

МГТУ им. БАУМАНА

ЛАБОРАТОРНАЯ РАБОТА №4

По курсу: "ОПЕРАЦИОННЫЕ СИСТЕМЫ"

**Процессы.
Системные вызовы `fork()` и `exec()`.**

Работу выполнил: Мокеев Даниил, ИУ7-56

Преподаватель: Рязанова Н.Ю.

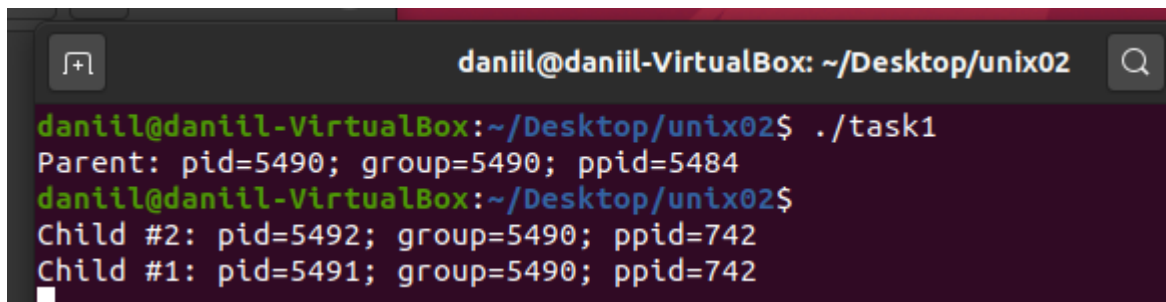
Москва, 2020

0.1 Листинг кода алгоритмов

В данном разделе будут приведены листинги кода реализованных программ.

Листинг 1: Процессы-сироты

```
1  #include <stdio.h>
2  #include <stdlib.h>
3
4  int main(){
5      int child_1, child_2;
6      child_1 = fork();
7      if(child_1 == -1){
8          perror("Coulnd't fork child #1");
9          exit(1);
10     }
11     if (child_1 == 0){
12         sleep(1);
13         printf("Child #1: pid=%d; group=%d; ppid=%d\n",
14             getpid(), getpgrp(), getppid());
15
16         return 0;
17     }
18     if (child_1 > 0){
19         child_2 = fork();
20         if(child_2 == -1){
21             perror("Coulnd't fork child #2");
22             exit(1);
23         }
24         if (child_2 == 0){
25             printf("\nChild #2: pid=%d; group=%d; ppid=%d\n",
26                 getpid(), getpgrp(), getppid());
27
28             return 0;
29         }else{
30             printf("Parent: pid=%d; group=%d; ppid=%d\n",
31                 getpid(), getpgrp(), getppid());
32
33             return 0;
34         }
35     }
36 }
```



The image shows a terminal window titled "daniil@daniil-VirtualBox: ~/Desktop/unix02". The prompt is "daniil@daniil-VirtualBox:~/Desktop/unix02\$". The user enters the command "./task1". The output is "Parent: pid=5490; group=5490; ppid=5484". The prompt changes to "daniil@daniil-VirtualBox:~/Desktop/unix02\$". The user enters the command "Child #2: pid=5492; group=5490; ppid=742". The output is "Child #1: pid=5491; group=5490; ppid=742".

```
daniil@daniil-VirtualBox:~/Desktop/unix02$ ./task1
Parent: pid=5490; group=5490; ppid=5484
daniil@daniil-VirtualBox:~/Desktop/unix02$
Child #2: pid=5492; group=5490; ppid=742
Child #1: pid=5491; group=5490; ppid=742
```

Рис. 1: Пример работы программы №1

```
1  #include <stdio.h>
2  #include <stdlib.h>
3  #include <sys/types.h>
4  #include <sys/wait.h>
5
6  int main(){
7      int child_1, child_2;
8      child_1 = fork();
9      if(child_1 == -1){
10         perror("Coulnd't fork child #1");
11         exit(1);
12     }
13     if (child_1 == 0){
14         sleep(1);
15         printf("Child #1: pid=%d; group=%d; ppid=%d\n",
16             getpid(), getpgrp(), getppid());
17
18         return 0;
19     }
20     if (child_1 > 0){
21         child_2 = fork();
22         if(child_2 == -1){
23             perror("Coulnd't fork child #2");
24             exit(1);
25         }
26         if (child_2 == 0){
27             printf("\nChild #2: pid=%d; group=%d; ppid=%d\n",
28                 getpid(), getpgrp(), getppid());
29
30             return 0;
31         }else{
32             sleep(2);
33             printf("Parent: pid=%d; group=%d; ppid=%d\n",
34                 getpid(), getpgrp(), getppid());
35
36             pid_t child_pid;
37             int status;
38
39             child_pid = wait(&status);
40             if (WIFEXITED(status))
41                 printf("Parent: child %d finished with code %d\n",
42                     child_pid, WEXITSTATUS(status) );
43             else if (WIFSTOPPED(status))
44                 printf("Parent: child %d finished with code %d\n",
45                     child_pid, WSTOPSIG(status) );
46             return 0;
47         }
48     }
```

```
daniil@daniil-VirtualBox:~/Desktop/unix02$ ./task2  
Child #2: pid=5891; group=5889; ppid=5889  
Child #1: pid=5890; group=5889; ppid=5889  
Parent: pid=5889; group=5889; ppid=5879  
Parent: child 5890 finished with code 0  
daniil@daniil-VirtualBox:~/Desktop/unix02$
```

Рис. 2: Пример работы программы №2

```
1  #include <stdio.h>
2  #include <stdlib.h>
3  #include <unistd.h>
4
5  int main(){
6      int child_1, child_2;
7      child_1 = fork();
8      if(child_1 == -1){
9          perror("Coulnd't fork child #1");
10         exit(1);
11     }
12     if (child_1 == 0){
13         sleep(1);
14         printf("\nChild #1 executes ps -al\n\n");
15         if(execlp("ps", "ps", "-al", (char*)NULL) == -1){
16             printf("Couldn't exec ps command\n");
17             exit(1);
18         }
19
20         return 0;
21     }
22     if (child_1 > 0){
23         child_2 = fork();
24         if(child_2 == -1){
25             perror("Coulnd't fork child #2");
26             exit(1);
27         }
28         if (child_2 == 0){
29             printf("\nChild #2 executes ls -l\n\n");
30             if(execlp("ls", "ls", "-l", (char*)NULL) == -1){
31                 printf("Couldn't exec ps command\n");
32                 exit(1);
33             }
34             return 0;
35         }else{
36             printf("\nParent: pid=%d; group=%d; ppid=%d\n",
37                 getpid(), getpgrp(), getppid());
38
39             pid_t child_pid;
40             int status;
41
42             //waiting for the second child to finish
43             child_pid = wait(&status);
44             if (WIFEXITED(status))
45                 printf("\nParent: child with pid = %d finished with code %d\n"↵
46                     ,
47                     child_pid, WEXITSTATUS(status) );
48             else if (WIFSTOPPED(status))
```

```

48     printf("\nParent: child %d finished with code %d\n",
49           child_pid, WSTOPSIG(status) );
50
51     //waiting for the first child to finish
52     child_pid = wait(&status);
53     if (WIFEXITED(status))
54         printf("\nParent: child with pid = %d finished with code %d\n"↵
55               ,
56               child_pid, WEXITSTATUS(status) );
57     else if (WIFSTOPPED(status))
58         printf("\nParent: child %d finished with code %d\n",
59               child_pid, WSTOPSIG(status) );
60
61     return 0;
62 }
63 }

```

```

danil@danil-VirtualBox:~/Desktop/unix02$ ./task3
Parent: pid=5957; group=5957; ppid=5879
Child #2 executes ls -l
total 120
-rwxrwxr-x 1 danil danil 17000 ноя  8 18:26 task1
-rw-rw-r-- 1 danil danil   734 ноя  8 18:28 task1.c
-rwxrwxr-x 1 danil danil 17096 ноя  9 15:52 task2
-rw-rw-r-- 1 danil danil  1121 ноя  9 16:01 task2.c
-rwxrwxr-x 1 danil danil 17184 ноя  9 16:29 task3
-rw-rw-r-- 1 danil danil  1633 ноя  9 16:29 task3.c
-rwxrwxr-x 1 danil danil 17176 ноя  9 17:06 task4
-rw-rw-r-- 1 danil danil  1903 ноя  9 17:17 task4.c
-rwxrwxr-x 1 danil danil 17256 ноя 10 18:39 task5
-rw-rw-r-- 1 danil danil  2132 ноя 10 18:40 task5.c
.
| Parent: child with pid = 5959 finished with code 0
Child #1 executes ps -al
ng-
 F S  UID    PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
ere4 S   1000    830     822   0  80   0 - 76634 ep_pol  tty2        00:00:28 Xorg
 0 S   1000    942     822   0  80   0 - 47711 poll_s  tty2        00:00:00 gnome-sess
 0 S   1000   5957   5879   0  80   0 -    622 do_wai pts/0        00:00:00 task3
 4 R   1000   5958   5957   0  80   0 -   2850 -      pts/0        00:00:00 ps
Parent: child with pid = 5958 finished with code 0
danil@danil-VirtualBox:~/Desktop/unix02$

```

Рис. 3: Пример работы программы №3

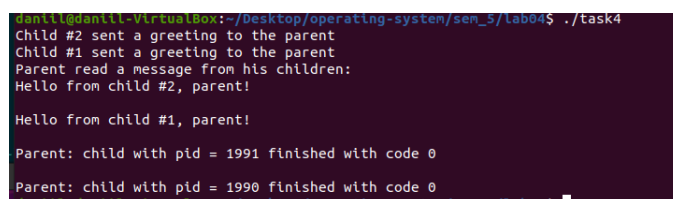
```
1  /*
2  exchanging messages with parent
3  */
4  #include <stdio.h>
5  #include <stdlib.h>
6  #include <unistd.h>
7  #define MESSAGE_SIZE 32
8
9  int main(){
10     int child_1, child_2;
11
12     //initializing pipe
13     int fd[2];
14     if (pipe(fd) == -1){
15         printf("Coundn't create a pipe\n");
16         exit(1);
17     }
18
19     child_1 = fork();
20     if(child_1 == -1){
21         perror("Coulnd't fork child #1");
22         exit(1);
23     }
24     if (child_1 == 0){
25
26
27         close(fd[0]);
28         if (write(fd[1], "Hello from child #1, parent!\n",
29             MESSAGE_SIZE) > 0)
30             printf("Child #1 sent a greeting to the parent\n");
31         return 0;
32     }
33     if (child_1 > 0){
34         child_2 = fork();
35         if(child_2 == -1){
36             perror("Coulnd't fork child #2");
37             exit(1);
38         }
39         if (child_2 == 0){
40             sleep(1);
41             close(fd[0]);
42             if (write(fd[1], "Hello from child #2, parent!\n",
43                 MESSAGE_SIZE) > 0)
44                 printf("Child #2 sent a greeting to the parent\n");
45             return 0;
46         }else{
47
48             char msg1[MESSAGE_SIZE], msg2[MESSAGE_SIZE];
```



```

49     close(fd[1]);
50     read(fd[0], msg1, MESSAGE_SIZE);
51     read(fd[0], msg2, MESSAGE_SIZE);
52
53     printf("Parent read a message from his children: \n%s\n%s",
54           msg1, msg2);
55
56
57
58     pid_t child_pid;
59     int status;
60
61     //waiting for the second child to finish
62     child_pid = wait(&status);
63     if (WIFEXITED(status))
64     printf("\nParent: child with pid = %d finished with code %d\n"↵
65           ,
66           child_pid, WEXITSTATUS(status) );
67     else if (WIFSTOPPED(status))
68     printf("\nParent: child %d finished with code %d\n",
69           child_pid, WSTOPSIG(status) );
70
71     //waiting for the first child to finish
72     child_pid = wait(&status);
73     if (WIFEXITED(status))
74     printf("\nParent: child with pid = %d finished with code %d\n"↵
75           ,
76           child_pid, WEXITSTATUS(status) );
77     else if (WIFSTOPPED(status))
78     printf("\nParent: child %d finished with code %d\n",
79           child_pid, WSTOPSIG(status) );
80
81     return 0;
82 }

```



```

daniil@denit1-VirtualBox: ~/Desktop/operating-system/sem_5/lab04$ ./task4
Child #2 sent a greeting to the parent
Child #1 sent a greeting to the parent
Parent read a message from his children:
Hello from child #2, parent!

Hello from child #1, parent!

Parent: child with pid = 1991 finished with code 0
Parent: child with pid = 1990 finished with code 0
daniil@denit1-VirtualBox: ~/Desktop/operating-system/sem_5/lab04$

```

Рис. 4: Пример работы программы №4

```

1  /*
2  DIY sig handler
3  */
4  #include <stdio.h>
5  #include <stdlib.h>
6  #include <unistd.h>
7  #include <signal.h>
8  #include <stdbool.h>
9  #include <string.h>
10
11 #define MESSAGE_SIZE 64
12 #define SLEEP_TIME 3
13
14 //flag is set to true if signal has been caught
15 bool flag = false;
16
17 void mySignalHandler(int snum){
18     printf("\nHandlig signal snum = %d in prosses...\n", snum);
19     printf("Done!\n");
20     flag = true;
21 }
22
23 int main(){
24     int child_1, child_2;
25     signal(SIGINT, mySignalHandler);
26
27     //initializing pipe
28     int fd[2];
29     if (pipe(fd) == -1){
30         printf("Coundn't create a pipe\n");
31         exit(1);
32     }
33
34     child_1 = fork();
35     if(child_1 == -1){
36         perror("Coulnd't fork child #1");
37         exit(1);
38     }
39     if (child_1 == 0){
40         close(fd[1]);
41         sleep(SLEEP_TIME);
42         if (flag){
43             char msg[MESSAGE_SIZE];
44             if (read(fd[0], msg, MESSAGE_SIZE) > 0){
45                 printf("Child #1 read from parent %s\n", msg);
46             }
47         }
48

```

```

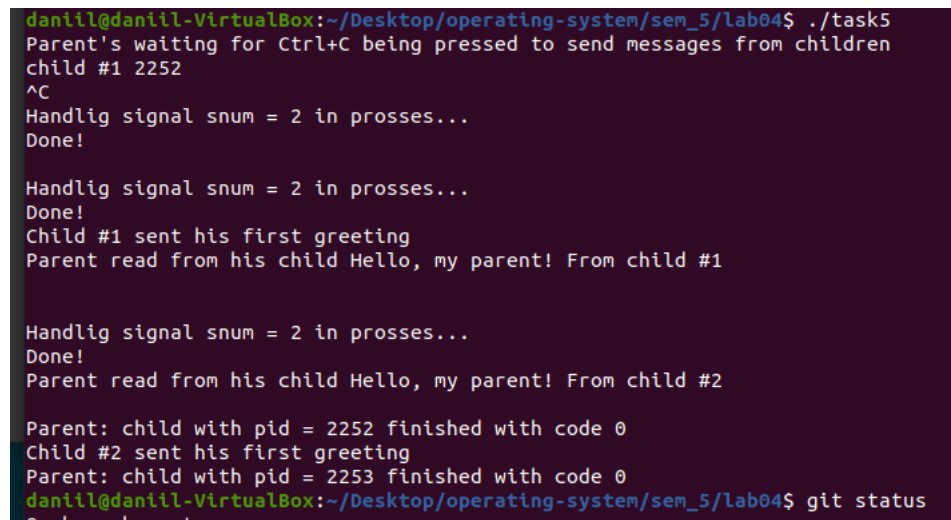
49     return 0;
50 }
51 if (child_1 > 0){
52     child_2 = fork();
53     if(child_2 == -1){
54         perror("Coulnd't fork child #2");
55         exit(1);
56     }
57     if (child_2 == 0){
58         close(fd[1]);
59
60         sleep(SLEEP_TIME);
61         if (flag){
62             char msg[MESSAGE_SIZE];
63             if (read(fd[0], msg, MESSAGE_SIZE) > 0){
64                 printf("Child #2 read from parent %s\n", msg);
65             }
66         }
67
68         return 0;
69     }else{
70         close(fd[0]);
71         printf("Parent's waiting for Ctrl+C being pressed to send ↵
72             messages from children\n");
73         sleep(SLEEP_TIME);
74
75         if (flag){
76             //writing in pipe if we cought the signal
77             if (write(fd[1], "Hello, my child!\n", MESSAGE_SIZE) > 0)
78                 printf("Parent sent his first greeting\n");
79             if (write(fd[1], "Hello again, my child!\n", MESSAGE_SIZE) >↵
80                 0)
81                 printf("Parent sent his second greeting\n");
82         }
83
84         pid_t child_pid;
85         int status;
86
87         //waiting for the second child to finish
88         child_pid = wait(&status);
89         if (WIFEXITED(status))
90             printf("Parent: child with pid = %d finished with code %d\n",
91                 child_pid, WEXITSTATUS(status) );
92         else if (WIFSTOPPED(status))
93             printf("Parent: child %d finished with code %d\n",
94                 child_pid, WSTOPSIG(status) );
95
96         //waiting for the first child to finish
97         child_pid = wait(&status);

```

```

96     if (WIFEXITED(status))
97         printf("Parent: child with pid = %d finished with code %d\n",
98             child_pid, WEXITSTATUS(status) );
99     else if (WIFSTOPPED(status))
100         printf("Parent: child %d finished with code %d\n",
101             child_pid, WSTOPSIG(status) );
102     return 0;
103 }
104 }
105 }

```



```

danil@danil-VirtualBox:~/Desktop/operating-system/sem_5/lab04$ ./task5
Parent's waiting for Ctrl+C being pressed to send messages from children
child #1 2252
^C
Handlig signal snum = 2 in prosses...
Done!

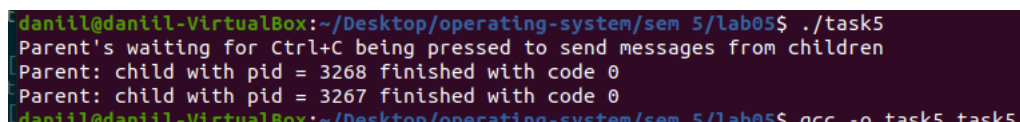
Handlig signal snum = 2 in prosses...
Done!
Child #1 sent his first greeting
Parent read from his child Hello, my parent! From child #1

Handlig signal snum = 2 in prosses...
Done!
Parent read from his child Hello, my parent! From child #2

Parent: child with pid = 2252 finished with code 0
Child #2 sent his first greeting
Parent: child with pid = 2253 finished with code 0
danil@danil-VirtualBox:~/Desktop/operating-system/sem_5/lab04$ git status
On branch master

```

Рис. 5: Пример работы программы №5: был подан сигнал



```

danil@danil-VirtualBox:~/Desktop/operating-system/sem_5/lab05$ ./task5
Parent's waiting for Ctrl+C being pressed to send messages from children
Parent: child with pid = 3268 finished with code 0
Parent: child with pid = 3267 finished with code 0
danil@danil-VirtualBox:~/Desktop/operating-system/sem_5/lab05$ gcc -o task5 task5.c

```

Рис. 6: Пример работы программы №5: сигнал не был подан