Métodos Formais em Eng.ª de Software

EXERCÍCIOS

1) Which of the specifications in plain English below convey the mathematical meaning of the CTL formula AG (p →A[q U r]) ?
    a. Any reachable state in which p is true has a path from it on which r is eventually true, and until then q is true.
    b. If p is true in every reachable state, then there is a path along which q is continuously true, until r becomes true.
    c. If p is true in every reachable state, then for any path along which q is continuously true, r becomes true.
    d. For any reachable state in which p is true, then, on any path from that state, q is continuously true until r becomes true, and r is guaranteed to become true.
    e. If p is true in every reachable state, then on every path there is a state at which r is true, and q is true continuously until then.

2) Consider the transition system (S, →, L) where,

    the set of states S equals {s_0, s_1, s_2, s_3};
    the state transitions are (s_0, s_0), (s_0, s_1), (s_0, s_3), (s_1, s_2), (s_2, s_1) and (s_3, s_2); and
    the labeling function is given by L(s_0) = {r}, L(s_1) = {p,r}, L(s_2) = {q,r}, and L(s_3) = {p,q}.

    This model may be pictured as follows:
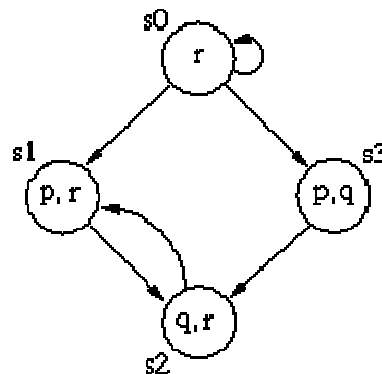
    Which of the CTL formulas below are satisfied in state s_0?

    a. AF (q∧r)
    b. AG (p →AF (p∧r))
    c. A[r U q]
    d. AG(p →AG(p∨q))
    e. AG EF ¬r

3) Which of the following pairs of CTL formulas are equivalent?

   a. EF p and EG p
   b. EF p ∨EF q and EF (p ∨q)
   c. AF p ∨AF q and AF (p ∨q)
   d. AF p and A[p U ⊤]
   e. EF¬p and ¬AF p

4) Consider the SMV program fragment:

```
MODULE main()
VAR
    a : boolean;
    b : boolean;
ASSIGN
    init(a) := 0;
    init(b) := 0;
    next(a) :=
      case
         ~a : 1;
         1  : {0,1};
       esac;
    next(b) :=
      case
       ~a : 0;
       b  : 1;
       1  : {0,1};
       esac;
```

Which of the following CTL models is adequately modeled by this SMV program fragment?