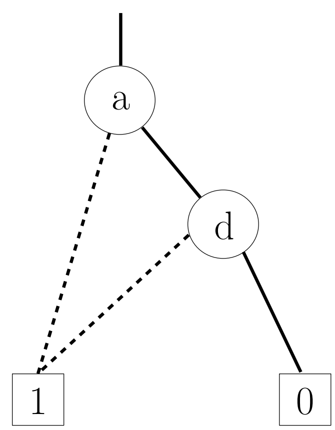
1. Write LTL properties over the alphabet A,B,C for each of the following statements.
   (a) G[A $\implies$ X ((B U C) ∨ GB)]
   (b) G[A $\implies$ X ((¬A U B) ∨ G(¬A))]
   (c) G[XA ∧ XXB $\implies$ C]
   (d) G[A ∧ XB $\implies$ XXC ∨ XXXC] ∨
   G[A ∧ XXB $\implies$ XXXC ∨ XXXXC] ∨
   G[A ∧ XXXB $\implies$ XXXXC ∨ XXXXXXC]
   (e) G[A $\implies$ ¬XFB ∨ X(¬B U (B ∧ FC))]
2. Draw the ROBDD for f using the ordering $a > b > c > d$.
   The given circuit reduces to $\bar{a} + \bar{d}$. Hence the BDD is as follows.



3. Equivalence Checking
   (a) Not equivalent. LHS can be satisfied even when no state satisfies p ∧ q.
   (b) Equivalent
   (c) Not equivalent. If start state satisfies ¬p ∧ ¬q ∧r, then RHS is satisfied, but LHS fails.
4. 3-bit Gray Counter
   (a) The equations for x_1', x_2', and x_3' can be written as follows
      - $x_1' = \bar{x}_1 x_2 \bar{x}_3 + x_1 x_2 \bar{x}_3 + x_1 x_2 x_3 + x_1 \bar{x}_2 x_3 = x_2 \bar{x}_3 + x_1 x_3$
      - $x_2' = \bar{x}_1 \bar{x}_2 x_3 + \bar{x}_1 x_2 x_3 + \bar{x}_1 x_2 \bar{x}_3 + x_1 x_2 \bar{x}_3 = x_2 \bar{x}_3 + \bar{x}_1 x_3$
      - $x_3' = \bar{x}_1 \bar{x}_2 \bar{x}_3 + \bar{x}_1 \bar{x}_2 x_3 + x_1 x_2 \bar{x}_3 + x_1 x_2 x_3 = x_1 x_2 + \bar{x}_1 \bar{x}_2$

      Therefore, $cf = [x_1' \odot (x_2\bar{x}_3 + x_1 x_3)][x_2' \odot (x_2\bar{x}_3 + \bar{x}_1 x_3)][x_3' \odot (x_1 x_2 + \bar{x}_1\bar{x}_2)]$
   (b) $\psi = [(x_1' = \bar{x}_1) \iff (x_2' = x_2)(x_3' = x_3)]$
      $\wedge[(x_2' = \bar{x}_2) \iff (x_1' = x_1)(x_3' = x_3)]$
      $\wedge[(x_3' = \bar{x}_3) \iff (x_1' = x_1)(x_2' = x_2)\,]$
      $\therefore \varphi = \neg\psi \wedge cf$
   (c) $\zeta = G\left[\bigwedge_{i=2}^{i=7} \neg\left[(x_1 = X^i x_1)(x_2 = X^i x_2)(x_3 = X^i x_3)\right]\right]$