

Build Your Own Lisp

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```
1  <parsing.c 1>≡
    <Include the necessary headers. 5d>

    <Load the Lispy grammar. 2c>

    int main(int argc, char *argv[])
    {
        <Define the language. 2d>

        <Print version and exit information. 2a>

        <Loop until the input is empty. 4e>

        <Undefine and delete the parsers. 3c>

        return 0;
    }
```

Root chunk (not used in this document).

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Welcome

What good is a REPL without a welcome message? For now, simply print the version and describe how to exit.

acronym

2a `<Print version and exit information. 2a>≡`
`puts("Lispy v0.4.0");`
`puts("Press ctrl-c to exit\n");`

Uses Lispy 2d.

This code is used in chunk 1.

Defining the Language

In order to make sense of user input, we need to define a grammar.

2b `<lispy.mpc 2b>≡`
`integer : /-?[0-9]+/ ;`
`decimal : /-?[0-9]+\.[0-9]+/ ;`
`number : <decimal> | <integer> ;`
`operator : '+' | '-' | '*' | '/' ;`
`expr : <number> | '(' <operator> <expr>+ ')' ;`
`lispy : /^/ <expr>+ /$/ ;`

Root chunk (not used in this document).

Describe this trick

2c `<Load the Lispy grammar. 2c>≡`
`static const char LISPY_GRAMMAR[] = {`
`#include "lispy.xxd"`
`};`

Defines:

LISPY_GRAMMAR, used in chunk 3b.

This code is used in chunk 1.

See: <https://stackoverflow.com/a/411000>

To implement the grammar, we need to create some parsers.

2d `<Define the language. 2d>≡`
`mpc_parser_t *Integer = mpc_new("integer");`
`mpc_parser_t *Decimal = mpc_new("decimal");`
`mpc_parser_t *Number = mpc_new("number");`
`mpc_parser_t *Operator = mpc_new("operator");`
`mpc_parser_t *Expr = mpc_new("expr");`
`mpc_parser_t *Lispy = mpc_new("lispy");`

Defines:

Decimal, used in chunk 3a.

Expr, used in chunk 3a.

Integer, used in chunk 3a.

Lispy, used in chunks 2–4.

Number, used in chunk 3a.

Operator, used in chunk 3a.

Uses mpc_parser_t 6b.

This definition is continued in chunk 3b.

This code is used in chunk 1.

Finally, using the defined grammar and each of the *created parsers 3a*,

3a *created parsers 3a* \equiv
 Integer, Decimal, Number, Operator, Expr, Lispy
 Uses Decimal **2d**, Expr **2d**, Integer **2d**, Lispy **2d**, Number **2d**, and Operator **2d**.
 This code is used in chunk **3**.

we can define the Lispy language.

3b *Define the language. 2d* \equiv
 mpca_lang(MPCA_LANG_DEFAULT, LISPY_GRAMMAR,
 created parsers 3a);
 Uses LISPY_GRAMMAR **2c**.

Since we're implementing this in C, we need to clean up after ourselves. The `mpc` library makes this easy, by providing the `mpc_cleanup` function.

3c *Undefine and delete the parsers. 3c* \equiv
 mpc_cleanup(6, *created parsers 3a*);
 Uses `mpc_cleanup` **6b**.
 This code is used in chunk **1**.

R is for Read

To implement the R in REPL, use `readline` from `editline`.

3d *Read a line of user input. 3d* \equiv
 char *input = readline("> ");
 Defines:
 input, used in chunks **3–5**.
 Uses `readline` **6a**.
 This code is used in chunk **5a**.

acronym

Add a link

To check whether user input is nonempty, and thus whether we should continue looping, use the following expression.

3e *input is nonempty 3e* \equiv
 input && *input
 Uses input **3d**.
 This code is used in chunk **5b**.

Here, `input` is functionally equivalent to `input != NULL`, and `*input` is functionally equivalent to `input[0] != '\0'`, i.e. `input` is non-null and nonempty, respectively.

So long as `input` is nonempty, add it to the `editline` history table.

3f *Add input to the history table. 3f* \equiv
 add_history(input);
 Uses `add_history` **6a** and input **3d**.
 This code is used in chunk **5b**.

Declare a variable, `res`, to hold the results of attempting to parse user input as Lispy code.

3g *Declare a variable to hold parsing results. 3g* \equiv
 mpc_result_t res;
 Uses `mpc_result_t` **6b** and `res` **4b**.
 This code is used in chunk **4b**.

To attempt said parsing, use `mpc_parse`, the result of which we can branch on to handle success and failure.

4a *⟨The input can be parsed as Lispy code. 4a⟩*≡
`mpc_parse("<stdin>", input, Lispy, &res)`

Uses Lispy 2d, input 3d, `mpc_parse` 6b, and res 4b.
 This code is used in chunk 4b.

E is for Eval(uate)

Evaluate the AST

4b *⟨Eval(uate) user input and print the result. 4b⟩*≡
⟨Declare a variable to hold parsing results. 3g⟩
`if (⟨The input can be parsed as Lispy code. 4a⟩) {`
 ⟨Print and delete the AST. 4c⟩
`} else {`
 ⟨Print and delete the error. 4d⟩
`}`

Defines:

 res, used in chunks 4b, 3, and 4.
 This code is used in chunk 5b.

P is for Print

For now, simply print the AST upon success,

acronym

4c *⟨Print and delete the AST. 4c⟩*≡
`mpc_ast_print(res.output);`
`mpc_ast_delete(res.output);`

Uses `mpc_ast_delete` 6b, `mpc_ast_print` 6b, and res 4b.
 This code is used in chunk 4b.

or the error upon failure.

4d *⟨Print and delete the error. 4d⟩*≡
`mpc_err_print(res.error);`
`mpc_err_delete(res.error);`

Uses `mpc_err_delete` 6b, `mpc_err_print` 6b, and res 4b.
 This code is used in chunk 4b.

L is for Loop

4e *⟨Loop until the input is empty. 4e⟩*≡
`bool nonempty;`
`do {`
 ⟨Read, eval(uate), and print. 5a⟩
`} while (nonempty);`

Defines:

 nonempty, used in chunk 5b.
 Uses bool 5e.
 This code is used in chunk 1.

As previously described, in the body of the loop, Read a line of user input.

5a *⟨Read, eval(uate), and print. 5a⟩≡*
⟨Read a line of user input. 3d⟩

This definition is continued in chunk 5.

This code is used in chunk 4e.

If, and only if, it's not empty, add it to the history table, evaluate it, and print the result.

5b *⟨Read, eval(uate), and print. 5a⟩+≡*
if ((nonempty = (⟨input is nonempty 3e⟩))) {
 ⟨Add input to the history table. 3f⟩
 ⟨Eval(uate) user input and print the result. 4b⟩
}

Uses *nonempty* 4e.

Dealloc the space pointed to by *input*, making it available for further allocation.

5c *⟨Read, eval(uate), and print. 5a⟩+≡*
 free(input);

Uses *free* 5g and *input* 3d.

N.B. This is a no-op when *!input*.

Headers

5d *⟨Include the necessary headers. 5d⟩≡*
 ⟨Include the boolean type and values. 5e⟩
 ⟨Include the standard I/O functions. 5f⟩
 ⟨Include the standard library definitions. 5g⟩

 ⟨Include the line editing functions from libedit. 6a⟩
 ⟨Include the micro parser combinator definitions. 6b⟩

This code is used in chunk 1.

5e *⟨Include the boolean type and values. 5e⟩≡*
 #include <stdbool.h>

Defines:

bool, used in chunk 4e.

This code is used in chunk 5d.

5f *⟨Include the standard I/O functions. 5f⟩≡*
 #include <stdio.h>

Defines:

printf, never used.

This code is used in chunk 5d.

5g *⟨Include the standard library definitions. 5g⟩≡*
 #include <stdlib.h>

Defines:

free, used in chunk 5c.

This code is used in chunk 5d.

6a *<Include the line editing functions from libedit. 6a>*≡
 #include <editline/readline.h>

Defines:

 add_history, used in chunk 3f.
 readline, used in chunks 6a and 3d.

This code is used in chunk 5d.

6b *<Include the micro parser combinator definitions. 6b>*≡
 #include <mpc.h>

Defines:

 mpc_ast_delete, used in chunk 4c.
 mpc_ast_print, used in chunk 4c.
 mpc_cleanup, used in chunks 6b and 3c.
 mpc_err_delete, used in chunk 4d.
 mpc_err_print, used in chunk 4d.
 mpc_parse, used in chunks 6b and 4a.
 mpc_parser_t, used in chunk 2d.
 mpc_result_t, used in chunk 3g.

This code is used in chunk 5d.

Full Listing

```

1  #include <stdbool.h>
2  #include <stdio.h>
3  #include <stdlib.h>
4
5  #include <editline/readline.h>
6  #include <mpc.h>
7
8
9  static const char LISPY_GRAMMAR[] = {
10 #include "lispy.xxd"
11 };
12
13
14 int main(int argc, char *argv[])
15 {
16     mpc_parser_t *Integer = mpc_new("integer");
17     mpc_parser_t *Decimal = mpc_new("decimal");
18     mpc_parser_t *Number = mpc_new("number");
19     mpc_parser_t *Operator = mpc_new("operator");
20     mpc_parser_t *Expr = mpc_new("expr");
21     mpc_parser_t *Lispy = mpc_new("lispy");
22
23     mpca_lang(MPCA_LANG_DEFAULT, LISPY_GRAMMAR,
24               Integer, Decimal, Number, Operator, Expr, Lispy);
25
26
27     puts("Lispy v0.4.0");
28     puts("Press ctrl-c to exit\n");
29
30
31     bool nonempty;
32     do {
33         char *input = readline("> ");
34         if ((nonempty = (input && *input))) {
35             add_history(input);
36             mpc_result_t res;
37             if (mpc_parse("<stdin>", input, Lispy, &res)) {
38                 mpc_ast_print(res.output);
39                 mpc_ast_delete(res.output);
40             } else {
41                 mpc_err_print(res.error);
42                 mpc_err_delete(res.error);
43             }
44         }
45
46         free(input);
47     } while (nonempty);
48
49
50     mpc_cleanup(6, Integer, Decimal, Number, Operator, Expr, Lispy);
51
52
53     return 0;
54 }

```

Chunks

⟨Add **input** to the history table. 3f⟩ [3f](#), [5b](#)
 ⟨Declare a variable to hold parsing results. 3g⟩ [3g](#), [4b](#)
 ⟨Define the language. 2d⟩ [1](#), [2d](#), [3b](#)
 ⟨Eval(uate) user input and print the result. 4b⟩ [4b](#), [5b](#)
 ⟨Include the boolean type and values. 5e⟩ [5d](#), [5e](#)
 ⟨Include the line editing functions from libedit. 6a⟩ [5d](#), [6a](#)
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 ⟨Load the Lispy grammar. 2c⟩ [1](#), [2c](#)
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 ⟨Print and delete the AST. 4c⟩ [4b](#), [4c](#)
 ⟨Print and delete the error. 4d⟩ [4b](#), [4d](#)
 ⟨Print version and exit information. 2a⟩ [1](#), [2a](#)
 ⟨Read a line of user input. 3d⟩ [3d](#), [5a](#)
 ⟨Read, eval(uate), and print. 5a⟩ [4e](#), [5a](#), [5b](#), [5c](#)
 ⟨The input can be parsed as Lispy code. 4a⟩ [4a](#), [4b](#)
 ⟨Undefine and delete the parsers. 3c⟩ [1](#), [3c](#)
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