Com S 417
Software Testing

Fall 2017 – Week 6, Lecture 10

Announcements

- I will be changing my Tuesday office hours.
  - Suggestions?

Topics

- Exam return
- Logic Coverage Criteria
- Subsumption
- TDD (Test Driven Development)

Logic Coverage

There are many, many coverage criteria related to logic expressions. Each tries to capture how to reasonably exercise a range of decision outcomes.

We will cover only:

- conditional coverage
  - aka predicate coverage
- branch coverage
  - aka decision coverage
- branch AND condition coverage
- MCDC (modified condition/decision coverage)
  - mandated by the FAA and other agencies.

It would seem obvious ...

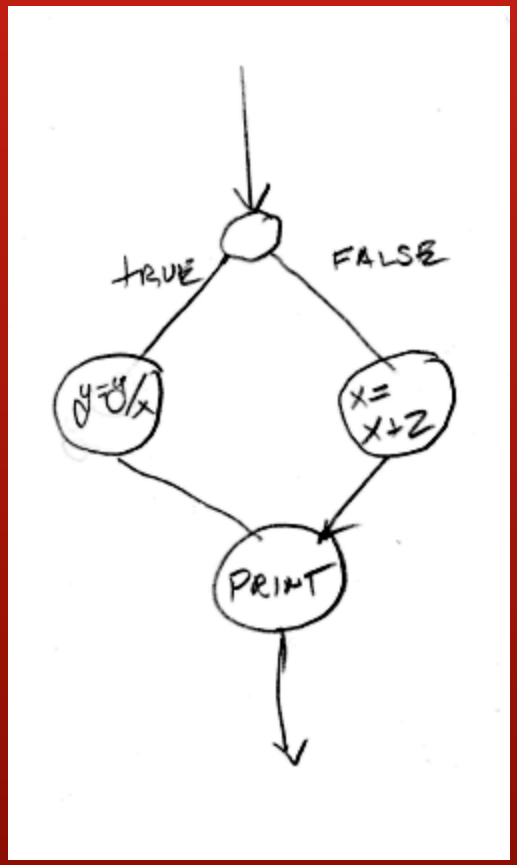
- If you want to excercise a range of decisions, make the conditions force all decisions: branch coverage.
- Every logic test must be true in at least one test case, and false in at least one test case.

Example: Branch Coverage

Each decision is true in at least one TC and false in at least one.

```
4
5   public void demo(int x, int y) {
6       if ((x == 0) || (y > 0)) {
7           y = y / x;
8       } else {
9           x = y + 2;
10      }
11      System.out.println("x is " + x + ", y is " + y);
12  }
13
```

TC1: (x=5, y=-6) ->F, F
TC2: (x=5, y=5) ->F, T

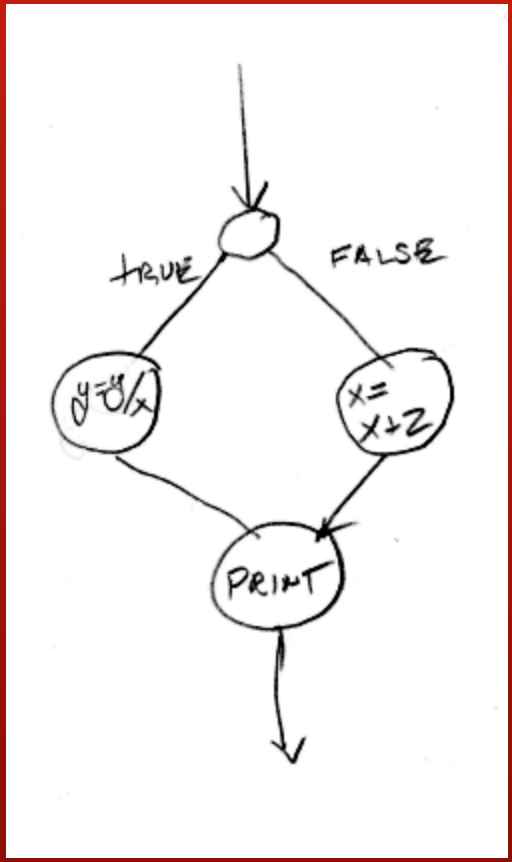


Example: Condition Coverage

Every *condition* is true in at least one TC and false in one.

```
4
5   public void demo(int x, int y) {
6      if ((x == 0) || (y > 0)) {
7         y = y / x;
8      } else {
9         x = y + 2;
10     }
11     System.out.println("x is " + x + ", y is " + y);
12  }
13
```

TC1: (x=0, y=-6) ->T, F
TC2: (x=5, y= 5) ->F, T



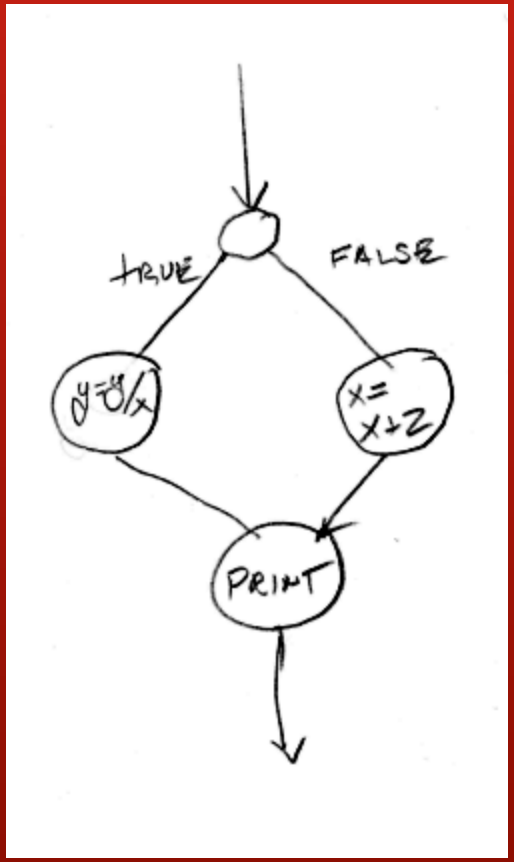
Branch *and* Condition coverage

What if we do Both?

```
4
5   public void demo(int x, int y) {
6       if ((x == 0) || (y > 0)) {
7           y = y / x;
8       } else {
9           x = y + 2;
10      }
11      System.out.println("x is " + x + ", y is " + y);
12  }
13
```

TC1: (x=0, y=5) ->T, T
TC2: (x=5, y=-5) ->F, F

Is y really contributing anything?

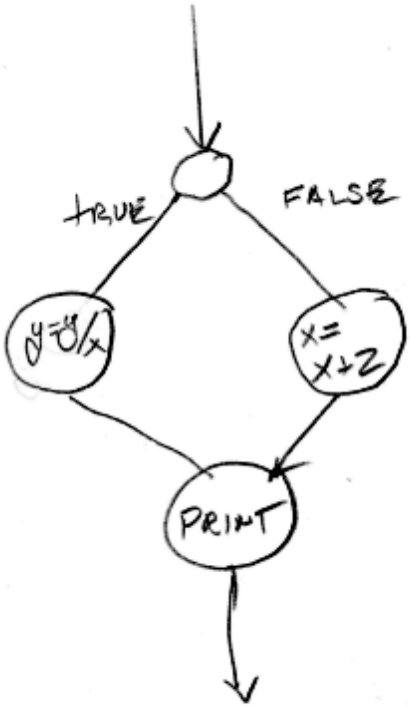


MC/DC Example Test Set

```
public void demo(boolean a, boolean b, boolean c,
        int y, int x)
{
    if (a || (b && c)) {
        y = y / x;
    } else {
        x = y + 2;
    }
    System.out.println("x is " + x + ", y is " + y);
}
```

A	B	C	V
T	F	T	T
F	F	T	F
F	T	F	F
F	T	T	T

Condition coverage, Branch Coverage, and every condition takes a TF values that *control* the decision.



Example

Independent Determination

For “a || (b and c)” we can create a truth table (V is result)

A	B	C	V
T	F	F	T
T	F	T	T
T	T	F	T
T	T	T	T
F	F	F	F
F	F	T	F
F	T	F	F
F	T	T	T

A	B	C	V
T	F	F	T
T	**F**	**T**	**T**
T	T	F	T
T	T	T	T
F	F	F	F
F	**F**	**T**	**F**
F	T	F	F
F	T	T	T

A	B	C	V
T	F	F	T
T	F	T	T
T	T	F	T
T	T	T	T
F	F	F	F
F	**F**	**T**	**F**
F	T	F	F
F	**T**	**T**	**T**

A	B	C	V
T	F	F	T
T	F	T	T
T	T	F	T
T	T	T	T
F	F	F	F
F	F	T	F
F	**T**	**F**	**F**
F	**T**	**T**	**T**

MC/DC without truth tables

Let P be a predicate with multiple conditions, including A.

let P_A = P | all instances of A = true.

Let $P_{A'}$ = P | all instances of A = false.

Then the predicate which is determined by A, will be

$true = P_A \oplus P_{A'}$

Examples:

$true = a \vee b$

$true = a \wedge b$

$true = a \wedge (b \vee c)$

What if the right side resolves to “true” or maybe “false”?

MCDC Worked out Examples

$$
\begin{aligned}
& p = a \wedge b \\
& = (true \wedge b) \oplus (false \wedge b) \\
& = b \oplus false \\
& \mathrm{b} \Longrightarrow true
\end{aligned}
$$

$$
\begin{aligned}
& p = a \vee b \\
& = (true \vee b) \oplus (false \vee b) \\
& = true \oplus b \\
& \mathrm{b} \Longrightarrow false
\end{aligned}
$$

MCDC Worked out Examples

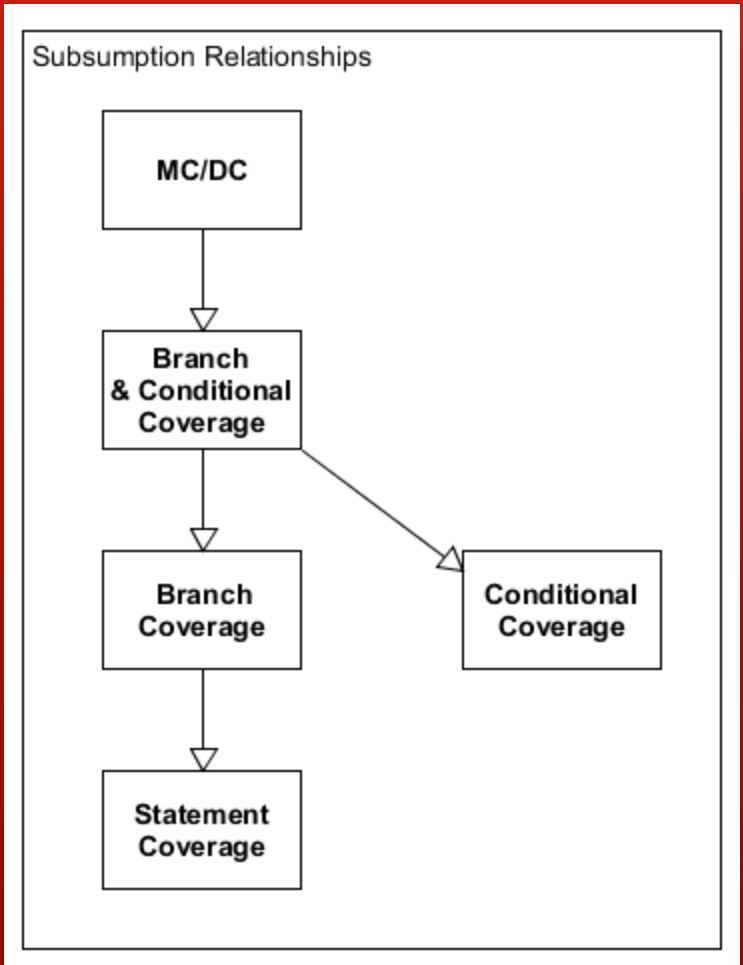
$$p = a \wedge (b \vee c)$$
$$= (true \wedge (b \vee c)) \oplus (false \wedge (b \vee c))$$
$$= (b \vee c) \oplus false$$
$$(b \vee c)$$

b	c
T	T
T	F
F	T

Subsumption

- Notice that Conditional Coverage did not ensure Branch coverage and vice versa, but MCDC ensures both.
- When one kind of coverage “implies” or “includes” another, we say the first “subsumes” the second.

Subsumption for Conditionals

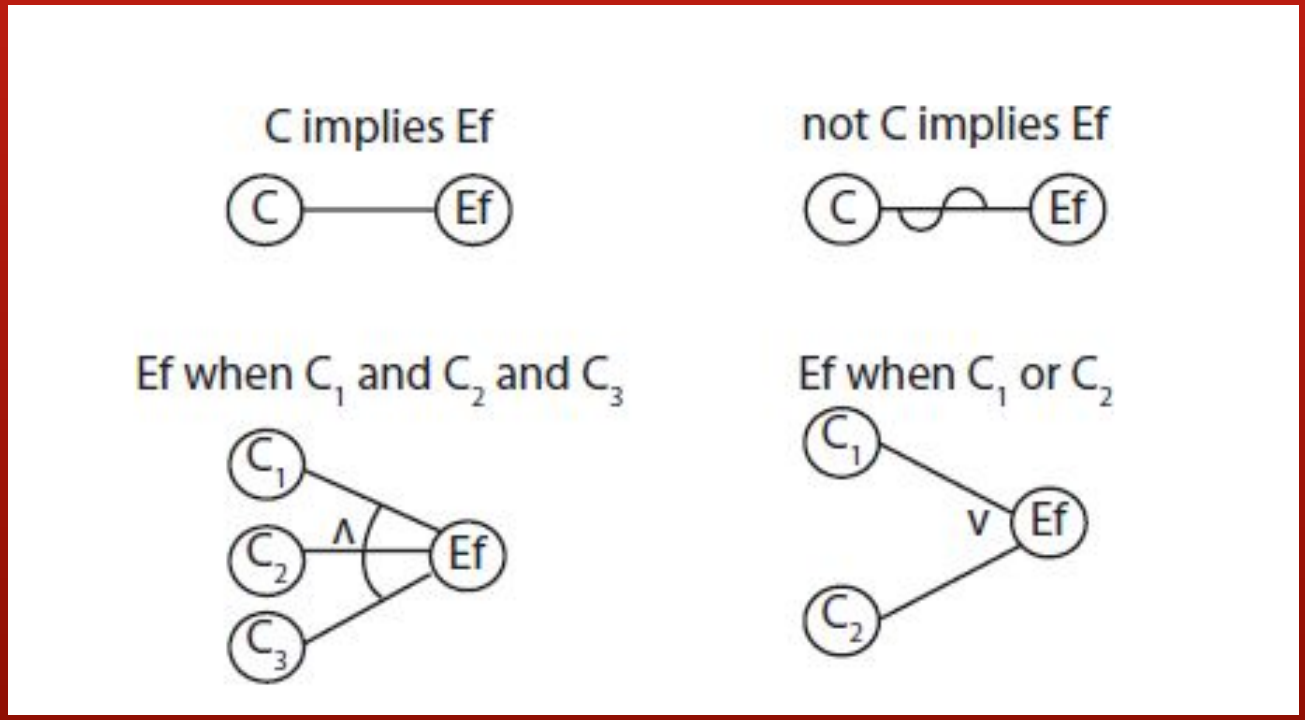


Why does it matter?

What about for graph coverage criteria?

Cause and Effect Graphs

Elements



from Mathur

Example

Cause and Effect Graphs

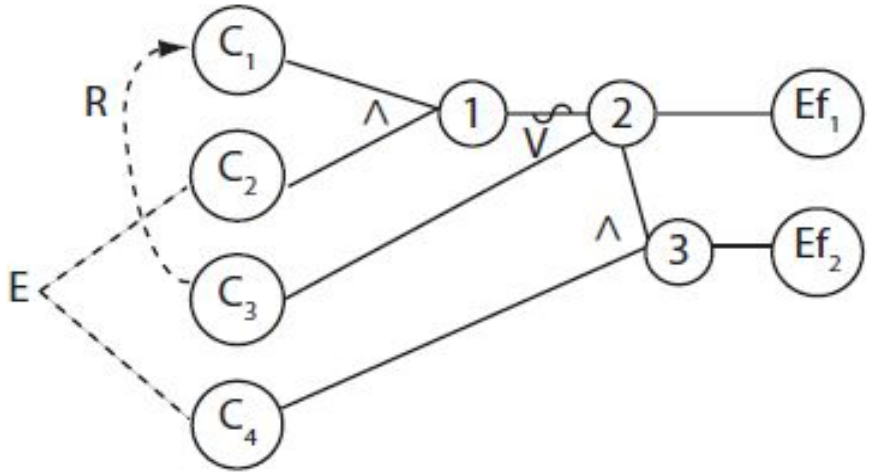


Fig. 2.15 A cause-effect graph to illustrate procedure CEGDT.

From Mathur.

Reading Assignment

- https://martinfowler.com/articles/mocksArentStubs.html
- Mockito Tutorial
  - https://www.tutorialspoint.com/mockito/index.htm
- Using the Mockito API (section 4 et. seq.)
  - http://www.vogella.com/tutorials/Mockito/article.html
- Chapter 4 from Ammann & Offutt
  - soon to be available at the library via digital reserve.