

# Test Theory

SE323 Software Construction Testing and Maintenance

# Testing

- Selected Data from infinite set of data
- Which data should be selected?

# Software Testing Technique

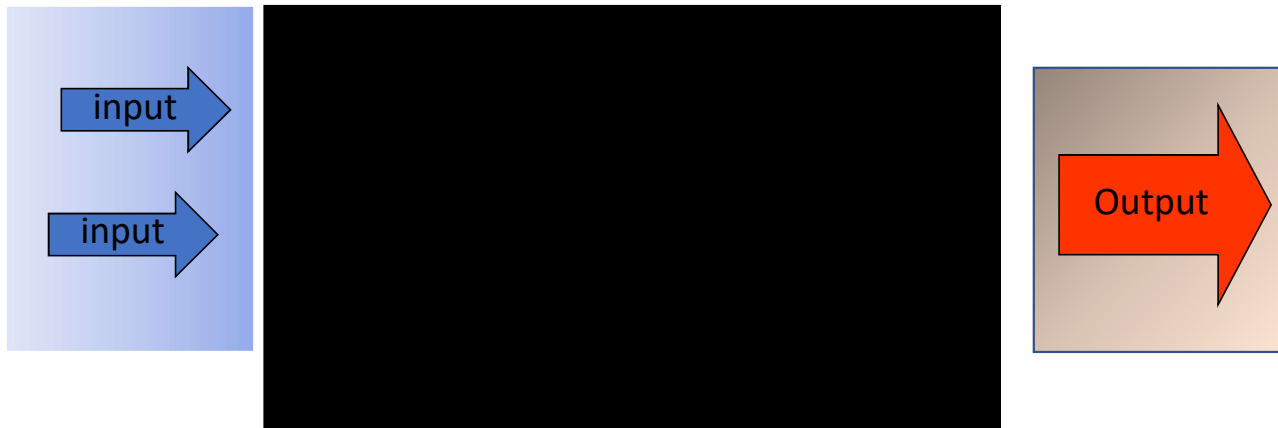
- Experience-based techniques
- Black-box testing
  - Specification-based
- White-box testing
  - Code-based

# Experience-based Technique

- Ad hoc testing
  - Test only for some **special** purposed
- Exploratory testing
  - Simultaneous learning, test design, and test execution
  - Dynamically design, execute and modify
  - Rely on the **testers** knowledge and experience

# Black-Boxed Testing

- Test from the specification
- Do not care how to implement
- Check for the result as expected



# Equivalence Class Testing

- Equivalence class
  - A set of partition program which respond in the **same ways**
  - **Reduce** redundancy
  - Ensure the completeness
  - Looking at input that treat the same
  - Or the same part of output

# Example code to represent equivalence class

- `int x;`
- `if x > 0 & x < 5 return y = 1`
- `else return y = 0`
- `expect y = 1 test input = 1, 2, 3, 4`
- `expect y = 0 test input = -inf, ...-1, 0, 5, 6 .....inf`

# Triangle Problem

- The triangle program accepts three integer a,b, and c as input
- The output of program is the type of triangle ??? More specific??
- a, b, c must satisfy the following condition ( use Integer)
  - $1 \leq a \leq 200; 1 \leq b \leq 200; 1 \leq c \leq 200$  Condition 1 -inf,..-1, 201,..205,..inf  
all the possible  $200 \times 200 \times 200$  est 8,000,000
  - $a < b + c; b < a + c; c < a + b$  Condition 2
  - from this condition, there are 2 equivalence class

The input those pass the condition  
Mean a,b,c can generate triangle  
*How many input should be test?*

The input those does not pass the condition  
a,b,c cannot generate triangle  
*??? How many input should be test*



# List types of triangle

- 7 types
  - Equiangular
  - Acute
  - Right
  - Obtuse
  - Equilateral
  - Isosceles
  - Scalene

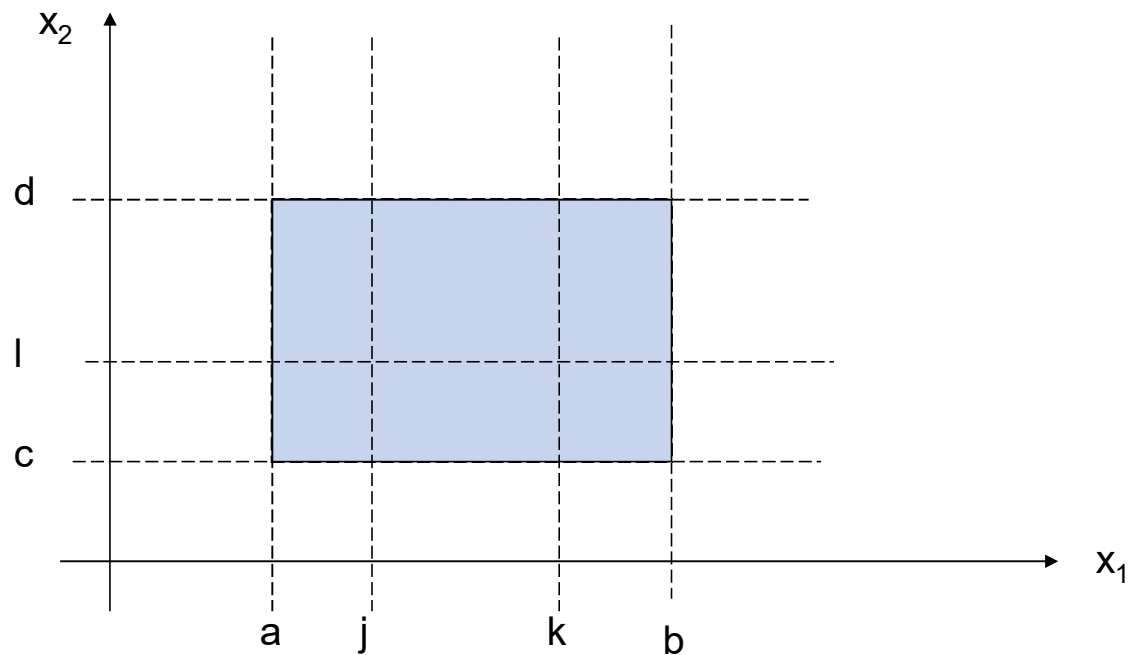
What are the equivalence classes of the test

# Consider on the equivalence class

- A set of input
- For each input, it can share the classes
- Only 1 representative of each class can be selected
- If 1 representative can express many classes?

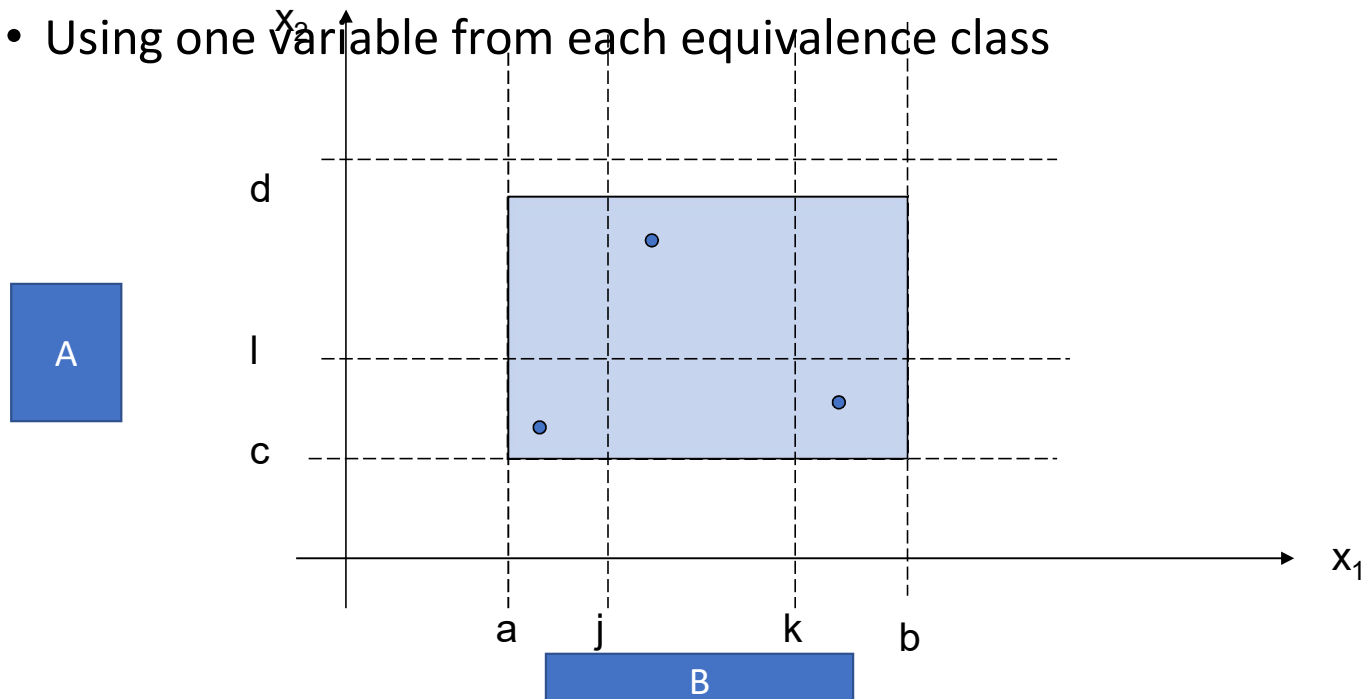
# Equivalence Class Testing

- Equivalence class



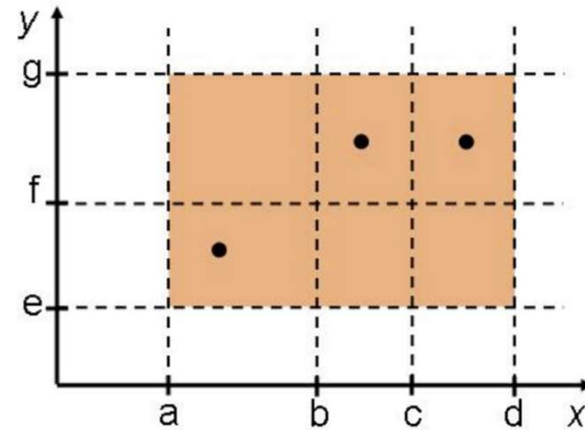
# Equivalence Class Testing

- Weak normal equivalence class testing
  - The word 'weak' means 'single fault assumption'. This type of testing is accomplished by using one variable from each equivalence class in a test case.
  - Using one variable from each equivalence class



## Weak Normal EC: Idea

- ▶ Define **equivalence classes** on the **domain (range)** of input (output) for **each** variable:  
(independent input)
- ▶ **cover** equivalence classes for the domain of **each variable**:  
single fault assumption
- ▶ **how many** test-cases are needed?
- ▶ also called: (equivalence, category) partition method



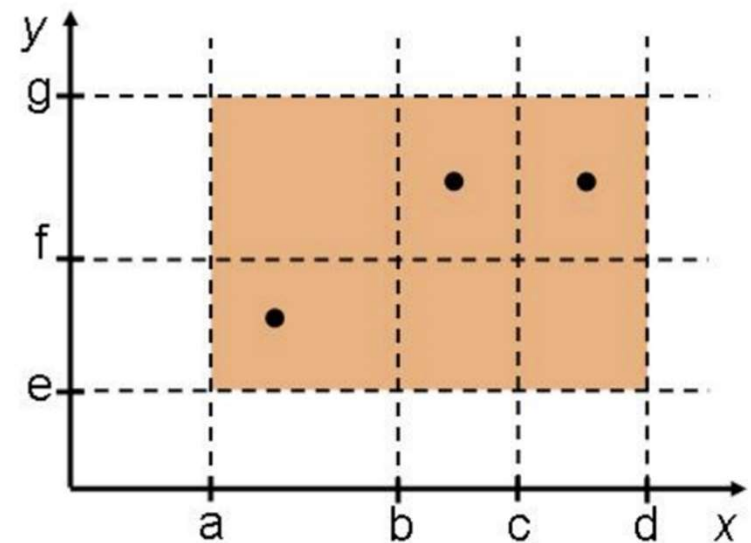
<https://people.eecs.ku.edu/~hossein/Teaching/Fa14/814/Lectures/Mousavi-EC-Testing.pdf>

## Little Puzzle

What is the **minimal number** of tokens that are needed to be put in an  $m \times n$  **grid** such that each row and column contains at least one **token**?

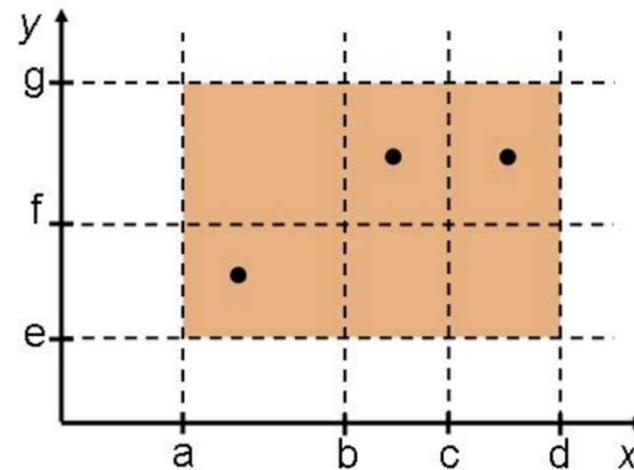
**$\max(m,n)$ :**

Put token number  $i$  at  $(\max(i, m), \max(i, n))$ .



## Weak Normal EC: Idea

- ▶ Define **equivalence classes** on the **domain (range)** of input (output) for **each** variable:  
(independent input)
- ▶ **cover** equivalence classes for the domain of **each variable**:  
single fault assumption
- ▶ **how many** test-cases are needed?  
 $\max_x |S_x|$ .



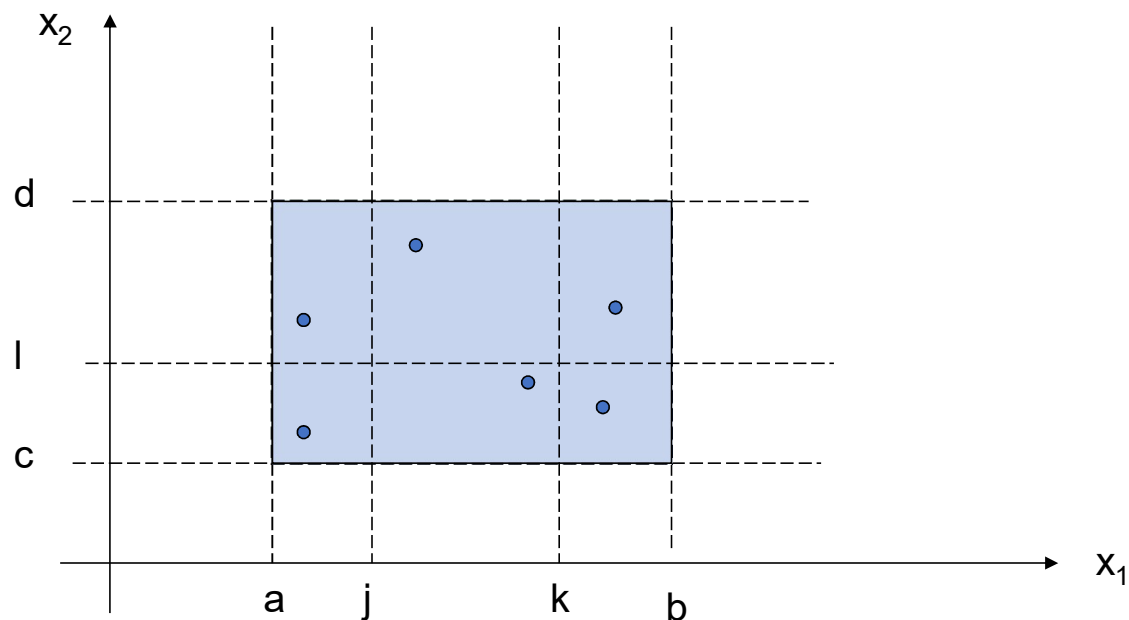


# Question 1 on Quiz Nov 23 2021

- What are the test cases of Triangle Problem for Weak Normal Equivalence class?

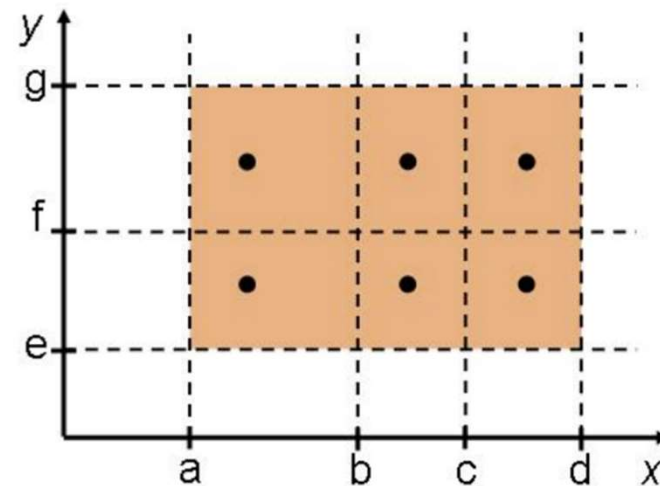
# Equivalence Class Testing

- Strong normal equivalence class
- This type of testing is based on the multiple fault assumption theory
  - Test case from Cartesian product of the equivalence class



## Strong Normal EC Testing

- ▶ cover the **all combinations** of equivalence classes for the domain of all variables:  
multiple fault assumption
- ▶ number of test-cases?  $\prod_x |S_x|$

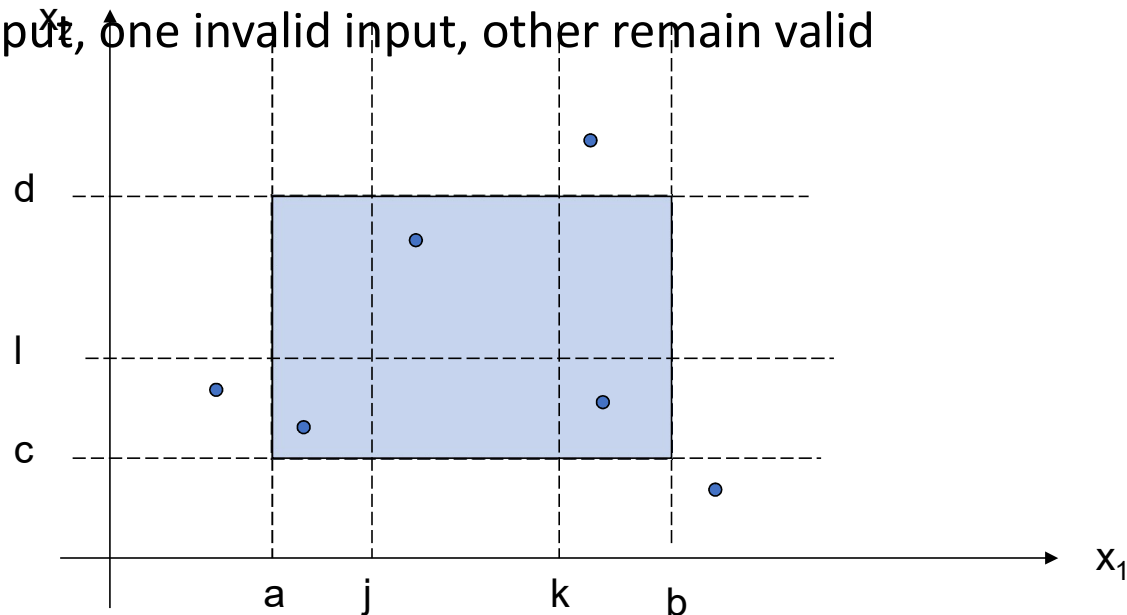


## Question 2 on Quiz Nov 23 2021

- What are the test cases of Triangle Problem for Strong Normal Equivalence class?

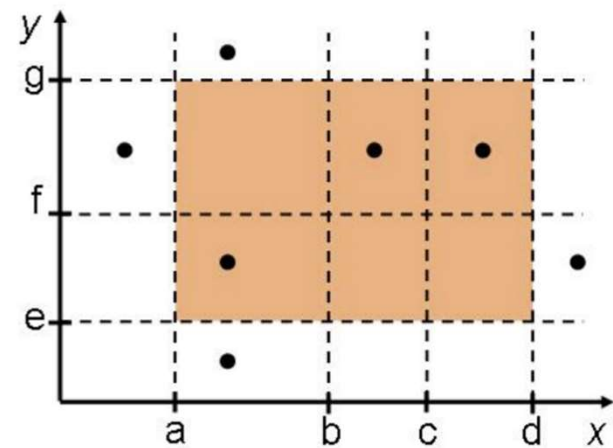
# Equivalence Class Testing

- Weak robust equivalent class testing
  - The word 'weak' means 'single fault assumption'. This type of testing is accomplished by using one variable from each equivalence class in a test case
    - Valid input, use one value from each valid class
    - Invalid input, one invalid input, other remain valid



## Weak Robust EC

- ▶ includes weak normal; adds out of range test-cases for each variable
- ▶ number of test-cases?  
 $(\max_x |S_x|) + 2 * n$

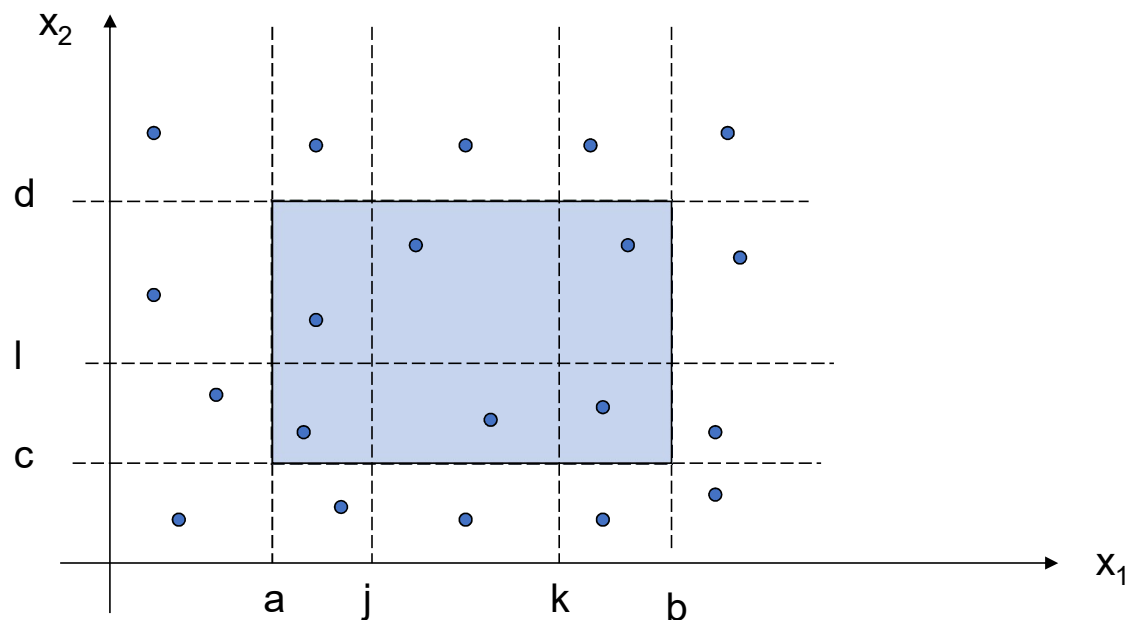


## Question 3 on Quiz Nov 23 2021

- What are the test cases of Triangle Problem for Weak Robust Equivalence class?

# Equivalence Class Testing

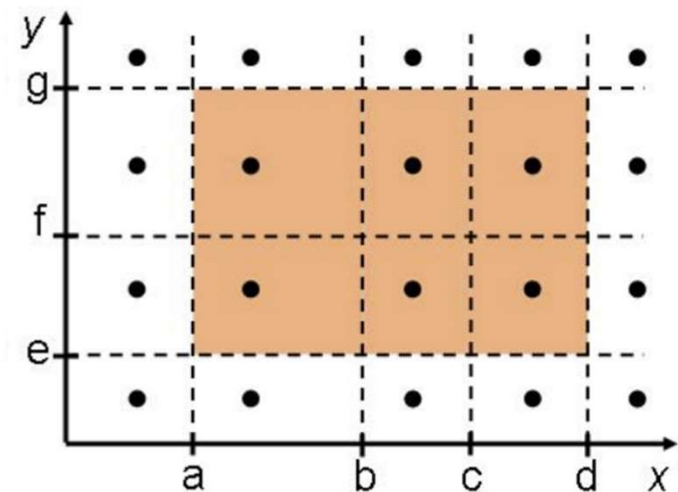
- Strong robust equivalence class
  - Test case from each element of the Cartesian product of all the equivalence class





## Strong Robust EC

- ▶ Same as strong normal but also checks for all out of range combinations
- ▶ number of test-cases?  
 $\prod_x (|S_x| + 2)$



## Question 4 on Quiz Nov 23 2021

- What are the test cases of Triangle Problem for Strong Robust Equivalence class?