МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ
(НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ)

Институт №8 «Компьютерные науки и прикладная математика»
Кафедра 806 «Вычислительная математика и программирование»

Лабораторная работа №1
по курсу «Операционные системы»

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Условие

Цель работы: Приобретение практических навыков в:

- Управление процессами в ОС

- Обеспечение обмена данных между процессами посредством каналов

Задание: Составить и отладить программу на языке Си, осуществляющую работу с процессами и взаимодействие между ними в одной из двух операционных систем. В результате работы программа (основной процесс) должен создать для решение задачи один или несколько дочерних процессов. Взаимодействие между процессами осуществляется через системные сигналы/события и/или каналы (pipe). Необходимо обрабатывать системные ошибки, которые могут возникнуть в результате работы.

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 pipe1 или в pipe2 в зависимости от правила фильтрации. Процесс child1 и child2 производят работу над строками. Процессы пишут результаты своей работы в стандартный вывод. Правило фильтрации: нечетные строки отправляются в pipe1, четные в pipe2. Дочерние процессы инвертируют строки.

Вариант: 21

Метод решения

Родительский процесс принимает пользовательский ввод названий двух файлов — для нечетных и четных строк, создаёт или открывает их. Далее создаются два канала (p_odd, p_even) и два дочерних процесса (child_odd, child_even). Родитель читает строки из стандартного ввода и по очереди отправляет их в первый или второй канал. Дочерние процессы получают строки из своих каналов, инвертируют их и записывают в соответствующие файлы.

Описание программы

Общие интерфейсы системных вызовов оформлены в os.h. Функции Linux-реализации (pipe, fork и execve объединены в аналог CreateProcess (Windows), open, dup2, write, read, getline, waitpid, kill) описаны в os_linux.c/os_linux.h.

В parent.c:

- Запрос имён файлов;

- Открытие файлов на запись;

- Создание каналов и дочерних процессов через CreateProc;

- Чтение строк и пересылка в нужный канал;

- Ожидание завершения дочерних процессов.

В child.c: - Чтение строк из STDIN канала через DoGetline;

- Инвертирование строки функцией Reverse;

- Запись результата в STDOUT (файл назначенный родителем).

Результаты

При запуске программы, открытии файлов odd.txt и even.txt и вводе тестовых строк нечётные строки попали в файл odd.txt в перевёрнутом виде, а четные — в файл even.txt так же в перевернутом виде.

Пример работы:

Ввод:

odd

even

text

asd

123das

Test

Содержимое odd.txt:

txet

sad321

Содержимое even.txt:

dsa

tseT

Выводы

Реализован обмен данными между процессами через безымянные каналы. Дочерние процессы корректно инвертируют строки и записывают их в разные файлы. Программа удовлетворяет требованиям задания. При выполнение приобретены и опробованы на практике навыки работы с процессами ОС и обменом данных между процессами посредством каналов

Исходная программа

```
#pragma once

#include <stddef.h>
#include <sys/types.h>

typedef int pipe_t;

typedef struct {
  pid_t pid;
} proc_info_t;

int CreatePipe(pipe_t new_pipe[2]);

proc_info_t CreateProc(const char* file, char* const argv[], char* const envp[],
                       pipe_t stdin_pipe, pipe_t stdout_pipe);

int DoDup2(pipe_t old_fd, int new_fd);

int CloseObject(pipe_t fd);

int WaitObject(proc_info_t proc_info, int* status, int options);

pipe_t OpenObject(const char* path, int flags, int mode);

ssize_t PipeWrite(pipe_t fd, const void* line, size_t count);

ssize_t PipeRead(pipe_t fd, void* line, size_t count);

ssize_t DoGetline(char** line, size_t* n, FILE* stream);

void TerminateProc(int status);
```

Листинг 1: *Общий интерфейс*

```
#pragma once

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

#include "os.h"

#define _GNU_SOURCE

#ifndef STDIN_FILENO
#define STDIN_FILENO 0
#endif
#ifndef STDOUT_FILENO
#define STDOUT_FILENO 1
```

```
#endif
#ifndef STDERR_FILENO
#define STDERR_FILENO 2
#endif
```

Листинг 2: *Linux-специфичный определяющий файл*

```
#include "os_linux.h"

int CreatePipe(pipe_t new_pipe[2]) { return pipe(new_pipe); }

proc_info_t CreateProc(const char* file, char* const argv[], char* const envp[],
                       pipe_t stdin_pipe, pipe_t stdout_pipe) {
  proc_info_t result;

  pid_t pid = fork();

  if (pid == -1) {
    result.pid = -1;
    return result;
  }

  if (pid == 0) {
    if (stdin_pipe != -1) {
      if (dup2(stdin_pipe, STDIN_FILENO) == -1) {
        perror("error while dup2 stdin");
        TerminateProc(1);
      }
    }

    if (stdout_pipe != -1) {
      if (dup2(stdout_pipe, STDOUT_FILENO) == -1) {
        perror("error while dup2 stdout");
        TerminateProc(1);
      }
    }

    execve(file, argv, envp);
    perror("error while execve");
    TerminateProc(1);
  }

  result.pid = pid;
  return result;
}

int DoDup2(pipe_t old_fd, int new_fd) { return dup2(old_fd, new_fd); }

int CloseObject(pipe_t fd) { return close(fd); }

int WaitObject(proc_info_t proc_info, int* status, int options) {
  return waitpid(proc_info.pid, status, options);
}

pipe_t OpenObject(const char* path, int flags, int mode) {
  return open(path, flags, mode);
}
```

```
51
52 ssize_t PipeWrite(pipe_t fd, const void* line, size_t count) {
53   return write(fd, line, count);
54 }
55
56 ssize_t PipeRead(pipe_t fd, void* line, size_t count) {
57   return read(fd, line, count);
58 }
59
60 ssize_t DoGetline(char** line, size_t* n, FILE* stream) {
61   return getline(line, n, stream);
62 }
63
64 void TerminateProc(int status) {
65   kill(getpid(), SIGTERM);
66   _exit(status);
67 }
```

Листинг 3: *Реализация системных вызов только для Linux*

```
1  #include "os_linux.h"
2
3  void WriteToPipe(pipe_t fd, const char *line, size_t n) {
4    size_t written = 0;
5
6    while (written < n) {
7      ssize_t s = PipeWrite(fd, line + written, n - written);
8
9      if (s == -1) {
10       if (errno == EINTR) {
11         continue;
12       }
13       perror("error while write to pipe");
14       TerminateProc(1);
15     }
16
17     written += (size_t)s;
18   }
19 }
20
21 int main(int argc, char *argv[], char *envp[]) {
22   char file_odd[4096];
23   char file_even[4096];
24   printf("Enter a file name for odd lines: ");
25   fgets(file_odd, sizeof(file_odd), stdin);
26   printf("Enter a file name for even lines: ");
27   fgets(file_even, sizeof(file_even), stdin);
28
29   file_odd[strcspn(file_odd, "\n")] = 0;
30   file_even[strcspn(file_even, "\n")] = 0;
31
32   pipe_t fd_odd = OpenObject(file_odd, O_CREAT | O_TRUNC | O_WRONLY, 00666);
33   if (fd_odd == -1) {
34     perror("error while create/open file for odd");
35     TerminateProc(1);
36   }
37   pipe_t fd_even = OpenObject(file_even, O_CREAT | O_TRUNC | O_WRONLY, 00666);
```

```
38  if (fd_even == -1) {
39    perror("error while create/open file for even");
40    TerminateProc(1);
41  }
42
43  pipe_t p_odd[2];
44  pipe_t p_even[2];
45  if (CreatePipe(p_odd) == -1) {
46    perror("error while create pipe for odd");
47    TerminateProc(1);
48  }
49  if (CreatePipe(p_even) == -1) {
50    perror("error while create pipe for even");
51    TerminateProc(1);
52  }
53
54  char *args[] = {"child", NULL};
55
56  proc_info_t child_odd = CreateProc("./child", args, envp, p_odd[0], fd_odd);
57  if (child_odd.pid == (pid_t)-1) {
58    perror("error while create odd child process");
59    TerminateProc(1);
60  }
61
62  proc_info_t child_even =
63      CreateProc("./child", args, envp, p_even[0], fd_even);
64  if (child_even.pid == (pid_t)-1) {
65    perror("error while create even child process");
66    TerminateProc(1);
67  }
68
69  CloseObject(fd_odd);
70  CloseObject(fd_even);
71  CloseObject(p_odd[0]);
72  CloseObject(p_even[0]);
73
74  char *line = NULL;
75  int line_num = 1;
76  size_t capacity = 0;
77  pipe_t curr_pipe;
78  ssize_t s;
79
80  while ((s = DoGetline(&line, &capacity, stdin)) != -1) {
81    if (line_num % 2 != 0) {
82      curr_pipe = p_odd[1];
83    } else {
84      curr_pipe = p_even[1];
85    }
86
87    WriteToPipe(curr_pipe, line, (size_t)s);
88    line_num++;
89  }
90
91  CloseObject(p_odd[1]);
92  CloseObject(p_even[1]);
93
94  int status;
95  if (WaitObject(child_odd, &status, 0) == -1) {
```

```
    perror("error in waitpid child_odd");
    TerminateProc(1);
  }
  if (WaitObject(child_even, &status, 0) == -1) {
    perror("error in waitpid child_even");
    TerminateProc(1);
  }

  free(line);
  return 0;
}
```

Листинг 4: *Родительский процесс*

```
#include "os_linux.h"

void Reverse(char* line, size_t n) {
  int is_new_line = 0;
  if (n > 0 && line[n - 1] == '\n') {
    is_new_line = 1;
    n--;
  }

  size_t i = 0;
  size_t j = 0;
  if (n > 0) {
    j = n - 1;
  }

  while (i < j) {
    char temp = line[i];
    line[i] = line[j];
    line[j] = temp;
    j--;
    i++;
  }

  if (is_new_line == 1) {
    line[n] = '\n';
    line[n + 1] = '\0';
  } else {
    line[n] = '\0';
  }
}

int main() {
  char* line = NULL;
  size_t capacity = 0;
  ssize_t s;

  while ((s = DoGetline(&line, &capacity, stdin)) != -1) {
    Reverse(line, (size_t)s);
    if (fwrite(line, 1, strlen(line), stdout) != strlen(line)) {
      perror("error while write in file");
      TerminateProc(1);
    }
    fflush(stdout);
```

```
  }

  free(line);

  return 0;
}
```

Листинг 5: *Дочерний процесс*

```
      113118 22:44:26.343351
execve("./parent",["./parent","arg1","arg2"],0x7ffe6dec32a0 /* 36 vars
*/) = 0
      113118 22:44:26.344261 brk(NULL)        = 0x555911c13000
      113118 22:44:26.344535 arch_prctl(0x3001 /* ARCH_???
*/,0x7ffcc099f6e0) = -1 EINVAL (Invalid argument)
      113118 22:44:26.344773
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7f1e97317000
      113118 22:44:26.345040 access("/etc/ld.so.preload",R_OK) = -1
ENOENT (No such file or directory)
      113118 22:44:26.345386
openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC) = 3
      113118 22:44:26.345803
newfstatat(3,"",{st_mode=S_IFREG|0644,st_size=29840,...},AT_EMPTY_PATH) =
0
      113118 22:44:26.346199 mmap(NULL,29840,PROT_READ,MAP_PRIVATE,3,0) =
0x7f1e9730f000
      113118 22:44:26.346473 close(3)         = 0
      113118 22:44:26.346775
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC) = 3
      113118 22:44:26.347028
read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\237\2\0\0\0\0\0"...,832)
= 832
      113118 22:44:26.347239
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
      113118 22:44:26.347464 pread64(3,"\4\0\0\0
\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,48,848) = 48
      113118 22:44:26.347679
pread64(3,"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32$\230\266\235
= 68
      113118 22:44:26.347862
newfstatat(3,"",{st_mode=S_IFREG|0755,st_size=2220400,...},AT_EMPTY_PATH)
= 0
      113118 22:44:26.348064
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
      113118 22:44:26.348263
mmap(NULL,2264656,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
```

```
0x7f1e970e6000
     113118 22:44:26.348462 mprotect(0x7f1e9710e000,2023424,PROT_NONE) =
0
     113118 22:44:26.348652
mmap(0x7f1e9710e000,1658880,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3
= 0x7f1e9710e000
     113118 22:44:26.348860
mmap(0x7f1e972a3000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1bd000)
= 0x7f1e972a3000
     113118 22:44:26.349084
mmap(0x7f1e972fc000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,
= 0x7f1e972fc000
     113118 22:44:26.349314
mmap(0x7f1e97302000,52816,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
= 0x7f1e97302000
     113118 22:44:26.349553 close(3)         = 0
     113118 22:44:26.349807
mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7f1e970e3000
     113118 22:44:26.350084 arch_prctl(ARCH_SET_FS,0x7f1e970e3740) = 0
     113118 22:44:26.350333 set_tid_address(0x7f1e970e3a10) = 113118
     113118 22:44:26.350551 set_robust_list(0x7f1e970e3a20,24) = 0
     113118 22:44:26.350794 rseq(0x7f1e970e40e0,0x20,0,0x53053053) = 0
     113118 22:44:26.351202 mprotect(0x7f1e972fc000,16384,PROT_READ) = 0
     113118 22:44:26.351602 mprotect(0x5558fad92000,4096,PROT_READ) = 0
     113118 22:44:26.351876 mprotect(0x7f1e97351000,8192,PROT_READ) = 0
     113118 22:44:26.352211
prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY})
= 0
     113118 22:44:26.352618 munmap(0x7f1e9730f000,29840) = 0
     113118 22:44:26.353018
newfstatat(1,"",{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0xc),...},AT_EMPTY_PATH)
= 0
     113118 22:44:26.353437
getrandom("\x85\xac\xe1\xe1\x27\x32\x46\x0e",8,GRND_NONBLOCK) = 8
     113118 22:44:26.353753 brk(NULL)        = 0x555911c13000
     113118 22:44:26.353989 brk(0x555911c34000) = 0x555911c34000
     113118 22:44:26.354265
newfstatat(0,"",{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0xc),...},AT_EMPTY_PATH)
= 0
     113118 22:44:26.354550 write(1,"Enter a file name for odd
lines:"...,33) = 33
     113118 22:44:26.354821 read(0,"odd\n",1024) = 4
     113118 22:44:29.248117 write(1,"Enter a file name for even
lines"...,34) = 34
     113118 22:44:29.248526 read(0,"even\n",1024) = 5
     113118 22:44:30.637384
openat(AT_FDCWD,"odd",O_WRONLY|O_CREAT|O_TRUNC,0666) = 3
```

```
     113118 22:44:30.637869
openat(AT_FDCWD,"even",O_WRONLY|O_CREAT|O_TRUNC,0666) = 4
     113118 22:44:30.638386 pipe2([5,6],0) = 0
     113118 22:44:30.638886 pipe2([7,8],0) = 0
     113118 22:44:30.639285
clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,child_ti
= 113149
     113149 22:44:30.639836 set_robust_list(0x7f1e970e3a20,24
<unfinished ...>
     113118 22:44:30.639917
clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD
<unfinished ...>
     113149 22:44:30.639955 <... set_robust_list resumed>) = 0
     113149 22:44:30.640122 dup2(5,0)       = 0
     113118 22:44:30.640270 <... clone
resumed>,child_tidptr=0x7f1e970e3a10) = 113150
     113150 22:44:30.640329 set_robust_list(0x7f1e970e3a20,24
<unfinished ...>
     113118 22:44:30.640371 close(3 <unfinished ...>
     113149 22:44:30.640406 dup2(3,1 <unfinished ...>
     113118 22:44:30.640464 <... close resumed>) = 0
     113150 22:44:30.640498 <... set_robust_list resumed>) = 0
     113118 22:44:30.640539 close(4 <unfinished ...>
     113149 22:44:30.640574 <... dup2 resumed>) = 1
     113118 22:44:30.640633 <... close resumed>) = 0
     113150 22:44:30.640667 dup2(7,0 <unfinished ...>
     113118 22:44:30.640725 close(5 <unfinished ...>
     113149 22:44:30.640759 execve("./child",["child"],0x7ffcc099f8c8 /*
36 vars */ <unfinished ...>
     113118 22:44:30.640841 <... close resumed>) = 0
     113150 22:44:30.640875 <... dup2 resumed>) = 0
     113118 22:44:30.640910 close(7 <unfinished ...>
     113150 22:44:30.640947 dup2(4,1 <unfinished ...>
     113118 22:44:30.641047 <... close resumed>) = 0
     113150 22:44:30.641125 <... dup2 resumed>) = 1
     113118 22:44:30.641179 read(0, <unfinished ...>
     113150 22:44:30.641242 execve("./child",["child"],0x7ffcc099f8c8 /*
36 vars */ <unfinished ...>
     113149 22:44:30.641312 <... execve resumed>) = 0
     113149 22:44:30.641470 brk(NULL <unfinished ...>
     113150 22:44:30.641653 <... execve resumed>) = 0
     113149 22:44:30.641718 <... brk resumed>) = 0x555fda6f0000
     113150 22:44:30.641848 brk(NULL <unfinished ...>
     113149 22:44:30.641970 arch_prctl(0x3001 /* ARCH_???
*/,0x7ffd84451e60 <unfinished ...>
     113150 22:44:30.642051 <... brk resumed>) = 0x562eaecc3000
     113149 22:44:30.642131 <... arch_prctl resumed>) = -1 EINVAL
(Invalid argument)
```

```
     113150 22:44:30.642215 arch_prctl(0x3001 /* ARCH_???
*/,0x7ffc5474d710 <unfinished ...>
     113149 22:44:30.642331
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     113150 22:44:30.642412 <... arch_prctl resumed>) = -1 EINVAL
(Invalid argument)
     113149 22:44:30.642493 <... mmap resumed>) = 0x7f4204573000
     113150 22:44:30.642635
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     113149 22:44:30.642671 access("/etc/ld.so.preload",R_OK <unfinished
...>
     113150 22:44:30.642735 <... mmap resumed>) = 0x7f252a7bf000
     113149 22:44:30.642770 <... access resumed>) = -1 ENOENT (No such
file or directory)
     113150 22:44:30.642809 access("/etc/ld.so.preload",R_OK <unfinished
...>
     113149 22:44:30.642870
openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC <unfinished ...>
     113150 22:44:30.642912 <... access resumed>) = -1 ENOENT (No such
file or directory)
     113149 22:44:30.642973 <... openat resumed>) = 9
     113150 22:44:30.643008
openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC <unfinished ...>
     113149 22:44:30.643048 newfstatat(9,"", <unfinished ...>
     113150 22:44:30.643162 <... openat resumed>) = 9
     113149 22:44:30.643225 <... newfstatat
resumed>{st_mode=S_IFREG|0644,st_size=29840,...},AT_EMPTY_PATH) = 0
     113150 22:44:30.643275 newfstatat(9,"", <unfinished ...>
     113149 22:44:30.643341 mmap(NULL,29840,PROT_READ,MAP_PRIVATE,9,0
<unfinished ...>
     113150 22:44:30.643378 <... newfstatat
resumed>{st_mode=S_IFREG|0644,st_size=29840,...},AT_EMPTY_PATH) = 0
     113149 22:44:30.643444 <... mmap resumed>) = 0x7f420456b000
     113150 22:44:30.643560 mmap(NULL,29840,PROT_READ,MAP_PRIVATE,9,0
<unfinished ...>
     113149 22:44:30.643655 close(9 <unfinished ...>
     113150 22:44:30.643750 <... mmap resumed>) = 0x7f252a7b7000
     113149 22:44:30.643806 <... close resumed>) = 0
     113150 22:44:30.643843 close(9 <unfinished ...>
     113149 22:44:30.643882
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
     113150 22:44:30.643951 <... close resumed>) = 0
     113149 22:44:30.643988 <... openat resumed>) = 9
     113150 22:44:30.644038
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC
```

```
<unfinished ...>
     113149 22:44:30.644081 read(9, <unfinished ...>
     113150 22:44:30.644118 <... openat resumed>) = 9
     113149 22:44:30.644154 <... read
resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\237\2\0\0\0\0\0"...,832)
= 832
     113150 22:44:30.644196 read(9, <unfinished ...>
     113149 22:44:30.644233 pread64(9, <unfinished ...>
     113150 22:44:30.644286 <... read
resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\237\2\0\0\0\0\0"...,832)
= 832
     113149 22:44:30.644330 <... 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"...,784,64)
= 784
     113150 22:44:30.644371 pread64(9, <unfinished ...>
     113149 22:44:30.644408 pread64(9, <unfinished ...>
     113150 22:44:30.644444 <... 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"...,784,64)
= 784
     113149 22:44:30.644485 <... pread64 resumed>"\4\0\0\0
\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,48,848) = 48
     113150 22:44:30.644526 pread64(9, <unfinished ...>
     113149 22:44:30.644563 pread64(9, <unfinished ...>
     113150 22:44:30.644600 <... pread64 resumed>"\4\0\0\0
\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,48,848) = 48
     113149 22:44:30.644640 <... pread64
resumed>"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32$\230\266\235".
= 68
     113150 22:44:30.644683 pread64(9, <unfinished ...>
     113149 22:44:30.644720 newfstatat(9,"", <unfinished ...>
     113150 22:44:30.644765 <... pread64
resumed>"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32$\230\266\235".
= 68
     113149 22:44:30.644816 <... newfstatat
resumed>{st_mode=S_IFREG|0755,st_size=2220400,...},AT_EMPTY_PATH) = 0
     113150 22:44:30.644877 newfstatat(9,"", <unfinished ...>
     113149 22:44:30.644918 pread64(9, <unfinished ...>
     113150 22:44:30.644959 <... newfstatat
resumed>{st_mode=S_IFREG|0755,st_size=2220400,...},AT_EMPTY_PATH) = 0
     113149 22:44:30.645021 <... 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"...,784,64)
= 784
     113150 22:44:30.645069 pread64(9, <unfinished ...>
     113149 22:44:30.645106
mmap(NULL,2264656,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,9,0 <unfinished
...>
     113150 22:44:30.645229 <... 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"...,784,64)
```

```
= 784
     113149 22:44:30.645322 <... mmap resumed>) = 0x7f4204342000
     113150 22:44:30.645441
mmap(NULL,2264656,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,9,0 <unfinished
...>
     113149 22:44:30.645504 mprotect(0x7f420436a000,2023424,PROT_NONE
<unfinished ...>
     113150 22:44:30.645541 <... mmap resumed>) = 0x7f252a58e000
     113150 22:44:30.645707 mprotect(0x7f252a5b6000,2023424,PROT_NONE
<unfinished ...>
     113149 22:44:30.645835 <... mprotect resumed>) = 0
     113150 22:44:30.645876 <... mprotect resumed>) = 0
     113149 22:44:30.645913
mmap(0x7f420436a000,1658880,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9
<unfinished ...>
     113150 22:44:30.645953
mmap(0x7f252a5b6000,1658880,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9
<unfinished ...>
     113149 22:44:30.646005 <... mmap resumed>) = 0x7f420436a000
     113150 22:44:30.646043 <... mmap resumed>) = 0x7f252a5b6000
     113149 22:44:30.646079
mmap(0x7f42044ff000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,0x1bd000
<unfinished ...>
     113150 22:44:30.646117
mmap(0x7f252a74b000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,0x1bd000
<unfinished ...>
     113149 22:44:30.646172 <... mmap resumed>) = 0x7f42044ff000
     113150 22:44:30.646209 <... mmap resumed>) = 0x7f252a74b000
     113149 22:44:30.646247
mmap(0x7f4204558000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,
<unfinished ...>
     113150 22:44:30.646285
mmap(0x7f252a7a4000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,
= 0x7f252a7a4000
     113149 22:44:30.646468 <... mmap resumed>) = 0x7f4204558000
     113150 22:44:30.646516
mmap(0x7f252a7aa000,52816,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
<unfinished ...>
     113149 22:44:30.646587
mmap(0x7f420455e000,52816,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
<unfinished ...>
     113150 22:44:30.646637 <... mmap resumed>) = 0x7f252a7aa000
     113149 22:44:30.646675 <... mmap resumed>) = 0x7f420455e000
     113150 22:44:30.646715 close(9 <unfinished ...>
     113149 22:44:30.646753 close(9 <unfinished ...>
     113150 22:44:30.646792 <... close resumed>) = 0
     113149 22:44:30.646829 <... close resumed>) = 0
     113150 22:44:30.646886
```

```
mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     113149 22:44:30.646939
mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     113150 22:44:30.646984 <... mmap resumed>) = 0x7f252a58b000
     113149 22:44:30.647045 <... mmap resumed>) = 0x7f420433f000
     113150 22:44:30.647082 arch_prctl(ARCH_SET_FS,0x7f252a58b740
<unfinished ...>
     113149 22:44:30.647122 arch_prctl(ARCH_SET_FS,0x7f420433f740
<unfinished ...>
     113150 22:44:30.647158 <... arch_prctl resumed>) = 0
     113149 22:44:30.647195 <... arch_prctl resumed>) = 0
     113150 22:44:30.647233 set_tid_address(0x7f252a58ba10 <unfinished
...>
     113149 22:44:30.647272 set_tid_address(0x7f420433fa10 <unfinished
...>
     113150 22:44:30.647308 <... set_tid_address resumed>) = 113150
     113149 22:44:30.647345 <... set_tid_address resumed>) = 113149
     113150 22:44:30.647381 set_robust_list(0x7f252a58ba20,24
<unfinished ...>
     113149 22:44:30.647419 set_robust_list(0x7f420433fa20,24
<unfinished ...>
     113150 22:44:30.647477 <... set_robust_list resumed>) = 0
     113149 22:44:30.647536 <... set_robust_list resumed>) = 0
     113150 22:44:30.647575 rseq(0x7f252a58c0e0,0x20,0,0x53053053
<unfinished ...>
     113149 22:44:30.647613 rseq(0x7f42043400e0,0x20,0,0x53053053
<unfinished ...>
     113150 22:44:30.647650 <... rseq resumed>) = 0
     113149 22:44:30.647687 <... rseq resumed>) = 0
     113150 22:44:30.647831 mprotect(0x7f252a7a4000,16384,PROT_READ
<unfinished ...>
     113149 22:44:30.647901 mprotect(0x7f4204558000,16384,PROT_READ
<unfinished ...>
     113150 22:44:30.647940 <... mprotect resumed>) = 0
     113149 22:44:30.647978 <... mprotect resumed>) = 0
     113150 22:44:30.648029 mprotect(0x562e9817b000,4096,PROT_READ
<unfinished ...>
     113149 22:44:30.648090 mprotect(0x555fa72a8000,4096,PROT_READ
<unfinished ...>
     113150 22:44:30.648183 <... mprotect resumed>) = 0
     113149 22:44:30.648237 <... mprotect resumed>) = 0
     113150 22:44:30.648324 mprotect(0x7f252a7f9000,8192,PROT_READ
<unfinished ...>
     113149 22:44:30.648361 mprotect(0x7f42045ad000,8192,PROT_READ
<unfinished ...>
     113150 22:44:30.648400 <... mprotect resumed>) = 0
```

```
     113149 22:44:30.648438 <... mprotect resumed>) = 0
     113150 22:44:30.648596 prlimit64(0,RLIMIT_STACK,NULL, <unfinished
...>
     113149 22:44:30.648693 prlimit64(0,RLIMIT_STACK,NULL, <unfinished
...>
     113150 22:44:30.648733 <... prlimit64
resumed>{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY}) = 0
     113149 22:44:30.648786 <... prlimit64
resumed>{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY}) = 0
     113150 22:44:30.648828 munmap(0x7f252a7b7000,29840 <unfinished ...>
     113149 22:44:30.648866 munmap(0x7f420456b000,29840 <unfinished ...>
     113150 22:44:30.648957 <... munmap resumed>) = 0
     113149 22:44:30.649028 <... munmap resumed>) = 0
     113150 22:44:30.649108 getrandom( <unfinished ...>
     113149 22:44:30.649167 getrandom( <unfinished ...>
     113150 22:44:30.649203 <... getrandom
resumed>"\x89\x88\xfb\x9e\x31\xd6\x64\x22",8,GRND_NONBLOCK) = 8
     113149 22:44:30.649251 <... getrandom
resumed>"\xe3\xfc\xd9\xaa\xf3\x21\x1f\x9f",8,GRND_NONBLOCK) = 8
     113150 22:44:30.649312 brk(NULL)        = 0x562eaecc3000
     113149 22:44:30.649470 brk(NULL <unfinished ...>
     113150 22:44:30.649517 brk(0x562eaece4000 <unfinished ...>
     113149 22:44:30.649553 <... brk resumed>) = 0x555fda6f0000
     113150 22:44:30.649589 <... brk resumed>) = 0x562eaece4000
     113149 22:44:30.649645 brk(0x555fda711000 <unfinished ...>
     113150 22:44:30.649743 newfstatat(0,"", <unfinished ...>
     113149 22:44:30.649861 <... brk resumed>) = 0x555fda711000
     113150 22:44:30.649901 <... newfstatat
resumed>{st_mode=S_IFIFO|0600,st_size=0,...},AT_EMPTY_PATH) = 0
     113149 22:44:30.650007 newfstatat(0,"", <unfinished ...>
     113150 22:44:30.650089 read(0, <unfinished ...>
     113149 22:44:30.650128 <... newfstatat
resumed>{st_mode=S_IFIFO|0600,st_size=0,...},AT_EMPTY_PATH) = 0
     113149 22:44:30.650236 read(0, <unfinished ...>
     113118 22:44:33.442894 <... read resumed>"text\n",1024) = 5
     113118 22:44:33.443177 write(6,"text\n",5) = 5
     113149 22:44:33.443538 <... read resumed>"text\n",4096) = 5
     113118 22:44:33.443587 read(0, <unfinished ...>
     113149 22:44:33.443649
newfstatat(1,"",{st_mode=S_IFREG|0644,st_size=0,...},AT_EMPTY_PATH) = 0
     113149 22:44:33.443979 write(1,"txet\n",5) = 5
     113149 22:44:33.444496 read(0, <unfinished ...>
     113118 22:44:34.881714 <... read resumed>"asd\n",1024) = 4
     113118 22:44:34.881937 write(8,"asd\n",4) = 4
     113150 22:44:34.882386 <... read resumed>"asd\n",4096) = 4
     113118 22:44:34.882467 read(0, <unfinished ...>
     113150 22:44:34.882504
newfstatat(1,"",{st_mode=S_IFREG|0644,st_size=0,...},AT_EMPTY_PATH) = 0
```

```
     113150 22:44:34.882755 write(1,"dsa\n",4) = 4
     113150 22:44:34.883162 read(0, <unfinished ...>
     113118 22:44:36.972577 <... read resumed>"123das\n",1024) = 7
     113118 22:44:36.972937 write(6,"123das\n",7) = 7
     113149 22:44:36.973393 <... read resumed>"123das\n",4096) = 7
     113118 22:44:36.973458 read(0, <unfinished ...>
     113149 22:44:36.973503 write(1,"sad321\n",7) = 7
     113149 22:44:36.973950 read(0, <unfinished ...>
     113118 22:44:39.232415 <... read resumed>"Test\n",1024) = 5
     113118 22:44:39.232683 write(8,"Test\n",5) = 5
     113150 22:44:39.232992 <... read resumed>"Test\n",4096) = 5
     113118 22:44:39.233076 read(0, <unfinished ...>
     113150 22:44:39.233157 write(1,"tseT\n",5) = 5
     113150 22:44:39.233491 read(0, <unfinished ...>
     113118 22:44:39.737369 <... read resumed>0x555911c136b0,1024) = ?
ERESTARTSYS (To be restarted if SA_RESTART is set)
     113150 22:44:39.737532 <... read resumed>0x562eaecc3320,4096) = ?
ERESTARTSYS (To be restarted if SA_RESTART is set)
     113149 22:44:39.737612 <... read resumed>0x555fda6f0320,4096) = ?
ERESTARTSYS (To be restarted if SA_RESTART is set)
     113118 22:44:39.737694 ---SIGINT
{si_signo=SIGINT,si_code=SI_KERNEL} ---
     113150 22:44:39.737934 ---SIGINT
{si_signo=SIGINT,si_code=SI_KERNEL} ---
     113149 22:44:39.738058 ---SIGINT
{si_signo=SIGINT,si_code=SI_KERNEL} ---
     113118 22:44:39.738524 +++ killed by SIGINT +++
     113150 22:44:39.738611 +++ killed by SIGINT +++
     113149 22:44:39.738641 +++ killed by SIGINT +++
```

Листинг 6: *Strace логи*