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Лабораторная работа №3 по курсу
«Операционные системы»

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Постановка задачи

Вариант 22.

Родительский процесс создает два дочерних процесса. Первой строкой пользователь в консоль родительского процесса вводит имя файла, которое будет использовано для открытия *file* с таким именем на запись для *child1*. Аналогично для второй строки и процесса *child2*. Родительский и дочерний процесс должны быть представлены разными программами.

Родительский процесс принимает от пользователя строки произвольной длины и пересылает их в *child1* или в *child2* в зависимости от правила фильтрации. Процесс *child1* и *child2* производят работу над строками. Процессы пишут результаты своей работы в стандартный вывод.

Правило фильтрации: с вероятностью 80% строки отправляются в *child1*, иначе в *child2*. Дочерние процессы инвертируют строки.

Общий метод и алгоритм решения

Использованные системные вызовы:

- *pid_t fork(void)*; - создает дочерний процесс.
- *int execl(const char *path, const char *arg, ...)*; - заменяет образ текущего процесса на указанный, принимая аргументы в качестве списка.
- *pid_t waitpid(pid_t pid, int *status, int options)*; - ожидает изменения состояния входного процесса с заданными опциями.
- *int open(const char *pathname, int flags, mode_t mode)*; - открывает файл по входному пути с заданными флагами и правами доступа.
- *int close(int fd)*; - закрывает файловый дескриптор.
- *ssize_t read(int fd, void *buf, size_t count)*; - читает данные из файлового дескриптора и записывает их в буфер.
- *ssize_t write(int fd, const void *buf, size_t count)*; - записывает данные из буфера в файловый дескриптор.
- *int shm_open(const char *name, int oflag, mode_t mode)*; - открытие (создание) разделяемой памяти.
- *int shm_unlink(const char *name)*; - закрытие разделяемой памяти.
- *int ftruncate(int fd, off_t length)*; - обрезание файла до требуемой длины.
- *void *mmap(void *addr, size_t length, int prot, int flags, int fd, off_t offset)*; - отображение памяти в память процесса.
- *int munmap(void *addr, size_t length)*; - удаление отображения памяти из памяти процесса.
- *sem_t *sem_open(const char *name, int oflag, ...)*; - открытие (создание) семафора.
- *int sem_unlink(const char *name)*; - удаление семафора из системы, когда перестанет использоваться во всех процессах.
- *int sem_close(sem_t *sem)*; - закрытие семафора в рамках процесса.
- *int sem_wait(sem_t *sem)*; - декрементирование (захват) семафора.
- *int sem_post(sem_t *sem)*; - инкрементирование (освобождение) семафора.

В рамках лабораторной работы создавался родительский процесс, считывающий имена файлов, которые далее передаются как аргументы командной строки дочерним процессам, созданным с помощью *fork()* и *execl()*. Межпроцессорное взаимодействие осуществляется посредством разделяемой памяти, созданной системным вызовом *shm_open()* и отображаемой в память процесса с помощью *mmap()*. Доступ к памяти координируется с помощью семафора,

создаваемого вызовом *sem_open()*. Дочерние процессы с помощью тех же вызовов получают доступ к памяти и семафору.

Родительский процесс построчно считывает со стандартного потока ввода текст с помощью метода *read()*, который затем случайным образом передаётся одному из дочерних процессов в соответствии с требованиями, описанными в условиях.

Дочерний процесс при успешном захвате семафора с помощью *sem_wait()* производит проверку первого символа в буфере. Если оно равно числу процесса, то он считывает остальную часть строки из буфера и отпускает семафор с помощью *sem_post()*. В противном случае, процесс отпускает семафор, и засыпает на некоторый небольшой промежуток времени. Далее инвертирует строку и с помощью метода *write()* записывает в файл, который соответствует процессу.

При вводе слова *Stop* родительский процесс записывает в буфер сообщение о завершении работы дочерним процессам и с помощью *waitpid()* ожидает их завершения.

Все выделенные ресурсы корректно освобождаются при завершении работы программы.

Код программы

parent.c

```
#include <fcntl.h>
#include <semaphore.h>
#include <stdint.h>
#include <stdlib.h>
#include <string.h>
#include <sys/mman.h>
#include <sys/wait.h>
#include <unistd.h>

#include <lab1/constants.h>

#define PROBABILITY 80

int32_t WriteMessage(char *buffer,
                    const char *text,
                    sem_t *semaphore) {
    sem_wait(semaphore);

    memcpy(buffer, text, strlen(text) + 1);

    sem_post(semaphore);

    return 0;
}

ssize_t ReadFilename(char *buffer) {
    ssize_t size = read(STDIN_FILENO, buffer, MAX_BUFFER_SIZE);
```

```

    if (size == -1) {
        char message[] = "[ERROR] Can't read filename for process!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        return size;
    }

    buffer[size - 1] = '\0';
    --size;

    return size;
}

int32_t ProcessInput(char *buffer,
                    sem_t *semaphore) {
    char text[MAX_BUFFER_SIZE] = {0};

    while (read(STDIN_FILENO, text + 1, MAX_MESSAGE_SIZE) > 0) {
        if (strncmp(text + 1, EXIT_MESSAGE, sizeof(EXIT_MESSAGE) - 1) == 0) {
            break;
        }

        char process_to_send = rand() % 100 < PROBABILITY ? '1' : '2';

        text[0] = process_to_send;

        WriteMessage(buffer, text, semaphore);

        memset(text, 0, MAX_BUFFER_SIZE);
    }

    return 0;
}

void UnlinkMemory(const char *name) {
    if (shm_unlink(name) != 0) {
        char message[] = "[ERROR] Can't unlink shared memory!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }
}

void UnmapMemory(void *buffer,
                size_t length) {
    if (munmap(buffer, length) != 0) {
        char message[] = "[ERROR] Can't unmap shared memory!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }
}

```

```

void CloseSemaphore(sem_t *semaphore) {
    if (sem_unlink(SEMAPHORE_NAME) != 0) {
        char message[] = "[ERROR] Can't unlink semaphore!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }

    if (sem_close(semaphore) != 0) {
        char message[] = "[ERROR] Can't close semaphore!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }
}

int main(void) {
    char filename1[MAX_BUFFER_SIZE], filename2[MAX_BUFFER_SIZE];

    if (ReadFilename(filename1) == -1) {
        return 1;
    }

    if (ReadFilename(filename2) == -1) {
        return 1;
    }

    int shared_memory = shm_open(SHARED_MEMORY_NAME,
                                O_RDWR | O_CREAT | O_TRUNC,
                                S_IRUSR | S_IWUSR);

    if (shared_memory == -1) {
        char message[] = "[ERROR] Can't create shared memory!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        return 1;
    }

    if (ftruncate(shared_memory, MAX_BUFFER_SIZE) == -1) {
        UnlinkMemory(SHARED_MEMORY_NAME);

        char message[] = "[ERROR] Can't truncate shared memory!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        return 1;
    }

    char *buffer = mmap(NULL,
                        MAX_BUFFER_SIZE,
                        PROT_WRITE,
                        MAP_SHARED,
                        shared_memory,
                        0);

```

```

if (buffer == MAP_FAILED) {
    UnlinkMemory(SHARED_MEMORY_NAME);

    char message[] = "[ERROR] Can`t map shared memory!\n";
    write(STDOUT_FILENO, message, sizeof(message));

    return 1;
}

memset(buffer, 0, MAX_BUFFER_SIZE);

sem_unlink(SEMAPHORE_NAME);

sem_t *semaphore = sem_open(SEMAPHORE_NAME,
                             O_RDWR | O_CREAT | O_TRUNC,
                             S_IRUSR | S_IWUSR,
                             1);

if (semaphore == SEM_FAILED) {
    UnmapMemory(buffer, MAX_BUFFER_SIZE);
    UnlinkMemory(SHARED_MEMORY_NAME);

    char message[] = "[ERROR] Can`t create semaphore!\n";
    write(STDOUT_FILENO, message, sizeof(message));

    return 1;
}

pid_t pid1, pid2;

pid1 = fork();

if (pid1 == -1) {
    CloseSemaphore(semaphore);
    UnmapMemory(buffer, MAX_BUFFER_SIZE);
    UnlinkMemory(SHARED_MEMORY_NAME);

    char message[] = "[ERROR] Can`t create first child process!\n";
    write(STDOUT_FILENO, message, sizeof(message));

    return 1;
}

// child1
if (pid1 == 0) {
    execl("./child", "1", filename1, NULL);

    CloseSemaphore(semaphore);

```

```

    UnmapMemory(buffer, MAX_BUFFER_SIZE);
    UnlinkMemory(SHARED_MEMORY_NAME);

    char message[] = "[ERROR] Failed executing of first child!\n";
    write(STDOUT_FILENO, message, sizeof(message));

    return 1;
}

pid2 = fork();

if (pid2 == -1) {
    WriteMessage(buffer, EXIT_MESSAGE, semaphore);

    waitpid(pid1, NULL, 0);

    CloseSemaphore(semaphore);
    UnmapMemory(buffer, MAX_BUFFER_SIZE);
    UnlinkMemory(SHARED_MEMORY_NAME);

    char message[] = "[ERROR] Can't create second child process!\n";
    write(STDOUT_FILENO, message, sizeof(message));

    return 1;
}

// child2
if (pid2 == 0) {
    execl("./child", "2", filename2, NULL);

    CloseSemaphore(semaphore);
    UnmapMemory(buffer, MAX_BUFFER_SIZE);
    UnlinkMemory(SHARED_MEMORY_NAME);

    char message[] = "[ERROR] Failed executing of second child!\n";
    write(STDOUT_FILENO, message, sizeof(message));

    return 1;
}

// parent
int32_t result = ProcessInput(buffer, semaphore);

WriteMessage(buffer, EXIT_MESSAGE, semaphore);

waitpid(pid1, NULL, 0);
waitpid(pid2, NULL, 0);

CloseSemaphore(semaphore);

```

```

    UnmapMemory(buffer, MAX_BUFFER_SIZE);
    UnlinkMemory(SHARED_MEMORY_NAME);

    return result;
}

```

child.c

```

#include <fcntl.h>
#include <semaphore.h>
#include <stdbool.h>
#include <stdint.h>
#include <string.h>
#include <sys/mman.h>
#include <unistd.h>

#include <lab1/constants.h>

void InvertString(char *buffer,
                  uint64_t size) {
    for (uint64_t i = 0; i < size / 2; ++i) {
        char tmp = buffer[size - i - 1];

        buffer[size - i - 1] = buffer[i];
        buffer[i] = tmp;
    }
}

void CloseDescriptor(int descriptor) {
    if (close(descriptor) != 0) {
        char message[] = "[ERROR] Can't close descriptor!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }
}

void UnmapMemory(void *buffer,
                  size_t length) {
    if (munmap(buffer, length) != 0) {
        char message[] = "[ERROR] Can't unmap shared memory!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }
}

void CloseSemaphore(sem_t *semaphore) {
    if (sem_close(semaphore) != 0) {
        char message[] = "[ERROR] Can't close semaphore!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }
}

```



```

int main(int argc,
        char **argv) {
    if (argc != 2) {
        char message[] = "[ERROR] Child process must start with process id and output arguments!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        return 1;
    }

    char *id = argv[0];
    int file = open(argv[1],
                    O_RDWR | O_CREAT,
                    S_IRWXU);

    if (file == -1) {
        char message[] = "[ERROR] Can't create or open file in child process!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        return 1;
    }

    int shared_memory = shm_open(SHARED_MEMORY_NAME,
                                O_RDWR,
                                0);

    if (shared_memory == -1) {
        CloseDescriptor(file);

        char message[] = "[ERROR] Can't create shared memory!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        return 1;
    }

    char *buffer = mmap(NULL,
                        MAX_BUFFER_SIZE,
                        PROT_READ | PROT_WRITE,
                        MAP_SHARED,
                        shared_memory,
                        0);

    if (buffer == MAP_FAILED) {
        CloseDescriptor(shared_memory);
        CloseDescriptor(file);

        char message[] = "[ERROR] Can't map shared memory!\n";
        write(STDOUT_FILENO, message, sizeof(message));
    }
}

```

```

        return 1;
    }

    sem_t *semaphore = sem_open(SEMAPHORE_NAME,
                                O_RDWR);

    if (semaphore == SEM_FAILED) {
        UnmapMemory(buffer, MAX_BUFFER_SIZE);
        CloseDescriptor(shared_memory);
        CloseDescriptor(file);

        char message[] = "[ERROR] Can't create semaphore!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        return 1;
    }

    char text[MAX_MESSAGE_SIZE + 1] = {0};

    bool running = true;
    while (running) {
        sem_wait(semaphore);

        if (strncmp(buffer, EXIT_MESSAGE, sizeof(EXIT_MESSAGE) - 1) == 0) {
            sem_post(semaphore);

            running = false;

            continue;
        }

        if (buffer[0] != id[0]) {
            sem_post(semaphore);

            usleep(100000);

            continue;
        }

        memcpy(text, buffer + 1, MAX_MESSAGE_SIZE);
        memset(buffer, 0, MAX_BUFFER_SIZE);

        sem_post(semaphore);

        size_t length = strlen(text);

        if (text[length - 1] == '\n') {
            InvertString(text, length - 1);

```

```

    } else {
        InvertString(text, length);
    }

    ssize_t written = write(file, text, length);

    if (written != (ssize_t) length) {
        char message[] = "[ERROR] Can't write all text to file!\n";
        write(STDOUT_FILENO, message, sizeof(message));

        running = false;

        continue;
    }
}

CloseSemaphore(semaphore);
UnmapMemory(buffer, MAX_BUFFER_SIZE);
CloseDescriptor(shared_memory);
CloseDescriptor(file);

return 0;
}

```

constants.h

```

#ifndef MAI_OS_2025_CONSTANTS_H
#define MAI_OS_2025_CONSTANTS_H

#include <stdint.h>

#define MAX_BUFFER_SIZE 4096
#define MAX_MESSAGE_SIZE 4094

static const char SHARED_MEMORY_NAME[] = "lab3_shared_memory";
static const char SEMAPHORE_NAME[] = "lab3_semaphore";

static const char EXIT_MESSAGE[] = "Stop\n";

#endif //MAI_OS_2025_CONSTANTS_H

```

Протокол работы программы

Тестирование:

```

$ ./parent
test1.txt
test2.txt
Hello, World!
Hi

```

```

Test messageeeeeee
Finish
Stop
$ cat < test1.txt
eeeeeeegassem tseT
hsiniF
$ cat < test2.txt
!dlroW ,olleH
iH

```

Strace:

```

$ strace -f ./parent
247938 execve("./parent", [ "./parent" ], 0x7ffd72d44658 /* 29 vars */) = 0
247938 brk(NULL) = 0x6170c8a96000
247938 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x70062f074000
247938 access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or directory)
247938 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
247938 fstat(3, {st_mode=S_IFREG|0644, st_size=23159, ...}) = 0
247938 mmap(NULL, 23159, PROT_READ, MAP_PRIVATE, 3, 0) = 0x70062f06e000
247938 close(3) = 0
247938 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
247938 read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0"...
832) = 832
247938 pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"...
784, 64) = 784
247938 fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
247938 pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"...
784, 64) = 784
247938 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x70062ee00000
247938 mmap(0x70062ee28000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x70062ee28000
247938 mmap(0x70062efb0000, 323584, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x1b0000) = 0x70062efb0000
247938 mmap(0x70062efff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x70062efff000
247938 mmap(0x70062f005000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x70062f005000
247938 close(3) = 0
247938 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x70062f06b000
247938 arch_prctl(ARCH_SET_FS, 0x70062f06b740) = 0
247938 set_tid_address(0x70062f06ba10) = 247938
247938 set_robust_list(0x70062f06ba20, 24) = 0
247938 rseq(0x70062f06c060, 0x20, 0, 0x53053053) = 0
247938 mprotect(0x70062efff000, 16384, PROT_READ) = 0
247938 mprotect(0x6170b3207000, 4096, PROT_READ) = 0
247938 mprotect(0x70062f0ac000, 8192, PROT_READ) = 0
247938 prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY})

```

$$= 0$$

```

247986 access("/etc/ld.so.preload", R_OK <unfinished ...>
247985 access("/etc/ld.so.preload", R_OK <unfinished ...>
247986 <... access resumed>) = -1 ENOENT (No such file or directory)
247985 <... access resumed>) = -1 ENOENT (No such file or directory)
247986 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC <unfinished ...>
247985 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC <unfinished ...>
247986 <... openat resumed>) = 3
247985 <... openat resumed>) = 3
247986 fstat(3, <unfinished ...>
247985 fstat(3, <unfinished ...>
247986 <... fstat resumed>{st_mode=S_IFREG|0644, st_size=23159, ...}) = 0
247985 <... fstat resumed>{st_mode=S_IFREG|0644, st_size=23159, ...}) = 0
247986 mmap(NULL, 23159, PROT_READ, MAP_PRIVATE, 3, 0 <unfinished ...>
247985 mmap(NULL, 23159, PROT_READ, MAP_PRIVATE, 3, 0 <unfinished ...>
247986 <... mmap resumed>) = 0x747ce9e38000
247986 close(3 <unfinished ...>
247985 <... mmap resumed>) = 0x7b35ce585000
247986 <... close resumed>) = 0
247985 close(3 <unfinished ...>
247986 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC
<unfinished ...>
247985 <... close resumed>) = 0
247986 <... openat resumed>) = 3
247985 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC
<unfinished ...>
247986 read(3, <unfinished ...>
247985 <... openat resumed>) = 3
247986 <... read
resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0\0"... , 832) = 832
247985 read(3, <unfinished ...>
247986 pread64(3, <unfinished ...>
247985 <... read
resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0\0"... , 832) = 832
247986 <... pread64
resumed>"\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0"... , 784, 64) = 784
247985 pread64(3, <unfinished ...>
247986 fstat(3, <unfinished ...>
247985 <... pread64
resumed>"\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0"... , 784, 64) = 784
247986 <... fstat resumed>{st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
247985 fstat(3, <unfinished ...>
247986 pread64(3, <unfinished ...>
247985 <... fstat resumed>{st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
247986 <... pread64
resumed>"\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0"... , 784, 64) = 784
247985 pread64(3, <unfinished ...>
247986 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0 <unfinished ...>
247985 <... pread64
resumed>"\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0@\0\0\0\0\0\0\0\0"... , 784, 64) = 784

```

```

247986 <... mmap resumed>) = 0x747ce9c00000
247985 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0 <unfinished ...>
247986 mmap(0x747ce9c28000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000 <unfinished ...>
247985 <... mmap resumed>) = 0x7b35ce200000
247986 <... mmap resumed>) = 0x747ce9c28000
247985 mmap(0x7b35ce228000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000 <unfinished ...>
247986 mmap(0x747ce9db0000, 323584, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x1b0000) = 0x747ce9db0000
247985 <... mmap resumed>) = 0x7b35ce228000
247986 mmap(0x747ce9dff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000 <unfinished ...>
247985 mmap(0x7b35ce3b0000, 323584, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x1b0000 <unfinished ...>
247986 <... mmap resumed>) = 0x747ce9dff000
247986 mmap(0x747ce9e05000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0 <unfinished ...>
247985 <... mmap resumed>) = 0x7b35ce3b0000
247986 <... mmap resumed>) = 0x747ce9e05000
247985 mmap(0x7b35ce3ff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000 <unfinished ...>
247986 close(3 <unfinished ...>
247985 <... mmap resumed>) = 0x7b35ce3ff000
247986 <... close resumed>) = 0
247985 mmap(0x7b35ce405000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0 <unfinished ...>
247986 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0
<unfinished ...>
247985 <... mmap resumed>) = 0x7b35ce405000
247986 <... mmap resumed>) = 0x747ce9e35000
247985 close(3 <unfinished ...>
247986 arch_prctl(ARCH_SET_FS, 0x747ce9e35740 <unfinished ...>
247985 <... close resumed>) = 0
247986 <... arch_prctl resumed>) = 0
247986 set_tid_address(0x747ce9e35a10 <unfinished ...>
247985 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0
<unfinished ...>
247986 <... set_tid_address resumed>) = 247986
247985 <... mmap resumed>) = 0x7b35ce582000
247986 set_robust_list(0x747ce9e35a20, 24) = 0
247985 arch_prctl(ARCH_SET_FS, 0x7b35ce582740 <unfinished ...>
247986 rseq(0x747ce9e36060, 0x20, 0, 0x53053053 <unfinished ...>
247985 <... arch_prctl resumed>) = 0
247986 <... rseq resumed>) = 0
247985 set_tid_address(0x7b35ce582a10) = 247985
247986 mprotect(0x747ce9dff000, 16384, PROT_READ <unfinished ...>
247985 set_robust_list(0x7b35ce582a20, 24 <unfinished ...>
247986 <... mprotect resumed>) = 0

```

```

247985 <... set_robust_list resumed>) = 0
247986 mprotect(0x650d6fc32000, 4096, PROT_READ <unfinished ...>
247985 rseq(0x7b35ce583060, 0x20, 0, 0x53053053 <unfinished ...>
247986 <... mprotect resumed>) = 0
247985 <... rseq resumed>) = 0
247986 mprotect(0x747ce9e76000, 8192, PROT_READ) = 0
247985 mprotect(0x7b35ce3ff000, 16384, PROT_READ <unfinished ...>
247986 prlimit64(0, RLIMIT_STACK, NULL, <unfinished ...>
247985 <... mprotect resumed>) = 0
247986 <... prlimit64 resumed>{rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) = 0
247985 mprotect(0x5f392b32b000, 4096, PROT_READ <unfinished ...>
247986 munmap(0x747ce9e38000, 23159 <unfinished ...>
247985 <... mprotect resumed>) = 0
247986 <... munmap resumed>) = 0
247985 mprotect(0x7b35ce5c3000, 8192, PROT_READ <unfinished ...>
247986 openat(AT_FDCWD, "test2.txt", O_RDWR|O_CREAT, 0700 <unfinished ...>
247985 <... mprotect resumed>) = 0
247985 prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY})
= 0
247986 <... openat resumed>) = 3
247985 munmap(0x7b35ce585000, 23159 <unfinished ...>
247986 openat(AT_FDCWD, "/dev/shm/lab3_shared_memory", O_RDWR|O_NOFOLLOW|O_CLOEXEC
<unfinished ...>
247985 <... munmap resumed>) = 0
247986 <... openat resumed>) = 4
247985 openat(AT_FDCWD, "test1.txt", O_RDWR|O_CREAT, 0700 <unfinished ...>
247986 mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 4, 0) = 0x747ce9e3d000
247986 openat(AT_FDCWD, "/dev/shm/sem.lab3_semaphore", O_RDWR|O_NOFOLLOW|O_CLOEXEC) = 5
247986 fstat(5, {st_mode=S_IFREG|0600, st_size=32, ...}) = 0
247985 <... openat resumed>) = 3
247986 getrandom("\x66\xfb\x3b\xe0\x5f\x95\xcf\xa7", 8, GRND_NONBLOCK) = 8
247985 openat(AT_FDCWD, "/dev/shm/lab3_shared_memory", O_RDWR|O_NOFOLLOW|O_CLOEXEC
<unfinished ...>
247986 brk(NULL <unfinished ...>
247985 <... openat resumed>) = 4
247986 <... brk resumed>) = 0x650da5061000
247985 mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 4, 0 <unfinished ...>
247986 brk(0x650da5082000 <unfinished ...>
247985 <... mmap resumed>) = 0x7b35ce58a000
247986 <... brk resumed>) = 0x650da5082000
247985 openat(AT_FDCWD, "/dev/shm/sem.lab3_semaphore", O_RDWR|O_NOFOLLOW|O_CLOEXEC
<unfinished ...>
247986 mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0 <unfinished ...>
247985 <... openat resumed>) = 5
247986 <... mmap resumed>) = 0x747ce9e3c000
247985 fstat(5, <unfinished ...>
247986 close(5 <unfinished ...>
247985 <... fstat resumed>{st_mode=S_IFREG|0600, st_size=32, ...}) = 0
247986 <... close resumed>) = 0

```



```

247985 getrandom( <unfinished ...>
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... getrandom resumed>"\x49\x05\xab\xd7\xdd\x62\xc7\xe", 8, GRND_NONBLOCK) = 8
247985 brk(NULL) = 0x5f393cd96000
247985 brk(0x5f393cdb7000) = 0x5f393cdb7000
247985 mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0) = 0x7b35ce589000
247985 close(5) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247986 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, NULL) = 0

```

[illegible]

[illegible]

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```
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
```

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

```

...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247985 <... clock_nanosleep resumed>NULL) = 0
247986 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247938 <... read resumed>"Hello, World!\n", 4094) = 14
247938 read(0, <unfinished ...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 write(3, "!dlroW ,olleH\n", 14 <unfinished ...>
247985 <... clock_nanosleep resumed>NULL) = 0
247986 <... write resumed> = 14
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, NULL) = 0
247986 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0

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247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
247986 futex(0x747ce9e3c000, FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,
FUTEX_BITSET_MATCH_ANY <unfinished ...>
247985 futex(0x7b35ce589000, FUTEX_WAKE, 1 <unfinished ...>
247986 <... futex resumed>) = -1 EAGAIN (Resource temporarily unavailable)
247985 <... futex resumed>) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0
247986 futex(0x747ce9e3c000, FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,
FUTEX_BITSET_MATCH_ANY <unfinished ...>
247985 futex(0x7b35ce589000, FUTEX_WAKE, 1 <unfinished ...>
247986 <... futex resumed>) = -1 EAGAIN (Resource temporarily unavailable)
247985 <... futex resumed>) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
247986 <... clock_nanosleep resumed>NULL) = 0
247985 <... clock_nanosleep resumed>NULL) = 0

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[illegible]

[illegible]

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```

...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247986 <... clock_nanosleep resumed>NULL) = 0
      247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247986 <... clock_nanosleep resumed>NULL) = 0
      247985 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247938 <... read resumed>"Test messageeeeeeee\n", 4094) = 19
      247938 read(0, <unfinished ...>
      247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247985 <... clock_nanosleep resumed>NULL) = 0
      247985 write(3, "eeeeeeegassem tseT\n", 19) = 19
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247985 <... clock_nanosleep resumed>NULL) = 0
...> 247985 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247986 <... clock_nanosleep resumed>NULL) = 0
...> 247986 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=100000000}, <unfinished
      247985 <... clock_nanosleep resumed>NULL) = 0

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[illegible]

[illegible]

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```

247938 <... read resumed>"Stop\n", 4094) = 5
247938 wait4(247985, <unfinished ...>
247985 <... clock_nanosleep resumed>NULL) = 0
247985 munmap(0x7b35ce589000, 32)          = 0
247985 munmap(0x7b35ce58a000, 4096)        = 0
247985 close(4)                          = 0
247985 close(3)                          = 0
247985 exit_group(0)                     = ?
247985 +++ exited with 0 +++
247938 <... wait4 resumed>NULL, 0, NULL) = 247985
247938 --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=247985, si_uid=1000,
si_status=0, si_utime=0, si_stime=1 /* 0.01 s */} ---
247938 wait4(247986, <unfinished ...>
247986 <... clock_nanosleep resumed>NULL) = 0
247986 munmap(0x747ce9e3c000, 32)          = 0
247986 munmap(0x747ce9e3d000, 4096)        = 0
247986 close(4)                          = 0
247986 close(3)                          = 0
247986 exit_group(0)                     = ?
247986 +++ exited with 0 +++
247938 <... wait4 resumed>NULL, 0, NULL) = 247986
247938 --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=247986, si_uid=1000,
si_status=0, si_utime=0, si_stime=3 /* 0.03 s */} ---
247938 unlink("/dev/shm/sem.lab3_semaphore") = 0
247938 munmap(0x70062f072000, 32)          = 0
247938 munmap(0x70062f073000, 4096)        = 0
247938 unlink("/dev/shm/lab3_shared_memory") = 0
247938 exit_group(0)                     = ?
247938 +++ exited with 0 +++

```

Вывод

В ходе выполнения лабораторной работы были успешно приобретены практические навыки в управлении процессами в ОС, обеспечении обмена данных между процессами посредством разделяемой памяти и её отображения в процесс, обработке ошибок вызова системных вызовов ОС.

Возникли сложности со считыванием и записью строк посредством системных вызовов в консоль (особенности нулевого символа) и некорректной очисткой ресурсов, время жизни которых превышает время жизни процесса. Проблема была обнаружена с помощью программ *gdb* и *strace*. Была решена посредством незначительных изменений в обработке ввода-вывода из консоли и проверкой очистки ресурсов в программе.