#

CSC3150 A1 Report

## Part1: Problem Brief

The project is divided into three parts. In part1, we are required to write a program(program1.c) to complete the tasks in part1.

The tasks in part1 includes: 1. Fork a child process to execute test programs (15 of them) 2. Use wait() to let the parent process receives the SIGCHLD signal 3. Print out the termination information of child process (normal or abnormal)

The tasks un part2 includes: 1. Create a kernel thread and run my\_fork function 2. Fork a process to execute test.o 3. Use do\_wait() to let the parent process wait for the child process 4. Print out pid of both parent and child processes 5. Catch the signal raised by the child process and print out related log 6. Recompile the Linux kernel source code to use its functions

## Part2: Overall Project Structure

## Part3: Program Design

#### Program1:

Fork the child process

pid\_t pid;  
printf("Process start to fork\n");  
pid = fork();

wait for SIGCHLD signal

/\* wait for child process terminates \*/  
waitpid(-1, &status, WUNTRACED);   
printf("Parent process receives the SIGCHLD signal\n");

Child process execute test programs

if (pid == 0) { // child process  
 int i;  
 char \*arg[argc];  
  
 for (i = 0; i < argc - 1; i++) {  
 arg[i] = argv[i + 1];  
 }  
 arg[argc - 1] = NULL;  
  
 /\* execute test program \*/  
 printf("I'm the child process, my pid = %d\n", getpid());  
 printf("Child process start to execute test program:\n");  
 // start execute the program  
 execve(arg[0], arg, NULL);  
  
 printf("Continue to run original child process!\n");  
  
 perror("execve");  
 exit(SIGCHLD);

Analyse exit status and print out info

/\* check child process' termination status \*/  
if(WIFEXITED(status)){ // normal exit  
 printf("Normal termination with EXIT STATUS = %d\n",WEXITSTATUS(status));  
}  
  
else if(WIFSIGNALED(status)){ // abnormal exit  
 int num = WTERMSIG(status);  
 switch (num){  
 case 6: // SIGABRT  
 printf("child process get SIGABRT signal\n");  
 printf("child process is abort by abort signal\n");  
 printf("CHILD EXECUTION FAILED!!\n");  
 break;  
 case 14: // SIGALRM  
 printf("child process get SIGALRM signal\n");  
 printf("child process is abort by alarm signal\n");  
 printf("CHILD EXECUTION FAILED!!\n");  
 break;  
 case 7: // SIGBUS  
 printf("child process get SIGBUS signal\n");  
 printf("child process is abort by bus error signal\n");  
 printf("CHILD EXECUTION FAILED!!\n");  
 break;  
 ......  
 }  
  
}  
else if(WIFSTOPPED(status)){ // stop signal  
 printf("child process get SIGSTOP signal\n");  
 printf("child process stopped\n");  
 printf("CHILD EXECUTION STOPPED\n"); }  
else{  
 printf("CHILD PROCESS CONTINUED\n");  
}

#### Program2

Create a kernel thread and run my\_fork

task = kthread\_create(&my\_fork, NULL, "MyThread");  
//wake up new thread if ok  
if (!IS\_ERR(task)) {  
 printk("[program2] : Module\_init kthread starts\n");  
 wake\_up\_process(task);  
}

Fork a process and print out pid

pid\_t pid;  
/\* fork a process using do\_fork \*/  
pid = \_do\_fork(SIGCHLD, (unsigned long) &my\_exec, 0, NULL, NULL, 0);  
  
printk("[program2] : The child process has pid= %d\n", pid);  
printk("[program2] : The parent process has pid= %d\n", (int) current->pid);

Execute the test program

int my\_exec(void) {  
 int result;  
 const char path[] = "/mnt/hgfs/CSC3150/Project/CSC3150\_Assignment\_1/  
 source/program2/test";  
 const char \*const argv[] = {path, NULL, NULL};  
 const char \*const envp[] = {"HOME=/", "PATH=/sbin:/user/sbin:/bin:/usr/bin", NULL};  
  
 struct filename \*my\_filename = getname(path);  
  
 /\* execute a test program in child process \*/  
 printk("[program2] : child process");  
  
 result = do\_execve(my\_filename, argv, envp);  
   
 if (!result) {  
 return 0;  
 } else {  
 do\_exit(result);  
 }  
}

Wait for child process termination

void my\_wait(pid\_t pid) {  
 struct wait\_opts wo;  
 struct pid \*wo\_pid = NULL;  
 enum pid\_type type;  
 type = PIDTYPE\_PID;  
 wo\_pid = find\_get\_pid(pid);  
  
 wo.wo\_type = type;  
 wo.wo\_pid = wo\_pid;  
 wo.wo\_flags = WEXITED;  
 wo.wo\_info = NULL;  
 wo.wo\_stat = (int \_\_user\*)&status;  
 wo.wo\_rusage = NULL;  
  
 int a;  
 a = do\_wait(&wo);  
  
 output\_info(status);  
  
 put\_pid(wo\_pid);  
 return;  
}

Catch the signal and printed out message

void output\_info(int exit){  
 switch (exit) {  
 case 1:  
 printk("[program2] : get SIGHUP signal\n");  
 printk("[program2] : child process is hung up\n");  
 printk("[program2] : The return signal is 1\n");  
 break;  
 case 2:  
 printk("[program2] : get SIGINT signal\n");  
 printk("[program2] : terminal interrupt\n");  
 printk("[program2] : The return signal is 2\n");  
 break;  
 case 131:  
 printk("[program2] : get SIGQUIT signal\n");  
 printk("[program2] : terminal quit\n");  
 printk("[program2] : The return signal is 3\n");  
 break;  
 ......  
 }  
 return;  
}

Recompile the kernel in order to use kernel function

Since I am able to declare these extern functions and use them in my program, it proves that I have recompiled the kernel and exported these symbols.

extern long do\_wait(struct wait\_opts \*wo);  
extern struct filename \* getname(const char \_\_user \* filename);  
extern long \_do\_fork(unsigned long clone\_flags,unsigned long stack\_start,  
 unsigned long stack\_size,int \_\_user \*parent\_tidptr, int \_\_user \*child\_tidptr,  
 unsigned long tls);  
extern int do\_execve(struct filename \*filename,const char \_\_user \*const \_\_user \*\_\_argv,   
 const char \_\_user \*const \_\_user \*\_\_envp);

## Part4: Program Environment

Virtual machine application: VM Ware fusion 11

The program is run on a Ubuntu 16.04 LTS operation system, with kernel version 4.10.14.

Compiler: gcc version 5.4.0

## Part5: How to run my program

#### Program1:

cd ./program1  
make  
./program1 filename

#### Program2:

cd ./program2  
gcc test.c -o test  
make  
insmod program2.ko  
rmmod program2.ko  
dmesg | tail -n 10

(You might need to export functions in linux kernel and recompile first)