長庚大學113學年度第一學期作業系統期中測驗（滿分103）

系級: 姓名: 學號:

1. (8%) For operating systems, interrupts are an important hardware and software mechanism to let processors know some specific events. Please provide one example for using software interrupts and one example for using hardware interrupts.

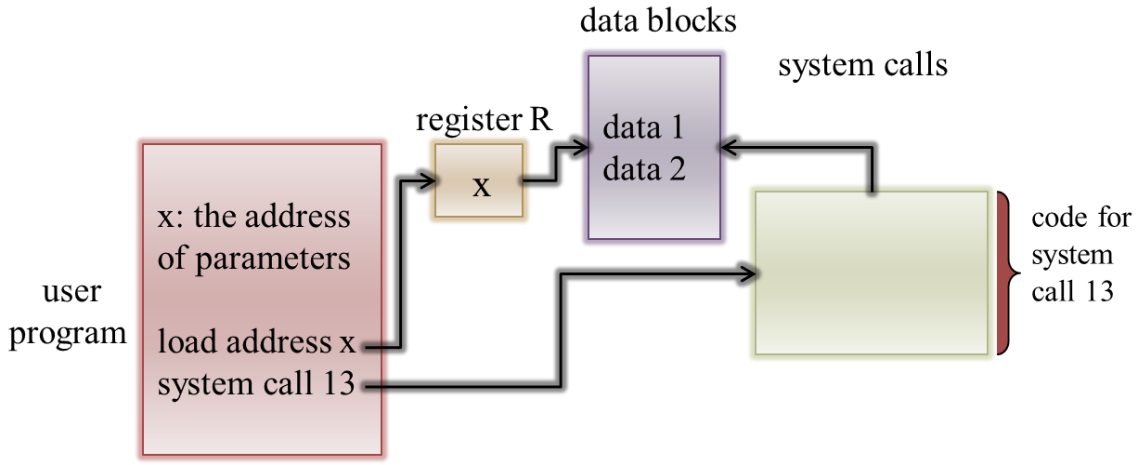
Answer: Software Interrupts: signals, invalid memory access, division by zero, system calls, etc.
Hardware Interrupts: services requests of I/O devices, e.g., keyboards, Ethernet adapters, touch

2. (9%) Please provide the definitions of (a) multiprogramming (3%) and (b) time sharing (3%). (c) What is the problem if an OS has only multiprogramming technique without the time-sharing support? (3%)

Answer: (a) Multiprogramming: The operating system keeps several jobs in memory simultaneously.
(b) Time Sharing: Time sharing is a logical extension of multiprogramming, in which CPU switches jobs frequently so that users can interact with each job while it is running.
(c) When some processes take long execution time continuously, the other processes would suffer from long waiting time (thus, the response time could be long).

3. (8%) When a user process calls a system call, it might need to pass some parameters to the operating system. There three methods for passing parameters: using registers, using stacks, using registers pointing to blocks. Please carefully illustrate the flow of using registers pointing to blocks for the system call parameter passing.

Answer:



4. (8%) When compared with Monolithic Kernel, please provide (a) one advantage of Microkernel and (b) one disadvantage of Microkernel.

Answer: (a) Advantage: Microkernel is more modulized, and thus, it is more portable, reliable, and easy for extensions. (4%)
(b) Disadvantage: There are more inter-process communication (IPC) calls in Microkernel. Thus, the performance might be worse. (4%)

5. (8%) Please define I/O-bound processes and CPU-bound processes。

Answer: An I/O-bound process – spends more time doing I/O than computations. (4%)
A CPU-bound process – spends more time doing computations. (4%)

6. (8%) For multiple threads in a process, we have thread-local storage (TLS). (a) What is the difference between TLS and global variables? (b) What is the difference between TLS and local variables?

Answer: (a) Global variables are available in all threads of the process, and TLS is available in only the thread which declares the TLS. (4%)
(b) Local variables are visible only during single function invocation, but TLS visible across function invocations in a thread. (4%)

7. (8%) For inter-process communication (IPC), we have message passing IPC and shared memory IPC. Please complete the following example of using shared memory IPC by provide the two lines of C codes.

Shared Memory– Producer

```
while (true)
{
  … /* produce a new item */
  while (((in + 1) % BUFFER_SIZE) == out);
  /* do nothing */
  buffer[in] = next_produced;
  in = FIRST LINE for ANSWER;
}
```

Shared Memory– Consumer

```
while (true)
{
  while (SECOMD LINE for ANSWER);
  /* do nothing and have to wait */
  next_consumed = buffer[out];
  out = (out + 1) % BUFFER_SIZE;
  … /* use the consumed item */
}
```

Answer: (in + 1) % BUFFER SIZE
in == out

8. (8%) Both of multi-process and multi-thread are techniques to explore parallelism for using the computing resources of multi-core processors. What is the advantage of using multiple processes when compared with multiple processes?

Answer: (Only one correct reason is required)
1. Threads can share resources of a process, e.g., global data, binary code and opened files. Thus, it is much more efficient in terms of resource saving.
2. Commutation among the threads of a process is easier than that among processes.

9. (8%) Please give the definition of (a) long-term scheduler (or job scheduler) and (b) short-term scheduler (or CPU scheduler).

Answer: (a) Long-term scheduler – selects which processes should be brought into the ready queue.
(b) Short-term scheduler – selects which process should be executed next and allocates CPU.

10. (6%) Please explain the purposes of using the following Linux commands in Homework 1: (a) *insmod*, (b) *rmmod* and .(c) *dmesg*.

Answer: (a) to insert a kernel module
(b) to remove a kernel module
(c) to read the kernel ring buffer for checking the information printed by the kernel module

11. (12%) We assume that all the fork functions are successfully executed. Please provide the output of the following program:

```
#include<sys/types.h>
#include<stdio.h>
#include<unistd.h>
int main()
{
        pid_t pid, pid2;
        printf("X\n");
        pid = fork();
        if (pid == 0)
        {
                printf("Y\n");
                pid2 = fork();
                if (pid2 != 0)
                {
                        wait(NULL);
                }
                else
                {
                        printf("W\n");
                }
        }
        else
        {
                wait(NULL);
        }
        printf("Z\n");
        return 0;
}
```

Answer:

X
Y
W
Z
Z
Z

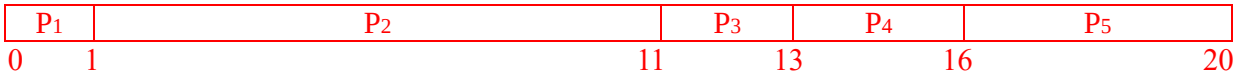
12. (12%) For five ready processes with the arriving order: P_1, P_2, P_3, P_4, P_5, let's use FCFS, SJF and RR for the process scheduling, where the time quantum of RR is 4 ms. (a) Please draw scheduling results of the three scheduling algorithms. (9%) (b) Provide the waiting time of each process for the three scheduling algorithms respectively. (3%)

Process	Burst Time
P_1	1 ms
P_2	10 ms
P_3	2 ms
P_4	3 ms
P_5	4 ms

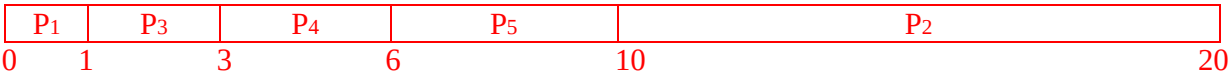
Answer:

(b)

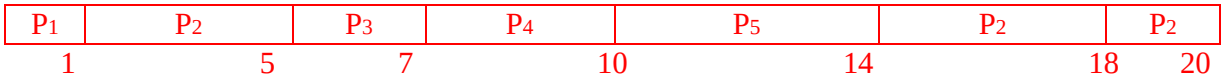
FCFS:



SJF:



RR:



(b)

FCFS: P_1: 1-1=0, P_2: 11-10=1, P_3: 13-2=1, P_4: 16-3=13, P_5: 20-4=16

SJF: P_1: 1-1=0, P_2: 20-10=10, P_3: 3-2=1, P_4: 6-3=3, P_5: 10-4=6

RR: P_1: 1-1=0, P_2: 20-10=10, P_3: 7-2=5, P_4: 10-3=7, P_5: 14-4=10