CS 428: Software Quality & Testing
SPRING2025

Exercise Sheet 04: MutationTesting

Exercise 1

Consider the method **Sum** below. Line 6 is mutated as 6′ in the code below. Answer the following questions related to the given mutant in the method

```
/**
 * Sum values in an array
 *
 * @param x array to sum
 *
 * @return sum of values in x
 * @throws NullPointerException if x is null
 */
1. public static int sum(int[] x)
2. {
3.     int s = 0;
4.     for (int i=0; i < x.length; i++) }
5.     {
6.         s = s + x[i];
6'.    // s = s - x[i];
7.     }
8.     return s;
9.  }
```

1. If possible, find a test case that does not reach the mutant.
2. If possible, find a test case that satisfy reachability but **not infection** for the mutant.
3. If possible, find a test case that kill the mutant.

Exercise 2

Consider the method **findVal** below. Line 6 is mutated as 6′ in the code below. Answer the following questions related to the given mutant in the method

```
/**
 * Find last index of element
 *
 * @param numbers array to search
 * @param val value to look for
 * @return last index of val in numbers; -1 if absent
 * @throws NullPointerException if numbers is null
 */
1.  public static int findVal(int numbers[], int val)
2.  {
3.     int findVal = -1;
4.
5.     for (int i=0; i<numbers.length; i++)
5'. // for (int i=(0+1); i<numbers.length; i++)
6.        if (numbers [i] == val)
7.           findVal = i;
8.     return (findVal);
9.  }
```

1. If possible, find a test case that does not reach the mutant.
2. If possible, find a test case that satisfy reachability but **not infection** for the mutant.

3. If possible, find a test case that kill the mutant.

Exercise 3

A test engineer generates 80 mutants of a program P and 120 test cases to test the program P. After the first iteration of mutation testing, the tester finds 60 dead mutants and 5 equivalent mutants. Calculate the mutation score for this test suite. Is the test suite adequate for program P? Should the test engineer develop additional test cases? Justify your answer.