

These exercises are intended to check your understanding of CTL. You do not need to turn in your answers, but you should make sure you can do all the problems.

Exercise 1 Draw computation trees that satisfy the following formulas:

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| 1. $p \wedge AXAX(q \vee r)$ | 4. $A[p \text{ U } AGq]$ |
| 2. $A FEGp$ | 5. $EX(p \wedge EFq)$ |
| 3. $AG(p \vee (q \rightarrow r))$ | 6. $E[p \text{ U } A[q \text{ U } r]]$ |

Exercise 2 Which of the following statements can be translated into CTL? If a statement can be translated, give the translation. If you feel it cannot be translated, explain why.

1. p is true in the current state and some path has q true in some future state.
2. There exists a path such that p is true in the next state and q is true in the state after that.
3. If p is true in two consecutive states, there exists a future state in which q is true.
4. If p is true, then p remains true until q is true. Else, p must be true after at least two steps.
5. No path along which p is eventually true can ever have q or r true.
6. Whenever p is true, it cannot be true again until both q and r have been true (q and r need not have been true simultaneously).
7. It is possible to reach a state in which p is true and q is always true thereafter.
8. There does not always exist a future state in which p is true.
9. There exists a path on which q is true before p is true.