
Exercice Sheet 5

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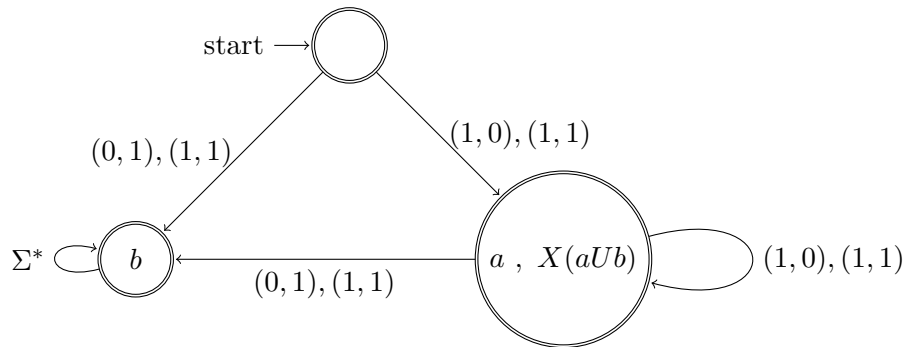
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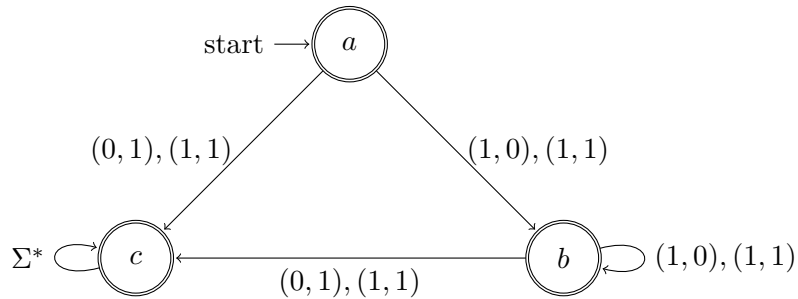
Exercice 1

(1)

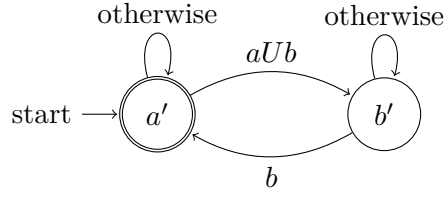
Local automata :



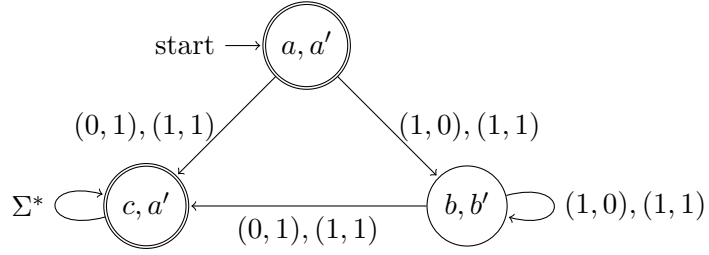
We use some annotation in order to simplify the readings :



Eventuality automata :



Complete automaton :



(2)

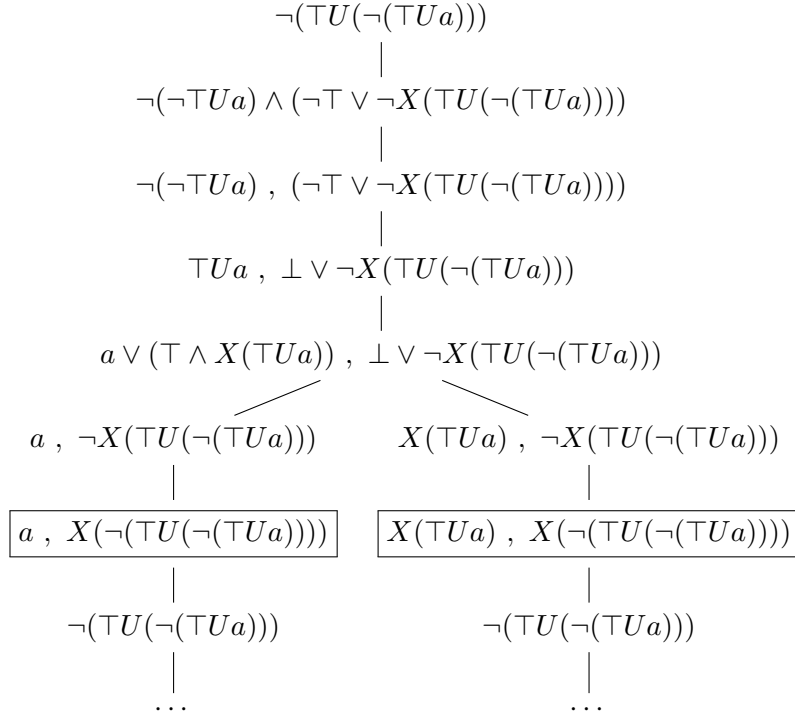
First, we transform

$$\Box \Diamond a$$

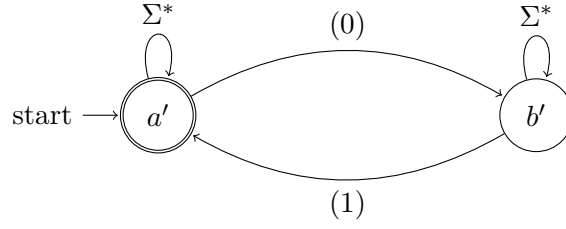
into

$$\begin{aligned} \Box \Diamond a &\equiv \neg \Diamond \neg (\Diamond a) \\ &\equiv \neg (\top U (\neg (\Diamond a))) \\ &\equiv \neg (\top U (\neg (\top U a))) \end{aligned}$$

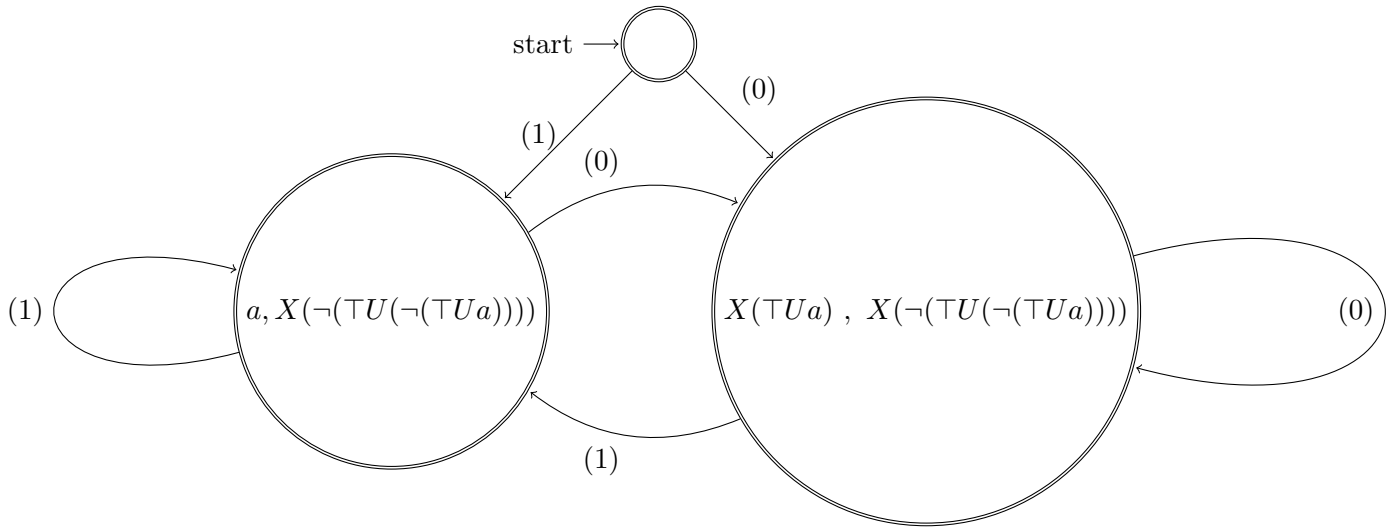
Algorithmic sugar (note : we simplify formulae like $\top \wedge a \equiv a$ and $\perp \vee a \equiv a$) :



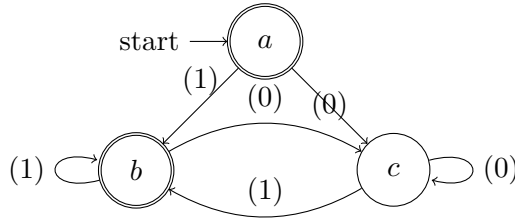
Eventuality automaton for $(\top U a)$



Local automaton :



Complete automaton



Exercise 2

(1)

$$\Box\Diamond(x == 1)$$

It is not a safety property, because it does not exist a finite execution of the system that would not satisfies this formula, because we always need to “know” if $x == 1$ or not in order to unvalidate the property.

It is a liveness property, because the property is checking, at any moment, if $x == 1$ would occurs now or in the future.

(2)

$$\neg(\Box\Diamond(x < 36))$$

It is not a safety property, because it does no exist a finite execution of the system that would not satisfies the formula. For example, if $x < 36$ occurs 2 times, we don’t know if the property would hold or not in the future.

It is a liveness property, we could transform the formula to $\neg(\Box\Diamond(x < 36)) = \neg(\neg(\Diamond\neg(\Diamond(x < 36)))) = \Diamond\neg(\Diamond(x < 36))$, and here the property would check if $\Diamond(x < 36)$ would not happen.

(3)

$$\Diamond(\neg(x > 10))$$

It is a liveness property, we check if $\neg(x > 10)$ would eventually happen or not. We could transform $\neg(x > 10)$ to $x \leq 10$, and $\Diamond(x \leq 10)$ is a liveness property.

It is not a safety property, because it is a liveness property.

(4)

$$\neg\Diamond(x == 12)$$

It is a safety property, because it exist a finite execution of the system that does not satisfy this property, for example if $x == 12$ now, the property does not hold and any further execution of the system would satisfies the property.

It is not a liveness property, because it is a safety property.