CS 560: Homework 0

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1. If a language consists only of four 0-nary predicate symbols then it very limited.

    a. The only facts that can be written are the predicates themselves: a(), b(), c() and d().

    b. If all four of the predicates can be contained in a body then the number of possible bodies becomes a summation of combination as follows: $B = \sum_{i=1}^{4} \binom{4}{i} = \sum_{i=1}^{4} \frac{4!}{i!(4-i)!} = \frac{24}{24} + \frac{24}{6} + \frac{24}{4} + \frac{24}{6} = 15$. If you don't allow all four to be used in a body, because you know one must be atom must be used as the head of a rule, then the math only changes slightly: $B = \sum_{i=0}^{3} \binom{4}{i} = \sum_{i=1}^{3} \frac{4!}{i!(4-i)!} = \frac{24}{6} + \frac{24}{4} + \frac{24}{6} = 14$ {a^b^c}, {a^c^d}, {b^d}, {a,b} and {c}.

    c. To calculate the total number of rules that can be created using this set of predicates we use similar math as we used to calculate the number of possible bodies. Here though, there must be a head. Since there can only be one head at a time there are four options for heads. That leaves combinations of the three remaining predicates. The math to calculate the number of possible rules is as follows: $R = 4\sum_{i=1}^{3} \binom{3}{i} = 4\sum_{i=1}^{3} \frac{3!}{i!(3-i)!} = 4\left(\frac{6}{6} + \frac{6}{2} + \frac{6}{2}\right) = 28$. Some examples of these rules might be: {d <- a^b^c}, {a <- c^d}, {c <- b^d}, {a <- b} and {a <- c}.

2. Write a datalong that states: *If you have a son then you have a child.*
    a. Child() <- Son()