Universität Koblenz-Landau

FB 4 Informatik

Prof. Dr. Viorica Sofronie-Stokkermans **June 24, 2014**

Exercises for "Formal Specification and Verification"
Exercise sheet 6

We use the following abbreviations in LTL:

- The future diamond $\Diamond\phi := \top\mathcal{U}\phi$
- The future box $\Box\phi := \neg\Diamond\neg\phi$

Exercise 6.1:
Prove the following equivalences of LTL formulae:

(1) $\neg \bigcirc F \equiv \bigcirc\neg F$
(2) $\Diamond\Diamond F \equiv \Diamond F$
(3) $F\mathcal{U}G \equiv G \vee (F \wedge \bigcirc(F\mathcal{U}G))$ (unfolding of until)
(4) $F\mathcal{R}G \equiv (F \wedge G) \vee (G \wedge \bigcirc(F\mathcal{R}G))$ (unfolding of release)

Exercise 6.2:
Consider a signature with $\Pi = \{P, Q, S\}$. Which of the following formulae are CTL formulae? Justify your answer.

(1) $\bigcirc P$
(2) $A(\bigcirc(P \wedge Q) \vee (S\mathcal{U}P))$
(3) $A(\bigcirc(P \wedge Q)) \vee E(S\mathcal{U}P)$
(4) $(A\Diamond P) \vee (\Box(EQ))$
(5) $(A\Diamond P) \vee A(\Box(EQ))$
(6) $(A\Diamond P) \vee A(E\Box Q)$

Exercise 6.3:
Prove the following equivalences of CTL formulae:

(1) $\neg A\Diamond F \equiv E\Box\neg F$
(2) $\neg E\Diamond F \equiv A\Box\neg F$
(3) $\neg A \bigcirc F \equiv E \bigcirc \neg F$
(4) $E(F\mathcal{U}G) \equiv G \vee (F \wedge E \bigcirc E(F\mathcal{U}G))$

(5) $E\Box F \equiv \phi \wedge E \bigcirc E\Box F$

(6) $\neg A(F\mathcal{U}G) \equiv E(\neg G\mathcal{U}(\neg F \wedge \neg G)) \vee E\Box\neg G$

Please submit your solution until Wednesday, July 2, 2014 at 11:00. Please do not forget to write your name on your solution.

Submission possibilities:

- By e-mail to `sofronie@uni-koblenz.de` with the keyword "Homework FSV" in the subject.
- Hand it in to me (Room B225) or drop it in the box in front of Room B224.