HEAAP Software

Arithmetic Expression Evaluator in C++

Test Case

Version 1.1

Revision History

Date	Version	Description	Author
12/11/2024	1.0	Document created with roles assigned and discussed. Table created.	All
12/12/2024	1.1	All 50 test cases added, tested, and passed.	All

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Test Case

1. Purpose

The Test Case document defines 50 test cases for a wide array of test items so that the Arithmetic Expression Evaluator in C++ can be accurately and fully tested. The test items cover all scenarios of expression entries as well as invalid expressions and operator usages that result in errors. A test case has an identifier, item, input/output specifications, and a result (pass/fail). The latest and final version of the software passed all test cases.

Test Case ID	Test Item	Input Specifications	Output Specifications	Result
TC-ADD-001	Addition	3 + 4	Expected: 7 Actual: 7	Pass
TC-SUB-PAR-002	Subtraction with Parentheses	8 - (5 – 2)	Expected: 5 Actual: 5	Pass
TC-MULT-DIV-003	Multiplication and Division	10 * 2 / 5	Expected: 4 Actual: 4	Pass
TC-EXP-004	Exponentiation	2 ** 3	Expected: 8 Actual: 8	Pass
TC-MIX-OP-005	Mixed Operators 1	4 * (3 + 2) % 7 – 1	Expected: 5 Actual: 5	Pass
TC-ADD-XTRA-006	Complex Addition with Extraneous Operators	(((2 + 3))) + (((1 + 2)))	Expected: 8 Actual: 8	Pass
TC-MIX-XTRA-PAR-007	Mixed Operators with Extraneous Parentheses	(5 * 2) - ((3 / 1) + ((4 % 3))))	Expected: 6 Actual: 6	Pass
TC-NEST-PAR-EXP-008	Nested Parentheses with Exponents	(((2 ** (1 + 1)) + ((3 - 1) ** 2)) / ((4 / 2) % 3))	Expected: 4 Actual: 4	Pass
TC-COMBO-PAR-009	Combination of Extraneous and Necessary Parentheses	(((((5 - 3))) * (((2 + 1))) + ((2 * 3))))	Expected: 12 Actual: 12	Pass
TC-INT-DIV-010	Effects of Integer Division 1	10 * (3 / 2)	Expected: 10 Actual: 10	Pass
TC-UNARY-ARITH-011	Combining Unary Operators with Arithmetic Operations	+(-2) * (-3) – ((-4) / (+5))	Expected: 6 Actual: 6	Pass

TC-NEG-ADD-PAR-012	Unary Negation and Addition in Parentheses	-(+1) + (+2)	Expected: 1 Actual: 1	Pass
TC-NEG-ADD-NEG-PAR-013	Negation and Addition with Negated Parentheses	-(-(-3)) + (-4) + (+5)	Expected: -2 Actual: -2	Pass
TC-UNARY-NEG-EXP-INT-DIV-014	Unary Negation, Exponentiation, and Int Division	+2 ** (-3)	Expected: 0 Actual: 0	Pass
TC-COMBO-UNARY-PAR-015	Combining Unary Operators with Parentheses	-(+2) * (+3) - (-4) / (-5)	Expected: -6 Actual: -6	Pass
TC-IMP-MULT-016	Implied Multiplication	5(4)	Expected: 20 Actual: 20	Pass
TC-UNMATCHED-PAR-017	Unmatched Parentheses	2 * (4 + 3 - 1	Expected: "Error: Unmatched opening parenthesis." Actual: "Error: Unmatched opening parenthesis."	Pass
TC-NO-OPERANDS-018	Operators Without Operands 1	* 5 + 2	Expected: "Error: Invalid operator usage." Actual "Error: Invalid operator usage."	Pass
TC-DIV-ZERO-019	Divide By Zero	4 / 0	Expected: "Error: Division by zero occurred." Actual: "Error: Division by zero occurred."	Pass
TC-MOD-DIV-ZERO-020	Modulo By Zero	4 % 0	Expected: "Error: Division by zero occurred." Actual: "Error: Division by zero occurred."	Pass
TC-INVALID-CHAR-021	Invalid Characters	7 & 3	Expected: "Error: Invalid character in input."	Pass

			Actual: "Error: Invalid character in input.	
TC-MISMATCH-PAR-022	Mismatched Parentheses 1	(((3 + 4) - 2) + (1)	Expected: "Error: Unmatched opening parenthesis. Actual: "Error: Unmatched opening parenthesis."	Pass
TC-MUL-PROD-DIV-ZERO-023	Divide By Zero Multiplication Product	((5 + 2) / (3 * 0))	Expected: "Error: Division by zero occurred." Actual: "Error: Division by zero occurred."	Pass
TC-OPERAND-MISSING-024	Operator Without Operands 2	((2 -) 1 + 3)	Expected: "Error: Invalid operator usage" Actual: "Error: Invalid operator usage."	Pass
TC-OPERAND-MISSING-025	Operators Without Operands 3	((4 * 2) + (-))	Expected: "Error: Invalid operator usage." Actual: "Error: Invalid operator usage."	Pass
TC-MULT-ZERO-026	Multiply by Zero	4 % 2 (1) + 3 ** 5	Expected: 243 Actual: 243	Pass
TC-EXP-MOD-027	Exponent and Modulo 1	2 ** 5 % 4	Expected: 0 Actual: 0	Pass
TC-INT-OVER-ADD-028	Overflow by Addition	9223372036854775806+12	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass
TC-INT-UNDER-ADD-029	Underflow by Addition	-9223372036854775806+-12	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass
TC-INT-OVER-SUB-030	Overflow by Subtraction	9223372036854775806--12	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass

TC-INT-UNDER-SUB-031	Underflow by Subtraction	-9223372036854775806-12	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass
TC-INT-OVER-MUL-032	Overflow by Multiplication	4611686018427387915 * 2	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass
TC-INT-UNDER-MUL-033	Underflow by Multiplication	-4611686018427387915 * 2	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass
TC-INT-OVER-EXP-034	Overflow by Exponentiation	200 ** 75	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass
TC-INT-UNDER-EXP-035	Underflow by Exponentiation	(-200) ** 75	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass
TC-COMPLEX-MIX-036	Complex Mixed Operators 1	(((4+2)-6)**2) + ((2*4)-(2**3)) * ((64/8) % 3)	Expected: 0 Actual:0	Pass
TC-COMPLEX-MIX-OP-037	Complex Mixed Operators 2	(((5**3)/14)+27)*((17-15)**2)-(57+((7*3)-18))	Expected: 80 Actual: 80	Pass
TC-EXP-MOD-038	Exponent and Modulo 2	72 % 7 **2	Expected: 23 Actual: 23	Pass
TC-MOD-PROD-DIV-ZERO-039	Divide by Zero Modulo Product	456 / (81%9)	Expected: "Error: Division by 0 occurred." Actual: "Error Division by 0 occurred."	Pass
TC-MIX-OP-040	Mixed Operators 2	15 – 27 * 2 + 38 % 12	Expected: -37 Actual: -37	Pass
TC-COMBO-UNARY-IMP-MULT-041	Combining Unary Operators with Parentheses and Implied Multiplication	−(+4)(−2)+(+6)(−3)−(−8)	Expected: -18 Actual: -18	Pass
TC-MISMATCH-PAREN-042	Mismatched Parentheses 2	((7-2) % 3))	Expected: "Error: Unmatched closing parenthesis."	Pass

Test Case ID	Test Item	Input	Expected/Actual	Result
			Actual: "Error: Unmatched closing parenthesis."	
TC-OPERAND-MISSING-043	Operators Without Operands 4	**7+3	Expected: "Error: Invalid operator usage." Actual "Error: Invalid operator usage."	Pass
TC-OPERAND-MISSING-044	Operators without Operands 5	% 5 - (9-0) /2 +5	Expected: "Error: Invalid operator usage." Actual "Error: Invalid operator usage."	Pass
TC-MIX-OP-045	Mixed Operators 3	3 + 9 – 2 * 2 **2 % 2	Expected: 12 Actual: 12	Pass
TC-INT-DIV-046	Effects of Integer Division 2	(7 % 4) ** 3 / 4	Expected: 6 Actual: 6	Pass
TC-IMP-MULT-EXP-047	Implied Multiplication and Exponentiation 1	(5) 7 ** 2	Expected: 245 Actual: 245	Pass
TC-IMP-MULT-EXP-048	Implied Multiplication and Exponentiation 2	8 ** 5 (6)	Expected: 196608 Actual: 196608	Pass
TC-COM-EXP-049	Complex Exponentiation	2 ** 3 ** 4	Expected: 4096 Actual: 4096	Pass
TC-COM-EXP-OVER-050	Complex Exponentiation Overflow	2 ** (3 ** 4)	Expected: "Integer over/underflow." Actual: "Integer over/underflow."	Pass

2. Test case identifier

Covered in column 1 (Test Case ID) of above table.

3. Test item

Covered in column 2 (Test Item) of above table.

4. Input specifications

Covered in column 3 (Input Specifications) of above table.

5. Output specifications

Covered in column 4 (Output Specifications) of above table.

6. Environmental needs

6.1.1 Hardware

6.1.2 Software

6.1.3 Other

Access to the internet is required to view the project GitHub page and download the Arithmetic Expression Evaluator in C++.

7. Special procedural requirements

8. Intercase dependencies