Assignment No. 2(A)

Date:

TITLE: Process control system calls: The demonstration of FORK, EXECVE and WAIT system calls along with zombie and orphan states.

A. Implement the C program in which main program accepts the integers to be sorted. Main program uses the FORK system call to create a new process called a child process. Parent process sorts the integers using sorting algorithm and waits for child process using WAIT system call to sort the integers using any sorting algorithm. Also demonstrate zombie and orphan states.

OBJECTIVE:

- Study how to create a process in UNIX using fork() system call.
- Study of zombie, daemon and orphan states.

SOFTWARE REQUIREMENTS:

1. Ubuntu 16.04
2. GNU C Compiler

THEORY:

fork( ): It is a system call that creates a new process under the UNIX operating system. It takes no arguments. The purpose of fork() is to create a new process, which becomes the child process of the caller. After a new child process is created, both processes will execute the next instruction following the fork() system call. Therefore, we have to distinguish the parent from the child. This can be done by testing the returned value of fork():

- If fork() returns a negative value, the creation of a child process was unsuccessful.
- fork() returns a zero to the newly created child process.
- fork() returns a positive value, the process ID of the child process, to the parent. The returned process ID is of type pid_t defined in sys/types.h. Normally, the process ID is an integer. Moreover, a process can use function getpid() to retrieve the process ID assigned to this process.

Therefore, after the system call to fork(), a simple test can tell which process is the child. Note that Unix will make an exact copy of the parent's address space and give it to the child. Therefore, the parent and child processes have separate address spaces.

Let us take an example:

```
int main()
{
        printf("Before Forking");
        fork();
        printf("After Forking");
        return 0;
}
```

If the call to fork() is executed successfully, Unix will

- Make two identical copies of address spaces, one for the parent and the other for the child.
- Both processes will start their execution at the next statement following the fork() call.

If we run this program, we might see the following on the screen:

```
Before Forking
After Forking
After Forking
```

Here printf() statement after fork() system call executed by parent as well as child process.

Both processes start their execution right after the system call fork(). Since both processes have identical but separate address spaces, those variables initialized before the fork() call have the same values in both address spaces. Since every process has its own address space, any modifications will be independent of the others. In other words, if the parent changes the value of its variable, the modification will only affect the variable in the parent process's address space. Other address spaces created by fork() calls will not be affected even though they have identical variable names.

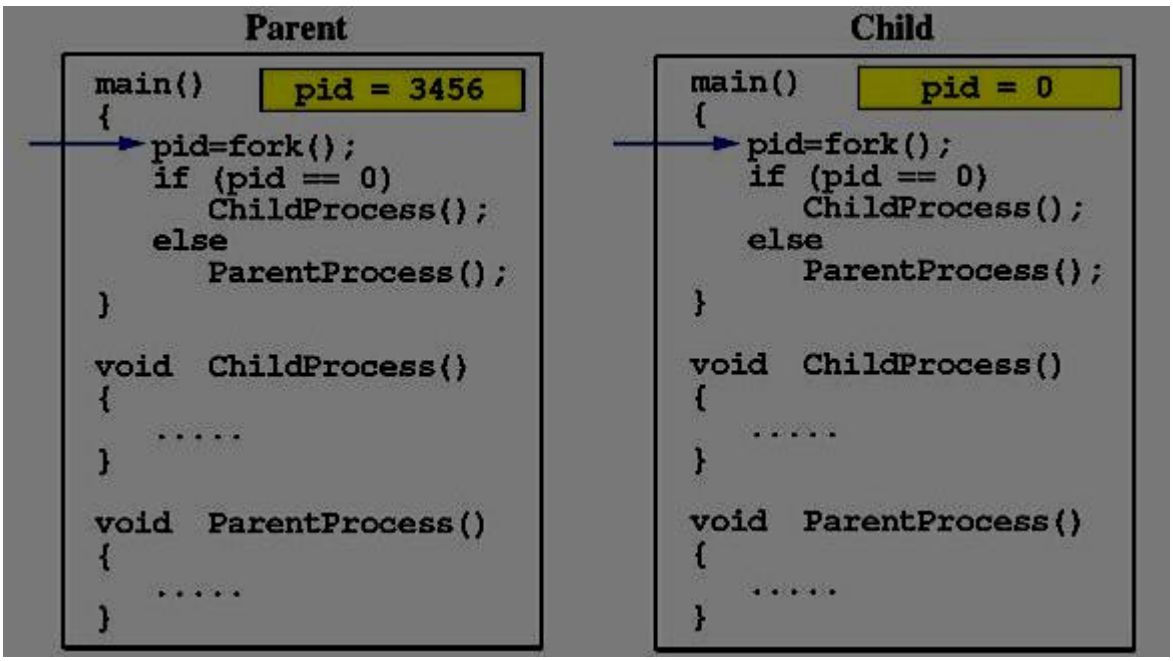
Consider one simpler example, which distinguishes the parent from the child.

```
#include <stdio.h>
#include <sys/types.h>
void ChildProcess();      /* child process prototype  */ void
ParentProcess();        /* parent process prototype */  int
main()
```

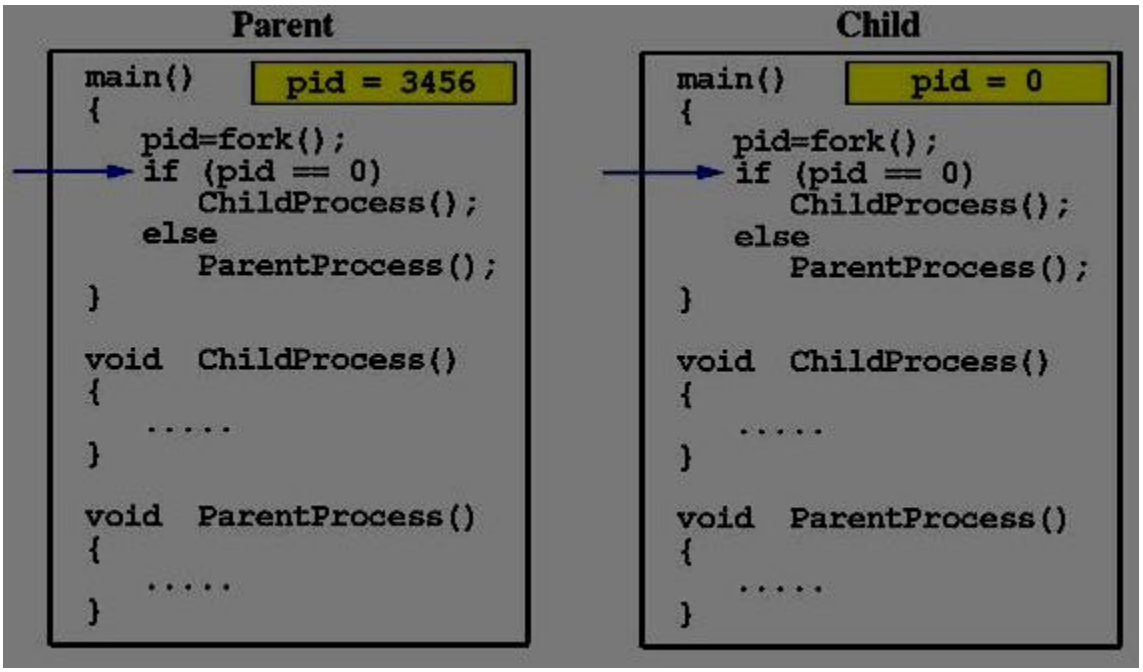
```
  {

        pid_t  pid;
        pid = fork();
        if (pid == 0)

           ChildProcess();


        else

           ParentProcess();

     return 0;

  }
void ChildProcess()

  {

  }

  void ParentProcess()

  {

  }
```

In this program, both processes print lines that indicate (1) whether the line is printed by the child or by the parent process, and (2) the value of variable i.

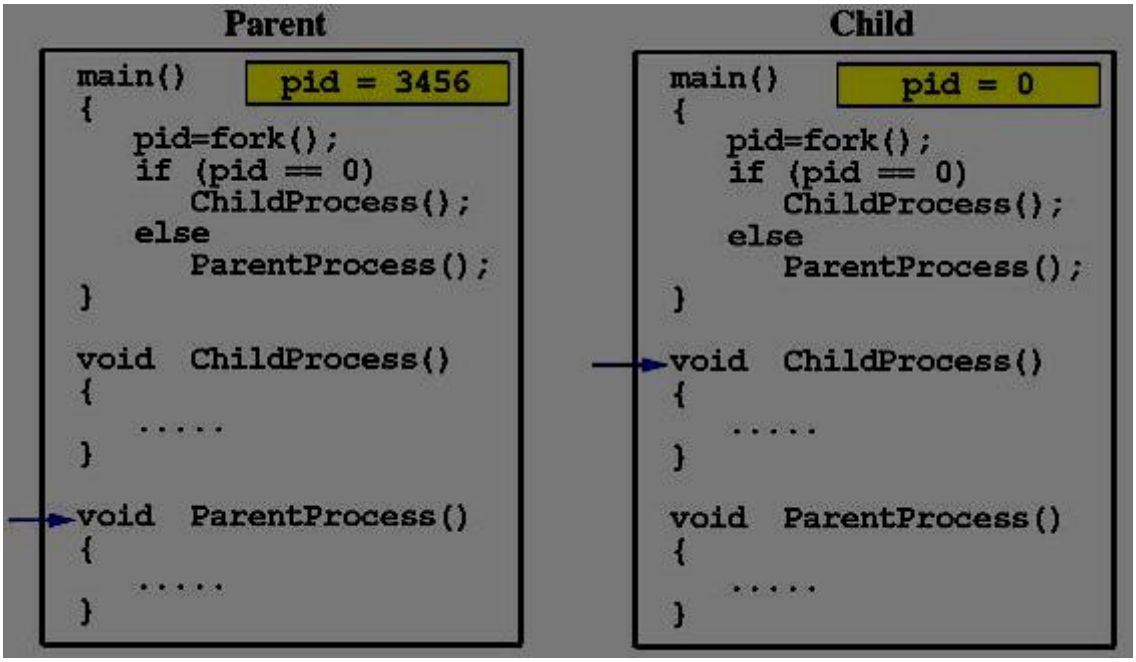
When the main program executes fork(), an identical copy of its address space, including the program and all data, is created. System call fork() returns the child process ID to the parent and returns 0 to the child process. The following figure shows that in both address spaces there is a variable pid. The one in the parent receives the child's process ID 3456 and the one in the child receives 0.



Now both programs (i.e., the parent and child) will execute independent of each other starting at the next statement:



In the parent, since pid is non-zero, it calls function parentprocess(). On the other hand, the child has a zero pid and calls childprocess() as shown below:



Due to the fact that the CPU scheduler will assign a time quantum to each process, the parent or the child process will run for some time before the control is switched to the other and the running process will print some lines before you can see any line printed by the other process.

ps command:

The ps command shows the processes we're running, the process another user is running, or all the processes on the system. E.g.

$ ps –ef

By default, the ps program shows only processes that maintain a connection with a terminal, a console, a serial line, or a pseudo terminal. Other processes run without needing to communicate with a user on a terminal. These are typically system processes that Linux uses to manage shared resources. We can use **ps** to see all such processes using the -e option and to get "full" information with -f.

Zombie Process:

When a child process terminates, an association with its parent survives until the parent in turn either terminates normally or calls wait. The child process entry in the process table is therefore not freed up immediately. Although no longer active, the child process is still in the system because its exit code needs to be stored in case the parent subsequently calls wait. It becomes what is known as defunct, or a zombie process.

Orphan Process:

An orphan process is a computer process whose parent process has finished or terminated, though itself remains running. A process may also be intentionally orphaned so that it becomes detached from the user's session and left running in the background; usually to allow a long-running job to

complete without further user attention, or to start an indefinitely running service. Under UNIX, the latter kinds of processes are typically called daemon processes. The UNIX *nohup* command is one means to accomplish this.

Daemon Process:

It is a process that runs in the background, rather than under the direct control of a user; they are usually initiated as background processes.

Upstart Process:

Upstart is an event-based replacement for the `/sbin/init` daemon which handles starting of tasks and services during boot, stopping them during shutdown and supervising them while the system is running.

Conclusion: Thus we have studied and shown demonstration of FORK and WAIT system calls along with zombie and orphan states.