МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ
(НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ)

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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.

В parent.c:

- Запрос имён файлов;

- Открытие файлов на запись;

- Создание каналов используя CreatePipe и дочерних процессов через CreateProc;

- Чтение строк и их пересылка в нужный канал согласно правилу фильтрации;

- 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>

#define _GNU_SOURCE

#ifdef _WIN32

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

typedef int pipe_t;
typedef int pid_t;

typedef struct {
  pid_t pid;
} proc_info_t;
#endif

int CreatePipe(pipe_t new_pipe[2]);

proc_info_t CreateProc(const char* file, char* argv[], char* 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*

```
#include "os.h"

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

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

```
8
9   pid_t pid = fork();
10
11  if (pid == -1) {
12    result.pid = -1;
13    return result;
14  }
15
16  if (pid == 0) {
17    if (stdin_pipe != -1) {
18      if (dup2(stdin_pipe, STDIN_FILENO) == -1) {
19        perror("error while dup2 stdin");
20        TerminateProc(1);
21      }
22    }
23
24    if (stdout_pipe != -1) {
25      if (dup2(stdout_pipe, STDOUT_FILENO) == -1) {
26        perror("error while dup2 stdout");
27        TerminateProc(1);
28      }
29    }
30
31    execve(file, argv, envp);
32    perror("error while execve");
33    TerminateProc(1);
34  }
35
36  result.pid = pid;
37  return result;
38 }
39
40 int DoDup2(pipe_t old_fd, int new_fd) { return dup2(old_fd, new_fd); }
41
42 int CloseObject(pipe_t fd) { return close(fd); }
43
44 int WaitObject(proc_info_t proc_info, int* status, int options) {
45   return waitpid(proc_info.pid, status, options);
46 }
47
48 pipe_t OpenObject(const char* path, int flags, int mode) {
49   return open(path, flags, mode);
50 }
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);
```

```
  _exit(status);
}
```

Листинг 2: *Реализация системных вызов только для POSIX-систем*

```
#include "os.h"

void WriteToPipe(pipe_t fd, const char *line, size_t n) {
  size_t written = 0;

  while (written < n) {
    ssize_t s = PipeWrite(fd, line + written, n - written);

    if (s == -1) {
      if (errno == EINTR) {
        continue;
      }
      perror("error while write to pipe");
      TerminateProc(1);
    }

    written += (size_t)s;
  }
}

int main(int argc, char *argv[], char *envp[]) {
  char file_odd[4096];
  char file_even[4096];
  printf("Enter a file name for odd lines: ");
  fgets(file_odd, sizeof(file_odd), stdin);
  printf("Enter a file name for even lines: ");
  fgets(file_even, sizeof(file_even), stdin);

  file_odd[strcspn(file_odd, "\n")] = 0;
  file_even[strcspn(file_even, "\n")] = 0;

  pipe_t fd_odd = OpenObject(file_odd, O_CREAT | O_TRUNC | O_WRONLY, 00666);
  if (fd_odd == -1) {
    perror("error while create/open file for odd");
    TerminateProc(1);
  }
  pipe_t fd_even = OpenObject(file_even, O_CREAT | O_TRUNC | O_WRONLY, 00666);
  if (fd_even == -1) {
    perror("error while create/open file for even");
    TerminateProc(1);
  }

  pipe_t p_odd[2];
  pipe_t p_even[2];
  if (CreatePipe(p_odd) == -1) {
    perror("error while create pipe for odd");
    TerminateProc(1);
  }
  if (CreatePipe(p_even) == -1) {
    perror("error while create pipe for even");
    TerminateProc(1);
  }
```

```
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) {
96      perror("error in waitpid child_odd");
97      TerminateProc(1);
98    }
99    if (WaitObject(child_even, &status, 0) == -1) {
100     perror("error in waitpid child_even");
101     TerminateProc(1);
102   }
103
104   free(line);
105   return 0;
106 }
```

Листинг 3: *Родительский процесс*

```c
#include "os.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 4: *Дочерний процесс*

```
      29442 19:31:19.257664
execve("./parent",["./parent","arg1","arg2"],0x7fff7d2cf130 /* 36 vars
*/) = 0
      29442 19:31:19.258756 brk(NULL)         = 0x55e8112be000
```

```
     29442 19:31:19.259140 arch_prctl(0x3001 /* ARCH_???
*/,0x7ffcfc511420) = -1 EINVAL (Invalid argument)
     29442 19:31:19.259393
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7ff00eb17000
     29442 19:31:19.259776 access("/etc/ld.so.preload",R_OK) = -1 ENOENT
(No such file or directory)
     29442 19:31:19.260172
openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC) = 3
     29442 19:31:19.260391
newfstatat(3,"",{st_mode=S_IFREG|0644,st_size=29840,...},AT_EMPTY_PATH) =
0
     29442 19:31:19.260693 mmap(NULL,29840,PROT_READ,MAP_PRIVATE,3,0) =
0x7ff00eb0f000
     29442 19:31:19.260890 close(3)          = 0
     29442 19:31:19.261060
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC) = 3
     29442 19:31:19.261247
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
     29442 19:31:19.261405
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
     29442 19:31:19.261562 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
     29442 19:31:19.261759
pread64(3,"\4\0\0\0\24\0\0\0\3\0\0\0GNU\00{\f\225\\=\201\327\312\301P\32$\230\266\235
= 68
     29442 19:31:19.261932
newfstatat(3,"",{st_mode=S_IFREG|0755,st_size=2220400,...},AT_EMPTY_PATH)
= 0
     29442 19:31:19.262098
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
     29442 19:31:19.262276
mmap(NULL,2264656,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
0x7ff00e8e6000
     29442 19:31:19.262431 mprotect(0x7ff00e90e000,2023424,PROT_NONE) =
0
     29442 19:31:19.262568
mmap(0x7ff00e90e000,1658880,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3
= 0x7ff00e90e000
     29442 19:31:19.262808
mmap(0x7ff00eaa3000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1bd000)
= 0x7ff00eaa3000
     29442 19:31:19.263048
mmap(0x7ff00eafc000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,
= 0x7ff00eafc000
```

```
     29442 19:31:19.263404
mmap(0x7ff00eb02000,52816,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
= 0x7ff00eb02000
     29442 19:31:19.263615 close(3)          = 0
     29442 19:31:19.263754
mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7ff00e8e3000
     29442 19:31:19.263917 arch_prctl(ARCH_SET_FS,0x7ff00e8e3740) = 0
     29442 19:31:19.264164 set_tid_address(0x7ff00e8e3a10) = 29442
     29442 19:31:19.264303 set_robust_list(0x7ff00e8e3a20,24) = 0
     29442 19:31:19.264480 rseq(0x7ff00e8e40e0,0x20,0,0x53053053) = 0
     29442 19:31:19.264732 mprotect(0x7ff00eafc000,16384,PROT_READ) = 0
     29442 19:31:19.264914 mprotect(0x55e80c0b2000,4096,PROT_READ) = 0
     29442 19:31:19.265157 mprotect(0x7ff00eb51000,8192,PROT_READ) = 0
     29442 19:31:19.265423
prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY})
= 0
     29442 19:31:19.265686 munmap(0x7ff00eb0f000,29840) = 0
     29442 19:31:19.266014
newfstatat(1,"",{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0xe),...},AT_EMPTY_PATH)
= 0
     29442 19:31:19.266296
getrandom("\xe2\xe2\xfe\x55\xb2\xdf\xfa\x50",8,GRND_NONBLOCK) = 8
     29442 19:31:19.266531 brk(NULL)         = 0x55e8112be000
     29442 19:31:19.266749 brk(0x55e8112df000) = 0x55e8112df000
     29442 19:31:19.267193
newfstatat(0,"",{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0xe),...},AT_EMPTY_PATH)
= 0
     29442 19:31:19.267442 write(1,"Enter a file name for odd
lines:"...,33) = 33
     29442 19:31:19.267766 read(0,"odd\n",1024) = 4
     29442 19:31:21.501558 write(1,"Enter a file name for even
lines"...,34) = 34
     29442 19:31:21.502507 read(0,"even\n",1024) = 5
     29442 19:31:23.372959
openat(AT_FDCWD,"odd",O_WRONLY|O_CREAT|O_TRUNC,0666) = 3
     29442 19:31:23.373364
openat(AT_FDCWD,"even",O_WRONLY|O_CREAT|O_TRUNC,0666) = 4
     29442 19:31:23.373791 pipe2([5,6],0)  = 0
     29442 19:31:23.374111 pipe2([7,8],0)  = 0
     29442 19:31:23.374445
clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,child_ti
= 29462
     29462 19:31:23.374886 set_robust_list(0x7ff00e8e3a20,24 <unfinished
...>
     29442 19:31:23.374950
clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD
<unfinished ...>
```

```
     29462 19:31:23.374999 <... set_robust_list resumed>) = 0
     29462 19:31:23.375162 dup2(5,0)         = 0
     29442 19:31:23.375324 <... clone
resumed>,child_tidptr=0x7ff00e8e3a10) = 29463
     29463 19:31:23.375365 set_robust_list(0x7ff00e8e3a20,24 <unfinished
...>
     29442 19:31:23.375409 close(3 <unfinished ...>
     29463 19:31:23.375454 <... set_robust_list resumed>) = 0
     29442 19:31:23.375497 <... close resumed>) = 0
     29463 19:31:23.375557 dup2(7,0 <unfinished ...>
     29442 19:31:23.375603 close(4 <unfinished ...>
     29463 19:31:23.375645 <... dup2 resumed>) = 0
     29442 19:31:23.375715 <... close resumed>) = 0
     29463 19:31:23.375764 dup2(4,1 <unfinished ...>
     29442 19:31:23.375808 close(5 <unfinished ...>
     29463 19:31:23.375854 <... dup2 resumed>) = 1
     29462 19:31:23.375900 dup2(3,1 <unfinished ...>
     29442 19:31:23.375952 <... close resumed>) = 0
     29463 19:31:23.375991 execve("./child",["child"],0x7ffcfc511608 /*
36 vars */ <unfinished ...>
     29442 19:31:23.376058 close(7 <unfinished ...>
     29462 19:31:23.376102 <... dup2 resumed>) = 1
     29442 19:31:23.376145 <... close resumed>) = 0
     29462 19:31:23.376188 execve("./child",["child"],0x7ffcfc511608 /*
36 vars */ <unfinished ...>
     29442 19:31:23.376270 read(0, <unfinished ...>
     29463 19:31:23.376379 <... execve resumed>) = 0
     29463 19:31:23.376522 brk(NULL <unfinished ...>
     29462 19:31:23.376565 <... execve resumed>) = 0
     29463 19:31:23.376634 <... brk resumed>) = 0x55764c376000
     29462 19:31:23.376691 brk(NULL <unfinished ...>
     29463 19:31:23.376736 arch_prctl(0x3001 /* ARCH_???
*/,0x7ffc11df1130 <unfinished ...>
     29462 19:31:23.376784 <... brk resumed>) = 0x561090aac000
     29463 19:31:23.376830 <... arch_prctl resumed>) = -1 EINVAL
(Invalid argument)
     29462 19:31:23.376878 arch_prctl(0x3001 /* ARCH_???
*/,0x7ffcc499bdc0 <unfinished ...>
     29463 19:31:23.376989
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     29462 19:31:23.377065 <... arch_prctl resumed>) = -1 EINVAL
(Invalid argument)
     29463 19:31:23.377111 <... mmap resumed>) = 0x7fae11b5b000
     29462 19:31:23.377153
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     29463 19:31:23.377197 access("/etc/ld.so.preload",R_OK <unfinished
```

```
...>
     29462 19:31:23.377249 <... mmap resumed>) = 0x7f54a5c2f000
     29463 19:31:23.377293 <... access resumed>) = -1 ENOENT (No such
file or directory)
     29462 19:31:23.377339 access("/etc/ld.so.preload",R_OK <unfinished
...>
     29463 19:31:23.377386
openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC <unfinished ...>
     29462 19:31:23.377439 <... access resumed>) = -1 ENOENT (No such
file or directory)
     29463 19:31:23.377481 <... openat resumed>) = 9
     29462 19:31:23.377526
openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC <unfinished ...>
     29463 19:31:23.377574 newfstatat(9,"", <unfinished ...>
     29462 19:31:23.377627 <... openat resumed>) = 9
     29463 19:31:23.377669 <... newfstatat
resumed>{st_mode=S_IFREG|0644,st_size=29840,...},AT_EMPTY_PATH) = 0
     29462 19:31:23.377721 newfstatat(9,"", <unfinished ...>
     29463 19:31:23.377770 mmap(NULL,29840,PROT_READ,MAP_PRIVATE,9,0
<unfinished ...>
     29462 19:31:23.377814 <... newfstatat
resumed>{st_mode=S_IFREG|0644,st_size=29840,...},AT_EMPTY_PATH) = 0
     29463 19:31:23.377862 <... mmap resumed>) = 0x7fae11b53000
     29462 19:31:23.377905 mmap(NULL,29840,PROT_READ,MAP_PRIVATE,9,0
<unfinished ...>
     29463 19:31:23.377949 close(9 <unfinished ...>
     29462 19:31:23.377991 <... mmap resumed>) = 0x7f54a5c27000
     29463 19:31:23.378034 <... close resumed>) = 0
     29462 19:31:23.378076 close(9 <unfinished ...>
     29463 19:31:23.378118
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
     29462 19:31:23.378166 <... close resumed>) = 0
     29463 19:31:23.378208 <... openat resumed>) = 9
     29462 19:31:23.378250
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
     29463 19:31:23.378309 read(9, <unfinished ...>
     29462 19:31:23.378351 <... openat resumed>) = 9
     29463 19:31:23.378394 <... 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
     29462 19:31:23.378441 read(9, <unfinished ...>
     29463 19:31:23.378483 pread64(9, <unfinished ...>
     29462 19:31:23.378526 <... 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
     29463 19:31:23.378573 <... 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
     29462 19:31:23.378630 pread64(9, <unfinished ...>
     29463 19:31:23.378679 pread64(9,"\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
     29462 19:31:23.378879 <... 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
     29463 19:31:23.378931 pread64(9, <unfinished ...>
     29462 19:31:23.378975 pread64(9, <unfinished ...>
     29463 19:31:23.379018 <... pread64
resumed>"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32$\230\266\235".
= 68
     29462 19:31:23.379068 <... pread64 resumed>"\4\0\0\0
\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,48,848) = 48
     29463 19:31:23.379118 newfstatat(9,"", <unfinished ...>
     29462 19:31:23.379169 pread64(9, <unfinished ...>
     29463 19:31:23.379212 <... newfstatat
resumed>{st_mode=S_IFREG|0755,st_size=2220400,...},AT_EMPTY_PATH) = 0
     29462 19:31:23.379294 <... pread64
resumed>"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32$\230\266\235".
= 68
     29463 19:31:23.379342 pread64(9, <unfinished ...>
     29462 19:31:23.379385 newfstatat(9,"", <unfinished ...>
     29463 19:31:23.379435 <... 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
     29462 19:31:23.379487 <... newfstatat
resumed>{st_mode=S_IFREG|0755,st_size=2220400,...},AT_EMPTY_PATH) = 0
     29463 19:31:23.379538
mmap(NULL,2264656,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,9,0 <unfinished
...>
     29462 19:31:23.379584 pread64(9, <unfinished ...>
     29463 19:31:23.379625 <... mmap resumed>) = 0x7fae1192a000
     29462 19:31:23.379668 <... 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
     29463 19:31:23.379714 mprotect(0x7fae11952000,2023424,PROT_NONE
<unfinished ...>
     29462 19:31:23.379756
mmap(NULL,2264656,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,9,0 <unfinished
...>
     29463 19:31:23.379798 <... mprotect resumed>) = 0
     29462 19:31:23.379848 <... mmap resumed>) = 0x7f54a59fe000
     29463 19:31:23.379891
mmap(0x7fae11952000,1658880,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9
<unfinished ...>
     29462 19:31:23.379943 mprotect(0x7f54a5a26000,2023424,PROT_NONE
```

```
<unfinished ...>
     29463 19:31:23.380003 <... mmap resumed>) = 0x7fae11952000
     29462 19:31:23.380046 <... mprotect resumed>) = 0
     29463 19:31:23.380087
mmap(0x7fae11ae7000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,0x1bd000
<unfinished ...>
     29462 19:31:23.380131
mmap(0x7f54a5a26000,1658880,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9
<unfinished ...>
     29463 19:31:23.380174 <... mmap resumed>) = 0x7fae11ae7000
     29463 19:31:23.380310
mmap(0x7fae11b40000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,
<unfinished ...>
     29462 19:31:23.380385 <... mmap resumed>) = 0x7f54a5a26000
     29463 19:31:23.380509 <... mmap resumed>) = 0x7fae11b40000
     29462 19:31:23.380598
mmap(0x7f54a5bbb000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,0x1bd000
<unfinished ...>
     29463 19:31:23.380672
mmap(0x7fae11b46000,52816,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
= 0x7fae11b46000
     29462 19:31:23.380902 <... mmap resumed>) = 0x7f54a5bbb000
     29463 19:31:23.381026 close(9 <unfinished ...>
     29462 19:31:23.381098
mmap(0x7f54a5c14000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,9,
<unfinished ...>
     29463 19:31:23.381142 <... close resumed>) = 0
     29462 19:31:23.381183 <... mmap resumed>) = 0x7f54a5c14000
     29463 19:31:23.381237
mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     29462 19:31:23.381277
mmap(0x7f54a5c1a000,52816,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
<unfinished ...>
     29463 19:31:23.381320 <... mmap resumed>) = 0x7fae11927000
     29462 19:31:23.381361 <... mmap resumed>) = 0x7f54a5c1a000
     29463 19:31:23.381410 arch_prctl(ARCH_SET_FS,0x7fae11927740
<unfinished ...>
     29462 19:31:23.381452 close(9 <unfinished ...>
     29463 19:31:23.381492 <... arch_prctl resumed>) = 0
     29462 19:31:23.381531 <... close resumed>) = 0
     29463 19:31:23.381580 set_tid_address(0x7fae11927a10 <unfinished
...>
     29462 19:31:23.381621
mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0
<unfinished ...>
     29463 19:31:23.381752 <... set_tid_address resumed>) = 29463
     29462 19:31:23.381830 <... mmap resumed>) = 0x7f54a59fb000
```

```
     29463 19:31:23.381871 set_robust_list(0x7fae11927a20,24 <unfinished
...>
     29462 19:31:23.381912 arch_prctl(ARCH_SET_FS,0x7f54a59fb740
<unfinished ...>
     29463 19:31:23.381954 <... set_robust_list resumed>) = 0
     29462 19:31:23.381994 <... arch_prctl resumed>) = 0
     29463 19:31:23.382032 rseq(0x7fae119280e0,0x20,0,0x53053053
<unfinished ...>
     29462 19:31:23.382071 set_tid_address(0x7f54a59fba10 <unfinished
...>
     29463 19:31:23.382108 <... rseq resumed>) = 0
     29462 19:31:23.382144 <... set_tid_address resumed>) = 29462
     29462 19:31:23.382252 set_robust_list(0x7f54a59fba20,24 <unfinished
...>
     29463 19:31:23.382321 mprotect(0x7fae11b40000,16384,PROT_READ
<unfinished ...>
     29462 19:31:23.382361 <... set_robust_list resumed>) = 0
     29463 19:31:23.382398 <... mprotect resumed>) = 0
     29462 19:31:23.382435 rseq(0x7f54a59fc0e0,0x20,0,0x53053053
<unfinished ...>
     29463 19:31:23.382474 mprotect(0x55763e747000,4096,PROT_READ
<unfinished ...>
     29462 19:31:23.382511 <... rseq resumed>) = 0
     29463 19:31:23.382548 <... mprotect resumed>) = 0
     29463 19:31:23.382675 mprotect(0x7fae11b95000,8192,PROT_READ
<unfinished ...>
     29462 19:31:23.382762 mprotect(0x7f54a5c14000,16384,PROT_READ
<unfinished ...>
     29463 19:31:23.382798 <... mprotect resumed>) = 0
     29462 19:31:23.382835 <... mprotect resumed>) = 0
     29463 19:31:23.382871 prlimit64(0,RLIMIT_STACK,NULL, <unfinished
...>
     29462 19:31:23.382908 mprotect(0x561062049000,4096,PROT_READ
<unfinished ...>
     29463 19:31:23.382944 <... prlimit64
resumed>{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY}) = 0
     29462 19:31:23.382990 <... mprotect resumed>) = 0
     29463 19:31:23.383024 munmap(0x7fae11b53000,29840) = 0
     29462 19:31:23.383247 mprotect(0x7f54a5c69000,8192,PROT_READ
<unfinished ...>
     29463 19:31:23.383296 getrandom( <unfinished ...>
     29462 19:31:23.383342 <... mprotect resumed>) = 0
     29463 19:31:23.383380 <... getrandom
resumed>"\x2d\x9f\x98\x9c\x12\xbd\x41\xb6",8,GRND_NONBLOCK) = 8
     29462 19:31:23.383429 prlimit64(0,RLIMIT_STACK,NULL, <unfinished
...>
     29463 19:31:23.383467 brk(NULL <unfinished ...>
     29462 19:31:23.383503 <... prlimit64
```

```
resumed>{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY}) = 0
     29463 19:31:23.383549 <... brk resumed>) = 0x55764c376000
     29462 19:31:23.383585 munmap(0x7f54a5c27000,29840 <unfinished ...>
     29463 19:31:23.383629 brk(0x55764c397000 <unfinished ...>
     29462 19:31:23.383669 <... munmap resumed>) = 0
     29463 19:31:23.383705 <... brk resumed>) = 0x55764c397000
     29463 19:31:23.383817 newfstatat(0,"", <unfinished ...>
     29462 19:31:23.383906 getrandom( <unfinished ...>
     29463 19:31:23.383944 <... newfstatat
resumed>{st_mode=S_IFIFO|0600,st_size=0,...},AT_EMPTY_PATH) = 0
     29462 19:31:23.383992 <... getrandom
resumed>"\x32\xae\xb2\x50\xd9\xc0\x40\x10",8,GRND_NONBLOCK) = 8
     29463 19:31:23.384034 read(0, <unfinished ...>
     29462 19:31:23.384069 brk(NULL)         = 0x561090aac000
     29462 19:31:23.384307 brk(0x561090acd000) = 0x561090acd000
     29462 19:31:23.384539
newfstatat(0,"",{st_mode=S_IFIFO|0600,st_size=0,...},AT_EMPTY_PATH) = 0
     29462 19:31:23.384770 read(0, <unfinished ...>
     29442 19:31:28.275864 <... read resumed>"text\n",1024) = 5
     29442 19:31:28.276094 write(6,"text\n",5) = 5
     29462 19:31:28.276331 <... read resumed>"text\n",4096) = 5
     29442 19:31:28.276418 read(0, <unfinished ...>
     29462 19:31:28.276460
newfstatat(1,"",{st_mode=S_IFREG|0644,st_size=0,...},AT_EMPTY_PATH) = 0
     29462 19:31:28.276801 write(1,"txet\n",5) = 5
     29462 19:31:28.277232 read(0, <unfinished ...>
     29442 19:31:29.442575 <... read resumed>"asd\n",1024) = 4
     29442 19:31:29.442848 write(8,"asd\n",4) = 4
     29463 19:31:29.443312 <... read resumed>"asd\n",4096) = 4
     29442 19:31:29.443384 read(0, <unfinished ...>
     29463 19:31:29.443540
newfstatat(1,"",{st_mode=S_IFREG|0644,st_size=0,...},AT_EMPTY_PATH) = 0
     29463 19:31:29.444063 write(1,"dsa\n",4) = 4
     29463 19:31:29.444559 read(0, <unfinished ...>
     29442 19:31:32.316947 <... read resumed>"123das\n",1024) = 7
     29442 19:31:32.317173 write(6,"123das\n",7) = 7
     29462 19:31:32.317561 <... read resumed>"123das\n",4096) = 7
     29442 19:31:32.317666 read(0, <unfinished ...>
     29462 19:31:32.317750 write(1,"sad321\n",7) = 7
     29462 19:31:32.318236 read(0, <unfinished ...>
     29442 19:31:35.532146 <... read resumed>"Test\n",1024) = 5
     29442 19:31:35.532361 write(8,"Test\n",5) = 5
     29463 19:31:35.532605 <... read resumed>"Test\n",4096) = 5
     29442 19:31:35.532655 read(0, <unfinished ...>
     29463 19:31:35.532685 write(1,"tseT\n",5) = 5
     29463 19:31:35.532933 read(0, <unfinished ...>
     29442 19:31:36.948532 <... read resumed>0x55e8112be6b0,1024) = ?
ERESTARTSYS (To be restarted if SA_RESTART is set)
```

```
     29463 19:31:36.948701 <... read resumed>0x55764c376320,4096) = ?
ERESTARTSYS (To be restarted if SA_RESTART is set)
     29462 19:31:36.948780 <... read resumed>0x561090aac320,4096) = ?
ERESTARTSYS (To be restarted if SA_RESTART is set)
     29442 19:31:36.948916 ---SIGINT {si_signo=SIGINT,si_code=SI_KERNEL}
---
     29463 19:31:36.949047 ---SIGINT {si_signo=SIGINT,si_code=SI_KERNEL}
---
     29462 19:31:36.949185 ---SIGINT {si_signo=SIGINT,si_code=SI_KERNEL}
---
     29442 19:31:36.949397 +++ killed by SIGINT +++
     29463 19:31:36.949972 +++ killed by SIGINT +++
     29462 19:31:36.950065 +++ killed by SIGINT +++
```

Листинг 5: *Strace логи*