Assignment 1

SWE30009 Software Testing and Reliability

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Task 1:

In order to design the test cases, first of all, we have to define the testing objectives. The testing objective is to identify the incorrect use of arithmetic operators in the program. For the program, there are only three possible operators: +, -, *

As a result, we can then determine the design of the test cases, which will detect when the operators are incorrectly utilized. We can simplify the program as follows:

$C = ((A+B) *B) – 5$

From the simplification result, we can determine 26 other unique possible alternatives to the program, by replacing and exchanging the operators in the program, which can be identified as follows:

$C = ((A-B) *B) -5$	$C = ((A-B) *B) +5$	$C = (A+B) *B) *5$
$C = ((A*B) *B)-5$	$C = ((A*B) *B) +5$	$C = ((A-B) *B) *5$
$C = ((A+B) +B)-5$	$C = ((A+B)-B) +5$	$C = ((A*B) *B) *5$
$C = ((A-B) +B)-5$	$C = ((A*B)-B) +5$	$C = ((A+B) +B) *5$
$C = ((A*B) +B)-5$	$C = ((A-B)-B) +5$	$C = ((A*B) +B) *5$
$C = ((A+B)-B)-5$	$C = ((A*B) +B) +5$	$C = ((A-B) +B) *5$
$C = ((A*B)-B)-5$	$C = ((A-B) +B) +5$	$C = ((A*B)-B) *5$
$C = ((A-B)-B)-5$	$C = ((A+B) +B) +5$	$C = ((A-B)-B) *5$
$C = (A+B) *B) +5$		$C = ((A+B)-B) *5$

After identifying all the possible alternatives, oracle testing can be utilized to check the quality of the test case, by making sure that the faulty program's outputs are different from the original and correct program.

Task 2:

For the test case (A = 10, B=0):

For the original program, which is the correct case, we can substitute the values into the program and get the following results: C = ((A+B) * B) – 5 = ((10+0) * 0) – 5 = -5

However, because multiplying (A+B), (A-B), or (A*B) by B results in zero when B is 0, and then subtracting 5, the program will always produce a result of -5, which is the same result as the output for the correct program. Here's an illustration:

C = ((A-B) *B) -5 = ((10-0) *0) – 5 = -5

C = ((A*B) *B)-5= ((10 * 0) * 0) – 5 = -5

However, we need to make sure that all the outputs of the faulty alternatives produce different results compared to the original program. The test case (10,0) does not detect any errors in the aforementioned cases, when it is multiplied by B, making this test case ineffective in achieving the required testing objective.

Task 3:

In order to identify the correct test case, we should first identify the criteria, in this case, A, B and C are integers and B is not 0. We can come up with test case (A, B) as (2,1), then we substitute (2,1) and evaluate the expressions:

Correct expression: ((A + B) *B) – 5 = 1

Faulty expressions:
C = ((A-B) *B) -5 = -4

C = ((A*B) *B)-5 = -3

C = ((A+B) +B)-5 = -1

C = ((A-B) +B)-5 = -3

C = ((A*B) +B)-5 = -2

C = ((A+B)-B)-5 = -3

C = ((A*B)-B)-5 = - 4

C = ((A-B)-B)-5 = -5

C = (A+B) *B) +5 = 8

C = ((A-B) *B) +5 = 6

C = ((A*B) *B) +5 = 7

C = ((A+B)-B) +5 = 7

C = ((A*B)-B) +5 = 6

C = ((A-B)-B) +5 = 5

C = ((A*B) +B) +5 = 8

C = ((A-B) +B) +5 = 7

C = ((A+B) +B) +5 = 9

C = (A+B) *B) *5 = 15

C = ((A-B) *B) *5 = 5

C = ((A*B) *B) *5 = 10

C = ((A+B) +B) *5 = 20

C = ((A*B) +B) *5 = 15

C = ((A-B) +B) *5 = 10

C = ((A*B)-B) *5 = 5

C = ((A-B)-B) *5 = 0

C = ((A+B)-B) *5 = 10

Hence, the test case (2,1) achieves the testing objective due to the fact that the outputs of the faulty expression are different from the output of the correct case.

Task 4:

When B = 2, then the correct expression can be written as C = ((A+2) *2) – 5 = 2A - 1

Then we can substitute B = 2 to the incorrect alternatives and set the output to the output of the correct expression to identify the values of A that cannot achieve the testing objective, which can be expressed as follows:

Output of the faulty program (when B = 2) = 2A – 1 (Output of the correct program)

We also need to make sure that A, B and C are integers to satisfy the condition.

C = ((A-2) *2) -5 = 2A – 1 ⇔ 2A-9 = 2A-1 (No solution)

C = ((A*2) *2)-5 = 2A – 1 ⇔ 4A-5 = 2A-1 => A = 2 (Satisfied)

C = ((A+2) +2)-5 = 2A – 1 $\Leftrightarrow$ A – 1 = 2A – 1 => A = 0 (Satisfied)

C = ((A-2) +2)-5 = 2A -1 $\Leftrightarrow$ A – 5 = 2A – 1 => A = -4 (Satisfied)

C = ((A*2) +2)-5 = 2A – 1 $\Leftrightarrow$ 2A – 3 = 2A – 1 (No solution)

C = ((A+2)-2)-5 = 2A – 1 $\Leftrightarrow$ A – 5 = 2A – 1 => A = -4 (Satisfied)

C = ((A*2)-2)-5 = 2A -1 $\Leftrightarrow$ 2A – 7 = 2A – 1 (No solution)

C = ((A-2)-2)-5 = 2A – 1 $\Leftrightarrow$ A – 9 = 2A – 1 => A = -8 (Satisfied)

C = (A+2) *2) +5 = 2A -1 $\Leftrightarrow$ 2A + 9 = 2A – 1 (No solution)

C = ((A-2) *2) +5 = 2A-1 $\Leftrightarrow$ 2A + 1 = 2A – 1 (No solution)

C = ((A*2) *2) +5 = 2A -1 $\Leftrightarrow$ 4A + 5 = 2A – 1 => A = -3 (Satisfied)

C = ((A+2)-2) +5 = 2A -1 $\Leftrightarrow$ A + 5 = 2A – 1 => A = 6 (Satisfied)

C = ((A*2)-2) +5 = 2A -1 $\Leftrightarrow$ 2A + 3 = 2A – 1 (No solution)

C = ((A-2)-2) +5 = 2A – 1 $\Leftrightarrow$ A + 1 = 2A – 1 => A = 2 (Satisfied)

C = ((A*2) +2) +5 = 2A-1 $\Leftrightarrow$ 2A + 7 = 2A – 1 (No solution)

C = ((A-2) +2) +5 = 2A-1 $\Leftrightarrow$ A + 5 = 2A – 1 => A = 6 (Satisfied)

C = ((A+2) +2) +5 = 2A-1 $\Leftrightarrow$ A + 9 = 2A – 1 => A = 10 (Satisfied)

C = ((A+2) *2) *5 = 2A-1 $\Leftrightarrow$ 10A + 20 = 2A – 1 => A = -21/8 (Not satisfied)

C = ((A-2) *2) *5 = 2A -1 $\Leftrightarrow$ 10A – 20 = 2A – 1 => A = 19/8 (Not satisfied)

C = ((A*2) *2) *5 = 2A-1 $\Leftrightarrow$ 20A = 2A – 1 => A = -1/18 (Not satisfied)

C = ((A+2) +2) *5 = 2A-1 $\Leftrightarrow$ 5A + 20 = 2A – 1 => A = -7 (Satisfied)

C = ((A*2) +2) *5 = 2A-1 $\Leftrightarrow$ 10A + 10 = 2A – 1 => A = -11/8 (Not satisfied)

C = ((A-2) +2) *5 = 2A-1 $\Leftrightarrow$ 5A = 2A – 1 => A = -1/3 (Not satisfied)

C = ((A*2)-2) *5 = 2A-1 $\Leftrightarrow$ 10A – 10 = 2A – 1 => A = 9/8 (Not satisfied)

C = ((A-2)-2) *5 = 2A-1 $\Leftrightarrow$ 5A -20 = 2A – 1 => A = 19/3 (Not satisfied)

C = ((A+2)-2) *5 = 2A-1 $\Leftrightarrow$ 5A = 2A – 1 => A = -1/3 (Not satisfied)

Hence, when A = (0, -4, -8, -3,6,2,10, -7), B = 2 then the test case (A, B) cannot achieve the testing objective.