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Институт №8 “Компьютерные науки и прикладная математика”
Кафедра №806 “Вычислительная математика и программирование”

Лабораторная работа №1 по курсу
«Операционные системы»

Группа: М8О-209БВ-24

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Оценка: _____

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Постановка задачи

Вариант 18.

Составить и отладить программу на языке Си, осуществляющую работу с процессами и взаимодействие между ними в одной из двух операционных систем. В результате работы программы (основной процесс) должен создать для решения 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.

Группа вариантов 5: 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 пересыпает их в pipe1 или в pipe2 в зависимости от правила фильтрации. Процессы child1 и child2 производят работу над строками. Процессы пишут результаты своей работы в стандартный вывод.

Вариант 18: правило фильтрации: нечетные строки отправляются в pipe1, четные в pipe2.
Дочерние процессы удаляют все гласные из строк.

Общий метод и алгоритм решения

Использованные системные вызовы:

- fork() — создает новый процесс; используется дважды для создания двух дочерних процессов child1 и child2
- pipe() — создает канал для межпроцессного взаимодействия; используется дважды для создания pipe1 (child1) и pipe2 (child2)
- dup2() — переназначает файловые дескрипторы; дочерние процессы перенаправляют стандартный ввод на свои каналы
- exec() — заменяет код текущего процесса новой программой child, которая удаляет гласные из строк
- waitpid() — приостанавливает родительский процесс до завершения дочерних
- write() — записывает данные в канал; родитель отправляет строки дочерним процессам
- getline() — читает строки произвольной длины от пользователя и из каналов
- open() — открывает выходные файлы для записи обработанных строк
- close() — закрывает неиспользуемые концы каналов, сигнализируя о завершении передачи
- exit() — завершает процессы с кодом возврата

Алгоритм:

Родитель создает два канала через pipe() и два дочерних процесса через fork()

1. Каждый дочерний процесс перенаправляет свой стандартный ввод на соответствующий канал с помощью `dup2()` и запускает программу `child` через `execl()`
2. Родитель читает строки от пользователя с помощью `getline()` и отправляет нечетные строки в `pipe1`, четные — в `pipe2` через `write()`
3. Дочерние процессы читают строки из стандартного ввода (перенаправленного канала), удаляют гласные буквы и записывают результат в свои файлы
4. После завершения ввода (EOF) родитель закрывает каналы с помощью `close()` и ожидает завершения дочерних процессов через `waitpid()`
5. Родитель выводит статус завершения и содержимое результирующих файлов, затем завершает работу

Код программы

parent.c

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

static ssize_t write_all(int fd, const void *buf, size_t count) {
    const char *p = buf;
    size_t left = count;
    while (left > 0) {
        ssize_t w = write(fd, p, left);
        if (w < 0) {
            if (errno == EINTR) continue;
            return -1;
        }
        left -= (size_t)w;
        p += w;
    }
    return (ssize_t)count;
}
```

```
}
```

```
int main() {
    char *filename1 = NULL, *filename2 = NULL;
    size_t fncap = 0;
    ssize_t r;

    printf("Введите имя файла для child1: ");
    fflush(stdout);
    r = getline(&filename1, &fncap, stdin);
    if (r <= 0) {
        perror("Ошибка чтения имени файла 1");
        free(filename1);
        return 1;
    }
    if (filename1[r-1] == '\n') filename1[r-1] = '\0';

    printf("Введите имя файла для child2: ");
    fflush(stdout);
    fncap = 0;
    r = getline(&filename2, &fncap, stdin);
    if (r <= 0) {
        perror("Ошибка чтения имени файла 2");
        free(filename1);
        free(filename2);
        return 1;
    }
    if (filename2[r-1] == '\n') filename2[r-1] = '\0';

    int pipe1[2], pipe2[2];
```

```
if (pipe(pipe1) == -1) {
    perror("Ошибка создания pipe1");
    free(filename1);
    free(filename2);
    return 1;
}

if (pipe(pipe2) == -1) {
    perror("Ошибка создания pipe2");
    close(pipe1[0]);
    close(pipe1[1]);
    free(filename1);
    free(filename2);
    return 1;
}

printf("\n==== Начало обработки строк ====\n");
printf("Введите строки (Ctrl+D для завершения ввода):\n");
printf("-----\n");

pid_t pid1 = fork();
if (pid1 < 0) {
    perror("Ошибка fork для child1");
    close(pipe1[0]); close(pipe1[1]); close(pipe2[0]); close(pipe2[1]);
    free(filename1); free(filename2);
    return 1;
}

if (pid1 == 0) {
    if (dup2(pipe1[0], STDIN_FILENO) == -1) {
        perror("child1: ошибка dup2");
    }
}
```

```
_exit(1);
}

close(pipe1[0]); close(pipe1[1]);
close(pipe2[0]); close(pipe2[1]);

execl("./child", "child", filename1, (char *)NULL);
perror("child1: ошибка execl");
_exit(1);

}

close(pipe1[0]);

pid_t pid2 = fork();
if (pid2 < 0) {
    perror("Ошибка fork для child2");
    close(pipe1[1]); close(pipe2[0]); close(pipe2[1]);
    free(filename1); free(filename2);
    return 1;
}

if (pid2 == 0) {
    if (dup2(pipe2[0], STDIN_FILENO) == -1) {
        perror("child2: ошибка dup2");
        _exit(1);
    }
    close(pipe2[0]); close(pipe2[1]);
    close(pipe1[0]); close(pipe1[1]);

    execl("./child", "child", filename2, (char *)NULL);
    perror("child2: ошибка execl");
}
```

```
_exit(1);

}

close(pipe2[0]);

char *line = NULL;
size_t linecap = 0;
long lineno = 0;

while (getline(&line, &linecap, stdin) != -1) {
    ++lineno;

    int target_fd = (lineno % 2 == 1) ? pipe1[1] : pipe2[1];
    const char *child_name = (lineno % 2 == 1) ? "child1" : "child2";

    if (write_all(target_fd, line, strlen(line)) == -1) {
        fprintf(stderr, "Ошибка записи в %s: %s\n", child_name, strerror(errno));
    }
}

size_t len = strlen(line);
if (len > 0 && line[len-1] == '\n') line[len-1] = '\0';
printf("[%s] Стока %ld: %s\n", child_name, lineno, line);
}

free(line);

printf("\n[INFO] Конец ввода (EOF)\n");
printf("\n-----\n");
printf("Ожидание завершения дочерних процессов...\n");
```

```
close(pipe1[1]);
close(pipe2[1]);

int status1, status2;
if (waitpid(pid1, &status1, 0) == -1) perror("Ошибка waitpid для child1");
if (waitpid(pid2, &status2, 0) == -1) perror("Ошибка waitpid для child2");

printf("\n==== РЕЗУЛЬТАТЫ РАБОТЫ ====\n");
printf("child1 завершился с кодом: %d\n", WEXITSTATUS(status1));
printf("child2 завершился с кодом: %d\n", WEXITSTATUS(status2));
printf("\nРезультаты записаны в файлы:\n");
printf("• %s (child1, нечетные строки)\n", filename1);
printf("• %s (child2, четные строки)\n", filename2);

printf("\n--- Содержимое %s ---\n", filename1);
char cmd[1024];
snprintf(cmd, sizeof(cmd), "cat %s 2>/dev/null", filename1);
system(cmd);

printf("\n--- Содержимое %s ---\n", filename2);
snprintf(cmd, sizeof(cmd), "cat %s 2>/dev/null", filename2);
system(cmd);

free(filename1);
free(filename2);
printf("\nРодительский процесс завершен.\n");
return 0;
}
```

child.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>

int is_vowel(char c) {
    c = tolower(c);
    return (c == 'a' || c == 'e' || c == 'i' ||
            c == 'o' || c == 'u' || c == 'y');
}

void remove_vowels(char *str) {
    char *src = str;
    char *dst = str;

    while (*src) {
        if (!is_vowel(*src)) {
            *dst = *src;
            dst++;
        }
        src++;
    }
    *dst = '\0';
}

int main(int argc, char *argv[]) {
    if (argc < 2) {
        fprintf(stderr, "Использование: %s output_filename\n", argv[0]);
        return 1;
    }
}
```

```
const char *outname = argv[1];
FILE *out = fopen(outname, "w");
if (!out) {
    perror("Ошибка открытия файла");
    return 1;
}

char *line = NULL;
size_t cap = 0;

while (getline(&line, &cap, stdin) != -1) {
    size_t len = strlen(line);
    if (len > 0 && line[len-1] == '\n') {
        line[len-1] = '\0';
        len--;
    }
}

char original[1024];
if (len >= sizeof(original)) len = sizeof(original) - 1;
strncpy(original, line, len);
original[len] = '\0';

remove_vowels(line);

printf("%s\n", line);
fflush(stdout);

fprintf(out, "%s\n", line);
fflush(out);
```

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

Протокол работы программы

Тестирование:

\$ make

```
gcc -Wall -Wextra -std=c99 -D_POSIX_C_SOURCE=200809L parent.c -o parent
```

```
gcc -Wall -Wextra -std=c99 -D_POSIX_C_SOURCE=200809L child.c -o child
```

\$./parent

Введите имя файла для child1: file01.txt

Введите имя файла для child2: file02.txt

==== Начало обработки строк ===

Вводите строки (Ctrl+D для завершения ввода):

Hello World

[child1] Стока 1: Hello World

Hll Wrld

Operating System

[child2] Стока 2: Operating System

prtng Sstm

Test String

[child1] Стока 3: Test String

Tst Strng

[INFO] Конец ввода (EOF)

Ожидание завершения дочерних процессов...

==== РЕЗУЛЬТАТЫ РАБОТЫ ===

child1 завершился с кодом: 0

child2 завершился с кодом: 0

Результаты записаны в файлы:

- file01.txt (child1, нечетные строки)
- file02.txt (child2, четные строки)

--- Содержимое file01.txt ---

Hll Wrld

Tst Strng

--- Содержимое file02.txt ---

prtng Sstm

Родительский процесс завершен.

Strace:

```
$ strace -f ./parent
execve("./parent", ["/./parent"], 0x7ffc10cd9a28 /* 27 vars */) = 0
brk(NULL)                               = 0x646315eb6000
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7472697ca000
access("/etc/ld.so.preload", R_OK)        = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=41635, ...}) = 0
mmap(NULL, 41635, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7472697bf000
close(3)                                 = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
832  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\0"..., 832) =
= 784  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\0\0"..., 784, 64)
      fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
= 784  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"..., 784, 64)
      mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x747269400000
      mmap(0x747269428000, 1605632, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x28000) = 0x747269428000
```

```
0x1b0000) mmap(0x7472695b0000, 323584, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
3, 0x1fe000) mmap(0x7472695ff000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
-1, 0) mmap(0x747269605000, 52624, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,
close(3) = 0
0x7472697bc000 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
arch_prctl(ARCH_SET_FS, 0x7472697bc740) = 0
set_tid_address(0x7472697bca10) = 430
set_robust_list(0x7472697bca20, 24) = 0
rseq(0x7472697bd060, 0x20, 0, 0x53053053) = 0
mprotect(0x7472695ff000, 16384, PROT_READ) = 0
mprotect(0x646307470000, 4096, PROT_READ) = 0
mprotect(0x747269802000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) = 0
munmap(0x7472697bf000, 41635) = 0
fstat(1, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
getrandom("\x4d\xf2\x81\xd3\x9e\xbf\x8a\x a2", 8, GRND_NONBLOCK) = 8
brk(NULL) = 0x646315eb6000
brk(0x646315ed7000) = 0x646315ed7000
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
для child1: \320\270\320\274\321\217\321\204\320\260\320\271\320\273\320\260...", 48Введите имя файла
) = 48
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
read(0, "\320\260\321file_1.txt\n", 1024) = 14
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
для child2: \320\270\320\274\321\217\321\204\320\260\320\271\320\273\320\260...", 48Введите имя файла
) = 48
read(0, "file_2.txt\n", 1024) = 11
pipe2([3, 4], 0) = 0
pipe2([5, 6], 0) = 0
clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7472697bca10) = 435
strace: Process 435 attached
[pid 430] close(3 <unfinished ...>
[pid 435] set_robust_list(0x7472697bca20, 24 <unfinished ...>
[pid 430] <... close resumed> = 0
[pid 435] <... set_robust_list resumed> = 0
[pid 430] clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD <unfinished ...>
[pid 435] dup2(3, 0) = 0
strace: Process 436 attached
[pid 435] close(3 <unfinished ...>
[pid 430] <... clone resumed>, child_tidptr=0x7472697bca10) = 436
[pid 436] set_robust_list(0x7472697bca20, 24 <unfinished ...>
[pid 435] <... close resumed> = 0
[pid 430] close(5 <unfinished ...>
[pid 436] <... set_robust_list resumed> = 0
[pid 430] <... close resumed> = 0
[pid 435] close(4 <unfinished ...>
[pid 430] read(0, <unfinished ...>
[pid 436] dup2(5, 0 <unfinished ...>
[pid 435] <... close resumed> = 0
```

```
[pid  436] <... dup2 resumed>          = 0
[pid  435] close(5 <unfinished ...>
[pid  436] close(5 <unfinished ...>
[pid  435] <... close resumed>         = 0
[pid  436] <... close resumed>         = 0
[pid  436] close(6 <unfinished ...>
[pid  435] close(6 <unfinished ...>
[pid  436] <... close resumed>         = 0
[pid  435] <... close resumed>         = 0
[pid  436] close(3 <unfinished ...>
vars [pid 435] execve("./child", ["child", "\320\260\321file_1.txt"], 0x7fffcde32678 /* 27
      <unfinished ...>)
[pid  436] <... close resumed>         = -1 EBADF (Bad file descriptor)
[pid  436] close(4)                      = 0
0  [pid  436] execve("./child", ["child", "file_2.txt"], 0x7fffcde32678 /* 27 vars */) =
[pid  435] <... execve resumed>        = 0
[pid  436] brk(NULL <unfinished ...>
[pid  435] brk(NULL <unfinished ...>
[pid  436] <... brk resumed>           = 0x618ae7bbc000
[pid  435] <... brk resumed>           = 0x5810ffcb7000
<unfinished 436] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0
<unfinished ...>
<unfinished 435] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0
<unfinished ...>
[pid  436] <... mmap resumed>          = 0x7ad6eb49c000
[pid  435] <... mmap resumed>          = 0x72c27fcad000
[pid  436] access("/etc/ld.so.preload", R_OK <unfinished ...>
[pid  435] access("/etc/ld.so.preload", R_OK <unfinished ...>
[pid  436] <... access resumed>        = -1 ENOENT (No such file or directory)
[pid  435] <... access resumed>        = -1 ENOENT (No such file or directory)
[pid  436] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC <unfinished ...>
[pid  435] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC <unfinished ...>
[pid  436] <... openat resumed>         = 3
[pid  435] <... openat resumed>         = 3
[pid  436] fstat(3, <unfinished ...>
[pid  435] fstat(3, <unfinished ...>
[pid  436] <... fstat resumed>{st_mode=S_IFREG|0644, st_size=41635, ...}) = 0
[pid  435] <... fstat resumed>{st_mode=S_IFREG|0644, st_size=41635, ...}) = 0
[pid  436] mmap(NULL, 41635, PROT_READ, MAP_PRIVATE, 3, 0 <unfinished ...>
[pid  435] mmap(NULL, 41635, PROT_READ, MAP_PRIVATE, 3, 0 <unfinished ...>
[pid  436] <... mmap resumed>          = 0x7ad6eb491000
[pid  435] <... mmap resumed>          = 0x72c27fca2000
[pid  436] close(3 <unfinished ...>
[pid  435] close(3 <unfinished ...>
[pid  436] <... close resumed>         = 0
[pid  435] <... close resumed>         = 0
<unfinished 436] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC
<unfinished ...>
<unfinished 435] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC
<unfinished ...>
[pid  436] <... openat resumed>        = 3
```

```
[pid 435] <... openat resumed> = 3
[pid 436] read(3, <unfinished ...>
[pid 435] read(3, <unfinished ...>
[pid 436] <... 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
[pid 435] <... 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
[pid 436] pread64(3, <unfinished ...>
[pid 435] pread64(3, <unfinished ...>
[pid 436] <... 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"..., 784, 64) = 784
[pid 435] <... 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"..., 784, 64) = 784
[pid 436] fstat(3, <unfinished ...>
[pid 435] fstat(3, <unfinished ...>
[pid 436] <... fstat resumed> {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
[pid 435] <... fstat resumed> {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
[pid 436] pread64(3, <unfinished ...>
[pid 435] pread64(3, <unfinished ...>
[pid 436] <... 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"..., 784, 64) = 784
[pid 435] <... 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"..., 784, 64) = 784
...> [pid 436] mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0 <unfinished ...>
...> [pid 435] mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0 <unfinished ...>
[pid 436] <... mmap resumed> = 0x7ad6eb200000
[pid 435] <... mmap resumed> = 0x72c27fa00000
[pid 436] mmap(0x7ad6eb228000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000 <unfinished ...>
[pid 435] mmap(0x72c27fa28000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000 <unfinished ...>
[pid 436] <... mmap resumed> = 0x7ad6eb228000
[pid 435] <... mmap resumed> = 0x72c27fa28000
[pid 436] mmap(0x7ad6eb3b0000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000 <unfinished ...>
[pid 435] mmap(0x72c27fb0000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000 <unfinished ...>
[pid 436] <... mmap resumed> = 0x7ad6eb3b0000
[pid 435] <... mmap resumed> = 0x72c27fb0000
[pid 436] mmap(0x7ad6eb3ff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000 <unfinished ...>
[pid 435] mmap(0x72c27fbff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000 <unfinished ...>
[pid 436] <... mmap resumed> = 0x7ad6eb3ff000
[pid 435] <... mmap resumed> = 0x72c27fbff000
[pid 436] mmap(0x7ad6eb405000, -52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0 <unfinished ...>
[pid 435] mmap(0x72c27fc05000, -52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0 <unfinished ...>
[pid 436] <... mmap resumed> = 0x7ad6eb405000
[pid 435] <... mmap resumed> = 0x72c27fc05000
[pid 436] close(3 <unfinished ...>
[pid 435] close(3 <unfinished ...>
[pid 436] <... close resumed> = 0
[pid 435] <... close resumed> = 0
[pid 436] mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0 <unfinished ...>
```

```
[pid 435] mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0
<unfinished ...>
[pid 436] <... mmap resumed>          = 0x7ad6eb48e000
[pid 435] <... mmap resumed>          = 0x72c27fc9f000
[pid 436] arch_prctl(ARCH_SET_FS, 0x7ad6eb48e740 <unfinished ...>
[pid 435] arch_prctl(ARCH_SET_FS, 0x72c27fc9f740 <unfinished ...>
[pid 436] <... arch_prctl resumed>    = 0
[pid 435] <... arch_prctl resumed>    = 0
[pid 436] set_tid_address(0x7ad6eb48ea10 <unfinished ...>
[pid 435] set_tid_address(0x72c27fc9fa10 <unfinished ...>
[pid 436] <... set_tid_address resumed> = 436
[pid 435] <... set_tid_address resumed> = 435
[pid 436] set_robust_list(0x7ad6eb48ea20, 24 <unfinished ...>
[pid 435] set_robust_list(0x72c27fc9fa20, 24 <unfinished ...>
[pid 436] <... set_robust_list resumed> = 0
[pid 435] <... set_robust_list resumed> = 0
[pid 436] rseq(0x7ad6eb48f060, 0x20, 0, 0x53053053 <unfinished ...>
[pid 435] rseq(0x72c27fc0060, 0x20, 0, 0x53053053 <unfinished ...>
[pid 436] <... rseq resumed>          = 0
[pid 435] <... rseq resumed>          = 0
[pid 436] mprotect(0x7ad6eb3ff000, 16384, PROT_READ <unfinished ...>
[pid 435] mprotect(0x72c27fbff000, 16384, PROT_READ <unfinished ...>
[pid 436] <... mprotect resumed>      = 0
[pid 435] <... mprotect resumed>      = 0
[pid 436] mprotect(0x618ade20a000, 4096, PROT_READ <unfinished ...>
[pid 435] mprotect(0x5810de128000, 4096, PROT_READ <unfinished ...>
[pid 436] <... mprotect resumed>      = 0
[pid 435] <... mprotect resumed>      = 0
[pid 436] mprotect(0x7ad6eb4d4000, 8192, PROT_READ <unfinished ...>
[pid 435] mprotect(0x72c27fce5000, 8192, PROT_READ <unfinished ...>
[pid 436] <... mprotect resumed>      = 0
[pid 435] <... mprotect resumed>      = 0
[pid 436] prlimit64(0, RLIMIT_STACK, NULL, <unfinished ...>
[pid 435] prlimit64(0, RLIMIT_STACK, NULL, <unfinished ...>
[pid 436] <... prlimit64 resumed>{rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY} = 0
[pid 435] <... prlimit64 resumed>{rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY} = 0
[pid 436] munmap(0x7ad6eb491000, 41635 <unfinished ...>
[pid 435] munmap(0x72c27fc0000, 41635 <unfinished ...>
[pid 436] <... munmap resumed>        = 0
[pid 435] <... munmap resumed>        = 0
[pid 436] getrandom( <unfinished ...>
[pid 435] getrandom( <unfinished ...>
[pid 436] <... getrandom resumed>"\xa0\x8c\x8a\x17\x4c\xf5\x73\xcb", 8,
GRND_NONBLOCK)
[pid 435] <... getrandom resumed>"\x4f\x7c\x5c\x43\xba\x5f\xd4\xf2", 8,
GRND_NONBLOCK)
[pid 436] brk(NULL)                  = 0x618ae7bbc000
[pid 435] brk(NULL <unfinished ...>
[pid 436] brk(0x618ae7bdd000 <unfinished ...>
[pid 435] <... brk resumed>         = 0x5810ffcb7000
[pid 436] <... brk resumed>         = 0x618ae7bdd000
```

```
[pid 435] brk(0x5810ffcd8000 <unfinished ...>
[pid 436] openat(AT_FDCWD, "file_2.txt", O_WRONLY|O_CREAT|O_TRUNC, 0666 <unfinished
...>
[pid 435] <... brk resumed> = 0x5810ffcd8000
<unfinished ...>
[pid 435] openat(AT_FDCWD, "\320\260\321file_1.txt", O_WRONLY|O_CREAT|O_TRUNC, 0666
[pid 436] <... openat resumed> = 3
[pid 436] fstat(0, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
[pid 436] read(0, <unfinished ...>
[pid 435] <... openat resumed> = 3
[pid 435] fstat(0, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
[pid 435] read(0, <unfinished ...>
[pid 430] <... read resumed>"hello world\n", 1024) = 12
[pid 430] write(4, "hello world\n", 12) = 12
[pid 435] <... read resumed>"hello world\n", 4096) = 12
[pid 430] read(0, <unfinished ...>
[pid 435] fstat(1, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
[pid 435] write(1, "hll wrld\n", 9hll wrld
) = 9
[pid 435] fstat(3, {st_mode=S_IFREG|0777, st_size=0, ...}) = 0
[pid 435] write(3, "hll wrld\n", 9) = 9
[pid 435] read(0, <unfinished ...>
[pid 430] <... read resumed>"test\n", 1024) = 5
[pid 430] write(6, "test\n", 5) = 5
[pid 436] <... read resumed>"test\n", 4096) = 5
[pid 430] read(0, <unfinished ...>
[pid 436] fstat(1, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
[pid 436] write(1, "tst\n", 4tst
) = 4
[pid 436] fstat(3, {st_mode=S_IFREG|0777, st_size=0, ...}) = 0
[pid 436] write(3, "tst\n", 4) = 4
[pid 436] read(0, <unfinished ...>
[pid 430] <... read resumed>"string\n", 1024) = 7
[pid 430] write(4, "string\n", 7) = 7
[pid 435] <... read resumed>"string\n", 4096) = 7
[pid 430] read(0, <unfinished ...>
[pid 435] write(1, "strng\n", 6strng
) = 6
[pid 435] write(3, "strng\n", 6) = 6
[pid 435] read(0, <unfinished ...>
[pid 430] <... read resumed>"operating system\n", 1024) = 17
[pid 430] write(6, "operating system\n", 17) = 17
[pid 436] <... read resumed>"operating system\n", 4096) = 17
[pid 430] read(0, <unfinished ...>
[pid 436] write(1, "prtng sstm\n", 11prtng sstm
) = 11
[pid 436] write(3, "prtng sstm\n", 11) = 11
[pid 436] read(0, <unfinished ...>
[pid 430] <... read resumed> "", 1024) = 0
[pid 430] close(4) = 0
```



```
[pid 438] getrandom("\x9b\xad\xd9\x3c\xce\x32\x3c\x61", 8, GRND_NONBLOCK) = 8
[pid 438] brk(NULL) = 0x5dc0dc685000
[pid 438] brk(0x5dc0dc6a6000) = 0x5dc0dc6a6000
ENOENT [pid 438] openat(AT_FDCWD, "/usr/lib/locale/locale-archive", O_RDONLY|O_CLOEXEC) = -1
[pid 438] openat(AT_FDCWD, "/usr/share/locale/locale.alias", O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=2996, ...}) = 0
[pid 438] read(3, "# Locale name alias data base.\n#..., 4096) = 2996
[pid 438] read(3, "", 4096) = 0
[pid 438] close(3) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_IDENTIFICATION",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_IDENTIFICATION",
O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=258, ...}) = 0
[pid 438] mmap(NULL, 258, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666b6000
[pid 438] close(3) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/gconv/gconv-modules.cache",
O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=27028, ...}) = 0
[pid 438] mmap(NULL, 27028, PROT_READ, MAP_SHARED, 3, 0) = 0x77ab666af000
[pid 438] close(3) = 0
[pid 438] futex(0x77ab6660472c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_MEASUREMENT",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_MEASUREMENT",
O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=23, ...}) = 0
[pid 438] mmap(NULL, 23, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666ae000
[pid 438] close(3) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_TELEPHONE",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
= 3 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_TELEPHONE", O_RDONLY|O_CLOEXEC)
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=47, ...}) = 0
[pid 438] mmap(NULL, 47, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666ad000
[pid 438] close(3) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_ADDRESS", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
3 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_ADDRESS", O_RDONLY|O_CLOEXEC) =
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=127, ...}) = 0
[pid 438] mmap(NULL, 127, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666ac000
[pid 438] close(3) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_NAME", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_NAME", O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=62, ...}) = 0
[pid 438] mmap(NULL, 62, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666a8000
[pid 438] close(3) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_PAPER", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_PAPER", O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=34, ...}) = 0
[pid 438] mmap(NULL, 34, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666a7000
[pid 438] close(3) = 0
```

```
= -1 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_MESSAGES", O_RDONLY|O_CLOEXEC)
= 3 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_MESSAGES", O_RDONLY|O_CLOEXEC)
[pid 438] fstat(3, {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
[pid 438] close(3) = 0
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_MESSAGES/SYS_LC_MESSAGES",
O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=48, ...}) = 0
[pid 438] mmap(NULL, 48, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666a6000
[pid 438] close(3) = 0
= -1 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_MONETARY", O_RDONLY|O_CLOEXEC)
= 3 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_MONETARY", O_RDONLY|O_CLOEXEC)
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=270, ...}) = 0
[pid 438] mmap(NULL, 270, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666a5000
[pid 438] close(3) = 0
= -1 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_COLLATE", O_RDONLY|O_CLOEXEC)
= 3 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_COLLATE", O_RDONLY|O_CLOEXEC)
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=1406, ...}) = 0
[pid 438] mmap(NULL, 1406, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666a4000
[pid 438] close(3) = 0
= -1 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_TIME", O_RDONLY|O_CLOEXEC)
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_TIME", O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=3360, ...}) = 0
[pid 438] mmap(NULL, 3360, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666a3000
[pid 438] close(3) = 0
= -1 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_NUMERIC", O_RDONLY|O_CLOEXEC)
= 3 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_NUMERIC", O_RDONLY|O_CLOEXEC)
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=50, ...}) = 0
[pid 438] mmap(NULL, 50, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab666a2000
[pid 438] close(3) = 0
= -1 [pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_CTYPE", O_RDONLY|O_CLOEXEC)
[pid 438] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_CTYPE", O_RDONLY|O_CLOEXEC) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0644, st_size=360460, ...}) = 0
[pid 438] mmap(NULL, 360460, PROT_READ, MAP_PRIVATE, 3, 0) = 0x77ab66649000
[pid 438] close(3) = 0
[pid 438] fstat(1, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
[pid 438] openat(AT_FDCWD, "\320\260\321file_1.txt", O_RDONLY) = 3
[pid 438] fstat(3, {st_mode=S_IFREG|0777, st_size=15, ...}) = 0
[pid 438] fadvise64(3, 0, 0, POSIX_FADV_SEQUENTIAL) = 0
[pid 438] mmap(NULL, 139264, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
= 0x77ab66627000
[pid 438] read(3, "hll wrld\nstrng\n", 131072) = 15
[pid 438] write(1, "hll wrld\nstrng\n", 15hll wrld
strng
) = 15
[pid 438] read(3, "", 131072) = 0
[pid 438] munmap(0x77ab66627000, 139264) = 0
```

```
[pid  438] close(3)          = 0
[pid  438] close(1)          = 0
[pid  438] close(2)          = 0
[pid  438] exit_group(0)     = ?
[pid  438] +++ exited with 0 ===
[pid  437] <... wait4 resumed>[{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 438
[pid  437] --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=438, si_uid=1000,
si_status=0, si_utime=0, si_stime=0} ---
[pid  437] rt_sigreturn({mask=[]}) = 438
[pid  437] wait4(-1, 0x7fff849a385c, WNOHANG, NULL) = -1 ECHILD (No child processes)
[pid  437] dup2(10, 2)        = 2
[pid  437] close(10)         = 0
[pid  437] exit_group(0)     = ?
[pid  437] +++ exited with 0 ===
<... wait4 resumed>[{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 437
[pid  437] rt_sigaction(SIGINT, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, NULL, 8) = 0
[pid  437] rt_sigaction(SIGQUIT, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, NULL, 8) = 0
[pid  437] rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
[pid  437] --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=437, si_uid=1000,
si_status=0, si_utime=0, si_stime=0} ---
[pid  437] rt_sigaction(SIGINT, {sa_handler=SIG_TGN, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, 8) = 0
[pid  437] rt_sigaction(SIGQUIT, {sa_handler=SIG_TGN, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, 8) = 0
[pid  437] rt_sigprocmask(SIG_BLOCK, [CHLD], [], 8) = 0
[pid  437] mmap(NULL, 36864, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) =
0x7472697c1000
[pid  437] rt_sigprocmask(SIG_BLOCK, ~[], [CHLD], 8) = 0
[pid  437] clone3({flags=CLONE_VM|CLONE_VFORK|CLONE_CLEAR_SIGHAND, exit_signal=SIGCHLD,
stack=0x7472697c1000, stack_size=0x9000}, 88trace:-Process 439 attached
[pid  437] <unfinished ...>
[pid  439] rt_sigprocmask(SIG_BLOCK, NULL, ~[KILL STOP], 8) = 0
[pid  439] rt_sigaction(SIGINT, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, NULL, 8) = 0
[pid  439] rt_sigaction(SIGQUIT, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, NULL, 8) = 0
[pid  439] rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
[pid  439] execve("/bin/sh", ["sh", "-c", "--", "cat file_2.txt 2>/dev/null"], 0x7fffcde32678 /* 27 vars */ <unfinished ...>
[pid  430] <... clone3 resumed> = 439
[pid  430] munmap(0x7472697c1000, 36864) = 0
[pid  439] <... execve resumed> = 0
[pid  430] rt_sigprocmask(SIG_SETMASK, [CHLD], NULL, 8) = 0
[pid  439] brk(NULL <unfinished ...>
[pid  430] wait4(439, <unfinished ...>
[pid  439] <... brk resumed> = 0x59a9128f3000
[pid  439] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x729b74cb0000
[pid  439] access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or directory)
[pid  439] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
[pid  439] fstat(3, {st_mode=S_IFREG|0644, st_size=41635, ...}) = 0
[pid  439] mmap(NULL, 41635, PROT_READ, MAP_PRIVATE, 3, 0) = 0x729b74ca5000
[pid  439] close(3)          = 0
[pid  439] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
```



```
[pid 440] munmap(0x7c6cc2612000, 41635) = 0
[pid 440] getrandom("\x9a\xf3\x6f\x41\xd2\x3e\xd0\xf5", 8, GRND_NONBLOCK) = 8
[pid 440] brk(NULL) = 0x571ee0e63000
[pid 440] brk(0x571ee0e84000) = 0x571ee0e84000
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/locale-archive", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
[pid 440] openat(AT_FDCWD, "/usr/share/locale/locale.alias", O_RDONLY|O_CLOEXEC) = 3
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=2996, ...}) = 0
[pid 440] read(3, "# Locale name alias data base.\n#..., 4096) = 2996
[pid 440] read(3, "", 4096) = 0
[pid 440] close(3) = 0
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_IDENTIFICATION",
O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_IDENTIFICATION",
O_RDONLY|O_CLOEXEC) = 3
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=258, ...}) = 0
[pid 440] mmap(NULL, 258, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc261c000
[pid 440] close(3) = 0
[pid 440] openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/gconv/gconv-modules.cache",
O_RDONLY|O_CLOEXEC) = 3
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=27028, ...}) = 0
[pid 440] mmap(NULL, 27028, PROT_READ, MAP_SHARED, 3, 0) = 0x7c6cc2615000
[pid 440] close(3) = 0
[pid 440] futex(0x7c6cc240472c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_MEASUREMENT",
O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_MEASUREMENT",
O_RDONLY|O_CLOEXEC) = 3
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=23, ...}) = 0
[pid 440] mmap(NULL, 23, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc2614000
[pid 440] close(3) = 0
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_TELEPHONE",
O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
= 3 [pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_TELEPHONE", O_RDONLY|O_CLOEXEC)
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=47, ...}) = 0
[pid 440] mmap(NULL, 47, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc2613000
[pid 440] close(3) = 0
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_ADDRESS", O_RDONLY|O_CLOEXEC)
= -1
ENOENT (No such file or directory)
3 [pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_ADDRESS", O_RDONLY|O_CLOEXEC) =
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=127, ...}) = 0
[pid 440] mmap(NULL, 127, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc2612000
[pid 440] close(3) = 0
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_NAME", O_RDONLY|O_CLOEXEC) =
-1
ENOENT (No such file or directory)
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_NAME", O_RDONLY|O_CLOEXEC) = 3
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=62, ...}) = 0
[pid 440] mmap(NULL, 62, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc260e000
[pid 440] close(3) = 0
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_PAPER", O_RDONLY|O_CLOEXEC) =
-1
ENOENT (No such file or directory)
[pid 440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_PAPER", O_RDONLY|O_CLOEXEC) = 3
[pid 440] fstat(3, {st_mode=S_IFREG|0644, st_size=34, ...}) = 0
[pid 440] mmap(NULL, 34, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc260d000
```

```
[pid  440] close(3)          = 0
= -1 ENOENT (No such file or directory)
= 3  [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_MESSAGES", O_RDONLY|O_CLOEXEC)
      [pid  440] fstat(3, {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
      [pid  440] close(3)         = 0
      [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_MESSAGES", O_RDONLY|O_CLOEXEC)
      [pid  440] fstat(3, {st_mode=S_IFREG|0644, st_size=48, ...}) = 0
      [pid  440] mmap(NULL, 48, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc260c000
      [pid  440] close(3)         = 0
= -1 ENOENT (No such file or directory)
= 3  [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_MONETARY", O_RDONLY|O_CLOEXEC)
      [pid  440] fstat(3, {st_mode=S_IFREG|0644, st_size=270, ...}) = 0
      [pid  440] mmap(NULL, 270, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc260b000
      [pid  440] close(3)         = 0
= -1 ENOENT (No such file or directory)
= 3  [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_COLLATE", O_RDONLY|O_CLOEXEC)
      [pid  440] fstat(3, {st_mode=S_IFREG|0644, st_size=1406, ...}) = 0
      [pid  440] mmap(NULL, 1406, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc260a000
      [pid  440] close(3)         = 0
= -1 ENOENT (No such file or directory)
= 3  [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_TIME", O_RDONLY|O_CLOEXEC)
      [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_TIME", O_RDONLY|O_CLOEXEC) = 3
      [pid  440] fstat(3, {st_mode=S_IFREG|0644, st_size=3360, ...}) = 0
      [pid  440] mmap(NULL, 3360, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc2609000
      [pid  440] close(3)         = 0
= -1 ENOENT (No such file or directory)
= 3  [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_NUMERIC", O_RDONLY|O_CLOEXEC)
      [pid  440] fstat(3, {st_mode=S_IFREG|0644, st_size=50, ...}) = 0
      [pid  440] mmap(NULL, 50, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc2608000
      [pid  440] close(3)         = 0
= -1 ENOENT (No such file or directory)
= 3  [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.UTF-8/LC_CTYPE", O_RDONLY|O_CLOEXEC)
      [pid  440] openat(AT_FDCWD, "/usr/lib/locale/C.utf8/LC_CTYPE", O_RDONLY|O_CLOEXEC) = 3
      [pid  440] fstat(3, {st_mode=S_IFREG|0644, st_size=360460, ...}) = 0
      [pid  440] mmap(NULL, 360460, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c6cc25af000
      [pid  440] close(3)         = 0
      [pid  440] fstat(1, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
      [pid  440] openat(AT_FDCWD, "file_2.txt", O_RDONLY) = 3
      [pid  440] fstat(3, {st_mode=S_IFREG|0777, st_size=15, ...}) = 0
      [pid  440] fadvise64(3, 0, 0, POSIX_FADV_SEQUENTIAL) = 0
= 0x7c6cc258d000 [pid  440] mmap(NULL, 139264, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
      [pid  440] read(3, "tst\nprtng sstm\n", 131072) = 15
      [pid  440] write(1, "tst\nprtng sstm\n", 15tst
      prtng sstm
) = 15
      [pid  440] read(3, "", 131072)      = 0
```

```
[pid  440] munmap(0x7c6cc258d000, 139264) = 0
[pid  440] close(3)                  = 0
[pid  440] close(1)                  = 0
[pid  440] close(2)                  = 0
[pid  440] exit_group(0)             = ?
[pid  440] +++ exited with 0 +++
[pid  439] <... wait4 resumed>[{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 440
[pid  439] --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=440, si_uid=1000,
si_status=0, si_utime=0, si_stime=0} ---
[pid  439] rt_sigreturn({mask=[]})    = 440
[pid  439] wait4(-1, 0x7ffe44538fec, WNOHANG, NULL) = -1 ECHILD (No child processes)
[pid  439] dup2(10, 2)                = 2
[pid  439] close(10)                 = 0
[pid  439] exit_group(0)              = ?
[pid  439] +++ exited with 0 +++
<... wait4 resumed>[{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 439
[pid  439] rt_sigaction(SIGINT, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, NULL, 8) = 0
[pid  439] rt_sigaction(SIGQUIT, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER,
sa_restorer=0x747269445330}, NULL, 8) = 0
[pid  439] rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
[pid  439] --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=439, si_uid=1000,
si_status=0, si_utime=0, si_stime=0} ---
\320\276\320\261\321\202\320\260\320\260\320\260\320\273\320\276
\320\276\320\261\321\200\320\260\320\261\320\276\321\202..., 914
==== Начало обработки строк ====
Вводите строки (Ctrl+D для завершения ввода):
-----
```

```
[child1] Стока 1: hello world
[child2] Стока 2: test
[child1] Стока 3: string
[child2] Стока 4: operating system
```

```
[INFO] Конец ввода (EOF)
```

```
-----  
Ожидание завершения дочерних процессов...
```

```
==== РЕЗУЛЬТАТЫ РАБОТЫ ====
child1 завершился с кодом: 0
child2 завершился с кодом: 0
```

Результаты записаны в файлы:

- a file_1.txt (child1, нечетные строки)
- file_2.txt (child2, четные строки)

```
--- Содержимое a file_1.txt ---
```

```
--- Содержимое file_2.txt ---
```

Родительский процесс завершен.

) = 914

```
exit_group(0) = ?  
+++ exited with 0 +++
```

Вывод

Лабораторная работа продемонстрировала использование системных вызовов для создания процессов и обмена данными через каналы. Родительский процесс создает двух дочерних, распределяет строки по четности, а дочерние процессы удаляют гласные буквы и записывают результаты в файлы. Программа демонстрирует корректное межпроцессное взаимодействие и обработку системных ошибок.