



# Unit 9 - Syntax and semantics of CTL, Equivalences between CTL formulas and Introduction to Model Checking

## Course outline

How to access the portal ?

Introduction and Overview of VLSI Design

Scheduling in High-Level Synthesis

Resource Sharing and Binding in HLS

Logic Synthesis

Physical Design

Introduction to Verification Techniques

Syntax and semantics of CTL, Equivalences between CTL formulas and Introduction to Model Checking

● Syntax and semantics of CTL continued

● Equivalences between CTL Formulas

● Introduction to Model Checking

○ Quiz : Week 6-- Assignment

CTL Model checking

## Week 6--Assignment

The due date for submitting this assignment has passed. **Due on 2016-09-05, 23:58 IST.**

### Submitted assignment

1) \_\_\_\_\_ is not a well formed CTL formula. Where p, q and r are atomic propositions. 1 point

- ☐  $EX(p \vee q)$
- ☐  $E[qU(p \wedge r)]$
- ☐  $E[(qUp) \wedge (qUr)]$
- ☐  $AGAXr$

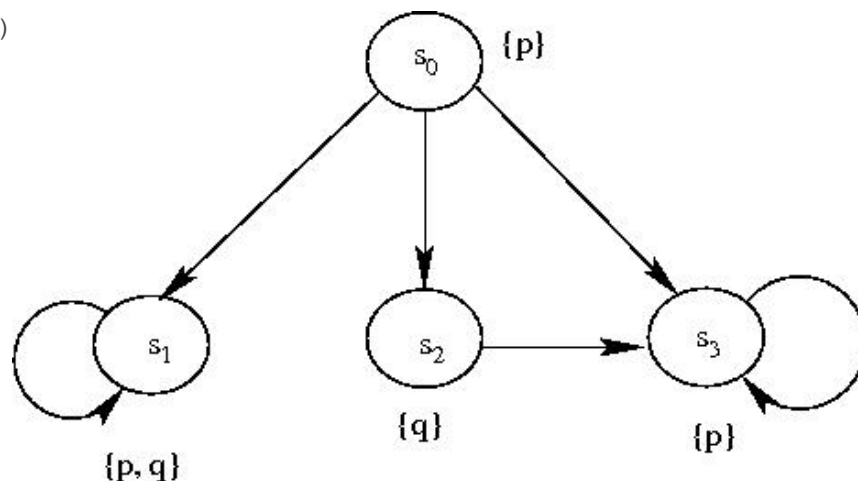
No, the answer is incorrect.

Score: 0

Accepted Answers:

$E[(qUp) \wedge (qUr)]$

2)



System M

Consider the system M shown in the figure. Which one of the followings is true?

- ☐  $M, s_0 \models AG(q)$
- ☐  $M, s_2 \models EX(q \rightarrow p)$
- ☐  $M, s_0 \models AF(q)$

Algorithms and  
Introduction to  
Binary Decision  
Diagrams

Binary Decision  
Diagram and  
Symbolic model  
checking

Introduction to  
Digital Testing

Fault Simulation  
and Testability  
Measures

Combinational  
Circuit Test  
Pattern  
Generation

Sequential  
Circuit Testing  
and Scan Chains

Built In Self Test  
(BIST)

☐  $M, s_3 \models AG (p \rightarrow q)$

No, the answer is incorrect.

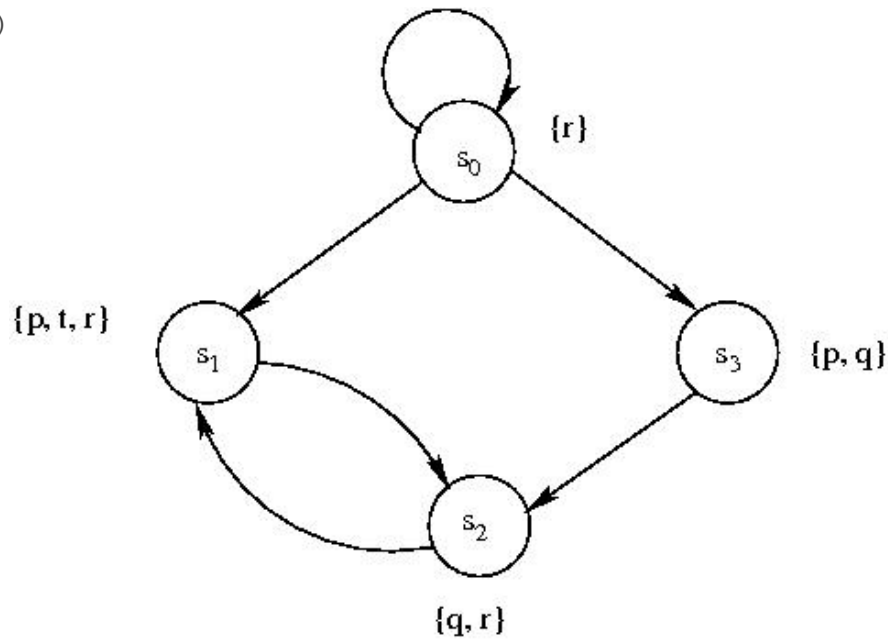
Score: 0

Accepted Answers:

$M, s_2 \models EX (q \rightarrow p)$

3)

1 point



System M

Consider the system M shown in the figure. Which one of the following CTL formulas holds in state  $s_0$ ?

- ☐  $AG (p \rightarrow r)$
- ☐  $AF (t)$
- ☐  $EG (r)$
- ☐  $E (t \cup q)$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$EG (r)$

4) Consider the system shown in question no. 3. Which of the followings are true?

0 points

- ☐  $M, s_2 \models AG (r \cup p)$
- ☐  $M, s_3 \models AF (t)$
- ☐  $M, s_2 \models \neg (AG (r))$
- ☐  $M, s_2 \models E (t \cup q)$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$M, s_2 \models AG (r \cup p)$

$M, s_3 \models AF (t)$

5) Which one of the following pairs of CTL formulas are equivalent? Where  $\phi$  is an atomic proposition.

1 point

- ☐  $AG(\phi)$  and  $\phi \vee AXAG(\phi)$
- ☐  $\neg (EF \phi)$  and  $EG(\phi)$
- ☐  $\neg(A X \phi)$  and  $EG(\neg \phi)$

- ☐  $\neg EG(\neg \phi)$  and  $AF(\phi)$

No, the answer is incorrect.

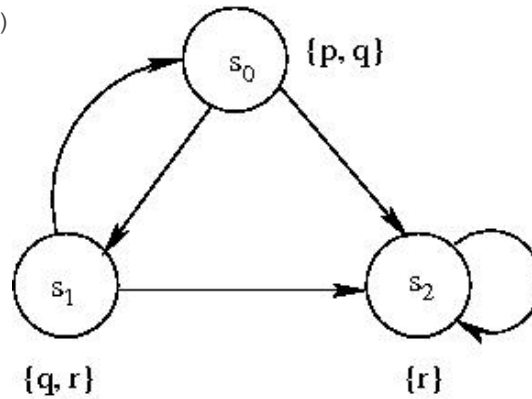
Score: 0

Accepted Answers:

$\neg EG(\neg \phi)$  and  $AF(\phi)$

6)

1 point



System M

Consider the system M shown in the figure. Choose the correct one?

- ☐  $M, s_0 \models EF(p \wedge r)$
- ☐  $M, s_0 \models E[(p \wedge q) \cup r]$
- ☐  $M, s_0 \models AX(q \wedge r)$
- ☐ All of the above

No, the answer is incorrect.

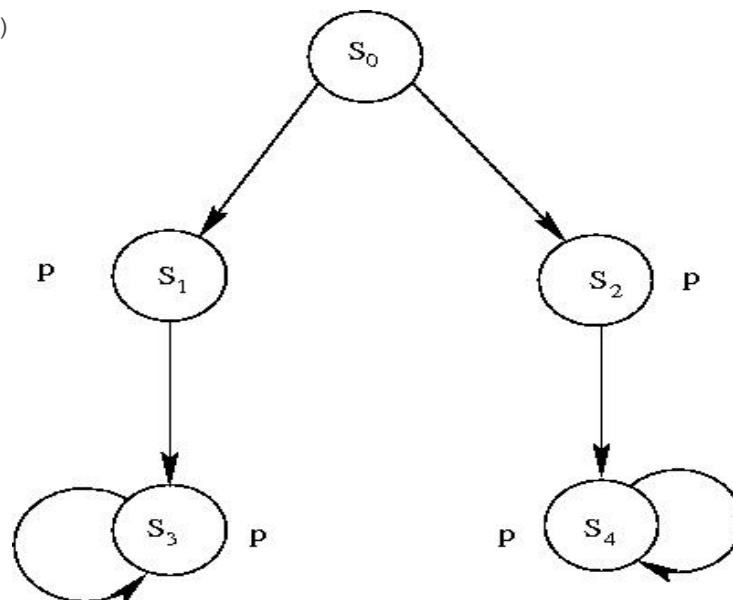
Score: 0

Accepted Answers:

$M, s_0 \models E[(p \wedge q) \cup r]$

7)

1 point



System M

Consider the system M shown in the figure. Choose the incorrect one.

- ☐  $M, s_0 \models AGp$
- ☐  $M, s_2 \models AGp$
- ☐  $M, s_0 \models AFp$
- ☐  $M, s_0 \models AXp$

No, the answer is incorrect.

Score: 0

**Accepted Answers:** $M, S_0 \models AGp$ 

8) Chose the correct one? Where p is an atomic proposition.

**1 point**

- ☐  $AF(p) \equiv E[T \cup p]$
- ☐  $AF(p) \equiv p \vee AXAF(p)$
- ☐  $EF(p) \equiv p \vee AXAF(p)$
- ☐ None of the above

**No, the answer is incorrect.****Score: 0****Accepted Answers:** $AF(p) \equiv p \vee AXAF(p)$ 

9) Consider the mutual exclusion example with 3 processes,  $P_1$ ,  $P_2$  and  $P_3$ . The atomic propositions for  $P_i$  are  $n_i$ ,  $t_i$  and  $c_i$ , where  $1 \leq i \leq 3$ . What is the CTL formula to represent Safety property? **1 point**

- ☐  $AG \neg((c_1 \wedge c_2) \vee c_3)$
- ☐  $AG \neg((c_1 \wedge c_3) \vee c_2)$
- ☐  $AG \neg(c_1 \wedge c_2 \wedge c_3)$
- ☐  $AG \neg((c_2 \wedge c_3) \vee c_1)$

**No, the answer is incorrect.****Score: 0****Accepted Answers:** $AG \neg(c_1 \wedge c_2 \wedge c_3)$ 

10) Consider the mutual exclusion example with 3 processes,  $P_1$ ,  $P_2$  and  $P_3$ . The atomic propositions for  $P_i$  are  $n_i$ ,  $t_i$  and  $c_i$ , where  $1 \leq i \leq 3$ . What is the CTL formula to represent the specification “ $P_2$  can always request to enter its critical section”.

- ☐  $AG(n_2 \rightarrow EXt_2)$
- ☐  $AG(n_1 \rightarrow EXt_2)$
- ☐  $AG(n_3 \rightarrow EXt_2)$
- ☐ None of the above

**No, the answer is incorrect.****Score: 0****Accepted Answers:** $AG(n_2 \rightarrow EXt_2)$ 





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