

## Exercises for FFL, Fall 2015, sheet 9

Return Tuesday Nov 17, in class.

**Exercise 1.** Formalize in FOL the following English statements. In each case, declare the type of each signature symbol that you use. Use the strict syntax declared by the definitions in the lecture notes – not using more or less brackets than demanded by those strict syntax rules.

1. When a glass of water is half full, it is also half empty and vice versa.
2. Obama is the President of the United States.
3. Some dogs are stupid.
4. A dog can't be clever and stupid at the same time, but some humans are.
5. A knife lies on my breakfast table.
6. Barber's coffee bar is located at the south corner of the intersection of High Street and Barber's street.

**Exercise 2.** Let  $S = \{\text{father-of, Tom, Anne}\}$ , where father-of is a unary function symbol and Tom, Anne are constant symbols. Give a concrete  $S$ -structure which is *not* a model of the  $S$ -expression "father-of Anne = Tom". And give a concrete  $S$ -structure which *is* a model of the  $S$ -expression "father-of Tom = Anne".

**Exercise 3.** You know that a binary relation is called an *equivalence relation* if it is (i) reflexive, (ii) symmetric, and (iii) transitive. Let  $S = \{\equiv\}$ , where  $\equiv$  is a binary relation symbol. Give an  $S$ -expression  $\varphi$  such that in any  $S$ -structure  $\mathcal{A} = (A, \equiv^{\mathcal{A}})$ , which is a model of  $\varphi$ ,  $\equiv^{\mathcal{A}}$  is an equivalence relation on  $A$ .