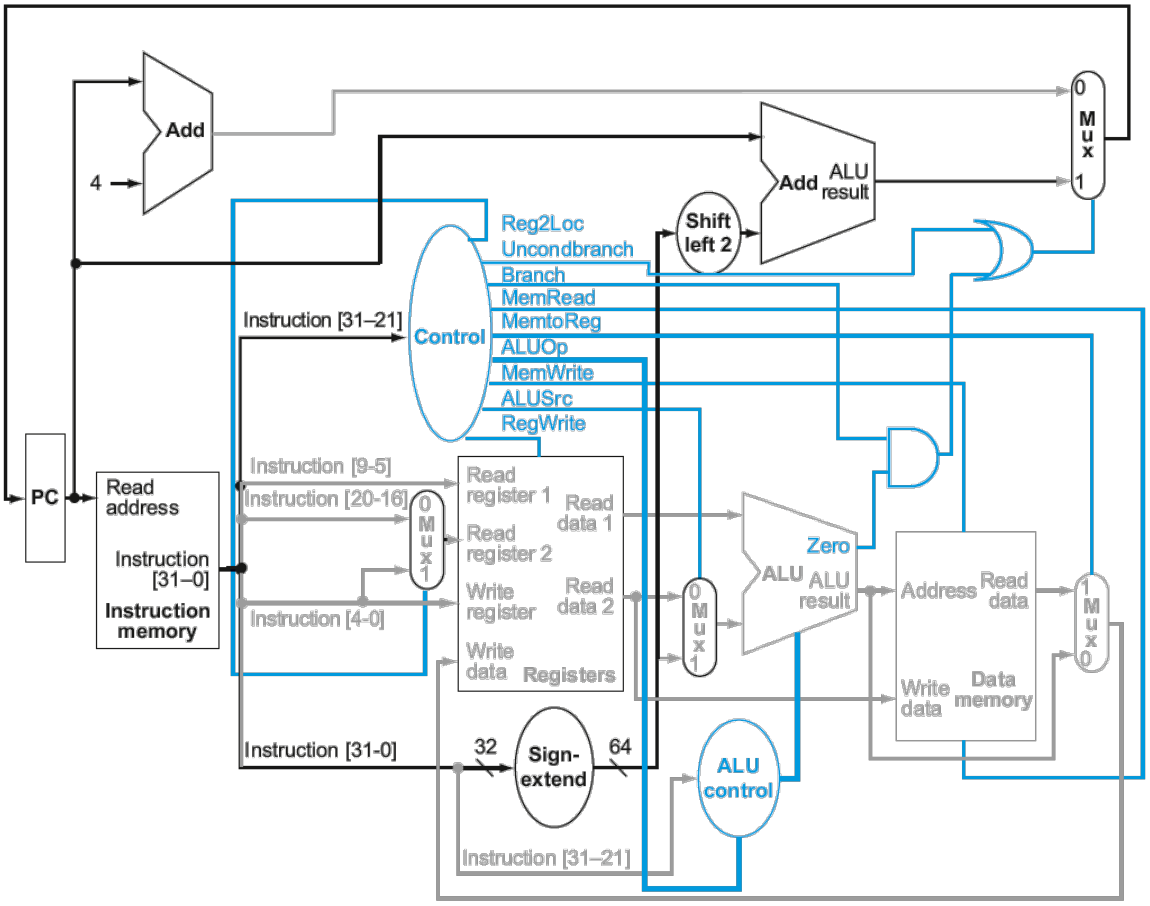
ECE 331 – Fall 2025
Homework 4
Assigned Friday, October 11
Due Friday, October 18

1. (50 pts) Use the Arm control datapath diagram below to solve the problems that follow:



(a) Fill out the values of the control signals for each instruction with either a 1, 0, or X (to indicate don't care). The 'ALUOp' control signal consists of two bits.

Instr.	Reg2Loc	Unc.b	Branch	MemRead	MemtoReg	ALUOp[1:0]	MemWrite	ALUSrc	RegWrite
add									
b									
cbz									
stur									

(b) Using X's to indicate in the table below which blocks in the datapath diagram are used for each instruction

Instr.	Registers	Sign-Extend	Branch	ALU Control	Lower ALU	Upper ALU	Shift Left	Data Memory
add								
b								
cbz								
stur								

(c) Given the execution times for each of the blocks listed below, determine the total execution times for the instructions: add, b, cbz and stur. Note, this problem is challenging. You must determine the different components of the data path that each instruction uses, then find the time that signals require to complete the path, and then use the path that takes the longest to determine the total execution time for that instruction.

Instruction Memory	Add	Control	Mux	Registers	Sign-Extend	ALU	Data Memory	Shift Left 2	And Gate
280 ps	230 ps	70 ps	40 ps	170 ps	40 ps	240 ps	280 ps	12 ps	3 ps

2. (20 pts) The logic latencies for individual stages in a processor are listed in the following table.

IF	ID	EXE	MEM	WB
310 ps	340 ps	490 ps	325 ps	260 ps

(a) What is the minimum clock period for a pipelined and a non-pipelined processor using these parameters?

(b) What is total latency of an Arm ldur instruction in a pipelined processor? What is the throughput of a large series of ldur instructions with no stalls or hazards? Express your answer in millions of instructions per second (MIPs).

3. (30 pts) Do Zybooks 4.17.7: [20] <COD §4.4> in chapter 4.17, but with the following latencies:

Instruction Memory	Add	Mux	ALU	Registers	Data Memory	Sign Extend	Shift Left 2
250 ps	90 ps	45 ps	110 ps	130 ps	250 ps	26 ps	25 ps