SWE30009- Software Testing and Reliability

Assignment 1

Name: Pham Do Tien Phong

Student ID: 104189767

Program:
Input A, B // A and B are real variables
A = A - B
C = A * 2
Output C // C is a real variable

Task 1: Explain and show all the details on how to design the test cases for the above testing objective.

To design test cases with the goal of identifying ANY possible incorrect use of arithmetic operators, I consider all potential replacements for “-” , "*," or both.

I will replace ‘-’ and ‘*’ with the other three operators to generate incorrect versions of the program:

- Replacing ‘-’ with ‘+’, ‘*’, ‘/’
- Replacing ‘*’ with ‘+’, ‘-’, ‘/’

Example 1 : A = 10, B = 5 (2 positive integers)

A = 10 -5 = 5

C = 5 * 2 = 10

Expected Output: 10

Test cases	**Input**	**Expected Output**
Replacing ‘-’ with ‘+’,‘*’,‘/’ (Incorrect use of ‘-’ in A = A - B)	A = 10, B = 5	30, 100 , 4
Replacing ‘*’ with ‘+, ‘-’, ‘/’ (Incorrect use of ‘*’ in C = A * 2)	A = 10 , B = 5	7, 3, 2.5

Both replace ‘-’ and ‘*’, leading to 9 situations	A = 10, B = 5	17, 13, 7.5, 52, 48, 25, 4, 0, 1

Example 2: A= -3, B = 4 => *Expected Output*: -14 (negative integer and positive integer)

Test cases	**Input**	**Expected Output**
Replacing ‘-’ with ‘+’,‘*’,‘/’ (Incorrect use of ‘-’ in A = A - B)	A = -3, B = 4	2, -24 , -1.5
Replacing ‘*’ with ‘+, ‘-’, ‘/’ (Incorrect use of ‘*’ in C = A * 2)	A = -3 , B = 4	-5, -9, -3.5
Both replace ‘-’ and ‘*’, leading to 9 situations	A = -3, B = 4	3, -1, 0.5, -10, -14, -6, 1.25,-2.75 , -0.375

Example 3: A = 0, B = 5 => *Expected Output*: -10 (zero and positive integer)

Test cases	**Input**	**Expected Output**
Replacing ‘-’ with ‘+’,‘*’,‘/’ (Incorrect use of ‘-’ in A = A - B)	A = 0, B = 5	10, 0 , 0
Replacing ‘*’ with ‘+, ‘-’, ‘/’ (Incorrect use of ‘*’ in C = A * 2)	A = 0 , B = 5	-3, -7, -2.5
Both replace ‘-’ and ‘*’, leading to 9 situations	A = 0, B = 5	7, 3, 2.5, 2, -2, 0, 2, -2, 0

Example 3: A = 4.5, B = -3 => *Expected Output*: 15 (real number and negative integer)

Test cases	**Input**	**Expected Output**
Replacing ‘-’ with ‘+’,‘*’,‘/’ (Incorrect use of ‘-’ in A = A - B)	A = 4.5, B = -3	3, -27 , –3
Replacing ‘*’ with ‘+, ‘-’, ‘/’ (Incorrect use of ‘*’ in C = A * 2)	A = 4.5 , B = -3	9.5, 5.5, 3.75
Both replace ‘-’ and ‘*’, leading to 9 situations	A = 4.5, B = -3	3.5, -0.5, 0.75, -11.5, -15.5, -6.75, 0.5, -3.5, -0.75

Task 2: Suppose you use test case (A=3, B=1) to test the above program. Is this test case able to achieve the required testing objective? Provide your answer with justifications.

The test case (A=3, B=1) can not fulfill the requirements of the testing goal because it cannot detect the completely possible incorrect use of arithmetic operations. To be more specific, if we apply A=3,B = 1 as the inputs for the program, the expected output is 4, while in this case (replacing '*' by '+' in C = A * 2 : A = 3-1 = 2 -> C = 2 + 2 = 4), the output of the incorrect arithmetic operator is still 4, which is the same as the expected correct output. This means that this specific incorrect operator use cannot be detected in this test case. Therefore, the test case (A=3,B=1) is not sufficient to detect all possible incorrect use of arithmetic operators.

Task 3: Based on your design in Task 1, what is (or are) the concrete test case (or cases) that can achieve the above testing objective? Explain and justify your concrete test case (or cases).

To ensure that we can detect any possible incorrect use of arithmetic operators in the program, we need to choose test cases that result in distinct output for each type of operator replacement. Based on task 1, there are 3 concrete test cases designed to adapt to the requirements of testing:

- A = 10, B = 5 (2 positive integers)
- A = -3, B = 4 (1 positive integer and 1 negative integer)
- A = 4.5 , B = -3 (1 real number and 1 negative integer)

The chosen test cases effectively achieve the testing objective by covering a range of scenarios, including positive integers, negative integers, and real numbers. They also produce different output for each type of incorrect operator replacement, allowing easy detection of any errors. Each test case ensures that if either the '-' or '*' operator is replaced by '+','-',' *', or '/', the output will clearly differ from the correct result, ensuring comprehensive testing of all possible replacements.

Task 4: Given B=1, find all possible values of A so that the concrete test cases (A,B) cannot achieve the above testing objective? Explain and justify the correctness of your solution.

With B = 1, we find 6 possible values of A so that test cases (A, B) cannot fulfil the the testing requirements A = [-1, 0 , 1 ,3 ,4,5]

Input	**Expected Output**	**Justification**
A = -1 , B = 1	-4	When we replace '*' by '-' in C = A * 2, we receive the incorrect expected output, which is still -4

		A = -1 - 1 = -2 C = -2 * 2 = -4
A = 0 , B = 1	-2	When we replace '-' by '*' and '/' in A = A - B and '*' by '-' in C = A * 2, we get -2 as the expected output, same as the correct expected output ● Case 1: ○ A = 0 * 1 = 0 ○ C = 0 -2 = -2 ● Case 2: ○ A = 0 / 1 = 0 ○ C = 0 -2 = -2
A = 1 , B = 1	0	_ Case 1: We replace '*' by '/' in C = A* 2 A = 1 - 1 = 0 C = 0 / 2 = 0 _ Case 2: We replace '-' by'+' in A = A - B and '*' by '-' in C = A * 2 A = 1 + 1 =2 C = 2 - 2 = 0
A = 3 , B = 1	4	We replace '*' by '+' in C = A * 2, We have 4 as expected output, same as correct expected output A = 3 - 1 = 2 C = 2 + 2 = 4
A = 4 , B = 1	6	_ Case 1: We replace '-' by '*' in A = A - B , and '*' by '+' in C = C * 2 A = 4 * 1 = 4 C = 4 + 2 = 6 _ Case 2: We replace '-' by /*' in A = A - B , and '*' by '+' in C = C * 2 A = 4 / 1 = 4 C = 4 + 2 = 6
A = 5, B = 1	8	We replace '-' by '+' in A = A - B and '*' by '+' in C = C * 2, we receive 8 as output but it is as same as the correct expected output A = 5 + 1 = 6 C = 6 + 2 = 8