Arithmetic Expression Evaluator in C++

Test Case Specifications

Version 1.2

Revision History

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| --- | --- | --- | --- |
| **Date** | **Version** | **Description** | **Author** |
| 11/24/2023 | 1.0 | Test Case Document Created | Benjamin Kozlowski, MJ McGee, Jacob Leehy, Nicholas Hausler, Steve Gan |
| 11/28/2023 | 1.1 | Began Adding Test Cases in earnest, got complex cases from each member | Benjamin Kozlowski, MJ McGee, Jacob Leehy, Nicholas Hausler, Steve Gan |
| 12/1/2023 | 1.2 | Added the final test cases, tested the final page of cases. | Benjamin Kozlowski, MJ McGee, Jacob Leehy, Nicholas Hausler, Steve Gan |
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Test Case Document

# Purpose

The Test Case Specification Document contains a table of test cases which will be used with the Arithmetic Expression Evaluator in C++ to try and find any errors in the program. In the case that a test case results in a failure of the program, the error will be found, a solution will be devised, and changes will be made so that such an error does not appear again when the program is in use.

# Test Cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test ID | Test Description | Test Data | Expected Result | Actual Result | Pass/Fail |
| B001 | Nested Parenthesis, constant multiplication | ((e \* (pi) \* pi)) | 26.8284 | 26.8284 | Pass |
| B002 | Order of Operations, Parenthesis | 6 \* 4 – 8 / 2 + (9 / 3 ^ 2) | 21 | 21 | Pass |
| B003 | Parenthetical Negation, Exponentiation | -(3 ^ 4) | -81 | -81 | Pass |
| B004 | Unsupported Characters Handling | 4 + t | Invalid Combination Error | Invalid Combination Error | Pass |
| B005 | Parenthetical Negation with Numeric Constants | -e + -(pi) | -5.85987 | -5.85987 | Pass |
| B006 | Parenthesis, Single term expression | (1) | 1 | 1 | Pass |
| B007 | Nested Parenthesis, Single term expression | ((1)) | 1 | 1 | Pass |
| B008 | Order of Operations, Expression Multiplication | (1 + 1) \* (5 + 3) | 16 | 16 | Pass |
| B009 | Unmatched Grouping Symbols | 1( | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B010 | Unmatched Grouping Symbols | (5 | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B011 | Unmatched Grouping Symbols, Nested Parenthesis | ((7) | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B012 | Unmatched Grouping Symbols | 8) | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B013 | Unmatched Grouping Symbols | (1 \* 5) + (1 / 2)) | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B014 | Order of Operations | 1 + 2 \* 3 | 7 | 7 | Pass |
| B015 | Order of Operations | (1 + 2) \* 3 | 9 | 9 | Pass |
| B016 | Order of Operations | 1 + 2 ^ 2 | 5 | 5 | Pass |
| B017 | Expression Exponentiation | (1 + 2) ^ 3 | 27 | 27 | Pass |
| B018 | Expression Exponentiation, Expression as Exponent | (3 + 2) ^ (1 + 2) | 125 | 125 | Pass |
| B019 | Operands Without Operators | 1 1 | Invalid Combination Error | Invalid Combination Error | Pass |
| B020 | Operands Without Operators | 1 -1 | Invalid Combination Error | Invalid Combination Error | Pass |
| B021 | Incorrect Operator/Operand Ordering | 1 1 + | Operators without Operand | Operators without Operand | Pass |
| B022 | Exponentiation with Numeric Constants | pi ^ e | 22.4592 | 22.4592 | Pass |
| B023 | Exponentiation with Negative Numbers | 5 ^ -2 | 0.04 | 0.04 | Pass |
| B024 | Usage of the Modulo Operator | 15 % 4 | 3 | 3 | Pass |
| B025 | Improper Usage of Modulo Operator | 10 % e | Modulo Operators must be Integers | Modulo Operators must be Integers | Pass |
| B026 | Addition | 3 + 4 | 7 | 7 | Pass |
| B027 | Subtraction with Parentheses | 8 - (5 - 2) | 5 | 5 | Pass |
| B028 | Multiplication and Division | 10 \* 2 / 5 | 4 | 4 | Pass |
| B029 | Exponentiation | 2 ^ 3 | 8 | 8 | Pass |
| B030 | Mixed Operators | 4 \* (3 + 2) % 7 - 1 | 5 | 5 | Pass |
| B031 | Complex Addition with Extraneous Parentheses | (((2 + 3))) + (((1 + 2))) | 8 | 8 | Pass |
| B032 | Mixed Operators with Extraneous Parentheses | ((5 \* 2) - ((3 / 1) + ((4 % 3)))) | 6 | 6 | Pass |
| B033 | Nested Parentheses with Exponents | (((2 ^ (1 + 1)) + ((3 - 1) ^ 2)) / ((4 / 2) % 3)) | 4 | 4 | Pass |
| B034 | Combination of Extraneous and Necessary Parentheses | (((((5 - 3))) \* (((2 + 1))) + ((2 \* 3)))) | 12 | 12 | Pass |
| B035 | Extraneous Parentheses with Division | ((9 + 6)) / ((3 \* 1) / (((2 + 2))) - 1) | -60 | -60 | Pass |
| B036 | Combining Unary Operators with Arithmetic Operations | +(-2) \* (-3) – ((-4) / (+5)) | 6.8 | 6.8 | Pass |
| B037 | Unary Negation and Addition in Parentheses | -(+1) + (+2) | 1 | 1 | Pass |
| B038 | Negation and Addition with Negated Parentheses | -(-(-3)) + (-4) + (+5) | -2 | -2 | Pass |
| B039 | Unary Negation and Exponentiation | +2 ^ (-3) | .125 | .125 | Pass |
| B040 | Combining Unary Operators with Parentheses | -(+2) \* (+3) - (-4) / (-5) | -6.8 | -6.8 | Pass |
| B041 | Unmatched Parentheses | 2 \* (4 + 3 - 1 | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B042 | Operators Without Operands | \* 5 + 2 | Invalid Combination Error | Invalid Combination Error | Pass |
| B043 | Incorrect Operator Usage | 4 / 0 | Division by Zero Error | Division by Zero Error | Pass |
| B044 | Missing Operator | 5 (2 + 3) | Invalid Combination Error | Invalid Combination Error | Pass |
| B045 | Invalid Characters | 7 & 3 | Invalid Combination Error | Invalid Combination Error | Pass |
| B046 | Mismatched Parentheses | (((3 + 4) - 2) + (1) | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B047 | Invalid Operator Usage | ((5 + 2) / (3 \* 0)) | Division by Zero | Division by Zero | Pass |
| B048 | Invalid Operator Sequence | ((2 -) 1 + 3) | Operators must have spaces | Operators must have  spaces | Pass |
| B049 | Missing Operand | ((4 \* 2) + ( - )) | Invalid Combination Error | Invalid Combination Error | Pass |
| B050 | Invalid Characters | ((7 \* 3) @ 2) | Invalid Combination Error | Invalid Combination Error | Pass |
| B051 | Missing Operand | -( ) + 5 | Invalid Combination Error | Invalid Combination Error | Pass |
| B052 | Parenthesis without Internals | ( ) + 5 + 2 | Empty Parenthesis | Empty Parenthesis | Pass |
| B053 | Unary Operator Negation | -(14 / 2) + (15 % 3) | -7 | -7 | Pass |
| B054 | Invalid Characters | [1] + 4(5) | Invalid Combination Error | Invalid Combination Error | Pass |
| B055 | Invalid Characters | e \* -e + E | Invalid Combination Error | Invalid Combination Error | Pass |
| B056 | Invalid Characters | 2 + p i | Invalid Combination Error | Invalid Combination Error | Pass |
| B057 | Order of Operations (multiplication vs exponentiation) | 2 \* 4 ^ 2 | 32 | 32 | Pass |
| B058 | Invalid Characters (Decimals) | 15 \* 1.5 | Invalid Combination Error | Invalid Combination Error | Pass |
| B059 | Multiple Nested Parenthesis with Negative Numbers | (((-1 + (7 \* (2)) - 5)) / -12) / 2 | -0.33 | -0.33 | Pass |
| B060 | Incorrect numeric constant | pie | Invalid Combination Error | Invalid Combination Error | Pass |
| B061 | Invalid Operator Sequence | 1 ( + ) 1 | Invalid Combination Error | Invalid Combination Error | Pass |
| B062 | Two different errors throw correct first found | ((((\* 1))) | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B063 | Large Digit Numbers | 1000 ^ 100 | 1e300 | 1e300 | Pass |
| B064 | Modulo Output Divided | (24 % 4) / 2 | 0 | 0 | Pass |
| B065 | Two Equations | 2 \* 5 = 20 / 2 | Invalid Combination Error | Invalid Combination Error | Pass |
| B066 | Order of Operation: All | (2 + 2) \* 4 ^ 2 + 6 | 70 | 70 | Pass |
| B067 | Verify negation and floating + | +(-6) - +6 | -12 | -12 | Pass |
| B068 | Square Root | Sqrt(100) | Invalid Combination Errors | Invalid Combination Error | Pass |
| B069 | Modulo Operator | (((24 % 5) % 5) % 2) | 0 | 0 | Pass |
| B070 | Invalid Characters | pI ^ e | Invalid Character Error | Invalid Character Error | Pass |
| B071 | Test the grouping symbols check | (((4) + ((3)))) | Invalid Grouping Symbols | Invalid Grouping Symbols | Pass |
| B072 | Incorrect Spacing | 5 + - 5 | Invalid Combination Error | Invalid Combination Error | Pass |
| B073 | Invalid placement of operator | 3 \*7 | Invalid Combination Error | Invalid Combination Error | Pass |
| B074 | Incorrect Spacing | 5 -5 | Invalid Combination Error | Invalid Combination Error | Pass |
| B075 | Taking the power of a negative (even exponent) | -3 ^ 2 | 9 | 9 | Pass |
| B076 | Taking the power of a positive | +5 ^ 2 | 25 | 25 | Pass |
| B077 | Taking the power of a negative (odd exponent) | -3 ^ 3 | -27 | -27 | Pass |
| B078 | Negative Exponents with Parenthesis | 2 ^ -(2 + 1) | 0.125 | 0.125 | Pass |
| B079 | Long Equations | 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 \* 10 | 126 | 126 | Pass |
| B080 | Exponentiation of Numerical Constants | 2 ^ pi ^ e | 372.148 | 372.148 | Pass |