

COMS W4115

Programming Languages and Translators

Homework Assignment 1

Prof. Stephen A. Edwards Due October 12th, 2011
Columbia University at 4:10 PM

On-campus students: submit paper solutions, not email.
CVN students: FAX the solutions to CVN.
Include your name and your Columbia ID (e.g., se2007).
Do this assignment alone. You may consult the instructor
or a TA, but not other students.

All the problems ask you to use O'CAML. You may down-
load the compiler from `caml.inria.fr`.

1. In O'Caml, write a function "uniq" that takes a list and returns the same list with adjacent duplicate entries removed. Show that for the list `[1;1;1;3;4;1;1]` your function returns the list `[1;3;4;1]`. Hint: my solution is a six-line, three-way case split.
2. Write a word frequency counter. Here is a starting point: an `ocamllex` program (`wordcount.mll`) that gathers in a list of strings all the words in a file, then prints them.

```
{ type token = EOF | Word of string }

rule token = parse
  | eof { EOF }
  | ['a'-'z' 'A'-'Z']+ as word { Word(word) }
  | _ { token lexbuf }

{
  let lexbuf = Lexing.from_channel stdin in
  let wordlist =
    let rec next l =
      match token lexbuf with
      EOF -> l
      | Word(s) -> next (s :: l)
    in next []
  in
  List.iter print_endline wordlist
}
```

Instead of `List.iter`, write code that scans through the list and builds a string map whose keys are words and whose values are the number of times a string was found, then uses `StringMap.fold` to convert this to a list of (count, word) tuples, sorts them using `List.sort`, and prints them with `List.iter`.

Sort the list of (count, word) pairs using

```
let wordcounts =
  List.sort (fun (c1, _) (c2, _) ->
    Pervasives.compare c2 c1)
  wordcounts in
```

Compiling and running my (20-more-line) solution:

```
$ ocamllex wordcount.mll
4 states, 315 transitions, table size 1284 bytes

$ ocamlc -o wordcount wordcount.ml

$ ./wordcount < wordcount.mll

9 word
7 map
7 let
7 StringMap
6 in
...
```

3. Extend the three-slide "calculator" example shown at the end of the Introduction to O'Caml slides (the source is also available on the class website) to accept the variables named `$0` through `$9`, assignment to those variables, and sequencing using the `","` operator. For example,

```
$1 = 3, $2 = 6, $1 * $2 + 2
```

should print "20"

Use an array of length 10 initialized to all zeros to store the values of the variables. You'll need to add tokens to the parser and scanner for representing assignment, sequencing, and variable names.

The `ocamllex` rule for the variable names, which converts the numerals 0–9 into the corresponding literals, is

```
| '$'['0'-'9'] as lit
  { VARIABLE(int_of_char lit.[1] - 48) }
```

The new `ast.mli` file is

```
type operator = Add | Sub | Mul | Div
type expr =
  Binop of expr * operator * expr
  | Lit of int
  | Seq of expr * expr
  | Asn of int * expr
  | Var of int
```

My solution required adding just 20 lines of code across the four files.