

L7: Busy-Wait

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Mapa Conceptual

Concurrency = Simultaneous + Nondeterminism + Interaction

Interaction = Communication | Synchronization

Synchronization = Mutual Exclusion | Conditional Synchronization

- Terminology:

atomic

interleaving

mutual exclusion

race condition

busy-wait

critical section

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Critical Section and Mutual exclusion

Critical Section:

a piece of code that accesses a shared resource (data structure or device) that must not be concurrently accessed by more than one thread of execution. A critical section will usually terminate in fixed time, and a thread will have to wait for a fixed time to enter it.

Mutual exclusion:

the requirement of ensuring that no two concurrent processes are in their critical section at the same time; it is a basic requirement in concurrency control, to prevent race conditions.

The logo for Cartagena99 features the text "Cartagena99" in a stylized, teal-colored font. The "99" is significantly larger and more prominent than the word "Cartagena". The text is set against a light blue background with a subtle wave-like pattern. Below the text, there is a horizontal orange and yellow gradient bar.

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Busy0.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            // CRITICAL_BEGIN:
            en_sc_inc = true;
            cont++;
            // intentamos detectar violaciones de mutex
            if (en_sc_inc && en_sc_dec) {
                System.out.print("CRAAAAAAAAAASH!!!!!!!!\n");
            }
            en_sc_inc = false;
            // CRITICAL_END
        }
    }
}
```

The logo for Cartagena99, featuring the text "Cartagena99" in a stylized font with a blue and orange gradient background.

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Busy0.java

Problems?

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    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            // CRITICAL_BEGIN:
            en_sc_inc = true;
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            if (en_sc_inc && en_sc_dec) {
                System.out.print("CRAAAAAAAAAASH!!!!!!!!\n");
            }
            en_sc_inc = false;
            // CRITICAL_END
        }
    }
}
```

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BusyAE.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            while (turno != INC) {};
            en_sc_inc = true;
            cont++;
            if (en_sc_inc && en_sc_dec) {
                System.out.print("CRAAAAAAAAAASH!!!!!!!\n");
            }
            if (ultima_op == INC) {
                probable_alternancia_estricta = false;
            }
            ultima_op = INC;
            en_sc_inc = false;
        }
    }
}
```

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BusyAE.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            while (turno != INC) {};
```

**Protocolo
Entrada**

**Protocolo
Salida**

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BusyAE.java

```
static class Incrementador2 extends Thread {
```

```
    public void run() {
```

Protocolo for (int i = 0; i < N_OPS; i++) {

Entrada

```
        while (turno != INC) {};
```

```
        en_sc_inc = true;
```

```
        cont++;
```

```
        if (en_sc_inc && en_sc_dec) {
```

```
            System.out.print("CRAAAAAAAAAASH!!!!!!!!\n");
```

```
        }
```

**Critical
Section**

```
        if (ultima_op == INC) {
```

```
            probable_alternancia_estrieta = false;
```

```
        }
```

```
        ultima_op = INC;
```

Protocolo

```
        en_sc_inc = false;
```

Salida

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Busy-wait

Busy-waiting:

busy-waiting or spinning is a technique in which a process repeatedly checks to see if a condition is true, such as whether keyboard input or a lock is available.

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Busy-wait

Busy-waiting:

busy-waiting or spinning is a technique in which a process repeatedly checks to see if a condition is true, such as whether keyboard input or a lock is available.

```
static class Incrementador2 extends Thread {  
    public void run() {  
        //...  
        while (turno != INC) {};  
        //...  
    }  
}
```

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Strict Alternation

Strict Alternation:

Mutual exclusion can be achieved by a thread going from non critical region to the critical region by checking the value of turn, and switching turns at the end of the critical section.

```
static class Incrementador2
extends Thread {
    public void run() {
        //..
        while (turno != INC) {};
        //...
        turno = DEC;
    }
}
```

```
static class Decrementador2
extends Thread {
    public void run() {
        //..
        while (turno != DEC) {};
        //...
        turno = INC;
    }
}
```

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Strict Alternation

Strict Alternation:

Mutual exclusion can be achieved by a thread going from non critical region to the critical region by checking the value of turn, and switching turns at the end of the critical section.

```
static class Incrementador2  
extends Thread {
```

```
    public void run() {
```

```
        //..
```

```
        while (turno != INC) {};
```

```
        //...
```

```
        turno = DEC;
```

```
static class Decrementador2  
extends Thread {
```

```
    public void run() {
```

```
        //..
```

```
        while (turno != DEC) {};
```

```
        //...
```

```
        turno = INC;
```

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BusyNM.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            while (en_sc_dec) { };
            // avisamos de que estamos dentro
            en_sc_inc = true;
            // seccion critica
            cont++;
            // intentamos detectar violaciones de mutex
            if (en_sc_inc && en_sc_dec) {
                System.out.print("CRAAAAAAAAAASH!!!!!!!!!!\n");
            }
            // protocolo de salida
            en_sc_inc = false;
        }
    }
}
```

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BusyNM.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            while (en_sc_dec) { };
            // avisamos de que estamos dentro
            en_sc_inc = true;
            // seccion critica
            cont++;
            // intentamos detectar violaciones de mutex
            if (en_sc_inc && en_sc_dec) {
                System.out.print("CRAAAAAAAAAASH!!!!!!!!!!\n");
            }
            // protocolo de salida
            en_sc_inc = false;
        }
    }
}
```

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BusyLL.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            incrementador_quiere = true; // PROTOCOL IN
            while (decrementador_quiere) {
                busy_inc = true;
                if (busy_inc && busy_dec) {
                    System.out.print("INC: la he liao parda!!\n");
                }
            }
            busy_inc = false;
            critical_section(); //CRITICAL
        }
    }
}
```

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BusyLL.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            incrementador_quiere = true; // PROTOCOL IN
            while (decrementador_quiere) {
                busy_inc = true;
                if (busy_inc && busy_dec) {
                    System.out.print("INC: la he liao parda!!\n");
                }
            }
            busy_inc = false;
            critical_section(); //CRITICAL
        }
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}
```

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Deadlock

Deadlock:

a deadlock is a situation in which two or more competing actions are each waiting for the other to finish, and thus neither ever does.

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“When two trains approach each other at a crossing, both shall come to a full stop and neither shall start up again until the other has gone.”

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Livelock

Livelock:

A livelock is similar to a deadlock, except that the states of the processes involved in the livelock constantly change with regard to one another, none progressing.

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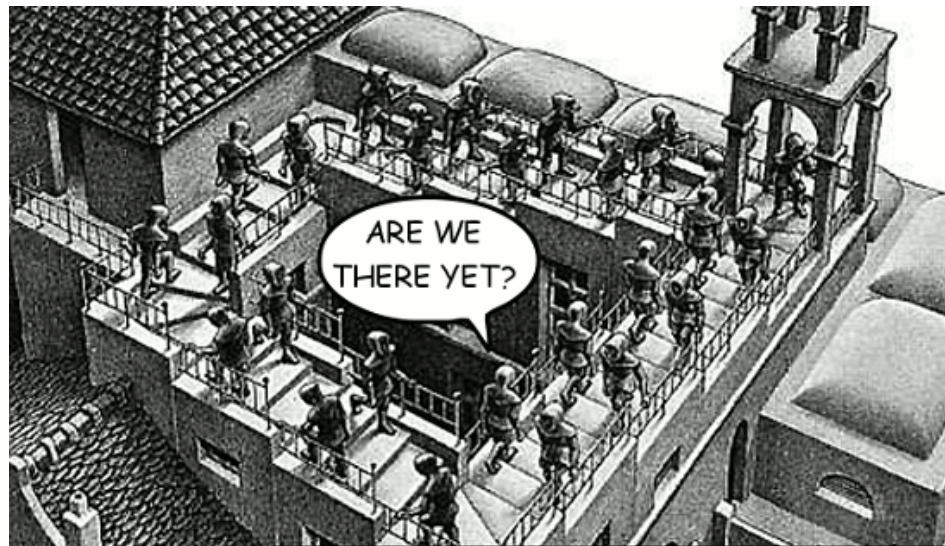
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BusyST.java

```
static class Incrementador2 extends Thread {
    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            incrementador_quiere = true;    //PROTOCOL IN
            while (decrementador_quiere) {
                incrementador_quiere = false;
                incrementador_quiere = true;
            }
            critical_section();    //CRITICAL SECTION
            incrementador_quiere = false;    //PROTOCOL OUT
        }
    }
}
```

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    public void run() {
        for (int i = 0; i < N_OPS; i++) {
            incrementador_quiere = true;    //PROTOCOL IN
            while (decrementador_quiere) {
                incrementador_quiere = false;
                incrementador_quiere = true;
            }
            critical_section();    //CRITICAL SECTION
            incrementador_quiere = false;    //PROTOCOL OUT
        }
    }
}
```

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Starvation

Starvation:

Starvation describes a situation where a thread is unable to gain regular access to shared resources and is unable to make progress. This happens when shared resources are made unavailable for long periods by “greedy” threads.

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