# C499H Modal Logic Exam 2017/2018

1

a

i)

If A is true for all possible valuations of ℱ. I.e. for all models M based on ℱ.

ii)

If A is true in all possible frames. I.e. for all frames ℱ.

b

i)

If where M is an arbitrary model and an arbitrary world, then for all worlds with , . Moreover, there exists a world with , where . Since A holds for all such worlds, as well. Thus, and . This is valid, since M and w are arbitrary.

ii)

No. Consider a frame where only and only and the only relations are and . Then , but .

c

i)

This is a Sahlqvist formula because it is a negated untied formula. The formula inside the negation is untied, as it consists of a boxed formula and a negative formula which are only connected with a ⋄ and an ∧.

ii)

Let and thus . The following diagram shows what it means for A to be true at world t:



where . The lazy assignment for p is . The standard translation for A is:

We now move existentials to the front, replace boxed atoms with truths and replace predicates with their corresponding lazy assignment:

is valid in F iff :

iii)



In this frame, , as both and trivially. However, p is not true in any world, so .

2

a

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b

A bisimulation between and is a relation such that, if then: For all atoms p, iff . Forth: If and , then there is with and . Back: If and , then there is with and .

c

i)

ii)

Since and ) are the only relations going out, by the forth property we have . Again by the forth property, we have . But now we violate the back property: We have , but there is no world such that . Thus, there does not exists such a bisimulation.

3

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