Problem Set 2 - Part 1
Modal Logic

Fall 2004, cs112 – James Pustejovsky

Handed Out: Mon. October 4, 2004
Due Date: Fri. October 15, 2004

This Problem Set is to be submitted ON PAPER, IN CLASS on the due date.

Exercise 1

1.1 Modal Propositional Logic Translations

Translate the following sentences into formulas of modal propositional logic. Represent the logical structure as well as you can and state the translation key you use.

(Use $\Box$ for contexts introduced by English modal *must* and $\Diamond$ for *might*.

a. It is possible that Harry said that if Nora must take cs112 then Betty must possibly not take cs112.

b. If it may be necessary that John leaves the party or Fred leaves the party, then it is necessary that Mary possibly stays or Bill possibly arrives.

c. Fred must think Bill might either believe that Leni is dating Sarah or that Ben must be dating Sally.

1.2 Modal Predicate Logic Translations

Translate the following sentences into formulas of modal predicate logic. Represent the logical structure as well as you can and state the translation key you use.

(Use $\Box$ for contexts introduced by English modal *must* and $\Diamond$ for *might*.

a. Every student thinks that someone may be cheating.

b. Every student might think that someone must be cheating.

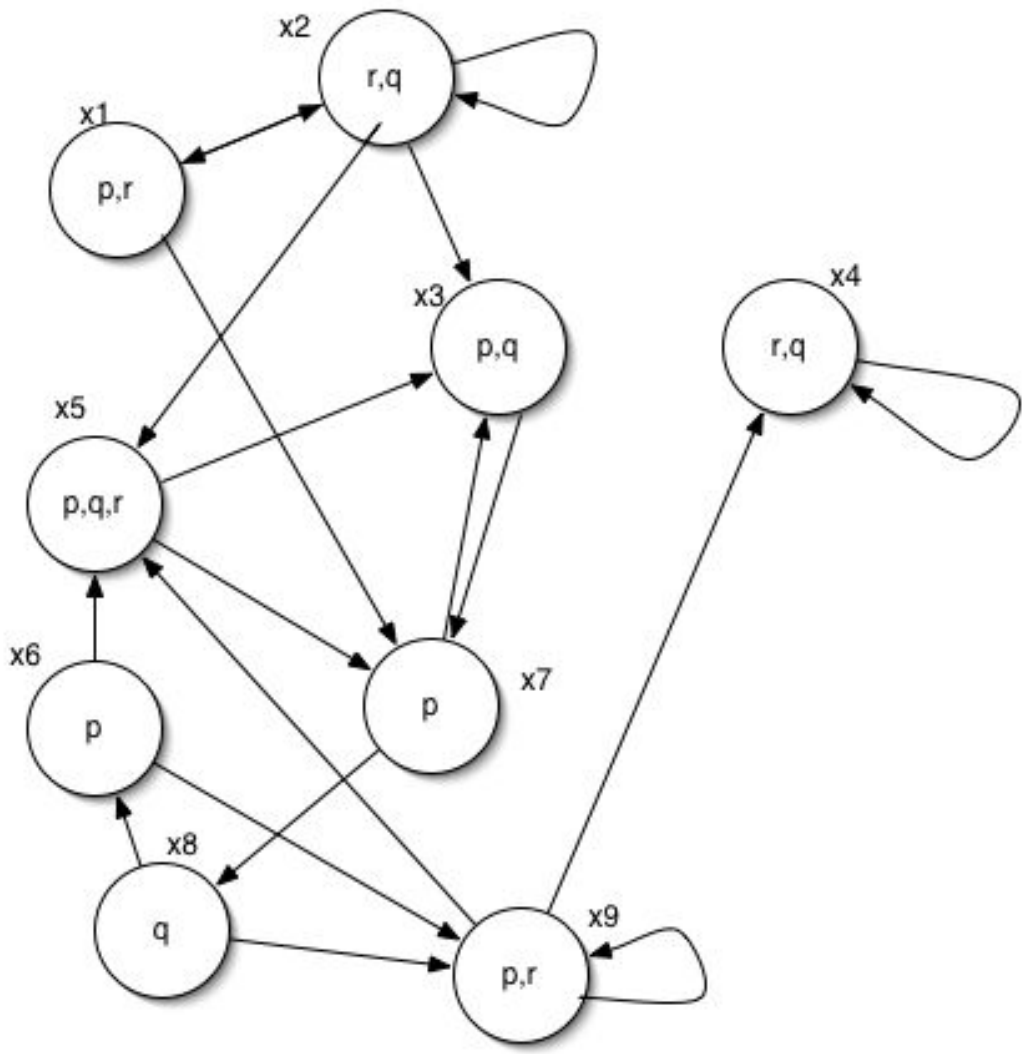
c. Every student must take cs35 if she thinks she might apply for grad-school.

d. Some student might not necessarily take every course that Storer might offer.

Exercise 2

2.1

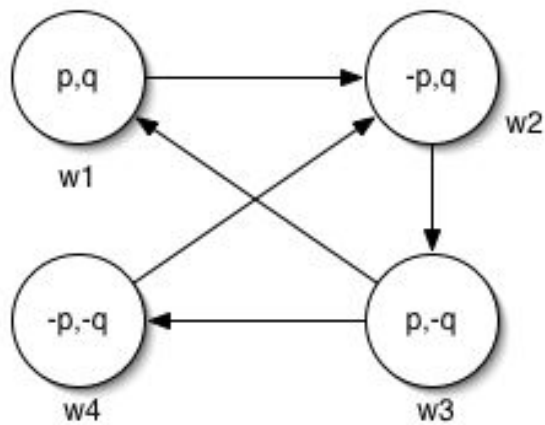
Consider this model:



1. Find all worlds satisfying:
   (a) $x \Vdash \Diamond(p \wedge q)$;
   (b) $x \Vdash \Box(p \vee r)$;
2. Does $x_1 \Vdash \Diamond\Box q$? Show why or why not.
3. Does $x_7 \Vdash \Box\Box\Diamond p$? Show why or why not.
4. Does $x_9 \Vdash \Diamond(r \vee \Diamond p)$? Show why or why not.
5. Decide whether the following formulas are valid in the model:
   (a) $\Diamond p \vee \Diamond q$
   (b) $\Box(r \wedge \Diamond p)$

2.2

Consider the simple model below:



Decide whether the following formulas are valid in the model:

a. $\Diamond\Box p \vee \Diamond\Diamond\Box p$

b. $\Box p \rightarrow \neg p$

c. $\Diamond(p \vee \neg p) \rightarrow \Box(p \vee \neg q)$