1. (2) If you are mainly worried about program size, what type of instruction set would you use?

2. (2 pts) There are two different ways to measure performance. What are they?

3. (3 pts) Write down the 3-term CPU performance equation developed in class.

4. (3) What is Amdahl's law (in words)?

5. (2 pts) Why doesn't MIPS have a subtract immediate instruction?

6. (5) Why are there multiple dies per silicon wafer? Why not just fabricate one huge die per wafer?

7. (3 pts) What is the advantage of using a fixed-size instruction?

8. (5 pts) Why is industry putting more and more cores on a die?

9. (5pts) Both in the book and in class we talked about "families" of computers. What did we mean? What is a family of computers?

10. (6pts) What are the three types of instructions in MIPS? For each type, show which bits are assigned to which field, and give the name of each field.

11. (6 pts) The MIPS jump instruction uses the distance field to indicate distance away from the PC. What is that distance measured in? How is this accomplished? What must be done if you need to jump further than that distance?

12. (6 pts) What are the 4 benchmark types we discussed in class? Do benchmark programs remain valid indefinitely? Why or why not?

13. (6 pts) What is a dispatch table? Where (and why) is it used?

14. (30 pts) In class we developed a 12-bit machine. In this question, we are going to wire a version of it up and write down the boolean equation for one of the signals.
The machine has 3 different instruction formats: R, I, and J.

R-type:

Opcode	rs	rt	rd	funct
11-8	7-6	5-4	3-2	1-0

I-type:

Opcode	rs	rt	Immediate
11-8	7-6	5-4	3-0

J-type:

Opcode	Offset
11-8	7-0

The machine is word-addressable, where a word is 12 bits.
Immediates are sign-extended.
In a jump instruction, the jump is relative to the current PC, so the address field is treated as a signed value.

The ALU can perform 4 functions:

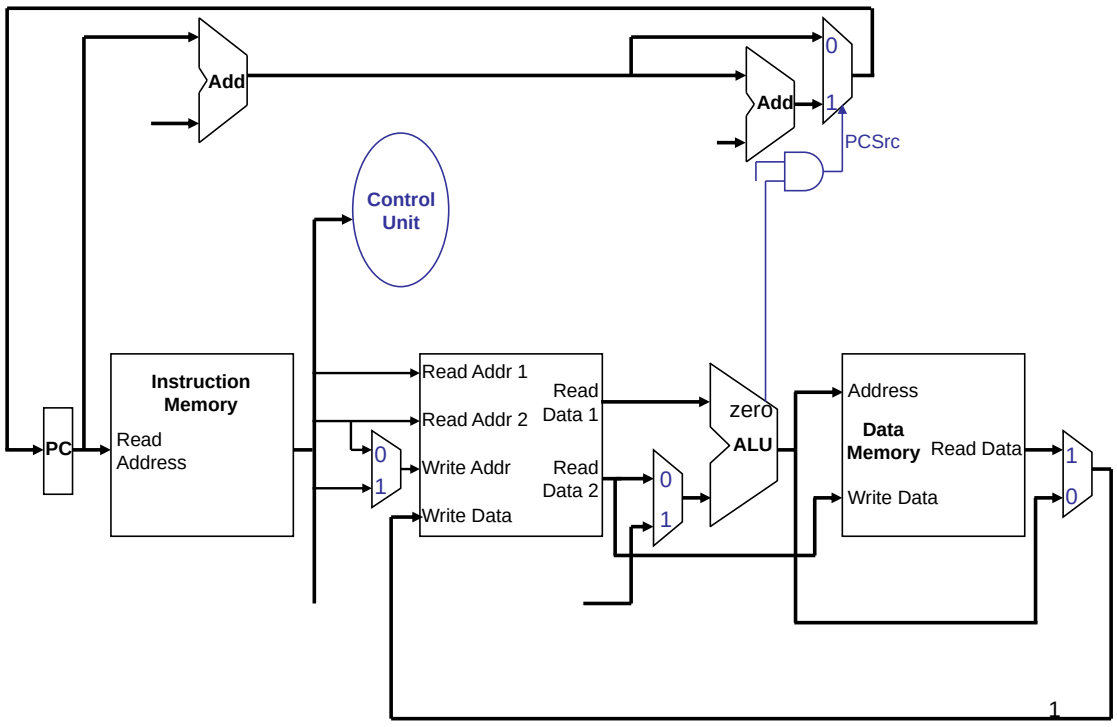
Add	00
Sub	01
And	10
Not	11

There are 16 instructions:

NOP	0000	Add	0010	Sub	0100	And	0110
Not	0001	Add Imm	0011	Sub Imm	0101	And Imm	0111
lw	1000	sw	1001	beqz	1010	j	1011

There are 9 control signals. Here are 5 of them:
DoingBranch
DoingJump
MemoryToReg
ALU1
RegWrite

Your job: list the other 4 control signals, then wire up the diagram below.
Add all the parts and the various signal names so that someone like me could implement the circuit.



Now, write down the exact boolean equation for the DoingBranch signal.

15. (16 pts) There are a number of changes that must be made to the previous design in order to make it a multicycle CPU. What are the 5 new registers that must be added, and were do they go? (Sketch them in on the diagram below). Also, there are several new control signals - list 3 of them, and explain what they do.