



CHALMERS
UNIVERSITY OF TECHNOLOGY



UNIVERSITY OF GOTHENBURG

Exercise 5: Mutation Testing

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The Planning System Returns

- Everybody likes meetings.
 - Not true - but we need to book them.
- We don't want to double-book rooms or employees for meetings.
- System to manage schedules and meetings.



Mutate the Meeting Planner

- Create at least four mutants for classes from the MeetingPlanner system.
 - Try to create at least one from each category:
 - invalid (does not compile)
 - valid-but-not-useful (fails for almost any test case)
 - useful (requires specific input or input ranges to detect)
 - equivalent (no test will ever fail)
 - Use different operators for each mutant
 - 1+ from each category in handout.
 - Try mutating different parts of the code.

Assess Your Test Cases

- Run the tests you created in previous exercises. Do they detect the non-equivalent mutants?
 - (Pass on original code, fail for mutated code)
 - If not, create new test cases that will detect them.
 - If equivalent, make sure you understand why the mutant will never be detected.
- If you finish quickly, try this for the CoffeeMaker.
 - (part of Assignment 3)

Example 1

- Valid, but not useful: **constant-for-constant replacement**

```
public boolean isBusy(int month, int day, int start, int end) throws TimeConflictException{
    boolean busy = false; BECOMES
    boolean busy = true;
    checkTimes(month,day,start,end);
    for(Meeting toCheck : occupied.get(month).get(day)){
        if(start >= toCheck.getStartTime() && start <= toCheck.getEndTime()){
            busy=true;
        }else if(end >= toCheck.getStartTime() && end <= toCheck.getEndTime()){
            busy=true;
        }
    }
    return busy;
}
```

@Test

```
public void testIsBusy_NotBusy() {  
    // Meeting with no conflict with our dates.  
    Meeting noConflict = new Meeting(1,13,1,3);  
    Calendar calendar = new Calendar();  
    // Add meeting to calendar  
    try {  
        calendar.addMeeting(noConflict);  
        // Enter a time that has no conflict.  
        boolean result = calendar.isBusy(1, 13, 14, 16);  
        assertFalse("Should cause no conflict", result);  
    } catch(TimeConflictException e) {  
        fail("Should not throw exception: " + e.getMessage());  
    }  
}
```

**ANY test
where the
person is not
busy will fail
for this
mutant!**

Example 2

- Useful: Statement Deletion

```
public boolean isBusy(int month, int day, int start, int end) throws TimeConflictException{
    boolean busy = false;
checkTimes(month, day, start, end);
    for(Meeting toCheck : occupied.get(month).get(day)){
        if(start >= toCheck.getStartTime() && start <= toCheck.getEndTime()){
            busy=true;
        }else if(end >= toCheck.getStartTime() && end <= toCheck.getEndTime()){
            busy=true;
        }
    }
    return busy;
}
```

Example 2

- Test passes in invalid date and expects a `TimeConflictException` to be thrown.

```
@Test
```

```
public void testIsBusy_invalid_date() {  
    Calendar calendar = new Calendar();  
    Throwable exception = assertThrows(  
        TimeConflictException.class, () -> {  
            boolean result = calendar.isBusy(14, 13, 14, 16);  
        });  
}
```




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