SAPIENZA Università di Roma – MSc. in Engineering in Computer Science
Formal Methods – January 11, 2024
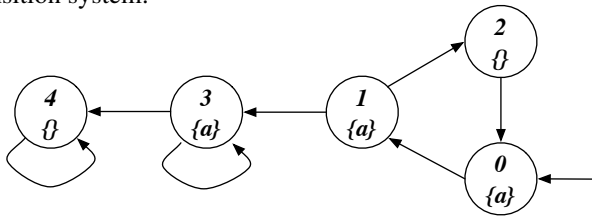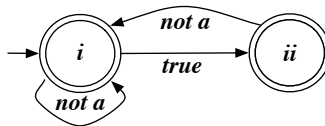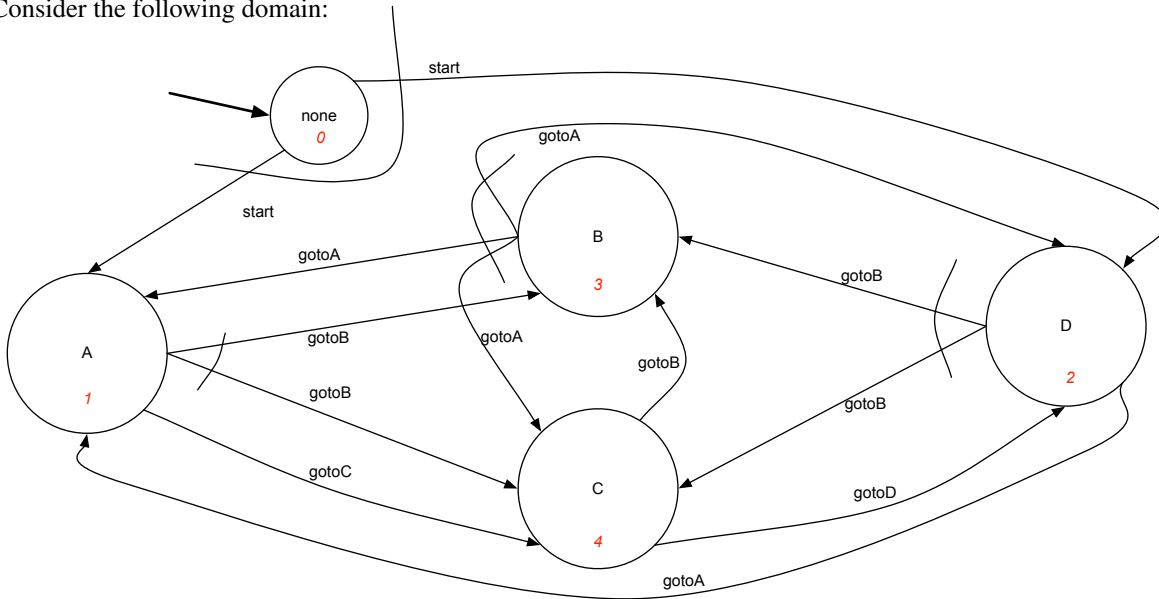*(Time to complete the test online: 2:00 hours)*

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

- **Exercise 1.1:** Model check the CTL formula $AF(EFa \wedge (EGa \vee AGa))$, by translating it in Mu-Calculus.

- **Exercise 1.2:** Model check the LTL formula $\Diamond(a \wedge \bigcirc a)$, by considering that the Büchi automaton for $\neg\Diamond(a \wedge \bigcirc a))$ is:

Part 2. Consider the following domain:

- **Exercise 2.1:** Synthesize a strategy (a plan) for realizing the LTLf formula $\Diamond(B \wedge \bigcirc\Diamond(A \wedge \bullet false))$, by considering that the corresponding DFA is the one below:
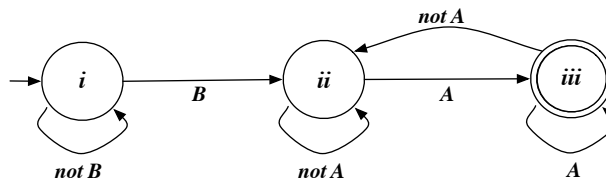
Part 3.

- **Exercise 3.1:** Given the following conjunctive queries:

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q1(x) :- edge(x,y), edge(y,y), edge(y,z), edge(z,y).
q2(x) :- edge(x,y), edge(y,z), edge(x,z), edge(x,v), edge(v,z), edge(v,y).
```

  check whether $q1$ is contained into $q2$, explaining the technique used and, in case of containment, showing the homomorphism between the canonical databases.