Josiah Schmitz

CS-2210

9/4/25

Exercise Set 2

**Exercise 7**

c and d are atoms over L because they have predicates *r* and *s* with variables *w* and *y* with the correct arities (*r* with arity 1 and *s* with arity 2). a is not an atom because *r* has the wrong arity, and b is not an atom because *d* is a constant, not a predicate. None of them are ground atoms because both the parameters in c and d (the only atoms given) are variables and not constants.

**Exercise 8**

None of the Datalog facts are atoms over L because the only facts that have the correct *R* from *L* (facts 1, 3, 5, and 7) have constants that are not in *C* (such as marian and ann).

**Exercise 9**

orphan(Luke Skywalker)

childOf(x, y) ^ orphan(x) → dead(y)

fatherOf(Anakin Skywalker, Luke Skywalker)

orphan(x) → human(x)

motherOf(x, y) → parentOf(x, y)

**Exercise 10**

*I1* = {*q*(a), *p*(a), *r*(b)}

*I2* = {*q*(a), *q*(c), *p*(b)}

*I3 =* {∅}

**Exercise 11**

1. (*p*(c) **∧** *q*(c) **→** *r*(c))
2. (*p*(a, b, a) ∧ *q*(a, b, b) ∧ *r*(b, b) → *t*(a))
3. (*p*(b, b) ∧ *q*(b, b) → *p*(b, b))
4. (*q*(a, a) ∧ *p*(a, y) ∧ *q*(y, a) → *r*(y))

**Exercise 12**

Substitutions for problems a, b, and c are all ground substitutions because they leave the Datalog rule with no variables.

**Exercise 13**

*I*= { *q*(a), *q*(c), *p*(b), *p*(a), *p*(c), *r*(b)}

**Exercise 14**

ground(*P*) = { *q*(a), *q*(c), *p*(b), *q*(a) → *p*(a), *q*(b) → *p*(b), *q*(c) → *p*(c), *q*(a) ∧ *p*(a) → *r*(b), *q*(b) ∧ *p*(b) → *r*(b), *q*(c) ∧ *p*(c) → *r*(b)}

**Exercise 15**

*I1* = { *p*(a, b), *q*(c), *q*(d), *q*(a)}

*I2*= { *p*(a, b), *p*(b, a), *q*(c), *q*(d), *q*(a), *q*(b)}

*I3*= { *p*(a, b), *p*(b, a), *p*(c, d), *q*(c), *q*(d), *q*(a), *q*(b)}