

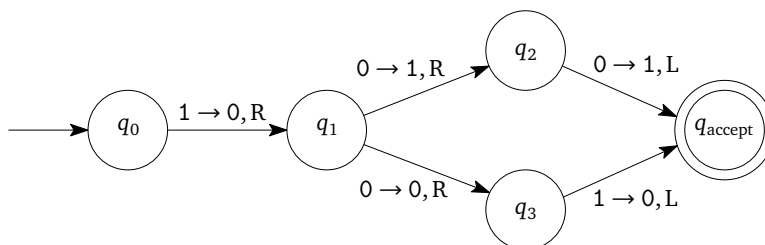
Prework 7.3a: Languages in NP

Write your preliminary solutions to each problem and submit a PDF on Canvas. The names in brackets indicate the subset responsible for presenting the problem.

- [Ky, Todd, Levi] A formula in Boolean (i.e., propositional) logic is *satisfiable* if there are 1/0 values (i.e., T/F values) that can be assigned to the variables to make the statement true. See pp. 14–15 if you need to refresh your memory. Determine whether the following formula is satisfiable.

$$(x \vee y) \wedge (x \vee \bar{y}) \wedge (\bar{x} \vee y) \wedge (\bar{x} \vee \bar{y})$$

- [Grace, Meghan, Ben] Let $SAT = \{\langle \phi \rangle \mid \phi \text{ is a satisfiable Boolean formula}\}$. Show that $SAT \in NP$. Specifically, explain what a certificate is in this example, and estimate the running time of a verifier when the input formula $\langle \phi \rangle$ has n variables.
- [Allie, Micah] A *coloring* of a graph is an assignment of colors to its vertices so that no two adjacent vertices have the same color. Let $3COLOR = \{\langle G \rangle \mid G \text{ is colorable with 3 colors}\}$. Estimate the running time of a verifier when the input is a graph with n vertices. Is $3COLOR \in NP$?
- [Curtis, Connor, Andrew] The following nondeterministic TM has two nondeterministic branches when executed on input $w = 101$. For each of these branches, draw the tableau whose rows are the configurations of the NTM, as in Figure 7.38 on page 305 (page 277 in the 2nd edition).



- [Joshua, David] A *window* in a tableau is a 2×3 rectangle of table cells. There are examples of “legal” windows on page 308 (p. 280 in 2/e). For the tableau in question 3 that represents the accepting branch, find legal windows that correspond to (a) a rightward tape move, (b) a leftward tape move, and (c) something else.

BEGIN YOUR SOLUTIONS BELOW THIS LINE