

## Exercises for FLL, Fall 2015, sheet 7

Return Tuesday Nov 3 in class

**Exercise 1.** Here is a famous photo<sup>1</sup>:



**(a)** Imagine you would have to describe this picture to a blind friend in 5 sentences. Write these 5 sentences down in FOL. You don't have to specify the type and arity of your symbols; for simplicity and clarity, use "xyz\_of" for function symbols; all other symbols are constants or relations.

**(b)** This photo invites aesthetic and philosophical thinking (take a look at the website it was taken from!). Think of one such "deep" thought and argue why it can't be formalized in FOL.

(Alternatively, argue that all aesthetic and philosophical thoughts can be expressed in FOL). You think this is a strange exercise? Well, it has been tried to formalize legal reasoning in FOL, for juridical expert systems... and legal reasoning is "deep".

**Exercise 2.** List all subformulas and terms that occur in

$$\exists x ((Qxy \vee \forall y (\neg Pffa \rightarrow Qaa)) \vee R yxa),$$

where  $Q$  is a binary predicate symbol,  $P$  is a unary predicate symbol,  $f$  is a unary function symbol,  $a$  is a constant symbol and  $R$  is a ternary predicate symbol. Determine for each occurrence of a variable whether it is free or bound.

<sup>1</sup> <http://www.dienes-and-dienes.com/Cartier-Bresson.html>