Algorithm 1 LQR-Tree (x_G, u_G, Q, R)

1: $[\mathbf{A}, \mathbf{B}] \Leftarrow$ linearization of $f(x, u)$ around $\mathbf{x}_G$, $\mathbf{u}_G$
2: $[\mathbf{K}, \mathbf{S}] \Leftarrow$ LQR($\mathbf{A}$, $\mathbf{B}$, $\mathbf{Q}$, $\mathbf{R}$)
3: $\rho_c \Leftarrow$ level-set computed as described in section III-A.2
4: T.init($\{\mathbf{x}_g, \mathbf{u}_g, \mathbf{S}, \mathbf{K}, \rho_c, \text{NULL}\}$)
5: **for** k = 1 to K **do**
6: $\mathbf{x}_{rand} \Leftarrow$ random sample as described in section III-A.5; if no samples are found, then FINISH
7: $\mathbf{x}_{near}$ from cost-to-go distance metric described in section III-A.4
8: $\mathbf{u}_{tape}$ from extend operation described in section III-A.4
9: **for each** $\mathbf{u}$ in $\mathbf{u}_{tape}$ **do**
10: $\mathbf{x} \Leftarrow$ Integrate backwards from $\mathbf{x}_{near}$ with action $\mathbf{u}$
11: $[\mathbf{K}, \mathbf{S}]$ from LQR derivation in section III-A.1
12: $\rho_c \Leftarrow$ level-set computed as in section III-A.3
13: $i \Leftarrow$ pointer to node containing $\mathbf{x}_{near}$
14: T.add-node($\mathbf{x}$, $\mathbf{u}$, $\mathbf{S}$, $\mathbf{K}$, ρ_c, i)
15: $\mathbf{x}_{near} \Leftarrow \mathbf{x}$
16: **end for**
17: **end for**