Project #3

CpSc 8270: Language Translation

Computer Science Division, Clemson University

Evaluation and Visualization of an Expression Tree

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Due Date:

In order to receive credit for this assignment, your submission must be submitted, using the `web handin` command, by 8 AM, Thursday, October 6th of 2016. If you are unable to complete the project by the first due date, you may submit the project within three days after the due date with a ten point deduction.

Project Specification:

You will find a directory, astCalc, in the course repo at:

```
8270Assets-2016/projects/3/astCalc
```

astCalc contains a scanner and parser, scan.l and parse.y, that adapts the routines found in "flex & bison", fb3-1, by John Levine. Also, astCalc has a class, Ast, that builds an *abstract syntax tree* for the expressions evaluated in the parser, alltest.py, and cases. You can use all of astCalc as a starting point to accomodate the specification of this project, or begin fresh if you wish, but I suggest you study it in either case.

The specification of the project is that you must use flex and bison to build an *abstract syntax tree* or *expression tree* to evaluate arithmetic expressions. The code in astCalc already evaluates some expressions but, for the project, you must extend this code to include additional operators, and add code that uses dot to build a graphical representation of the expression tree built by the bison generated parser. However, don't use the factored grammar in astCalc but rather set operator precedence in your bison specification.

Your solution should allow the operators in expressions of the form: $\{x + y,\ x - y,\ x * y,\ x/y,\ x{*}{*}e,\ (x),\ -x\}$; which are *addition*, *subtraction*, *multiplication*, *division*, *exponentiation*, *parentheses*, and *unary minus*, respectively.

We will discuss the astCalc example, and the dot tool, during lecture. dot is a graph drawing tool, included as part of the graphviz suite of drawing tools, and is considered by many to be the default tool to use to visualize graphs. I have placed a dot reference in the repo and you will probably find there all of the information you will need about dot. Sample expression tree solutions can also be found on the next page.

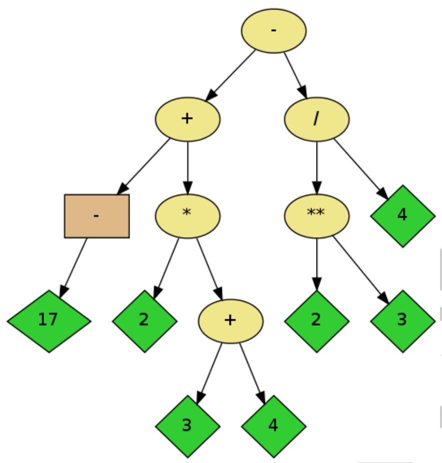
Your code should be properly organized, indented, and free of memory leaks in both your flex/bison specifications as well as the code that builds the expression tree itself. If you complete these specifications you can receive a grade of 90%. Additional credit may also be earned through interesting extensions of the project. For one example, the code in astCalc is patterned after the code written by Levine and is not object oriented. An object oriented implementation would therefore be an example of an interesting extension. Another alternative: *variables*. Also, provide for two types: int and float.

Submission:

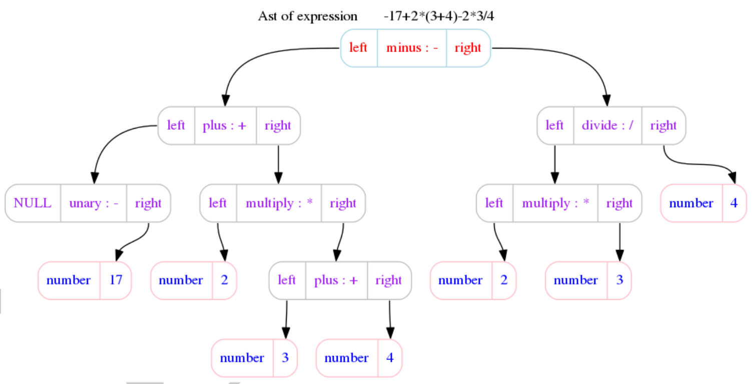
Your submission must be a compressed directory, use tar or zip, and should include a README file. Your README must be an ascii file. **Do not** submit a README in rtf, word, pdf, or **any other** format. Submit only an ascii file consisting of digits or upper/lower case letters. You must name your file README.

Your project will be tested on an Ubuntu platform running Linux 14.04, and compiled with gcc C^{++} version 4.9.3, or clang++ 3.3. You must submit your project using the web handin command.

```
input:  -17 + 2*(3+4) - 2**3/4
output: -5
```



```
input:  -17 + 2*(3+4) - 2*3/4
```


Ast of expression -17+2*(3+4)-2*3/4
left | minus : - | right
left | plus : + | right
left | divide : / | right
NULL | unary : - | right
left | multiply : * | right
left | multiply : * | right
number | 4
number | 17
number | 2
left | plus : + | right
number | 2
number | 3
number | 3
number | 4