Day 18

Task 1: Creating and Managing Threads

Write a program that starts two threads, where each thread prints numbers from 1 to 10 with a 1-second delay between each number

```
package com.wipro
class ThreadA {
	public synchronized void print1_10() {
		System.out.println("Run Started");
		try {
			for (int i = 1; i <= 10; i++) {
				Thread.sleep(1000);
				System.out.println("i = " + i);
			}
		} catch (InterruptedException e) {

			e.printStackTrace();
		}
		System.out.println("Run Ended");
	}
}
class ThreadB extends Thread {
	ThreadA ta;

	public ThreadB(ThreadA ta) {
		this.ta = ta;
	}
```

```
	public void run() {
		ta.print1_10();
	}
}

public class ThreadEg3 {
	public static void main(String[] args) {
		System.out.println("Main Started");
		ThreadA ta = new ThreadA();
		ThreadB t1 = new ThreadB(ta);
		t1.start();

		ThreadB t2 = new ThreadB(ta);
		t2.start();

		ThreadB t3 = new ThreadB(ta);
		t3.start();
		System.out.println("Main Ended");
	}

}
```

Task 2: States and Transitions

Create a Java class that simulates a thread going through different lifecycle states: NEW, RUNNABLE, WAITING, TIMED_WAITING, BLOCKED, and TERMINATED. Use methods like sleep(), wait(), notify(), and join() to demonstrate these states..

```
public class ThreadLifecycleDemo {

    public static void main(String[] args) throws InterruptedException {
        Thread thread = new Thread(() -> {
            try {
                System.out.println("Thread state: " + Thread.currentThread().getState());
                Thread.sleep(1000); // Thread sleeps for 1 second
                System.out.println("Thread state: " + Thread.currentThread().getState());

                synchronized(ThreadLifecycleDemo.class) {
                    ThreadLifecycleDemo.class.wait(); // Thread waits until notified
                }

                System.out.println("Thread state: " + Thread.currentThread().getState());

                Thread.sleep(2000); // Sleep to give other thread time to acquire lock
                synchronized(ThreadLifecycleDemo.class) {
                    System.out.println("Thread state: " + Thread.currentThread().getState());
                }

                System.out.println("Thread state: " + Thread.currentThread().getState());
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        });

        thread.start();
```

```
        System.out.println("Thread state: " + thread.getState());
        thread.join();

        System.out.println("Thread state: " + thread.getState());
    }
}
```

Task 3: Synchronization and Inter-thread Communication

Implement a producer-consumer problem using wait() and notify() methods to handle the correct processing sequence between threads.

```
package com.wipro;


class Common {
        int num;
        boolean available = false;


        public synchronized int put(int num) {
                if (available)
                        try {
                                wait();
                        } catch (InterruptedException e) {


                                e.printStackTrace();
                        }
                this.num = num;
```

```
		System.out.println("From Prod :" + this.num);

		try {
			Thread.sleep(1000);
		} catch (InterruptedException e) {

			e.printStackTrace();
		}

		available = true;
		notify();
		return num;
	}

	public synchronized int get() {
		if (!available)
			try {
				wait();
			} catch (InterruptedException e) {

				e.printStackTrace();
			}
		System.out.println("From COnsumer : " + this.num);

		try {
			Thread.sleep(1000);
		} catch (InterruptedException e) {
			// TODO Auto-generated catch block
			e.printStackTrace();
```

```
                }
                available = false;
                notify();
                return num;

        }
}

class Producer extends Thread {
        Common c;

        public Producer(Common c) {
                this.c = c;
                new Thread(this, "Producer :").start();
        }

        public void run() {
                int x = 0, i = 0;
                while (x <= 10) {
                        c.put(i++);
                        x++;
                }
        }
}

class Consumer extends Thread {
        Common c;

        public Consumer(Common c) {
```

```
        this.c = c;
        new Thread(this, "Consumer :").start();
    }

    public void run() {
        int x = 0;
        while (x <= 10) {
            c.get();
            x++;
        }
    }
}

public class PC {

    public static void main(String[] args) {
        Common c = new Common();
        new Producer(c);
        new Consumer(c);
    }

}
```

Task 4: Synchronized Blocks and Methods

Write a program that simulates a bank account being accessed by multiple threads to perform deposits and withdrawals using synchronized methods to prevent race conditions.

public class BankAccount {

```
private double balance;

public BankAccount(double initialBalance) {
    this.balance = initialBalance;
}

public synchronized void deposit(double amount) {
    balance += amount;
    System.out.println("Deposited: " + amount + ", Current Balance: " + balance);
}
public synchronized void withdraw(double amount) {
    if (balance >= amount) {
        balance -= amount;
        System.out.println("Withdrawn: " + amount + ", Current Balance: " + balance);
    } else {
        System.out.println("Insufficient balance for withdrawal.");
    }
}
public synchronized double getBalance() {
    return balance;
}

public static void main(String[] args) {
    BankAccount account = new BankAccount(1000);
    Thread depositThread = new Thread(() -> {
        for (int i = 0; i < 5; i++) {
            account.deposit(200);
        }
    });
```

```
        Thread withdrawThread = new Thread(() -> {
            for (int i = 0; i < 5; i++) {
                account.withdraw(300);
            }
        });
        depositThread.start();
        withdrawThread.start();
        try {
            depositThread.join();
            withdrawThread.join();
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
        System.out.println("Final Balance: " + account.getBalance());
    }
}
```

Task 5: Thread Pools and Concurrency Utilities

Create a fixed-size thread pool and submit multiple tasks that perform complex calculations or I/O operations and observe the execution.

```
import java.util.concurrent.ExecutorService;
import java.util.concurrent.Executors;

public class ThreadPoolDemo {

    public static void main(String[] args) {
```

```
        ExecutorService executor = Executors.newFixedThreadPool(3);


            for (int i = 1; i <= 5; i++) {
          int taskId = i;
          executor.submit(() -> {
             System.out.println("Task " + taskId + " started by thread: " +
Thread.currentThread().getName());
             // Perform some complex calculation or I/O operation
             try {
                Thread.sleep(2000); // Simulating a time-consuming task
             } catch (InterruptedException e) {
                e.printStackTrace();
             }
             System.out.println("Task " + taskId + " completed by thread: " +
Thread.currentThread().getName());
          });
       }


             executor.shutdown();
    }
}
```

Task 6: Executors, Concurrent Collections, Completable Future

Use an ExecutorService to parallelize a task that calculates prime numbers up to a given number and then use CompletableFuture to write the results to a file asynchronously.

```
import java.io.FileWriter;
```

```
import java.io.IOException;
import java.util.ArrayList;
import java.util.List;
import java.util.concurrent.CompletableFuture;
import java.util.concurrent.ExecutorService;
import java.util.concurrent.Executors;

public class PrimeNumberCalculator {

    public static void main(String[] args) throws IOException {
        int n = 100;
        String filePath = "primes.txt";
        ExecutorService executor =
Executors.newFixedThreadPool(Runtime.getRuntime().availableProcessors());
        CompletableFuture<List<Integer>> primesFuture = CompletableFuture.supplyAsync(() -
> calculatePrimes(n), executor);
        primesFuture.thenAcceptAsync(primes -> {
            try (FileWriter writer = new FileWriter(filePath)) {
                for (Integer prime : primes) {
                    writer.write(prime + "\n");
                }
                System.out.println("Prime numbers written to file: " + filePath);
            } catch (IOException e) {
                e.printStackTrace();
            }
        }, executor);
        executor.shutdown();
    }

    private static List<Integer> calculatePrimes(int n) {
```

```
        List<Integer> primes = new ArrayList<>();
        for (int i = 2; i <= n; i++) {
            if (isPrime(i)) {
                primes.add(i);
            }
        }
        return primes;
    }

    private static boolean isPrime(int number) {
        if (number <= 1) {
            return false;
        }
        for (int i = 2; i <= Math.sqrt(number); i++) {
            if (number % i == 0) {
                return false;
            }
        }
        return true;
    }
}
```

Task 7: Writing Thread-Safe Code, Immutable Objects

Design a thread-safe Counter class with increment and decrement methods. Then demonstrate its usage from multiple threads. Also, implement and use an immutable class to share data between threads.

```
import java.util.concurrent.locks.Lock;
```

```
import java.util.concurrent.locks.ReentrantLock;
class Counter {
    private int count;
    private final Lock lock = new ReentrantLock();
    public void increment() {
        lock.lock();
        try {
            count++;
        } finally {
            lock.unlock();
        }
    }
    public void decrement() {
        lock.lock();
        try {
            count--;
        } finally {
            lock.unlock();
        }
    }
    public int getCount() {
        lock.lock();
        try {
            return count;
        } finally {
            lock.unlock();
        }
    }
}
```

```
final class ImmutableData {
    private final int value;

    public ImmutableData(int value) {
        this.value = value;
    }

    public int getValue() {
        return value;
    }
}

public class ThreadSafeDemo {
    public static void main(String[] args) throws InterruptedException {
        Counter counter = new Counter();
        Thread incrementThread = new Thread(() -> {
            for (int i = 0; i < 1000; i++) {
                counter.increment();
            }
        });

        Thread decrementThread = new Thread(() -> {
            for (int i = 0; i < 1000; i++) {
                counter.decrement();
            }
        });

        incrementThread.start();
        decrementThread.start();
```

```
        incrementThread.join();
        decrementThread.join();
        System.out.println("Final Count: " + counter.getCount());
        ImmutableData immutableData = new ImmutableData(10);
        Thread accessThread1 = new Thread(() -> {
            System.out.println("Thread 1: Value = " + immutableData.getValue());
        });

        Thread accessThread2 = new Thread(() -> {
            System.out.println("Thread 2: Value = " + immutableData.getValue());
        });

        accessThread1.start();
        accessThread2.start();
    }
}
```