



BU CAS CS 320 (FALL SEMESTER, 2006)
CONCEPTS OF PROGRAMMING LANGUAGES

Assignment 1

Out: Friday, 8 September 2006
Due: Tuesday, 19 September 2006

Academic Integrity We pledge strict adherence to the university guidelines.

- All work you turn in must be *your own* unless specified otherwise.
- You are allowed to discuss problems with your classmates but you must write your own code and solutions.
- Please always remember that every student deserves a chance to achieve a fair grade!

Total: 10 points

Exercise 1 (70 points) *The following is a description of Game-of-24.*

Given four natural numbers n_1, n_2, n_3 and n_4 , one chooses two of them and generates a rational number r_1 using either addition, subtraction, multiplication or division; one mixes r_1 with the remaining two numbers and chooses two of them to generate a rational number r_2 using either addition, subtraction, multiplication or division; one then takes r_2 and the last remaining number to get a rational number r_3 using addition, subtraction, multiplication, or division; if there is a way to make r_3 equal to 24, then we say that (n_1, n_2, n_3, n_4) is a good quad. For instance, $(10, 10, 4, 4)$ is a good quad since we have

$$(10 * 10 - 4) / 4 = 24$$

Similarly, $(5, 7, 7, 11)$ is a good quad since we have

$$(5 - 11/7) * 7 = 24$$

Game-of-24 is a game that determines whether four given natural numbers are a good quad.

Please implement a program in your favorite programming language that takes four given natural numbers and returns 1 or 0 according to whether the four natural numbers are a good quad; if they are a good quad, the program should also print out an arithmetic expression that attests to their being a good quad.

Exercise 2 (10 points) *Alyssa P. Hacker doesn't see why `if` needs to be provided as a special form. "Why can't I define as an ordinary procedure in terms of `cond`" she asks. Alyssa's friend Eval Lu Ator claims this can indeed be done, and she defines a new version of `if`:*

```
fun new_if (predicate, then_clause, else_clause) =  
  if predicate then then_clause else else_clause
```

Delighted, Alyssa uses `new_if` to implement the factorial function as follows:

```
fun factorial (n: int): int =  
  new_if (n>0, n * factorial (n-1), 1)
```

What happens when Alyssa attempts to use this to compute factorials? Please explain.

Exercise 3 (20 points) *Please implement a function in SML that takes three numbers as its arguments and returns true or false according to whether these numbers can be the sides of a triangle. Note that three given real numbers can be the sides of a triangle if and only if the sum of any two of these numbers is greater than the third.*