1.1 Translate the following sentences into first-order predicate logic. Try to retain as much of the structure as possible. The expressions “works hard” and “will … pass” can be translated using a single predicate symbol.

(1) Bill is intelligent but lazy.

(2) Although Bill is an intelligent student, he will not pass unless he works hard.

(3) Every student who works hard will pass.

(4) If somebody is noisy, everybody is annoyed.

(5) If a student works hard, (s)he will pass.

(6) A whale is a mammal

(7) Barking dogs don‘t bite

1.2 Translate the following formulae of first-order predicate logic into English. Use the translation key given below. Predicates can be translated freely.

(1) $S(j) \vee R(m)$

(2) $\forall x\,(R(x) \vee S(x))$

(3) $\exists x\,(\neg S(x) \wedge \forall y\,(\neg x{=}y \rightarrow S(y)))$

(4) $\forall x\,(S(x) \rightarrow \exists y\,(R(y) \wedge L(x,y)))$

(5) $\exists x\,\neg(F(x) \rightarrow (F(x) \wedge G(x)))$

j	John
m	Mary
S(x)	x is a student
R(x)	x is rich
L(x, y)	x is related to y

1.3 Consider the following sentences and their translations into predicate logic.

(1) a. Every student did not pay attention
b. $\forall x(\text{student}'(x) \rightarrow \neg\text{pay-attention}'(x)$

(2) a. No student payed attention
b. $\neg\exists x(\text{student}'(x) \wedge \text{pay-attention}'(x))$

a) Compute the truth-conditions of (1b) and (2b) and compare them.

b) Give one model structure under which (1b) is true, and one under which (1b) is false.

To be turned in Tuesday 2013-04-30, 10:15h