

F04, Lecturer: Brian Grattan; Date: Thursday, Oct. 28, 2004

CS120B Midterm

Name: _____ UCR Student ID: _____

Due at 11:00AM

1. (1 point) Which of the following is an embedded system:

a. Apple G5 desktop b. iPod MP3 player c. A block of wood d. A tick embedded in your skin

2. (2 points) If you designed a custom multiplier 3 years ago and found it took 0.1mm^2 of silicon in an IC, and you were asked to re-design the same multiplier using today's technology, how many multipliers could you fit into 0.1mm^2 according to Moore's Law?

In three years the size of transistors would have halved twice, so FOUR multipliers would fit on the same space.

3. (4 points) For the following questions, write the letter (or letters) for the IC technology that fits the description (include all answers that are appropriate):

A) PLD (Programmable Logic Device)**B) Semi-Custom****C) Full-Custom**___ **A** ___ Use this process for the lowest NRE and the fastest time to market___ **ABC** ___ You can implement a single purpose processor in this IC technology___ **B** ___ This type of IC technology includes standard-cell and gate-array, but NOT field programmable gate array___ **A** ___ The Xilinx IC you use in lab is a part of this IC technology

4. (2 points) What type of processor has a customized ALU, program memory, and data memory.

a. General Purpose b. Application-Specific c. Single Purpose

5. (2 points) True or False: The amount of money a product makes over its lifetime is not affected by whether it was released on time or not.

a. True b. False

6. (2 points) True or False: A synthesizer takes a high level language and converts it into assembly instructions to be executed on a processor.

a. True b. False

Points on this page: _____/_____

7. (2 points) True or False: According to the mythical man month, the productivity of designers gets worse as the size of the team they are working on gets bigger.

a. True b. False

For the following three questions you have an image processor that processes images line by line with the following steps:

1. Read line of image (1200 clock cycles)
2. Process line (2000 clock cycles)
3. Write new line of image (1200 clock cycles)

8. (2 points) If an image had 640 lines, what would be the throughput in images/clock cycle?

$$(1200 + 2000 + 1200) \text{ clks/line} * 640 \text{ lines/image} = 2816000 \text{ clocks/image}$$

$$\approx 3.55 \text{ E-7 images/clock cycle}$$

9. (2 points) If four processors could run in parallel on the same image, how would that affect the throughput? _____

a. It would have 0.5X the throughput b. It would have 2X the throughput

c. The throughput would be the same **d. It would be 4x the throughput**

10. (2 points) Imagine this processor was used for video, and there were two systems. System one had four processors working in parallel on the same image. System two had four processors, but each one worked on a different image simultaneously, which of the following statements would be true? _____

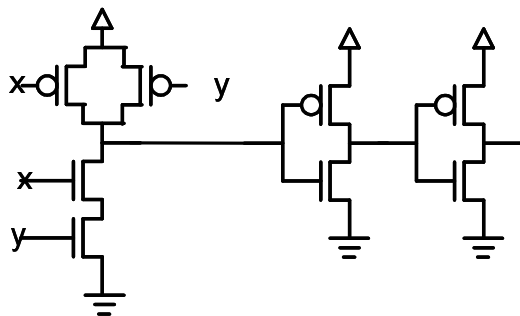
a. The throughput (in images/clock cycle) of system one would be faster

b. The throughput of system two would be faster.

c. The throughput would be the same for each, but the latency for one image to be processed would be faster for system one

d. The throughput would be the same for each, but the latency for one image to be processed would be faster for system two

11. (4 points) Create the truth table for this CMOS circuit:



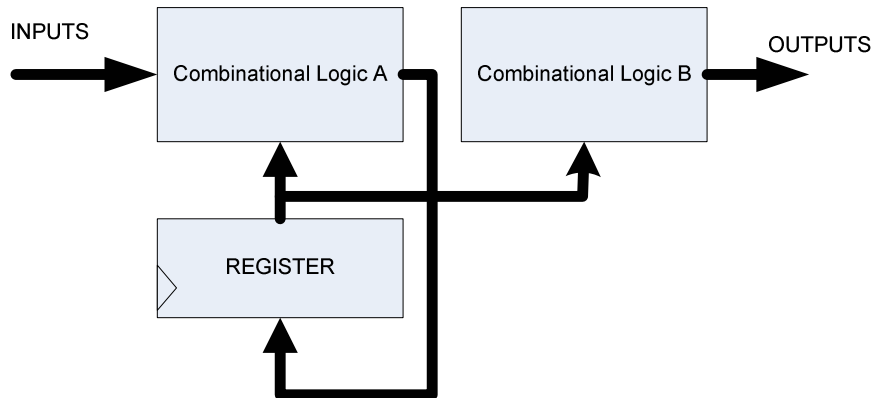
F = ?

X	Y	F (output)
0	0	1
0	1	1
1	0	1
1	1	0

12. (2 points) If your co-worker said he had used 3000 NAND's and 500 NOR's, roughly how many transistors did he use?

- a) **14,000** b) 3500 c) 7000 d) 20,000 e) 21,000 f) 100,000

13. (2 points) Here is the diagram for a simple Moore State Machine:



What is the purpose of 'Combinational Logic A'?

Determine the next state depending on the current state and the inputs.

14. (2 points) In a general purpose processor, the address of the instruction to be read is held where?

- a) **Program Counter** b) Instruction Register c) ALU d) Accumulator

15. (2 points) If you had written some code and wanted to determine which functions took the majority of the execution time which tool would tell you this?

- a) Emulator b) Simulator c) Compiler **d) Profiler** e) Synthesizer

16. (4 points) What is the difference between combinational and sequential components? Give an example of each.

Combinational components have outputs that are determined only by the present inputs, like a multiplexer. The outputs of sequential components are dependant on current and or previous inputs, like a register.

17. (2 points) If you cascade two counters so that the 'top' (the signal that indicates it has reached it's maximum and is starting over) is fed to the input of the next one, then the resolution will:

- a) increase b) decrease **c) stay the same**

18. (2 points) What is the purpose of a *watchdog timer*? _____

- a) **Restart the processor if it gets stuck**
 b) Monitor another timer to be sure it is working
 c) Set off an alarm if a counter reaches it's maximum
 d) It gets rid of bugs in your code by eating them

19. (16 points) Write an algorithm and create an FSMD (FSM with data) to solve the following problem statement. Don't go any further than the FSMD.

Inputs: X, Y

Outputs: B

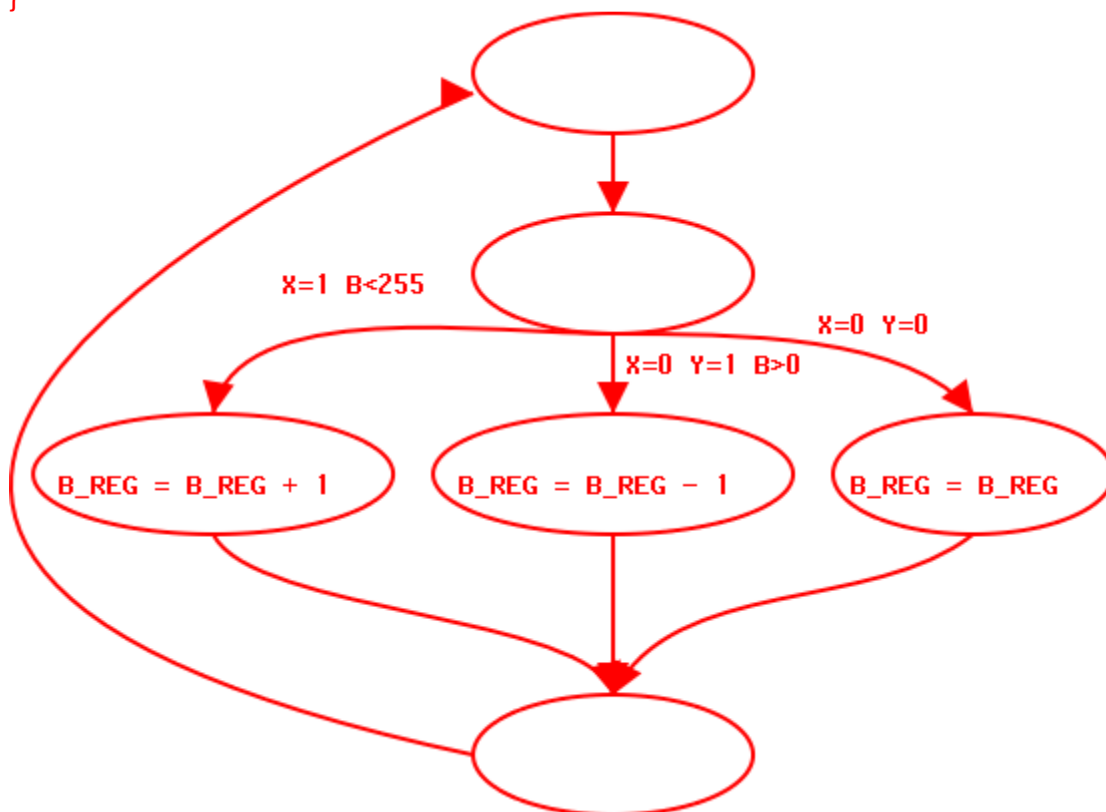
As long as X is '1' increase the output B, but not past 255. If X is '0' and Y is '1' decrease B, but not past 0. If X is '0' and Y is '0' then do not change B. The system should run in an infinite loop.

NOTE: Some solutions that are different may be accepted if it is clear that the student had a different understanding of the problem description, but their algorithm and FSMD still make sense.

```

While (1) {
  If (X = 1 and B < 255) {
    B = B + 1 }
  else if (X = 0 and Y = 1 and B > 0) {
    B = B - 1 }
  else
    B = B
}

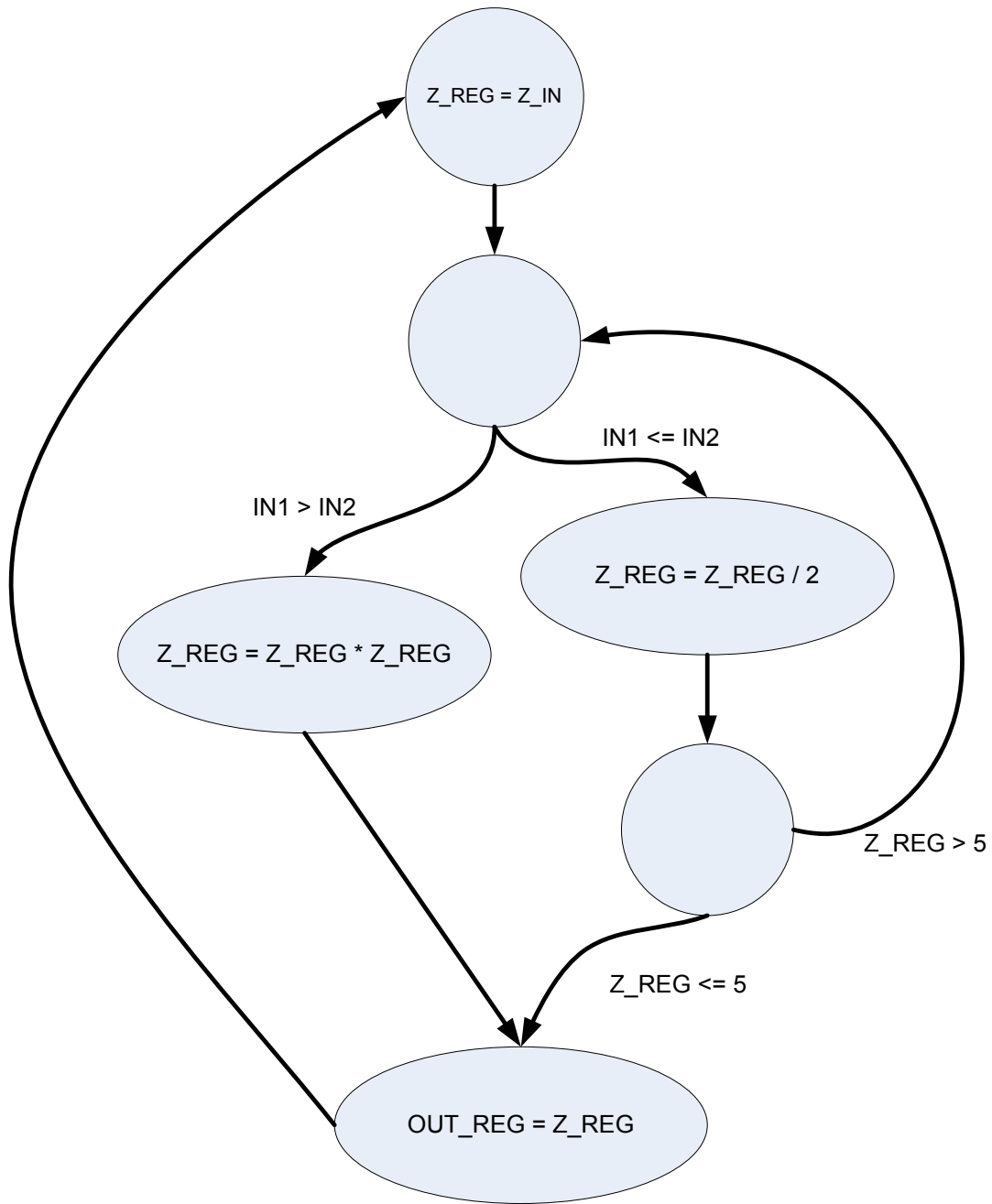
```

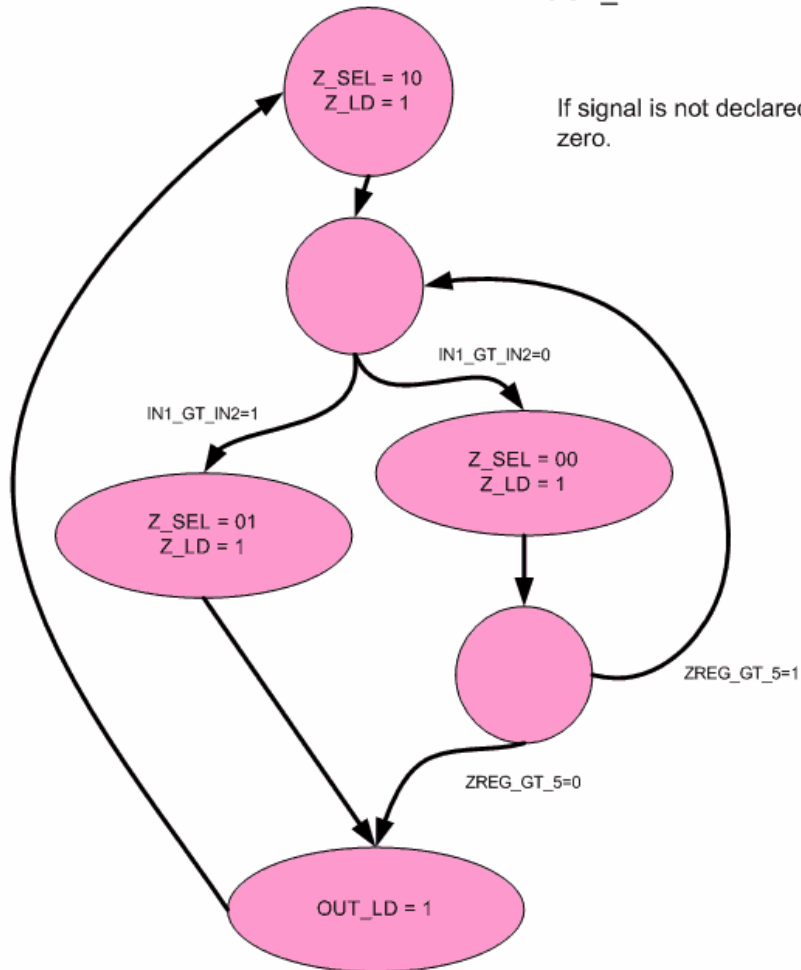
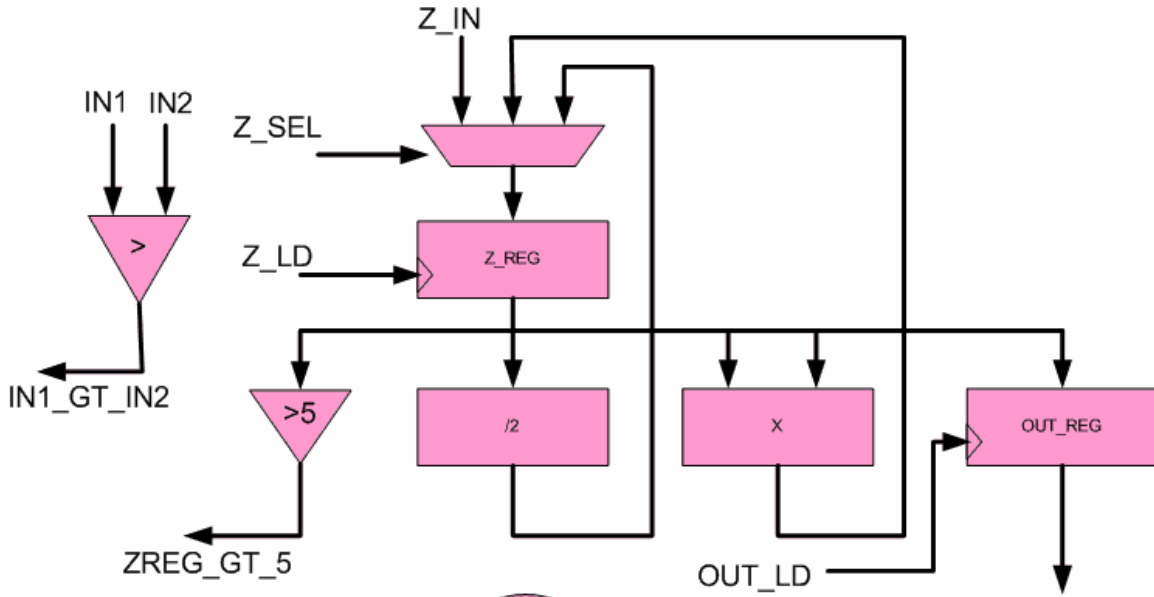


20. (20 points) For the given FSMD, create an FSM and a datapath on the next page.

inputs: Z_IN, IN1, IN2

outputs: OUT (OUT is registered and an output of OUT_REG)





If signal is not declared, assume it is zero.

21. (12 points) Fill in the table at the bottom of the page for every instruction, in the order they would be executed. The first two lines have been filled in for you. Under "Memory Change?" put the memory address that changed and what the it's new value is, or put 'none' if there were not any memory changes. Make sure to note memory changes in case that data is read later!

Instructions:		
MOV Rn, direct	Rn = M(direct)	
MOV direct, Rn	M(direct) = Rn	
MOV @Rn, Rm	M(Rn) = Rm	
MOV Rn, #immed.	Rn = immediate	
ADD Rn, Rm	Rn = Rn + Rm	
SUB Rn, Rm	Rn = Rn - Rm	
NOP	No Operation	
JZ Rn, immediate	PC = immediate (only if Rn is 0)	

Instructions

AD	OPCD	OPERAND1	OPERAND2
10	MOV	R0	#0
11	MOV	R1	#101
12	MOV	@R1	R0
13	MOV	R2	M(102)
14	MOV	R3	#1
15	JZ	R1	1D
16	ADD	R1	R3
17	MOV	@R1	R3
18	MOV	M(103)	R1
19	JZ	R2	12
1A	NOP		
1B	ADD	R1	R3
1C	MOV	R2	#0
1D	JZ	R0	17

Memory

ADDRESS	DATA (8 bit HEX)
0x101	2
0x102	4
0x103	6
0x104	8
0x105	10

Program Counter	R0	R1	R2	R3	Memory Change?
10	0	X	X	X	None
11	0	101	X	X	None
12	0	101	X	X	101->0
13	0	101	4	X	None
14	0	101	4	1	None
15	0	101	4	1	None
16	0	102	4	1	None
17	0	102	4	1	102->1
18	0	102	4	1	103->102
19	0	102	4	1	None
1a	0	102	4	1	None
1b	0	103	4	1	None
1c	0	103	0	1	None
1d	0	103	0	1	None
17	0	103	0	1	103->1
18	0	103	0	1	103 ->103
19	0	103	0	1	None
12	0	103	0	1	103->0
13	0	103	1	1	None
14	0	103	1	1	None

22. (2 points) List one thing you learned in the class that wasn't on this test: *Any decent answer accepted.*