

# Foundations of Logic Programming

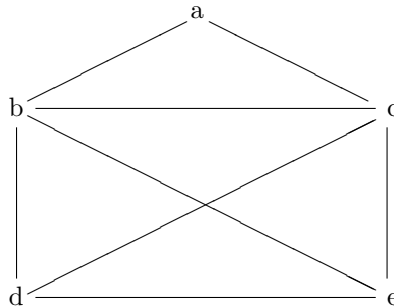
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International Master Program in Computational Logic — winter term 2009/2010

Date of Exercise: 02.11.2009

## Exercise 2.1

The following figure should be drawn at one go without drawing a line more than once.



Write a Prolog program to solve the problem.

## Exercise 2.2

Find two terms  $s$  and  $t$  such that  $s$  is an instance of  $t$  but where  $s$  and  $t$  cannot be unified. Explain your answer.

## Exercise 2.3

For the following terms  $s$  and  $t$  determine whether  $s$  is a variant of  $t$ ,  $t$  is a variant of  $s$ ,  $s$  is an instance of  $t$  or  $s$  is more general than  $t$  (where  $x$ ,  $y$  and  $z$  are variables):

- a)  $s = f(x, a(y, z), y)$  and  $t = f(b(x), a(c, b(x)), c)$
- b)  $s = g(a(x), x)$  and  $t = g(y, a(y))$
- c)  $s = h(b(x), a(z, y))$  and  $t = h(b(y), a(z, x))$

## Exercise 2.4

Prove that for every term  $s$ :

$$(s\theta)\delta = s(\theta\delta)$$

Hint: You may want to use structural induction on the structure of  $s$ .

### Exercise 2.5

Compute the substitution composition  $\theta\eta\tau$ , where  $w, x, y, z$  are variables and

$$\theta = \{y/a(x, z), z/y\} \quad \eta = \{y/x, x/f(w)\} \quad \tau = \{w/g(a), x/z, z/b\}$$

### Exercise 2.6

Use the Martelli-Montanari algorithm step by step to unify the following pairs of terms with variables  $x$ ,  $y$ , and  $z$ . For each step indicate which rule you have used.

- a)  $f(g(x), g(c), y)$  and  $f(g(g(y)), x, a)$
- b)  $f(b, x, x, y)$  and  $f(b, g(y), g(g(z)), g(a))$
- c)  $f(x, g(z), g(z))$  and  $f(h(y), y, g(h(x)))$

Give the corresponding most general unifier (mgu) or give the reason why the terms are not unifiable.