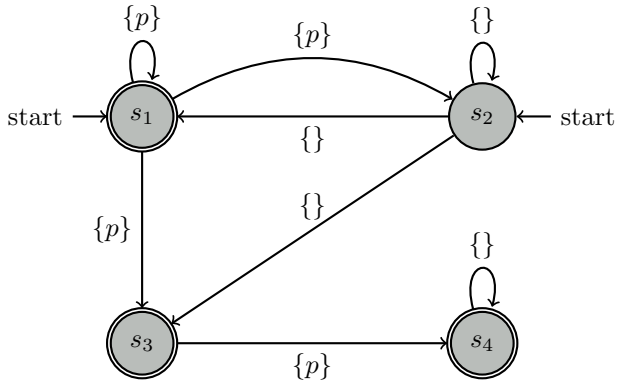
ASSIGNMENT 3B

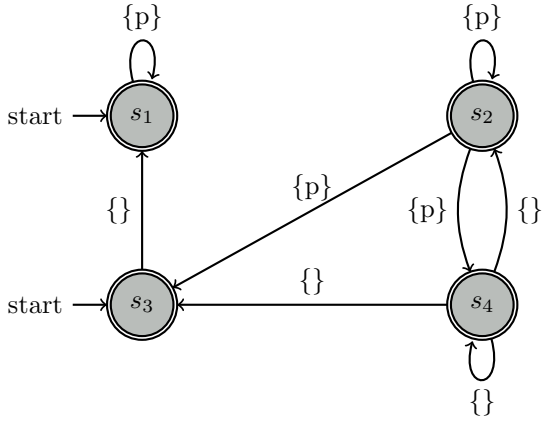
1. $\alpha = XFp$.

   $Voc(\alpha) = \{p\}$
   $CL(\alpha) = \{XFp, Fp, p, \neg XFp, \neg Fp, \neg p\}$
   $S = \{s_1, s_2, s_3, s_4\}$
   $I = \{s_1, s_2\}$
   $G = \{s_1, s_3, s_4\}$



2. $\alpha = XGp$.

   $Voc(\alpha) = \{p\}$
   $CL(\alpha) = \{XGp, Gp, p, \neg XGp, \neg Gp, \neg p\}$
   $S = \{s_1, s_2, s_3, s_4\}$
   $I = \{s_1, s_3\}$
   $G = \{s_1, s_2, s_3, s_4\}$



3. $\alpha = FXp$.

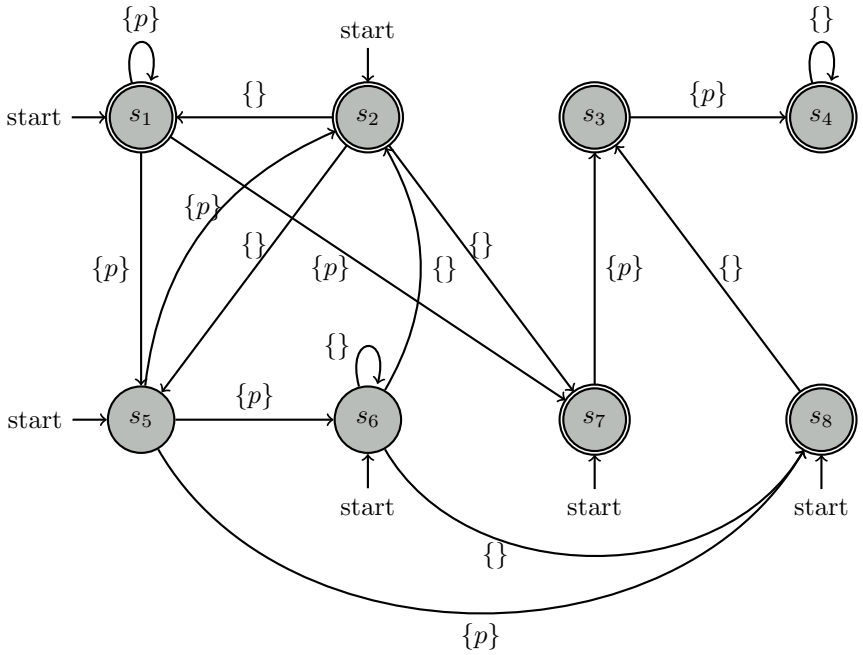
$Voc(\alpha) = \{p\}$

$CL(\alpha) = \{XFXp, FXp, Xp, p, \neg XFXp, \neg FXp, \neg Xp, \neg p\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$

$I = \{s_1, s_2, s_5, s_6, s_7, s_8\}$

$G = \{s_1, s_2, s_3, s_4, s_7, s_8\}$



4. $\alpha = GFp$.

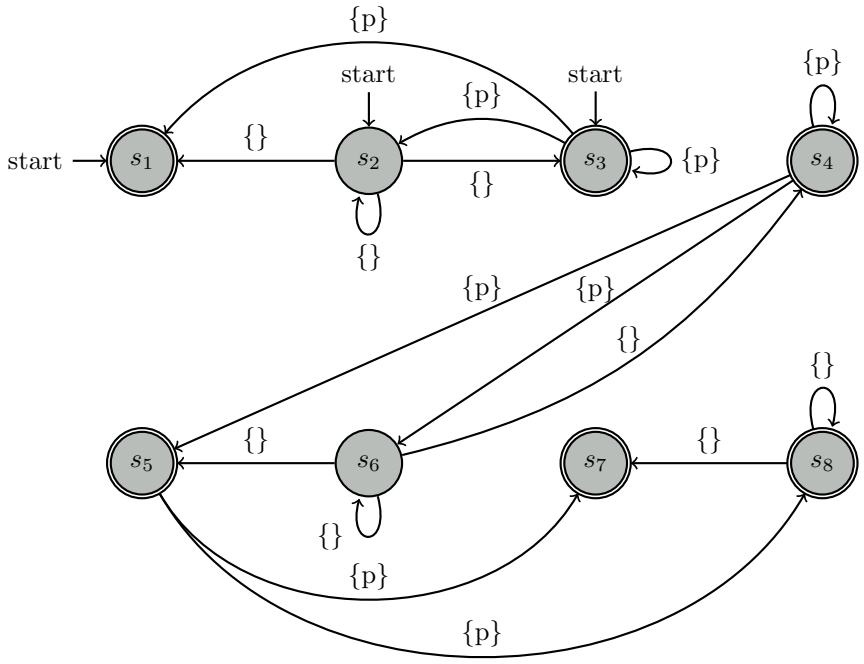
$Voc(\alpha) = \{p\}$

$CL(\alpha) = \{GFp, Fp, p, XGFp, XFp, \neg GFp, \neg Fp, \neg p, \neg XFp, \neg XGFp\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$

$I = \{s_1, s_2, s_3\}$

$G = \{s_1, s_3, s_4, s_5, s_7, s_8\}$



5. $\alpha = XXp$.

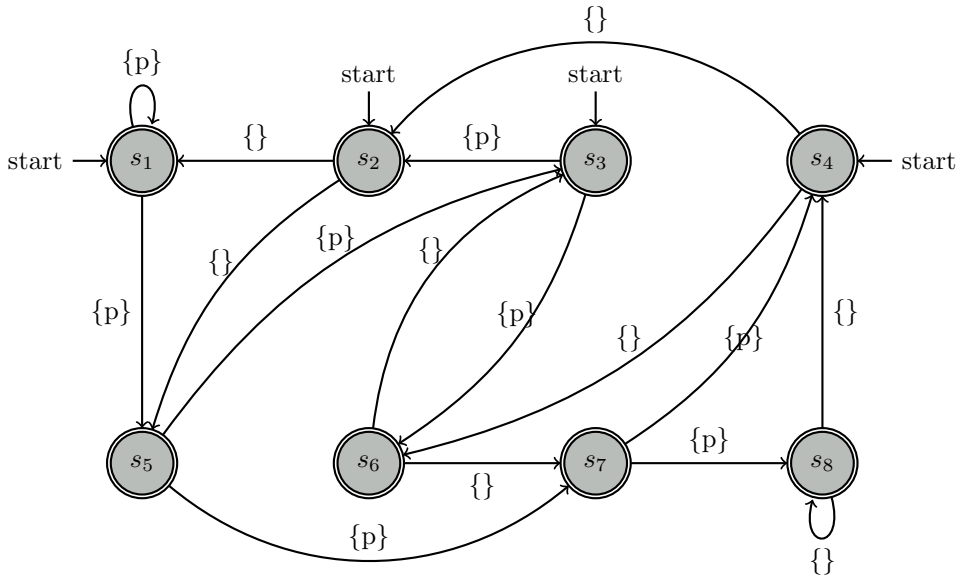
$Voc(\alpha) = \{p\}$

$CL(\alpha) = \{XXp, Xp, p, \neg XXp, \neg Xp, \neg p\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$

$I = \{s_1, s_2, s_3, s_4\}$

$G = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$



6. $\alpha = FFp$.

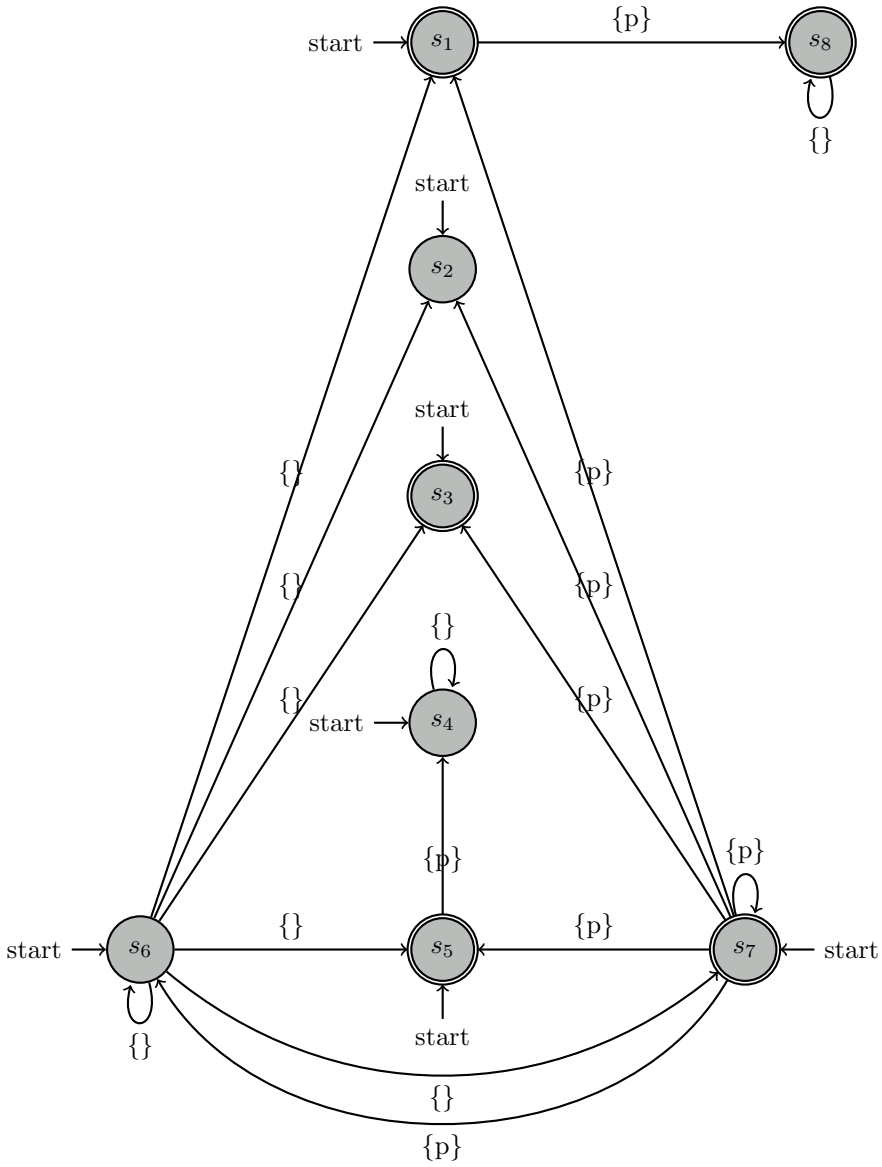
$Voc(\alpha) = \{p\}$

$CL(\alpha) = \{FFp, Fp, p, XFFp, XFp, \neg FFp, \neg Fp, \neg p, \neg XFFp, \neg XFp\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$

$I = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7\}$

$G = \{s_1, s_3, s_5, s_7, s_8\}$



7. $\alpha = GGp$.

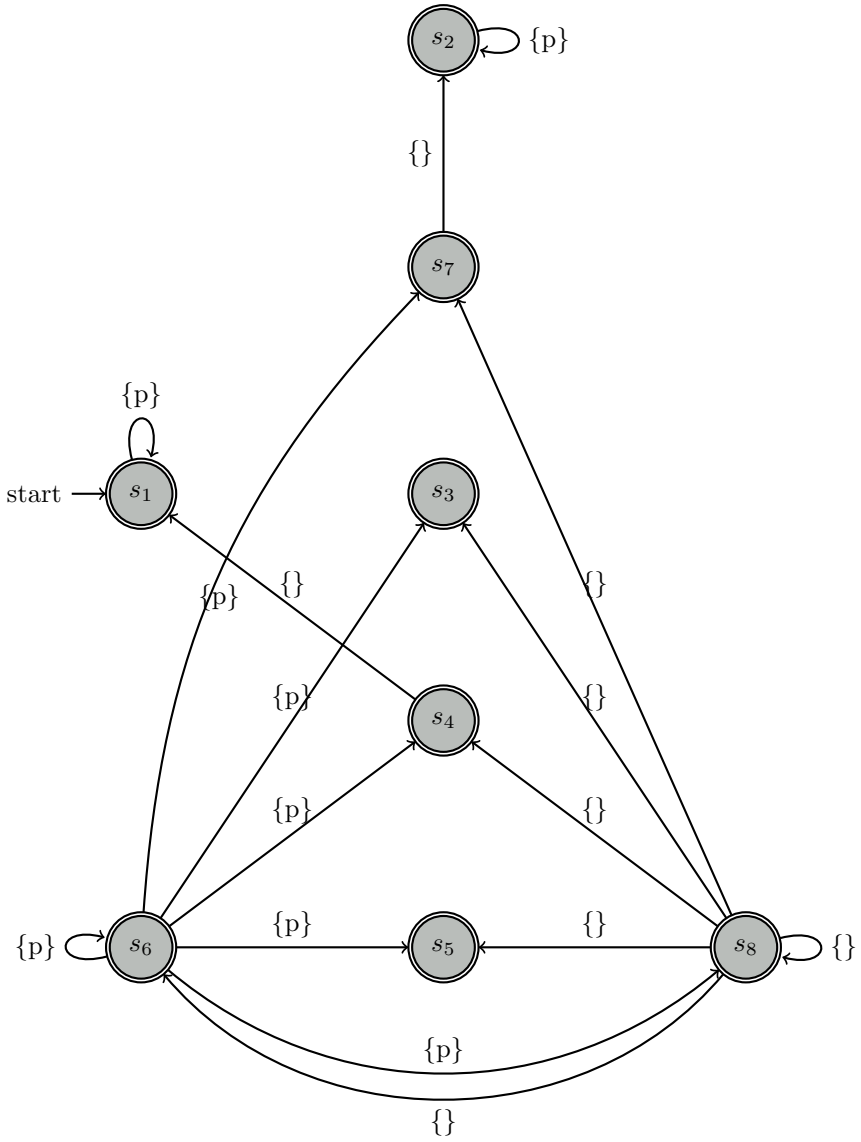
$Voc(\alpha) = \{p\}$

$CL(\alpha) = \{GGp, Gp, p, XGGp, XGp, \neg GGp, \neg Gp, \neg p, \neg XGGp, \neg XGp\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$

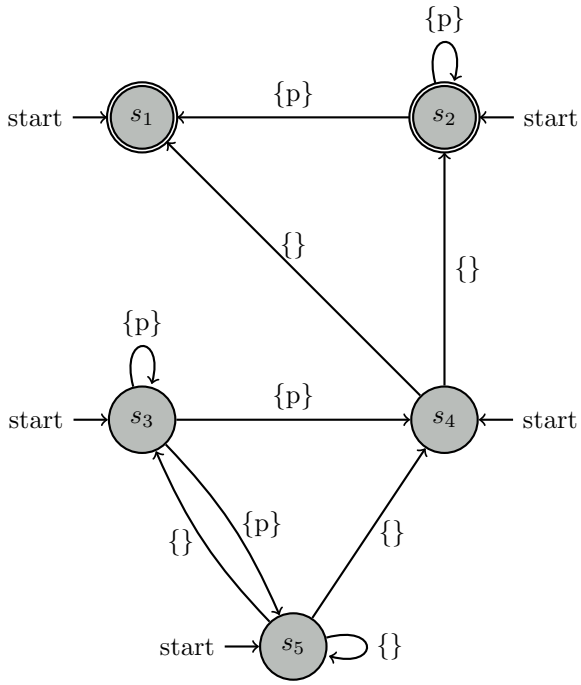
$I = \{s_1\}$

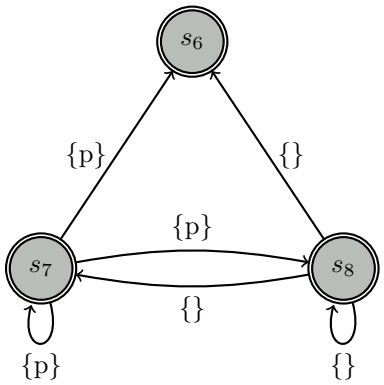
$G = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$



8. $\alpha = FGp$.

$Voc(\alpha) = \{p\}$
$CL(\alpha) = \{FGp, Gp, p, XFGp, XGp, \neg FGp, \neg Gp, \neg p, \neg XFGp, \neg XGp\}$
$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$
$I = \{s_1, s_2, s_3, s_4, s_5\}$
$G = \{s_1, s_2, s_6, s_7, s_8\}$





9. $\alpha = GFp$.

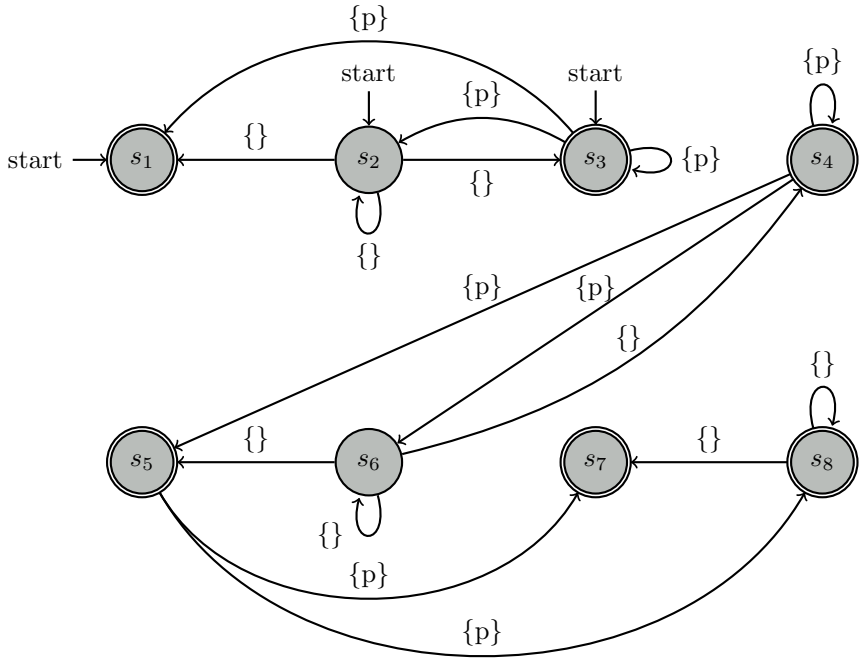
$Voc(\alpha) = \{p\}$

$CL(\alpha) = \{GFp, Fp, p, XGFp, XFp, \neg GFp, \neg Fp, \neg p, \neg XFp, \neg XGFp\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8\}$

$I = \{s_1, s_2, s_3\}$

$G = \{s_1, s_3, s_4, s_5, s_7, s_8\}$



10. $\alpha = Fp \vee Fq$.

$Voc(\alpha) = \{p, q\}$

$CL(\alpha) = \{Fp \vee Fq, Fp, Fq, p, q, XFp, XFq, \neg(Fp \vee Fq), \neg Fp, \neg Fq, \neg p, \neg q, \neg XFp, \neg XFq\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$I = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}\}$

$G = \{s_1, s_3, s_4, s_6, s_7, s_9, s_{10}, s_{12}, s_{16}\}$

Transitions

$s_1 \xrightarrow{\{p\}} \{s_{16}\}$

$s_2 \xrightarrow{\{\}} \{s_1, s_2, s_3\}$

$s_3 \xrightarrow{\{p\}} \{s_1, s_2, s_3\}$

$s_4 \xrightarrow{\{q\}} \{s_{16}\}$

$s_9 \xrightarrow{\{p,q\}} \{s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}\}$

$s_{10} \xrightarrow{\{p,q\}} \{s_{16}\}$

$s_{11} \xrightarrow{\{p\}} \{s_4, s_5, s_6\}$

$s_{12} \xrightarrow{\{p,q\}} \{s_4, s_5, s_6\}$

$s_5 \xrightarrow{\{\}} \{s_4, s_5, s_6\}$ $\quad$ $s_{13} \xrightarrow{\{q\}} \{s_1, s_2, s_3\}$

$s_6 \xrightarrow{\{q\}} \{s_4, s_5, s_6\}$ $\quad$ $s_{14} \xrightarrow{\{\}} \{s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}\}$

$s_7 \xrightarrow{\{p,q\}} \{s_1, s_2, s_3\}$ $\quad$ $s_{15} \xrightarrow{\{q\}} \{s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}\}$

$s_8 \xrightarrow{\{p\}} \{s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}\}$ $\quad$ $s_{16} \xrightarrow{\{\}} \{s_{16}\}$

11. $\alpha = Gp \wedge Gq$.

$Voc(\alpha) = \{p, q\}$

$CL(\alpha) = \{Gp \wedge Gq, Gp, Gq, p, q, XGp, XGq, \neg(Gp \wedge Gq), \neg Gp, \neg Gq, \neg p, \neg q, \neg XGp, \neg XGq\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$I = \{s_1\}$

$G = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

Transitions

$s_1 \xrightarrow{\{p,q\}} \{s_1\}$ $\quad$ $s_9 \xrightarrow{\{q\}} \{s_5, s_6, s_7\}$

$s_2 \xrightarrow{\{q\}} \{s_1\}$ $\quad$ $s_{10} \xrightarrow{\{\}} \{s_5, s_6, s_7\}$

$s_3 \xrightarrow{\{p,q\}} \{s_2, s_3, s_4\}$ $\quad$ $s_{11} \xrightarrow{\{p\}} \{s_2, s_3, s_4\}$

$s_4 \xrightarrow{\{q\}} \{s_2, s_3, s_4\}$ $\quad$ $s_{12} \xrightarrow{\{p,q\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$s_5 \xrightarrow{\{p\}} \{s_1\}$ $\quad$ $s_{13} \xrightarrow{\{p\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$s_6 \xrightarrow{\{p,q\}} \{s_5, s_6, s_7\}$ $\quad$ $s_{14} \xrightarrow{\{q\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$s_7 \xrightarrow{\{p\}} \{s_5, s_6, s_7\}$ $\quad$ $s_{15} \xrightarrow{\{\}} \{s_2, s_3, s_4\}$

$s_8 \xrightarrow{\{\}} \{s_1\}$ $\quad$ $s_{16} \xrightarrow{\{\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

12. $\alpha = F(p \rightarrow Gq)$.

$Voc(\alpha) = \{p, q\}$

$CL(\alpha) = \{F(\neg p \vee Gq), \neg p \vee Gq, \neg p, Gq, q, XF(\neg p \vee Gq), XGq, \neg(F(\neg p \vee Gq), \neg(\neg p \vee Gq), p, \neg Gq, \neg q, \neg XF(\neg p \vee Gq), \neg XGq\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$I = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}\}$

$G = \{s_1, s_2, s_3, s_4, s_5, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

Transitions

$s_1 \xrightarrow{\{q\}} \{\}$ $\quad$ $s_9 \xrightarrow{\{\}} \{s_1, s_2, s_{12}, s_{13}\}$

$s_2 \xrightarrow{\{p,q\}} \{\}$ $\quad$ $s_{10} \xrightarrow{\{q\}} \{s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}\}$

$s_3 \xrightarrow{\{\}} \{\}$ $\quad$ $s_{11} \xrightarrow{\{\}} \{s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}\}$

$s_4 \xrightarrow{\{q\}} \{s_{14}, s_{15}, s_{16}\}$ $s_{12} \xrightarrow{\{p,q\}} \{s_1, s_2, s_{12}, s_{13}\}$

$s_5 \xrightarrow{\{\}} \{s_{14}, s_{15}, s_{16}\}$ $s_{13} \xrightarrow{\{q\}} \{s_1, s_2, s_{12}, s_{13}\}$

$s_6 \xrightarrow{\{p\}} \{s_1, s_2, s_{12}, s_{13}\}$ $s_{14} \xrightarrow{\{p,q\}} \{s_{14}, s_{15}, s_{16}\}$

$s_7 \xrightarrow{\{p,q\}} \{s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}\}$ $s_{15} \xrightarrow{\{p\}} \{\}$

$s_8 \xrightarrow{\{p\}} \{s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}\}$ $s_{16} \xrightarrow{\{p\}} \{s_{14}, s_{15}, s_{16}\}$

13. $\alpha = G(p \rightarrow Fq)$.

$Voc(\alpha) = \{p, q\}$

$CL(\alpha) = \{G(\neg p \vee Fq), \neg p \vee Fq, \neg p, Fq, q, XFq, XG(\neg p \vee Fq), \neg G(\neg p \vee Fq), \neg(\neg p \vee Fq), p, \neg Fq, \neg q, \neg XFq, \neg XG(\neg p \vee Fq)\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$I = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7\}$

$G = \{s_1, s_2, s_3, s_5, s_7, s_8, s_{10}, s_{11}, s_{13}, s_{14}, s_{15}, s_{16}\}$

Transitions

$s_1 \xrightarrow{\{\}} \{\}$ $s_9 \xrightarrow{\{\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}\}$

$s_2 \xrightarrow{\{p,q\}} \{s_2, s_2, s_3, s_4, s_5, s_6, s_7\}$ $s_{10} \xrightarrow{\{q\}} \{s_{14}, s_{15}, s_{16}\}$

$s_3 \xrightarrow{\{p,q\}} \{s_1\}$ $s_{11} \xrightarrow{\{p,q\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}\}$

$s_4 \xrightarrow{\{p\}} \{s_2, s_3, s_4, s_5, s_6, s_7\}$ $s_{12} \xrightarrow{\{p\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}\}$

$s_5 \xrightarrow{\{q\}} \{s_2, s_3, s_4, s_5, s_6, s_7\}$ $s_{13} \xrightarrow{\{p,q\}} \{s_{14}, s_{15}, s_{16}\}$

$s_6 \xrightarrow{\{\}} \{s_2, s_3, s_4, s_5, s_6, s_7\}$ $s_{14} \xrightarrow{\{\}} \{s_{14}, s_{15}, s_{16}\}$

$s_7 \xrightarrow{\{q\}} \{s_1\}$ $s_{15} \xrightarrow{\{p\}} \{s_1\}$

$s_8 \xrightarrow{\{q\}} \{s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}\}$ $s_{16} \xrightarrow{\{p\}} \{s_{14}, s_{15}, s_{16}\}$

14. $\alpha = F(p \rightarrow Xq)$.

$Voc(\alpha) = \{p, q\}$

$CL(\alpha) = \{F(\neg p \vee Xq), \neg p \vee Xq, \neg p, Xq, q, XF(\neg p \vee Xq), \neg F(\neg p \vee Xq), \neg(\neg p \vee Xp), p, \neg Xq, \neg q, \neg XF(\neg p \vee Xq)\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$I = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}\}$

$G = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{15}, s_{16}\}$

Transitions

$s_1 \xrightarrow{\{q\}} \{s_2, s_4, s_6, s_8, s_{10}, s_{12}, s_{14}\}$ $s_9 \xrightarrow{\{p,q\}} \{s_{15}\}$

$s_2 \xrightarrow{\{\}} \{s_2, s_4, s_6, s_8, s_{10}, s_{12}, s_{14}\}$ $s_{10} \xrightarrow{\{p\}} \{s_{15}\}$

$s_3 \xrightarrow{\{q\}} \{s_1, s_3, s_5, s_7, s_9, s_{11}, s_{13}\}$ $\quad$ $s_{11} \xrightarrow{\{q\}} \{s_{15}\}$

$s_4 \xrightarrow{\{\}} \{s_1, s_3, s_5, s_7, s_9, s_{11}, s_{13}\}$ $\quad$ $s_{12} \xrightarrow{\{\}} \{s_{15}\}$

$s_5 \xrightarrow{\{p,q\}} \{s_1, s_3, s_5, s_7, s_9, s_{11}, s_{13}\}$ $\quad$ $s_{13} \xrightarrow{\{p,q\}} \{s_2, s_4, s_6, s_8, s_{10}, s_{12}, s_{14}\}$

$s_6 \xrightarrow{\{p\}} \{s_1, s_3, s_5, s_7, s_9, s_{11}, s_{13}\}$ $\quad$ $s_{14} \xrightarrow{\{p\}} \{s_2, s_4, s_6, s_8, s_{10}, s_{12}, s_{14}\}$

$s_7 \xrightarrow{\{q\}} \{s_{16}\}$ $\quad$ $s_{15} \xrightarrow{\{p,q\}} \{s_{16}\}$

$s_8 \xrightarrow{\{\}} \{s_{16}\}$ $\quad$ $s_{16} \xrightarrow{\{p\}} \{s_{16}\}$

15. $\alpha = G(p \rightarrow Xq)$.

$Voc(\alpha) = \{p, q\}$

$CL(\alpha) = \{G(\neg p \vee Xq), \neg p \vee Xq, \neg p, Xq, q, XG(\neg p \vee Xq), \neg G(\neg p \vee Xq), \neg(\neg p \vee Xp), p, \neg Xq, \neg q, \neg XG(\neg p \vee Xq)\}$

$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

$I = \{s_1, s_2, s_3, s_4, s_5, s_6\}$

$G = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}, s_{14}, s_{15}, s_{16}\}$

Transitions

$s_1 \xrightarrow{\{q\}} \{s_1, s_3, s_5\}$ $\quad$ $s_9 \xrightarrow{\{q\}} \{s_8, s_{10}, s_{12}, s_{14}, s_{16}\}$

$s_2 \xrightarrow{\{\}} \{s_1, s_3, s_5\}$ $\quad$ $s_{10} \xrightarrow{\{\}} \{s_8, s_{10}, s_{12}, s_{14}, s_{16}\}$

$s_3 \xrightarrow{\{q\}} \{s_2, s_4, s_6\}$ $\quad$ $s_{11} \xrightarrow{\{p,q\}} \{s_7, s_9, s_{11}, s_{13}, s_{15}\}$

$s_4 \xrightarrow{\{\}} \{s_2, s_4, s_6\}$ $\quad$ $s_{12} \xrightarrow{\{p\}} \{s_7, s_9, s_{11}, s_{13}, s_{15}\}$

$s_5 \xrightarrow{\{p,q\}} \{s_1, s_3, s_5\}$ $\quad$ $s_{13} \xrightarrow{\{p,q\}} \{s_2, s_4, s_6\}$

$s_6 \xrightarrow{\{p\}} \{s_1, s_3, s_5\}$ $\quad$ $s_{14} \xrightarrow{\{p\}} \{s_2, s_4, s_6\}$

$s_7 \xrightarrow{\{q\}} \{s_7, s_9, s_{11}, s_{13}, s_{15}\}$ $\quad$ $s_{15} \xrightarrow{\{p,q\}} \{s_8, s_{10}, s_{12}, s_{14}, s_{16}\}$

$s_8 \xrightarrow{\{\}} \{s_7, s_9, s_{11}, s_{13}, s_{15}\}$ $\quad$ $s_{16} \xrightarrow{\{p\}} \{s_8, s_{10}, s_{12}, s_{14}, s_{16}\}$