

## HW4

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### (a) How many mutants are there?

- 237

The screenshot shows the 'Traditional Mutants Viewer' tab of the TestCase Runner. The 'Class' is set to 'Cal' and the 'Method' is 'int\_cal(int,int,int,int)'. The 'Test Case' is 'CalTest' and the 'Time-Out' is '3 seconds'. The 'Execute all mutants' option is selected. The 'Traditional Mutants Result' table shows 26 Live Mutants, 211 Killed Mutants, and a Total of 237 Mutants, with a Mutant Score of 89.0%. The 'Class Mutants Result' table shows 0 Live Mutants, 0 Killed Mutants, and a Total of 0 Mutants, with a Mutant Score of - %.

Op	#	Op	#
AORB	36	IHI	0
AORS	1	IHD	0
AOIU	12	IOD	0
AOIS	74	IOP	0
AO...	0	IOR	0
AODS	0	ISI	0
ROR	34	ISD	0
COR	4	IPC	0
COD	0	PNC	0
COI	7	PMD	0
SOR	0	PPD	0
LOR	0	PCI	0
LOI	19	PCC	0
LOD	0	PCD	0
ASRS	0	PRV	0
SDL	10	OMR	0
VDL	13	OMD	0
CDL	5	OAN	0
ODL	22	JTI	0
		JTD	0
		JSI	0
		JSD	0
		JID	0
		JDC	0
		EOA	0
		EOC	0
		EAM	0
		EMM	0

Total : 237      Total : 0

Traditional Mutants Result	
Live Mutants #	26
Killed Mutants #	211
Total Mutants #	237
Mutant Score	89.0%

Class Mutants Result	
Live Mutants #	0
Killed Mutants #	0
Total Mutants #	0
Mutant Score	- %

### (b) How many test cases do you need to kill the non-equivalent mutants?

- 9
  - original testcases

```
public class CalTest {  
    // Normal year  
    @Test  
    public void test1() {  
        Assert.assertEquals(59, Cal.cal(1, 1, 3, 1, 2022));  
    }  
}
```

```

// leap year
@Test
public void test2() {
    Assert.assertEquals(121, Cal.cal(1, 1, 5, 1, 2020));
}

// (m100 == 0) && (m400 != 0)
@Test
public void test3() {
    Assert.assertEquals(181, Cal.cal(1, 1, 7, 1, 2100));
}

// (m100 == 0) && (m400 == 0)
@Test
public void test4() {
    Assert.assertEquals(244, Cal.cal(1, 1, 9, 1, 2000));
}

```

- o additional testcases

```

// kill ROR_22
@Test
public void test5() {
    Assert.assertEquals(89, Cal.cal(2, 1, 5, 1, -2100));
}

// kill ROR_18
@Test
public void test6(){
    Assert.assertEquals(90, Cal.cal(2, 1, 5, 1, -2020));
}

// kill ROR_8
@Test
public void test7(){
    Assert.assertEquals(89, Cal.cal(2, 1, 5, 1, -2022));
}

// kill ROR_7
@Test
public void test8(){
    Assert.assertEquals(30, Cal.cal(1, 1, 1, 31, -2000));
}

// kill ROR_4
@Test
public void test9(){
    Assert.assertEquals(31, Cal.cal(5, 1, 2, 1, -2020));
}
}

```

(c) What mutation score were you able to achieve before analyzing for equivalent mutants?

The screenshot shows the 'Traditional Mutants Viewer' tab in the TestCase Runner. The configuration is as follows:

- Class: Cal
- Method: int\_cal(int,int,int,int)
- TestCase: CalTest
- Time-Out: 3 seconds
- Execution Options: ☒ Execute all mutants

The results are displayed in two main sections:

#### Traditional Mutants Result

Live	Killed
ROR_8	AOIS_21
AOIS_10	AOIS_19
AOIS_28	AOIS_26
AOIS_43	ROR_6
AOIS_44	SDL_10
AOIS_72	AOIS_17
AOIS_16	ROR_1
AOIS_11	ODL_7
ROR_7	ODL_9
AOIS_27	AOIS_29
AOIS_74	SDL_11
AOIS_73	AOIS_18
AOIU_4	ROR_9
AOIU_3	AOIS_20
LOI_2	ODL_8
AOIS_8	AOIS_45
AORB_2	AOIS_42
AOIS_6	ODL_6
AOIU_2	AORB_35
AOIU_5	ODL_24
ROR_18	ODL_23
LOI_4	AORB_32
AORB_3	COR_1

Summary statistics for Traditional Mutants:

- Live Mutants #: 54
- Killed Mutants #: 183
- Total Mutants #: 237
- Mutant Score: 77.0%

#### Class Mutants Result

Live	Killed
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Summary statistics for Class Mutants:

- Live Mutants #: 0
- Killed Mutants #: 0
- Total Mutants #: 0
- Mutant Score: - %

On the left, a list of operators and their counts is shown:

Op	#
AORB	36
AORS	1
AOIU	12
AOIS	74
AO...	0
AODS	0
ROR	34
COR	4
COD	0
COI	7
SOR	0
LOR	0
LOI	19
LOD	0
ASRS	0
SDL	10
VDL	13
CDL	5
ODL	22

Total: 237

(d) How many equivalent mutants are there?

• 26