

CS 402  
Artificial Intelligence  
Summer, 2015  
Homework 1  
Due: Thursday, July 2

**This should be typewritten. Where appropriate, use the Microsoft Equation Editor or LaTeX.**

1. Formalize the following sentence, using the vocabulary indicated parenthetically:

A man who loves himself more than he loves anyone else is not loved by anyone other than himself. ( $F^1$ :  $a$  is a man;  $G^1$ :  $a$  is a person;  $H^2$ :  $a$  loves  $b$ ;  $J^2$ :  $a$  is different from  $b$ ;  $L^4$ :  $a$  loves  $b$  more than  $c$  loves  $d$ )

2. Formalize the following sentence, using the vocabulary indicated parenthetically:

If a father has only male children, then he does not have to provide a dowry for anyone of them. ( $F^1$ :  $a$  is a father;  $G^1$ :  $a$  is male;  $H^2$ :  $a$  is a child of  $b$ ;  $J^2$ :  $a$  has to provide a dowry for  $b$ )

3. The following story is from N. Wirth's (1976) *Algorithms + data structures = programs*.

I married a widow (let's call her W) who has a grown-up daughter (call her D). My father (F), who visited us quite often, fell in love with my step-daughter and married her. Hence my father became my son-in-law and my step-daughter became my mother. Some months later, my wife gave birth to a son (S1), who became the brother-in-law of my father, as well as my uncle. The wife of my father, that is, my step-daughter, also had a son (S2).

Using predicate calculus, create a set of expressions that represent the situation in the above story. Add expressions defining basic family relationships such as the definition of father-in-law and use *modus ponens* on this system to prove the conclusion that "I am my own grandfather."

4. Attempt to unify the following pairs of expressions. Either show their most general unifiers or explain why they will not unify.
- $p(X,Y)$  and  $p(a,Z)$
  - $p(X,X)$  and  $p(a,b)$
  - $\text{ancestor}(X,Y)$  and  $\text{ancestor}(\text{bill}, \text{father}(\text{bill}))$
  - $\text{ancestor}(X, \text{father}(X))$  and  $\text{ancestor}(\text{david}, \text{george})$
  - $q(X)$  and  $\neg q(a)$