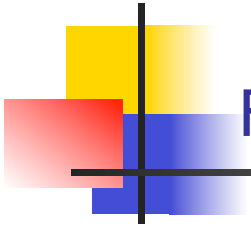
Functional Testing Review

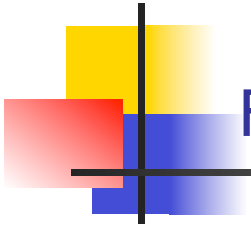
Chapter 8



Functional Testing

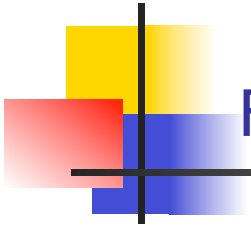
- We saw three types of functional testing
  - Boundary Value Testing
  - Equivalence Class Testing
  - Decision Table-Based Testing

- **What is the common thread among the above methods?**



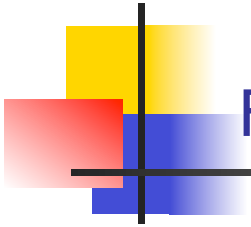
Functional Testing – 2

- The common thread among these techniques
  - they all view a program as a mathematical function that maps its inputs to its outputs.



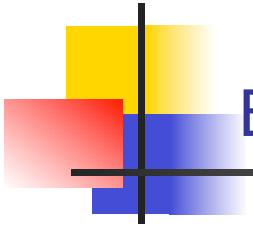
Functional Testing – 3

- **What do we look at when comparing functional testing methods?**



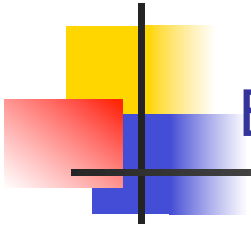
Functional Testing – 4

- Look at
  - testing effort
  - testing efficiency
  - testing effectiveness



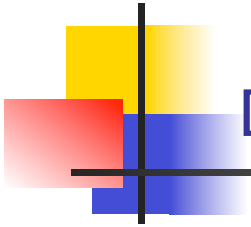
Boundary Value Test Cases

Test Case	a	b	c	Expected Output
1	100	100	1	Isosceles
2	100	100	2	Isosceles
3	100	100	100	Equilateral
4	100	100	199	Isosceles
5	100	100	200	Not a Triangle
6	100	1	100	Isosceles
7	100	2	100	Isosceles
8	100	100	100	Equilateral
9	100	199	100	Isosceles
10	100	200	100	Not a Triangle
11	1	100	100	Isosceles
12	2	100	100	Isosceles
13	100	100	100	Equilateral
14	199	100	100	Isosceles
15	200	100	100	Not a Triangle



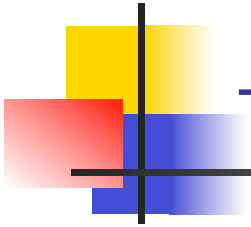
Equivalence Class Test Cases

Test Case	a	b	c	Expected Output
WN1	5	5	5	Equilateral
WN2	2	2	3	Isosceles
WN3	3	4	5	Scalene
WN4	4	1	2	Not a Triangle
WR1	-1	5	5	a not in range
WR2	5	-1	5	b not in range
WR3	5	5	-1	c not in range
WR4	201	5	5	a not in range
WR5	5	201	5	b not in range
WR6	5	5	201	c not in range



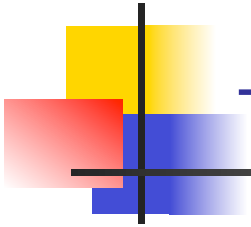
Decision Table Test Cases

Case ID	a	b	c	Expected Output
DT1	4	1	2	Not a Triangle
DT2	1	4	2	Not a Triangle
DT3	1	2	4	Not a Triangle
DT4	5	5	5	Equilateral
DT5	???	???	???	Impossible
DT6	???	???	???	Impossible
DT7	2	2	3	Isosceles
DT8	???	???	???	Impossible
DT9	2	3	2	Isosceles
DT10	3	2	2	Isosceles
DT11	3	4	5	Scalene



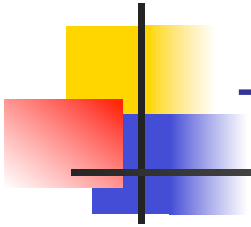
Testing Effort Sophistication

- **Describe the level of sophistication of the following test methods for how the methods are used to generate test cases?**
  - Boundary value
  - Equivalence classes
  - Decision tables



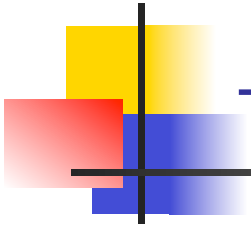
Testing Effort Sophistication Boundary Value

- Has no recognition of data or logical dependencies
  - Mechanical generation of test cases



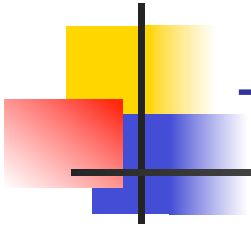
Testing Effort Sophistication Equivalence Classes

- Takes into account data dependencies
  - More thought and care is required to define the equivalence classes
  - Mechanical generation after that



Testing Effort Sophistication Decision Tables

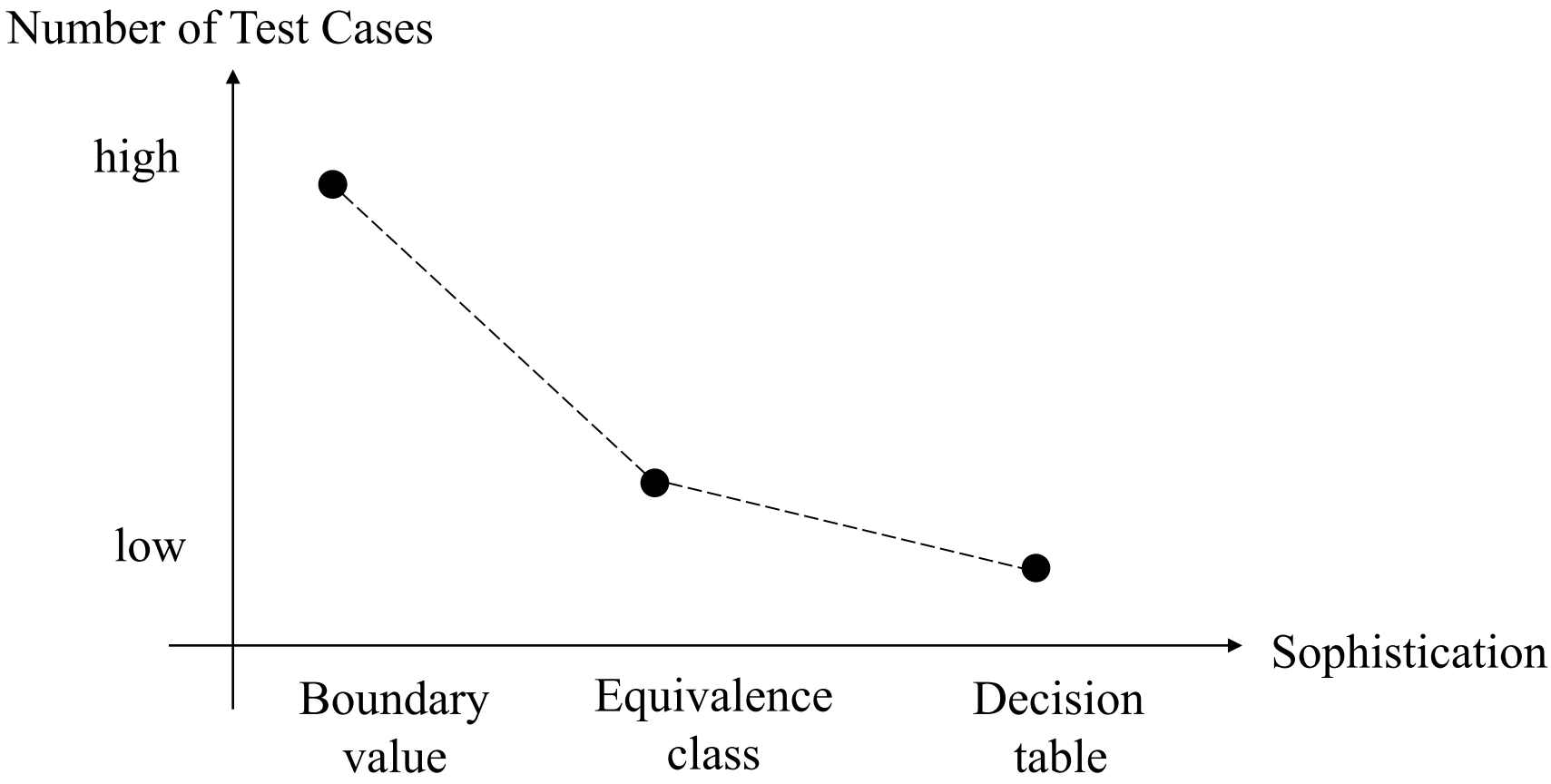
- The most sophisticated
  - It requires that we consider both data and logical dependencies.
  - Iterative process
  - Allows manual identification of redundant test cases
- Tradeoff between test identification effort and test execution effort

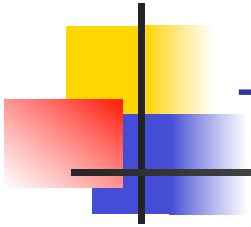


Trend Line Testing Effort

- **What does the trend line look like for the following axes?**
  - Number of test cases
  - Test method – boundary, equivalence, decision

Trend Line Testing Effort – number of test cases

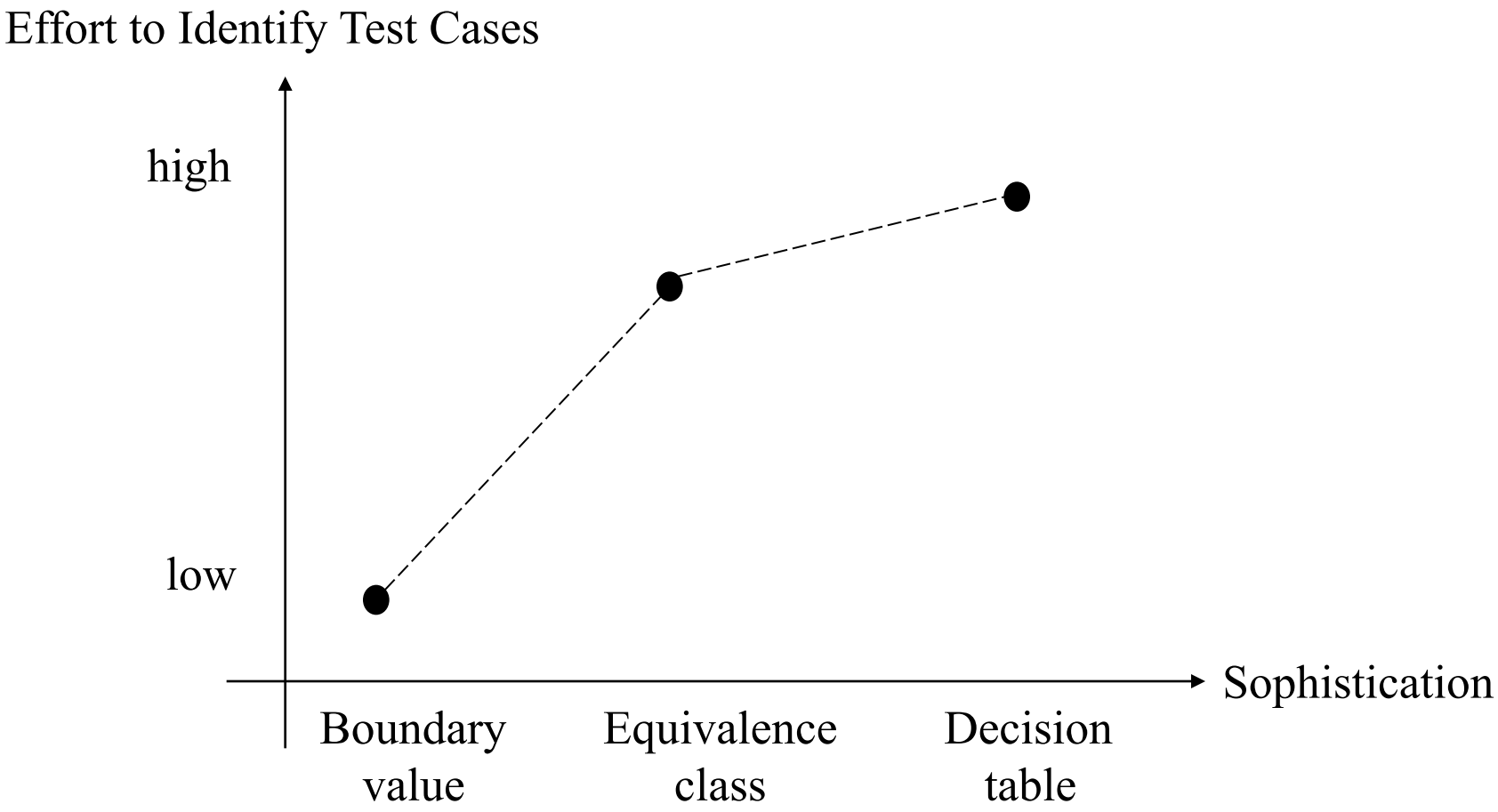


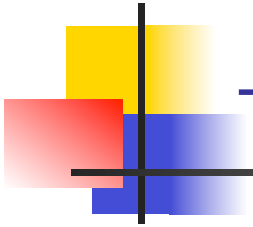


Trend Line Testing Effort – 2

- **What does the trend line look like for the following axes?**
  - Effort to identify test cases
  - Test method – boundary, equivalence, decision

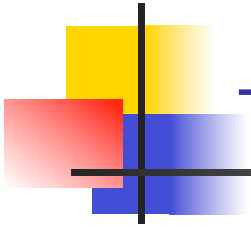
Trend Line Testing Effort – identifying test cases





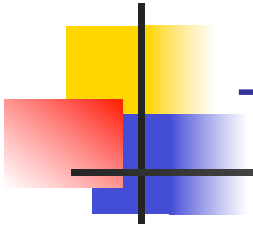
Testing Limitations

- **What are the fundamental limitation of functional testing?**



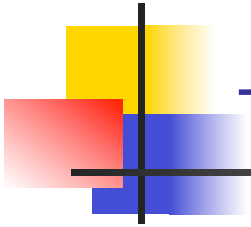
Testing Limitations – 2

- Fundamental limitations of functional testing
  - Gaps of untested functionality
  - Redundant tests



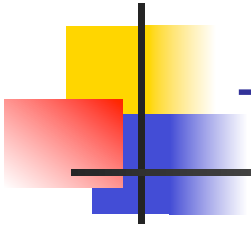
Testing Efficiency

- **What is the "Testing efficiency" question?**
- **What problem are we trying to solve?**



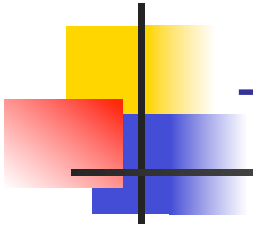
Testing Efficiency – 2

- **Testing efficiency** question
  - How can we create a set of test cases that is “just right”?
  - Difficult to answer
    - Can only rely on the general knowledge that more sophisticated techniques, such as decision tables, are usually more efficient
- Structural testing methods will allow us to define more interesting metrics for efficiency



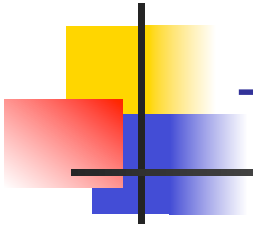
Testing Efficiency Example

- The worst case boundary analysis for the NextDate program generated 125 cases.
  - Redundancy
    - check January 1 for five different years
    - only a few February cases
  - Gaps
    - None on February 28, and February 29
    - No major testing for leap years



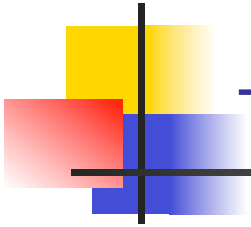
Testing Efficiency Example – 2

- The strong equivalence class test cases generated 36 test cases
  - 11 of which are impossible.
- The decision table technique generated 22 test cases
  - Fairly complete



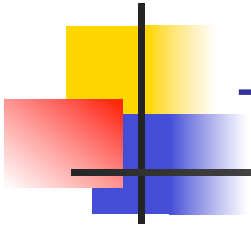
Testing Effectiveness

- **How effective is a method or a set of test cases for finding faults present in a program?**



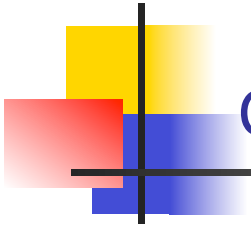
Testing Effectiveness – 2

- Difficult to answer because
  - It presumes we know all faults in a program
  - It is impossible to prove that a program is free of faults (equivalent to solving the halting problem)
- **What is the best we can do?**



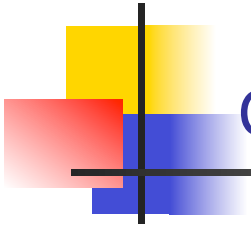
Testing Effectiveness – 3

- Given a fault type we can choose testing methods that are likely to reveal faults of that type
  - Track kinds and frequencies of faults in the software applications we develop
  - Use knowledge related to the most likely kinds of faults to occur



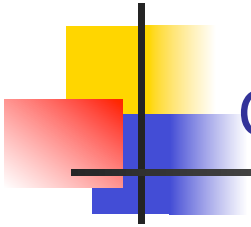
Guidelines

- **What guidelines can you give for functional testing?**
  - What attributes/properties do you consider?



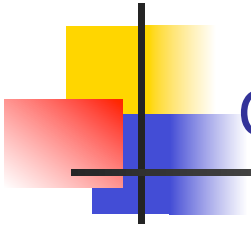
Guidelines – 2

- Kinds of faults may reveal some pointers as to which testing method to use.
- If we do not know the kinds of faults that are likely to occur in the program then the attributes most helpful in choosing functional testing methods are:
  - Whether the variables represent physical or logical quantities
  - Whether or not there are dependencies among variables
  - Whether single or multiple faults are assumed
  - Whether exception handling is prominent



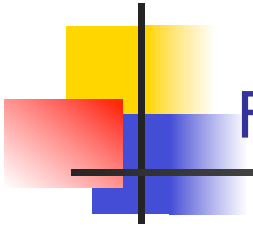
Guidelines – 3

- If the variables refer to physical quantities and/or are independent, domain testing and equivalence testing can be considered.
- If the variables are dependent, decision table testing can be considered
- If the single-fault assumption is plausible to assume, boundary value analysis and robustness testing can be considered



Guidelines – 4

- If the multiple-fault assumption is plausible to assume, worst case testing, robust worst case testing, and decision table testing can be considered
- If the program contains significant exception handling, robustness testing and decision table testing can be considered
- If the variables refer to logical quantities, equivalence class testing and decision table testing can be considered



Functional Testing Decision Table

C1: Variables (P=Physical, L=Logical)?	P	P	P	P	P	L	L	L	L	L
C2: Independent Variables?	Y	Y	Y	Y	N	Y	Y	Y	Y	N
C3: Single fault assumption?	Y	Y	N	N	-	Y	Y	N	N	-
C4: Exception handling?	Y	N	Y	N	-	Y	N	Y	N	-
A1: Boundary value analysis		X								
A2: Robustness testing	X									
A3: Worst case testing				X						
A4: Robust worst case testing			X							
A5: Weak robust equivalence testing	X		X			X		X		
A6: Weak normal equivalence testing	X	X				X	X			
A7: Strong normal equivalence testing			X	X	X			X	X	X
A8: Decision table					X					X