B1 - Unix & C Lab Seminar

B-CPE-101

Bootstrap

EvalExpr

Bootstrap

repository name: *CPool_evalexpr_bootstrap_$ACADEMICYEAR*
repository rights: ramassage-tek
language: C

- Your repository must contain the totality of your source files, but no useless files (binary, temp files, obj files,...).

The goal of the *EvalExpr* project is to help you understand the basis of parsing (syntax analysis).
Mathematical expressions analysis is quite simple; the main difficulty lies in managing precedence (parentheses are prioritized over products, and products are prioritized over additions).

There are three representations of mathematical expressions:

- **Infix Notation**: operators are written between the operands they operate on. For instance, `21 + 42`.
- **Prefix Notation**: operators are written before operands. For instance, `+ 21 42`.
- **Postfix Notation**: operators are written after operands. For instance, `21 42 +`.

The **infix notation** operator is the most common. However, it is the most complex notation for a computer to understand.
There are many algorithms such as, *Shunting-yard*, written by Edsger Dijkstra, that converts infix notations into the two other ones.

Part 1: Recursive Descent Parsing

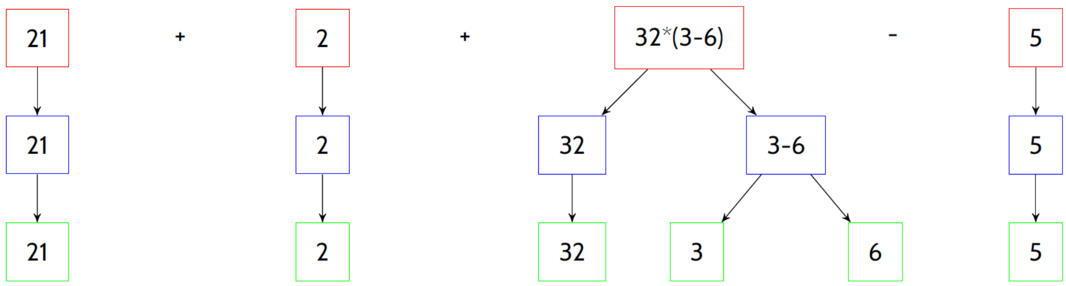
Recursive descent parsing is a popular approach to the preceding problem.
Like its name suggests, it is a parser that is composed of mutually recursive functions.

Each function implements a specific type of operation.
Technically speaking, it is a predictive parser, and belongs to the **LL(k)** grammar category.
The goal is to view an expression like you would a hierarchical structure, with a set of summands on the top level. Summands are separated by `'+'` and `'-'` signs.

Each summand consists of a single number or of several factors. Factors are separated by `'*'`, `'/'` and `'%'`.

Factors can be whether a single number or a **sub-expression in parentheses**. Those sub-expressions can be parsed like whole expressions.

For instance, here is how `21 + 2 + 32 * (3 - 6)- 5` gets parsed:



https://en.wiktionary.org/wiki/summand

PART 2: NUMBER

Write a function that converts the beginning of a string, given as parameter, into an integer. The function should return the previously converted integer, and must be prototyped the following way:

```c
int number(char **str);
```

As with **strtol**, you should move your string's pointer, given as parameter, to the end of the number (or the first invalid character).
You can also use a second parameter to accomplish this.

```c
int my_strtol(char *str, char **endptr);
```

man strtol
This function is the key to dealing with parentheses, signs before parentheses, ...

Part 3: Summands

Write a function named `summands` that returns the sum of the expression given as parameter.

```
int summands(char **str);
```

Call your previous function in order to handle each summand separately.

Start by handling one number, `42`, then two, `42+12` or `42-21`, eventually leading to infinity.

Part 4: Factors

Write a function named `factors` that returns the product of the expression given as parameter.

```
int factors(char **str);
```

Call the `number` function in order to handle each factor separately.

Start by handling one number, `42`, then two, `42*12` or `42/21`, eventually leading to infinity.

Conclusion

Given that an expression is a set of additions of products of numbers, you should modify your `summands` function to handle factors instead of numbers.
This modification should enable you to handle expressions like `42+23*36+42/42-1`.

What's next?

In order to finish this project, you need to work with a few more things, such as: parantheses, whitespaces, error handling,...

> Parentheses are sub-expressions. A sub-expression can be parsed in the same way as an entire expression: **another recursive call...**