Homework 5 — ML core language— due Wednesday 27 March

Total number of points available on this homework is 230. Full credit is equivalent to 100 points.

Reading assignment

Read Chapters 1, 2, and 3 of *ML for the Working Programmer*.

5.1 Integers (5pts)

Define a function called *cube*, of type $int \to int$, which returns the integer which is the cube of the integer it is applied to.

5.2 Real numbers (5pts)

Define a function *doublingtime* that calculates the number of years it takes for an amount of money to double at a certain interest. For instance, *doublingtime* 100.0 should give the result 1.0.

5.3 Characters (5pts)

Given a list of characters, determine whether it is a palindrome.

5.4 Strings (5pts)

Given a list of one-letter strings, determine whether it is a palindrome.

5.5 Types (15pts)

What types are assigned to:

1. **fn** $x => x$
2. **fn** $(\_,(x,\_)) => x$
3. **fn** $(x,y) => (y,x)$

Give one instantiation of each type.

5.6 List types (20pts)

Write a function *swapl* that takes a list of pairs as argument and returns a list of pairs in which the elements are swapped. Specify its type.

5.7 Lists (20pts)

Represent sets using lists, and write a function that takes a set S and returns its powerset 2^S. Let $f(0) = \emptyset$, $f(k+1) = 2^{f(k)}$. Write an ML function f and compute the sets $f(k)$ for $k = 0,1,2,3,4$.

5.8 List types and higher-order functions (25pts)

Write a function *map2* that applies a function to all elements in all element lists in a list of lists. Specify its type. Compare the meaning of *map* in ML and in Scheme.

5.9 Using lists for arithmetic (20pts)

Numerals can be represented as lists of integers. For instance, decimal numerals can be expressed as lists of integers from 0 to 9. Write a function to convert such numerals from decimal to binary.

5.10 Using lists for arithmetic (20pts)

Continuing the preceding exercise, write a function to convert numerals from binary to decimal.

5.11 Using lists for arithmetic (20pts)

Continuing the preceding exercise, write a function to convert numerals from any radix to any radix.

5.12 Using lists for arithmetic (10pts)

Continuing the preceding exercise, write a function for addition of numerals in any radix.

5.13 Using lists for arithmetic (20pts)

Continuing the preceding exercise, write a function for multiplication of numerals in any radix.

5.14 Using lists for arithmetic (40pts)

Continuing the preceding exercise, write a function for division of numerals in any radix. Return a pair, consisting of the quotient and the remainder.

How to turn in

Turn in your code by running

~dmykola/handin your-file

on a regular UNM CS machine.

You should use whatever filename is appropriate in place of your-file. You can put multiple files on the command line, or even directories. Directories will have their entire contents handed in, so please be sure to clean out any cruft.

Remember to submit extensive tests of your programs!