

I confirm that I will keep the content of this assignment confidential. I confirm that I have not received any unauthorized assistance in preparing for or writing this assignment. I acknowledge that a mark of 0 may be assigned for copied work. Jason Choquette 104337378

For the implementation of this project, my main function calls an external program (the Parent), that forks a child (the Child) which immediately exits and becomes a zombie, upon which the parent's pid gets returned to the original main function.

The return value of the parent function is the pid of the parent. This pid is used in the kill system call to kill the parent.

At each step of the process, a process table is printed to standard out.

The implementation details are given below.

```
int main()
{
    pid_t    forkReturn;
    int      retCode;

    // call another C program to create a zombie
    // this main() function is the Parent process
    int parent = createZombie();

    // spawn a child process from this process
    forkReturn= fork();

    if (forkReturn == -1)
    {
        printf ("Error - fork failed!\n");
        exit (0);
    }
    else if (forkReturn == 0) // - this is the CHILD
    {
        sleep(1);

        /* when the child wakes, have it terminate the PARENT */
        retCode = kill( parent, SIGKILL);
        if(retCode == 0) // termination occurred
        {
            printf("\n(CHILD) : Parent has been terminated ...\n\n");
            sleep(1);
            system("ps -l");
            exit (0);
        }
        else
            printf("(CHILD) : Unable to terminate parent\n");
    }
}
```

```

        exit (0);
    }
    else // this is the PARENT
    {
        system("ps -l");
        sleep(5);
    }
    exit (0);
}

```

The createZombie function is quite simple. It simply spawns a child which immediately returns and then the pid of the parent is returned to the calling main() function.

The implementation details are given below.

```

int createZombie(void)
{
    switch (fork())
    {
        case -1:
            perror("\nfork() failed.\n");
            exit(1);

        case 0:
            // immediately exit to become zombie while parent sleeps
            exit(0);

        default:
            sleep(1);
            printf("\n\nCurrent processes: \n\n");
            system("ps -l");
            printf("\n");
            printf("\nFound the following zombies: \n");

            system(" ps aux | awk '\"[Zz]\" ~ $8 { printf(\"PID = %d\", $2); }' ");
            printf("\n\n");
            sleep(1);
            return getpid();
    }
}

```

Below I have provided three screen shots of the program.

Jason-Satellite-C650D: ~/CLionProjects/A2/cmake-build-debug

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$ ./A2 &  
[1] 7927
```

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$
```

Current processes:

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
0	S	1000	7927	7732	0	80	0	-	1085	wait	pts/0	00:00:00	A2
1	Z	1000	7928	7927	0	80	0	-	0	exit	pts/0	00:00:00	A2 <defunct>
0	S	1000	7929	7927	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7930	7929	0	80	0	-	7289	-	pts/0	00:00:00	ps

Found the following zombies:

PID = 7928

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
0	S	1000	7927	7732	0	80	0	-	1085	wait	pts/0	00:00:00	A2
1	Z	1000	7928	7927	0	80	0	-	0	exit	pts/0	00:00:00	A2 <defunct>
1	S	1000	7934	7927	0	80	0	-	1085	hrttime	pts/0	00:00:00	A2
0	S	1000	7935	7927	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7936	7935	0	80	0	-	7289	-	pts/0	00:00:00	ps

(CHILD) : Parent has been terminated ...

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
1	S	1000	7934	958	0	80	0	-	1085	wait	pts/0	00:00:00	A2
0	S	1000	7937	7934	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7938	7937	0	80	0	-	7289	-	pts/0	00:00:00	ps

^C

```
[1]+  Killed                  ./A2
```

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$
```

Jason-Satellite-C650D: ~/CLionProjects/A2/cmake-build-debug

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$ ./A2 &  
[1] 7960
```

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$
```

Current processes:

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
0	S	1000	7960	7732	0	80	0	-	1085	wait	pts/0	00:00:00	A2
1	Z	1000	7961	7960	0	80	0	-	0	exit	pts/0	00:00:00	A2 <defunct>
0	S	1000	7962	7960	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7963	7962	0	80	0	-	7289	-	pts/0	00:00:00	ps

Found the following zombies:

PID = 7961

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
0	S	1000	7960	7732	0	80	0	-	1085	wait	pts/0	00:00:00	A2
1	Z	1000	7961	7960	0	80	0	-	0	exit	pts/0	00:00:00	A2 <defunct>
1	S	1000	7967	7960	0	80	0	-	1085	hrttime	pts/0	00:00:00	A2
0	S	1000	7968	7960	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7969	7968	0	80	0	-	7289	-	pts/0	00:00:00	ps

(CHILD) : Parent has been terminated ...

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
1	S	1000	7967	958	0	80	0	-	1085	wait	pts/0	00:00:00	A2
0	S	1000	7970	7967	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7971	7970	0	80	0	-	7289	-	pts/0	00:00:00	ps

^C

[1]+ Killed ./A2

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$
```

ason-Satellite-C650D: ~/CLionProjects/A2/cmake-build-debug

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$ ./A2 &  
[1] 7990
```

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$
```

Current processes:

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
0	S	1000	7990	7732	0	80	0	-	1085	wait	pts/0	00:00:00	A2
1	Z	1000	7991	7990	0	80	0	-	0	exit	pts/0	00:00:00	A2 <defunct>
0	S	1000	7992	7990	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7993	7992	0	80	0	-	7289	-	pts/0	00:00:00	ps

Found the following zombies:

PID = 7991

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
0	S	1000	7990	7732	0	80	0	-	1085	wait	pts/0	00:00:00	A2
1	Z	1000	7991	7990	0	80	0	-	0	exit	pts/0	00:00:00	A2 <defunct>
1	S	1000	7997	7990	0	80	0	-	1085	hrtime	pts/0	00:00:00	A2
0	S	1000	7998	7990	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	7999	7998	0	80	0	-	7289	-	pts/0	00:00:00	ps

(CHILD) : Parent has been terminated ...

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
0	S	1000	7732	7725	0	80	0	-	5673	wait_w	pts/0	00:00:00	bash
1	S	1000	7997	958	0	80	0	-	1085	wait	pts/0	00:00:00	A2
0	S	1000	8000	7997	0	80	0	-	1123	wait	pts/0	00:00:00	sh
0	R	1000	8001	8000	0	80	0	-	7289	-	pts/0	00:00:00	ps

^C

[1]+ Killed ./A2

```
jason@jason-Satellite-C650D:~/CLionProjects/A2/cmake-build-debug$
```