Topic #3 – Boundary Value Testing Method

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Topic #3 – Boundary Value Testing Method

What is Boundary Value Testing Method?

Why Do We Need Boundary Value Testing?

How to Use Boundary Value Testing?

Boundary Value Testing Examples

Boundary Value Testing Summary

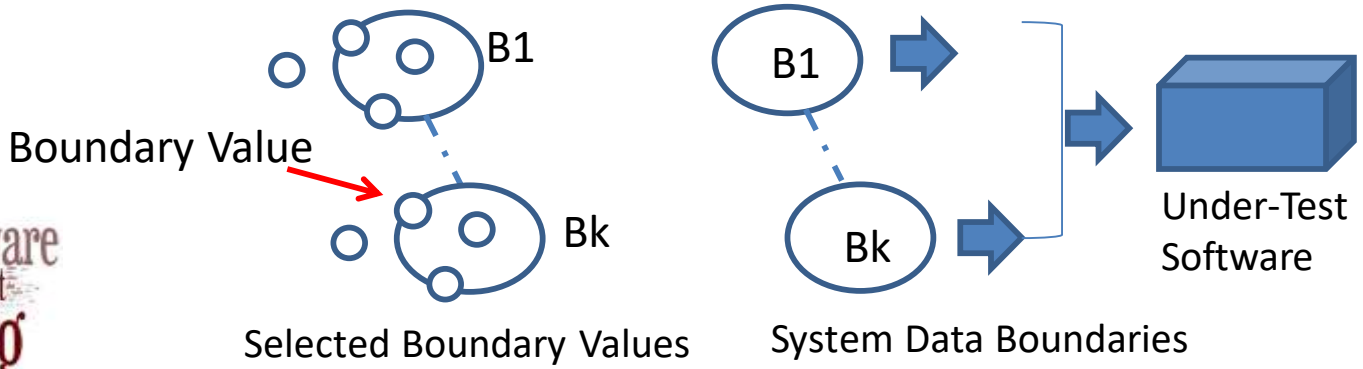
TOPIC #3 – BOUNDARY VALUE TEST METHOD

What is boundary value testing method?

Boundary value testing is also known as boundary value analysis (BVA).
It is one of the best-known functional test techniques in black-box testing.

Definition:
Boundary value analysis is a software testing technique in which tests are designed to validate software functions and behaviors by focusing on the representative boundary values for each system boundary.

Traditional boundary value analysis focuses on input or output values at the extreme boundary conditions of independent physical variables.

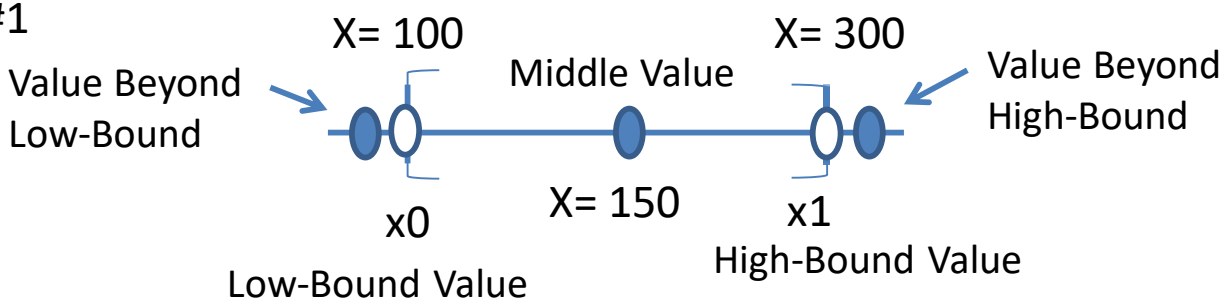


Different Types of Boundary in Software

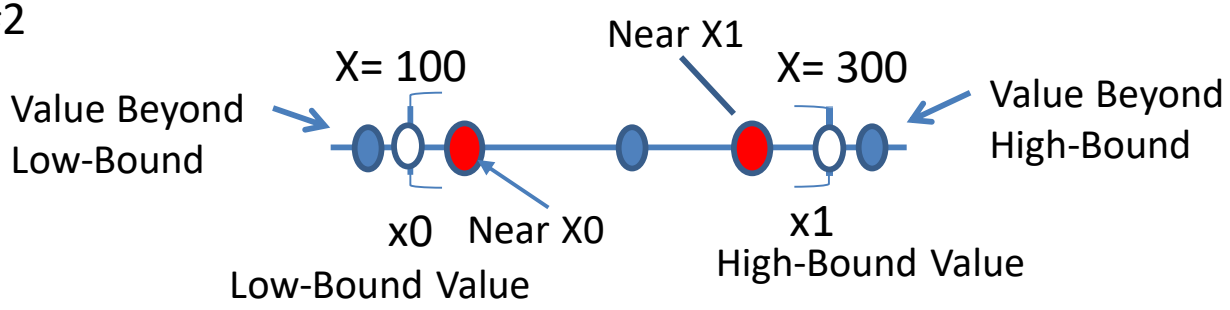
One-dimension input data boundary:

- Boundary: X in [100, 300] Boundary Value Examples: X = 100, X =300

Approach #1

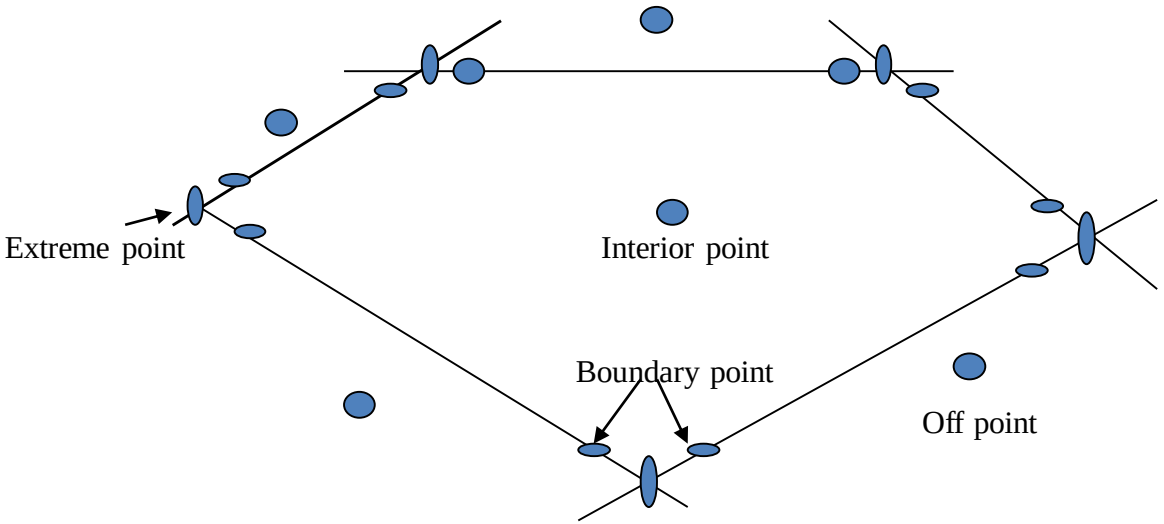


Approach #2



Different Types of Boundary in Software

Two-dimension input data boundary:



Two-dimension Domain Boundary

Why Do We Need the Boundary Value Analysis?

Answer:

- Historical evidence demonstrates errors tend to occur near the extreme boundaries of input and/or output values of physical variables.

- Achieve adequate boundary value test coverage criteria

- Reduce the test complexity by only focusing on boundary values of the under-test system.

System Boundary Examples

- Different data value ranges of input parameters
- Total counting parameters
- Aggregated data sizes: such as tree nodes, number of nodes in a linked list
- 2-dimensional boundary values
- 3-dimensional boundary values
- Condition boundaries of a system
- Resource boundaries for a system

How to Use the Boundary Value Test Method?

Step #1: Identify all of system boundaries

Step #2: For each boundary (i.e. B), identify representative boundary values

- Select representative boundary values on B.
- Select representative values beyond each lower bound of B.
- Select representative values beyond each higher bound of B.

Step #3: Define tests for identified boundary values

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A Boundary Value Testing Example

Example 2 for Boundary Value Analysis :

A name text box for users to allows them to enter 1 to 30 characters.

Input Data	Beyond Low-Bound	Low-Bound	Middle Length	High-Bound	Beyond High-Bound
User Name	Text Length = 0	Text Length = 1	Text Length = 15	Text Length = 30	Text Length = 31
Boundary Values	BV1: String with 0 length	BV2: String with 1 char	BV3: String with 15 chars	BV4: String with 30 chars	BV4: String with 31 chars

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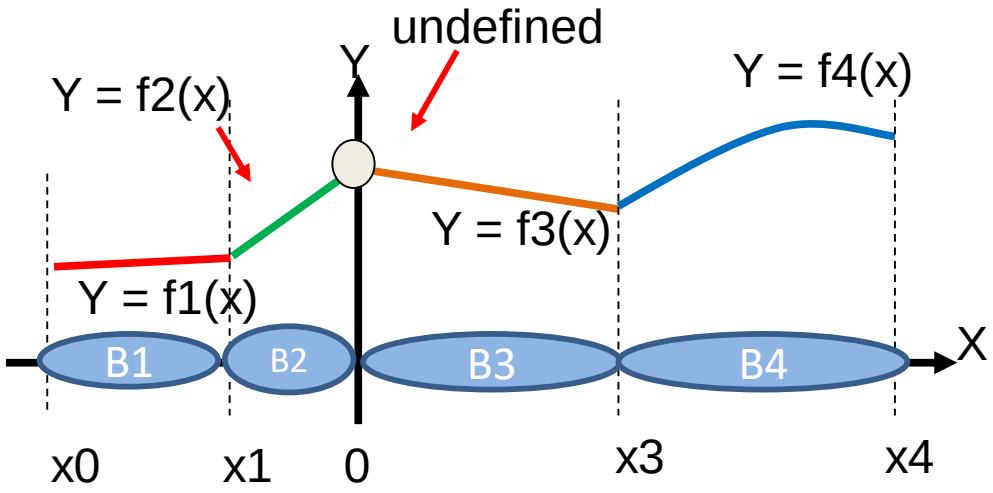
A Boundary Value Testing Example

A software component provides a set of application functions.
These functions generate a corresponding Y value based on the value of input data X.
Each function is called and executed when X value is fall into a specific data range.

$$Y(x) = \begin{cases} f1(x) & x \text{ in } [x0, x1] \\ f2(x) & x \text{ in } (x1, 0) \\ \text{Undefined} & x = 0 \\ f3(x) & x \text{ in } (0, x3] \\ f4(x) & x \text{ in } (x3, x4] \end{cases}$$

Existing Boundaries:

B1: x in [x0, x1]
B2: x in (x1, 0)
B3: x in (0, x3)
B4: x in [x3, x4]



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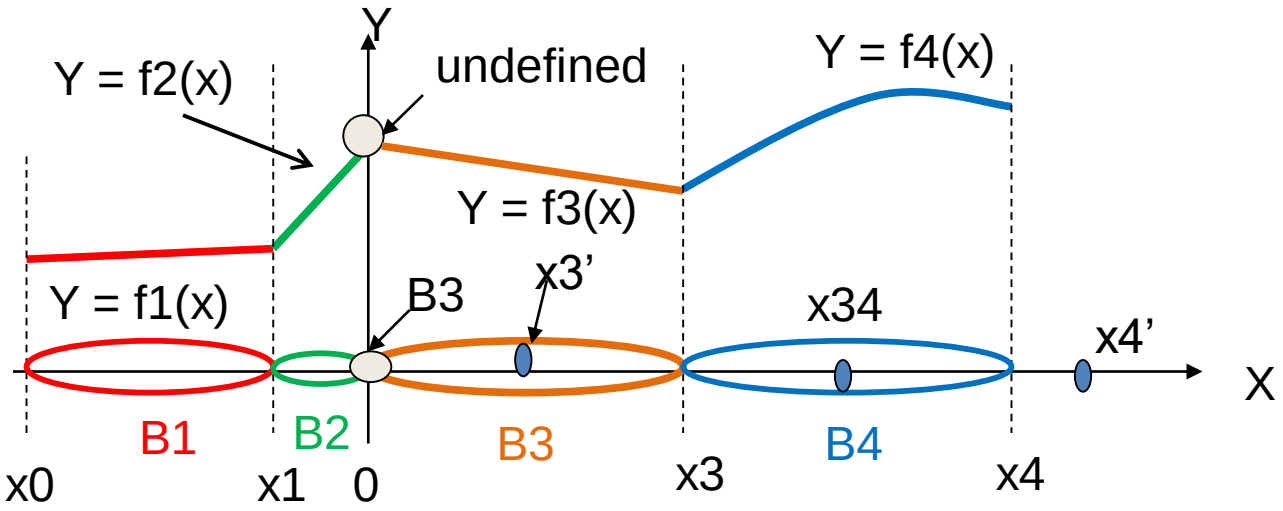
A Boundary Value Testing Example



Test Cases for Boundary #4:

x = x3', y = f3(x3'),	check y =?
x = x3, y = f4(x3),	check y =?
x = x34, y = f4(x34),	check y=?
x = x4, y = f4(x),	check y=?
x =x4', y = out of boundary	

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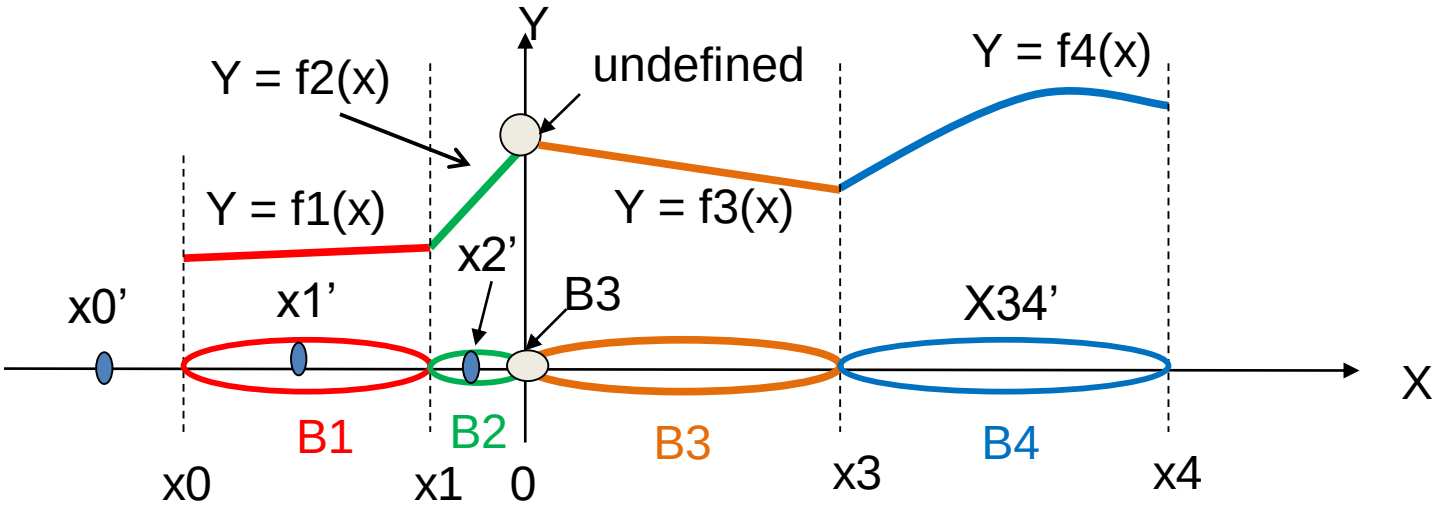
A Boundary Value Testing Example



Test Cases for Boundary #1:

x = x0',	y = Out of boundary	check y =?
x = x0,	y = f1(x0),	check y =?
x = x1',	y = f1(x1'),	check y=?
x = x1,	y = f1(x1),	check y=?
x =x2',	y = f2(x2')	check y=?

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Boundary Value Testing Summary

Advantage:

- Simple and easy to understand and use

Test Coverage:

- The boundary value method assures the boundary value test coverage.
- For each value boundary, there must be adequate boundary value tests to cover it.

Limitations:

Only effective to detect boundary value related software errors.

Challenges:

- It is difficult to identify all boundaries for a software when the given requirements are incomplete.