

CSC258 Computer Organization 2009 Fall

Assignment 2 due Thu.Nov.5 at 6pm in BA2220

1[20] Design a circuit to find the maximum of three binary natural numbers. The numbers are

$$A = a_{n-1} a_{n-2} a_{n-3} \dots a_2 a_1 a_0$$

$$B = b_{n-1} b_{n-2} b_{n-3} \dots b_2 b_1 b_0$$

$$C = c_{n-1} c_{n-2} c_{n-3} \dots c_2 c_1 c_0$$

and the result is

$$X = x_{n-1} x_{n-2} x_{n-3} \dots x_2 x_1 x_0$$

plus three more bits $f g h$ that have the following meaning.

$$f g h = 000 \text{ means the maximum is either } A \text{ or } B \text{ or } C \text{ (they are all equal)}$$

$$f g h = 001 \text{ means the maximum is either } A \text{ or } B \text{ (those two are equal)}$$

$$f g h = 010 \text{ means the maximum is either } A \text{ or } C \text{ (those two are equal)}$$

$$f g h = 011 \text{ means the maximum is } A$$

$$f g h = 100 \text{ means the maximum is either } B \text{ or } C \text{ (those two are equal)}$$

$$f g h = 101 \text{ means the maximum is } B$$

$$f g h = 110 \text{ means the maximum is } C$$

$$f g h = 111 \text{ is unused}$$

One way to solve the problem is to find the maximum of two of the inputs, then find the maximum of that and the third input. But that circuit takes two passes through the bits and requires too much time to produce its answer. Instead, find the maximum in one pass through the bits. Make your circuit as simple as possible. Explain your design well.

2[20] When you enter digits into the display of a calculator or ATM, each new digit goes into the rightmost position, and the other digits shift left one place. In this simple version, we enter binary digits into a 5 digit display. There are three buttons: z (zero), n (none), and c (clear); these are the inputs (there is no clock input, but there can be an internal clock). The five bits of output (the digits of the display) are, from left to right, u, v, w, x , and y . Implement the display using any circuits that we have covered in class. Explain your implementation clearly. Although the question does not specify what happens in the following circumstances, for your implementation, say what happens if:

- (a) two or three buttons are pressed at the same time.
- (b) more digits are entered than there is room in the display.

3 Here is a calculation expressed in everyday decimal notation, and the same calculation expressed in binary quote notation.

$$(3 / 7) - (7 / 3)$$

$$(0'11 / 0'111) - (0'111 / 0'11)$$

- (a)[5] Perform the calculation in everyday decimal notation. The divisions produce right-repeating digits.
- (b)[5] Perform the calculation in binary quote notation. The divisions produce left-repeating digits.
- (c)[2] In a few sentences, compare (a) with (b).