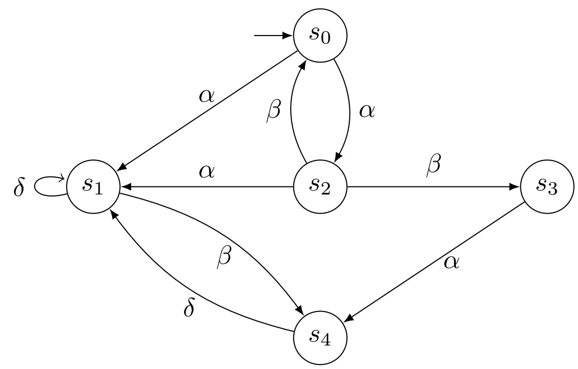
TD6 MVFA: Fairness and Revisions

Exercise 1

Consider the following transition system TS (without atomic propositions):



Decide which of the following fairness assumptions $\mathcal{F}_i$ are realizable for TS.

1. $\mathcal{F}_1 = (\{\{\alpha\}\}, \{\{\delta\}\}, \{\{\alpha, \beta\}\})$
2. $\mathcal{F}_2 = (\{\{\alpha, \delta\}\}, \{\{\alpha, \beta\}\}, \{\{\delta\}\})$
3. $\mathcal{F}_3 = (\{\{\alpha, \delta\}, \{\beta\}\}, \{\{\alpha, \beta\}\}, \{\{\delta\}\})$

Exercise 2

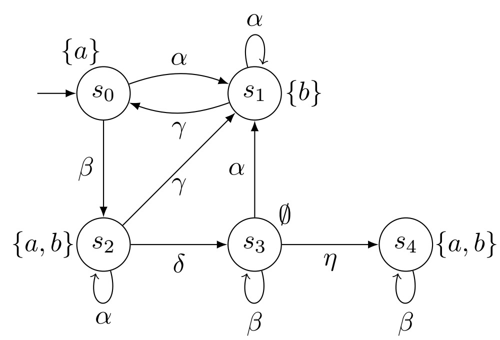
Let $AP = \{a, b\}$.

1. P_1 denotes the LT property that consists of all infinite words $\sigma = A_0 A_1 A_2 \cdots \in (2^{AP})^\omega$ such that there exists $n \geq 0$ with

$$\forall j < n, A_j = \emptyset \quad \wedge \quad A_n = \{a\} \quad \wedge \quad \forall k > n, (A_k = \{a\} \to A_{k+1} = \{b\})$$

   Give an ω-regular expression for P_1 and define a NBA $\mathcal{A}_1$ such that $\mathcal{L}(\mathcal{A}_1) = P_1$.

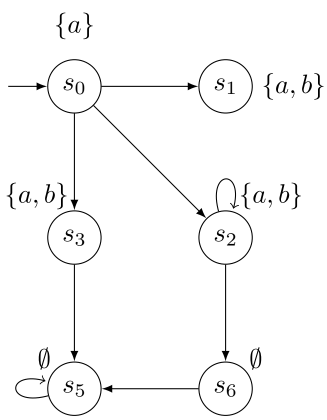
2. Consider the following transition system TS:

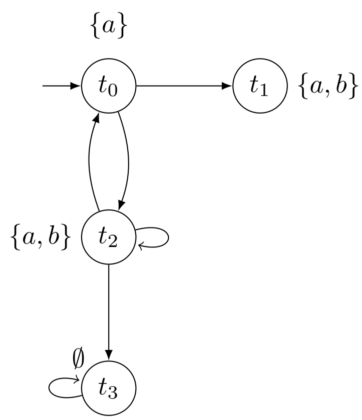


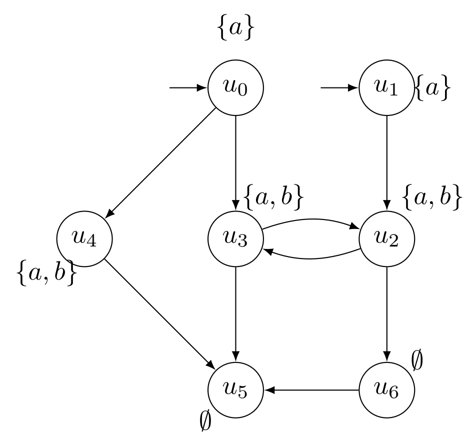
Consider the following fairness assumption $\mathcal{F}_1 = (\{\{\alpha\}\}, \{\{\beta\}, \{\delta, \gamma\}, \{\eta\}\}, \emptyset)$. Decide whether $TS \models_{\mathcal{F}_1} P_1$

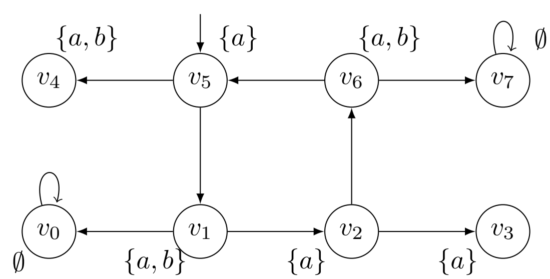
Exercise 3

For each pair of the following transition systems, determine whether they are bisimilar.



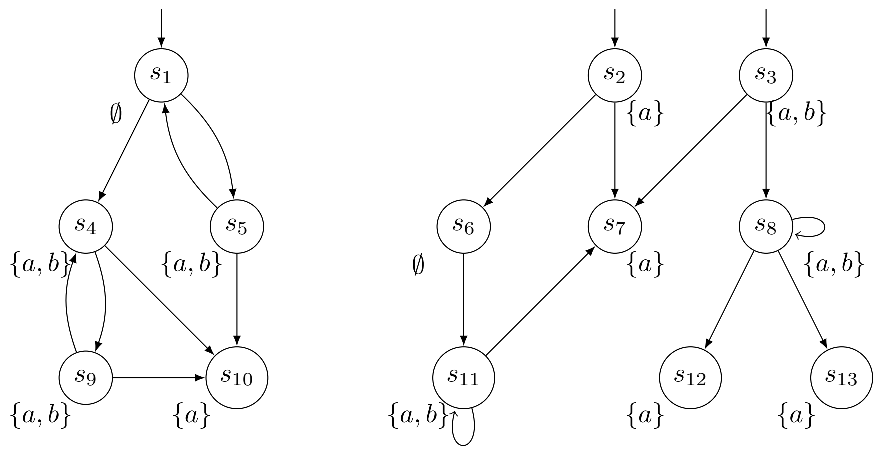






Exercise 4

Consider the following transition system. Determine the bisimulation equivalence and depict the bisimulation quotient system.



Exercise 5

Check for each of the following formula pairs (φ_i, ψ_i) whether the CTL formula φ_i is equivalent to the LTL formula ψ_i. Prove the equivalence or provide a counterexample that illustrates why $\varphi_i \not\equiv \psi_i$.

1. $\varphi_1 = \forall\Box\forall \bigcirc a$ and $\psi_1 = \Box \bigcirc a$
2. $\varphi_2 = \forall\Diamond\forall \bigcirc a$ and $\psi_2 = \Diamond \bigcirc a$
3. $\varphi_3 = \forall\Diamond(a \wedge \exists \bigcirc a)$ and $\psi_3 = \Diamond(a \wedge \bigcirc a)$
4. $\varphi_4 = \forall\Diamond a \vee \forall\Diamond b$ and $\psi_3 = \Diamond(a \vee b)$
5. $\varphi_5 = \forall\Box(a \rightarrow \forall\Diamond b)$ and $\psi_5 = \Box(a \rightarrow \Diamond b)$
6. $\varphi_6 = \forall(b \text{ U } (a \wedge \forall\Box b))$ and $\psi_6 = \Diamond a \wedge \Box b$