F28PL1 Programming Languages
Tutorial 6

1) Identify the types of the following functions:

```
a) fun f1 x = x+5
b) fun f2 x = x^x
c) fun f3 x = not x
d) fun f4 x = (x,2*x)
e) fun f5 x = (floor x,x)
f) fun f6 x y = x mod y
g) fun f7 x y = x+(real y)
h) fun f8 x y = x*(size y)
i) fun f9 x y = (x*y,x/y)
j) fun f10 x y = (x+y,x mod y)
k) fun f11 x y = (x<y,floor y)
l) fun f12 x y z =
      (floor x)+(floor y)+(size z)
m) fun f13 x y z = (real x,floor y,not z)
n) fun f14 x y z = (x-y,y*z,x<y,x div y)
o) fun a "earth" = 1 |
       a "water" = 2 |
       a "fire"  = 3 |
       a "air"   = 4 |
       a _ = 0
p) fun b true = "true" |
       b false = "false"
q) fun c "zero" = 0.0 |
       c "one" = 1.0 |
       c _ = 42.0
r) fun d 0 = 0 |
       d n = d (n-1)
s) fun e 0 = 0.0 |
       e n = (real n)+(e (n-1))
t) fun f 0 = "" |
       f n = "."^(f (n-1))
u) fun g 0 = true |
       g 1 = false |
       g n = (g (n-1)) orelse (g (n-2))
v) fun h n = if n<0.0
             then "negative"
             else "non-negative"
w) fun i n = if n<"m"
             then false
             else true
x) fun j 0 = 0.0 |
       j n = if n>50
             then 1.0
             else ~1.0
```

2) Write the following functions. Identify the type in each case:

a) add 3 to real y

b) check if integer n is bigger than 50

c) check if string s has less letters than "banana"

d) find the fourth power of integer x

e) find the remainder after dividing integer a by integer b

f) find the total lengths of strings s1 and s2

g) multiply the length of string s by real r

h) convert from English strings to Spanish strings using the following table:

```
English Spanish
one     uno
two     dos
three   tres
four    quatro
```

i) convert from word strings to string/string tuples using the following table:

```
word  tuple
cat   cat/singular
cats  cats/plural
dog   dog/singular
dogs  dog/plural
mouse mouse/singular
mice  mice/plural

- typeof "cats";
> ("cats","plural") : string * string
```

j) generate a string consisting of integer n strings's with spaces in between. Separate cases are needed for n==0, n==1 and n>1:

```
- sequence 3 "fish";
> "fish fish fish" : string
```

k) find the remainder on dividing integer x by integer y without using the SML built in function mod:

```
MOD x 0 = x
MOD x y = x if x<y
MOD x y = MOD (x-y) y if x>=y

- MOD 27 4;
> 3 : int
```

l) find the sum of the series 1/n, as a real, for values from 0 to integer n:

```
sum 0 == 0.0
sum n == 1/n+(sum n-1)
```

Note that n must be converted to a real each time.

m) given three strings s1, s2 and s3, return the shortest:

```
- shortest "vast" "big" "enormous";
> "big" : string
```

n) given three strings s1, s2 and s3, return a tuple of the longest and its length:

```
- longlength
    "tiny" "very small" "miniscule";
> ("very small",10) : string * int
```