EGR 270 Due date: See Due Dates Table
Fundamentals of Computer Engineering
File: N270H8

Homework Assignment #8

Reading Assignment:

Chapter 4 in the textbook Logic and Computer Design Fundamentals, 5th Edition by Mano
Online supplement "Design and Analysis using JK and T Flip-Flops" (see www.prenhall.com/mano)

Problem Assignment:

1) Chapter 4 problems: 27
2) A sequential circuit has the following state equations where A is the MSB:

   A(t+1) = A' + B'C'
   B(t+1) = AB'
   C(t+1) = A'B'

   A) Draw the logic diagram using D flip-flops
   B) Draw the Mealy state diagram
3) A sequential circuit has the following state equations, where A is the MSB and X is an input switch. Assume that states 6 and 7 are don't cares.

   A(t+1) = X'A + AB'C' + XBC
   B(t+1) = X'B + BC' + XA'B'C
   C(t+1) = X ⊕C

   C) Draw the logic diagram using D flip-flops
   D) Draw the Mealy state diagram (only show states 0-5).
4) Determine the state equations for a sequential circuit that counts out the prime numbers from 15 to 1 (highest to lowest) and repeats (i.e., 13, 11, 7, ...). Treat all unused counts as don't cares. Draw the logic diagram using D flip-flops.
5) Design a mod-6 UP/DOWN counter:
   A) Using JK flip-flops and the ***state equation method***. (Show the state diagram, state table, state equations, flip-flop input equations, and the logic diagram.)
   B) Using D flip-flops and the ***state equation method***. (Show the state diagram, state table, state equations, flip-flop input equations, and the logic diagram.)
   C) Using D flip-flops and the ***"one-hot" method***. (Show the state diagram, the ASM chart, and the logic diagram.)
6) Draw the Mealy state diagram for a ***sequence detector*** that detects the sequence 0101 using a minimal number of states. The detector should also detect overlapping sequences. Design the circuit using D flip-flops. Draw the logic diagram.
7) Draw the Mealy state diagram for a ***sequence detector*** that detects the sequence 11001100 using a minimal number of states. The detector should also detect overlapping sequences.

Selected Answers:

2) The state diagram follows the sequence 0,5,2,… and repeats

3) When X = 0, the state does not change. When X = 1 it counts in the sequence 0,1,2,… and repeats.

4) A(t+1) = B'C' + AB (or AC'), where A is the MSB

5A)

$$JA = XBC + X'B'C'$$

$$KA = (X + C)(B' + C')(X' + C)$$

$$JB = X'AC' + XA'C$$

$$KB = (X + C')(A' + C)(X' + C)$$

$$JC = 1, \quad KC = 1$$

5B)

$$DA = A(t+1) = X'AC + XBC + X'A'B'C' + XAC'$$

$$DB = B(t+1) = X'BC + X'AC' + XA'B'C + XBC'$$

$$DC = C(t+1) = C'$$

5C)

$$Q0(t+1) = D0 = XD5 + X'D1$$

$$Q1(t+1) = D1 = XD0 + X'D2$$

...

$$Q5(t+1) = D5 = XD4 + X'D0$$

6) D1 = XQ0 + X'Q1Q0'
D0 = X'
Y = XQ1Q0

7) Partial state diagram. Use 8 states:
A: 0 values in sequence correct
B: 1 value in sequence correct
etc