Formal Reasoning 2014
Test Block 5: Modal logic
(16/12/14)

Before you read on, write your name, student number and study on the answer sheet!

The mark for this test is the number of points divided by ten. The first ten points are free. Good luck!

Within the second and the fourth exercise we use this dictionary:

S	I study during the Christmas break
W	During the Christmas break I go skiing

1. Write the following formula of modal logic in such a way that it complies to the official grammar and draw the corresponding parse tree. (15 points)

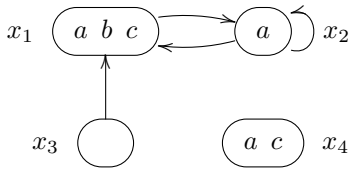
$$\Diamond(a \wedge b) \vee \Diamond\neg a \vee \Box\neg b$$

2. Give an English sentence that approximates the meaning of the formula from deontic logic as well as possible:

(10 points)

$$\Diamond(S \wedge W) \vee \Diamond\neg S \vee \Box\neg W$$

3. Let the Kripke-model $\mathcal{M}_3$ be defined as: (15 points)



Is the following statement true?

$$\mathcal{M}_3 \vDash \Diamond(a \wedge b) \vee \Diamond\neg a \vee \Box\neg b$$

Explain your answer.

4. This exercise is about the Dutch sentence:

During the Christmas break I study until I go skiing.

(a) Give an LTL formula that approximates the meaning of this sentence as well as possible. You may assume that this statement is given on the first day of the Christmas break. (10 points)

(b) According to the English sentence, is it possible that every now and then you are not studying before you go skiing? (5 points)

(c) According to your interpretation, does it follow from the sentence that you are no longer studying while gone skiing? Explain why your formula matches your interpretation of the sentence in this respect. (5 points)

5. This exercise is about the LTL formula

$$\mathcal{F}(a \wedge b) \vee \mathcal{F}\neg a \vee \mathcal{G}\neg b$$

(a) Explain what this formula means. (10 points)

(b) Give an LTL Kripke model in which this formula is true. Explain your answer. (10 points)

(c) Give a definition of logically true within LTL and explain whether the given formula complies to that definition or not. (10 points)