UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Departamento de Informática de Sistemas y Computadores (DISCA)

fSO

EEE2
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etsinf
Escola Tècnica Superior d'Enginyeria Informàtica

SURNAME		NAME		Group
ID		Signature		

- **Keep the exam sheets stapled.**

- **Write your answer inside the reserved space.**

- **Use clear and understandable writing. Answer briefly and precisely.**

- **The exam has 7 questions, everyone has its score specified.**

1. Libraries are files that contain code functions and can be linked statically or dynamically. Indicate by placing an X, which of the following characteristics correspond to one or another type of linking or both: (Note: An error voids a correct answer). **(1,0 point)**

1	Feature	Static	Dynamic
	It generates executable files of smaller size		
	It generates executable files containing the own process code and the libraries code		
	In the process memory map they appear independent regions whose support is the code file for each library linked		
	Several processes can share the library code after being allocated in main memory		
	Whenever the OS updates a library, the executable files that use that library have to be rebuild		
	Library linking is done at runtime and this can cause execution delay		
	It can generate multiple copies of the same library on main memory		
	On the memory map the code of libraries has support on the code file of the process itself		

2. Indicate how the MMU (Memory Management Unit) solves process relocation at runtime on contiguous allocation and what information it needs to carry it out: **(0.5 points)**

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3. A system with pure paging (without virtual memory), 32-bit logical addresses, equipped with a 64GBytes of main memory, uses 20 bits for the page id and 6 bytes for each page descriptor. Explain your answer to the following sections:

(1.5 points =0.5+0.25+0.25+0.5)

3	**a)** Formats for logical and physical addresses, telling the name and number of bits for every address field

Logical address

Physical address

b) Page table size of a process

c) Maximum multiprogramming level considering processes of 4 GByte

d) Considering two levels paging, with 256 second-level descriptors, obtain the formats of logical and physical addresses indicating the name and number of bits for every address field

Logical address

Physical address

4. On a system with demand paging (virtual memory) and local replacement policy, the maximum size of a logical process is 4K pages and the page size is 64Kbytes. The following table contains all the information about P and Q processes at time t = 170:

Information about P and Q processes at t = 170							
Process	**Frame**	**Page**	**Load instant**	**Last reference instant**	**Bit R (reference)**	**Bit M (modified)**	**Bits RWX**
P	0x4A	0xC72	160	161	1	0	101
P	0x4B	0xC71	120	140	1	1	101
P	0x4C	0xA70	36	152	0	1	110
P	0x4D	0xA73	30	163	1	1	110
Q	0x4E	0xA70	40	167	1	0	101
Q	0x4F	0xA73	42	142	0	1	110

Based on the information provided on the table, answer each section: **(2 points=0.25+0.5+0.5+0.75)**

4

a) Indicate which pages of P and Q have the valid bit set to 0 and enter the content of the page descriptors for pages with valid bit set to 1

b) From the table obtain the logical address corresponding to the physical address 0x4D4AB1

Physical address of P -> Logical address   *Physical address of Q -> Logical address*

```
0x4D4AB1   --->                          0x4D4AB1   --->
```

c) At time t = 171 the CPU sends P's logical address 0xB95603A and at time t = 172 the CPU sends Q's logical address 0xB95603A. Compute the corresponding physical addresses if the replacement policy is **second chance**:

Logical address of P -> Physical address   *Logical address of Q -> Physical address*

```
0xB95603A   --->                          0xB95603A   --->
```

d) Content evolution of the frames involved if the replacement policy is **LRU (least recently used)**, considering that from t = 171 the CPU sends P addresses with the following reference string : 0xA71, 0xB40, 0xC72, 0xB51

Frame	t = 170 (Start)					

5. When running the following code in C three processes are created:

```
{int fd_pipe[2], fd; /* pipe descriptor, regular file */
 int pid;
 /*** Initial table *************************/
  close(1);
  fd=open("result",O_WRONLY |O_CREAT|O_TRUNC,0666);
  dup2(2,3);
  fd=open("datos",O_RDONLY);
  close(0);close(2);
  pipe(fd_pipe);
  pid=fork();
  if (pid==0)
      { close(fd);
        dup2(3,2);
        /*** P2 table ********************/
        execlp("/usr/bin/wc", "wc", "-l",NULL);
      }
  pid=fork();
  if (pid==0)
      { dup2(2,1); dup2(fd,0);  dup2(3,2);
        /*** P3 table ******************/
        execlp("/bin/cat", "cat", NULL);
      }
   close(0); close(2);
        /*** P1 table ******************/
   while(pid != wait(&status));
}
```

	Initial table
0	STDIN
1	STDOUT
2	STDERR
3	
4	

(1.6 points=0.4+1.2)

5	**a)** Describe the relationship between processes P1, P2 and P3, and draw the communication scheme established

b) Obtain the descriptor table content for every process involved at the marks inserted on the code as /*** … table … ***/

	P1 table
0	
1	
2	
3	
4	
5	

	P2 table
0	
1	
2	
3	
4	
5	

	P3 table
0	
1	
2	
3	
4	
5	

6. Given the following directory listing on a POSIX system:

```
permissions links    user    group    size       date           name
drwxr-xr-x    2       sterr   fso      4096    dec  9 2016    .
drwxrwxr-x    8       sterr   fso      4096    sep 10 2016    ..
-r-xr-sr-x    1       sterr   fso   1139706    dec  9 2016    cp1
-r-sr-xr-x    1       sterr   fso   1139706    dec  9 2016    cp2
-r-xr-xr-x    1       sterr   fso   1139706    dec  9 2016    cp3
-r--r-----    1       sterr   fso      9706    dec  9 2016    f1
-r--rw-rw-    1       sterr   fso      4157    dec  9 2016    f2
-rw-r--r--    1       sterr   fso       222    dec  9 2016    f4
```
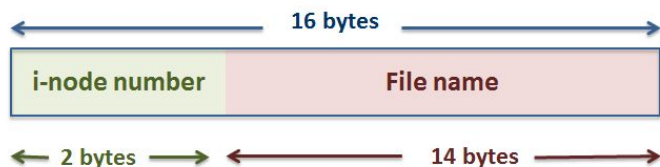
(1.4 points)

6	Considering that programs cp1, cp2 and cp3 are three identical copies of the cp system command that copies the contents of the file on the first argument into another one which name is indicated as the second argument. That is, "cp1 a b" copies the contents of file "a" into file "b", if "b" does not exist it is created and the copied. Fill the table indicating whether the command works or not, the EUID and EGID (effective process UID and GID when the command is being executed) and in case of error, which is the permission that fails.

| UID, GID	Command	Does it work?	EUID, EGID	In case of error explain
pepe, fso	cp2 f1 f2			
sterr, etc	cp1 f1 f4			
ana, etc	cp1 f1 f2			
ana, etc	cp1 f1 f5			
ana, etc	cp2 f1 f5			
ana, etc	cp3 f1 f2			
ana, etc	cp3 f4 f2			

7. The following figures refer to the sizes and structures of the elements of a MINIX file system used to format a disk partition. The block size is 1KByte and 1 zone = 1 block. Note that all fields in the i-node are 16 bits except "No. of links" and GID that are 8 bits. The directory entry format is:

```
<---------------- 16 bytes ---------------->
+------------------+---------------------------+
| i-node number    |        File name          |
+------------------+---------------------------+
<-- 2 bytes -->    <------- 14 bytes ------->
```

(2,0 points)

i-node structure (32 bytes, 16 bits wide):
- Mode
- UID
- File size in bytes
- Last change time
- Nº of links | GID
- 7 direct zone pointers
- 1 indirect pointer
- 1 double indirect pointer

a) Calculate the partition size given that it has been formatted for the maximum number of zones and to have the maximum number of i-nodes

b) Maximum number of i-nodes
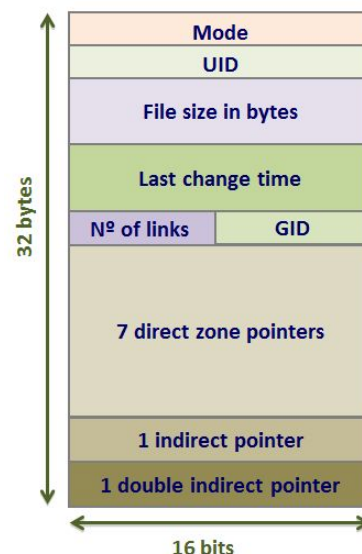
Answer the following sections considering a MINIX file system with the parameters described above and having a partition size of 32MBytes (Megabytes) and 32K i-nodes :

c) Number of blocks required for the i-node bit map, the zone bit map and the i-nodes

d) Free disk space after formatting (including the creation of the root directory)

e) Maximum number of physical links that a file can have

f) Maximum number of symbolic links that a file can have

g) Maximum number of directories that a directory can contain

h) Number of zones occupied by 10 files of 100 Bytes

i) Number of zones occupied by 10 files of 100 KBytes