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

\[
(10 \times 10 - 4)/4 = 24
\]

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

\[
(5 - 11/7) \times 7 = 24
\]

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 \texttt{if} needs to be provided as a special form. “Why can’t I define as an ordinary procedure in terms of \texttt{cond}” she asks. Alyssa’s friend Eval Lu Ator claims this can indeed be done, and she defines a new version of \texttt{if}:

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

Delighted, Alyssa uses \texttt{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.