

CS120B Final

Name: _____ **Solutions** _____ UCR Student ID: _____

Due at 4:30PM

1. (1 point) According to Moore's Law, if a leading edge chip currently contains 500 million transistors, in 1.5 years a leading edge chip will contain how many transistors?

1 billion

2. (4 points) For the following questions, write the letter (or letters) for the IC technology that fits the description (include multiple answers if appropriate):

A) PLD (Programmable Logic Device)

B) Semi-Custom

C) Full-Custom

 C This type of IC will give you the absolute best performance (speed and size) but will have the highest NRE cost.

 ABC You can implement a single purpose processor in this IC technology.

 ABC You can implement a general purpose processor in this IC technology.

 A The Xilinx IC you use in lab is a part of this IC technology

3. (1 point) You made a processor in lab that created different frequencies depending on which button was pressed. This would best be described as what type of processor?

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

4. (2 points) If you were a manager of a large company, and you wanted to buy a processor that would work in many different projects and was very flexible, which type of processor would you buy?

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

5. (2 points) Which of the following metrics may be used to evaluate an embedded system (circle all that apply)?

a. NRE cost b. Unit cost c. Time-to-market d. Size e. Power consumption

6. (2 points) Which of these best describes what a synthesizer can do?

**a. Simulate VHDL b. Convert VHDL into a gates c. Convert VHDL into C
d. Program FPGA's**

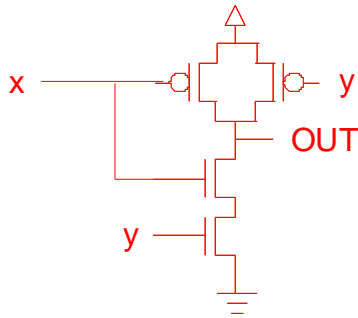
7. (2 points) The mythical man-month is best summarized as:

- a. **The more designers you add to a project, the less productive each designer is.**
- b. The more months the project drags on, the later you get the product to market.
- c. The difference between IC capacity and Designer productivity is growing.
- d. The myth that a designer can work for a month focused on one project is exaggerated.

8. (2 points) If a fellow designer told you she had designed a chip using 1,000 NOR gates and 2,000 NAND gates, roughly how many transistors would that design take?

- a. 3,000
- b. 6,000
- c. **12,000**
- d. 18,000
- e. 750
- f. 1500

9. (4 points) Using pMOS transistors and nMOS transistors, draw a NAND gate.



10. (4 points) Put a C by the combinational components and a S by the sequential components.

- C Multiplexer
- S 8-bit Register
- S D flip-flop
- S 128-bit counter

11. (2 points) Given a Moore state machine implemented in digital logic, what is the purpose of the state register?

- a. To hold the inputs
- b. To register the outputs
- c. **To hold the value of current state**
- d. To determine the value of the next state

12. (4 points) Give one advantage and one disadvantage of the Princeton architecture (shared memory) over the Harvard architecture.

advantage: more efficient memory usage, simpler memory bus

disadvantage: can't read data and instructions at the same time (slower), can't use different memory types for program and data memory

13. (5 points) Mix and Match--Put the letter of the correct definition by the component of a general purpose processor:

| Component: | Description: |
|-------------------------|---|
| ALU <u> E </u> | A. Holds the address of the next instruction |
| PC <u> A </u> | B. Determines how to set control lines in the processor |
| IR <u> D </u> | C. Holds data (like variables) |
| Registers <u> C </u> | D. Holds the instruction |
| Controller <u> B </u> | E. Does mathematical operations |

14. (2 points) What is the main advantage of a VLIW (Very Long Instruction Word) architecture compared to standard architectures?

- a. It has a cool acronym for a name.
- b. The instructions are very detailed, so can execute more efficiently
- c. VLIW is the only architecture that can be pipelined
- d. VLIW's encode several operations into one machine instruction**
- e. None

15. (2 points) Which development tool would you use for the purpose of finding which functions in your code took up most of the execution time?

- a. compiler
- b. synthesizer
- c. assembler
- d. profiler**
- e. linker

16. (2 points) Which tool allows you to test your code "on board" and in a real-world environment (or at least very close to it)?

- a. debugger
- b. profiler
- c. emulator**
- d. instruction set simulator
- e. compiler

17. (2 points) If processor 'A' runs at 125 MHz, is pipelined and has 32 instructions and processor 'B' runs at 80MHz, is not pipelined, but has 255 instructions, which one can execute more DMIPs?

- a. processor 'A'
- b. processor 'B'
- c. both will be about the same
- d. not enough information given**

18. (4 points) If an 8-bit timer's input is connected to a clock that runs at 1MHz, what is the range? What is the resolution?

$$\text{Range} = 255 * 1\text{E-}6 = 255\text{E-}6$$

$$\text{Resolution} = 1\text{E-}6$$

19. (2 points) In general, which component is going to take more gates (meaning it is more complex), a pulse-width modulator or an LCD controller?

- a. **LCD controller**
- b. **Pulse-Width modulator**
- c. **They are both about the same**
- d. **Not enough information given**

20. (2 points) If your embedded system contains a watch-dog timer, what do you definitely have to add to your program?

- a. **Code to reset the watchdog timer on a regular basis**
- b. **Code to monitor signals coming from the watchdog**
- c. **Code to read what value the watchdog timer is at**
- d. **Code to receive commands from the watchdog timer**
- e. **A few bugs for the watchdog to chase and eat**

21. (2 points) If you encode the value '00010101' using 9-bit odd parity, what will the result be?

- a. **'000101011'**
- b. **'100010101'**
- c. **'000111110'**
- d. **'000101010'**

22. (6 points) If a 10 bit A/D converter has a range of 0 to 5V and the output is '1001011011' what is the analog value does this represent (in volts with 4 significant digits)?

$$e/5 = 603/(2^{10} - 1) = 2.947V$$

23. (4 points) Due to quantization, the actual analog input to the A/D in question 22 can be anywhere within a range of values. What is the range of values for your answer in question 22? (Be sure to show your work! You might not have gotten 22 correct.)

$$\begin{aligned} \text{resolution} &= 5/(2^{10} - 1) = 0.004887 \\ \text{actual value} &= 2.9472 \pm (\frac{1}{2}) * 0.004887 \\ &= 2.9472 \pm 0.002444 \end{aligned}$$

24. (2 points) Which type of applications would BEST be solved with a stepper motor? (circle only one)

- a. **Applications that need the highest rotational speed possible**
- b. **Applications needing easy control of the position**
- c. **Applications needing high torque**
- d. **Applications needing the absolute least expensive motor**

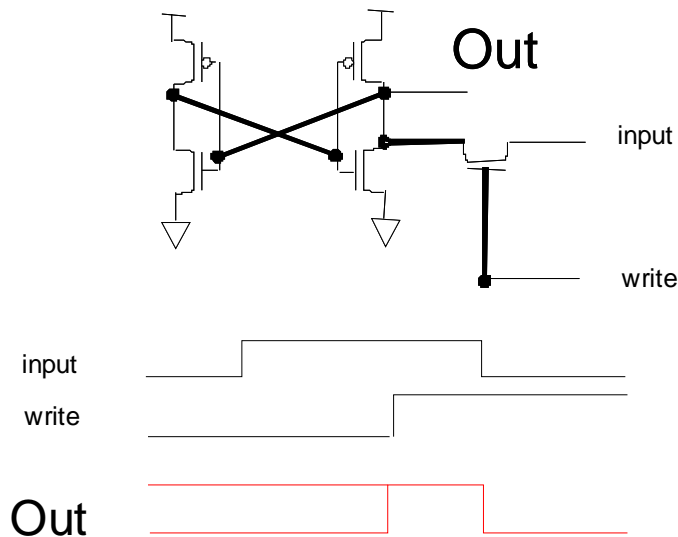
25. (4 points) Mix and Match: Put the letter of the best use, by the type of memory:

| Type of Memory: | Best Use: |
|------------------|--|
| EPROM <u>C</u> | A. On-Chip cache |
| OTP ROM <u>D</u> | B. Off-chip data memory |
| SRAM <u>A</u> | C. Instruction Memory during development |
| DRAM <u>B</u> | D. Instruction Memory during production |

26. (2 points) What specifically is it about how DRAM cells are designed that makes it necessary to continually refresh them--in other words, why do they need to be refreshed?

Since they hold their value using a capacitor, the charge on the capacitor must be refreshed or it will slowly leak and lose its value.

27. (6 points) Given the following inputs to this memory cell, draw the output, being sure to indicate its value at all times.



28. (6 points) If the value 0x4321 is stored in main memory at location 0xFB87640A and the processor requests the value stored there, what is the TAG, OFFSET and INDEX given the following specifications for the cache in the system: 4-Way set associative, 65536 lines, 8 data words per line (in this case, each word is 16 bits)

Address = 1111101110000 1110110010000001 010

Offset = three bits = 010

Index = 16 bits = 1110110010000001

Tag = leftovers = 1111101110000

29. (6 points) Briefly list the steps that occur when a peripheral asserts an interrupt in a vectored interrupt system (you should end up with anywhere from 5 to 10 steps).

1. Peripheral asserts interrupt
2. uP stores PC and acknowledges interrupt
3. Peripheral puts interrupt address on bus
4. uP jumps to address and executes ISR
5. Peripheral de-asserts interrupt
6. uP returns to original execution

31. (2 points) If you need to move data over a long distance using a cable, which method is typically used today for really fast communication?

- a. serial** b. parallel c. they are each used equally

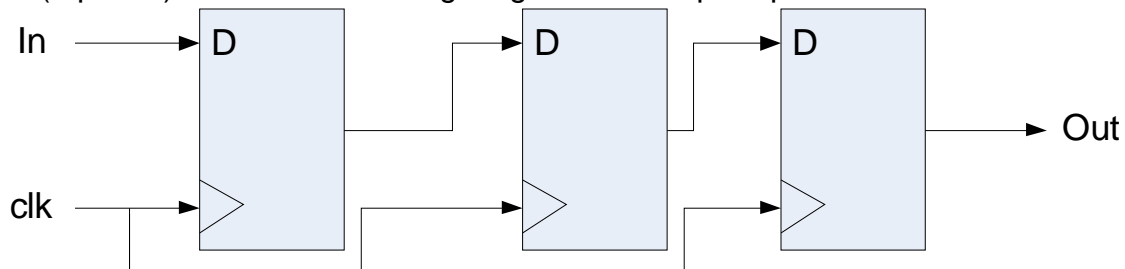
32. (2 points) The I²C protocol, which we talked about in class, has which of the following attributes (circle all that apply):

- a. It is wireless**
b. It uses only two wires for communication
c. It has higher data throughput than firewire
d. It can have more than two components on the same bus

33. (2 points) When doing JPEG compression, what is the purpose of Huffman Encoding?

- a. To compensate for manufacturing anomalies in the CCD**
b. To adjust the bias of the picture
c. To use fewer bits for commonly used values to save space
d. To do a discrete cosine transform

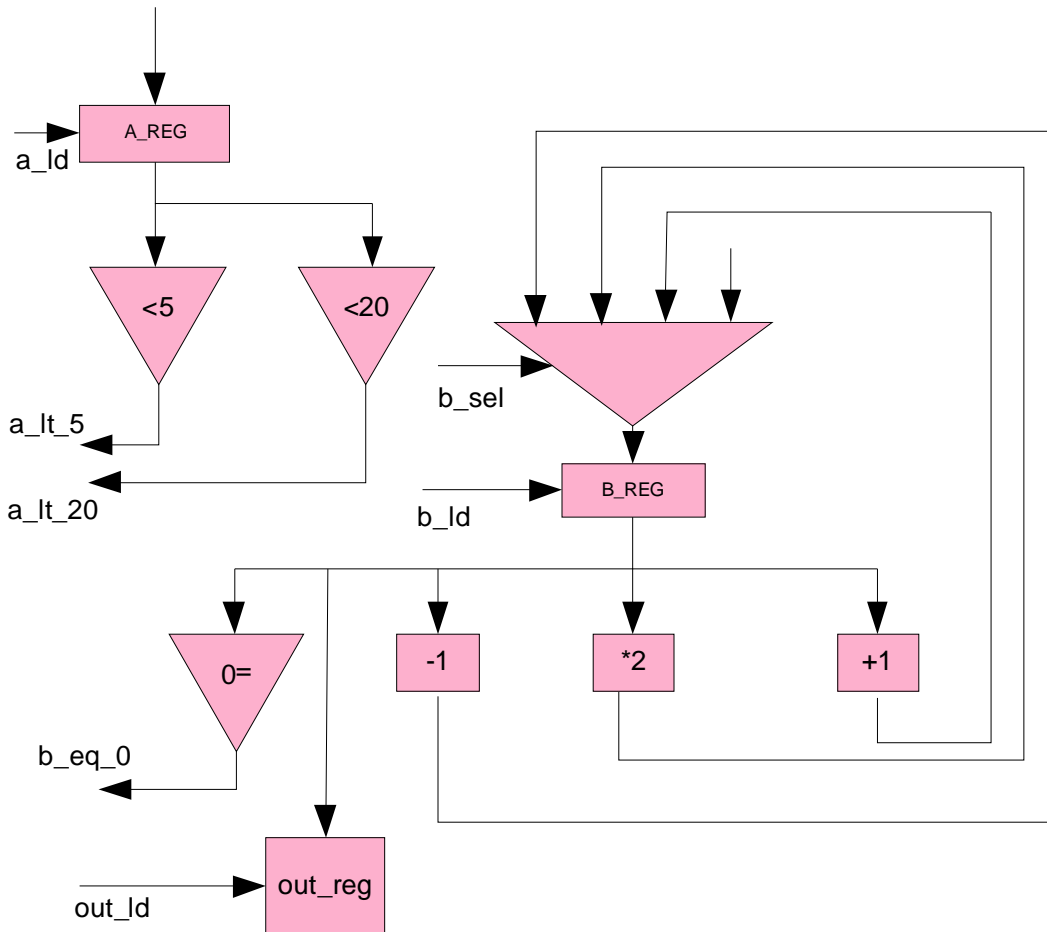
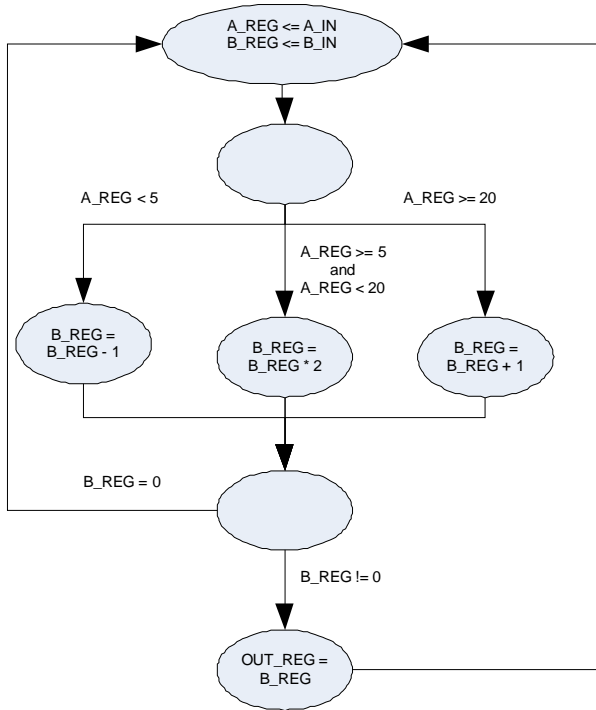
32. (4 points) Given the following diagram of D-Flip-Flops:



Assume that a new bit of data is present at 'In' on every clock cycle. What is the latency (in clock cycles)? What is the throughput (in bits/clock cycle)?

- latency = 3 clock cycles
 throughput = 1 bit/clock cycle

33. (15 points) Create the datapath for the following FSM. Be sure to label all components and every connection and indicate if the connections are inputs or outputs (a simple arrow will suffice). NOTE: You should use the minimum possible number of comparators.



34. (1 point) What is your favorite assembly instruction, and what does it do?

Any reasonable answer accepted.

35. (1 point) Make a multiple choice question on a topic that was covered in class but not on this test.

Any reasonable answer accepted.