Exercise 1 Can you derive the following from (1) to (14) in Example 1.1.1? Justify your answers.
(a) Michelle is a parent of Malia.
(b) Ann is a grandmother of Natasha.

Exercise 2 In the context of (1) to (14) of Example 1.1.1, write Datalog rules
(a) which define what an aunt is
(b) and which define what a niece is.
In addition to the predicate symbols from Example 1.1.1, use also the following predicate symbols:
auntOf (arity 2), sisterOf (arity 2), daughterOf (arity 2), and nieceOf (arity 2) for the predicate
symbols.

Exercise 3 In the context of (1) to (14) of Example 1.1.1,
(a) define siblingOf and
(b) state that siblingOf is symmetric.
Here, assume that someone can be a sibling of her/himself.

Exercise 4 Write a Datalog program which captures the following natural language sentences.
Use the predicates: orphan (of arity 1), parentOf (of arity 2), dead (of arity 1), fatherOf (of arity
2), and the constants: harrypotter, and jamespotter.
(a) Every orphan is a human being.
(b) Somebody’s father is also that person’s parent.
(c) If somebody is an orphan, then all his parents are dead.
(d) Harry Potter is an orphan.
(e) James Potter is the father of Harry Potter.

Exercise 5 Let $L = (V, C, R)$ be a Datalog language with the set of variables $V = \{w, y\}$, constants
$C = \{d, e\}$, and predicate symbols $R = \{r, s\}$ where $r$ has arity 1 and $s$ has arity 2. Which of the
following are atoms over $L$? Which are ground atoms? Justify your answers.
(a) $d(w, w)$          (b) $r(d, e)$          (c) $s(w, w)$          (d) $r(y)$

Exercise 6 Let $L = (V, C, R)$ be a Datalog language with the set of variables $V = \{x, y\}$, constants
$C = \{barack, michelle, craig, malia\}$, and predicate symbols $R = \{motherOf, parentOf, grandmotherOf\}$,
all with arity 2. Which of the Datalog facts (1) to (9) from Example 1.1.1 are atoms over $L$? Justify
your answers. (Note that the language $L$ is different from the language used in Example 1.1.1)