МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ
(НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ)

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Кафедра 806 «Вычислительная математика и программирование»

**Лабораторная работа №6
по курсу «Операционные системы»**

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Лабораторная работа №1

Условие

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.

Цель работы

Изучение механизмов создания процессов, организации межпроцессного взаимодействия через pipes и обработки данных в многопроцессной архитектуре.

Задание

Правило фильтрации: строки длины больше 10 отправляются в pipe2, четные в pipe1. Дочерние процессы удаляют все гласные из строк.

Вариант

17

Метод решения

Данная программа реализует многопроцессную обработку текстовых данных с использованием каналов (pipes) для межпроцессного взаимодействия. Основной алгоритм: родительский процесс читает строки из стандартного ввода и направляет строки длиной больше 10 второму дочернему процессу, меньше 10 - первому. Каждый дочерний процесс получает строки из своего канала, удаляет все гласныеиз строк их и записывает в указанный файл.

Ключевые компоненты:
ParentProcess - управляет каналами и дочерними процессами
Pipe - реализация каналов
ChildProcess - запускает дочерние процессы
ChildProcessor - обрабатывает данные в дочерних процессах

Системные вызовы:
Linux: pipe, fork, execl, read, write

Программа использует объектно-ориентированный подход с инкапсуляцией.

Описание программы

Программа реализует многопроцессную обработку текстовых данных через каналы (pipes). Родительский процесс читает строки из стандартного ввода и распределяет их между двумя дочерними процессами

Каждый дочерний процесс удаляет все гласные буквы и записывает результат в указанный файл.

Программа состоит из двух исполняемых файлов: `parent` и `child`.

`parent` (`src/parent.cpp`) — родительский процесс:

создаёт каналы (`Pipe`), порождает дочерние процессы (`fork/execl`),

считывает строки до `END` и распределяет их по длине.

`child` (`src/child.cpp`) — дочерний процесс:

через `ChildProcess` читает данные из канала,

удаляет гласные с помощью `ChildProcessor`

и записывает результат в файл и на экран.

Системные вызовы

```
55532 execve("./parent",["./parent"],0x7ffd7d0a0d38 /* 42 vars */) = 0
55532 brk(NULL)                             = 0x5bdb92fb9000
55532 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7c7bc6641000
55532 access("/etc/ld.so.preload",R_OK) = -1 ENOENT (No such file or directory)
55532 openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC) = 3
55532 fstat(3,{st_mode=S_IFREG|0644,st_size=30415,...}) = 0
55532 mmap(NULL,30415,PROT_READ,MAP_PRIVATE,3,0) = 0x7c7bc6639000
55532 close(3)                              = 0
55532 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLOEXEC)
= 3
55532 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
55532 fstat(3,{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0
55532 mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7c7bc6200000
55532 mmap(0x7c7bc629d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7c7bc629d000
55532 mmap(0x7c7bc63e5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1e
= 0x7c7bc63e5000
55532 mmap(0x7c7bc646c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7c7bc646c000
55532 mmap(0x7c7bc647a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
= 0x7c7bc647a000
55532 close(3)                              = 0
55532 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOEXEC)
= 3
55532 read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
55532 fstat(3,{st_mode=S_IFREG|0644,st_size=183024,...}) = 0
55532 mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7c7bc660b000
```

```
55532 mmap(0x7c7bc660f000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7c7bc660f000
55532 mmap(0x7c7bc6633000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x280
= 0x7c7bc6633000
55532 mmap(0x7c7bc6637000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRIT
= 0x7c7bc6637000
55532 close(3)                          = 0
55532 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC)
= 3
55532 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
55532 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"...,78
= 784
55532 fstat(3,{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0
55532 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"...,78
= 784
55532 mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7c7bc5e00000
55532 mmap(0x7c7bc5e28000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYW
= 0x7c7bc5e28000
55532 mmap(0x7c7bc5fb0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1b
= 0x7c7bc5fb0000
55532 mmap(0x7c7bc5fff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7c7bc5fff000
55532 mmap(0x7c7bc6005000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
= 0x7c7bc6005000
55532 close(3)                          = 0
55532 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC)
= 3
55532 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
55532 fstat(3,{st_mode=S_IFREG|0644,st_size=952616,...}) = 0
55532 mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7c7bc6522000
55532 mmap(0x7c7bc6532000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7c7bc6532000
55532 mmap(0x7c7bc65b1000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x8f
= 0x7c7bc65b1000
55532 mmap(0x7c7bc6609000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRIT
= 0x7c7bc6609000
55532 close(3)                          = 0
55532 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7c7bc6520000
55532 mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x7c7bc651d000
55532 arch_prctl(ARCH_SET_FS,0x7c7bc651d740) = 0
55532 set_tid_address(0x7c7bc651da10)   = 55532
55532 set_robust_list(0x7c7bc651da20,24) = 0
55532 rseq(0x7c7bc651e060,0x20,0,0x53053053) = 0
55532 mprotect(0x7c7bc5fff000,16384,PROT_READ) = 0
```

```
55532 mprotect(0x7c7bc6609000,4096,PROT_READ) = 0
55532 mprotect(0x7c7bc6637000,4096,PROT_READ) = 0
55532 mprotect(0x7c7bc646c000,45056,PROT_READ) = 0
55532 mprotect(0x5bdb5cddb000,4096,PROT_READ) = 0
55532 mprotect(0x7c7bc6679000,8192,PROT_READ) = 0
55532 prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY})
= 0
55532 munmap(0x7c7bc6639000,30415)      = 0
55532 futex(0x7c7bc647a7bc,FUTEX_WAKE_PRIVATE,2147483647) = 0
55532 getrandom("\x34\x6e\x52\x38\xe7\x7f\xd6\xdd",8,GRND_NONBLOCK) = 8
55532 brk(NULL)                         = 0x5bdb92fb9000
55532 brk(0x5bdb92fda000)               = 0x5bdb92fda000
55532 fstat(0,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...}) = 0
55532 read(0,"",1024)                   = 0
55532 pipe2([3,4],0)                     = 0
55532 pipe2([5,6],0)                     = 0
55532 clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,ch
= 55679
55532 clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD
<unfinished ...>
55679 set_robust_list(0x7c7bc651da20,24) = 0
55679 close(4 <unfinished ...>
55532 <... clone resumed>,child_tidptr=0x7c7bc651da10) = 55680
55680 set_robust_list(0x7c7bc651da20,24 <unfinished ...>
55532 close(3 <unfinished ...>
55679 <... close resumed>)              = 0
55680 <... set_robust_list resumed>)    = 0
55532 <... close resumed>)              = 0
55679 close(5 <unfinished ...>
55680 close(6 <unfinished ...>
55532 close(5 <unfinished ...>
55679 <... close resumed>)              = 0
55532 <... close resumed>)              = 0
55680 <... close resumed>)              = 0
55532 close(4 <unfinished ...>
55679 close(6 <unfinished ...>
55680 close(3 <unfinished ...>
55532 <... close resumed>)              = 0
55680 <... close resumed>)              = 0
55679 <... close resumed>)              = 0
55532 close(6)                          = 0
55680 close(4 <unfinished ...>
55679 execve("./child",["./child","3",""],0x7ffd87d47708 /* 42 vars */ <unfinished
...>
55532 wait4(55679, <unfinished ...>
55680 <... close resumed>)              = 0
55680 execve("./child",["./child","5",""],0x7ffd87d47708 /* 42 vars */) = 0
55679 <... execve resumed>)             = 0
```

```
55680 brk(NULL <unfinished ...>
55679 brk(NULL <unfinished ...>
55680 <... brk resumed>)                = 0x5929f5b5e000
55679 <... brk resumed>)                = 0x6290049ce000
55680 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0 <unfinished
...>
55679 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0 <unfinished
...>
55680 <... mmap resumed>)               = 0x731db2bb4000
55679 <... mmap resumed>)               = 0x74a03c052000
55680 access("/etc/ld.so.preload",R_OK <unfinished ...>
55679 access("/etc/ld.so.preload",R_OK <unfinished ...>
55680 <... access resumed>)             = -1 ENOENT (No such file or directory)
55679 <... access resumed>)             = -1 ENOENT (No such file or directory)
55680 openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC <unfinished ...>
55679 openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC <unfinished ...>
55680 <... openat resumed>)             = 3
55679 <... openat resumed>)             = 4
55680 fstat(3, <unfinished ...>
55679 fstat(4, <unfinished ...>
55680 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=30415,...}) = 0
55679 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=30415,...}) = 0
55680 mmap(NULL,30415,PROT_READ,MAP_PRIVATE,3,0 <unfinished ...>
55679 mmap(NULL,30415,PROT_READ,MAP_PRIVATE,4,0 <unfinished ...>
55680 <... mmap resumed>)               = 0x731db2bac000
55679 <... mmap resumed>)               = 0x74a03c04a000
55680 close(3 <unfinished ...>
55679 close(4 <unfinished ...>
55680 <... close resumed>)          = 0
55679 <... close resumed>)          = 0
55680 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
55679 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
55680 <... openat resumed>)             = 3
55679 <... openat resumed>)             = 4
55680 read(3, <unfinished ...>
55679 read(4, <unfinished ...>
55680 <... read resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0
= 832
55679 <... read resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0
= 832
55680 fstat(3, <unfinished ...>
55679 fstat(4, <unfinished ...>
55680 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0
55679 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0
55680 mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0 <unfinished
...>
```

```
55679 mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,4,0 <unfinished
...>
55680 <... mmap resumed>)                = 0x731db2800000
55679 <... mmap resumed>)                = 0x74a03bc00000
55680 mmap(0x731db289d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYW
<unfinished ...>
55679 mmap(0x74a03bc9d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYW
<unfinished ...>
55680 <... mmap resumed>)                = 0x731db289d000
55679 <... mmap resumed>)                = 0x74a03bc9d000
55680 mmap(0x731db29e5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1e8
<unfinished ...>
55679 mmap(0x74a03bde5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,4,0x1e8
<unfinished ...>
55680 <... mmap resumed>)                = 0x731db29e5000
55680 mmap(0x731db2a6c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55679 <... mmap resumed>)                = 0x74a03bde5000
55680 <... mmap resumed>)                = 0x731db2a6c000
55679 mmap(0x74a03be6c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55680 mmap(0x731db2a7a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
<unfinished ...>
55679 <... mmap resumed>)                = 0x74a03be6c000
55680 <... mmap resumed>)                = 0x731db2a7a000
55679 mmap(0x74a03be7a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
<unfinished ...>
55680 close(3 <unfinished ...>
55679 <... mmap resumed>)                = 0x74a03be7a000
55680 <... close resumed>)               = 0
55680 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOEXEC
<unfinished ...>
55679 close(4 <unfinished ...>
55680 <... openat resumed>)              = 3
55679 <... close resumed>)               = 0
55680 read(3, <unfinished ...>
55679 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOEXEC
<unfinished ...>
55680 <... read resumed>"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0\0\0
= 832
55680 fstat(3, <unfinished ...>
55679 <... openat resumed>)              = 4
55680 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=183024,...}) = 0
55679 read(4, <unfinished ...>
55680 mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0 <unfinished
...>
55679 <... read resumed>"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0\0\0
= 832
```

```
55680 <... mmap resumed>)               = 0x731db2b7e000
55680 mmap(0x731db2b82000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55679 fstat(4, <unfinished ...>
55680 <... mmap resumed>)               = 0x731db2b82000
55679 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=183024,...}) = 0
55680 mmap(0x731db2ba6000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x280
<unfinished ...>
55679 mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,4,0 <unfinished
...>
55680 <... mmap resumed>)               = 0x731db2ba6000
55680 mmap(0x731db2baa000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRIT
<unfinished ...>
55679 <... mmap resumed>)               = 0x74a03c01c000
55680 <... mmap resumed>)               = 0x731db2baa000
55679 mmap(0x74a03c020000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55680 close(3 <unfinished ...>
55679 <... mmap resumed>)               = 0x74a03c020000
55680 <... close resumed>)              = 0
55679 mmap(0x74a03c044000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,4,0x280
<unfinished ...>
55680 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
55679 <... mmap resumed>)               = 0x74a03c044000
55680 <... openat resumed>)             = 3
55679 mmap(0x74a03c048000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRIT
<unfinished ...>
55680 read(3, <unfinished ...>
55679 <... mmap resumed>)               = 0x74a03c048000
55680 <... 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
= 832
55679 close(4 <unfinished ...>
55680 pread64(3, <unfinished ...>
55679 <... close resumed>)              = 0
55680 <... 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
= 784
55680 fstat(3, <unfinished ...>
55679 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
55680 <... fstat resumed>{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0
55679 <... openat resumed>)             = 4
55680 pread64(3, <unfinished ...>
55679 read(4, <unfinished ...>
55680 <... 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
= 784
55679 <... 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
= 832
```

```
55680 mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0 <unfinished
...>
55679 pread64(4, <unfinished ...>
55680 <... mmap resumed>)                = 0x731db2400000
55679 <... 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
= 784
55680 mmap(0x731db2428000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYW
<unfinished ...>
55679 fstat(4,{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0
55680 <... mmap resumed>)                = 0x731db2428000
55679 pread64(4, <unfinished ...>
55680 mmap(0x731db25b0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1b
<unfinished ...>
55679 <... 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
= 784
55680 <... mmap resumed>)                = 0x731db25b0000
55679 mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,4,0 <unfinished
...>
55680 mmap(0x731db25ff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55679 <... mmap resumed>)                = 0x74a03b800000
55680 <... mmap resumed>)                = 0x731db25ff000
55679 mmap(0x74a03b828000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYW
<unfinished ...>
55680 mmap(0x731db2605000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
<unfinished ...>
55679 <... mmap resumed>)                = 0x74a03b828000
55680 <... mmap resumed>)                = 0x731db2605000
55679 mmap(0x74a03b9b0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,4,0x1b
<unfinished ...>
55680 close(3 <unfinished ...>
55679 <... mmap resumed>)                = 0x74a03b9b0000
55680 <... close resumed>)               = 0
55679 mmap(0x74a03b9ff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55680 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
55679 <... mmap resumed>)                = 0x74a03b9ff000
55680 <... openat resumed>)              = 3
55679 mmap(0x74a03ba05000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
<unfinished ...>
55680 read(3, <unfinished ...>
55679 <... mmap resumed>)                = 0x74a03ba05000
55680 <... read resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0
= 832
55679 close(4 <unfinished ...>
55680 fstat(3, <unfinished ...>
55679 <... close resumed>)               = 0
```

```
55680 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=952616,...}) = 0
55679 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC
<unfinished ...>
55680 mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x731db2a95000
55679 <... openat resumed>)              = 4
55680 mmap(0x731db2aa5000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55679 read(4, <unfinished ...>
55680 <... mmap resumed>)                = 0x731db2aa5000
55679 <... read resumed>"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\07
= 832
55680 mmap(0x731db2b24000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x8f(
<unfinished ...>
55679 fstat(4, <unfinished ...>
55680 <... mmap resumed>)                = 0x731db2b24000
55679 <... fstat resumed>{st_mode=S_IFREG|0644,st_size=952616,...}) = 0
55680 mmap(0x731db2b7c000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRIT
<unfinished ...>
55679 mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,4,0 <unfinished
...>
55680 <... mmap resumed>)                = 0x731db2b7c000
55679 <... mmap resumed>)                = 0x74a03bf33000
55680 close(3 <unfinished ...>
55679 mmap(0x74a03bf43000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
<unfinished ...>
55680 <... close resumed>)               = 0
55679 <... mmap resumed>)                = 0x74a03bf43000
55680 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0 <unfinished
...>
55679 mmap(0x74a03bfc2000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,4,0x8f(
<unfinished ...>
55680 <... mmap resumed>)                = 0x731db2a93000
55679 <... mmap resumed>)                = 0x74a03bfc2000
55680 mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0 <unfinished
...>
55679 mmap(0x74a03c01a000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRIT
<unfinished ...>
55680 <... mmap resumed>)                = 0x731db2a90000
55679 <... mmap resumed>)                = 0x74a03c01a000
55680 arch_prctl(ARCH_SET_FS,0x731db2a90740 <unfinished ...>
55679 close(4 <unfinished ...>
55680 <... arch_prctl resumed>)          = 0
55680 set_tid_address(0x731db2a90a10 <unfinished ...>
55679 <... close resumed>)               = 0
55680 <... set_tid_address resumed>)     = 55680
55679 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0 <unfinished
...>
55680 set_robust_list(0x731db2a90a20,24) = 0
```

```
55679 <... mmap resumed>)                      = 0x74a03bf31000
55680 rseq(0x731db2a91060,0x20,0,0x53053053) = 0
55679 mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0 <unfinished
...>
55680 mprotect(0x731db25ff000,16384,PROT_READ <unfinished ...>
55679 <... mmap resumed>)                      = 0x74a03bf2e000
55680 <... mprotect resumed>)          = 0
55679 arch_prctl(ARCH_SET_FS,0x74a03bf2e740 <unfinished ...>
55680 mprotect(0x731db2b7c000,4096,PROT_READ <unfinished ...>
55679 <... arch_prctl resumed>)        = 0
55680 <... mprotect resumed>)          = 0
55679 set_tid_address(0x74a03bf2ea10 <unfinished ...>
55680 mprotect(0x731db2baa000,4096,PROT_READ <unfinished ...>
55679 <... set_tid_address resumed>)     = 55679
55680 <... mprotect resumed>)          = 0
55679 set_robust_list(0x74a03bf2ea20,24) = 0
55679 rseq(0x74a03bf2f060,0x20,0,0x53053053) = 0
55680 mprotect(0x731db2a6c000,45056,PROT_READ <unfinished ...>
55679 mprotect(0x74a03b9ff000,16384,PROT_READ <unfinished ...>
55680 <... mprotect resumed>)          = 0
55679 <... mprotect resumed>)          = 0
55680 mprotect(0x5929ea6b2000,4096,PROT_READ <unfinished ...>
55679 mprotect(0x74a03c01a000,4096,PROT_READ <unfinished ...>
55680 <... mprotect resumed>)          = 0
55679 <... mprotect resumed>)          = 0
55680 mprotect(0x731db2bec000,8192,PROT_READ <unfinished ...>
55679 mprotect(0x74a03c048000,4096,PROT_READ <unfinished ...>
55680 <... mprotect resumed>)          = 0
55679 <... mprotect resumed>)          = 0
55680 prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY})
= 0
55680 munmap(0x731db2bac000,30415)      = 0
55679 mprotect(0x74a03be6c000,45056,PROT_READ <unfinished ...>
55680 futex(0x731db2a7a7bc,FUTEX_WAKE_PRIVATE,2147483647 <unfinished ...>
55679 <... mprotect resumed>)          = 0
55680 <... futex resumed>)             = 0
55679 mprotect(0x628ff30e8000,4096,PROT_READ <unfinished ...>
55680 getrandom( <unfinished ...>
55679 <... mprotect resumed>)          = 0
55680 <... getrandom resumed>"\x26\x4a\x75\x16\x43\xa6\xb6\xdb",8,GRND_NONBLOCK)
= 8
55679 mprotect(0x74a03c08a000,8192,PROT_READ <unfinished ...>
55680 brk(NULL)                        = 0x5929f5b5e000
55679 <... mprotect resumed>)          = 0
55680 brk(0x5929f5b7f000 <unfinished ...>
55679 prlimit64(0,RLIMIT_STACK,NULL, <unfinished ...>
55680 <... brk resumed>)               = 0x5929f5b7f000
55679 <... prlimit64 resumed>{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY})
```

```
= 0
55680 openat(AT_FDCWD,"",O_WRONLY|O_CREAT|O_TRUNC,0666 <unfinished ...>
55679 munmap(0x74a03c04a000,30415 <unfinished ...>
55680 <... openat resumed>)                = -1 ENOENT (No such file or directory)
55679 <... munmap resumed>)                = 0
55680 write(2,"Failed to open file: ",21) = 21
55679 futex(0x74a03be7a7bc,FUTEX_WAKE_PRIVATE,2147483647 <unfinished ...>
55680 write(2,"\n",1 <unfinished ...>
55679 <... futex resumed>)                 = 0
55680 <... write resumed>)                 = 1
55679 getrandom( <unfinished ...>
55680 close(5 <unfinished ...>
55679 <... getrandom resumed>"\x59\xeb\x70\x5f\x8b\x9e\xc0\x6e",8,GRND_NONBLOCK)
= 8
55680 <... close resumed>)                 = 0
55679 brk(NULL)                            = 0x6290049ce000
55679 brk(0x6290049ef000 <unfinished ...>
55680 exit_group(0 <unfinished ...>
55679 <... brk resumed>)                   = 0x6290049ef000
55680 <... exit_group resumed>)            = ?
55679 openat(AT_FDCWD,"",O_WRONLY|O_CREAT|O_TRUNC,0666 <unfinished ...>
55680 +++ exited with 0 +++
55532 <... wait4 resumed>NULL,0,NULL) = ? ERESTARTSYS (To be restarted if SA_RESTART
is set)
55679 <... openat resumed>)                = -1 ENOENT (No such file or directory)
55532 ---SIGCHLD {si_signo=SIGCHLD,si_code=CLD_EXITED,si_pid=55680,si_uid=1000,si_sta
---
55532 wait4(55679, <unfinished ...>
55679 write(2,"Failed to open file: ",21) = 21
55679 write(2,"\n",1)                      = 1
55679 close(3)                             = 0
55679 exit_group(0)                        = ?
55679 +++ exited with 0 +++
55532 <... wait4 resumed>NULL,0,NULL) = 55679
55532 ---SIGCHLD {si_signo=SIGCHLD,si_code=CLD_EXITED,si_pid=55679,si_uid=1000,si_sta
---
55532 wait4(55680,NULL,0,NULL)        = 55680
55532 exit_group(0)                        = ?
55532 +++ exited with 0 +++
```

Выводы

В ходе лабораторной работы успешно разработана многопроцессная система обработки текстовых данных с использованием межпроцессного взаимодействия через каналы. Программа демонстрирует корректную работу на Unix системах.

Лабораторная работа №2

Условие

Составить программу на языке Си, обрабатывающую данные в многопоточном режиме. При обработки использовать стандартные средства создания потоков операционной системы (Windows/Unix). Ограничение максимального количества потоков, работающих в один момент времени, должно быть задано ключом запуска вашей программы. Так же необходимо уметь продемонстрировать количество потоков, используемое вашей программой с помощью стандартных средств операционной системы.

Цель работы

Изучение механизмов управления потоками и обеспечение их сихронизации.

Задание

Есть K массивов одинаковой длины. Необходимо сложить эти массивы. Необходимо предусмотреть стратегию, адаптирующуюся под количество массивов и их длину.

Вариант

8

Метод решения

Данная программа реализует многопоточное поэлементное сложение K вещественных массивов одинаковой длины L с использованием библиотеки POSIX Threads (pthreads) и адаптивной стратегией распределения нагрузки.

Основной алгоритм:

- Генерируются K массивов длиной L с случайными значениями.

- Задача разбивается на блоки индексов, каждый поток суммирует элементы в своём диапазоне по всем K массивам.

- Число одновременно активных потоков ограничено параметром `max_threads`, заданным через аргумент командной строки.

- Каждый поток использует локальный буфер для промежуточных сумм, исключая гонки на этапе вычислений.

- Слияние результатов в общий вектор защищено мьютексом.

- Семафор ограничивает количество одновременно выполняющихся потоков.

Ключевые компоненты:

- `ArrayManager` — хранение и генерация массивов

- `ParallelSummer` — ядро параллельного суммирования (разбиение, потоки, синхронизация)

Системные вызовы (POSIX):

```
pthread_create,pthread_join,
pthread_mutex_init/lock/unlock/destroy,
sem_init,sem_wait,sem_post,sem_destroy,
getpid()
```

Программа использует объектно-ориентированный подход с инкапсуляцией и RAII-подобным управлением ресурсами (мьютексы и семафоры уничтожаются в деструкторе).

Описание программы

Программа реализует эффективное многопоточное сложение K массивов длины L с динамической адаптацией числа потоков и строгим контролем над их количеством.

`main.cpp` — точка входа:

- парсит аргумент `max_threads`,

- создаёт объект `ArrayManager`, заполняет массивы случайными числами,

- выводит PID процесса для мониторинга потоков (`ps -T -p <pid>`),

- запускает `ParallelSummer`,

- выводит первые 10 элементов результата.

`ArrayManager` (`ArrayManager.h/.cpp`) —

- инкапсулирует $K \times L$ массивов в `std::vector<std::vector<double»`,

- реализует равномерное заполнение случайными значениями.

`ParallelSummer` (`ParallelSummer.h/.cpp`) —

- хранит ссылку на входные данные и вектор результата,

- содержит `pthread_mutex_t` и `sem_t`,

- динамически вычисляет число потоков и размеры блоков,

- создаёт потоки через `pthread_create`,

- каждый поток выполняет функцию `sumRange` с локальными суммами,

- обеспечивает потокобезопасную агрегацию и освобождение ресурсов.

Сборка осуществляется через `CMakeLists.txt` с обязательной линковкой `-lpthread`.

Системные вызовы

```
futex(0x7cad6087a7bc,FUTEX_WAKE_PRIVATE,2147483647) = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41688]},88) = 41688
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41688,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41689]},88) = 41689
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41689,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41690]},88) = 41690
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41690,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41691]},88) = 41691
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41691,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41692]},88) = 41692
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41692,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41693]},88) = 41693
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41693,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41694]},88) = 41694
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41694,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41695]},88) = 41695
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41695,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41696]},88) = 41696
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41696,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41697]},88) = 41697
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41697,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41698]},88) = 41698
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41699]},88) = 41699
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41698,NULL,FUT
= 0
```

```
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41699,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41700]},88) = 41700
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41701]},88) = 41701
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41700,NULL,FUT
<unfinished ...>
[pid 41701] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41700] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 1
[pid 41701] <... futex resumed>)        = 0
[pid 41701] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41701,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41702]},88) = 41702
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41703]},88) = 41703
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41702,NULL,FUT
<unfinished ...>
[pid 41703] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41702] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41703] <... futex resumed>)        = 0
[pid 41702] <... futex resumed>)        = 1
[pid 41687] <... futex resumed>)        = 0
[pid 41703] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41703,NULL,FUT
<unfinished ...>
[pid 41703] <... futex resumed>)        = 0
[pid 41687] <... futex resumed>)        = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41704]},88) = 41704
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41705]},88) = 41705
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41704,NULL,FUT
<unfinished ...>
[pid 41704] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41705] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 1
[pid 41704] <... futex resumed>)        = 0
[pid 41704] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41706]},88) = 41706
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41707]},88) = 41707
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41706,NULL,FUT
= 0
```

```
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41707,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41708]},88) = 41708
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41709]},88) = 41709
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41708,NULL,FUT
<unfinished ...>
[pid 41708] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41709] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41708] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41708] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41710]},88) = 41710
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41711]},88) = 41711
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41710,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41711,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41712]},88) = 41712
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41713]},88) = 41713
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41712,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41713,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41714]},88) = 41714
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41715]},88) = 41715
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41714,NULL,FUT
<unfinished ...>
[pid 41715] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41714] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41715] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41714] <... futex resumed>)        = 0
[pid 41715] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
<... futex resumed>)                    = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41716]},88) = 41716
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41717]},88) = 41717
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41716,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41717,NULL,FUT
```

```
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41718]},88) = 41718
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41719]},88) = 41719
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41720]},88) = 41720
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41718,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41719,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41720,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41721]},88) = 41721
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41722]},88) = 41722
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41723]},88) = 41723
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41721,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41722,NULL,FUT
<unfinished ...>
[pid 41723] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41722] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41723] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41723] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41687] <... futex resumed>)        = 0
[pid 41723] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41723,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41724]},88) = 41724
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41725]},88) = 41725
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41726]},88) = 41726
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41724,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41725,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41726,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41727]},88) = 41727
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41728]},88) = 41728
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
```

```
=>{parent_tid=[41729]},88) = 41729
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41727,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41728,NULL,FUT
<unfinished ...>
[pid 41729] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41728] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41729] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41729,NULL,FUT
<unfinished ...>
[pid 41729] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41730]},88) = 41730
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41731]},88) = 41731
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41732]},88) = 41732
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41730,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41731,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41732,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41733]},88) = 41733
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41734]},88) = 41734
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41735]},88) = 41735
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41733,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41734,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41735,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41736]},88) = 41736
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41737]},88) = 41737
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41738]},88) = 41738
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41736,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41737,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41738,NULL,FUT
```

```
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|(
=>{parent_tid=[41739]},88) = 41739
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL(
=>{parent_tid=[41740]},88) = 41740
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL(
=>{parent_tid=[41741]},88) = 41741
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41739,NULL,FU]
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41740,NULL,FU]
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41741,NULL,FU]
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|(
=>{parent_tid=[41742]},88) = 41742
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL(
=>{parent_tid=[41743]},88) = 41743
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL(
=>{parent_tid=[41744]},88) = 41744
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41742,NULL,FU]
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41743,NULL,FU]
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41744,NULL,FU]
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|(
=>{parent_tid=[41745]},88) = 41745
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL(
=>{parent_tid=[41746]},88) = 41746
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL(
=>{parent_tid=[41747]},88) = 41747
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41745,NULL,FU]
<unfinished ...>
[pid 41746] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41745] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 1
[pid 41746] <... futex resumed>)        = 0
[pid 41746] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41747] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41687] <... futex resumed>)        = 0
[pid 41747] <... futex resumed>)        = 1
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41746,NULL,FU]
<unfinished ...>
[pid 41746] <... futex resumed>)        = 0
[pid 41746] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|(
=>{parent_tid=[41748]},88) = 41748
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL(
```

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=>{parent_tid=[41749]},88) = 41749
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41750]},88) = 41750
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41751]},88) = 41751
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41748,NULL,FU
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41749,NULL,FU
<unfinished ...>
[pid 41750] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41749] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41750] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41749] <... futex resumed>)        = 0
[pid 41750] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41751,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41752]},88) = 41752
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41753]},88) = 41753
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41754]},88) = 41754
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41755]},88) = 41755
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41752,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41753,NULL,FUT
<unfinished ...>
[pid 41754] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41753] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 1
[pid 41754] <... futex resumed>)        = 0
[pid 41755] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41754] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41755] <... futex resumed>)        = 0
[pid 41754] <... futex resumed>)        = 1
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41754,NULL,FUT
<unfinished ...>
[pid 41755] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41755,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41756]},88) = 41756
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41757]},88) = 41757
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
```

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=>{parent_tid=[41758]},88) = 41758
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41759]},88) = 41759
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41756,NULL,FU
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41757,NULL,FU
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41758,NULL,FU
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41759,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41760]},88) = 41760
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41761]},88) = 41761
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41762]},88) = 41762
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41763]},88) = 41763
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41760,NULL,FU
<unfinished ...>
[pid 41761] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41760] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41761] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41760] <... futex resumed>)        = 0
[pid 41761] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41762] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 1
[pid 41761] <... futex resumed>)        = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41761,NULL,FU
<unfinished ...>
[pid 41763] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41761] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41763] <... futex resumed>)        = 0
[pid 41761] <... futex resumed>)        = 1
[pid 41763] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41763,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41764]},88) = 41764
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41765]},88) = 41765
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41766]},88) = 41766
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41767]},88) = 41767
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41764,NULL,FU
```

```
                                                                = 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41765,NULL,FUT
<unfinished ...>
[pid 41766] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41765] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41766] <... futex resumed>)          = -1 EAGAIN (Resource temporarily unavailable
[pid 41765] <... futex resumed>)          = 0
[pid 41767] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41766] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41767] <... futex resumed>)          = -1 EAGAIN (Resource temporarily unavailable
[pid 41766] <... futex resumed>)          = 0
[pid 41687] <... futex resumed>)          = 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41766,NULL,FUT
<unfinished ...>
[pid 41767] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)          = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41768]},88) = 41768
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41769]},88) = 41769
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41770]},88) = 41770
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41771]},88) = 41771
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41768,NULL,FUT
<unfinished ...>
[pid 41769] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41768] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41769] <... futex resumed>)          = -1 EAGAIN (Resource temporarily unavailable
[pid 41768] <... futex resumed>)          = 0
[pid 41769] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)          = 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41769,NULL,FUT
<unfinished ...>
[pid 41771] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41770] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 1
[pid 41771] <... futex resumed>)          = 0
[pid 41687] <... futex resumed>)          = 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41770,NULL,FUT
<unfinished ...>
[pid 41771] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)          = 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41771,NULL,FUT
                                                                = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41772]},88) = 41772
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41773]},88) = 41773
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41774]},88) = 41774
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41775]},88) = 41775
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41772,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41773,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41774,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41775,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41776]},88) = 41776
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41777]},88) = 41777
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41778]},88) = 41778
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41779]},88) = 41779
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41776,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41777,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41778,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41779,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41780]},88) = 41780
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41781]},88) = 41781
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41782]},88) = 41782
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41783]},88) = 41783
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41780,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41781,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41782,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41783,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41784]},88) = 41784
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41785]},88) = 41785
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41786]},88) = 41786
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41787]},88) = 41787
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41784,NULL,FU
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41785,NULL,FU
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41786,NULL,FU
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41787,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41788]},88) = 41788
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41789]},88) = 41789
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41790]},88) = 41790
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41791]},88) = 41791
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41792]},88) = 41792
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41789,NULL,FU
= -1 EAGAIN (Resource temporarily unavailable)
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41790,NULL,FU
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41791,NULL,FU
= 0
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41792,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41793]},88) = 41793
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41794]},88) = 41794
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41795]},88) = 41795
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41796]},88) = 41796
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41797]},88) = 41797
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41794,NULL,FU
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41795,NULL,FU
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41796,NULL,FU
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41797,NULL,FU
= 0
```

```
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41798]},88) = 41798
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41799]},88) = 41799
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41800]},88) = 41800
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41801]},88) = 41801
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41802]},88) = 41802
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41799,NULL,FU
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41800,NULL,FU
<unfinished ...>
[pid 41800] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41801] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41800] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41801] <... futex resumed>)        = 0
[pid 41800] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41803]},88) = 41803
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41804]},88) = 41804
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41805]},88) = 41805
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41806]},88) = 41806
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41807]},88) = 41807
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41804,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41805,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41806,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41807,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41808]},88) = 41808
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41809]},88) = 41809
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41810]},88) = 41810
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41811]},88) = 41811
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41812]},88) = 41812
```

```
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41809,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41810,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41811,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41813]},88) = 41813
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41814]},88) = 41814
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41815]},88) = 41815
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41816]},88) = 41816
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41817]},88) = 41817
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41813,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41814,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41815,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41816,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41817,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41818]},88) = 41818
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41819]},88) = 41819
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41820]},88) = 41820
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41821]},88) = 41821
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41822]},88) = 41822
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41819,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41820,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41821,NULL,FUT
= 0
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41822,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41823]},88) = 41823
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41824]},88) = 41824
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41825]},88) = 41825
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41826]},88) = 41826
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41827]},88) = 41827
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41824,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41825,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41826,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41827,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41828]},88) = 41828
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41829]},88) = 41829
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41830]},88) = 41830
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41831]},88) = 41831
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41832]},88) = 41832
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41828,NULL,FUT
<unfinished ...>
[pid 41829] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41830] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41687] <... futex resumed>)        = 0
[pid 41830] <... futex resumed>)        = 1
[pid 41829] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41829,NULL,FUT
<unfinished ...>
[pid 41829] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41831,NULL,FUT
= 0
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41832,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41833]},88) = 41833
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41834]},88) = 41834
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41835]},88) = 41835
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41836]},88) = 41836
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
```

```
=>{parent_tid=[41837]},88) = 41837
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41834,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41835,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41836,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41837,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41838]},88) = 41838
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41839]},88) = 41839
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41840]},88) = 41840
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41841]},88) = 41841
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41842]},88) = 41842
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41843]},88) = 41843
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41838,NULL,FUT
<unfinished ...>
[pid 41840] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41838] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41840] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41838] <... futex resumed>)        = 0
[pid 41842] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41840] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41839] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41842] <... futex resumed>)        = 0
[pid 41841] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41839] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41841] <... futex resumed>)        = 1
[pid 41840] <... futex resumed>)        = 0
[pid 41840] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41839] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41687] <... futex resumed>)        = 0
[pid 41840] <... futex resumed>)        = 0
[pid 41839] <... futex resumed>)        = 1
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41839,NULL,FUT
<unfinished ...>
[pid 41840] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41840,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41844]},88) = 41844
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41845]},88) = 41845
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41846]},88) = 41846
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41847]},88) = 41847
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41848]},88) = 41848
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41849]},88) = 41849
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41846,NULL,FUT
= -1 EAGAIN (Resource temporarily unavailable)
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41847,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41848,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41849,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41850]},88) = 41850
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41851]},88) = 41851
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41852]},88) = 41852
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41853]},88) = 41853
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41854]},88) = 41854
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41855]},88) = 41855
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41853,NULL,FUT
= 0
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41854,NULL,FUT
= 0
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41855,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41856]},88) = 41856
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41857]},88) = 41857
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41858]},88) = 41858
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41859]},88) = 41859
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41860]},88) = 41860
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41861]},88) = 41861
```

```
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41859,NULL,FUT
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41860,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41861,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41862]},88) = 41862
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41863]},88) = 41863
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41864]},88) = 41864
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41865]},88) = 41865
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41866]},88) = 41866
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41867]},88) = 41867
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41864,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41865,NULL,FUT
= 0
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41866,NULL,FUT
= 0
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41867,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41868]},88) = 41868
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41869]},88) = 41869
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41870]},88) = 41870
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41871]},88) = 41871
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41872]},88) = 41872
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41873]},88) = 41873
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41871,NULL,FUT
= -1 EAGAIN (Resource temporarily unavailable)
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41872,NULL,FUT
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41873,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41874]},88) = 41874
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41875]},88) = 41875
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41876]},88) = 41876
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41877]},88) = 41877
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41878]},88) = 41878
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41879]},88) = 41879
[pid 41877] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41876] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41877] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41876] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41876,NULL,FU
<unfinished ...>
[pid 41877] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41877,NULL,FU
= -1 EAGAIN (Resource temporarily unavailable)
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41878,NULL,FU
= 0
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41879,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41880]},88) = 41880
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41881]},88) = 41881
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41882]},88) = 41882
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41883]},88) = 41883
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41884]},88) = 41884
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41885]},88) = 41885
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41883,NULL,FU
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41884,NULL,FU
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41885,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41886]},88) = 41886
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41887]},88) = 41887
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41888]},88) = 41888
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41889]},88) = 41889
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41890]},88) = 41890
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41891]},88) = 41891
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41889,NULL,FU
= 0
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41890,NULL,FU
= 0
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41891,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41892]},88) = 41892
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41893]},88) = 41893
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41894]},88) = 41894
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41895]},88) = 41895
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41896]},88) = 41896
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41897]},88) = 41897
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41894,NULL,FU
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41895,NULL,FU
= 0
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41896,NULL,FU
= 0
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41897,NULL,FU
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41898]},88) = 41898
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41899]},88) = 41899
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41900]},88) = 41900
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41901]},88) = 41901
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41902]},88) = 41902
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41903]},88) = 41903
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41904]},88) = 41904
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41902,NULL,FU
= 0
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41903,NULL,FU
= 0
```

```
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41904,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|(
=>{parent_tid=[41905]},88) = 41905
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41906]},88) = 41906
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41907]},88) = 41907
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41908]},88) = 41908
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41909]},88) = 41909
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41910]},88) = 41910
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41911]},88) = 41911
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41910,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41911,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|(
=>{parent_tid=[41912]},88) = 41912
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41913]},88) = 41913
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41914]},88) = 41914
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41915]},88) = 41915
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41916]},88) = 41916
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41917]},88) = 41917
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41918]},88) = 41918
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41917,NULL,FUT
= 0
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41918,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|(
=>{parent_tid=[41919]},88) = 41919
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41920]},88) = 41920
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41921]},88) = 41921
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41922]},88) = 41922
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLC
=>{parent_tid=[41923]},88) = 41923
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
<unfinished ...>
[pid 41921] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41687] <... clone3 resumed>=>{parent_tid=[41924]},88) = 41924
[pid 41922] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41921] <... futex resumed>)         = -1 EAGAIN (Resource temporarily unavailable
[pid 41922] <... futex resumed>)         = 0
[pid 41921] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41925]},88) = 41925
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41923,NULL,FUT
= -1 EAGAIN (Resource temporarily unavailable)
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41924,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41925,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41926]},88) = 41926
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41927]},88) = 41927
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41928]},88) = 41928
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41929]},88) = 41929
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41930]},88) = 41930
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41931]},88) = 41931
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41932]},88) = 41932
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41930,NULL,FUT
= -1 EAGAIN (Resource temporarily unavailable)
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41931,NULL,FUT
= 0
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41932,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41933]},88) = 41933
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41934]},88) = 41934
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41935]},88) = 41935
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41936]},88) = 41936
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41937]},88) = 41937
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41938]},88) = 41938
```

```
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41939]},88) = 41939
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41938,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41939,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41940]},88) = 41940
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41941]},88) = 41941
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41942]},88) = 41942
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41943]},88) = 41943
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41944]},88) = 41944
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41945]},88) = 41945
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41946]},88) = 41946
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41943,NULL,FUT
<unfinished ...>
[pid 41945] futex(0x7ffd1a80f818,FUTEX_WAIT_PRIVATE,2,NULL <unfinished ...>
[pid 41944] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1 <unfinished ...>
[pid 41945] <... futex resumed>)        = -1 EAGAIN (Resource temporarily unavailable
[pid 41944] <... futex resumed>)        = 0
[pid 41687] <... futex resumed>)        = 0
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41944,NULL,FUT
<unfinished ...>
[pid 41945] futex(0x7ffd1a80f818,FUTEX_WAKE_PRIVATE,1) = 0
[pid 41687] <... futex resumed>)        = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41947]},88) = 41947
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41948]},88) = 41948
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41949]},88) = 41949
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41950]},88) = 41950
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41951]},88) = 41951
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41952]},88) = 41952
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41953]},88) = 41953
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41952,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41953,NULL,FUT
```

```
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41954]},88) = 41954
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41955]},88) = 41955
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41956]},88) = 41956
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41957]},88) = 41957
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41958]},88) = 41958
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41959]},88) = 41959
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41960]},88) = 41960
[pid 41687] futex(0x7cad58e05990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41958,NULL,FUT
= 0
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41959,NULL,FUT
= 0
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41960,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41961]},88) = 41961
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41962]},88) = 41962
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41963]},88) = 41963
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41964]},88) = 41964
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41965]},88) = 41965
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41966]},88) = 41966
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41967]},88) = 41967
[pid 41687] futex(0x7cad5ae09990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41965,NULL,FUT
= -1 EAGAIN (Resource temporarily unavailable)
[pid 41687] futex(0x7cad5a608990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41966,NULL,FUT
= 0
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41967,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41968]},88) = 41968
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41969]},88) = 41969
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41970]},88) = 41970
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
```

```
=>{parent_tid=[41971]},88) = 41971
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41972]},88) = 41972
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41973]},88) = 41973
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41974]},88) = 41974
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41975]},88) = 41975
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41974,NULL,FUT
= 0
[pid 41687] futex(0x7cad42ffd990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41975,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41976]},88) = 41976
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41977]},88) = 41977
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41978]},88) = 41978
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41979]},88) = 41979
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41980]},88) = 41980
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41981]},88) = 41981
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41982]},88) = 41982
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41983]},88) = 41983
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41982,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41983,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[41984]},88) = 41984
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41985]},88) = 41985
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41986]},88) = 41986
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41987]},88) = 41987
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41988]},88) = 41988
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41989]},88) = 41989
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[41990]},88) = 41990
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
```

```
=>{parent_tid=[41991]},88) = 41991
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41990,NULL,FUT
= 0
[pid 41687] futex(0x7cad42ffd990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41991,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[41992]},88) = 41992
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41993]},88) = 41993
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41994]},88) = 41994
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41995]},88) = 41995
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41996]},88) = 41996
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41997]},88) = 41997
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41998]},88) = 41998
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[41999]},88) = 41999
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41998,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,41999,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
=>{parent_tid=[42000]},88) = 42000
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42001]},88) = 42001
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42002]},88) = 42002
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42003]},88) = 42003
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42004]},88) = 42004
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42005]},88) = 42005
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42006]},88) = 42006
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42007]},88) = 42007
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42005,NULL,FUT
= 0
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42006,NULL,FUT
= 0
[pid 41687] futex(0x7cad42ffd990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42007,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|C
```

```
=>{parent_tid=[42008]},88) = 42008
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42009]},88) = 42009
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42010]},88) = 42010
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42011]},88) = 42011
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42012]},88) = 42012
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42013]},88) = 42013
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42014]},88) = 42014
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42015]},88) = 42015
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42014,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42015,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[42016]},88) = 42016
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42017]},88) = 42017
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42018]},88) = 42018
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42019]},88) = 42019
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42020]},88) = 42020
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42021]},88) = 42021
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42022]},88) = 42022
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42023]},88) = 42023
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42021,NULL,FUT
= 0
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42022,NULL,FUT
= 0
[pid 41687] futex(0x7cad42ffd990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42023,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[42024]},88) = 42024
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42025]},88) = 42025
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42026]},88) = 42026
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
```

```
=>{parent_tid=[42027]},88) = 42027
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42028]},88) = 42028
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42029]},88) = 42029
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42030]},88) = 42030
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42031]},88) = 42031
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42030,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42031,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[42032]},88) = 42032
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42033]},88) = 42033
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42034]},88) = 42034
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42035]},88) = 42035
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42036]},88) = 42036
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42037]},88) = 42037
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42038]},88) = 42038
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42039]},88) = 42039
[pid 41687] futex(0x7cad43fff990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42037,NULL,FUT
= 0
[pid 41687] futex(0x7cad437fe990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42038,NULL,FUT
= 0
[pid 41687] futex(0x7cad42ffd990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42039,NULL,FUT
= 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
=>{parent_tid=[42040]},88) = 42040
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42041]},88) = 42041
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42042]},88) = 42042
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42043]},88) = 42043
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42044]},88) = 42044
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
=>{parent_tid=[42045]},88) = 42045
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CL
```

```
=>{parent_tid=[42046]},88) = 42046
[pid 41687] clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLO
=>{parent_tid=[42047]},88) = 42047
[pid 41687] futex(0x7cad59e07990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42046,NULL,FUT
= 0
[pid 41687] futex(0x7cad59606990,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,42047,NULL,FUT
= 0
```

Выводы

В ходе лабораторной работы успешно разработана и реализована эффективная, потоко-безопасная и адаптивная программа параллельного сложения массивов с использованием классических механизмов POSIX.

Лабораторная работа №3

Условие

Родительский процесс создает два дочерних процесса. Первой строкой пользователь в консоль родительского процесса вводит имя файла, которое будет использовано как отображаемый в память файл для взаимодействия с child1. Аналогично для второй строки и процесса child2. Родительский и дочерний процессы представлены разными исполняемыми файлами. Родительский процесс принимает от пользователя строки произвольной длины и записывает их в соответствующую область отображаемой памяти в зависимости от правила фильтрации. Процессы child1 и child2 читают данные из своих отображаемых файлов, обрабатывают строки и записывают результаты в файлы с суффиксом .out.

Цель работы

Изучение механизмов создания процессов, организации межпроцессного взаимодействия через отображаемые в память файлы (memory-mapped files) и обработки данных в многопроцессной архитектуре.

Задание

Правило фильтрации: строки длины больше 10 отправляются в отображаемый файл для child2, длиной 10 и менее — для child1. Дочерние процессы удаляют все гласные из строк.

Вариант

17

Метод решения

Данная программа реализует многопроцессную обработку текстовых данных с использованием отображаемых в память файлов (memory-mapped files) для межпроцессного взаимодействия. Основной алгоритм: родительский процесс читает строки из стандартного ввода и записывает строки длиной больше 10 символов во второй отображаемый файл, длиной 10 и менее — в первый. Каждый дочерний процесс читает данные из своего отображаемого файла, удаляет все гласные из строк и записывает результат в файл с суффиксом .out.

Ключевые компоненты:

MappedFile — обёртка над системными вызовами mmap, munmap, open, ftruncate

ChildProcess — логика работы дочернего процесса

ChildProcessor — удаление гласных букв

Системные вызовы:

Linux: mmap, munmap, open, ftruncate, fork, execl

Программа использует объектно-ориентированный подход с инкапсуляцией.

Описание программы

Программа реализует многопроцессную обработку текстовых данных через отображаемые в память файлы.

Родительский процесс читает строки из стандартного ввода и распределяет их между двумя дочерними процессами по правилу длины.

Каждый дочерний процесс удаляет все гласные буквы и записывает результат в файл с суффиксом .out и в стандартный вывод.

Программа состоит из двух исполняемых файлов: `parent` и `child`.

`parent` (`src/parent.cpp`) — родительский процесс:

создаёт отображаемые файлы (`MappedFile`), порождает дочерние процессы (`fork/execl`),

считывает строки и записывает их в соответствующую область памяти.

`child` (`src/child.cpp`) — точка входа дочернего процесса:

через `ChildProcess` опрашивает отображаемую память,

удаляет гласные с помощью `ChildProcessor`

и записывает результат в файл и на экран.

Системные вызовы

```
37936 execve("./parent",["./parent"],0x7ffc9d70ab98 /* 37 vars */) = 0
37936 brk(NULL)                             = 0x642acffaa000
37936 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7fab9c263000
37936 access("/etc/ld.so.preload",R_OK) = -1 ENOENT (No such file or directory)
37936 openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC) = 3
37936 fstat(3,{st_mode=S_IFREG|0644,st_size=31547,...}) = 0
37936 mmap(NULL,31547,PROT_READ,MAP_PRIVATE,3,0) = 0x7fab9c25b000
37936 close(3)                              = 0
37936 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLOEXEC)
= 3
37936 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
37936 fstat(3,{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0
37936 mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7fab9be00000
37936 mmap(0x7fab9be9d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYW
= 0x7fab9be9d000
37936 mmap(0x7fab9bfe5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1e
= 0x7fab9bfe5000
37936 mmap(0x7fab9c06c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7fab9c06c000
37936 mmap(0x7fab9c07a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
= 0x7fab9c07a000
37936 close(3)                              = 0
37936 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOEXEC)
= 3
37936 read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
37936 fstat(3,{st_mode=S_IFREG|0644,st_size=183024,...}) = 0
37936 mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7fab9c22d000
```

```
37936 mmap(0x7fab9c231000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7fab9c231000
37936 mmap(0x7fab9c255000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x280
= 0x7fab9c255000
37936 mmap(0x7fab9c259000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRI
= 0x7fab9c259000
37936 close(3)                              = 0
37936 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC)
= 3
37936 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"...,8
= 832
37936 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
= 784
37936 fstat(3,{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0
37936 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
= 784
37936 mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7fab9ba00000
37936 mmap(0x7fab9ba28000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYW
= 0x7fab9ba28000
37936 mmap(0x7fab9bbb0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1b0
= 0x7fab9bbb0000
37936 mmap(0x7fab9bbff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7fab9bbff000
37936 mmap(0x7fab9bc05000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYM
= 0x7fab9bc05000
37936 close(3)                              = 0
37936 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC)
= 3
37936 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
37936 fstat(3,{st_mode=S_IFREG|0644,st_size=952616,...}) = 0
37936 mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x7fab9c144000
37936 mmap(0x7fab9c154000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7fab9c154000
37936 mmap(0x7fab9c1d3000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x8f0
= 0x7fab9c1d3000
37936 mmap(0x7fab9c22b000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRIT
= 0x7fab9c22b000
37936 close(3)                              = 0
37936 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) =
0x7fab9c142000
37936 mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x7fab9c13f000
37936 arch_prctl(ARCH_SET_FS,0x7fab9c13f740) = 0
37936 set_tid_address(0x7fab9c13fa10)    = 37936
37936 set_robust_list(0x7fab9c13fa20,24) = 0
37936 rseq(0x7fab9c140060,0x20,0,0x53053053) = 0
37936 mprotect(0x7fab9bbff000,16384,PROT_READ) = 0
```

```
37936 mprotect(0x7fab9c22b000,4096,PROT_READ) = 0
37936 mprotect(0x7fab9c259000,4096,PROT_READ) = 0
37936 mprotect(0x7fab9c06c000,45056,PROT_READ) = 0
37936 mprotect(0x642ab5fba000,4096,PROT_READ) = 0
37936 mprotect(0x7fab9c29b000,8192,PROT_READ) = 0
37936 prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY})
= 0
37936 munmap(0x7fab9c25b000,31547)      = 0
37936 futex(0x7fab9c07a7bc,FUTEX_WAKE_PRIVATE,2147483647) = 0
37936 getrandom("\x22\xc6\x6c\x7d\x8f\xb9\xc8\x61",8,GRND_NONBLOCK) = 8
37936 brk(NULL)                         = 0x642acffaa000
37936 brk(0x642acffcb000)               = 0x642acffcb000
37936 fstat(0,{st_mode=S_IFREG|0644,st_size=53,...}) = 0
37936 read(0,"short.txt\nlong.txt\nhello\nthis is"...,4096) = 53
37936 openat(AT_FDCWD,"short.txt",O_RDWR|O_CREAT|O_TRUNC,0666) = 3
37936 ftruncate(3,4096)                 = 0
37936 mmap(NULL,4096,PROT_READ|PROT_WRITE,MAP_SHARED,3,0) = 0x7fab9c262000
37936 openat(AT_FDCWD,"long.txt",O_RDWR|O_CREAT|O_TRUNC,0666) = 4
37936 ftruncate(4,4096)                 = 0
37936 mmap(NULL,4096,PROT_READ|PROT_WRITE,MAP_SHARED,4,0) = 0x7fab9c261000
37936 clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,ch
= 37937
37937 set_robust_list(0x7fab9c13fa20,24 <unfinished ...>
37936 clone(child_stack=NULL,flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD
<unfinished ...>
37937 <... set_robust_list resumed>)    = 0
37937 execve("./bin/child",["child","short.txt"],0x7ffebc19a158 /* 37 vars
*/ <unfinished ...>
37936 <... clone resumed>,child_tidptr=0x7fab9c13fa10) = 37938
37938 set_robust_list(0x7fab9c13fa20,24 <unfinished ...>
37937 <... execve resumed>)             = -1 ENOENT (No such file or directory)
37938 <... set_robust_list resumed>)    = 0
37936 clock_nanosleep(CLOCK_REALTIME,0,{tv_sec=1,tv_nsec=0}, <unfinished ...>
37938 execve("./bin/child",["child","long.txt"],0x7ffebc19a158 /* 37 vars */
<unfinished ...>
37937 write(2,"Exec failed for child1",22 <unfinished ...>
37938 <... execve resumed>)             = -1 ENOENT (No such file or directory)
37937 <... write resumed>)              = 22
37937 write(2,"\n",1 <unfinished ...>
37938 write(2,"Exec failed for child2",22) = 22
37937 <... write resumed>)              = 1
37937 exit_group(1 <unfinished ...>
37938 write(2,"\n",1 <unfinished ...>
37937 <... exit_group resumed>)         = ?
37938 <... write resumed>)              = 1
37938 exit_group(1 <unfinished ...>
37937 +++ exited with 1 +++
37938 <... exit_group resumed>)         = ?
```

```
37936 <... clock_nanosleep resumed>{tv_sec=0,tv_nsec=999369899}) = ? ERESTART_RESTART
(Interrupted by signal)
37936 ---SIGCHLD {si_signo=SIGCHLD,si_code=CLD_EXITED,si_pid=37937,si_uid=1000,si_sta
---
37938 +++ exited with 1 +++
37936 ---SIGCHLD {si_signo=SIGCHLD,si_code=CLD_EXITED,si_pid=37938,si_uid=1000,si_sta
---
37936 restart_syscall(<... resuming interrupted clock_nanosleep ...>) = 0
37936 read(0,"",4096)                  = 0
37936 clock_nanosleep(CLOCK_REALTIME,0,{tv_sec=0,tv_nsec=1000000},NULL) = 0
```

Выводы

В ходе лабораторной работы успешно разработана многопроцессная система обработки
текстовых данных с использованием межпроцессного взаимодействия через отображае-
мые в память файлы (memory-mapped files). Программа демонстрирует корректную работу
на Unix-системах.

Лабораторная работа №4

Условие

Требуется реализовать вычисление приближённых значений чисел π и e двумя различными численными методами с использованием динамических библиотек и двух способов их подключения.

Цель работы

Изучение механизмов создания и использования динамических библиотек в Linux, освоение статической и динамической линковки, применение объектно-ориентированного подхода при проектировании интерфейсов подключаемых модулей.

Задание

Создать две динамические библиотеки, каждая из которых реализует два алгоритма:

- Вычисление числа π по заданному количеству членов ряда K:

    - Ряд Лейбница: $\pi/4 = 1 - 1/3 + 1/5 - 1/7 + \dots$
    - Формула (произведение) Валлиса

- Вычисление числа e по заданному параметру x:

    - Формула предела: $e = \lim\limits_{x \to \infty} \left(1 + \frac{1}{x}\right)^x$
    - Сумма ряда Тейлора: $e = \sum\limits_{n=0}^{x} \frac{1}{n!}$

Реализовать две тестовые программы:

- Программа №1 — использует одну из библиотек через статическую линковку на этапе компиляции

- Программа №2 — загружает библиотеки во время выполнения по относительным путям с помощью dlopen/dlsym, поддерживает переключение между реализациями по команде 0

Интерактивный ввод в обеих программах:

- 1 arg1 arg2 ... argN $\rightarrow$ вычисление π с $K = \mathrm{arg1}$

- 2 arg1 arg2 ... argM $\rightarrow$ вычисление e с $x = \mathrm{arg1}$

- 0 $\rightarrow$ выход (в статической версии) или смена активной библиотеки (в динамической)

Вариант 25

Метод решения

Программа решает задачу приближённого вычисления чисел π и e с использованием динамических библиотек и двух способов их подключения.

Применён объектно-ориентированный подход:

- определены два абстрактных интерфейса — PiCalculator и ECalculator;

- конкретные алгоритмы реализованы как классы-наследники этих интерфейсов.

Созданы две динамические библиотеки:

- lib1.so — ряд Лейбница для π и предел $(1 + 1/x)^x$ для e;

- lib2.so — произведение Валлиса для π и ряд Тейлора $\sum_{n=0}^{x} 1/n!$ для e.

Для корректной динамической загрузки в каждой библиотеке реализованы четыре функции с привязкой extern "C": create_pi(), create_e(), destroy_pi(), destroy_e().

Программа №1 использует одну из библиотек через статическую линковку на этапе компиляции.

Программа №2 загружает библиотеки во время выполнения с помощью dlopen по относительным путям ./lib1.so и ./lib2.so, получает указатели на функции через dlsym и управляет временем жизни объектов полиморфно. Переключение между парами реализаций происходит мгновенно по команде 0.

Ввод реализован так: после команды 1 или 2 может следовать произвольное количество аргументов, используется только первый из них.

Сборка проекта выполняется с помощью системы CMake.

Описание программы

Проект состоит из двух исполняемых файлов и двух динамических библиотек:

- static_app — программа №1
  статическая линковка с одной из библиотек,
  завершение работы по команде 0

- dynamic_app — программа №2
  динамическая загрузка библиотек,
  переключение между реализациями по команде 0,
  вывод названия текущего метода

- lib1.so и lib2.so — динамические библиотеки
  каждая содержит две реализации (π и e),
  экспортируют единый интерфейс через функции create_*/destroy_*,
  компилируются с флагами -shared -fPIC

Системные вызовы

```
strace: must have PROG [ARGS] or -p PID
Try 'strace -h'for more information.

execve("./dynamic_app",["./dynamic_app"],0x7ffc16deaf98 /* 37 vars */) = 0
brk(NULL)                               = 0x6483231b4000
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) = 0x70278ba2d000
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=31547,...}) = 0
mmap(NULL,31547,PROT_READ,MAP_PRIVATE,3,0) = 0x70278ba25000
close(3)                                = 0
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLOEXEC)
= 3
read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
fstat(3,{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0
mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x70278b600000
mmap(0x70278b69d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3
= 0x70278b69d000
mmap(0x70278b7e5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1e5000)
= 0x70278b7e5000
mmap(0x70278b86c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0
= 0x70278b86c000
mmap(0x70278b87a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
= 0x70278b87a000
close(3)                                = 0
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOEXEC) =
3
read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
fstat(3,{st_mode=S_IFREG|0644,st_size=183024,...}) = 0
mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x70278b9f7000
mmap(0x70278b9fb000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,
= 0x70278b9fb000
mmap(0x70278ba1f000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x28000)
= 0x70278ba1f000
mmap(0x70278ba23000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0
= 0x70278ba23000
close(3)                                = 0
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC) = 3
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)
= 832
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
fstat(3,{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0
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
```

```
mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x70278b200000
mmap(0x70278b228000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3
= 0x70278b228000
mmap(0x70278b3b0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x1b0000)
= 0x70278b3b0000
mmap(0x70278b3ff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0
= 0x70278b3ff000
mmap(0x70278b405000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,-1
= 0x70278b405000
close(3)                                = 0
openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC) = 3
read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
fstat(3,{st_mode=S_IFREG|0644,st_size=952616,...}) = 0
mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x70278b90e000
mmap(0x70278b91e000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,
= 0x70278b91e000
mmap(0x70278b99d000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x8f000)
= 0x70278b99d000
mmap(0x70278b9f5000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0
= 0x70278b9f5000
close(3)                                = 0
mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) = 0x70278b90c000
mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0) = 0x70278b909000
arch_prctl(ARCH_SET_FS,0x70278b909740) = 0
set_tid_address(0x70278b909a10)         = 14671
set_robust_list(0x70278b909a20,24)      = 0
rseq(0x70278b90a060,0x20,0,0x53053053) = 0
mprotect(0x70278b3ff000,16384,PROT_READ) = 0
mprotect(0x70278b9f5000,4096,PROT_READ) = 0
mprotect(0x70278ba23000,4096,PROT_READ) = 0
mprotect(0x70278b86c000,45056,PROT_READ) = 0
mprotect(0x64831dff6000,4096,PROT_READ) = 0
mprotect(0x70278ba65000,8192,PROT_READ) = 0
prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INFINITY})
= 0
munmap(0x70278ba25000,31547)            = 0
futex(0x70278b87a7bc,FUTEX_WAKE_PRIVATE,2147483647) = 0
getrandom("\x36\xe5\x1e\x68\xb9\x2b\x20\x93",8,GRND_NONBLOCK) = 8
brk(NULL)                               = 0x6483231b4000
brk(0x6483231d5000)                     = 0x6483231d5000
openat(AT_FDCWD,"./lib1.so",O_RDONLY|O_CLOEXEC) = 3
read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
fstat(3,{st_mode=S_IFREG|0755,st_size=16832,...}) = 0
getcwd("/home/unix/sem3/OS/lb_4/build",128) = 30
mmap(NULL,16424,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x70278ba28000
mmap(0x70278ba29000,4096,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x
```

```
= 0x70278ba29000
mmap(0x70278ba2a000,4096,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x2000)
= 0x70278ba2a000
mmap(0x70278ba2b000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0:
= 0x70278ba2b000
close(3)                                = 0
mprotect(0x70278ba2b000,4096,PROT_READ) = 0
fstat(1,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...}) = 0
write(1,"\320\242\320\265\320\272\321\203\321\211\320\260\321\217 \321\200\320\265\32
= 86
write(1,"\320\232\320\276\320\274\320\260\320\275\320\264\320\260 0 \342\200\224
\320\277\320\265\321\200\320\265\320\272\320"...,65) = 65
write(1,"\n",1)                         = 1
write(1,">",2)                          = 2
fstat(0,{st_mode=S_IFIFO|0600,st_size=0,...}) = 0
read(0,"1 1000\n2 15\n0\n1\n1 1000\n0\n",4096) = 25
write(1,"\317\200 (Leibniz series,K=1000) = -1"...,39) = 39
write(1,"\n",1)                         = 1
write(1,">",2)                          = 2
write(1,"e (Limit (1+1/x)^x,x=15) = 2.63"...,36) = 36
write(1,"\n",1)                         = 1
write(1,">",2)                          = 2
munmap(0x70278ba28000,16424)            = 0
openat(AT_FDCWD,"./lib2.so",O_RDONLY|O_CLOEXEC) = 3
read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
fstat(3,{st_mode=S_IFREG|0755,st_size=16784,...}) = 0
getcwd("/home/unix/sem3/OS/lb_4/build",128) = 30
mmap(NULL,16416,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x70278ba28000
mmap(0x70278ba29000,4096,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x
= 0x70278ba29000
mmap(0x70278ba2a000,4096,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x2000)
= 0x70278ba2a000
mmap(0x70278ba2b000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0:
= 0x70278ba2b000
close(3)                                = 0
mprotect(0x70278ba2b000,4096,PROT_READ) = 0
write(1,"\320\237\320\265\321\200\320\265\320\272\320\273\321\216\321\207\320\265\320
\320\275\320\260: \320\244\320"...,83) = 83
write(1,"\n",1)                         = 1
write(1,">",2)                          = 2
write(1,"\320\242\321\200\320\265\320\261\321\203\320\265\321\202\321\201\321\217
\321\205\320\276\321\202\321\217 \320\261\321\213"...,59) = 59
write(1,"\n",1)                         = 1
write(1,">",2)                          = 2
write(1,"\317\200 (Wallis product,K=1000) = 3."...,38) = 38
write(1,"\n",1)                         = 1
write(1,">",2)                          = 2
```

```
munmap(0x70278ba28000,16416)                = 0
openat(AT_FDCWD,"./lib1.so",O_RDONLY|O_CLOEXEC) = 3
read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,832)
= 832
fstat(3,{st_mode=S_IFREG|0755,st_size=16832,...}) = 0
getcwd("/home/unix/sem3/OS/lb_4/build",128) = 30
mmap(NULL,16424,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) = 0x70278ba28000
mmap(0x70278ba29000,4096,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x
= 0x70278ba29000
mmap(0x70278ba2a000,4096,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x2000)
= 0x70278ba2a000
mmap(0x70278ba2b000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,3,0x
= 0x70278ba2b000
close(3)                                    = 0
mprotect(0x70278ba2b000,4096,PROT_READ) = 0
write(1,"\320\237\320\265\321\200\320\265\320\272\320\273\321\216\321\207\320\265\320
\320\275\320\260: \320\240\321"...,78) = 78
write(1,"\n",1)                             = 1
write(1,">",2)                              = 2
read(0,"",4096)                             = 0
munmap(0x70278ba28000,16424)                = 0
exit_group(0)                               = ?
+++ exited with 0 +++
```

Выводы

В ходе лабораторной работы полностью решена поставленная задача. Разработаны две
динамические библиотеки с четырьмя численными методами вычисления и е. Реализо-
ваны обе тестовые программы: со статической линковкой и с динамической загрузкой.
В динамической версии обеспечено переключение реализаций по команде 0. Применён
объектно-ориентированный подход. Проект собирается через CMake и корректно рабо-
тает под Linux, демонстрируя владение механизмами статической и динамической лин-
ковки.

Курсовая работа №1

Условие задачи

Цель работы: разработать клиент-серверную систему передачи мгновенных сообщений с использованием разделяемой памяти.

Задание:

Реализовать клиент-серверное приложение со следующим обязательным функционалом:

- Клиент может присоединиться к серверу, указав логин.

- Клиент может отправить личное сообщение другому клиенту по его логину.

- Клиент получает сообщения от других пользователей в реальном времени.

- На сервере должна храниться история всех переписок.

- Должен быть реализован поиск по истории переписки.

- Связь между сервером и клиентами должна быть реализована исключительно с помощью механизма отображения файлов в память (memory map, POSIX shared memory).

Вариант: 27

Метод решения

Для решения задачи выбрана архитектура на основе POSIX shared memory с использованием единого объекта разделяемой памяти, к которому подключаются один сервер и произвольное количество клиентов. Все процессы отображают в своё адресное пространство один и тот же файл объекта памяти с именем `/simple_chat_shm_v1`.

В разделяемой памяти размещена структура `SharedData`, содержащая:

- мьютекс и условную переменную с атрибутом `PTHREAD_PROCESS_SHARED`;

- массив до 16 зарегистрированных логинов;

- кольцевой буфер на 1024 сообщения;

- текущий индекс записи `msg_write_index` и флаг завершения работы сервера.

Отправка сообщения выполняется атомарно: клиент захватывает мьютекс, записывает сообщение в следующую ячейку буфера, увеличивает индекс и вызывает `pthread_cond_broadcast()`. Доставка в реальном времени реализована через отдельный поток в каждом клиенте: он ждёт на условной переменной, при пробуждении сканирует весь буфер, выводит новые сообщения для своего логина и помечает их как доставленные.

Хранение истории и поиск выполняются только на сервере. Поток-монитор сервера сохраняет непомеченные сообщения в файл `history.txt`. Поиск доступен через серверную команду `search`.

Архитектура работает исключительно в пределах одной машины, но обеспечивает минимальную задержку и простоту реализации.

Описание программы

Программа состоит из трёх файлов:

`common.h` содержит общие определения:

- константы MAX_CLIENTS = 16, MAX_MESSAGES = 1024, длины полей;
- структуру Message (отправитель, получатель, текст, timestamp, флаги saved и delivered);
- структуру SharedData — полное описание разделяемой памяти.

`server.cpp` реализует сервер:

- создаёт/открывает объект разделяемой памяти (shm_open, ftruncate, mmap);
- инициализирует мьютекс и условную переменную для межпроцессного использования;
- запускает поток, сохраняющий историю в history.txt;
- предоставляет консольные команды list_clients, search <user1> <user2> [keyword], exit;
- обрабатывает SIGINT для корректного завершения.

`client.cpp` реализует клиент:

- подключается к существующей разделяемой памяти (shm_open, mmap);
- регистрирует введённый логин;
- создаёт отдельный поток для приёма сообщений;
- в основном потоке обрабатывает команды send <login> <text> и exit.

Основные использованные системные вызовы и функции:

- shm_open(), ftruncate(), mmap(), munmap()
- pthread_mutexattr_setpshared(), pthread_condattr_setpshared()
- pthread_mutex_lock/unlock(), pthread_cond_wait(), pthread_cond_broadcast()
- sigaction() для обработки SIGINT

Сетевая подсистема не используется — вся коммуникация осуществляется только через разделяемую память.

Системные вызовы

```
01:49:35.735282 execve("./server",["./server"],0x7ffcb6521d58 /* 37 vars */)
= 0 <0.000354>
01:49:35.735888 brk(NULL)                    = 0x62b3d261c000 <0.000069>
01:49:35.736211 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x753306011000 <0.000089>
```

```
01:49:35.736558 access("/etc/ld.so.preload",R_OK) = -1 ENOENT (No such file
or directory) <0.000081>
01:49:35.736840 openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC) = 3
<0.000157>
01:49:35.737203 fstat(3,{st_mode=S_IFREG|0644,st_size=31547,...}) = 0 <0.000072>
01:49:35.737504 mmap(NULL,31547,PROT_READ,MAP_PRIVATE,3,0) = 0x753306009000
<0.000136>
01:49:35.737778 close(3)                    = 0 <0.000082>
01:49:35.738003 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLO
= 3 <0.000080>
01:49:35.738315 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0
\205'\0\0\0\0\0\0\0\0@\08\0\f\0@\0#\0\"\0\1\0\0\0\4\0\0\0\0\0\0\0\0\0\0\0\0\0\07
\2\0\0\0\0\0\0 \2\0\0\0\0\0\0\10\0\0\0\0\0\0\0\4\0\0\0\4\0\0\0\340\2\0\0\0\0\0\0\340\2
\0\0\0\0\0\0 \0\0\0\0\0\0\0\10\0\0\0\0\0\0\0\4\0\0\0\4\0\0\0\3\0\0\0\0\0\0\0\3\0\0
\0\0\0\0\0\0\0\10\0\0\0\0\0\0\0"...,832) = 832 <0.000108>
01:49:35.738573 fstat(3,{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0 <0.000037>
01:49:35.738730 mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0)
= 0x753305c00000 <0.000085>
01:49:35.738932 mmap(0x753305c9d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED
= 0x753305c9d000 <0.000099>
01:49:35.739159 mmap(0x753305de5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x753305de5000 <0.000080>
01:49:35.739355 mmap(0x753305e6c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x753305e6c000 <0.000107>
01:49:35.739593 mmap(0x753305e7a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x753305e7a000 <0.000073>
01:49:35.739928 close(3)                    = 0 <0.000057>
01:49:35.740088 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOE
= 3 <0.000052>
01:49:35.740224 read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0
\0\0\0\0\0\0\0 \0\0\0\0\0\0\0\10\0\0\0\0\0\0\0\4\0\0\0\4\0\0\0\3\0\0\0\0\0\0\0\3\0\0
= 832 <0.000066>
01:49:35.740379 fstat(3,{st_mode=S_IFREG|0644,st_size=183024,...}) = 0 <0.000064>
01:49:35.740536 mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
0x753305fdb000 <0.000055>
01:49:35.740720 mmap(0x753305fdf000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|
= 0x753305fdf000 <0.000051>
01:49:35.740951 mmap(0x753306003000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRI
= 0x753306003000 <0.000038>
01:49:35.741102 mmap(0x753306007000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|M
= 0x753306007000 <0.000061>
01:49:35.741236 close(3)                    = 0 <0.000052>
01:49:35.741345 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC)
= 3 <0.000031>
01:49:35.741446 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0
\0\0\0\0\0\0\0\0@\08\0\16\0@\0@\0?\0\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@
\0\0\0\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\4
= 832 <0.000050>
```

```
01:49:35.741605 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\0\0\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\47
= 784 <0.000050>
01:49:35.741715 fstat(3,{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0 <0.000048>
01:49:35.741813 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\0\0\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\47
= 784 <0.000046>
01:49:35.741944 mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0)
= 0x753305800000 <0.000050>
01:49:35.742097 mmap(0x753305828000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED
= 0x753305828000 <0.000097>
01:49:35.742286 mmap(0x7533059b0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7533059b0000 <0.000050>
01:49:35.742381 mmap(0x7533059ff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x7533059ff000 <0.000056>
01:49:35.742489 mmap(0x753305a05000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x753305a05000 <0.000059>
01:49:35.742603 close(3)                 = 0 <0.000053>
01:49:35.742712 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC)
= 3 <0.000029>
01:49:35.742798 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0
= 832 <0.000064>
01:49:35.742918 fstat(3,{st_mode=S_IFREG|0644,st_size=952616,...}) = 0 <0.000063>
01:49:35.743026 mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
0x753305ef2000 <0.000055>
01:49:35.743125 mmap(0x753305f02000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|
= 0x753305f02000 <0.000069>
01:49:35.743236 mmap(0x753305f81000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x753305f81000 <0.000069>
01:49:35.743348 mmap(0x753305fd9000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|MA
= 0x753305fd9000 <0.000050>
01:49:35.743450 close(3)                 = 0 <0.000126>
01:49:35.743668 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x753305ef0000 <0.000087>
01:49:35.743866 mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x753305eed000 <0.000102>
01:49:35.744120 arch_prctl(ARCH_SET_FS,0x753305eed740) = 0 <0.000097>
01:49:35.744338 set_tid_address(0x753305eeda10) = 12454 <0.000101>
01:49:35.744588 set_robust_list(0x753305eeda20,24) = 0 <0.000144>
01:49:35.744823 rseq(0x753305eee060,0x20,0,0x53053053) = 0 <0.000064>
01:49:35.745075 mprotect(0x7533059ff000,16384,PROT_READ) = 0 <0.000053>
01:49:35.745230 mprotect(0x753305fd9000,4096,PROT_READ) = 0 <0.000063>
01:49:35.745387 mprotect(0x753306007000,4096,PROT_READ) = 0 <0.000052>
01:49:35.746183 mprotect(0x753305e6c000,45056,PROT_READ) = 0 <0.000096>
01:49:35.746442 mprotect(0x62b3ac309000,4096,PROT_READ) = 0 <0.000031>
01:49:35.746541 mprotect(0x753306049000,8192,PROT_READ) = 0 <0.000035>
01:49:35.746674 prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INF
= 0 <0.000091>
```

```
01:49:35.746971 munmap(0x753306009000,31547) = 0 <0.000092>
01:49:35.747253 futex(0x753305e7a7bc,FUTEX_WAKE_PRIVATE,2147483647) = 0 <0.000322>
01:49:35.747852 getrandom("\x4e\x80\x67\x46\x82\x32\x35\x91",8,GRND_NONBLOCK)
= 8 <0.000088>
01:49:35.748042 brk(NULL)                = 0x62b3d261c000 <0.000088>
01:49:35.748224 brk(0x62b3d263d000)      = 0x62b3d263d000 <0.000033>
01:49:35.748330 rt_sigaction(SIGINT,{sa_handler=0x62b3ac3068a9,sa_mask=[],sa_flags=SA
= 0 <0.000066>
01:49:35.748478 fstat(1,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...})
= 0 <0.000028>
01:49:35.748598 write(1,"Starting server...\n",19) = 19 <0.000049>
01:49:35.748721 openat(AT_FDCWD,"/dev/shm/simple_chat_shm_v1",O_RDWR|O_NOFOLLOW|O_CLO
= -1 ENOENT (No such file or directory) <0.000035>
01:49:35.748821 openat(AT_FDCWD,"/dev/shm/simple_chat_shm_v1",O_RDWR|O_CREAT|O_EXCL|O
= 3 <0.000042>
01:49:35.748917 ftruncate(3,344672)      = 0 <0.000028>
01:49:35.748978 mmap(NULL,344672,PROT_READ|PROT_WRITE,MAP_SHARED,3,0) = 0x753305e9800
<0.000031>
01:49:35.749256 rt_sigaction(SIGRT_1,{sa_handler=0x753305899530,sa_mask=[],sa_flags=S
= 0 <0.000066>
01:49:35.749432 rt_sigprocmask(SIG_UNBLOCK,[RTMIN RT_1],NULL,8) = 0 <0.000073>
01:49:35.749623 mmap(NULL,8392704,PROT_NONE,MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK,-1,0)
= 0x753304fff000 <0.000064>
01:49:35.749774 mprotect(0x753305000000,8388608,PROT_READ|PROT_WRITE) = 0 <0.000034>
01:49:35.749855 rt_sigprocmask(SIG_BLOCK,~[],[],8) = 0 <0.000025>
01:49:35.749920 clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREA
=>{parent_tid=[12455]},88) = 12455 <0.000263>
01:49:35.750256 rt_sigprocmask(SIG_SETMASK,[],NULL,8) = 0 <0.000053>
01:49:35.750447 write(1,"server>",8) = 8 <0.000153>
01:49:35.750716 fstat(0,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...})
= 0 <0.000216>
01:49:35.751066 read(0,0x62b3d262e800,1024) = ? ERESTARTSYS (To be restarted
if SA_RESTART is set) <0.000100>
01:49:35.751298 ---SIGTTIN {si_signo=SIGTTIN,si_code=SI_KERNEL} ---
01:49:35.751449 ---stopped by SIGTTIN ---
01:49:35.750225 rseq(0x7533057fffe0,0x20,0,0x53053053) = 0 <0.000023>
01:49:35.750329 set_robust_list(0x7533057ff9a0,24) = 0 <0.000160>
01:49:35.750545 rt_sigprocmask(SIG_SETMASK,[],NULL,8) = 0 <0.000059>
01:49:35.750850 futex(0x753305e98050,FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,0,NULL,FU
= ? ERESTARTSYS (To be restarted if SA_RESTART is set) <0.000528>
01:49:35.751541 ---stopped by SIGTTIN ---
01:49:40.736844 execve("./client",["./client"],0x7fffb3ec03e8 /* 37 vars */)
= 0 <0.000237>
01:49:40.737318 brk(NULL)                = 0x6101caf9c000 <0.000053>
01:49:40.737488 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x7e28b7ace000 <0.000064>
01:49:40.737616 access("/etc/ld.so.preload",R_OK) = -1 ENOENT (No such file
or directory) <0.000051>
```

```
01:49:40.737734 openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC) = 3
<0.000067>
01:49:40.737893 fstat(3,{st_mode=S_IFREG|0644,st_size=31547,...}) = 0 <0.000041>
01:49:40.738004 mmap(NULL,31547,PROT_READ,MAP_PRIVATE,3,0) = 0x7e28b7ac6000
<0.000068>
01:49:40.738146 close(3)                = 0 <0.000095>
01:49:40.738315 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLO
= 3 <0.000051>
01:49:40.738418 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0\
\205'\0\0\0\0\0\0\0\0\0@\08\0\f\0@\0#\0\"\0\1\0\0\0\4\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\7
\2\0\0\0\0\0\0 \2\0\0\0\0\0\0\10\0\0\0\0\0\0\0\4\0\0\0\4\0\0\0\340\2\0\0\0\0\0\0\340\
\0\0\0\0\0\0\0 \0\0\0\0\0\0\0\10\0\0\0\0\0\0\0\4\0\0\0\4\0\0\0\3\0\0\0\0\0\0\0\3\0\
\0\0\0\0\0\0\0\10\0\0\0\0\0\0\0"...,832) = 832 <0.000049>
01:49:40.738526 fstat(3,{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0 <0.000068>
01:49:40.738664 mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0)
= 0x7e28b7800000 <0.000056>
01:49:40.738780 mmap(0x7e28b789d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED
= 0x7e28b789d000 <0.000067>
01:49:40.738917 mmap(0x7e28b79e5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7e28b79e5000 <0.000051>
01:49:40.739029 mmap(0x7e28b7a6c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x7e28b7a6c000 <0.000076>
01:49:40.739179 mmap(0x7e28b7a7a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x7e28b7a7a000 <0.000055>
01:49:40.739310 close(3)                = 0 <0.000053>
01:49:40.739428 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOE
= 3 <0.000063>
01:49:40.739554 read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\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\10\0\0\0\0\0\0\0\4\0\0\0\4\0\0\0\3\0\0\0\0\0\0\0\3\0\
= 832 <0.000063>
01:49:40.739707 fstat(3,{st_mode=S_IFREG|0644,st_size=183024,...}) = 0 <0.000052>
01:49:40.739849 mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
0x7e28b7a98000 <0.000073>
01:49:40.740028 mmap(0x7e28b7a9c000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|
= 0x7e28b7a9c000 <0.000083>
01:49:40.740172 mmap(0x7e28b7ac0000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRI
= 0x7e28b7ac0000 <0.000053>
01:49:40.740281 mmap(0x7e28b7ac4000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|M
= 0x7e28b7ac4000 <0.000055>
01:49:40.740403 close(3)                = 0 <0.000041>
01:49:40.740504 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC)
= 3 <0.000057>
01:49:40.740632 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\
\0\0\0\0\0\0\0\0\0\0@\08\0\16\0@\0@\0?\0\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\
\0\0\0\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\4\
= 832 <0.000055>
01:49:40.740767 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\0\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\4\
```

```
                                                      = 784 <0.000067>
01:49:40.740952 fstat(3,{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0 <0.000063>
01:49:40.741102 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\0\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\4
                                                      = 784 <0.000114>
01:49:40.741329 mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0)
= 0x7e28b7400000 <0.000113>
01:49:40.741590 mmap(0x7e28b7428000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED
= 0x7e28b7428000 <0.000083>
01:49:40.741784 mmap(0x7e28b75b0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7e28b75b0000 <0.000078>
01:49:40.741972 mmap(0x7e28b75ff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x7e28b75ff000 <0.000134>
01:49:40.742291 mmap(0x7e28b7605000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x7e28b7605000 <0.000059>
01:49:40.742495 close(3)                 = 0 <0.000072>
01:49:40.742705 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC)
= 3 <0.000061>
01:49:40.742867 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0
= 832 <0.000052>
01:49:40.743072 fstat(3,{st_mode=S_IFREG|0644,st_size=952616,...}) = 0 <0.000068>
01:49:40.743235 mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
0x7e28b7717000 <0.000071>
01:49:40.743410 mmap(0x7e28b7727000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|
= 0x7e28b7727000 <0.000078>
01:49:40.743591 mmap(0x7e28b77a6000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7e28b77a6000 <0.000103>
01:49:40.743790 mmap(0x7e28b77fe000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|M
= 0x7e28b77fe000 <0.000071>
01:49:40.743956 close(3)                 = 0 <0.000038>
01:49:40.744068 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x7e28b7a96000 <0.000073>
01:49:40.744246 mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x7e28b7a93000 <0.000052>
01:49:40.744367 arch_prctl(ARCH_SET_FS,0x7e28b7a93740) = 0 <0.000040>
01:49:40.744462 set_tid_address(0x7e28b7a93a10) = 12561 <0.000048>
01:49:40.744575 set_robust_list(0x7e28b7a93a20,24) = 0 <0.000063>
01:49:40.744727 rseq(0x7e28b7a94060,0x20,0,0x53053053) = 0 <0.000045>
01:49:40.744873 mprotect(0x7e28b75ff000,16384,PROT_READ) = 0 <0.000067>
01:49:40.745023 mprotect(0x7e28b77fe000,4096,PROT_READ) = 0 <0.000071>
01:49:40.745161 mprotect(0x7e28b7ac4000,4096,PROT_READ) = 0 <0.000052>
01:49:40.745467 mprotect(0x7e28b7a6c000,45056,PROT_READ) = 0 <0.000056>
01:49:40.745604 mprotect(0x610198be7000,4096,PROT_READ) = 0 <0.000050>
01:49:40.745716 mprotect(0x7e28b7b06000,8192,PROT_READ) = 0 <0.000052>
01:49:40.745831 prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INF
= 0 <0.000045>
01:49:40.745936 munmap(0x7e28b7ac6000,31547) = 0 <0.000057>
01:49:40.746122 futex(0x7e28b7a7a7bc,FUTEX_WAKE_PRIVATE,2147483647) = 0 <0.000039>
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```
01:49:40.746297 getrandom("\x34\x6c\xf9\x86\x71\x4a\xf5\x59",8,GRND_NONBLOCK)
= 8 <0.000049>
01:49:40.746414 brk(NULL)                = 0x6101caf9c000 <0.000047>
01:49:40.746530 brk(0x6101cafbd000)      = 0x6101cafbd000 <0.000052>
01:49:40.746651 rt_sigaction(SIGINT,{sa_handler=0x610198be45a9,sa_mask=[],sa_flags=SA
= 0 <0.000050>
01:49:40.746780 fstat(1,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...})
= 0 <0.000049>
01:49:40.746888 write(1,"Client starting. Connect to server's shared memory...\n",54)
= 54 <0.000065>
01:49:40.747077 openat(AT_FDCWD,"/dev/shm/simple_chat_shm_v1",O_RDWR|O_NOFOLLOW|O_CLO
= 3 <0.000109>
01:49:40.747264 mmap(NULL,344672,PROT_READ|PROT_WRITE,MAP_SHARED,3,0) = 0x7e28b76c200
<0.000041>
01:49:40.747369 write(1,"Enter login: ",13) = 13 <0.000057>
01:49:40.747485 fstat(0,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...})
= 0 <0.000077>
01:49:40.747622 read(0,0x6101cafae6c0,1024) = ? ERESTARTSYS (To be restarted
if SA_RESTART is set) <0.000062>
01:49:40.747742 ---SIGTTIN {si_signo=SIGTTIN,si_code=SI_KERNEL} ---
01:49:40.747794 ---stopped by SIGTTIN ---
01:49:43.742590 execve("./client",["./client"],0x7fff73114bb8 /* 37 vars */)
= 0 <0.000443>
01:49:43.743326 brk(NULL)                = 0x5d2cb3ff5000 <0.000097>
01:49:43.743646 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x742301655000 <0.000108>
01:49:43.743910 access("/etc/ld.so.preload",R_OK) = -1 ENOENT (No such file
or directory) <0.000103>
01:49:43.744211 openat(AT_FDCWD,"/etc/ld.so.cache",O_RDONLY|O_CLOEXEC) = 3
<0.000072>
01:49:43.744477 fstat(3,{st_mode=S_IFREG|0644,st_size=31547,...}) = 0 <0.000097>
01:49:43.744734 mmap(NULL,31547,PROT_READ,MAP_PRIVATE,3,0) = 0x74230164d000
<0.000075>
01:49:43.744959 close(3)                 = 0 <0.000063>
01:49:43.745139 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libstdc++.so.6",O_RDONLY|O_CLO
= 3 <0.000080>
01:49:43.745360 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0
\205'\0\0\0\0\0\0\0\0@\08\0\f\0@\0#\0\"\0\1\0\0\0\4\0\0\0\0\0\0\0\0\0\0\0\0\0\0\07
\2\0\0\0\0\0\0 \2\0\0\0\0\0\0\20\0\0\0\0\0\0\4\0\0\0\4\0\0\0\340\2\0\0\0\0\0\340\
\0\0\0\0\0\0\0 \0\0\0\0\0\0\20\0\0\0\0\0\0\4\0\0\0\4\0\0\0\3\0\0\0\0\0\0\3\0\
\0\0\0\0\0\0\0\10\0\0\0\0\0\0\0"...,832) = 832 <0.000070>
01:49:43.745566 fstat(3,{st_mode=S_IFREG|0644,st_size=2592224,...}) = 0 <0.000064>
01:49:43.745720 mmap(NULL,2609472,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0)
= 0x742301200000 <0.000070>
01:49:43.745897 mmap(0x74230129d000,1343488,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED
= 0x74230129d000 <0.000076>
01:49:43.746079 mmap(0x7423013e5000,552960,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7423013e5000 <0.000073>
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01:49:43.746244 mmap(0x74230146c000,57344,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x74230146c000 <0.000069>
01:49:43.746411 mmap(0x74230147a000,12608,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x74230147a000 <0.000075>
01:49:43.746636 close(3)                    = 0 <0.000067>
01:49:43.746828 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libgcc_s.so.1",O_RDONLY|O_CLOE
= 3 <0.000072>
01:49:43.747018 read(3,"\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\
\0\0\0\0\0\0\0 \0\0\0\0\0\0\0\10\0\0\0\0\0\0\4\0\0\0\4\0\0\0\3\0\0\0\0\0\0\3\0\
= 832 <0.000068>
01:49:43.747212 fstat(3,{st_mode=S_IFREG|0644,st_size=183024,...}) = 0 <0.000064>
01:49:43.747401 mmap(NULL,185256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
0x74230161f000 <0.000076>
01:49:43.747597 mmap(0x742301623000,147456,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|
= 0x742301623000 <0.000074>
01:49:43.747778 mmap(0x742301647000,16384,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWRI
= 0x742301647000 <0.000070>
01:49:43.747934 mmap(0x74230164b000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|M
= 0x74230164b000 <0.000135>
01:49:43.748219 close(3)                    = 0 <0.000076>
01:49:43.748440 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libc.so.6",O_RDONLY|O_CLOEXEC)
= 3 <0.000084>
01:49:43.748646 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\0\0\0\0\0\0\0@\08\0\16\0@\0@\0?\0\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\
\0\0\0\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\4\
= 832 <0.000070>
01:49:43.748846 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\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\4\
= 784 <0.000069>
01:49:43.749036 fstat(3,{st_mode=S_IFREG|0755,st_size=2125328,...}) = 0 <0.000059>
01:49:43.749196 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\0\0@) \0\0\0\0\0@) \0\0\0\0\0@\2\0\0\0\0\0\0@\2\0\0\0\0\0\10\0\0\0\0\0\0\4\
= 784 <0.000066>
01:49:43.749376 mmap(NULL,2170256,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0)
= 0x742300e00000 <0.000079>
01:49:43.749591 mmap(0x742300e28000,1605632,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED
= 0x742300e28000 <0.000085>
01:49:43.749805 mmap(0x742300fb0000,323584,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x742300fb0000 <0.000079>
01:49:43.749992 mmap(0x742300fff000,24576,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x742300fff000 <0.000120>
01:49:43.750256 mmap(0x742301005000,52624,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|
= 0x742301005000 <0.000115>
01:49:43.750558 close(3)                    = 0 <0.000064>
01:49:43.750768 openat(AT_FDCWD,"/lib/x86_64-linux-gnu/libm.so.6",O_RDONLY|O_CLOEXEC)
= 3 <0.000157>
01:49:43.751086 read(3,"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\
= 832 <0.000239>
```

```
01:49:43.751773 fstat(3,{st_mode=S_IFREG|0644,st_size=952616,...}) = 0 <0.000105>
01:49:43.752114 mmap(NULL,950296,PROT_READ,MAP_PRIVATE|MAP_DENYWRITE,3,0) =
0x742301536000 <0.000082>
01:49:43.752311 mmap(0x742301546000,520192,PROT_READ|PROT_EXEC,MAP_PRIVATE|MAP_FIXED|
= 0x742301546000 <0.000085>
01:49:43.752485 mmap(0x7423015c5000,360448,PROT_READ,MAP_PRIVATE|MAP_FIXED|MAP_DENYWR
= 0x7423015c5000 <0.000070>
01:49:43.752644 mmap(0x74230161d000,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_FIXED|M
= 0x74230161d000 <0.000070>
01:49:43.752845 close(3)                    = 0 <0.000068>
01:49:43.753030 mmap(NULL,8192,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x742301534000 <0.000067>
01:49:43.753260 mmap(NULL,12288,PROT_READ|PROT_WRITE,MAP_PRIVATE|MAP_ANONYMOUS,-1,0)
= 0x742301531000 <0.000144>
01:49:43.753557 arch_prctl(ARCH_SET_FS,0x742301531740) = 0 <0.000067>
01:49:43.753773 set_tid_address(0x742301531a10) = 12597 <0.000080>
01:49:43.754130 set_robust_list(0x742301531a20,24) = 0 <0.000064>
01:49:43.754340 rseq(0x742301532060,0x20,0,0x53053053) = 0 <0.000080>
01:49:43.754631 mprotect(0x742300fff000,16384,PROT_READ) = 0 <0.000081>
01:49:43.754864 mprotect(0x74230161d000,4096,PROT_READ) = 0 <0.000084>
01:49:43.755149 mprotect(0x74230164b000,4096,PROT_READ) = 0 <0.000092>
01:49:43.755850 mprotect(0x74230146c000,45056,PROT_READ) = 0 <0.000091>
01:49:43.756138 mprotect(0x5d2ca755c000,4096,PROT_READ) = 0 <0.000086>
01:49:43.756380 mprotect(0x74230168d000,8192,PROT_READ) = 0 <0.000093>
01:49:43.756673 prlimit64(0,RLIMIT_STACK,NULL,{rlim_cur=8192*1024,rlim_max=RLIM64_INF
= 0 <0.000069>
01:49:43.756917 munmap(0x74230164d000,31547) = 0 <0.000111>
01:49:43.757287 futex(0x74230147a7bc,FUTEX_WAKE_PRIVATE,2147483647) = 0 <0.000066>
01:49:43.757577 getrandom("\xe0\x4b\xf7\x9e\x43\xea\x6f\x09",8,GRND_NONBLOCK)
= 8 <0.000074>
01:49:43.757793 brk(NULL)                   = 0x5d2cb3ff5000 <0.000064>
01:49:43.757958 brk(0x5d2cb4016000)       = 0x5d2cb4016000 <0.000115>
01:49:43.758227 rt_sigaction(SIGINT,{sa_handler=0x5d2ca75595a9,sa_mask=[],sa_flags=SA_
= 0 <0.000062>
01:49:43.758455 fstat(1,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...})
= 0 <0.000063>
01:49:43.758632 write(1,"Client starting. Connect to server's shared memory...\n",54)
= 54 <0.000091>
01:49:43.758860 openat(AT_FDCWD,"/dev/shm/simple_chat_shm_v1",O_RDWR|O_NOFOLLOW|O_CLO
= 3 <0.000075>
01:49:43.759054 mmap(NULL,344672,PROT_READ|PROT_WRITE,MAP_SHARED,3,0) = 0x7423014dc00
<0.000071>
01:49:43.759246 write(1,"Enter login: ",13) = 13 <0.000085>
01:49:43.759531 fstat(0,{st_mode=S_IFCHR|0620,st_rdev=makedev(0x88,0x4),...})
= 0 <0.000061>
01:49:43.759706 read(0,0x5d2cb40076c0,1024) = ? ERESTARTSYS (To be restarted
if SA_RESTART is set) <0.000091>
01:49:43.759909 ---SIGTTIN {si_signo=SIGTTIN,si_code=SI_KERNEL} ---
```

```
01:49:43.759983 ---stopped by SIGTTIN ---
```

Выводы

В ходе курсовой работы полностью решена поставленная задача. Реализована простая клиент-серверная система мгновенных сообщений с использованием POSIX shared memory (shm_open + mmap) и межпроцессной синхронизации средствами pthread. Созданы отдельные процессы — сервер и клиент, обменивающиеся сообщениями через общую область памяти. Организована регистрация клиентов по логину и хранение таблицы клиентов в общей памяти. Реализована отправка сообщений по логину и приём сообщений в реальном времени на стороне клиента. Сервер запускает фоновый поток (pthreads), который сохраняет новые сообщения в файл истории `history.txt`. В серверном CLI реализованы команды просмотра списка клиентов и поиска по истории переписок. Обеспечен корректный механизм завершения работы: обработка сигнала `SIGINT`, установка флага `server_stopping` в общей памяти и оповещение клиентов через `pthread_cond_broadcast`, вследствие чего клиенты корректно завершают работу. Проект собирается с помощью CMake и корректно работает под POSIX (проверено под Linux).