Embedded Real-Time Systems (AME 3623)
Homework 1 Solutions

February 17, 2010

Question 1

1. (5pts) Given the binary number: 110100101. What is the decimal equivalent? Show your work.

   $1 + 4 + 32 + 128 + 256 = 421$

2. (5pts) Given the binary number: 011011111. What is the decimal equivalent? Show your work.

   $1 + 2 + 4 + 8 + 16 + 64 + 128 = 223$

3. (5pts) Given the decimal number: 45. What is the binary equivalent? Show your work (all of the steps of the algorithm that we discussed in class).

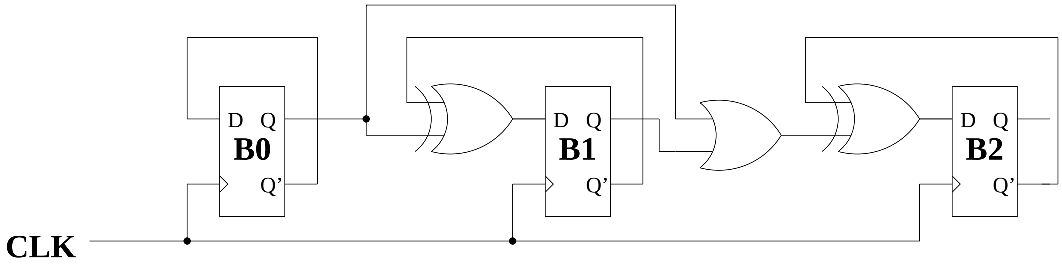
value	**binary**
45	x
22	1
11	01
5	101
2	1101
1	01101
0	101101

4. (5pts) Given the decimal number: 567. What is the binary equivalent? Show your work.

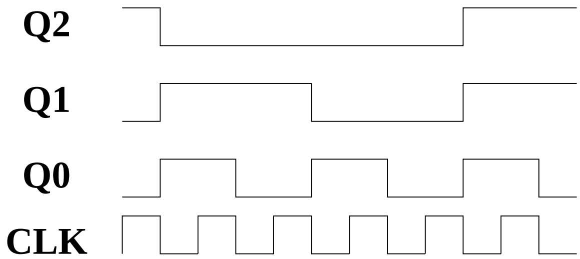
value	**binary**
567	x
283	1
141	11
70	111
35	0111
17	10111
8	110111
4	0110111
2	00110111
1	000110111
0	1000110111

Question 2

Consider the following circuit with input CLK:



1. (10pts) Assume that the initial state is: $Q0 = 0$, $Q1 = 0$, $Q2 = 1$. Show the timing diagram for $Q0$, $Q1$ and $Q2$ as the clock (CLK) is pulsed (show 6 transitions).



2. (10pts) Interpreting $Q2$, $Q1$, $Q0$ as a 3-bit binary number (with $Q0$ as the 1's digit), what is the sequence of values that this circuit produces?

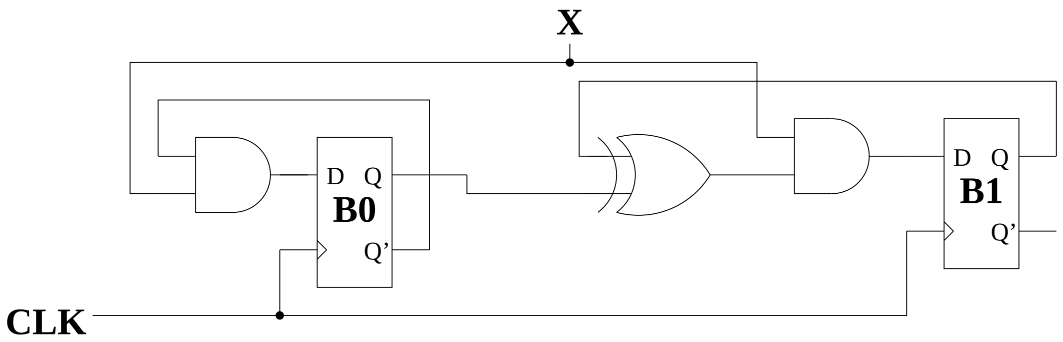
   $Q2, Q1, Q0 = 100, 011, 010, 001, 000, 111, 110, ...$

   or:

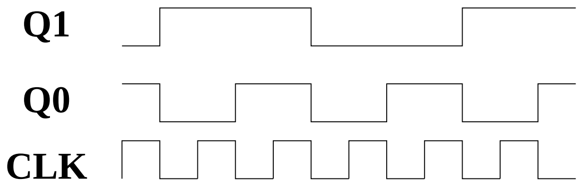
   $4, 3, 2, 1, 0, 7, 6, ...$

Question 3

Consider the following circuit with inputs CLK and X:



1. (10pts) Assume that the initial state is: $Q0 = 1$ and $Q1 = 0$. Assume also that $X = 1$. Show the timing diagram for $Q0$ and $Q1$ as the clock (CLK) is pulsed (for 6 transitions).



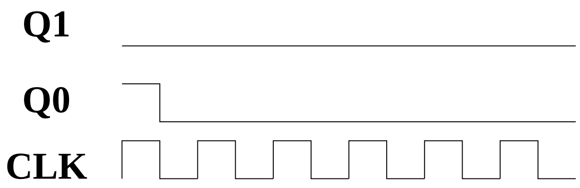
2. (10pts) Interpreting $Q1$, $Q0$ as a 2-bit binary number (with $Q0$ as the 1's digit), what is the sequence of values that this circuit produces?

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

3. (10pts) What is the mathematical function of this circuit when $X = 1$?

   Counts by 1 on each clock tick (flipping to 0 after 3).

4. (10pts) Assume the same initial state as above, and assume that $X = 0$. Show the timing diagram for $Q0$ and $Q1$ as the clock (CLK) is pulsed (for 6 transitions).



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

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

6. (10pts) What is the function of this circuit when $X = 0$?

   Always sets the binary value to 00. (we also refer to this as a *reset* operation)