Embedded Real-Time Systems (AME 3623)
Homework 2 Solutions

February 15, 2008

Question 1

1. (5pts) Given the binary number: 101101000. What is the decimal equivalent? What is the hexadecimal equivalent? Show your work.

   $8 + 32 + 64 + 256 = 360$

   168

2. (5pts) Given the binary number: 11101110. What is the decimal equivalent? What is the hexadecimal equivalent? Show your work.

   $2 + 4 + 8 + 32 + 64 + 128 = 238$

   EE

3. (5pts) Given the decimal number: 419. What is the binary equivalent? Show your work (all of the steps of the algorithm that we discussed in class).

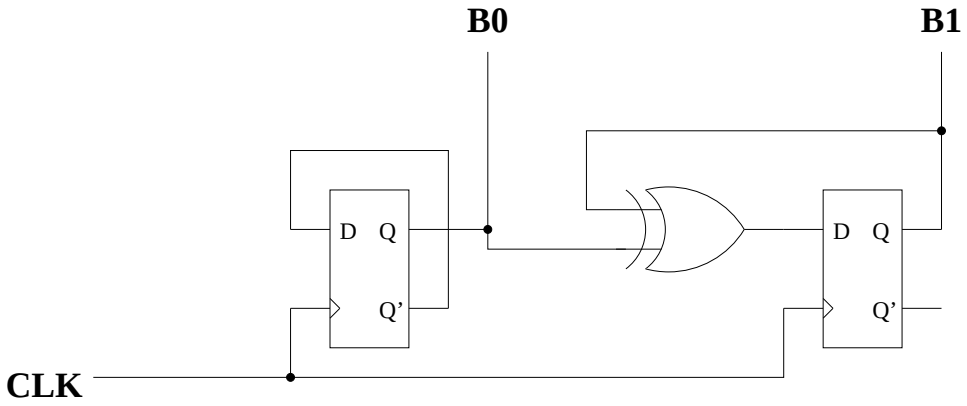
value	**binary**	i	2^i
419	000000000		
		8	256
163	100000000		
		7	128
35	110000000		
		5	32
3	110100000		
		1	2
1	110100010		
		0	1
0	110100011		

4. (5pts) Given the decimal number: 524. What is the binary equivalent? Show your work.

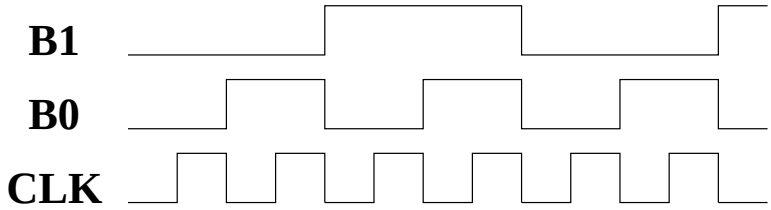
value	**binary**	i	2^i
524	0000000000		
		9	512
12	1000000000		
		3	8
4	1000001000		
		2	4
0	1000001100		

Question 2

Consider the following circuit with input CLK:



1. (10pts) Assume that the initial state is: $B0 = 0$ and $B1 = 0$. Show the timing diagram for $B0$ and $B1$ as the clock (CLK) is pulsed.



2. (10pts) Interpreting $B1$, $B0$ as a 2-bit binary number (with $B0$ as the 1's digit), what is the sequence of values that this circuit produces?

   $Q_1\ Q_0 = 00, 01, 10, 11, 00, 01, 10, ...$

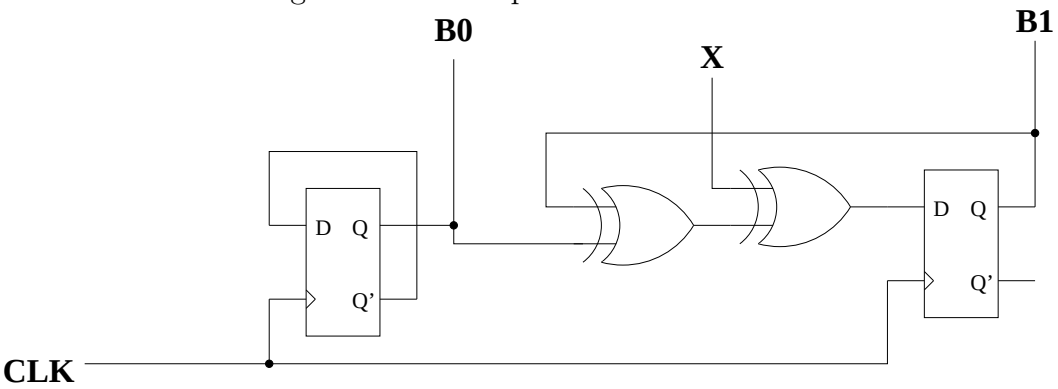
3. (10pts) What is the function of this circuit?

   It is a counter.

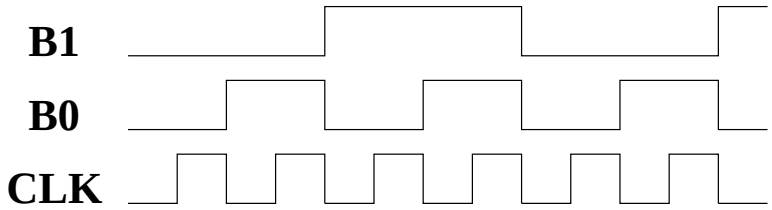
   (this is what we refer to as a *synchronous counter* because all of the bits change at the same time)

Question 3

Consider the following circuit with inputs CLK and X:



1. (10pts) Assume that the initial state is: $B0 = 0$ and $B1 = 0$. Assume also that $X = 0$. Show the timing diagram for $B0$ and $B1$ as the clock (CLK) is pulsed.



   Note: $A \oplus 0 = A$. This means that when $X = 0$, this circuit behaves the same as in question 2.

2. (10pts) Interpreting $B1$, $B0$ as a 2-bit binary number (with $B0$ as the 1's digit), what is the sequence of values that this circuit produces?

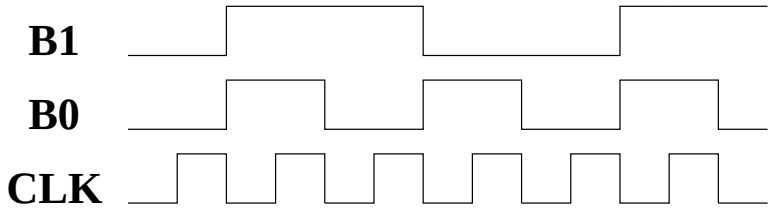
   $Q_1\ Q_0 = 00, 01, 10, 11, 00, 01, 10, ...$

3. (10pts) What is the function of this circuit when $X = 0$?

   It is also a counter.

4. (10pts) Assume the same initial state as above, and assume that $X = 1$. Show the timing diagram for $B0$ and $B1$ as the clock (CLK) is pulsed.

   Note: $A \oplus 1 = \bar{A}$.



5. (10pts) What is the sequence of values that this circuit produces?

   $Q_1\ Q_0 = 00, 11, 10, 01, 00, 11, 10, ...$

6. (10pts) What is the function of this circuit when $X = 1$?

   The circuit counts down with each clock tick.