Equivalence Class Testing

Chapter 6

Introduction

- Boundary Value Testing derives test cases with
  - Massive redundancy
  - Serious gaps
- Equivalence Class Testing attempts to alleviate these problems
- Two orthogonal dimensions
  - Robustness
  - Single/Multiple Fault Assumption

Equivalence Class Testing

- Partition the set of all test cases into mutually disjoint subsets whose union is the entire set
- Choose one test case from each subset
- Two important implications for testing:
  1. The fact that the entire set is represented provides a form of completeness
  2. The disjointness assures a form of non-redundancy

Equivalence Class Selection

- If the equivalence classes are chosen wisely, the potential redundancy among test cases is greatly reduced.
- The key point in equivalence class testing is the choice of the equivalence relation that determines the classes.
- We will differentiate below, between four different types of equivalence class testing.

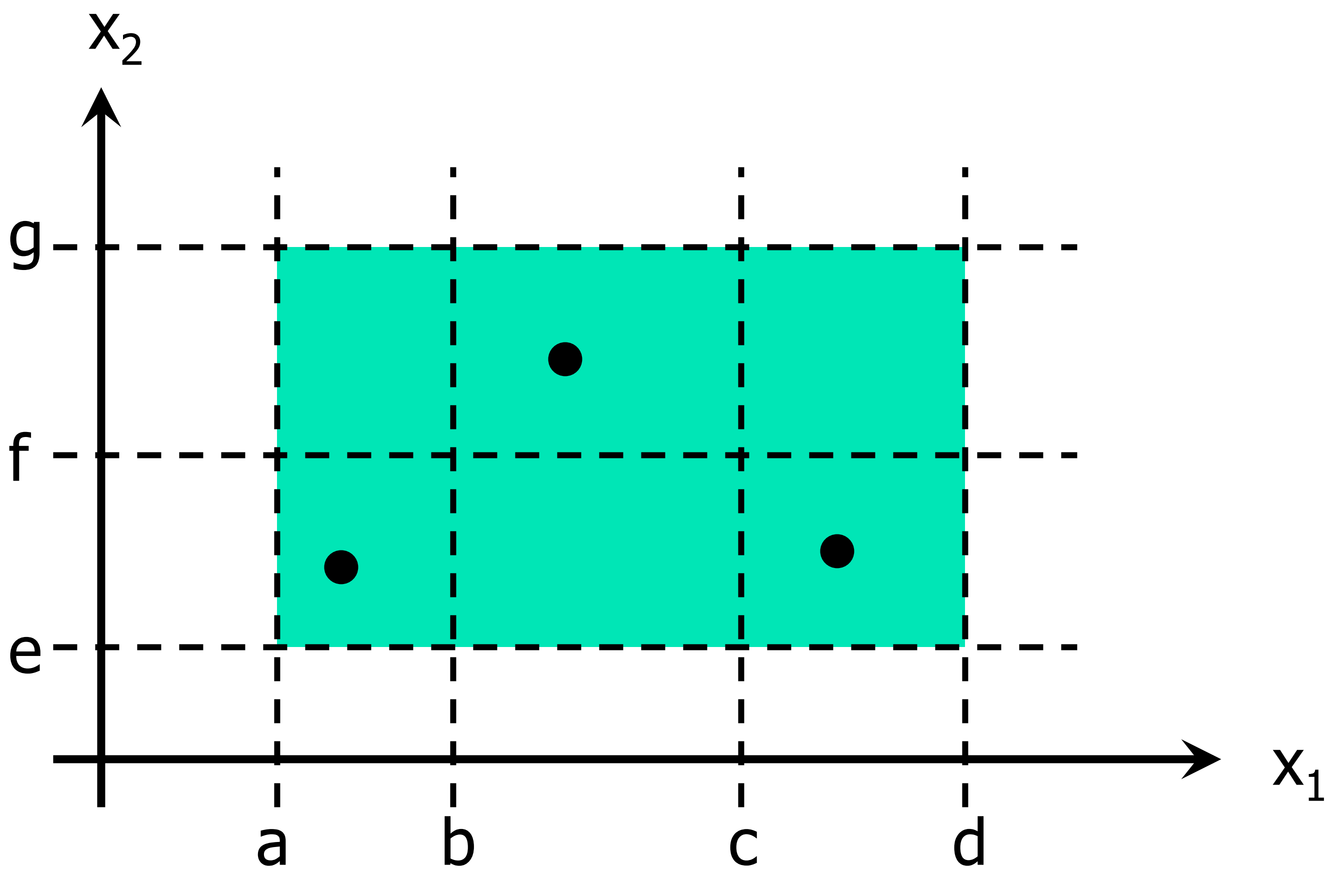
Applicability

- Equivalence Class Testing is appropriate when the system under test can be expressed as a function of one or more variables, whose domains have well defined intervals
- For a two-variable function F(x1,x2)

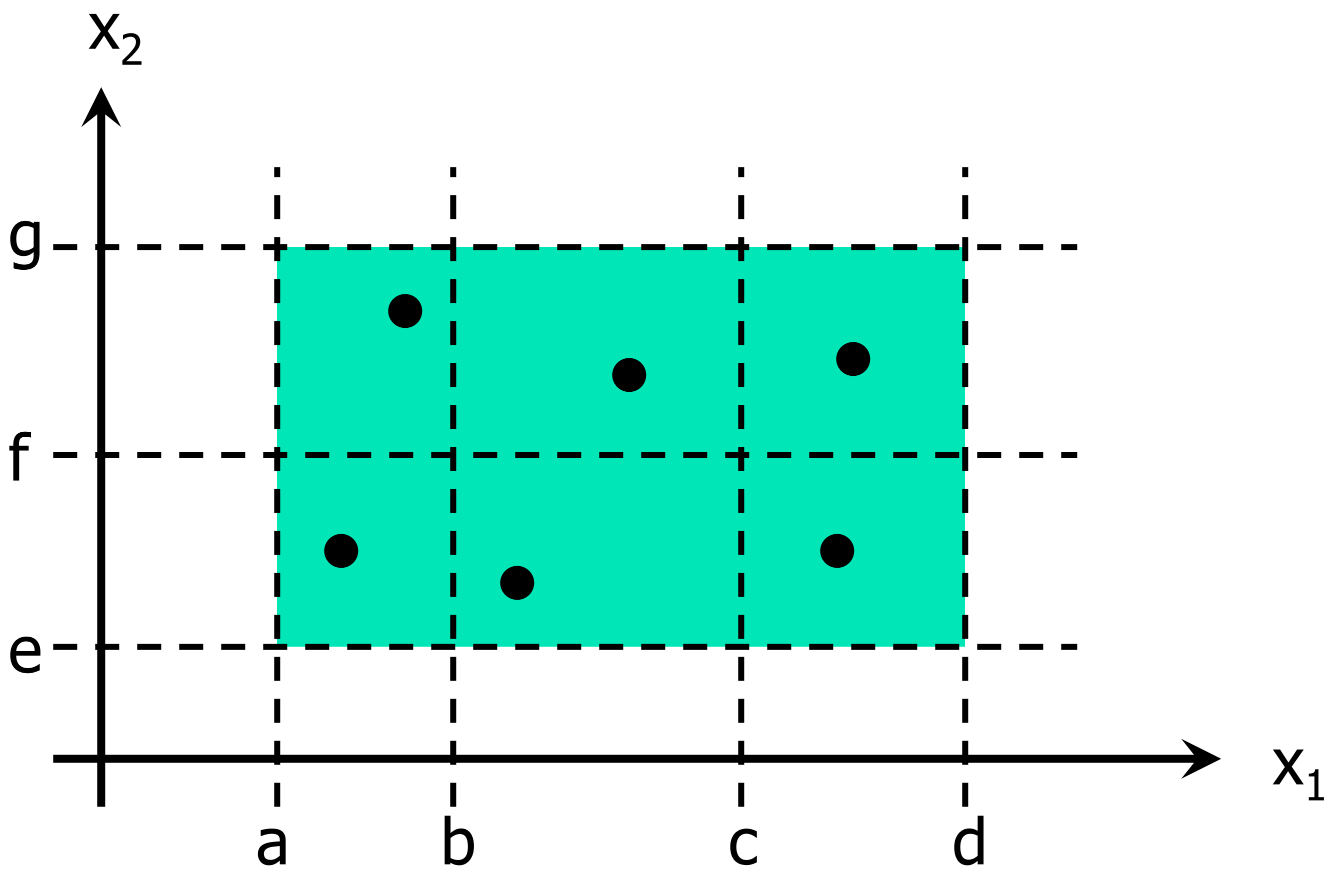
  $a \le x_1 \le d$, with intervals [a,b), [b,c), [c,d]

  $e \le x_2 \le g$, with intervals [e,f), [f,g]

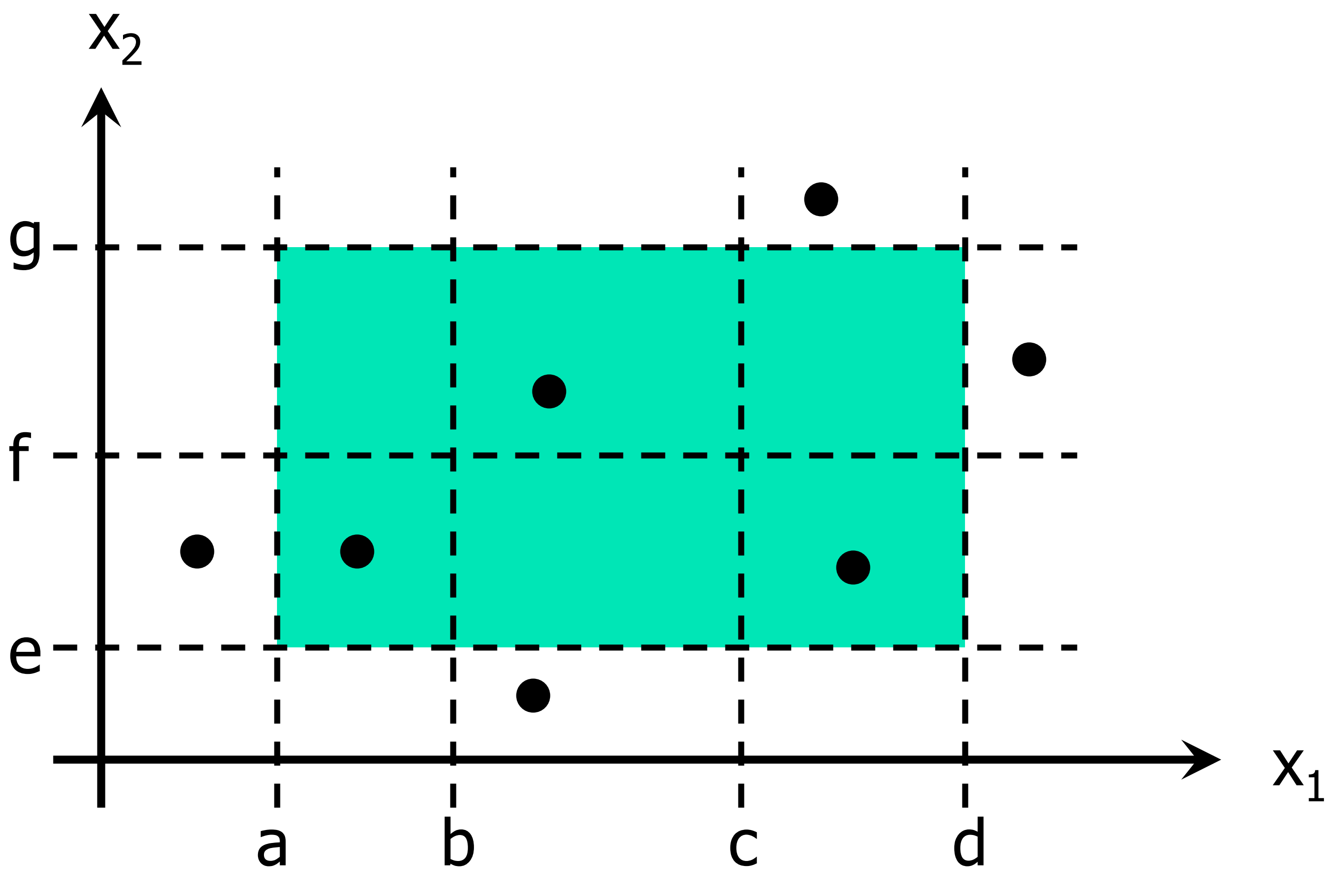
Weak Normal ECT



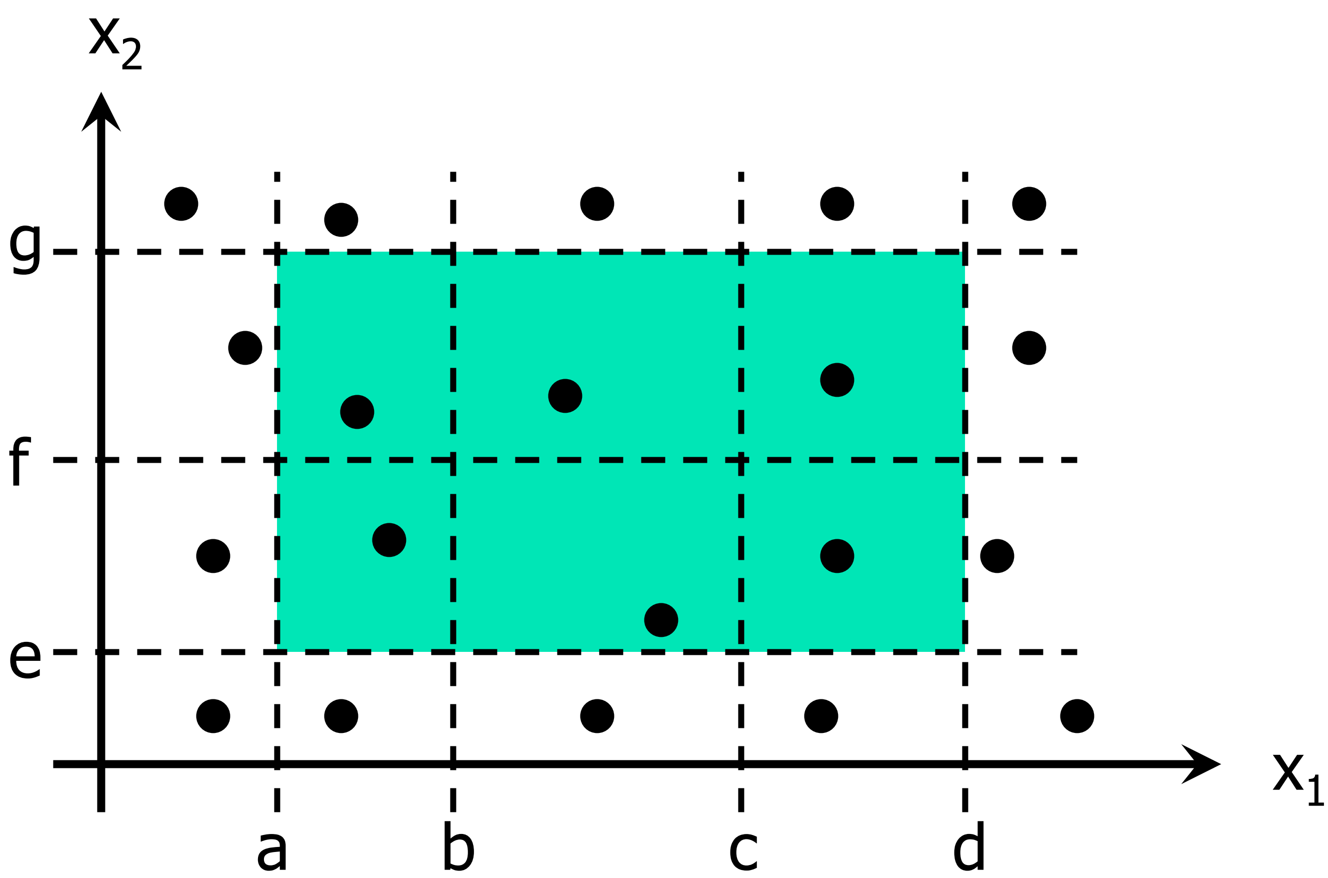
Strong Normal ECT



Weak Robust ECT



Strong Robust ECT



Triangle Equivalence Classes

- Four possible outputs:
  - Not a Triangle, Isosceles, Equilateral, Scalene
- We can use these to identify output (range) equivalence classes:

R1= {the triangle with sides a, b, c, is equilateral}

R2= {the triangle with sides a, b, c, is isosceles}

R3= {the triangle with sides a, b, c, is scalene}

R4= {sides a, b, c do not form a triangle}

Weak Normal 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

Weak Robust Test Cases

Test Case	a	b	c	Expected Output
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

Input equivalence classes

$D1= \{<a,b,c> \mid a = b = c\}$

$D2= \{<a,b,c> \mid a = b, a \neq c\}$

$D3= \{<a,b,c> \mid a = c, a \neq b\}$

$D4= \{<a,b,c> \mid b = c, a \neq b\}$

$D5= \{<a,b,c> \mid a \neq b, a \neq c, b \neq c\}$

$D6= \{<a,b,c> \mid a \geq b+c\}$

$D7= \{<a,b,c> \mid b \geq a+c\}$

$D8= \{<a,b,c> \mid c \geq a+b\}$

NextDate Equivalence Classes

M1= {month | month has 30 days}
M2= {month | month has 31 days}
M3= {month | month is February}
D1= {day | 1 ≤ day ≤ 28}
D2= {day | day = 29}
D3= {day | day = 30}
D4= {day | day=31}
Y1= {year | year = 1900}
Y2= {year | year is a leap year}
Y3= {year | year is a common year}

Weak Normal Test Cases

Test Case	Month	Day	Year	Expected Output
WN1	6	14	1900	6/15/1900
WN2	7	29	1996	7/30/1996
WN3	2	30	2002	Invalid input date
WN4	6	31	1900	Invalid input date

NextDate discussion

- There are 36 strong normal test cases (3 x 4 x 3)
- Some redundancy creeps in
  - Testing February 30 and 31 for three different types of years seems unlikely to reveal errors
- There are 150 strong robust test cases (5 x 6 x 5)

Guidelines and observations

- Equivalence Class Testing is appropriate when input data is defined in terms of intervals and sets of discrete values.
- Equivalence Class Testing is strengthened when combined with Boundary Value Testing
- Strong equivalence takes the presumption that variables are independent. If that is not the case, redundant test cases may be generated

Guidelines and observations

- Complex functions, such as the NextDate program, are well-suited for Equivalence Class Testing
- Several tries may be required before the “right” equivalence relation is discovered