BVA

single fault assumption.

Understanding the Formula

The formula **4n+1**represents the **maximum number of test cases required** when applying Boundary Value Analysis (BVA) under the **single fault assumption**.

Breaking It Down

1. **For a Single Variable (n = 1)**:
    - When testing a single variable, we check at **four boundary points**:
        - **Lower boundary** (Min)
        - **Lower boundary +1** (Min + 1)
        - **Upper boundary** (Max)
        - **Upper boundary -1** (Max - 1)
    - We also test **one nominal value** (some midpoint value).
    - **Total test cases for one variable = 4 + 1 = 5.**
2. **For Multiple Variables (n > 1)**:
    - **Single Fault Assumption:** We assume only **one variable** is faulty at a time, while all others remain at their extreme values.
    - So, for **each variable**, we need **4 tests (boundary values)** while keeping other variables constant at their extreme values.
    - Since there are **n variables**, we multiply by 4: **4n**.
    - We also include **one additional nominal test case**, where all variables are set to their typical mid-range values.

Thus, for **n variables**:

Total Test Cases} = 4n + 1

Example: Applying 4n + 1 Formula

Case 1: Single Variable (n = 1)

Consider an input **X** with a valid range **[10, 100]**:

- **Boundary values to test:**
    - **Lower bound:** 10
    - **Lower bound +1:** 11
    - **Upper bound:** 100

    - **Upper bound -1:** 99
    - **Nominal value (midpoint):** 55
- **Total Test Cases = 4(1) + 1 = 5**

Case 2: Two Variables (n = 2)

Consider **X** in [10, 100] and **Y** in [20, 200]:

- **Variable X** boundary tests: Keep **Y** at **extreme values** (either 20 or 200).
    - X = 10, Y = 20
    - X = 11, Y = 20
    - X = 99, Y = 20
    - X = 100, Y = 20
- **Variable Y** boundary tests: Keep **X** at **extreme values** (either 10 or 100).
    - Y = 20, X = 10
    - Y = 21, X = 10
    - Y = 199, X = 10
    - Y = 200, X = 10
- **Nominal test case**: X = 55, Y = 110

Total Test Cases = 4(2) + 1 = 9