

ARCOS group
Departamento de Informática
Universidad Carlos III de Madrid

Exercises

How OS works

Diseño de Sistemas Operativos
Grado en Ingeniería Informática y
Doble Grado I.I. y A.D.E.



Exercise

exercise (1/2)

There is a hardware system that includes a clock device, which generates an interruption with each tick of the clock.

A multithreaded operating system has foreseen (in the absence of implementation) the call to the system:

```
struct Date * GetDate ();
```

That returns the current date and time.

For helping in the implementation of GetDate, the following function is available:

```
struct Date * Convert_Ticks_in_Date (int ticks);
```

This function allows you to obtain the current date and time from the number of ticks that have elapsed.

Exercise

exercise (2/2)

It is requested:

- ▶ To implement in pseudocode the necessary functionality of the operating system kernel to manage the clock and offer users the functionality to obtain the current date and time when they request it. Take special interest in indicating which data structures are required or modified, the interface of the implemented functions and the events used (and involved).

Exercise

Solution

1. Initial approach
 1. Initial state of the system
 2. Study what must be modified
2. Answer the questions
3. Review the answers

Exercise

Solution

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Exercise

Solution

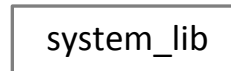
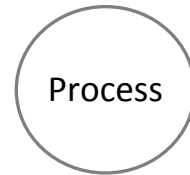
Let start with a diagram with the initial state of the system, with the most relevant elements of the problem...

U

K

Exercise

Solution



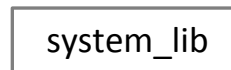
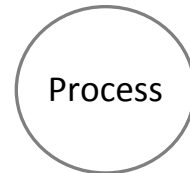
In user space (U) we have the processes that make system calls through the `system_lib` or make exceptions, both provoke the kernel execution (K)

U

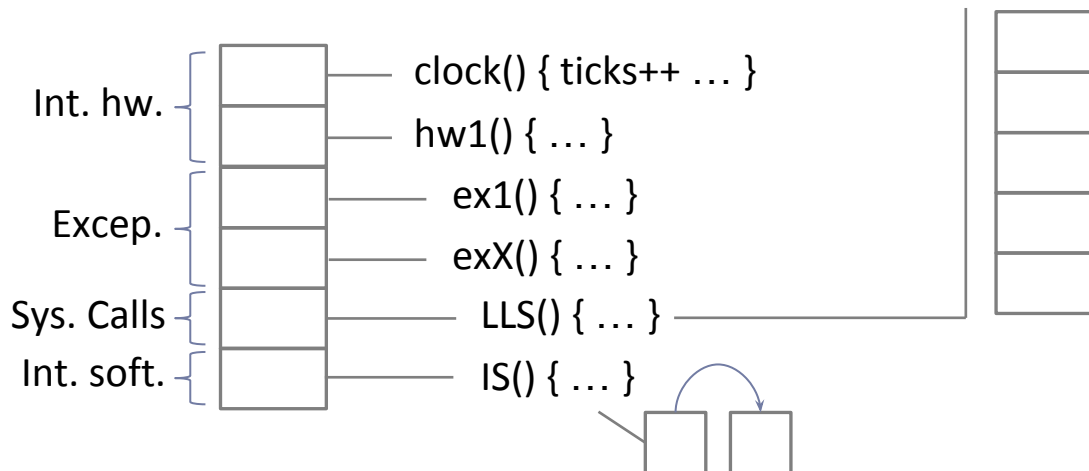
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Exercise Solution

In lesson 2, the internal operation of the operating system kernel was introduced: software interrupts, system calls, hardware interrupts, and exceptions

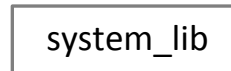
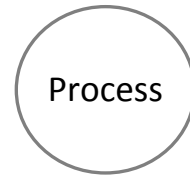


U
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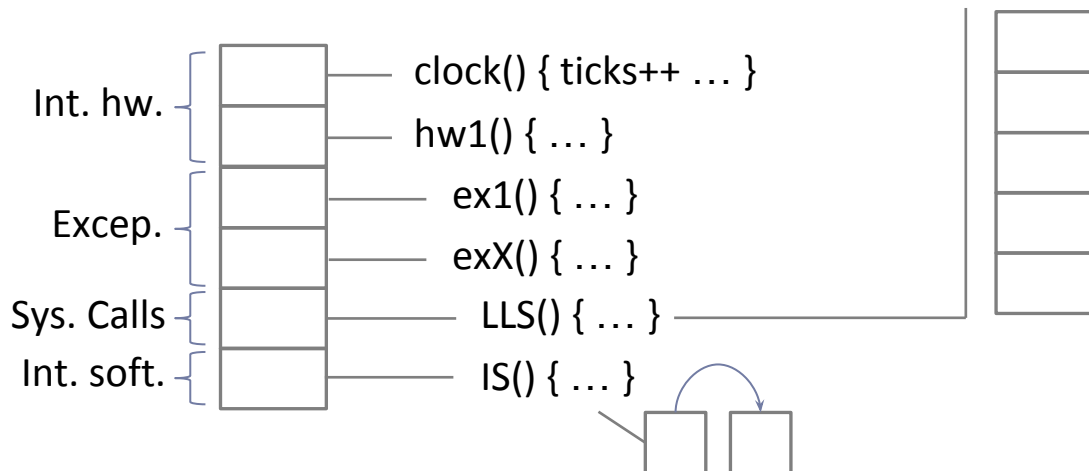
Exercise Solution

Now we have the diagram with the initial state of the system, with the elements more relevant for the exercise



U

K



Exercise

Solution

1. Initial approach

1. Initial state of the system

2. Study what must be modified

2. Answer the questions

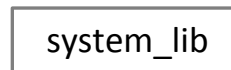
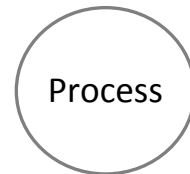
3. Review the answers

Exercise

Solution

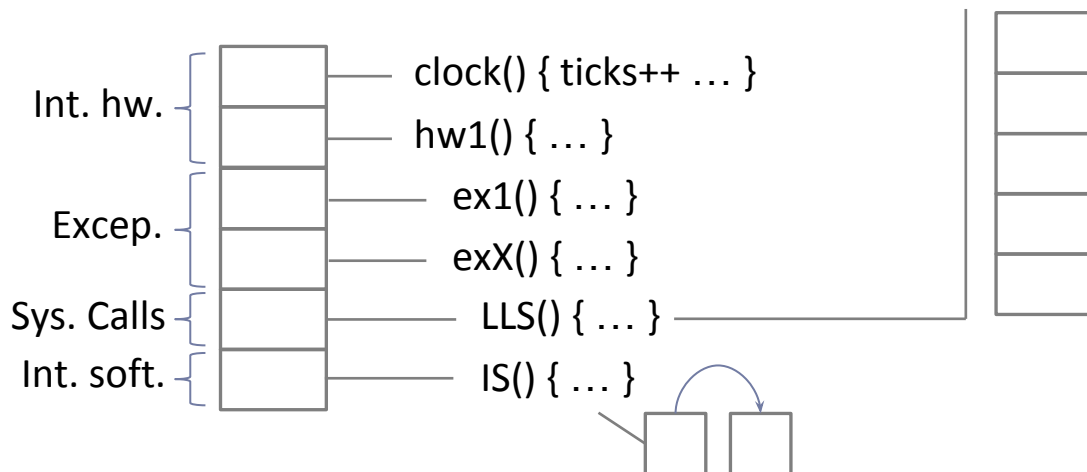
We start from the existing system,
and the exercise requirements:

- To add a system call.
- To add this system call to the already existing function in the kernel.



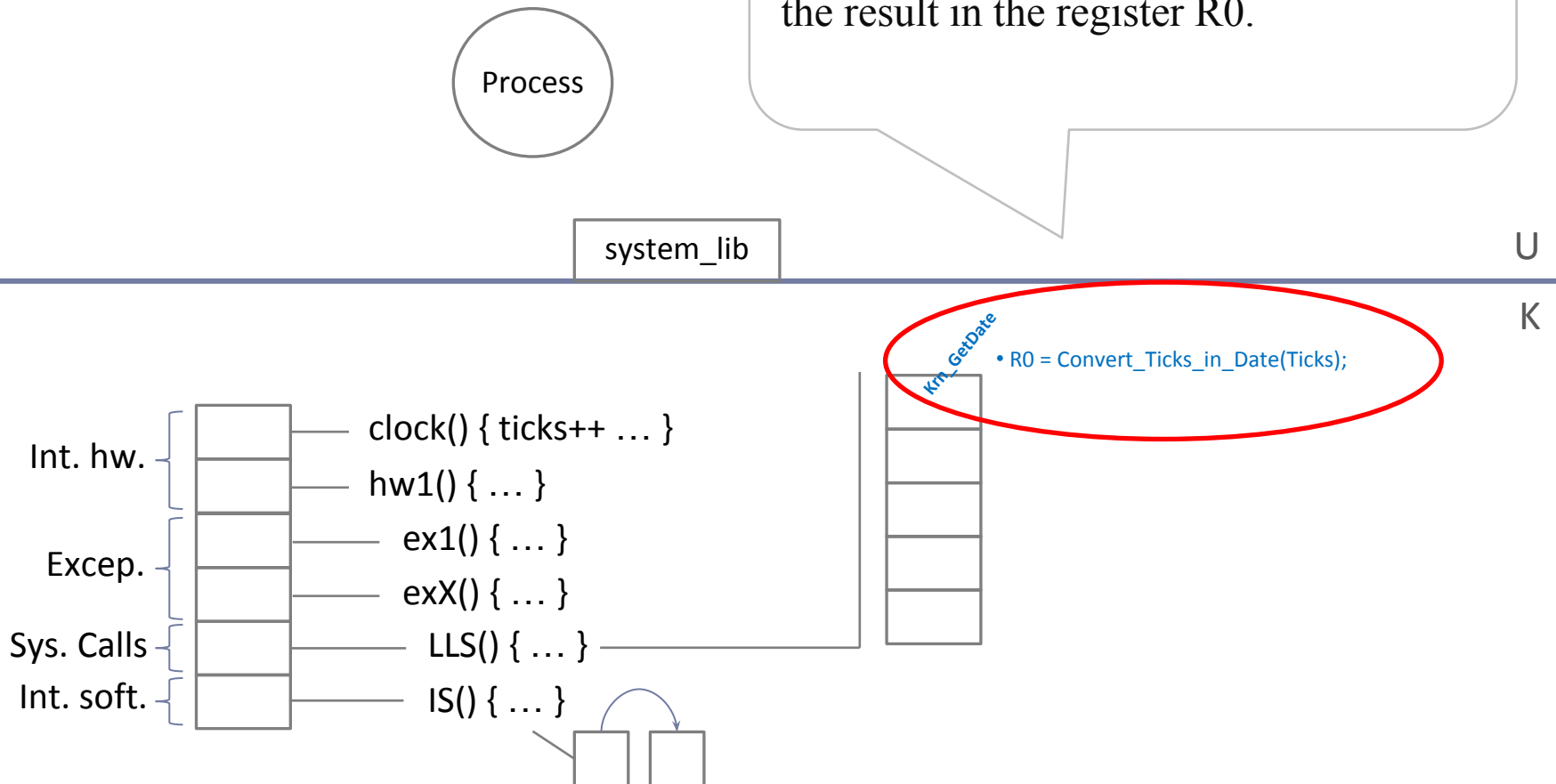
U

K



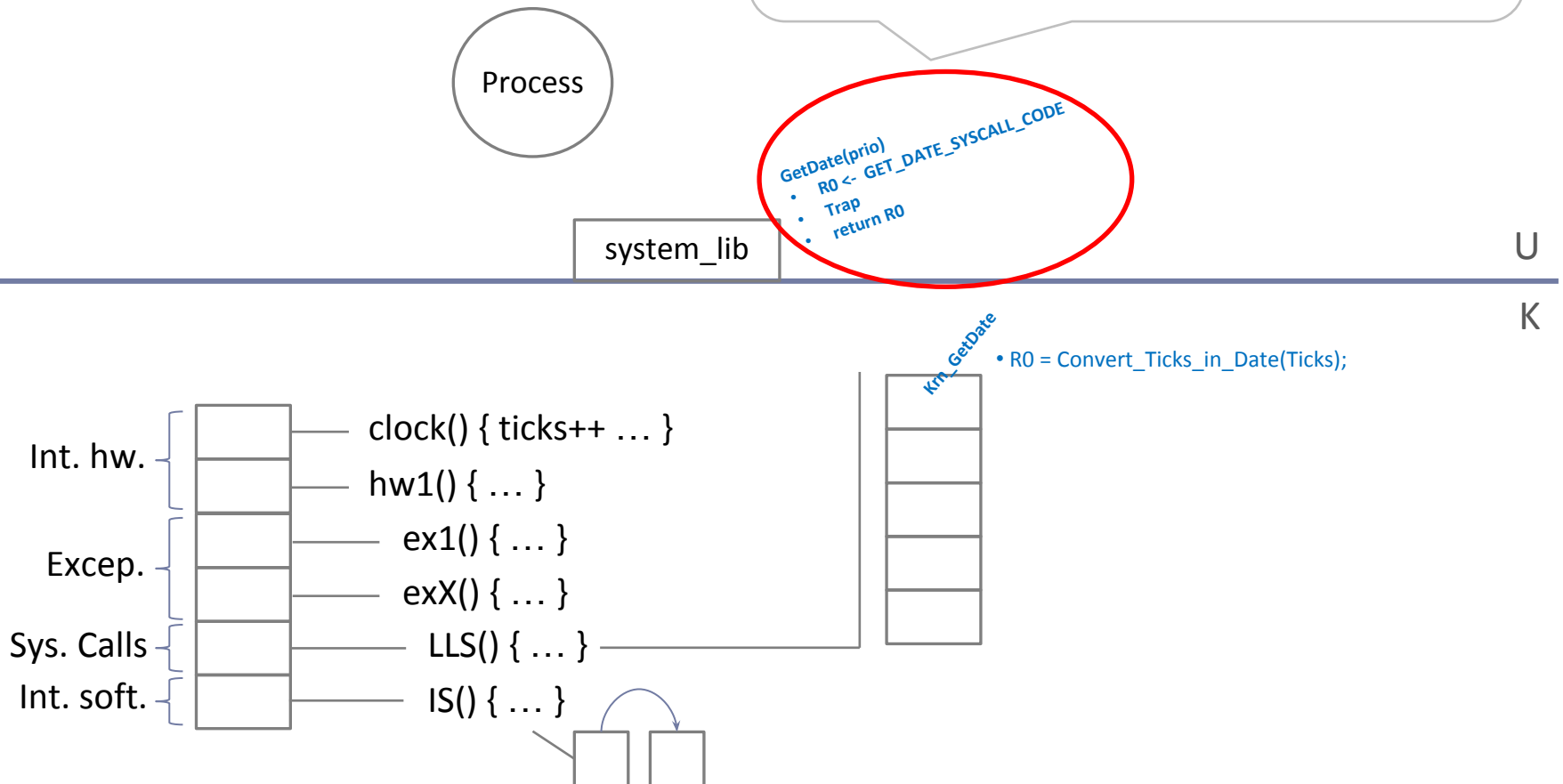
Exercise Solution

A syscall has one part inside the kernel and another part in the user space.
The part in the kernel (`krm_XX`) saves the result in the register `R0`.



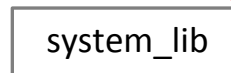
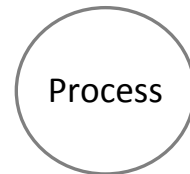
Exercise Solution

The user-space function writes the syscall code in R0, then the kernel executes the syscall, and returns the value of R0.



Exercise Solution

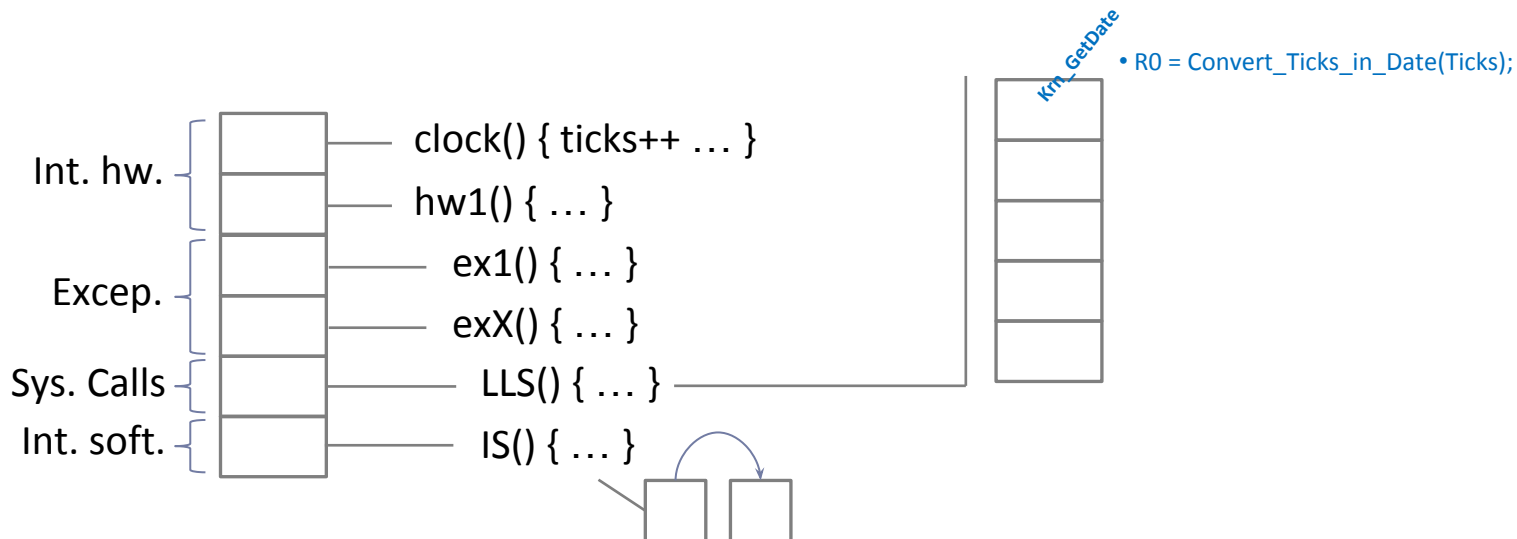
Finally we review the exercise to verify that each and every one of the requirements are fulfilled in the approach.



GetDate(prio)
• R0 <- GET_DATE_SYSCALL_CODE
• Trap
• return R0

U

K



Exercise

Solution

1. Initial approach

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Exercise

Solution

Looking at the approach taken, we answer the questions

Data structures:

- Ticks: Numbers of clock ticks since the operating system boots.

Exercise

Solution

Functions on the kernel:

Clock_interruption_handler ():

- Ticks = Ticks +1;

struct Date * KERNEL_GetDate ():

- RO = Convert_Ticks_in_Date (Ticks) ;

Exercise

Solution

Functions on user space:

struct Date * USER_GetDate ():

- RO = GET_DATE_SYSCALL_CODE
- Trap
- Return RO

Exercise

Solution

1. Initial approach

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Typical failures



- 1) Answer the first question of a section only.
- 2) Answer another request question.
- 3) Answer more than what is asked:
 - 1) If the extra part is wrong, it may be evaluated...

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Introducción

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