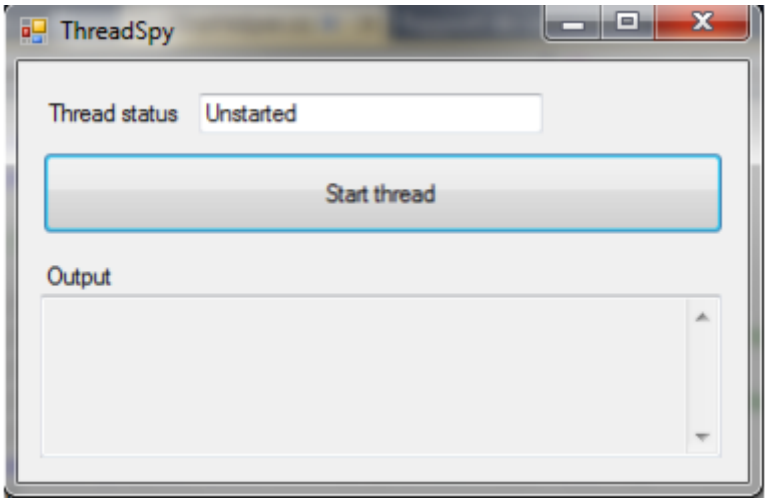
Utilisation des Semaphores pour synchronizer les Thread

On s'appuie sur l'application de la leçon 3. Utilisation des **locks**

Solution



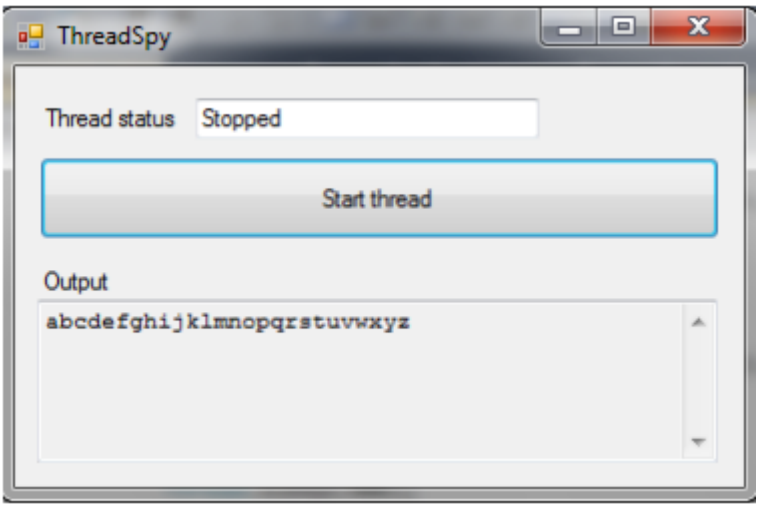
Voici le code

```
Imports System.Threading
Imports System.Collections.Generic
Imports System.Text
Imports System.Windows.Forms
namespace ThreadSpy
class TextBoxHelper
static private TextBox textbox
public delegate sub UpdateTextCallback(char c)
// /// /// This method will add the char c into the textbox tb
/// /// The TextBox where the char will be added
/// The char to add
static public sub AddChar(TextBox tbox, char c)
      textbox = tbox
      textbox.Invoke(new UpdateTextCallback(AddCharSave), c)
end sub
static private sub AddCharSave(char c)
      textbox.Text += c
 end sub
End sub
```

Ici c'est le TextBox **textbox** qui est partagé.

b. Changer le programme pour que plus d'une thread puisse placer un caractère dans la textbox toujours en utilisant les locks

Solution

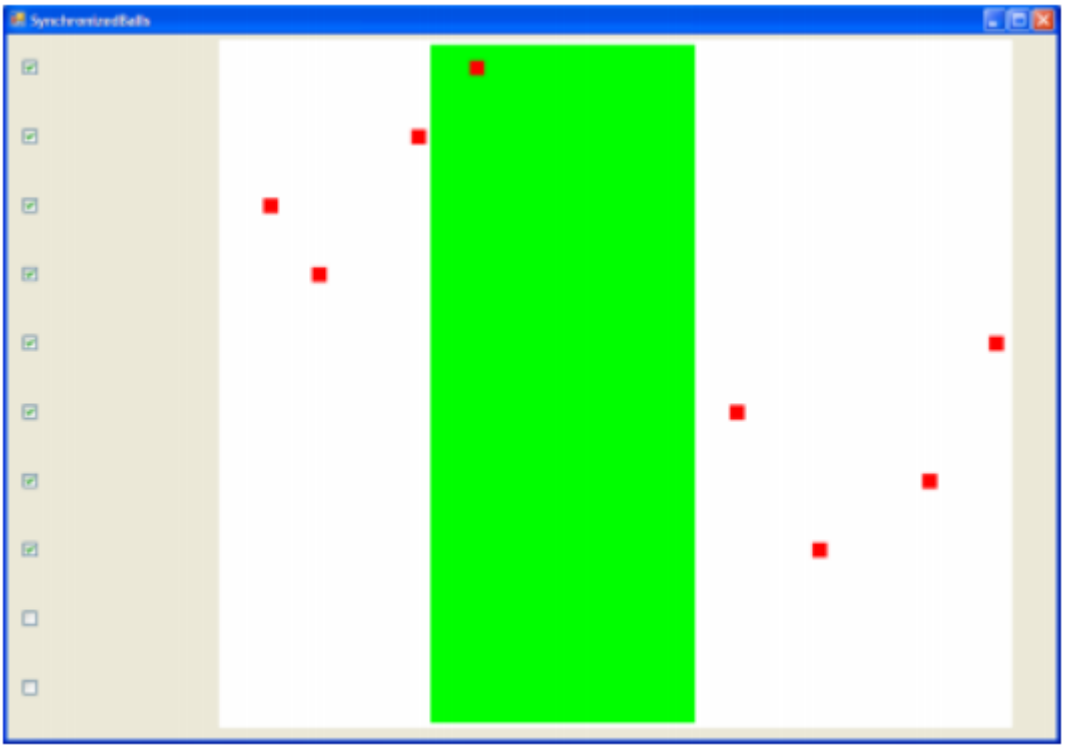


Code source

```
public sub Run()

while(true)

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, a)
   Next
      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, b)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, c)
   Next
      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, d)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, e)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, f)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, g)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, h)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, i)
   Next
      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, l)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, m)
   Next

      For K As Integer = 0 to 1
                  Thread.Sleep(300)
                  TextBoxHelper.AddChar(tb, n)
```

```
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, o)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, p)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, q)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, r)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, s)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, t)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, u)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, v)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, w)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, x)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, y)
Next
   For K As Integer = 0 to 1
                Thread.Sleep(300)
                TextBoxHelper.AddChar(tb, z)
Next

 End sub
```

Application SynchronizedBalls



On sait que la zone verte represente la section critique

Voici donc les classes :

```
Class SynchronisationTestForm

public partial class SynchronisationTestForm : Form

public const MINX = 0 As Int

public const MAXX = 750 As Int

public const CS_MINX = 200 As Int

public const CS_MAXX = 450 As Int

public PictureBox[] pictbxa = new PictureBox[10]

public Thread[] ta = new Thread[10]

public SynchronisationTestForm()

pictbxa [0] = pictureBox1

pictbxa [1] = pictureBox2

pictbxa [2] = pictureBox3

pictbxa [3] = pictureBox4

pictbxa [4] = pictureBox5

pictbxa [5] = pictureBox6

pictbxa [6] = pictureBox7

pictbxa [7] = pictureBox8

pictbxa [8] = pictureBox9

pictbxa [9] = pictureBox10

private sub checkBox_CheckedChanged(object sender, EventArgs e)

index As Integer = (((CheckBox)sender).Location.Y - 25) / 65

PictureBox pb = pictbxa [index]

if (((CheckBox)sender).Checked)

End if

else

// The CheckBox was unchecked, so

// the corresponding thread must be interrupted and

// pb must get transparant

background color

End else

End dub
```

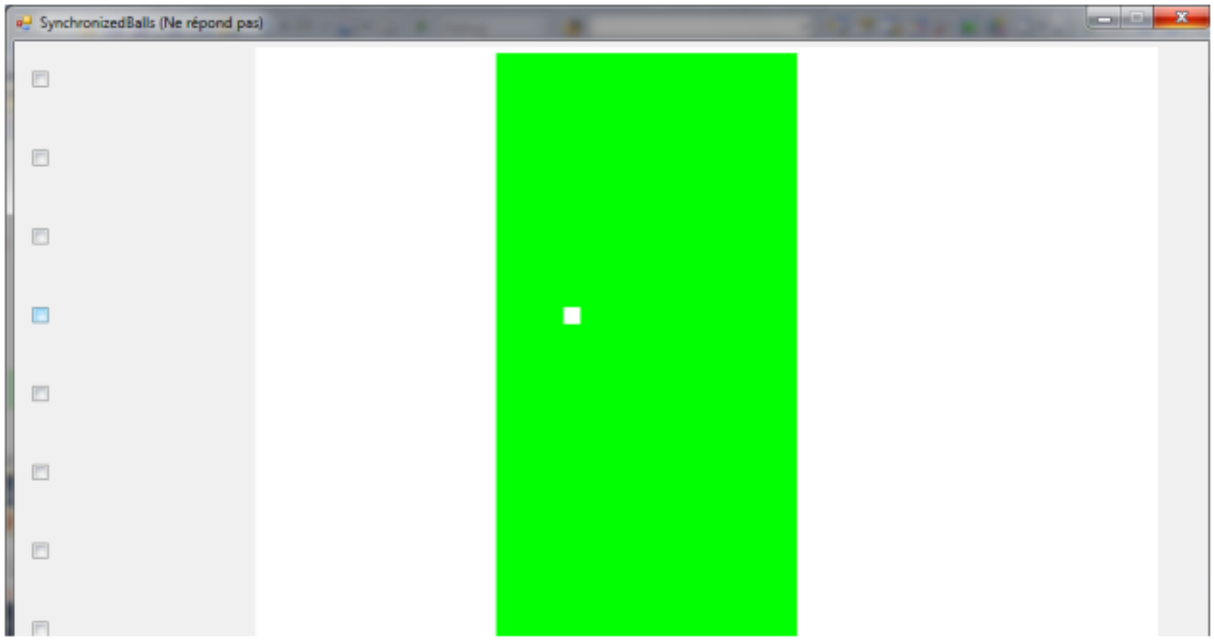
This is the form. Each time when a checkbox changes state, the method checkBox_CheckedChanged is called.

```
Classe BallMover

private delegate sub UpdatePictureBoxCallback(Point p)

private PictureBox pbox

public BallMover(PictureBox pbox)

this.pb = pbox

/// /// Move ball over X axis, bouncing at the right border ///

public sub Run()

try

while (true)

while (pb.Location.X < SynchronisationTestForm.CS_MINX)

MoveBall()

Thread.Sleep(10)

loop

while (pb.Location.X < SynchronisationTestForm.CS_MAXX)

MoveBall()

Thread.Sleep(10)

loop

while (pb.Location.X < SynchronisationTestForm.MAXX)

MoveBall()

Thread.Sleep(10)

loop

ResetBall()

Thread.CurrentThread.Interrupt()

catch (ThreadInterruptedException)

ResetBall()

Return

End sub

 /// /// This method moves the ball and returns the new location ///

private sub MoveBall()

p As Point = pb.Location

p.X++

pb.Invoke(new UpdatePictureBoxCallback(MovePictureBox), p)

/// /// This method sets the ball back to the left hand side of the white
area /// public void ResetBall()

p As Point = pb.Location; p.X = SynchronisationTestForm.MINX
```

```
pb.Invoke(new UpdatePictureBoxCallback(MovePictureBox), p)
end sub
private sub MovePictureBox(Point p)
pb.Location = p
End sub
End class
```

Cette classe contient la méthode Run, qui doit être exécutée par chaque thread. Dans cette méthode, une balle est déplacée de gauche à droite sur l'écran. Lorsque la balle est à l'extrême droite de la zone blanche, elle est replacée sur le côté gauche. Les balles sont toujours des Picturebox

c. Ici il est question de changer le programme donnée afin de pouvoir interrompre un thread lorsque la case est décochée, les threads créés doivent être placés dans un tableau, qui est déjà défini dans la classe SynchronisationTestForm. tous les threads s'arrêtent automatiquement lorsque la fenêtre principale est fermée.



Code source

```
private void checkBox_CheckedChanged(object sender, EventArgs e)
 // index is the number of the CheckBox that was clicked
// This index is derived from the y-position of the CheckBox
 index As Integer = (((CheckBox)sender).Location.Y - 25) / 65
// pbox is the PictureBox that belongs to this CheckBox
PictureBox pbox = pba[index]
if (((CheckBox)sender).Checked)
// The CheckBox was checked, so // pb must get a red background color and //
a new thread, that will move pb, must be created and put into ta[index]
  // TODO create thread BallMover
ct = new BallMover(pb)
ct.Run()
```

```
End if

else

// The CheckBox was unchecked, so // the corresponding thread must be interrupted and // pb must get transparant background color

 // TODO interrupt

thread Thread.CurrentThread.Interrupt()

End else

End sub
```

d. Give each ball a randomly chosen speed. This speed must be between roughly 100 and 200 pixels per second (so the Thread.Sleep must be between 5 and 10 msec). You can use class Random for that.

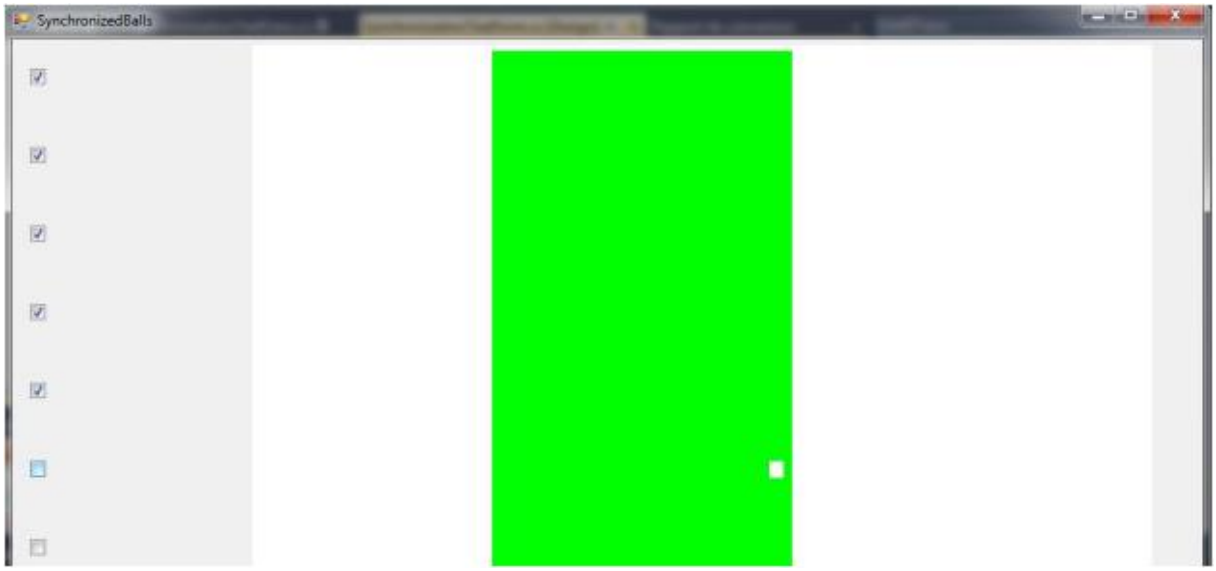
e. Identify which piece of code exactly is the Critical Section.

Solution

```
private sub MoveBall()

      p As Point = pb.Location;

      p.X++

pb.Invoke(new UpdatePictureBoxCallback(MovePictureBox), p)

End sub
```

f. ll est queston de modifiez le programme de telle sorte qu'au plus un thread se trouve à tout moment dans la section critique et d’utilisez un sémaphore partagé par tous les threads. Tous doit bien fonctionner lorsqu'un thread est interrompu dans sa section critique

Solution



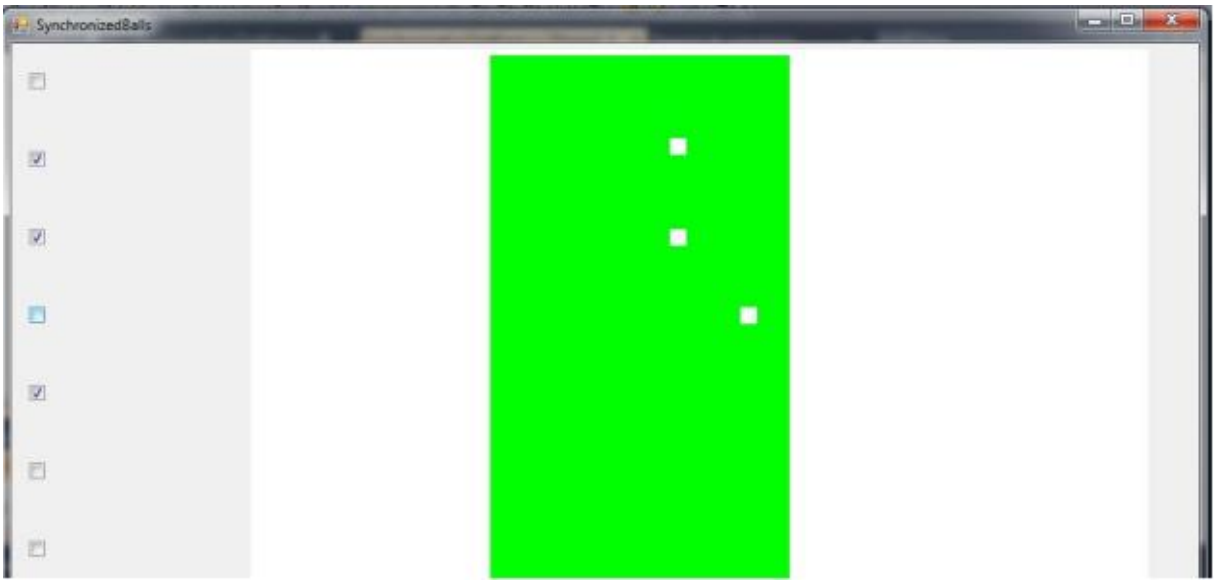
Code source

```
public sub Run()
try
while (true)
while (pb.Location.X < SynchronisationTestForm.CS_MINX)
MoveBall()
Thread.Sleep(10)
Next
while (pb.Location.X < SynchronisationTestForm.CS_MAXX)
 MoveBall()
Thread.Sleep(10)
 while (pb.Location.X < SynchronisationTestForm.MAXX)
MoveBall()
Thread.Sleep(10)
Next
 ResetBall()
 Thread.CurrentThread.Interrupt()
End sub
catch (ThreadInterruptedException)
```

```
 ResetBall()
 return
End sub
```

g. Changer le programme pour qu'au maximum seulement 3 thead s'exécutent dans la section critique.

Solution



Code source

```
Imports System
Imports System.Collections.Generic
Imports System.ComponentModel
Imports System.Data
Imports System.Drawing
Imports System.Text
Imports System.Windows.Forms
Imports System.Threading
public partial class SynchronisationTestForm
public const MINX As Int= 3
public const MAXX As Int = 750
public const CS_MINX As Int = 100
public const CS_MAXX As Int = 200
private PictureBox[] pitba = new PictureBox[10]
```

```
private Thread[] ta = new Thread[10]
Random rd
public SynchronisationTestForm()
pitba[0] = pictureBox1
pitba [1] = pictureBox2
pitba [2] = pictureBox3
pitba [3] = pictureBox4
pitba [4] = pictureBox5
pitba [5] = pictureBox6
pitba [6] = pictureBox7
pitba [7] = pictureBox8
pitba [8] = pictureBox9
pitba [9] = pictureBox10
private sub checkBox_CheckedChanged(object sender, EventArgs e)
// index is the number of the CheckBox that was clicked
// This index is derived from the y-position of the CheckBox
index As Integer = (((CheckBox)sender).Location.Y - 25) / 65
// pbox is the PictureBox that belongs to this CheckBox
PictureBox pbox = pitba[index]
if (((CheckBox)sender).Checked)
// The CheckBox was checked, so // pb must get a red background color and //
a new thread, that will move pb, must be created and put into
ta[index]
// TODO create thread
 BallMover ct = new BallMover(pbox)
ct.Run()
End if
else
// The CheckBox was unchecked, so
 // the corresponding thread must be interrupted and
// pbox must get transparant
background color
// TODO interrupt
thread Thread.CurrentThread.Interrupt()
End else
```

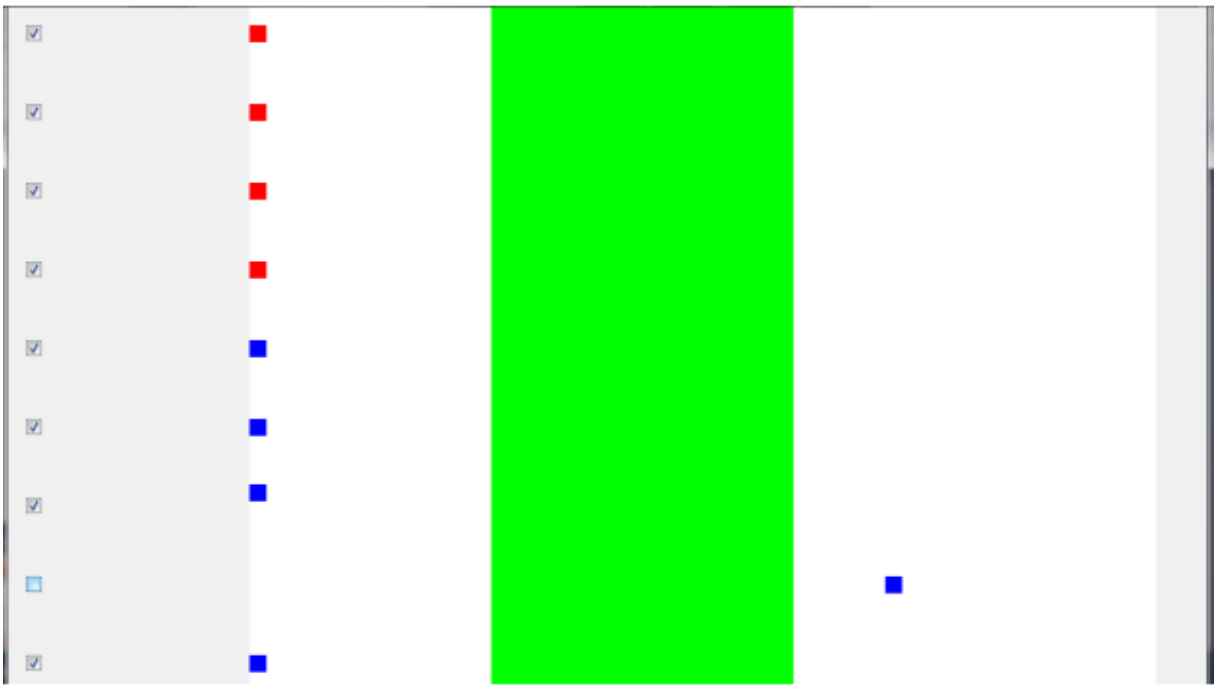
```
End sub
End class
```

Save this version.

Nous allons maintenant implémenter le problème lectures/écritures. Pour cela, nous avons besoin de deux sortes de fils, qui seront représentés par deux couleurs de billes différentes :

- • rouge (lecture) et
- • bleu (écriture).
- les 5 premières boules sont rouges et les 5 dernières boules sont bleues.
- Utilisation de 2 méthodes Run dans la classe BallMover au lieu de 1. Nommés RunReader et RunWriter. les boules rouges exécutent RunReader et les boules bleues exécutent RunWriter.

Solution



Code source

```
public void RunReader()
pb.BackColor = Color.Red
try
Random rd = new Random(200)
```

```
while (true)
 while (pb.Location.X < SynchronisationTestForm.CS_MINX)
MoveBall()
 Thread.Sleep(5)
Thread.EndCriticalRegion()
while (pb.Location.X < SynchronisationTestForm.CS_MAXX)
MoveBall()
 Thread.Sleep(5)
 Thread.EndCriticalRegion()
 while (pb.Location.X < SynchronisationTestForm.MAXX)
MoveBall()
Thread.Sleep(5)
 Thread.EndCriticalRegion()
Thread.CurrentThread.Interrupt()
 ResetBall()
catch (ThreadInterruptedException)
ResetBall()
return
End sub
public void RunWriter()
pb.BackColor = Color.Blue
try
Random rd = new Random(200)
while (true)
while (pb.Location.X < SynchronisationTestForm.CS_MINX)
MoveBall()
Thread.Sleep(5)
Thread.EndCriticalRegion()
while (pb.Location.X < SynchronisationTestForm.CS_MAXX)
 MoveBall()
 Thread.Sleep(5)
Thread.EndCriticalRegion()
while (pb.Location.X < SynchronisationTestForm.MAXX)
MoveBall()
Thread.Sleep(5)
```

```
 Thread.EndCriticalRegion()
 Thread.CurrentThread.Interrupt()
 ResetBall()
catch (ThreadInterruptedException)
ResetBall()
return
End sub
```

• j. Take the solution for the readers/writers problem that was given in the sheets (using semaphores wrt and mutex, and integer readcount) and make it work in this application. The semaphores can be handled in the same way as in question f. To simplify things, you can assume that a thread will never be stopped inside the green area, so you don't have to handle this situation.

Solution