TA responsible for HW1: Shuowei (scaiak@cse.ust.hk)

Spring 2022 COMP 3511 Homework Assignment 1 (HW1)

Handout Date: Feb. 18, 2022, Due Date: Mar. 4, 2022

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Please read the following instructions carefully before answering the questions:

- You should finish the homework assignment **individually**.
- This homework assignment contains **three** parts:
  1) Multiple choices 2) Short Answer 3) Program with fork()
- **Homework Submission:** submit to **Homework #1** on **Canvas**.
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1. (30 points) Multiple choices

Write your answers in the boxes below:

MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8	MC9	MC10

1) Which of the following items is not a component of hardware?

A) CPU
B) Basic computing resources
C) Database
D) I/O devices

2) Which of the following sentences about interrupt is incorrect?

A) Interrupts are widely used in modern operating systems to handle asynchronous events.
B) Some modern operating systems (e.g., Windows 10) are not interrupt-driven.
C) Interrupts have different priority. Low-priority interrupts' execution can be preempted by a high-priority interrupt.
D) I/O device can trigger interrupts by sending a signal to the CPU.

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3) Which of the following sentences about storage is incorrect?

A) In a hierarchy storage system, fast access of a kind of storage often means a smaller storage capacity.
B) Two essential design issues for cache memory are cache size and access privileges.
C) Mechanical storage is generally larger and less expensive per byte than electrical storage. It also needs more access time.
D) The access time of the register is faster than that of the cache.

4) Which of the following items is NOT an advantage of virtualization?

A) It allows operating systems to run as applications within another operating system.
B) It allows a single physical machine can run multiple operating systems concurrently.
C) It allows multiple users to run tasks concurrently in a system.
D) It allows programs to use the same resource (like storage) at the same time.

5) Command Line Interface (CLI) _____

A) allows users to enter commands to be performed by the operating system directly.
B) is always implemented in kernel.
C) uses the same syntax in different operating systems.
D) is not applicable when Graphical User Interface (GUI) is used.

6) _____ provide(s) an interface to the services provided by an operating system.

A) System calls
B) Application Program Interface (API)
C) Command line Interface
D) Graphical User Interface (GUI)

7) Which of the following sentences about system call is incorrect?

A) It is preferred to use APIs rather than directly invoking system calls
B) System calls are generally available as functions written in a high-level language and assembly languages
C) The parameters of system call can only be passed by using registers.
D) A system call interface is provided by the run-time environment for most programming languages.

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8) _____ is used to identify legitimate users of a system.

A) User authentication
B) Application Program Interface (API)
C) Graphical User Interface (GUI)
D) Access right

9) In _____, messages must be copied between the services when two user-level services must communicate with each other.

A) Monolithic structure
B) Layered Structure
C) Microkernel Structure
D) Loadable kernel modules Structure

10) What is true about the return value of a successful fork()?

A) fork() will return 0 at the parent process.
B) fork() will return the child's process ID at the child process.
C) fork() will return -1 at parent process.
D) fork() will return the child's process ID at the parent process.

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2. (30 points) Short answer

(1) (6 points) Please illustrate the jobs of operating systems in two aspects. When answering this question, please refer to the Operating System Definition slides

(2) (6 points) Briefly summarize the advantages of multi-core single-processor systems.

(3) (6 points) Please contrast the monolithic kernel design with the microkernel approach in terms of efficiency, scalability, and stability.

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(4) (6 points) Please explain the relation between Linker and Loaders.

(5) (6 points) Describe the similarities and differences between the two processes after calling fork().

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3. (40 points) Simple C programs on fork()

For all the C programs, you can assume that necessary header files are included

1) (10 points) Consider the following code segments:

```
int main(){
   int i = 0;
   int cnt = 10;
   for (; i<3; i++){
        fork();
        cnt += 10;
        printf(" +\n");
        printf(" %d\n ",cnt);
   }
   return 0;
}
```

(a) How many '30 ' will this code print? Please elaborate.

(b) How many '+' will this code print? Please elaborate.

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2) (15 points) Consider the following code segments:

```
int main(){
   pid_t pid = fork();
   int cnt = 10;
   if (pid != 0) {
      cnt += 10;
      pid = fork();
      if (pid == 0) {
         cnt += 10;
         pid = fork();
      }
   }
   printf("%d \n", pid);
   printf("%d \n", cnt);
   return 0;
}
```

(a) How many times will this code print none zero process ID (pid)? Please elaborate.

(b) How many '0' will this code print? Please elaborate.

(c) How many '30' will this code print? Please elaborate.

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3) (5points) Consider the following code segments:

```
int main() {
    pid_t pid = fork();
    printf("%d \n",getpid());
    printf("%d \n",pid);
    return 0;
}
```

Function description:

```
getpid(); //get current process id
```

If one process prints:

```
54319
54320
```

What will another process print? Please elaborate.

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4) (10 points) Consider the following code segments:

```
int main() {
    int i = 0;
    for (; i<2; i++) {
        if(_____X_____) {
            fork();
            printf("(A,%d) \n",i);
        }
        else {
             printf("(B,%d) \n",i);
        }
    }
    return 0;
}
```

(a) If the code always prints '(B,0)' twice, what is the possible code at position **X**? **X** contains no more than 20 characters

You can assume that fork() is always successful. You MUST use fork() in your answer. Please note that the program prints other lines not equal to (B,0). Please elaborate.

(b) Assume the child's PID created by fork() is always greater than 1000. If the code always prints '(B,1)' for six times, but prints '(B,0)' for only once, what is the possible code at position **X**? **X** contains no more than 20 characters.

You can assume that fork() is always successful. You MUST use fork() in your answer. Please note that the program prints other lines not equal to (B,1) and (B,0). Please elaborate.