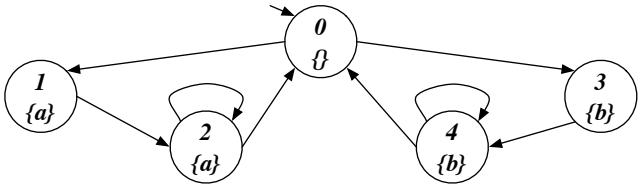
SAPIENZA Università di Roma – MSc. in Engineering in Computer Science

Formal Methods – September 15, 2023

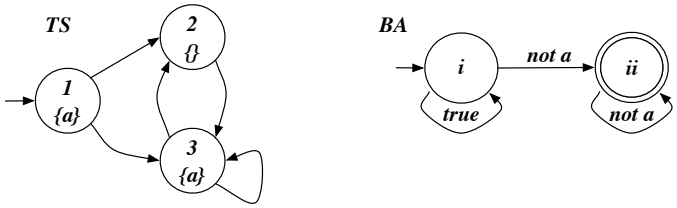
(Time to complete the test: 2:00 hours)

Part 1. Consider the following transition system:

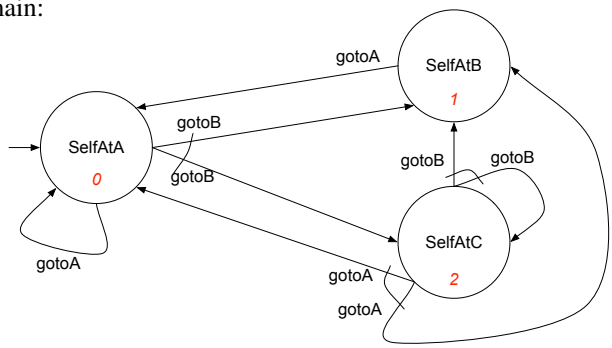


- **Exercise 1.1:** Model check the Mu-Calculus formula: $\nu X.\mu Y.((a \wedge [next]X) \vee (b \wedge \langle next \rangle Y))$
- **Exercise 1.2:** Model check the CTL formula $AF(EG(a \supset AXEX\neg a))$, by translating it in Mu-Calculus.

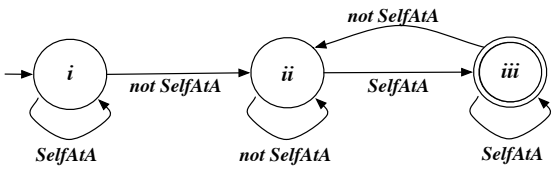
Part 2 Consider the transition system TS below. Model check the LTL formula $\Box\Diamond a$, by considering that the Büchi automaton BA for $\neg\Box\Diamond a$ (i.e., $\Diamond\Box\neg a$) is the one below:



Part 3 Consider the following domain:



- **Exercise 2.1:** Synthesize a strategy (a plan) for realizing the LTLf formula $\Diamond(\neg SelfAtA \wedge \Diamond(SelfAtA \wedge \bullet false))$, by considering that the corresponding DFA is the one below:



Part 4 (optional) Consider the following program:

```
while (x<10) do x := x + 1
```

Compute its *execution* and *final state*, starting from an *initial state* where $x = 9$, by using:

1. *Evaluation Semantics*;
2. *Transition Semantics*.
