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ФАКУЛЬТЕТ _____ «Информатика и системы управления» _____

КАФЕДРА «Программное обеспечение ЭВМ и информационные технологии»

Отчёт по лабораторной работе №4 по курсу «Операционные системы»

Тема _____ Процессы. Системные вызовы `fork()` и `exec()` _____

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Оценка (баллы) _____

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Задание 1

Процессы-сироты. В программе создаются не менее двух потомков. В потомках вызывается `sleep()`. Чтобы предок гарантированно завершился раньше своих потомков. Продемонстрировать с помощью соответствующего вывода информацию об идентификаторах процессов и их группе.

Листинг кода 1

```
#include <sys/types.h>
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>

#define CANT_FORK_ERROR 1
#define SUCCESS 0

int main(void)
{
    printf("From Parent. Parent identifiers: parentProcID is %d, groupID is %d\n", getpid(), getpgrp());
    pid_t childpid;
    int children[2];

    for (int i = 0; i < 2; i++)
    {
        if ((childpid = fork()) == -1)
        {
            perror("Can't fork");
            exit(CANT_FORK_ERROR);
        }
        else if (childpid == 0)
        {
            sleep(1);
            printf("From child. Child identifiers: childProcID is %d, groupID is %d, parentID is %d\n", getpid(), getpgrp(), getppid());
            exit(SUCCESS);
        }
        else
            children[i] = childpid;
    }

    printf("Children IDs from parent proccess: %d and %d\nEnd of parent existence\n\n", children[0], children[1]);

    return SUCCESS;
}
```

```

[trvehazzk3r@TrveHazzk3r lab_04]$ gcc ex1.c -o ex1.exe
[trvehazzk3r@TrveHazzk3r lab_04]$ ./ex1.exe
From Parent. Parent identifiers: parentProcID is 8320, groupID is 8320
Children IDs from parent proccess: 8321 and 8322
End of parent existence

[trvehazzk3r@TrveHazzk3r lab_04]$ From child. Child identifiers: childProcID is 8321, groupID is 8320, parentID is 1
From child. Child identifiers: childProcID is 8322, groupID is 8320, parentID is 1
[trvehazzk3r@TrveHazzk3r lab_04]$ 

```

Рисунок 1 Демонстрация работа написанной программы

Задание 2

Предок ждет завершения своих потомков, используя системный вызов `wait()`. Вывод соответствующих сообщений на экран.

Листинг кода 2

```

#include <sys/types.h>
#include <sys/wait.h>
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>

#define CANT_FORK_ERROR 1
#define SUCCESS 0

int main(void)
{
    printf("From Parent. Parent identifiers: parentProcID is %d, groupID is %d\n", getpid(), getpgrp());
    pid_t childpid;
    int children[2];

    for (int i = 0; i < 2; i++)
    {
        if ((childpid = fork()) == -1)
        {
            perror("Can't fork");
            return CANT_FORK_ERROR;
        }
        else if (childpid == 0)
        {
            sleep(1);
            printf("From child. Child identifiers: childProcID is %d, groupID is %d, parentID is %d\n", getpid(), getpgrp(), getppid());
            return SUCCESS;
        }
        else
            children[i] = childpid;
    }

    int childStatus;
    for (int i = 0; i < 2; i++)
    {

```

```

        childpid = wait(&childStatus);
        printf("Child has finished: PID = %d with status: %d\n", childpid, childStatus);
        if (WIFEXITED(childStatus))
            printf("Child exited with code %d\n", WEXITSTATUS(childStatus));
        else if (WIFSTOPPED(childStatus))
            printf("Child process is currently stopped. Code: %d\n", WSTOPSIG(childStatus));
        else if (WIFSIGNALED(childStatus))
            printf("Child process was terminated due to the receipt of a signal that was not caught. Code: %d\n", WTERMSIG(childStatus));
    }

    printf("Children IDs from parent process: %d and %d\nEnd of parent existence\n\n", children[0], children[1]);

    return SUCCESS;
}

```

```

[trvehazzk3r@TrveHazzk3r lab_04]$ gcc ex2.c -o ex2.exe
[trvehazzk3r@TrveHazzk3r lab_04]$ ./ex2.exe
From Parent. Parent identifiers: parentProcID is 8478, groupID is 8478
From child. Child identifiers: childProcID is 8479, groupID is 8478, parentID is 8478
From child. Child identifiers: childProcID is 8480, groupID is 8478, parentID is 8478
Child has finished: PID = 8479 with status: 0
Child exited with code 0
Child has finished: PID = 8480 with status: 0
Child exited with code 0
Children IDs from parent process: 8479 and 8480
End of parent existence

[trvehazzk3r@TrveHazzk3r lab_04]$ 

```

Рисунок 2 Демонстрация работы написанной программы

Задание 3

Потомки переходят на выполнение других программ. Предок ждет завершения своих потомков. Вывод соответствующих сообщений на экран.

Листинг кода 3

```

#include <sys/types.h>
#include <sys/wait.h>
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>

#define CANT_FORK_ERROR 1
#define CANT_EXECLP_ERROR 2
#define SUCCESS 0

int main(void)

```

```

{
    printf("From Parent. Parent identifiers: parentProcID is %d, groupID is %d\n", getpid(), getpgrp());
    pid_t childpid;
    int children[2];
    char *commands[2] = {"ps", "ls"};

    for (int i = 0; i < 2; i++)
    {
        if ((childpid = fork()) == -1)
        {
            perror("Can't fork");
            exit(CANT_FORK_ERROR);
        }
        else if (childpid == 0)
        {
            printf("From child. Child identifiers: childProcID is %d, groupID is %d, parentID is %d\n", getpid(), getpgrp(), getppid());

            if (execlp(commands[i], commands[i], NULL) < 0)
            {
                perror("Can't execlp");
                exit(CANT_EXECLP_ERROR);
            }

            exit(SUCCESS);
        }
        else
            children[i] = childpid;
    }
    printf("\n");

    int childStatus;
    for (int i = 0; i < 2; i++)
    {
        childpid = wait(&childStatus);
        printf("Child has finished: PID = %d with status: %d\n", childpid, childStatus);
        if (WIFEXITED(childStatus))
            printf("Child exited with code %d\n", WEXITSTATUS(childStatus));
        else if (WIFSTOPPED(childStatus))
            printf("Child process is currently stopped. Code: %d\n", WSTOPSIG(childStatus));
        else if (WIFSIGNALED(childStatus))
            printf("Child process was terminated due to the receipt of a signal that was not caught. Code: %d\n", WTERMSIG(childStatus));
    }

    printf("Children IDs from parent process: %d and %d\nEnd of parent existence\n\n", children[0], children[1]);

    return SUCCESS;
}

```

```

[trvehazzk3r@TrveHazzk3r lab_04]$ gcc ex3.c -o ex3.exe
[trvehazzk3r@TrveHazzk3r lab_04]$ ./ex3.exe
From Parent. Parent identifiers: parentProcID is 3212, groupID is 3212

From child. Child identifiers: childProcID is 3213, groupID is 3212, parentID is 3212
From child. Child identifiers: childProcID is 3214, groupID is 3212, parentID is 3212
a.out ex1.c ex1.exe ex2.c ex2.exe ex3.c ex3.exe ex4.c ex4.exe ex5.c ex5.exe Report.docx Report.pdf
Child has finished: PID = 3214 with status: 0
Child exited with code 0
  PID TTY          TIME CMD
  2873 pts/1        00:00:00 bash
   3212 pts/1        00:00:00 ex3.exe
   3213 pts/1        00:00:00 ps
Child has finished: PID = 3213 with status: 0
Child exited with code 0
Children IDs from parent proccess: 3213 and 3214
End of parent existence

[trvehazzk3r@TrveHazzk3r lab_04]$ 

```

Рисунок 3 Демонстрация работы написанной программы

Задание 4

Предок и потомки обмениваются сообщениями через неименованный программный канал. Предок ждет завершения своих потомков. Вывод соответствующих сообщений на экран.

Листинг кода 4

```

#include <sys/types.h>
#include <sys/wait.h>
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define CANT_FORK_ERROR 1
#define CANT_CREATE_PIPE_ERROR 3
#define SUCCESS 0

int main(void)
{
    printf("From Parent. Parent identifiers: parentProcID is %d, groupID is %d\n", getpid(), getpgrp());
    int fd[2];
    pid_t childpid;
    int children[2];
    char *pipeMessages[2] = {"Message №1\n", "Message №2\n"};

    if (pipe(fd) == -1)
    {
        perror("Can't create pipe");
        exit(CANT_CREATE_PIPE_ERROR);
    }

    for (int i = 0; i < 2; i++)
    {
        if ((childpid = fork()) == -1)

```

```

    {
        perror("Can't fork");
        exit(CANT_FORK_ERROR);
    }
    else if (childpid == 0)
    {
        close(fd[0]);
        write(fd[1], pipeMessages[i], strlen(pipeMessages[i]));
        printf("Message N%d was sent\n", i + 1);

        exit(SUCCESS);
    }
    else
        children[i] = childpid;

}
printf("\n");

int childStatus;
for (int i = 0; i < 2; i++)
{
    childpid = wait(&childStatus);
    printf("Child has finished: PID = %d with status: %d\n", childpid, childStatus);
    if (WIFEXITED(childStatus))
        printf("Child exited with code %d\n", WEXITSTATUS(childStatus));
    else if (WIFSTOPPED(childStatus))
        printf("Child process is currently stopped. Code: %d\n", WSTOPSIG(childStatus));
    else if (WIFSIGNALED(childStatus))
        printf("Child process was terminated due to the receipt of a signal that was not caught. Code: %d\n", WTERMSIG(childStatus));
}

char gotMessages[32] = { 0 };
close(fd[1]);
if (read(fd[0], gotMessages, 32) > 0)
    printf("Received from children:\n%s\n", gotMessages);
else
    printf("No messages from children.\n");

printf("Children IDs from parent process: %d and %d\nEnd of parent existence\n\n", children[0], children[1]);

return SUCCESS;
}

```

```

[trvehazzk3r@TrveHazzk3r lab_04]$ gcc ex4.c -o ex4.exe
[trvehazzk3r@TrveHazzk3r lab_04]$ ./ex4.exe
From Parent. Parent identifiers: parentProcID is 8723, groupID is 8723

Message №1 was sent
Message №2 was sent
Child has finished: PID = 8724; with status: 0
Child exited with code 0
Child has finished: PID = 8725; with status: 0
Child exited with code 0
Received from children:
Message №1
Message №2

Children IDs from parent proccess: 8724 and 8725
End of parent existence

[trvehazzk3r@TrveHazzk3r lab_04]$ █

```

Рисунок 4 Демонстрация работы написанной программы

Задание 5

Предок и потомки обмениваются сообщениями через неименованный программный канал. С помощью сигнала меняется ход выполнения программы. Предок ждет завершения своих потомков. Вывод соответствующих сообщений на экран.

Листинг кода 5

```

#include <sys/types.h>
#include <sys/wait.h>
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define CANT_FORK_ERROR 1
#define CANT_CREATE_PIPE_ERROR 3
#define SUCCESS 0

short canWrite = 0;

void noSIGTSTP()
{
}

void makeCanWriteTrue()

```



```

{
    canWrite = 1;
}

int main(void)
{
    printf("From Parent. Parent identifiers: parentProcID is %d, groupID is %d\n", getpid(), getpgrp());
    int fd[2];
    pid_t childpid;
    int children[2];
    char *pipeMessages[2] = {"Message №1\n", "Message №2\n"};

    if (pipe(fd) == -1)
    {
        perror("Can't create pipe");
        exit(CANT_CREATE_PIPE_ERROR);
    }

    signal(SIGTSTP, noSIGTSTP);

    for (int i = 0; i < 2; i++)
    {
        if ((childpid = fork()) == -1)
        {
            perror("Can't fork");
            exit(CANT_FORK_ERROR);
        }
        else if (childpid == 0)
        {
            signal(SIGTSTP, makeCanWriteTrue);
            sleep(4);
            if (canWrite)
            {
                close(fd[0]);
                write(fd[1], pipeMessages[i], strlen(pipeMessages[i]));
                printf("Message №%d was sent\n", i + 1);
            }
            else
                printf("Message №%d was NOT sent\n", i + 1);

            exit(SUCCESS);
        }
        else
            children[i] = childpid;
    }
    printf("\n\n");

    int childStatus;
    for (int i = 0; i < 2; i++)
    {
        childpid = wait(&childStatus);
        printf("Child has finished: PID = %d with status: %d\n", childpid, childStatus);
        if (WIFEXITED(childStatus))
            printf("Child exited with code %d\n", WEXITSTATUS(childStatus));
        else if (WIFSTOPPED(childStatus))

```

```

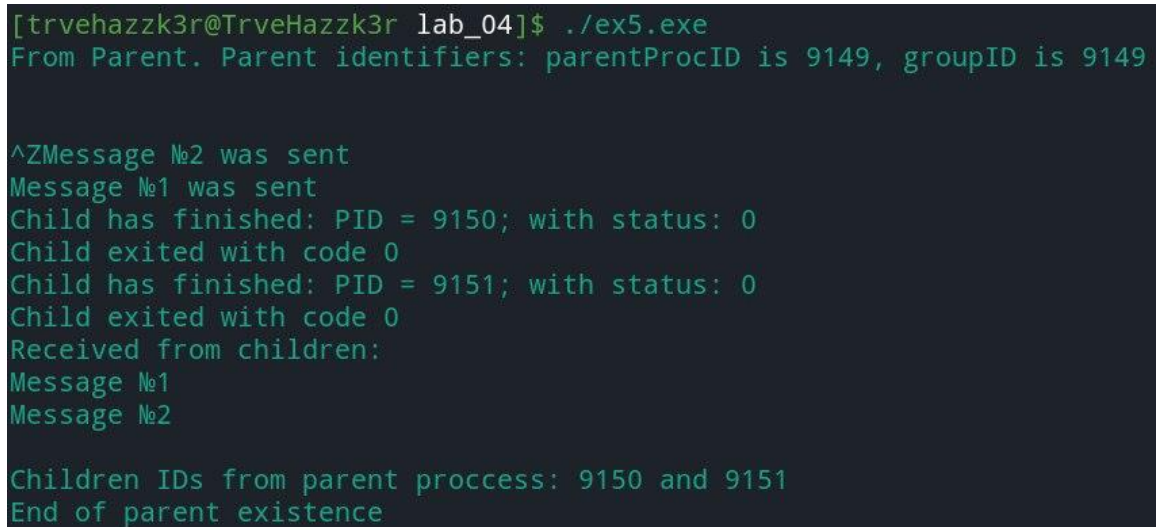
        printf("Child process is currently stopped. Code: %d\n", WSTOPSIG(c
hildStatus));
    else if (WIFSIGNALED(childStatus))
        printf("Child process was terminated due to the receipt of a signal
that was not caught. Code: %d\n", WTERMSIG(childStatus));
    }

    char gotMessages[32] = { 0 };
    close(fd[1]);
    if (read(fd[0], gotMessages, 32) > 0)
        printf("Received from children:\n%s\n", gotMessages);
    else
        printf("No messages from children.\n");

    printf("Children IDs from parent proccess: %d and %d\nEnd of parent existen
ce\n\n", children[0], children[1]);

    return SUCCESS;
}

```



```

[trvehazzk3r@TrveHazzk3r lab_04]$ ./ex5.exe
From Parent. Parent identifiers: parentProcID is 9149, groupID is 9149

^ZMessage №2 was sent
Message №1 was sent
Child has finished: PID = 9150; with status: 0
Child exited with code 0
Child has finished: PID = 9151; with status: 0
Child exited with code 0
Received from children:
Message №1
Message №2

Children IDs from parent proccess: 9150 and 9151
End of parent existence

```

Рисунок 5 Демонстрация работы написанной программы, сигнал вызывается

```
[trvehazzk3r@TrveHazzk3r lab_04]$ ./ex5.exe
From Parent. Parent identifiers: parentProcID is 9133, groupID is 9133

Message №1 was NOT sent
Message №2 was NOT sent
Child has finished: PID = 9134; with status: 0
Child exited with code 0
Child has finished: PID = 9135; with status: 0
Child exited with code 0
No messages from children.
Children IDs from parent proccess: 9134 and 9135
End of parent existence
```

Рисунок 6 Демонстрация работы написанной программы, сигнал не вызывается