EE382M-11, Verification of Digital Systems J. Abraham

Spring 2017 Exam March 23, 2017

Name: _____

Open Book, Open Notes, 80 minutes (pace yourself). Write all your answers in the spaces/boxes provided, and show any calculations in these pages using the back of the pages if needed.

1. (**15 Points**) **[SystemVerilog Constraints]** Given a 32 bit virtual address v_addr[31:0], write a constraint to produce only addresses that are word aligned. If the page size is 4KB, write a constraint to produce addresses only from page 20'd4096. (Memory is byte addressable.)

---

2. (**15 Points**) Which of the following sets can or cannot be recognized by finite state machines? Explain. In each case the alphabet is {0, 1}.

   (a) (**5 Points**) The set of sequences in which the number of 0s exceeds the number of 1s by at least five.

   (b) (**5 Points**) The set of sequences in which the number of 1s is a power of two.

   (c) (**5 Points**) The set of sequences in which the number of 1s is prime.

3. (**20 Points**) The input symbol set of the following 6-state FSM is {0, 1}, and the starting state is indicated by the arrow. Assume that any missing transition is a self loop.

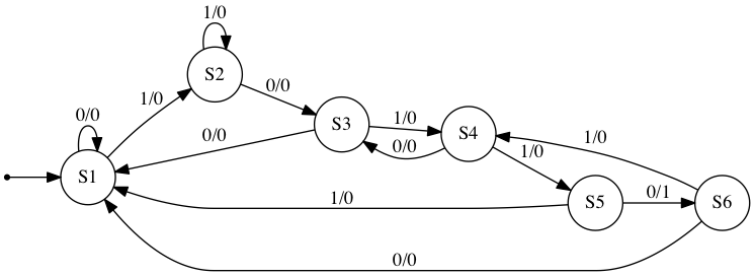

Figure 1: 6 State FSM

(a) (**10 Points**) Find a regular expression for the sequence detected by this FSM.

(b) (**5 Points**) What is the shortest sequence that takes this FSM through each of its states at least once?

(c) (**5 Points**) Find another 6-state FSM (with the same input symbol set), for which the shortest sequence traversing all nodes at least once, is longer than the sequence in (a).

4. (**15 Points**) Write the CNF clauses for the circuit in Figure 2, and find a satisfying assignment for it.

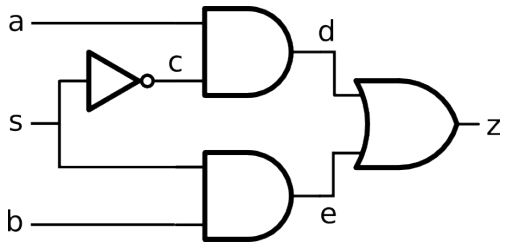

Figure 2: Circuit for SAT Check

5. (**20 Points**) State whether each of the strings listed below belong to the set $(00)^*01(0+1)^* + \lambda$

i. 100111000 Yes No

ii. 011000111 Yes No

iii. 001100100 Yes No

iv. 011110101 Yes No

v. 00 Yes No

vi. 01 Yes No

vii. 10 Yes No

viii. 11 Yes No

---

6. (**15 Points**) **[State Machines]** A certain three-state machine produces the output sequence Z in response to the input sequence X:

State: A

X : 0 0 0 0 1 0 0 0 1 0 0 0 1 0

Z : 0 1 0 1 0 0 0 0 1 0 1 0 0 1

Find a Mealy description of the machine and label the graph below.