L3 Mention Informatique
Parcours Informatique et MIAGE

Génie Logiciel Avancé - Advanced Software Engineering

White-Box Tests (Rev)

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Towards Static Program-based Unit Test

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  - What could be a coverage criterion ?
    (or: adequacy criterion,
    telling that we "tested enough")

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- Assumption: Programmers make most likely errors in branching points of a program (Condition, While-Loop, ...), but get the program "in principle right".
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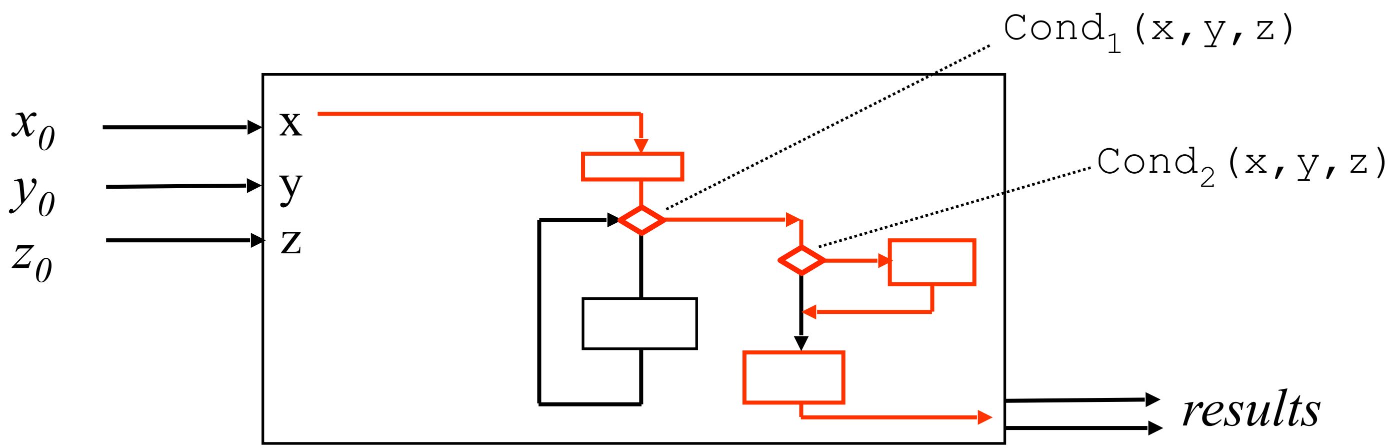
- Lets develop a test method that exploits this !

Static Structural ("white-box") Tests



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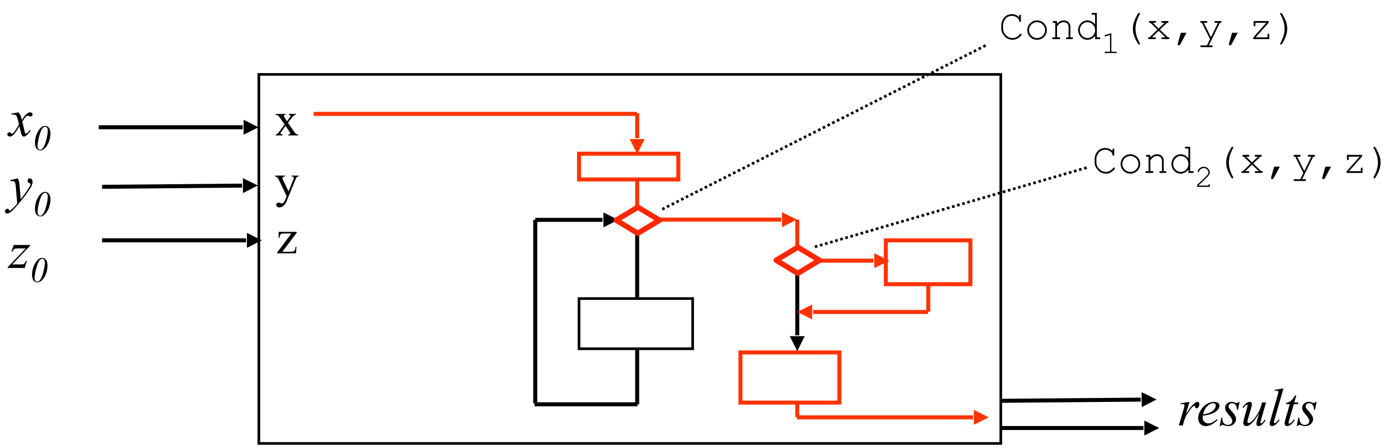

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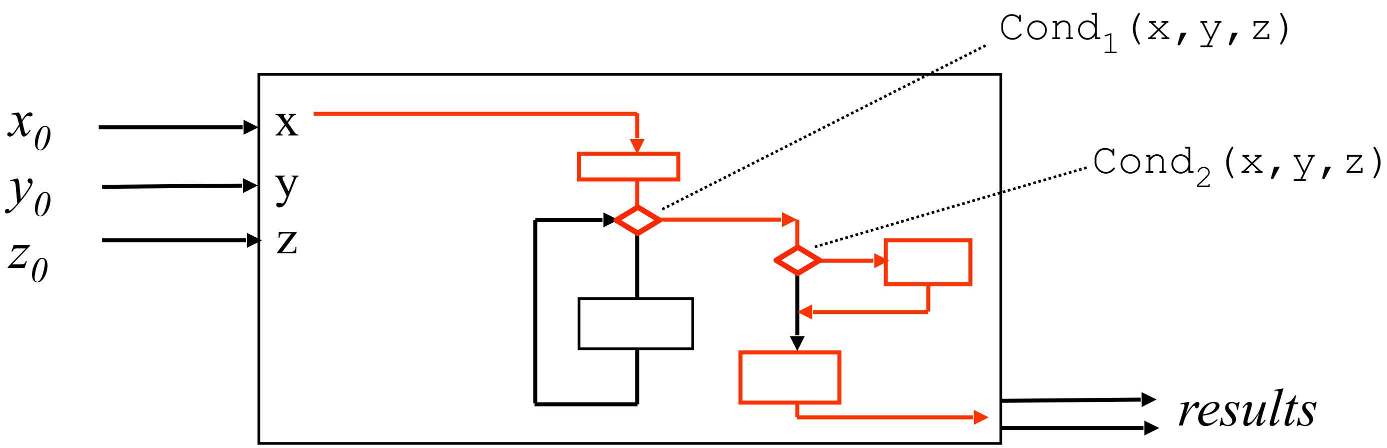

- we select "critical" paths
- specification used to verify the obtained resultants

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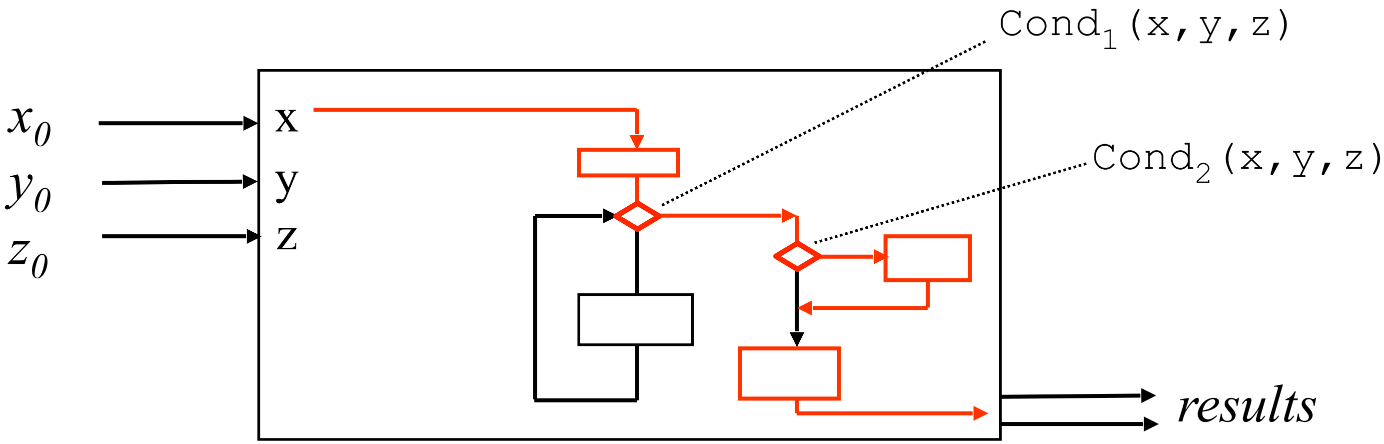

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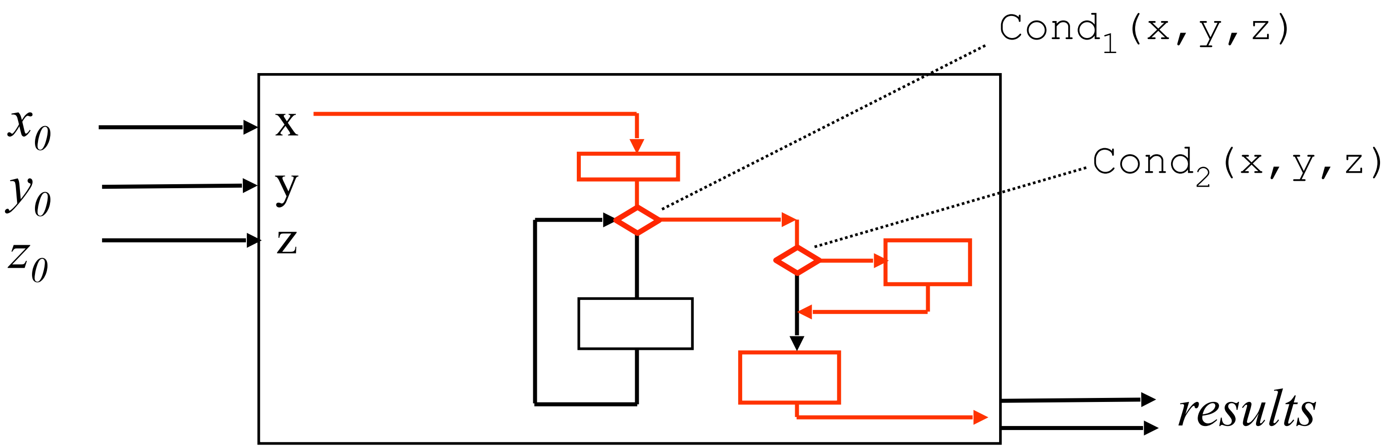

Idea:
a path corresponds to <u>one</u> logical expression over initial values x_0, y_0, z_0 .
corresponding to one test-case (comprising several test data ...)

$$\neg\, Cond_1(x_0,\ y_0,\ z_0) \wedge \neg\, Cond_2(x_0,\ y_0,\ z_0)$$

We are interested either in edges (control flow), or in nodes (data flow)

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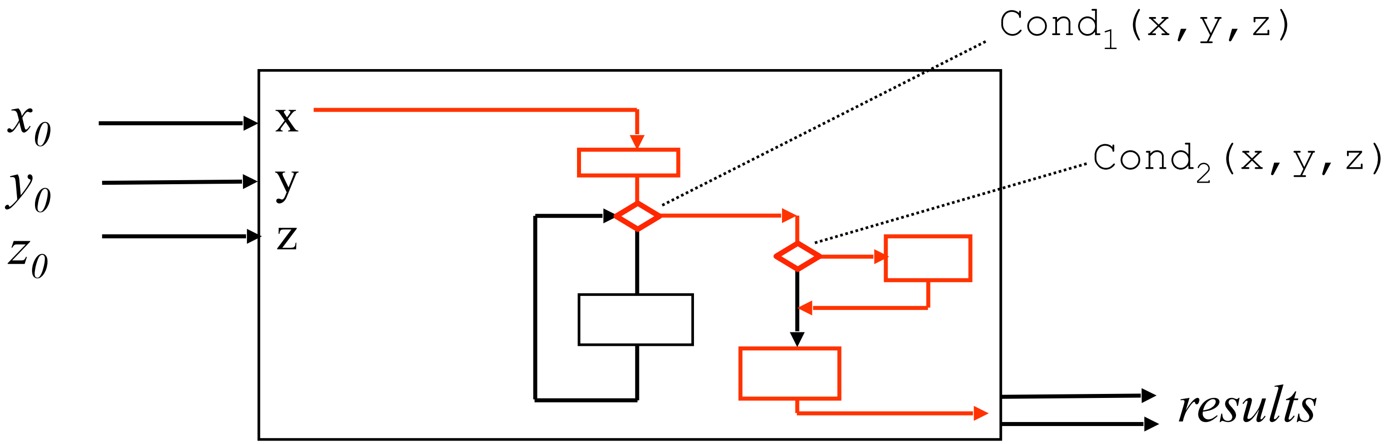

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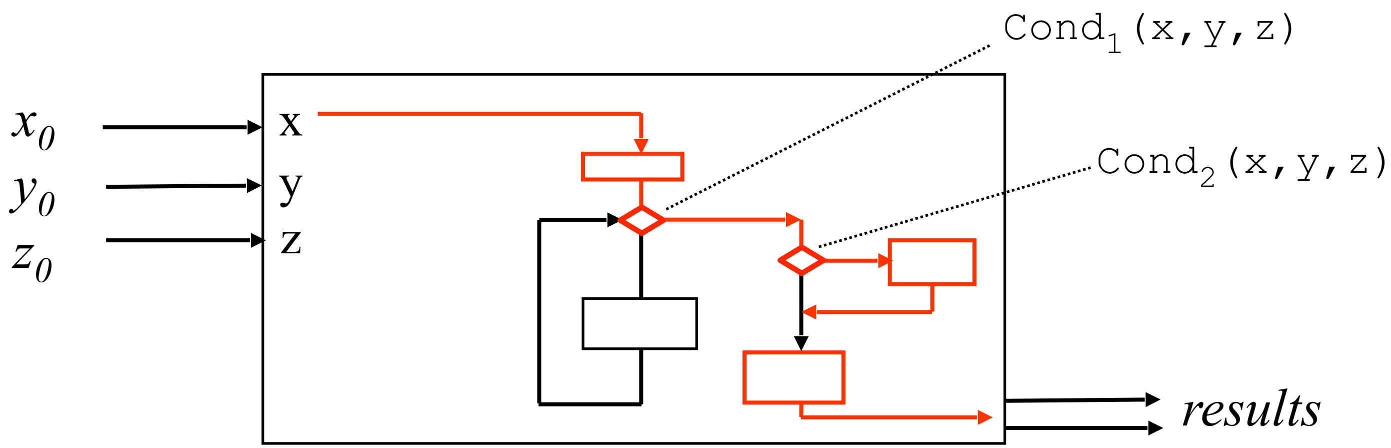

Recall: This path-condition can be effectively constructed by a process called "symbolic execution

The notion of a "coverage criterion"

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A coverage criterion is a function mapping a CFG
to a particular subset of its paths …

- the set of paths covering all basic blocks
- the set of paths covering all conditions
- the set with all loops are traversed
- a particular subset of calls/labels occurring in the CFG has been covered
- …

Well-known Coverage Criteria I

Criterion C = AllInstructions(CFG):

For all nodes N in CFG (basic instructions or decisions) exists a path in C that contains N

Well-known Coverage Criteria II

Criterion C = AllTransitions(CFG):

For all arcs A in the CFG exists a path in C that uses A

Well-known Coverage Criteria III

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All possible paths ...

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A Hierarchy of Coverage Criteria

- $\text{AllPaths(CFG)} \supseteq$
  $\text{AllPaths}_k\text{(CFG)} \supseteq$
  $\text{AllTransitions(CFG)} \supseteq$
  $\text{AllInstructions(CFG)}$

- Each of these implications reflects a proper containment; the other way round is never true.

Schmankerle

- Program:

```
int f (int a) {
        int i = 0;
        int tm = 1;
        int sum = 1;
        while(sum <= a) {
                i = i+1;
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Specification:

pre : $a \geq 0$

post: $a \leq result^2 \wedge a < (result+1)^2$

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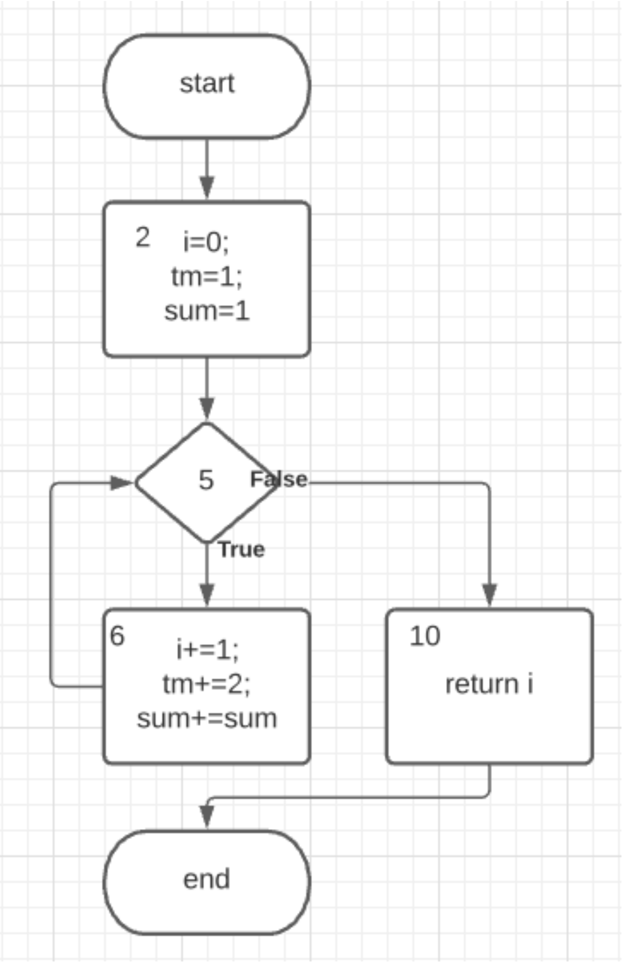

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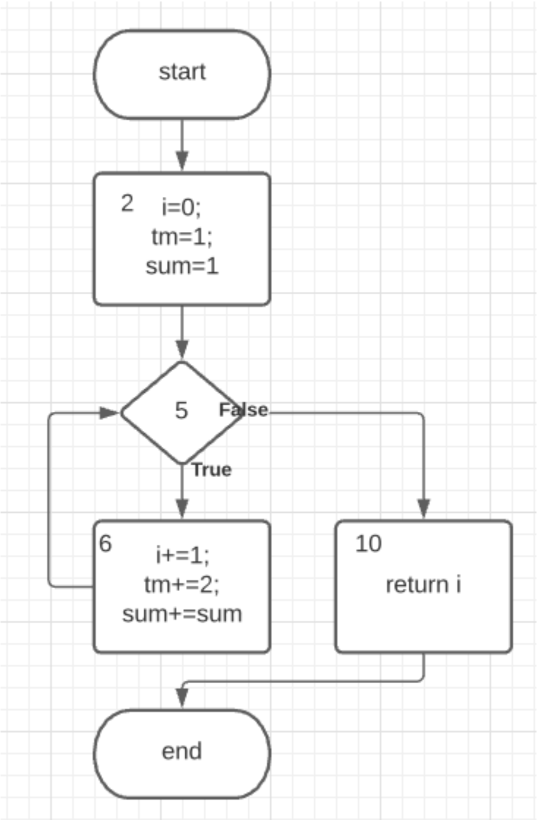

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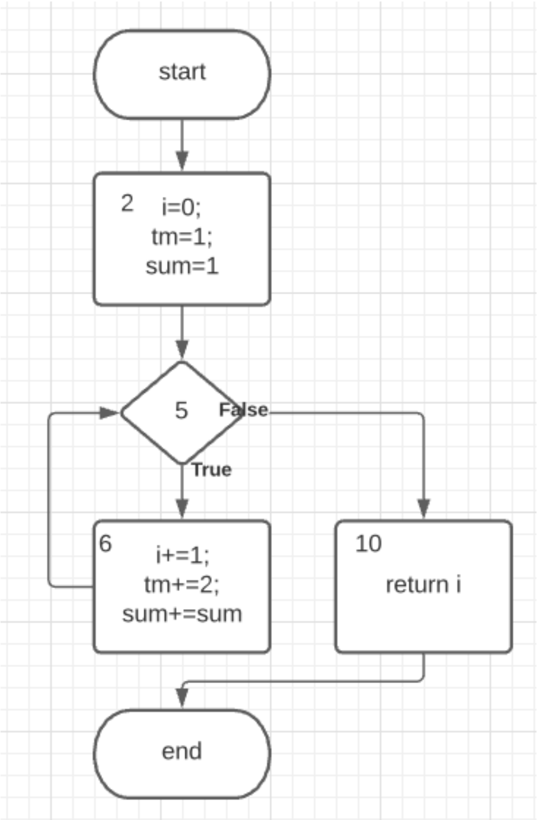

- For example:

AllInstructions(CFG)={[start,2,5,6,5,10,end]}

AllTransitions(CFG)={[start,2,5,6,5,10,end]}

AllPath_3(CFG)={[start,2,5,10,end],
[start,2,5,6,5,10,end],
[start,2,5,6,6,5,10,end],
[start,2,5,6,6,6,5,10,end]}

AllPath(CFG)={ $S \mid \exists\ k \in \mathbb{N}$.

S = [start,2,5,$(6,5)^k$,10,end]}

(infinite !)

Example: A Symbolic Path Execution

We want to execute the path from $AllPath_3$:

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For the path M=[start,2,5,6,5,10,end]

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