```
 1: (* $Id: bigint.mli,v 1.1 2011-04-26 13:39:18-07 - - $ *)
 2:
 3: module Bigint : sig
 4:    type bigint
 5:    val bigint_of_string : string -> bigint
 6:    val string_of_bigint : bigint -> string
 7:    val add : bigint -> bigint -> bigint
 8:    val sub : bigint -> bigint -> bigint
 9:    val mul : bigint -> bigint -> bigint
10:    val div : bigint -> bigint -> bigint
11:    val rem : bigint -> bigint -> bigint
12:    val pow : bigint -> bigint -> bigint
13:    val zero : bigint
14: end
15:
```

```
 1: (* $Id: bigint.ml,v 1.5 2014-11-11 15:06:24-08 - - $ *)
 2:
 3: open Printf
 4:
 5: module Bigint = struct
 6:
 7:     type sign     = Pos | Neg
 8:     type bigint   = Bigint of sign * int list
 9:     let  radix    = 10
10:     let  radixlen =  1
11:
12:     let car       = List.hd
13:     let cdr       = List.tl
14:     let map       = List.map
15:     let reverse   = List.rev
16:     let strcat    = String.concat
17:     let strlen    = String.length
18:     let strsub    = String.sub
19:     let zero      = Bigint (Pos, [])
20:
21:     let charlist_of_string str =
22:         let last = strlen str - 1
23:         in  let rec charlist pos result =
24:             if pos < 0
25:             then result
26:             else charlist (pos - 1) (str.[pos] :: result)
27:         in  charlist last []
28:
29:     let bigint_of_string str =
30:         let len = strlen str
31:         in  let to_intlist first =
32:                 let substr = strsub str first (len - first) in
33:                 let digit char = int_of_char char - int_of_char '0' in
34:                 map digit (reverse (charlist_of_string substr))
35:             in  if   len = 0
36:                 then zero
37:                 else if   str.[0] = '_'
38:                      then Bigint (Neg, to_intlist 1)
39:                      else Bigint (Pos, to_intlist 0)
40:
41:     let string_of_bigint (Bigint (sign, value)) =
42:         match value with
43:         | []    -> "0"
44:         | value -> let reversed = reverse value
45:                    in  strcat ""
46:                        ((if sign = Pos then "" else "-") ::
47:                         (map string_of_int reversed))
```

```
48:
49:     let rec add' list1 list2 carry = match (list1, list2, carry) with
50:         | list1, [], 0       -> list1
51:         | [], list2, 0       -> list2
52:         | list1, [], carry   -> add' list1 [carry] 0
53:         | [], list2, carry   -> add' [carry] list2 0
54:         | car1::cdr1, car2::cdr2, carry ->
55:           let sum = car1 + car2 + carry
56:           in  sum mod radix :: add' cdr1 cdr2 (sum / radix)
57:
58:     let add (Bigint (neg1, value1)) (Bigint (neg2, value2)) =
59:         if neg1 = neg2
60:         then Bigint (neg1, add' value1 value2 0)
61:         else zero
62:
63:     let sub = add
64:
65:     let mul = add
66:
67:     let div = add
68:
69:     let rem = add
70:
71:     let pow = add
72:
73: end
74:
```

```
 1: (* $Id: maindc.ml,v 1.4 2012-02-16 17:47:43-08 - - $ *)
 2:
 3: include Scanner
 4: include Bigint
 5:
 6: open Bigint
 7: open Printf
 8: open Scanner
 9:
10: type stack_t = Bigint.bigint Stack.t
11: let push = Stack.push
12: let pop = Stack.pop
13:
14: let ord thechar = int_of_char thechar
15: type binop_t = bigint -> bigint -> bigint
16:
17: let print_number number = printf "%s\n%!" (string_of_bigint number)
18:
19: let print_stackempty () = printf "stack empty\n%!"
20:
21: let executereg (thestack: stack_t) (oper: char) (reg: int) =
22:     try match oper with
23:         | 'l' -> printf "operator l reg 0%o is unimplemented\n%!" reg
24:         | 's' -> printf "operator s reg 0%o is unimplemented\n%!" reg
25:         | _   -> printf "0%o 0%o is unimplemented\n%!" (ord oper) reg
26:     with Stack.Empty -> print_stackempty()
27:
28: let executebinop (thestack: stack_t) (oper: binop_t) =
29:     try let right = pop thestack
30:         in  try let left = pop thestack
31:                 in  push (oper left right) thestack
32:             with Stack.Empty -> (print_stackempty ();
33:                                  push right thestack)
34:     with Stack.Empty -> print_stackempty ()
35:
36: let execute (thestack: stack_t) (oper: char) =
37:     try match oper with
38:         | '+'  -> executebinop thestack Bigint.add
39:         | '-'  -> executebinop thestack Bigint.sub
40:         | '*'  -> executebinop thestack Bigint.mul
41:         | '/'  -> executebinop thestack Bigint.div
42:         | '%'  -> executebinop thestack Bigint.rem
43:         | '^'  -> executebinop thestack Bigint.pow
44:         | 'c'  -> Stack.clear thestack
45:         | 'd'  -> push (Stack.top thestack) thestack
46:         | 'f'  -> Stack.iter print_number thestack
47:         | 'l'  -> failwith "operator l scanned with no register"
48:         | 'p'  -> print_number (Stack.top thestack)
49:         | 's'  -> failwith "operator s scanned with no register"
50:         | '\n' -> ()
51:         | ' '  -> ()
52:         | _    -> printf "0%o is unimplemented\n%!" (ord oper)
53:     with Stack.Empty -> print_stackempty()
```

```
54:
55: let toploop (thestack: stack_t) inputchannel =
56:     let scanbuf = Lexing.from_channel inputchannel in
57:     let rec toploop () =
58:         try  let nexttoken = Scanner.scanner scanbuf
59:              in  (match nexttoken with
60:                   | Number number       -> push number thestack
61:                   | Regoper (oper, reg) -> executereg thestack oper reg
62:                   | Operator oper       -> execute thestack oper
63:                  );
64:              toploop ()
65:         with End_of_file -> printf "End_of_file\n%!";
66:     in  toploop ()
67:
68: let readfiles () =
69:     let thestack : bigint Stack.t = Stack.create ()
70:     in  ((if Array.length Sys.argv > 1
71:           then try  let thefile = open_in Sys.argv.(1)
72:                     in  toploop thestack thefile
73:                with Sys_error message -> (
74:                     printf "%s: %s\n%!" Sys.argv.(0) message;
75:                     exit 1));
76:         toploop thestack stdin)
77:
78: let interact () =
79:     let thestack : bigint Stack.t = Stack.create ()
80:     in  toploop thestack stdin
81:
82: let _ = if not !Sys.interactive then readfiles ()
83:
```

```
 1: (* $Id: scanner.mll,v 1.1 2011-04-26 13:39:18-07 - - $ *)
 2:
 3: {
 4:
 5: module Scanner = struct
 6:     include Bigint
 7:
 8:     type token = Number   of Bigint.bigint
 9:                | Regoper  of char * int
10:                | Operator of char
11:
12:     let bigstr = Bigint.bigint_of_string
13:     let lexeme = Lexing.lexeme
14:     let ord    = int_of_char
15:     let strlen = String.length
16:
17:     let regoper lexbuf =
18:         let token = lexeme lexbuf
19:         in  Regoper (token.[0], ord token.[1])
20:
21: }
22:
23: let number  = '_'? ['0' - '9']*
24: let regoper = ['s' 'l']
25:
26: rule scanner = parse
27:    | number    { Number (bigstr (lexeme lexbuf)) }
28:    | regoper _ { regoper lexbuf }
29:    | _         { Operator (lexeme lexbuf).[0] }
30:    | eof       { raise End_of_file }
31:
32: {
33:
34: end
35:
36: }
```

```
 1: (* $Id: dc.ml,v 1.1 2011-04-26 13:39:18-07 - - $ *)
 2:
 3: (*
 4: * This file is useless for compilation.  However, for interactive
 5: * testing it make loading all three files easier.  Normally for
 6: * interactive use, type
 7: *
 8: *    #use "dc.ml";;
 9: *
10: * at the toplevel.  Alternately, to run it directly without
11: * interacting with the toplevel, just use:
12: *
13: *    ocaml dc.ml
14: *
15: * which will run the program without need for compilation.
16: *)
17:
18: #use "bigint.ml";;
19: #use "scanner.ml";;
20: #use "maindc.ml";;
21:
```

```
# $Id: Makefile,v 1.15 2014-11-17 15:28:57-08 - - $

MKFILE    = Makefile
DEPSFILE  = ${MKFILE}.deps
NOINCLUDE = ci clean spotless
NEEDINCL  = ${filter ${NOINCLUDE}, ${MAKECMDGOALS}}
SUBMAKE   = ${MAKE} --no-print-directory

SOURCE    = bigint.mli bigint.ml maindc.ml scanner.mll
ALLSRC    = ${SOURCE} dc.ml ${MKFILE}
OBJCMO    = bigint.cmo scanner.cmo maindc.cmo
OBJCMI    = ${patsubst %.cmo, %.cmi, ${OBJCMO}}
CAMLRUN   = ocamldc
LISTING   = Listing.ps

all : ${CAMLRUN}

${CAMLRUN} : ${OBJCMO} ${OBJCMI}
        ocamlc ${OBJCMO} -o ${CAMLRUN}

%.cmi : %.mli
        ocamlc -c $<

%.cmo : %.ml
        ocamlc -c $<

%.ml : %.mll
        ocamllex $<

clean :
        - rm ${OBJCMO} ${OBJCMI} ${DEPSFILE} scanner.ml

spotless : clean
        - rm ${CAMLRUN} ${LISTING} ${LISTING:.ps=.pdf}

ci : ${RCSFILES}
        cid + ${ALLSRC}
        checksource ${ALLSRC}

deps : ${SOURCE}
        ocamldep ${SOURCE} >${DEPSFILE}

${DEPSFILE} :
        @ touch ${DEPSFILE}
        ${SUBMAKE} deps

lis : ${ALLSRC}
        mkpspdf ${LISTING} ${ALLSRC} ${DEPSFILE}

again :
        ${SUBMAKE} spotless ci deps
        ${SUBMAKE} all lis

ifeq (${NEEDINCL}, )
include ${DEPSFILE}
endif

.PRECIOUS : scanner.ml
```

```
59:
```

```
1: bigint.cmi :
2: bigint.cmo : bigint.cmi
3: bigint.cmx : bigint.cmi
4: maindc.cmo : bigint.cmi
5: maindc.cmx : bigint.cmx
```