INGENIERIA EN SISTEMAS COMPUTACIONALES

TOPICOS AVANZADOS DE PROGRAMACION

REPORTE – THREAD SYNCHRONIZATION

ALUMNO:

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REDACCION DEL PROBLEMA:

El problema presentado en este reporte consiste en la creación de un programa que haga uso de la sincronización de subprocesos.

CODIGO FUENTE:

Clase ThreadSyncGUI

```
package com.milkyblue;

import java.awt.BorderLayout;
import java.awt.Color;
import java.awt.Dimension;
import java.awt.GridBagConstraints;
import java.awt.GridBagLayout;
import java.awt.Insets;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.util.concurrent.ExecutorService;
import java.util.concurrent.Executors;
import java.util.concurrent.TimeUnit;

import javax.swing.BorderFactory;
import javax.swing.JButton;
import javax.swing.JCheckBox;
import javax.swing.JFrame;
import javax.swing.JLabel;
import javax.swing.JPanel;

import com.github.tomaslanger.chalk.Chalk;

// ThreadSyncGUI class. Models the GUI of the program.
public class ThreadSyncGUI {
  // Constants to control color between threads.
  public static final int BLUE = 0, YELLOW = 1;

  private JFrame mainFrame;
  private JPanel mainPanel, topPanel, centerPanel, bottomPanel;
  private JCheckBox chkSync;
  private JLabel[][] arrayLookups;
  private JButton btnExecute;
```

```java
// Class constructor.
public ThreadSyncGUI() {
  // Enables colored output on terminal.
  Chalk.setColorEnabled(true);

  mainFrame = new JFrame("Thread Synchronization");
  mainPanel = new JPanel();
  topPanel = new JPanel();
  centerPanel = new JPanel();
  bottomPanel = new JPanel();
  chkSync = new JCheckBox("Thread Synchronization");

  // arrayLookups is initialized as a two dimensional array of labels, one row for
  // array positions and the other row for array actual values.
  arrayLookups = new JLabel[2][6];

  for (int i = 0; i < arrayLookups.length; i++)
    for (int j = 0; j < arrayLookups[i].length; j++) {
      if (i == 0)
        arrayLookups[i][j] = new JLabel(Integer.toString(j), JLabel.CENTER);
      else
        arrayLookups[i][j] = new JLabel("0", JLabel.CENTER);
    }

  btnExecute = new JButton("Execute");

  // Main methods are called.
  addAttributes();
  addListeners();
  build();
  launch();

}

// Adds attributes to elements in the program.
private void addAttributes() {
  mainPanel.setLayout(new BorderLayout());
  centerPanel.setLayout(new GridBagLayout());

  centerPanel.setBorder(BorderFactory.createEmptyBorder(0, 10, 0, 10));

  // Sets attributes to arrayLookups labels based on the correspondent row.
  for (int i = 0; i < arrayLookups.length; i++)
    for (int j = 0; j < arrayLookups[i].length; j++) {
      arrayLookups[i][j].setOpaque(true);
```

```
        if (i == 0)
          arrayLookups[i][j].setBackground(Color.decode("#333333"));
        else
          arrayLookups[i][j].setBackground(Color.decode("#888888"));

        arrayLookups[i][j].setForeground(Color.decode("#DDDDDD"));
        arrayLookups[i][j].setPreferredSize(new Dimension(30, 20));
      }

    mainFrame.setResizable(false);
    mainFrame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
  }

  // Adds listeners to elements in the GUI.
  private void addListeners() {

    // Creates a SimpleArray instance and uses two ArrayWriter instances to fill it.
    btnExecute.addActionListener(new ActionListener() {
      public void actionPerformed(ActionEvent e) {
        boolean useSync = chkSync.isSelected();

        // Resets values row background and text.
        for (JLabel lookup : arrayLookups[1]) {
          lookup.setBackground(Color.decode("#888888"));
          lookup.setText("0");
        }

        SimpleArray sharedArray = new SimpleArray(6);
        ArrayWriter writer1 = new ArrayWriter(1, sharedArray, arrayLookups[1], BLUE, useSy
nc);
        ArrayWriter writer2 = new ArrayWriter(11, sharedArray, arrayLookups[1], YELLOW, us
eSync);

        // Executes both instances of ArrayWriter.
        ExecutorService executor = Executors.newCachedThreadPool();
        executor.execute(writer1);
        executor.execute(writer2);
        executor.shutdown();

        // Waits for executor threads termination.
        try {
          boolean tasksStopped = executor.awaitTermination(1, TimeUnit.MINUTES);
          if (tasksStopped)
            System.out.println(sharedArray);
          else
            System.out
```

```
                .println("[" + Chalk.on("FAILURE").red() + "] Timeout expired while awaiti
ng for tasks termination");
        } catch (Exception ex) {
          System.out
              .println("[" + Chalk.on("ERROR").red() + "] Interruption ocurred while await
ing for tasks termination");
        }

      }
    });
  }

  // Builds the GUI.
  private void build() {
    topPanel.add(chkSync);

    GridBagConstraints gbc = new GridBagConstraints();

    // Adds arrayLookups labels.
    for (int i = 0; i < arrayLookups.length; i++)
      for (int j = 0; j < arrayLookups[i].length; j++) {
        gbc.gridy = i;
        gbc.gridx = j;
        gbc.ipadx = 0;
        gbc.ipady = 0;
        gbc.insets = new Insets(1, 2, 1, 2);
        centerPanel.add(arrayLookups[i][j], gbc);
      }

    bottomPanel.add(btnExecute);

    mainPanel.add(topPanel, BorderLayout.NORTH);
    mainPanel.add(centerPanel, BorderLayout.CENTER);
    mainPanel.add(bottomPanel, BorderLayout.SOUTH);

    mainFrame.add(mainPanel);
  }

  // Launches mainFrame by setting its visible value to true, then centers and
  // resizes the frame.
  private void launch() {
    mainFrame.setVisible(true);
    mainFrame.pack();
    mainFrame.setLocationRelativeTo(null);
  }
}
```

Clase ArrayWriter

```
package com.milkyblue;

import javax.swing.JLabel;

// ArrayWriter class. fills a SimpleArray instance.
public class ArrayWriter implements Runnable {

  private final SimpleArray sharedArray;
  private final int initValue;
  private JLabel[] lookups;
  private int color;
  private boolean useSync;

  // Class constructor. Keeps track of the lookup labels from the GUI, also the
  // selected color and if a Synchronized method will be used or not.
  public ArrayWriter(int value, SimpleArray array, JLabel[] lookups, int color, boolean us
eSync) {
    initValue = value;
    sharedArray = array;
    this.lookups = lookups;
    this.color = color;
    this.useSync = useSync;
  }

  // Method executed when thread runs. Calls wether a synchronized or
  // non-synchronized method to add a value to the SimpleArray element depending
  // on the constructor passed arguments.
  public void run() {
    for (int i = initValue; i < initValue + 3; i++)
      if (useSync)
        sharedArray.addSync(i, lookups, color);
      else
        sharedArray.addNonSync(i, lookups, color);

  }

}
```

Clase PrintableTask

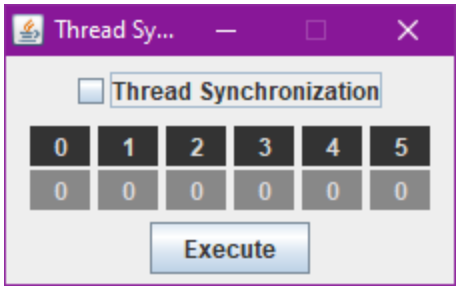
```java
package com.milkyblue;

import java.awt.Color;
import java.util.Random;

import javax.swing.JLabel;

import com.github.tomaslanger.chalk.Chalk;

// SimpleArray class. Models an array that keeps track of the last updated index. Also upd
ates the GUI when its own array is updated.
public class SimpleArray {
  private final int[] array;
  private int index;
  private final static Random generator = new Random();

  // Class constructor.
  public SimpleArray(int arrLength) {
    array = new int[arrLength];
    index = 0;
  }

  // Synchronized method.
  public synchronized void addSync(int value, JLabel[] lookups, int color) {
    add(value, lookups, color);
  }

  // Non-synchronized method.
  public void addNonSync(int value, JLabel[] lookups, int color) {
    add(value, lookups, color);
  }

  // Functionality method to update the array.
  private void add(int value, JLabel[] lookups, int color) {
    int postition = index;

    // Waits between 0 and 5 seconds before updating the array.
    try {
      Thread.sleep(generator.nextInt(5000));
    } catch (Exception e) {
      e.printStackTrace();
    }
```

```
    // Updates both the array and the correspondent GUI label.
    array[postition] = value;
    lookups[postition].setText(Integer.toString(value));

    // Prints the updated data depending on the tracked color.
    if (color == ThreadSyncGUI.BLUE) {
      lookups[postition].setBackground(Color.decode("#1D70A2"));
      System.out.println("[" + Chalk.on(Thread.currentThread().getName().toUpperCase()).cy
an() + "] wrote "
          + Chalk.on(Integer.toString(value)).green() + " in the element number "
          + Chalk.on(Integer.toString(postition)).green());
    } else {
      lookups[postition].setBackground(Color.decode("#F7B626"));
      System.out.println("[" + Chalk.on(Thread.currentThread().getName().toUpperCase()).ye
llow() + "] wrote "
          + Chalk.on(Integer.toString(value)).green() + " in the element number "
          + Chalk.on(Integer.toString(postition)).green());
    }

    // Increases the index.
    ++index;
    System.out.println("[" + Chalk.on("NEXT").magenta() + "] " + index);
  }

  // Overrides the toString method. Prints the actual elements in the array.
  public String toString() {
    String arrayString = "\n[" + Chalk.on("SIMPLE ARRAY CONTENT").magenta() + "]\n[";

    for (int i = 0; i < array.length; i++)
      arrayString += (i != array.length - 1) ? array[i] + ", " : array[i];

    arrayString += "]\n";

    return arrayString;
  }
}
```

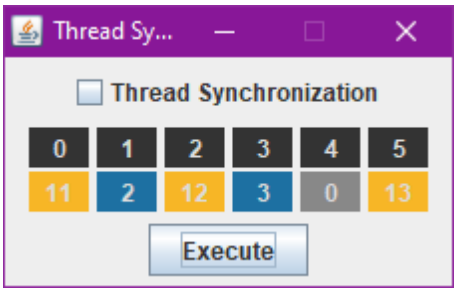
Clase App

```java
package com.milkyblue;

// App class.
public class App {
    // Creates an anonymous instance of ThreadSyncGUI.
    public static void main(String[] args) {
        new ThreadSyncGUI();
    }
}
```

CAPTURAS:

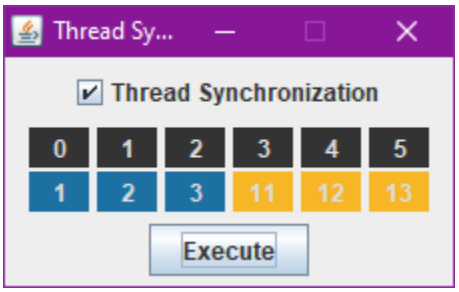


ESTADO INICIAL DE LA INTERFAZ.




```
[POOL-7-THREAD-1] wrote 1 in the element number 0
[NEXT] 1
[POOL-7-THREAD-2] wrote 11 in the element number 0
[NEXT] 2
[POOL-7-THREAD-1] wrote 2 in the element number 1
[NEXT] 3
[POOL-7-THREAD-1] wrote 3 in the element number 3
[NEXT] 4
[POOL-7-THREAD-2] wrote 12 in the element number 2
[NEXT] 5
[POOL-7-THREAD-2] wrote 13 in the element number 5
[NEXT] 6

[SIMPLE ARRAY CONTENT]
[11, 2, 12, 3, 0, 13]
```

LLENADO DEL ARREGLO CON EL METODO NO SINCRONIZADO.




```
[POOL-8-THREAD-1] wrote 1 in the element number 0
[NEXT] 1
[POOL-8-THREAD-1] wrote 2 in the element number 1
[NEXT] 2
[POOL-8-THREAD-1] wrote 3 in the element number 2
[NEXT] 3
[POOL-8-THREAD-2] wrote 11 in the element number 3
[NEXT] 4
[POOL-8-THREAD-2] wrote 12 in the element number 4
[NEXT] 5
[POOL-8-THREAD-2] wrote 13 in the element number 5
[NEXT] 6

[SIMPLE ARRAY CONTENT]
[1, 2, 3, 11, 12, 13]
```

LLENADO DEL ARREGLO CON EL METODO SINCRONIZADO.

PREGUNTAS:

1. **¿Crees que es importante la sincronización?**
   Si, porque nos permite evitar resultados inesperados al momento de acceder a un mismo recurso a través de subprocesos ejecutados en paralelo, permitiendo que exista un mejor orden en la ejecución de dichos subprocesos.

2. **Da un ejemplo real donde crees que esto podría funcionar.**
   Cuando deseemos actualizar una base de datos desde distintos clientes, por ejemplo, un programa que lleve el control del inventario de alguna tienda pero que se use en varias terminales por distintos usuarios a la vez. Puede suceder que varios usuarios hagan uso de un mismo recurso al mismo tiempo, por lo que si se accede de manera sincronizada se evitaran resultados inesperados.

3. **¿Cuándo no sería necesaria la sincronización de subprocesos?**
   Cuando no dependemos de recursos que hagan seguimiento a algún valor en base a las veces que este se modifica, por ejemplo, si quisiéramos acceder a un método que simplemente nos ayuda a obtener un cálculo, de esta manera no hay problema si varios subprocesos hacen uso de el al mismo tiempo, ya que el resultado obtenido no dependerá de si esta siendo utilizado por otros subprocesos.

CONCLUSION:

La implementación de subprocesos sincronizados en nuestras aplicaciones es una herramienta más que hace más flexible y útil la funcionalidad de estas mismas, es algo que siempre se debe de tener en cuenta para mejorar procesos y que estos se realicen de una manera óptima, en este caso en especifico cuando sabemos que vamos a utilizar un mismo recurso por distintos subprocesos.

NOTAS:

- Puede encontrar el repositorio de este proyecto en mi cuenta de github en el siguiente enlace: https://github.com/NoisyApple/AdTopics-15.ThreadSynchronization