East West University

Lab Report 02

Topic: JUnit Unit Testing

Course Title: Software Testing and Quality Assurance

Course Code: CSE 430

Section No: 01

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Lab Task 1

Source Code

TemperatureConverter.java:

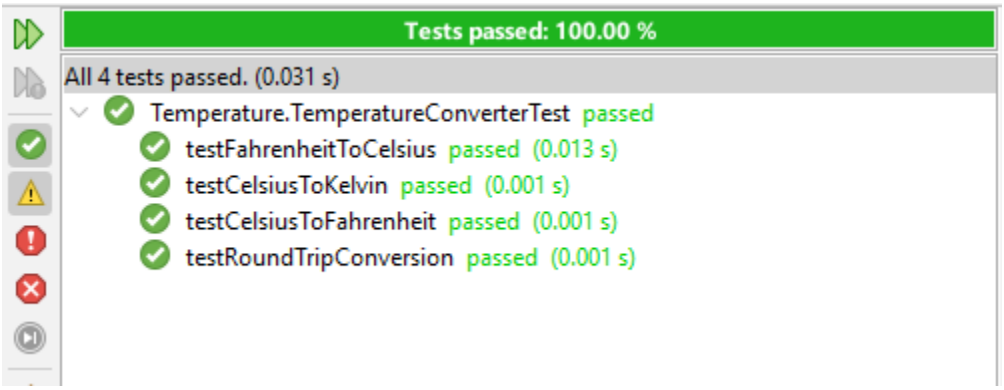
```
package Temperature;

public class TemperatureConverter {
    public double celsiusToFahrenheit(double c) {
        return (c * 9.0 / 5.0) + 32;
    }

    public double fahrenheitToCelsius(double f) {
        return (f - 32) * 5.0 / 9.0;
    }

    public double celsiusToKelvin(double c) {
        return c + 273.15;
    }
}
```

TemperatureConverterTest.java:

```
package Temperature;

import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class TemperatureConverterTest {

    private final TemperatureConverter converter = new TemperatureConverter();

    @Test
    void testCelsiusToFahrenheit() {
        assertEquals(32, converter.celsiusToFahrenheit(0), 0.01);
        assertEquals(212, converter.celsiusToFahrenheit(100), 0.01);
    }

    @Test
    void testFahrenheitToCelsius() {
        assertEquals(0, converter.fahrenheitToCelsius(32), 0.01);
        assertEquals(100, converter.fahrenheitToCelsius(212), 0.01);
    }

    @Test
```

```
    void testRoundTripConversion() {
        double c = 45.5;
        assertEquals(c, converter.fahrenheitToCelsius(converter.celsiusToFahrenheit(c)), 0.01);
    }

    @Test
    void testCelsiusToKelvin() {
        assertEquals(273.15, converter.celsiusToKelvin(0), 0.01);
    }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC1.1	celsiusToFahrenheit	0 °C	32 °F	Pass
TC1.2	celsiusToFahrenheit	100 °C	212 °F	Pass
TC1.3	fahrenheitToCelsius	212 °F	100 °C	Pass
TC1.4	celsiusToKelvin	25 °C	298.15 K	Pass
TC1.5	round-trip	45.5 °C → °F → °C	≈ 45.5 °C	Pass

Reflection

This task tests temperature conversions between Celsius, Fahrenheit, and Kelvin. The main goal was to verify formula accuracy and ensure round-trip consistency (C → F → C). Unit tests confirm correct outputs and floating-point precision within a small tolerance.

Lab Task 2

Source Code

BankAccount.java:

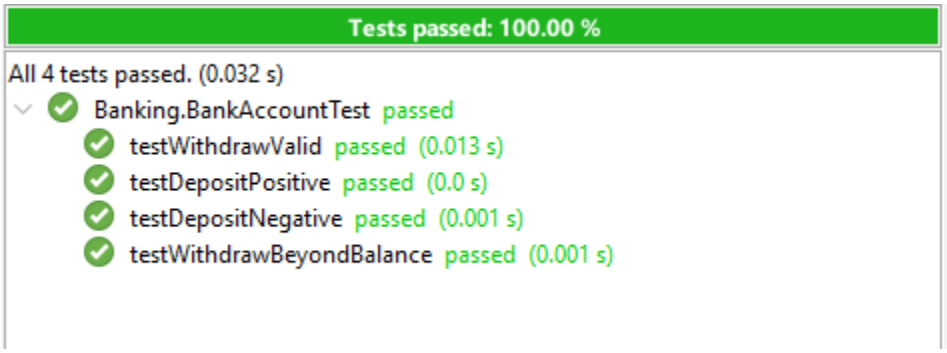
```
package Banking;

public class BankAccount {
   private double balance;

   public void deposit(double amt) {
      if (amt < 0) throw new IllegalArgumentException("Negative deposit not allowed");
      balance += amt;
   }

   public void withdraw(double amt) {
      if (amt > balance) throw new IllegalStateException("Insufficient balance");
      balance -= amt;
   }

   public double getBalance() {
      return balance;
   }
}
```

BankAccountTest.java:

```
package Banking;

import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class BankAccountTest {
   private final BankAccount account = new BankAccount();

   @Test
   void testDepositPositive() {
      account.deposit(100);
      assertEquals(100, account.getBalance());
```

```
    }

    @Test
    void testWithdrawValid() {
        account.deposit(200);
        account.withdraw(50);
        assertEquals(150, account.getBalance());
    }

    @Test
    void testWithdrawBeyondBalance() {
        assertThrows(IllegalStateException.class, () -> account.withdraw(500));
    }

    @Test
    void testDepositNegative() {
        assertThrows(IllegalArgumentException.class, () -> account.deposit(-100));
    }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC2.1	deposit	100	balance = 100	Pass
TC2.2	withdraw	deposit 200 → withdraw 50	balance = 150	Pass
TC2.3	withdraw	withdraw 500 (from 0 balance)	IllegalStateException	Pass
TC2.4	deposit	deposit −100	IllegalArgumentExcepti on	Pass

Reflection

The objective was to test deposits, withdrawals, and exception handling for invalid transactions. The program ensures no negative deposits or overdrafts occur. JUnit tests validate that exceptions are correctly thrown and account balances update properly.

Lab Task 3

Source Code

StringUtil.java:

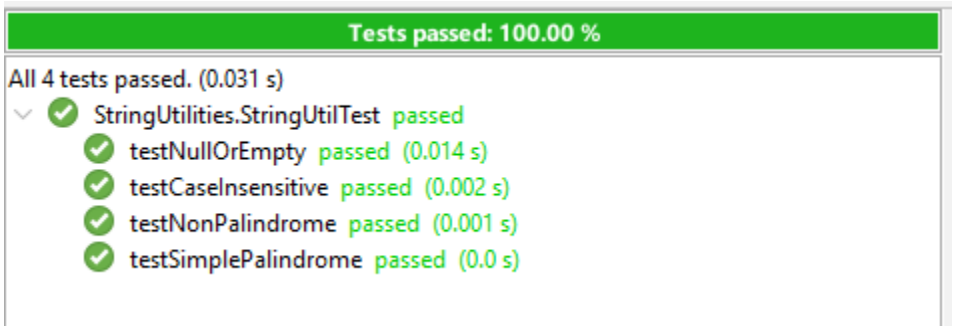
```
package StringUtilities;

public class StringUtil {
   public boolean isPalindrome(String s) {
      if (s == null || s.isEmpty()) return false;
      String clean = s.replaceAll("[^A-Za-z]", "").toLowerCase();
      return new StringBuilder(clean).reverse().toString().equals(clean);
   }
}
```

StringUtilTest .java:

```
package StringUtilities;

import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class StringUtilTest {
   private final StringUtil util = new StringUtil();

   @Test
   void testSimplePalindrome() {
      assertTrue(util.isPalindrome("madam"));
   }

   @Test
   void testCaseInsensitive() {
      assertTrue(util.isPalindrome("RaceCar"));
   }

   @Test
   void testNonPalindrome() {
```

```
        assertFalse(util.isPalindrome("hello"));
    }

    @Test
    void testNullOrEmpty() {
        assertFalse(util.isPalindrome(null));
        assertFalse(util.isPalindrome(""));
    }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC3.1	isPalindrome	"madam"	true	Pass
TC3.2	isPalindrome	"RaceCar"	true	Pass
TC3.3	isPalindrome	"hello"	false	Pass
TC3.4	isPalindrome	null / ""	false	Pass

Reflection

This task checks if a string reads the same forward and backward, ignoring case and punctuation. The test suite covers normal, mixed-case, and invalid inputs (null or empty). It demonstrates string cleaning and logic verification using JUnit assertions.

Lab Task 4

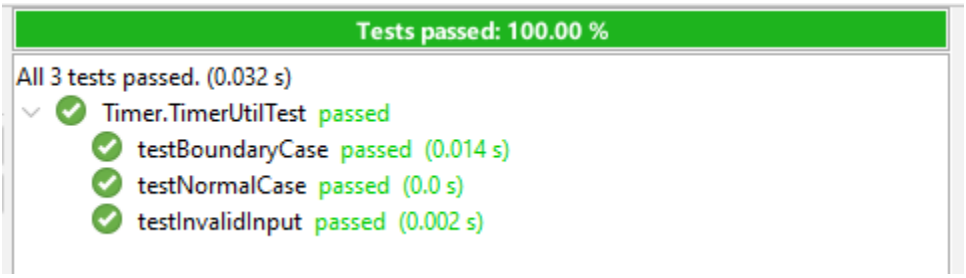
Source Code
TimerUtil .java:

```
package Timer;

public class TimerUtil {
   public int secondsBetween(int start, int end) {
      if (end < start) throw new IllegalArgumentException("End < start");
      return end - start;
   }
}
```

TimerUtilTest .java:

```
package Timer;

import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class TimerUtilTest {
   private final TimerUtil timer = new TimerUtil();

   @Test
   void testNormalCase() {
      assertEquals(15, timer.secondsBetween(10, 25));
   }

   @Test
   void testBoundaryCase() {
      assertEquals(0, timer.secondsBetween(0, 0));
   }

   @Test
   void testInvalidInput() {
      assertThrows(IllegalArgumentException.class, () -> timer.secondsBetween(20, 10));
   }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC4.1	secondsBetween	(10, 25)	15 s	Pass
TC4.2	secondsBetween	(0, 0)	0 s	Pass
TC4.3	secondsBetween	(20, 10)	IllegalArgumentException	Pass

Reflection

The Timer Utility computes elapsed seconds between two timestamps. Tests focus on normal cases, zero-length intervals, and invalid input (end < start). Exception testing ensures robust input validation and reliable function behavior.

Lab Task 5

Source Code

ShoppingCart .java:

```
package Shopping;

import java.util.*;
public class ShoppingCart {
   private final List<String> items = new ArrayList<>();

   public void addItem(String item) {
      items.add(item);
```

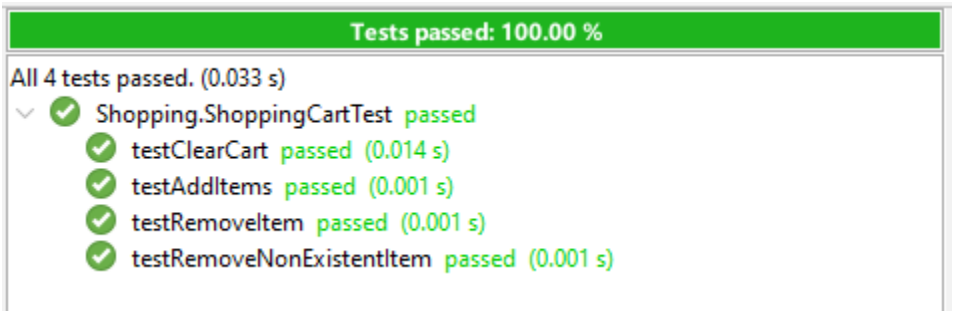
```
    }

    public void removeItem(String item) {
        items.remove(item);
    }

    public int getItemCount() {
        return items.size();
    }

    public void clear() {
        items.clear();
    }
}
```

ShoppingCartTest.java:

```
package Shopping;

import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class ShoppingCartTest {
    private final ShoppingCart cart = new ShoppingCart();

    @Test
    void testAddItems() {
        cart.addItem("A");
        cart.addItem("B");
        cart.addItem("C");
        assertEquals(3, cart.getItemCount());
    }

    @Test
    void testRemoveItem() {
        cart.addItem("X");
        cart.addItem("Y");
        cart.removeItem("Y");
        assertEquals(1, cart.getItemCount());
    }

    @Test
    void testClearCart() {
        cart.addItem("A");
        cart.addItem("B");
        cart.clear();
```

```
        assertEquals(0, cart.getItemCount());
    }

    @Test
    void testRemoveNonExistentItem() {
        assertDoesNotThrow(() -> cart.removeItem("Z"));
    }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC5.1	addItem / getItemCount	Add 3 items	count = 3	Pass
TC5.2	removeItem	Remove 1 of 3 items	count = 2	Pass
TC5.3	clear	Clear cart	count = 0	Pass
TC5.4	removeItem	Remove non-existent item	No error thrown	Pass

Reflection

This task simulates basic cart operations—adding, removing, and clearing items. Tests confirm item counts update correctly and that removing non-existent items doesn't cause errors. It demonstrates testing for state consistency in list-based objects.

Home Work 1

Source Code

Calculator1 .java:

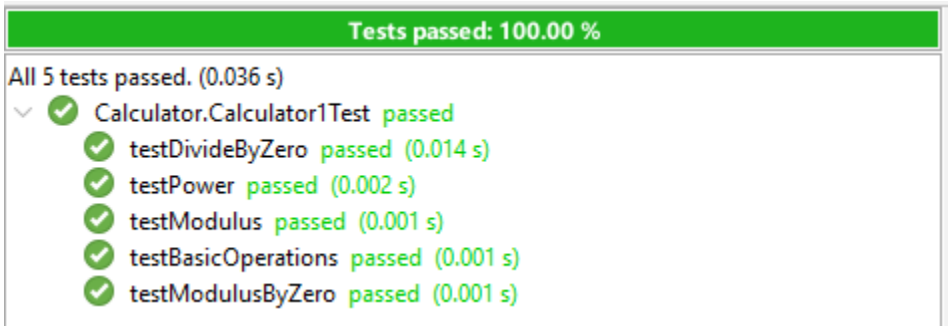
```
package Calculator;

public class Calculator1 {

    public int add(int a, int b) {
        return a + b;
    }

    public int subtract(int a, int b) {
        return a - b;
    }

    public int multiply(int a, int b) {
        return a * b;
    }

    public int divide(int a, int b) {
        if (b == 0) throw new IllegalArgumentException("Cannot divide by zero.");
        return a / b;
    }

    public double power(int base, int exp) {
        return Math.pow(base, exp);
    }

    public int modulus(int a, int b) {
        if (b == 0) throw new IllegalArgumentException("Modulus by zero not allowed.");
        return a % b;
    }
}
```

Calculator1Test .java:

```
package Calculator;

import org.junit.jupiter.api.*;
import static org.junit.jupiter.api.Assertions.*;

public class Calculator1Test {
```

```
    private Calculator1 calc;

    @BeforeEach
    void setUp() {
        calc = new Calculator1();
    }

    @AfterEach
    void tearDown() {
        calc = null;
    }

    @Test
    void testBasicOperations() {
        assertEquals(10, calc.add(7, 3));
        assertEquals(4, calc.subtract(7, 3));
        assertEquals(21, calc.multiply(7, 3));
        assertEquals(2, calc.divide(10, 5));
    }

    @Test
    void testPower() {
        assertEquals(8.0, calc.power(2, 3), 0.001);
        assertEquals(1.0, calc.power(5, 0), 0.001);
    }

    @Test
    void testModulus() {
        assertEquals(1, calc.modulus(10, 3));
    }

    @Test
    void testDivideByZero() {
        assertThrows(IllegalArgumentException.class, () -> calc.divide(5, 0));
    }

    @Test
    void testModulusByZero() {
        assertThrows(IllegalArgumentException.class, () -> calc.modulus(9, 0));
    }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC6.1	add	7, 3	10	Pass
TC6.2	power	2, 3	8.0	Pass
TC6.3	modulus	10, 3	1	Pass
TC6.4	divide	5, 0	IllegalArgumentException	Pass
TC6.5	modulus	9, 0	IllegalArgumentException	Pass

Reflection

The enhanced calculator adds power and modulus operations to a basic arithmetic class. Tests verify correct results for all operations, including exceptions for division and modulus by zero. Lifecycle annotations (@BeforeEach, @AfterEach) demonstrate structured test initialization and cleanup.

Home Work 2

Source Code
BankAccount2 .java:

```
package Banking;

public class BankAccount2 {
```

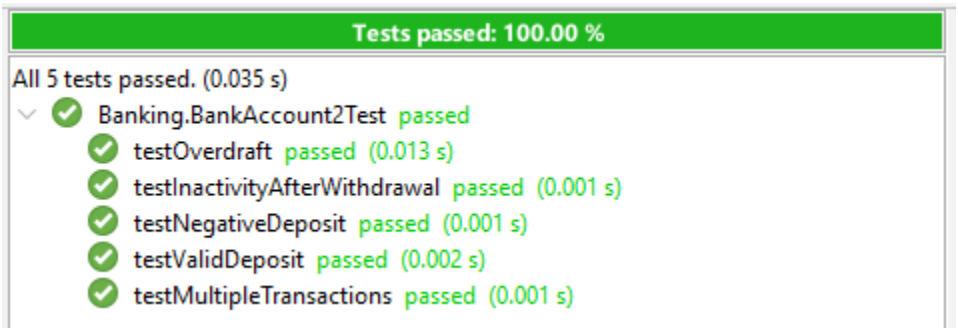
```
    private double balance;
    private boolean active = true;

    public void deposit(double amt) {
        if (amt < 0) throw new IllegalArgumentException("Negative deposit not allowed");
        balance += amt;
        checkActivity();
    }

    public void withdraw(double amt) {
        if (amt > balance) throw new IllegalStateException("Insufficient balance");
        balance -= amt;
        checkActivity();
    }

    public double getBalance() {
        return balance;
    }

    public boolean isActive() {
        return active;
    }

    private void checkActivity() {
        active = balance >= 100;
    }
}
```

BankAccount2Test .java:

```
package Banking;

import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class BankAccount2Test {

    @Test
    void testValidDeposit() {
        BankAccount2 acc = new BankAccount2();
        acc.deposit(500);
        assertEquals(500, acc.getBalance());
        assertTrue(acc.isActive());
    }

    @Test
```

```
    void testOverdraft() {
        BankAccount2 acc = new BankAccount2();
        assertThrows(IllegalStateException.class, () -> acc.withdraw(50));
    }

    @Test
    void testNegativeDeposit() {
        BankAccount2 acc = new BankAccount2();
        assertThrows(IllegalArgumentException.class, () -> acc.deposit(-100));
    }

    @Test
    void testInactivityAfterWithdrawal() {
        BankAccount2 acc = new BankAccount2();
        acc.deposit(150);
        acc.withdraw(100);
        assertFalse(acc.isActive());
    }

    @Test
    void testMultipleTransactions() {
        BankAccount2 acc = new BankAccount2();
        acc.deposit(200);
        acc.withdraw(50);
        assertEquals(150, acc.getBalance());
        assertTrue(acc.isActive());
    }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC7.1	deposit	+500	balance = 500, active = true	Pass
TC7.2	withdraw	withdraw 50 (from 0 balance)	IllegalStateException	Pass
TC7.3	deposit	−100	IllegalArgumentException	Pass
TC7.4	withdraw	deposit 150 → withdraw 100	active = false	Pass
TC7.5	multiple ops	deposit 200 → withdraw 50	balance = 150, active = true	Pass

Reflection

This version of BankAccount introduces an "active" status based on balance thresholds. Tests confirm correct balance updates, inactivity when funds fall below 100, and proper exception handling for invalid deposits or overdrafts. It connects business logic with rigorous unit testing.

Home Work 3

Source Code

StringAnalyzer .java:

```
package StringUtilities;

import java.util.Arrays;

public class StringAnalyzer {

    public boolean isPalindrome(String s) {
        if (s == null || s.isEmpty()) return false;
        String clean = s.replaceAll("[^A-Za-z]", "").toLowerCase();
        return new StringBuilder(clean).reverse().toString().equals(clean);
```

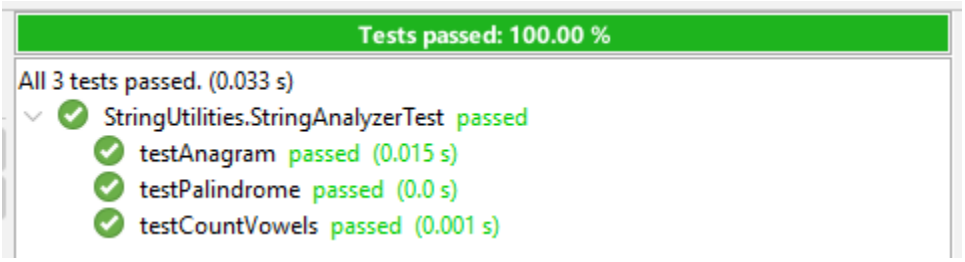
```
    }

    public int countVowels(String s) {
        if (s == null) return 0;
        int count = 0;
        for (char c : s.toLowerCase().toCharArray()) {
            if ("aeiou".indexOf(c) != -1) count++;
        }
        return count;
    }

    public boolean isAnagram(String s1, String s2) {
        if (s1 == null || s2 == null) return false;
        char[] a = s1.replaceAll("[^A-Za-z]", "").toLowerCase().toCharArray();
        char[] b = s2.replaceAll("[^A-Za-z]", "").toLowerCase().toCharArray();
        Arrays.sort(a);
        Arrays.sort(b);
        return Arrays.equals(a, b);
    }
}
```

StringAnalyzerTest .java:

```
package StringUtilities;

import org.junit.jupiter.api.DisplayName;
import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class StringAnalyzerTest {

    private final StringAnalyzer analyzer = new StringAnalyzer();

    @Test
    @DisplayName("Check palindrome detection")
    void testPalindrome() {
        assertTrue(analyzer.isPalindrome("Level"));
        assertFalse(analyzer.isPalindrome("Java"));
    }

    @Test
    @DisplayName("Count vowels in a string")
    void testCountVowels() {
        assertEquals(2, analyzer.countVowels("Hello"));
        assertEquals(0, analyzer.countVowels(""));
        assertEquals(0, analyzer.countVowels(null));
```

```
    }

    @Test
    @DisplayName("Check if two words are anagrams")
    void testAnagram() {
        assertTrue(analyzer.isAnagram("listen", "silent"));
        assertFalse(analyzer.isAnagram("test", "text"));
        assertFalse(analyzer.isAnagram(null, "text"));
    }
}
```

OutPut



TestCase Table

Test Case ID	Method	Input	Expected Output	Result
TC8.1	isPalindrome	"Level"	true	Pass
TC8.2	isPalindrome	"Java"	false	Pass
TC8.3	countVowels	"Hello"	3	Pass
TC8.4	countVowels	null / ""	0	Pass
TC8.5	isAnagram	"listen", "silent"	true	Pass
TC8.6	isAnagram	"test", "text"	false	Pass
TC8.7	isAnagram	null, "text"	false	Pass

Reflection

This utility performs three operations: palindrome checking, vowel counting, and anagram detection. The tests include case-insensitive checks, null handling, and various input combinations. It emphasizes robust text processing and comprehensive unit test coverage using descriptive test names.