Fall 2015 COMP 3511 Homework Assignment #1 Solution

Handout Date: Sept. 11, 2015 Due Date: Sept. 25, 2015

Name: _____ ID: _____E-Mail: _____

Please read the following instructions carefully before answering the questions:

- You should finish the homework assignment **individually**.
- There are a total of **4** questions.
- When you write your answers, please try to be precise and concise.
- Fill in your name, student ID, email at the top of each page.
- Please fill in your answers in the space provided, or you can type your answers in the MS Word file.

- **Homework Collection: the hardcopy** is required and the homework is collected in collection box #16(for L1) and #17(for L2). The collection boxes locate outside Room 4210, near lift 21 (there are labels attached on the boxes).

1. (20 points) Multiple choices

1) The two separate modes of operating in a system are
   A) supervisor mode and system mode
   B) kernel mode and privileged mode
   C) physical mode and logical mode
   D) user mode and kernel mode
   Answer: D

2) Which of the following statements concerning open source operating systems is true?
   A) Solaris is open source.
   B) Source code is freely available.
   C) They are always more secure than commercial, closed systems.
   D) All open source operating systems share the same set of goals.
   Answer: B

3) A _____ is an example of a systems program.
   A) command interpreter
   B) Web browser
   C) text formatter
   D) database system
   Answer: A

4) _____ provide(s) an interface to the services provided by an operating system.
   A) Shared memory
   B) System calls
   C) Simulators

D) Communication
Answer: B

5) Which of the following statements is incorrect?
A) An operating system provides an environment for the execution of programs.
B) An operating system manages system resources.
C) Operating systems provide both command line as well as graphical user interfaces.
D) Operating systems must provide both protection and security.
Answer: C

6) The ____ of a process contains temporary data such as function parameters, return addresses, and local variables.
A) text section
B) data section
C) program counter
D) stack
Answer: D

7) When a child process is created, which of the following is a possibility in terms of the execution or address space of the child process?
A) The child process runs concurrently with the parent.
B) The child process has a new program loaded into it.
C) The child is a duplicate of the parent.
D) All of the above
Answer: D

8) A process that has terminated, but whose parent has not yet called wait(), is known as a _____ process.
A) zombie
B) orphan
C) terminated
D) init
Answer: A

9) Imagine that a host with IP address 150.55.66.77 wishes to download a file from the web server at IP address 202.28.15.123. Select a valid socket pair for a connection between this pair of hosts.
A) 150.55.66.77:80 and 202.28.15.123:80
B) 150.55.66.77:150 and 202.28.15.123:80
C) 150.55.66.77:2000 and 202.28.15.123:80
D) 150.55.66.77:80 and 202.28.15.123:3500
Answer:C

10) Which of the following statements is true?
A) Named pipes do not allow bi-directional communication.

B) Only the parent and child processes can use named pipes for communication.
C) Reading and writing to ordinary pipes on both UNIX and Windows systems can be performed like ordinary file I/O.
D) Named pipes can only be used by communicating processes on the same machine.
Answer: C

2. (30 points) Please answer the following questions in 3-4 sentences

1) (6 points) What are the typical services that cloud computing deliver? What is the main or base technology that a cloud computing platform uses to provide such functionality?

Answer: Cloud computing is a type of computing that can deliver computing, storage, or/and application services over a network. Cloud computing uses *virtualization technique* to provide its functionality.

2) (6 points) Please compare and contrast a multiprocessor system and a multicore system.

Answer: A multicore system is one type of multiprocessor system, and both of which can enhance the throughout and reliability when comparing with a single processor system. A multicore system is considered to be more efficient than a general multiprocessor system, because a multicore system (one chip with multiple cores) enables faster communications (on-chip communication) and consumes significantly less power.

3) (6 points) What are the two main objectives of an operating system? Please briefly elaborate them.

Answer: (1) to provide user with the convenience, that is to provide an environment for users to execute programs on computer hardware in a safe convenient, protected and efficient manner; (2) it does resource allocation: to allocate resources in a fair and efficient manner.

4) (6 points) The best current technology for operating system design involves using loadable kernel modules. Please briefly describe what it is and what the major advantages of this approach are over layered and microkernel approaches

Answer: In loadable kernel modular design, an operating system only provides the core functionalities in its kernel, and enables the addition of other operating system services dynamically while the kernel is running. It is more flexible than a layered approach as any module can call any other module while layered

approach restrict a layer to interact with only a lower and a higher layer. It is also more efficient that a microkernel design because it does not require the often cumbersome and slow message passing mechanism needed in a microkernel approach.

5) (6 points) What is the main difference between an emulation technique and a virtualization technique?

Answer: Emulation is used when the source CPU type is different from the target CPU type, which allows applications complied for one type of CPU to run another type of CPU. Virtualization enables an operating system to run as an application within another operating system.

3. (20 points) Simple C programs on fork().

1) Consider the following code segments, what is the total number of processes (including the initial process)? Please elaborate. (10 points)

```
#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>

int main() {
    pid_t pid;
    pid = fork();
    if (pid == 0) {
        if(fork() > 0)
            fork();
    }
    else
       fork();
    return 0;
}
```

Answer: There are total 5 processes. The first fork() creates one child (1), the second fork() creates one child (2), and the third fork() creates one child(3), the forth fork() creates one child(4), so totally there are 5 processes.

2) Consider the following code segments, what is the total number of processes (including the initial process)? Please elaborate (10 points)

```
#include <stdlib.h>
#include <stdio.h>
```

```
#include <unistd.h>

int main() {
    for (i = 0; i < 10; i++)
        if (fork())
            fork();
        else{
            fork();
            fork();
        }
    return 0;
}
```

Answer: There are total 6^{10} processes. In each loop, there are 4 fork() operations. The first fork() creates one child (1). The second fork() create one child, the third fork create 1 child, and the forth fork() create 2 children. So after one loop there are 6 processes from the initial 1 process. And since there are 10 loops, after this program totally there are 6^{10} processes.

4. (30 points) Process

   1) (6 points) The text section of a process contains the program code; what are the other sections of the memory allocation for a process?

      Answer: The stack, heap and data sections.

   2) (6 points) What is the main difference between a single-thread process and a multi-thread process? Which one can take advantage of a multicore system?

      Answer: A single-thread process can only perform only one task at a time, while a multi-thread process can perform more than one task at a time, only which can take advantage of a multicore system.

   3) (6 points) Please briefly describe at least two differences of the process creation in a Unix system, i.e., fork() and in a Microsoft system, i.e., CreateProcess()

      Answer: There is no parameter in fork() system call while CreateProcess() system call requires no fewer than 10 parameters. fork() copies the address space of the parent process into the child address space, which implies that the parent and child processes run an identical program unless a new program is loaded into the child process explicitly (by exec()); CreateProcess() requires loading a

specific program into the address space of the child process at the time of process creation.

4) (6 points) What are the differences between an orphan process and a zombie process? How does UNIX handle them, respectively?

Answer: A parent terminates without first calling wait(), its children are considered as orphan processes. UNIX assigns the init process as the new parent of orphan processes and init periodically calls wait(), which allows any resources allocated to terminated processes to be reclaimed by the operating system.

5) (6 points) Please compare and contrast how multitasking is handled in iOS and Android systems, respectively?

Answer: Both iOS and Android systems provide multitasking, and both restricts only one single foreground process to be running and on display while there could be a number of background processes (remains in memory, but do not occupy the display screen). There are a limited number of application types that can run in background in iOS, but there is no such restriction in Android system, in which a background application must use a *service*, a separate application component that runs on behalf of the background process.