SAPIENZA Università di Roma – MSc. in Engineering in Computer Science
Formal Methods – January 26, 2023
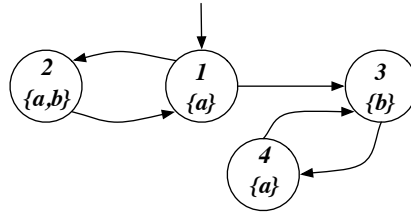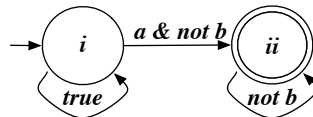*(Time to complete the test online: 2:00 hours)*

Part 1. Consider the following transition system:

- **Exercise 1.1:** Model check the Mu-Calculus formula: $\nu X.\mu Y.(((a \wedge b) \wedge [next]X) \vee [next]Y)$.

- **Exercise 1.2:** Model check the CTL formula $EF(AG(\neg(a \wedge b)))$, by translating it in Mu-Calculus.

- **Exercise 1.3:** 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:

Part 2 Consider the following domain:
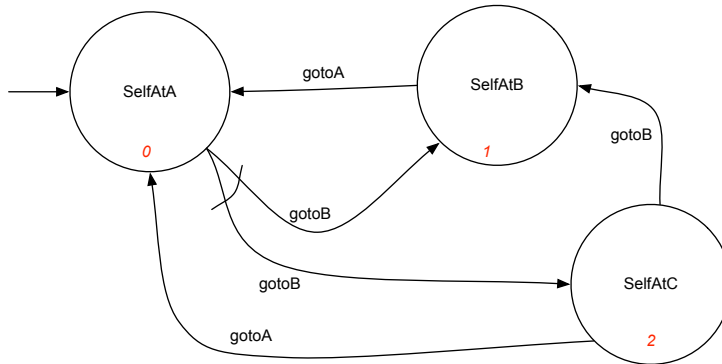
- **Exercise 2.1:** Synthesize a strategy (a plan) for realizing the LTLf formula $\Diamond(SelfAtB \wedge \Diamond(SelfAtA))$, by considering that the corresponding DFA is the one below:
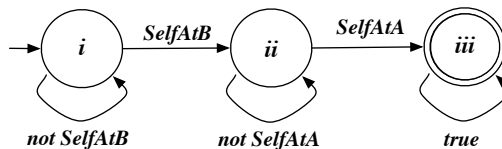
Part 3 Consider the notion of weakest precondition of a program.

- **Exercise 3.1:** Compute the weakest precondition for getting $\{x = y\}$ by executing the following program:

```
x := y + 1;
if (x > 0 & y >= 0) then {
    x := y - x;
    y := x - y
}
else if (x > 0) then
    x := x - y
```