EECS 348

Arithmetic Expression Evaluator

User's Manual

Version 3.0

Revision History

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11/28/2023	1.0	Create document	Marcos Lepage
12/3/2023	2.0	Update document	Marcos Lepage, Amrit Sian, Dylan O'Brien
12/3/2023	3.0	Finalize document	Marcos Lepage

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User's Manual

1. Purpose

The user manual is meant to provide a comprehensive and user-friendly guide for effectively utilizing the Arithmetic Expression Evaluator software. It is designed to cater to users of all proficiency levels, ensuring a seamless and enjoyable experience. Refer to the following sections below to learn more about how to navigate and harness the capabilities of the software.

- **Introduction**: Gain a brief overview of the software, including its purpose and additional features. Learn how to effortlessly install and run the software.
- **Getting Started**: Step-by-step guide on using the software to evaluate arithmetic expressions.
- **Advanced features**: Discover and leverage advanced features to enhance the user experience.
- **Troubleshooting**: Offers a comprehensive list of common problems users may face, providing straightforward solutions.
- **Examples**: Gain hands-on experience by referring to practical examples showcasing how to evaluate different types of arithmetic expressions.
- **Glossary of terms**: Navigate technical terms with concise definitions.
- **FAQ**: Explore to find answers to frequently asked questions, enhancing the user's understanding of the software.

2. Introduction

The Arithmetic Expression Evaluator is a program developed in C++ that is capable of parsing and evaluating arithmetic expressions, adhering to the principles of PEMDAS (Parentheses, Exponents, Multiplication, Division from left to right (Modulo included), Addition and Subtraction from left to right). The software serves as an indispensable tool for individuals seeking a reliable and efficient solution for parsing and evaluating arithmetic expressions. Features include expression parsing, operator support, parentheses handling, and numeric constants recognition. Follow the steps below to learn how to install and run the software:

- Use any CLI to clone the repository using the following commands:
  - user@cycle3:~$ git clone https://github.com/mlepage2/EECS348-Project.git
- Navigate to the directory of the cloned repository:
  - user@cycle3:~$ cd EECS348-Project/
- Navigate to the directory of the source program:
  - user@cycle3:~/EECS348-Project$ cd program/
- Build the software using the given Makefile:
  - user@cycle3:~/EECS348-Project/program$ make
- Now run the generated calculator executable to enter the Arithmetic Expression Evaluator:
  - user@cycle3:~/EECS348-Project/program$ ./calculator
- Later, to clean the project and remove the executable, run the following (after usage):
  - user@cycle3:~/EECS348-Project/program$ make clean

3. Getting started

Assuming that the software has been installed and is successfully running, follow the instructions below:

1. Enter an arithmetic expression into the given prompt. This can be done using the same input system that was used to access the CLI, such as a keyboard:
    - ---- CALCULATOR ----
      EECS348 Arithmetic
      Calculator

      :

2. Use any combination of operators ("+" for addition, "-" for subtraction, "*" for multiplication, "/" for division, "%" for modulo, "^" for exponential) along with numeric constants and parentheses to define precedence and grouping:
    - ---- CALCULATOR ----
      EECS348 Arithmetic
      Calculator

      : 10+5*(2/5)

3. Press "Enter" for the arithmetic expression to be evaluated. The output will be displayed following the arithmetic expression with the result.
    - ---- CALCULATOR ----
      EECS348 Arithmetic
      Calculator

      : 10+5*(2/5)
      = 4

4. Let's break down how to interpret the results. The given arithmetic expression was 10+5*(2/5). Following PEMDAS, the group of parentheses around 2/5 ensures that the division of these two numbers occurs first. The result of 2/5 is equal to 0.4. According to PEMDAS, the next operator in the leftover expression 10+5*0.4 will calculate the multiplication of 5*0.4, which is equal to 2. Finally, the "+" or addition operator calculates the sum of 10 and 2, which leads to the final evaluation of the arithmetic expression equal to 12.

4. Advanced features

- When an error is encountered within the Arithmetic Expression Evaluator, a message is printed to the user including carets pointing to where the error occurred given the arithmetic expression that was entered.
    - ---- CALCULATOR ----
      EECS348 Arithmetic
      Calculator

      : 5 # 3
        ^

[ERROR]: Unrecognized symbols in the expression.

5. Troubleshooting

Below is a list of common problems that a user may encounter, along with their corresponding solutions.

- A user may encounter [ERROR]: Open parenthesis is not closed. To solve this error, it is recommended that a user double-checks their input to ensure that any open parenthesis is followed by a closing parenthesis.
- A user may encounter [ERROR]: Closing parenthesis is never opened. To solve this error, it is recommended that a user double-checks their input to ensure that any closing parenthesis is followed by an opening parenthesis.
- A user may encounter [ERROR]: Operator left-hand is empty. To solve this error, it is recommended that a user double-checks their input to ensure that any given operator has a numerical value to its left.
- A user may encounter [ERROR]: Operator right-hand is empty. To solve this error, it is recommended that a user double-checks their input to ensure that any given operator has a numerical value to its right.
- A user may encounter [ERROR]: Divide by zero. To solve this error, it is recommended that a user double checks their input to ensure that no given value is divided by the value of 0.
- A user may encounter [ERROR]: Operands not separated by operator. To solve this error, it is recommended that a user double-checks their input to ensure that no two operands are directly next to each other.
- A user may encounter [ERROR]: Unrecognized symbols in expression. To solve this error, it is recommended that a user double-checks their input to ensure that no symbols are entered that are unrecognizable to the calculator function.
- A user may encounter [ERROR]: Expression group has no content. To solve this error, it is recommended that a user double-checks their input to ensure each group of parentheses is not left without a numeric expression.

6. Examples

- **Combining Unary Operators with Arithmetic Operations**:
  - ---- CALCULATOR ----
    EECS348 Arithmetic
    Calculator

    : +(-2)*(-3)-((-4)/(+5))
    = 6.8
  - Explanation: This expression combines unary "+" and "-" operators with multiplication, division, and addition.

- **Mixed Operators with Extraneous Parentheses**:
  - ---- CALCULATOR ----
    EECS348 Arithmetic
    Calculator

    : ((5*2)-((3/1)+((4%3))))
    = 6
  - Explanation: This expression combines various operators with multiple sets of extraneous parentheses, but they do not change the order of operations or the final result.

- **Nested Parentheses with Exponents**:
  - ---- CALCULATOR ----
    EECS348 Arithmetic
    Calculator

    : (((2^(1+1))+((3-1)^2))/((4/2)%3))
    = 4
  - Explanation: This expression includes nested parentheses and exponentiation, creating complexity, but adheres to the correct order of operations.

7. Glossary of terms

• CLI: Command Line Interface
• GUI: Guided User Interface
• OS: Operating System
• PEMDAS: Parentheses, Exponents, Multiplication and Division (from left to right), Addition and Subtraction (from left to right).
• SRS: Software Requirements Specification
• UI: User Interface
• UX: User Experience

8. FAQ

- How do I exit/terminate the Arithmetic Expression Evaluator?
  - Simply enter an empty expression to be calculated or one of the following keywords:
    - x, e, esc, exit, end, out, leave, done, finish, finished (these will all exit the program)
  - Ex: ---- CALCULATOR ----
    EECS348 Arithmetic
    Calculator

    : exit
    [Exited Calculator]

- Can the Arithmetic Expression Evaluator handle decimal numbers and floating-point arithmetic?
  - Yes, the calculator supports up to 15 decimal places and performs accurate calculations involving floating-point arithmetic.
  - Ex: ---- CALCULATOR ----
    EECS348 Arithmetic
    Calculator

    : 10.725*0.334
    = 3.58215