German University in Cairo
Department of Computer Science
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Knowledge Representation and Reasoning, Spring Term 2019
Assignment 3

Exercise 3-1

What requirements would you have to impose on an FOPL (in particular, on $\mathcal{F}$ and $\mathcal{I}_{\mathcal{F}}$) so that you can replace the notion of a variable assignment by that of a substitution in the definition of FOPL semantics?

Exercise 3-2

a) Give a recursive definition of a function, *Free*, that returns the set of variables occurring free in a given FOPL WFF.

b) Give a recursive definition of a function, *Bound*, that returns the set of variables occurring bound in a given FOPL WFF.

c) Given an example of an FOPL formula ϕ such that $\mathit{Free}(\phi) \cap \mathit{Bound}(\phi) \neq \{\}$.

Exercise 3-3

In the extended light-switch world introduced in class, determine the truth value of the following WFFs. You should justify your answer by working your way carefully through the definition of the interpretation function.

a) $\forall x[(\mathsf{Bulb}(x) \wedge \mathsf{Off}(x)) \Rightarrow \exists y[\mathsf{Switch}(y) \wedge \mathsf{Up}(y)]]$

b) $\forall x, y[(\mathsf{Switch}(x) \wedge \mathsf{Switch}(y) \wedge \mathsf{Down}(x) \wedge \mathsf{Down}(y)) \Rightarrow \forall z_1[\mathsf{Bulb}(z_1) \Rightarrow \mathsf{Off}(z_1)]]$

Note: Where Q is a quantifier, $Qx, y(\phi)$ is a short-hand for $Qx(Qy(\phi))$.

Exercise 3-4 **Submission**
Due by 13:45, Tuesday February 19th

Name: **App #:**

Part (b) of Exercise 3-3.