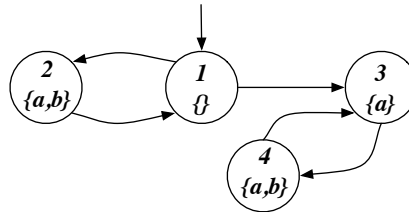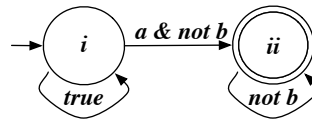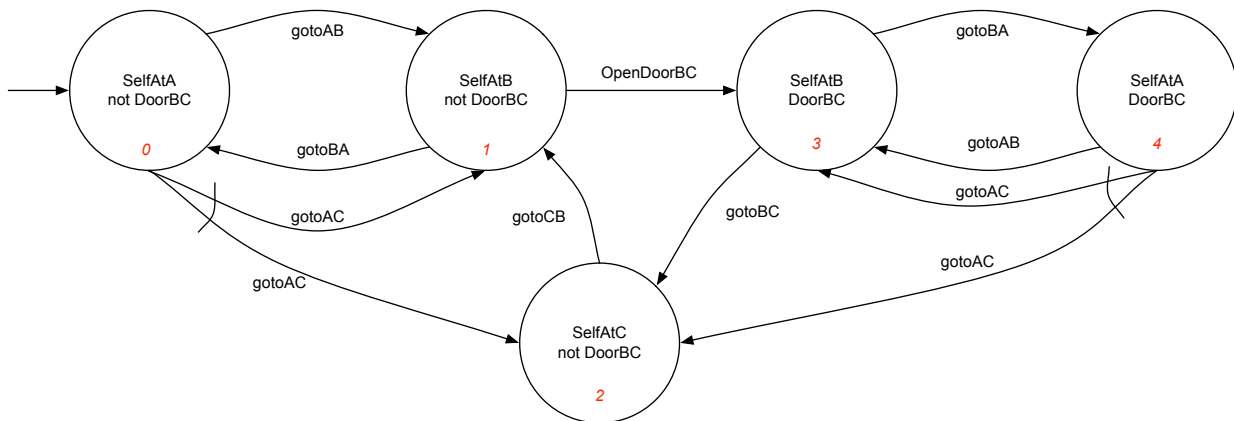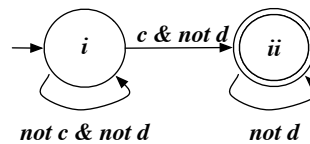**Part 1.** Consider the following transition system:

- **Exercise 1.1:** Model check the CTL formula $EG(b \supset EXAFa)$, by translating it in Mu-Calculus.

- **Exercise 1.2:** Model check the LTL formula $\square(a \supset \diamondsuit b)$, by considering that the Büchi automaton for $\neg(\square(a \supset \diamondsuit b))$ is the one below:

Part 2 Consider the following domain:

- **Exercise 2.1:** Model check the LTLf formula $\square(\neg DoorBC) \supset \square(\neg SelfAtC)$, by considering that the DFA for $\neg(\square(\neg DoorBC) \supset \square(\neg SelfAtC)$ is the one below:

- **Exercise 2.2:** Synthesize a strategy (a plan) for realizing the LTLf formula $\diamondsuit(SelfAtC)$, by considering that the DFA for $\diamondsuit(SelfAtC)$ is the one below:

- **Exercise 1.1:** Model check the CTL formula $EG(b \supset EX\,AFa)$, by translating it in Mu-Calculus.

- **Exercise 1.2:** Model check the LTL formula $\Box(a \supset \Diamond b)$, by considering that the Büchi automaton for $\neg(\Box(a \supset \Diamond b))$ is the one below:
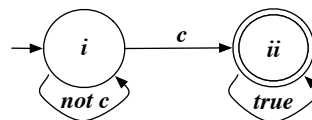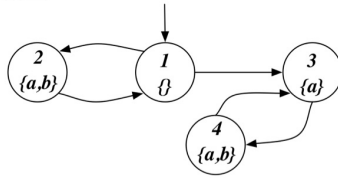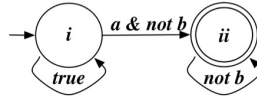

1) $EG(\underbrace{b \supset \underbrace{EX\,\underbrace{AF\,a}_{\alpha}}_{\beta}}_{\gamma})$
$\underbrace{}_{\delta}$

$[\alpha] = [AF\,a] = [\mu Z.\ a \lor [NEXT]\,Z]$

$\quad [Z_0] = \phi$

$\quad [Z_1] = [a] \cup PREA(NEXT, Z_0) =$

$\qquad = \{2,3,4\} \cup \phi = \{2,3,4\}$

$\quad [Z_2] = [a] \cup PREA(NEXT, Z_1) =$

$\qquad = \{2,3,4\} \cup \{1,3,4\} = \{1,2,3,4\}$

$\quad [Z_3] = [a] \cup PREA(NEXT, Z_2) =$

$\qquad = \{2,3,4\} \cup \{1,2,3,4\} = \{1,2,3,4\}$

$\quad [Z_2] = [Z_3] = [\alpha] = \{1,2,3,4\}$

$[\beta] = [EX\,\alpha] = [\langle NEXT \rangle \alpha] = PREE(NEXT, \alpha) = \{1,2,3,4\} = [\beta]$

$[\gamma] = [b \supset \beta] = [\neg b] \cup [\beta] = \{1,3\} \cup \{1,2,3,4\} = \{1,2,3,4\} = [\gamma]$

$[\delta] = [EG\,\gamma] = [\nu Z.\ \gamma \land \langle NEXT \rangle Z]$
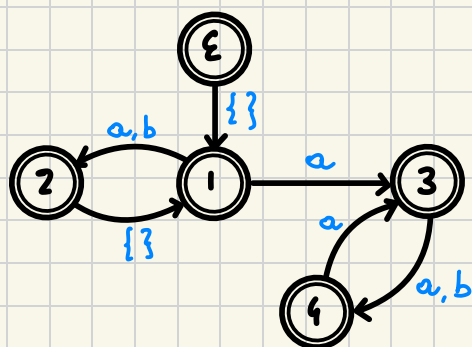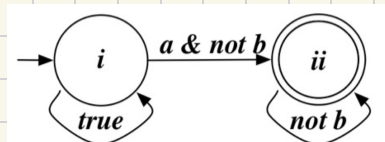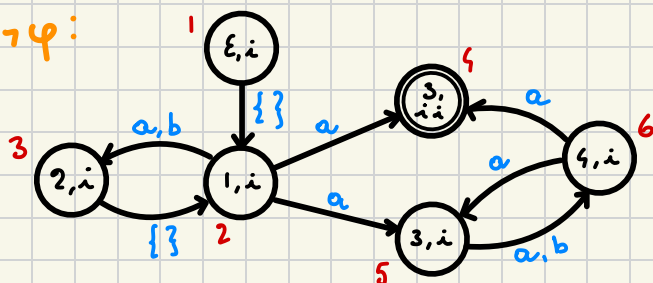
$\quad [Z_0] = \{1,2,3,4\}$

$\quad [Z_1] = [\gamma] \cap PREE(NEXT, Z_0) =$

$\qquad = \{1,2,3,4\} \cap \{1,2,3,4\} = \{1,2,3,4\}$

$\quad [Z_0] = [Z_1] = [\delta] = \{1,2,3,4\}$

$\qquad\quad \Upsilon_{s_1} \in \delta\ ? \rightarrow s_1 \in [\delta] = \{1,2,3,4\}\ ?\quad$ YES!

2)

A_γ:

$A_{\neg\varphi}$:

$A_\gamma \cap A_{\neg\varphi}$:

$$\varphi = \nu X. \mu Y (F \wedge \langle NEXT \rangle X \vee \langle NEXT \rangle Y)$$

$[X_0] = \{1, 2, 3, 4, 5, 6\}$

$[X_1] = [\mu Y. (F \wedge \langle NEXT \rangle X_0 \vee \langle NEXT \rangle Y]$

$\qquad [Y_0] = \phi$

$\qquad [Y_1] = [F] \wedge PREE(NEXT, X_0) \vee PREE(NEXT, Y_0) =$

$\qquad\qquad = \{4\} \cap \{1, 2, 3, 5, 6\} \cup \phi = \phi$

$\qquad [Y_0] = [Y_1] = [X_1] = \phi$

$[X_2] = [\mu Y. (F \wedge \langle NEXT \rangle X_1 \vee \langle NEXT \rangle Y]$

$\qquad [Y_0] = \phi$

$\qquad [Y_1] = [F] \wedge PREE(NEXT, X_1) \vee PREE(NEXT, Y_0) =$

$\qquad\qquad = \{4\} \cap \phi = \phi$

$\qquad [Y_0] = [Y_1] = [X_2] = \phi$
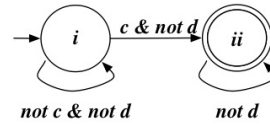
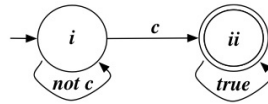$[X_1] = [X_2] = \phi$

$$s_1 \in [\varphi] = \phi ? \quad \text{NO!}$$
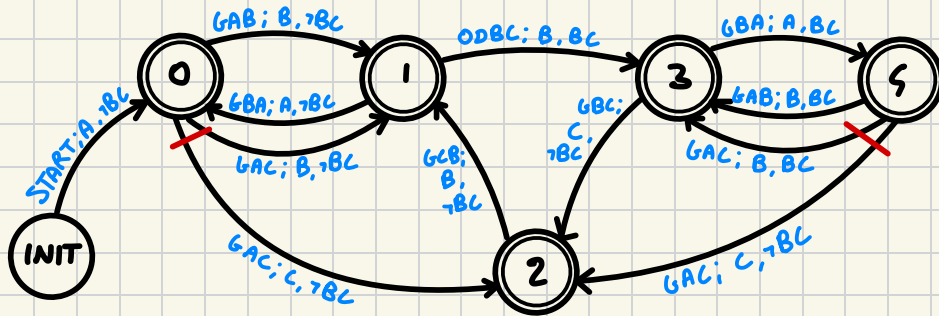
Consider the following domain:

- **Exercise 2.1:** Model check the LTLf formula $\Box(\neg DoorBC) \supset \Box(\neg SelfAtC)$, by considering that the DFA for $\neg(\Box(\neg DoorBC) \supset \Box(\neg SelfAtC))$ is the one below:
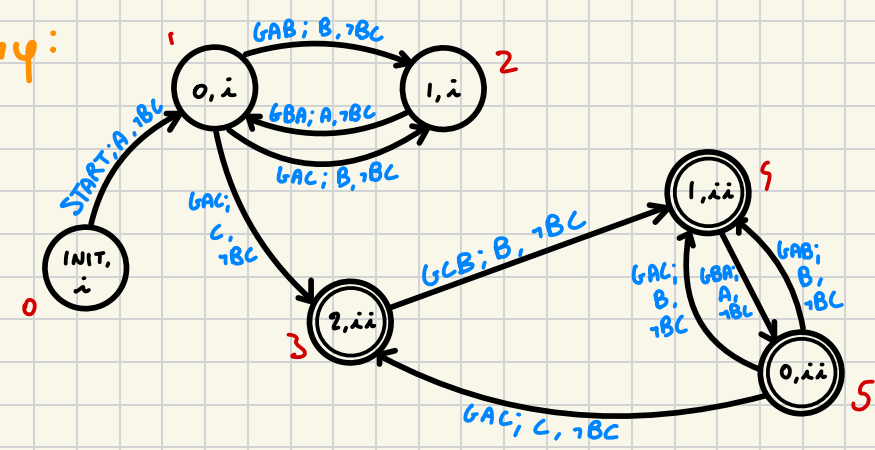

- **Exercise 2.2:** Synthesize a strategy (a plan) for realizing the LTLf formula $\Diamond(SelfAtC)$, by considering that the DFA for $\Diamond(SelfAtC)$ is the one below:

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1) A_D:

$A_D \times A_{\neg \varphi}$:

$\varphi = \mu X . \; F \vee \langle NEXT \rangle X$

$[X_0] = \phi$

$[X_1] = [F] \cup PREE(NEXT, X_0) =$

$\qquad = \{3,4,5\} \cup \phi = \{3,4,5\}$

$[X_2] = [F] \cup \text{PREE}(\text{NEXT}, X_1):$

$\qquad = \{3,4,5\} \cup \{1,3,4,5\} = \{1,3,4,5\}$

$[X_3] = [F] \cup \text{PREE}(\text{NEXT}, X_2):$

$\qquad = \{3,4,5\} \cup \{0,1,2,3,4,5\} = \{0,1,2,3,4,5\}$
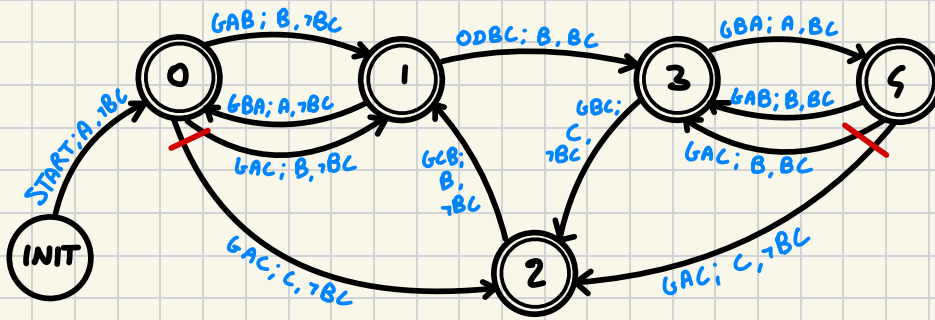
$[X_4] = [F] \cup \text{PREE}(\text{NEXT}, X_3):$

$\qquad = \{3,4,5\} \cup \{0,1,2,3,4,5\} = \{0,1,2,3,4,5\}$

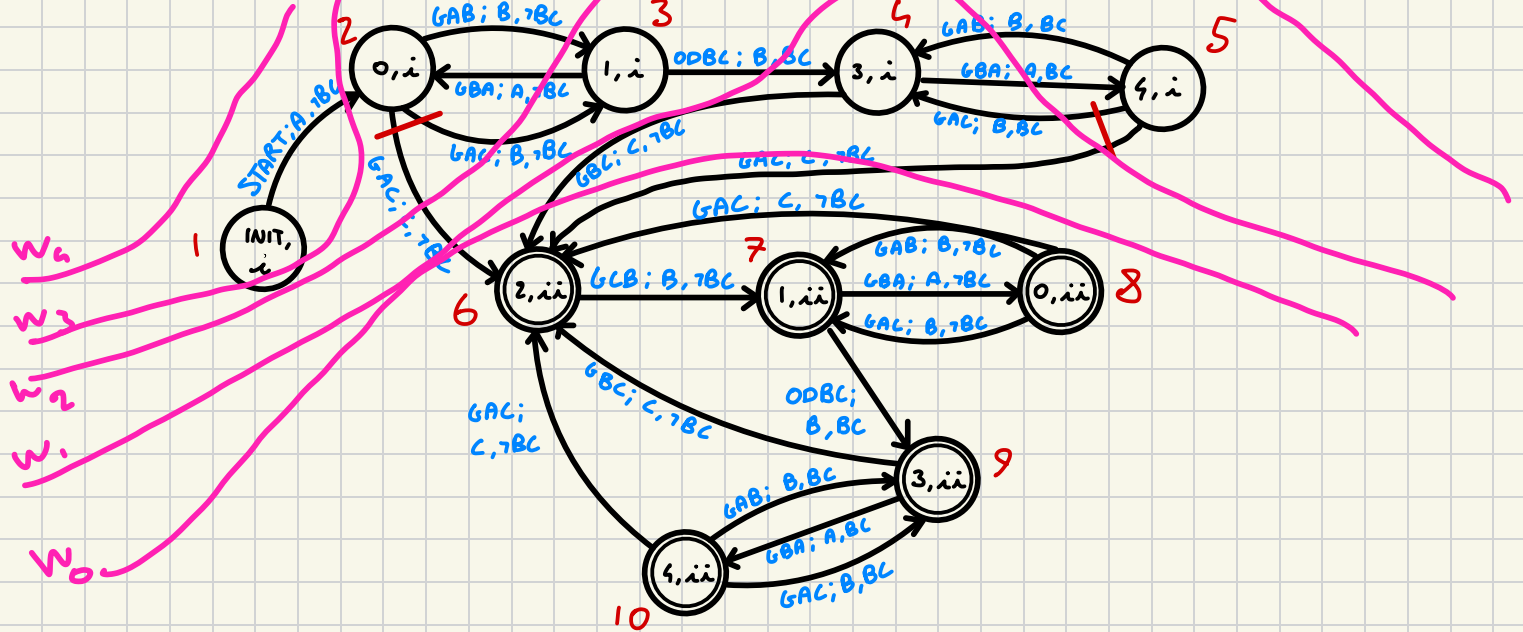$[X_3] = [X_4] = \{0,1,2,3,4,5\}$

$\qquad\qquad S_0 \in [X_4] \quad so \quad \Upsilon, S_0 \nvDash \varphi$

2) A_D:

$A_D \times A_\varphi$:

$W_0 = \{6, 7, 8, 9, 10\}$

$W_1 = W_0 \cup \text{PREADV}(W_0) = \{4, 6, 7, 8, 9, 10\}$

$W_2 = W_1 \cup \text{PREADV}(W_1) = \{3, 4, 5, 6, 7, 8, 9, 10\}$

$W_3 = W_2 \cup \text{PREADV}(W_2) = \{2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$W_4 = W_3 \cup \text{PREADV}(W_3) = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$W_5 = W_4 \cup \text{PREADV}(W_4) = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$W_4 = W_5 = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$W(1) = \{\text{START}\}$	$W_c(1) = \text{START}$
$W(2) = \{\text{GAB, GAC}\}$	$W_c(2) = \text{GAC}$
$W(3) = \{\text{ODBC}\}$	$W_c(3) = \text{ODBC}$
$W(4) = \{\text{GBC}\}$	$W_c(4) = \text{GBC}$
$W(5) = \{\text{GAB, GAC}\}$	$W_c(5) = \text{GAC}$
$W(6) = \text{WIN}$	$W_c(6) = \text{WIN}$
$W(7) = \text{WIN}$	$W_c(7) = \text{WIN}$
$W(8) = \text{WIN}$	$W_c(8) = \text{WIN}$
$W(9) = \text{WIN}$	$W_c(9) = \text{WIN}$
$W(10) = \text{WIN}$	$W_c(10) = \text{WIN}$

$T = (2^x, S, s_0, \rho, w_c)$

$S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$s_0 = \{1\}$

$\rho(s, x) = \delta(s, (w_c(s), x))$

$w_c =$