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## **CIT 593 Module 5 Assignment: Datapath**

*Remember that this is an individual assignment (NO group work).*

### **Part 1: Problems from *Intro to Computing Systems* by Patt & Patel**

#### **Textbook Problem 4.1:**

1. Memory: Storage of information.
2. Processing Unit: Processing of information by computation.
3. Input: Getting information into the computer from the user using devices like a mouse and keyboard.
4. Output: Getting information out of the computer using devices like a monitor.
5. Control Unit: Task manager of part performance at the correct time by controlling the order of instructions.

#### **Textbook Problem 4.2\*:**

*\* Answer this in the context of the “enhanced” CPU presented in lecture (not the book’s CPU)*

The register file is what contains the data our processor operates on. Then, instead of utilizing control memory like in a simple processor, the enhanced CPU skips the control memory by implementing a test circuit which can determine the next value of the program counter. This also allows the looping of the control memory. Now, the CPU can perform multiple read and write functions by jumping around the program.

#### **Textbook Problem 4.3:**

Simply because the program counter does not actually maintain a count of anything. It keeps track of which instructions have been processed by holding the address of the next instruction. That is why “Instruction pointer” would be more insightful.

#### **Textbook Problem 4.4:**

The word length of a computer is the number of bits processed by that computer’s CPU. It is the equivalent to the length of that computer’s instruction size processed by the ALU. The word size does not correlate to what the computer can perform. The only

thing that is different is the amount of time that is required to produce the same computation.

### Textbook Problem 4.16a:

$$1 = 2 \cdot 10^{-9}$$

$$= 5 \cdot 10^8$$

$$= 500000000$$

## Part 2: Custom Problems

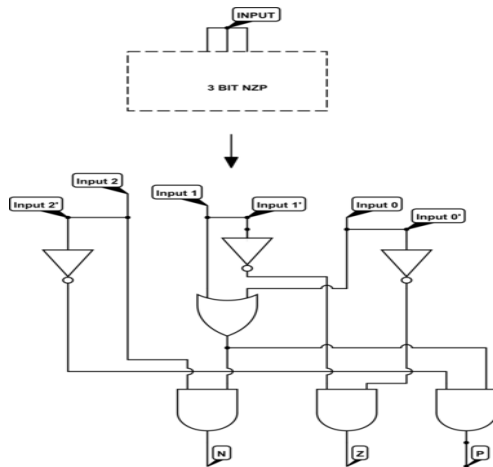
*(Please consider using a spreadsheet for items that require a table in this assignment!)*

### Custom Problem 1: Condition Codes

(a)

N	Z	P	Explanation
0	0	0	Conditionless
0	0	1	>0
0	1	0	=0
0	1	1	>=0
1	0	0	<0
1	0	1	<0,>0
1	1	0	<=0
1	1	1	<0,>0,=0

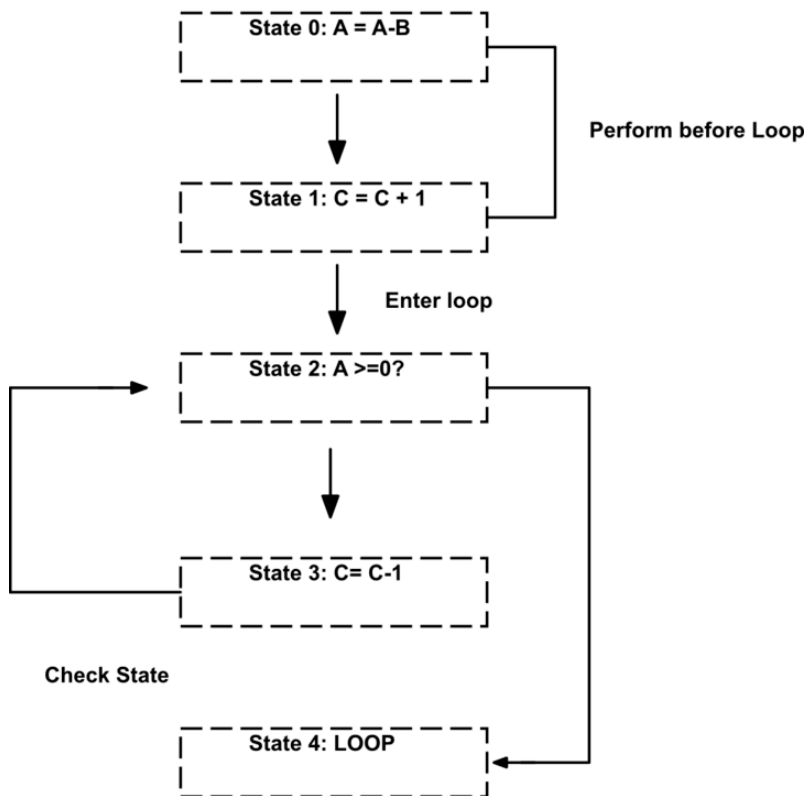
(b)



## Custom Problem 2: Integer Division

(a)

Custom Problem 2: part a Flow Chart



**(b)**

R0=0, R1=1, R2=A, R3=B, R4=C

	+/-	A_r1	A_r2	A_w	WE	NZP	NextPC
Row 0	-	R2	R3	R2	1	000	X
Row 1	+	R4	R1	R4	1	111	Row 2
Row 2	-	R2	R0	x	0	110	Row 4
Row 3	-	R4	R1	R4	1	110	Row 2
Row 4	x	x	x	x	0	111	Row 4

**(c)**

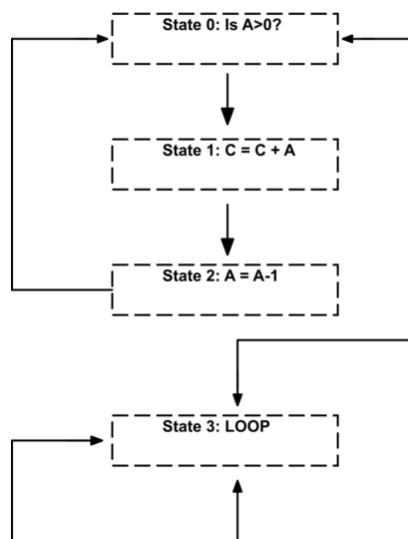
### Custom Problem 3: Summing Up Numbers

(a)

```
While (A > 0) {
  C = C + A;
  A = A - 1;
}
```

(b)

Custom Problem 3: part b Flow Chart



(c)

	+/-	A_r1	A_r2	A_w	WE	NZP	NextPC
Row 0	-	R2	R0	X	0	110	Row 3
Row 1	+	R3	R2	R3	1	000	X
Row 2	-	R2	R1	R2	1	111	Row 0
Row 3	X	X	X	X	0	111	Row 3

**(d)**

Clock Cycle	0	1	2	3	4	5	6	7	8	9	10
PC state	#0	#1	#2	#0	#1	#2	#0	#1	#2	#0	#3
+/-	1	0	1	1	0	1	1	0	1	1	X
A_r1	2	3	2	2	3	2	2	3	2	2	X
A_r2	0	2	1	0	2	1	0	2	1	0	X
WE	0	1	1	0	1	1	0	1	1	0	0
A_w	X	3	2	X	3	2	X	3	2	X	X
ALU out	3	3	2	2	5	1	1	6	0	0	X
R0	0	0	0	0	0	0	0	0	0	0	0
R1	1	1	1	1	1	1	1	1	1	1	1
R2(A)	3	3	2	2	2	1	1	1	0	0	0
R3(C)	0	3	3	3	5	5	5	6	6	6	6
Operation	A>0?	C=C+A	A=A-1	A>0?	C=C+A	A=A-1	A>0?	C=C+A	A=A-1	A>0	Loop

**(e)**

For this processor, the highest unsigned integer value is 65535.