

Software Testing

Advanced Coverage Criteria

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Decision/Condition Coverage

- Every condition in a decision in the program has taken all possible outcomes at least once
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Example: Decision/Condition Coverage

Consider the following example:

```
If (a >0) && (b >0)
    cout << "Hello" << endl;
else
    cout << "Bye" << endl;
```

Test cases to achieve decision/condition coverage:

$\langle a = 0, b = 0, \text{"Bye"} \rangle$, $\langle a = 1, b = 1, \text{"Hello"} \rangle$

Example: Decision/Condition Coverage

Consider the following example:

```
If (a >0) || (b >0)
    cout << "Hello" << endl;
else
    cout << "Bye" << endl;
```

Test cases to achieve decision/condition coverage:

$\langle a = 0, b = 0, \text{"Bye"} \rangle$, $\langle a = 1, b = 1, \text{"Hello"} \rangle$

Multiple Condition Coverage

- All the possible combinations of outcomes of conditions in a decision (therefore the complete decision table) are tested at least once.
- If there are n conditions in a decision, the number of test cases required for full coverage is 2^n

Modified Decision/Condition Coverage (MC/DC)

- Each condition in a decision has been shown to independently affect that decision's outcome
- A condition is shown to independently affect a decision's outcome by varying just that condition while holding fixed all other possible conditions
- If there are n conditions in a decision, the number of test cases required for full coverage is $n + 1$

Example: Modified Decision/Condition Coverage

Consider the following example:

```
if (a || b) && c { .... }
```

Test cases to achieve MC/DC coverage:

$\langle a = \text{false}, b = \text{true}, c = \text{false} \rangle$

$\langle a = \text{false}, b = \text{true}, c = \text{true} \rangle$

$\langle a = \text{false}, b = \text{false}, c = \text{true} \rangle$

$\langle a = \text{true}, b = \text{false}, c = \text{true} \rangle$

Other Coverage Criteria

- **Path coverage:** Has every possible route through a given part of the code been executed?
- **Loop coverage:** Has every possible loop been executed zero times, once, and more than once?
- **State coverage:** Has each state in a finite-state machine been reached and explored?

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