Московский Авиационный Институт

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Институт №8 “Компьютерные науки и прикладная математика”

Кафедра №806 “Вычислительная математика и программирование”

Лабораторная работа №2 по курсу

«Операционные системы»

Группа: М80-206Б-22

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Оценка: _____

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Постановка задачи

Вариант 18.

Поиск наивным алгоритмом образца в строке.

Общий метод и алгоритм решения

Использованные системные вызовы:

- void thread_create(pthread_t* thread, const pthread_attr_t* attr, void *(*start)(void *), void* arg); – создает поток.
- pthread_join(pthread_t, void *_Nullable *) – ждет завершение исполнения потока.

В наивном поиске образца в строке можно использовать многопоточность для разделения исходной строки на подстроки и обработки каждой из них параллельно. То есть, например, если пользователь предполагает использование 2 потоков, то исходная строка разделится на 2 подстроки и каждая из этих подстрок будет обработана отдельно и одновременно с отсальными, что должно сократить время работы программы, однако иногда инициализация потоков и их создание занимает больше времени, чем выполнение программы и использование нескольких потоков в таких случаях бессмысленно.

Код программы

func.h

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <pthread.h>
#include <time.h>

char* def;
char* res;
int res_len;
int max_threads;
int match_count;

void thread_create(pthread_t* thread, const pthread_attr_t* attr, void *(*start)(void *),
void* arg);
void* thread_func(void* arg);
```

main.c

```
#include "func.h"
#define MAXIMUM 12

void thread_create(pthread_t* thread, const pthread_attr_t* attr, void *(*start)(void *),
void* arg) {
   if (pthread_create(thread, attr, start, arg) != 0) {
      perror("create thread\n");
      exit(-1);
   }
}

void* thread_func(void* arg) {
   int start = *((int*) arg);
   int i, j;
   for (i = start; i <= (strlen(def) - res_len); i += max_threads) {
      for (j = 0; j < res_len; j++) {
         if (def[i + j] != res[j]) {
            break;
         }
      }
      if (j == res_len) {
         match_count++;
      }
   }
   pthread_exit(NULL);
}

int main(int argc, char* argv[]) {
   if (argc != 4) {
      printf("Некорректный ввод аргументов\n");
      return 1;
   }

   def = argv[1];
   res = argv[2];
   res_len = strlen(res);
   max_threads = atoi(argv[3]);
   if (max_threads > MAXIMUM) {
      printf("Нельзя вводить больше потоков, чем допустимо\n");
```

```
    return 1;
}

pthread_t* threads = (pthread_t*)malloc(max_threads * sizeof(pthread_t));
int* thread_args = (int*)malloc(max_threads * sizeof(int));

int i;
for (i = 0; i < max_threads; i++) {
    thread_args[i] = i;
    thread_create(&threads[i], NULL, thread_func, &thread_args[i]);
}
for (i = 0; i < max_threads; i++) {
    pthread_join(threads[i], NULL);
}

printf("Общее количество совпадений: %d\n", match_count);
free(thread_args);
free(threads);
return 0;
```

Протокол работы программы

Тестирование:

(в качестве входных данных использовалась строка длиной 65000 символов)

stepan@stepan-ASUS:~/Рабочий стол/учеба/prog 3 sem/OSI/laba2/src$ time ./a.out boevbcj….. naj a 1

Общее количество совпадений: 2553

real 0m0,064s

user 0m0,047s

sys 0m0,004s

stepan@stepan-ASUS:~/Рабочий стол/учеба/prog 3 sem/OSI/laba2/src$ time ./a.out boevbcj….. naj a 2

Общее количество совпадений: 2553

real 0m0,037s

user 0m0,046s

sys 0m0,008s

stepan@stepan-ASUS:~/Рабочий стол/учеба/prog 3 sem/OSI/laba2/src$ time ./a.out boevbcj….. naj a 3

Общее количество совпадений: 2553

real 0m0,031s

user 0m0,044s

sys 0m0,011s

stepan@stepan-ASUS:~/Рабочий стол/учеба/prog 3 sem/OSI/laba2/src$ time ./a.out boevbcj….. naj a 4

Общее количество совпадений: 2553

real 0m0,030s

user 0m0,058s

sys 0m0,004s

Кол-во потоков	Время (мс)	Ускорение	Эффективность
1	64	1	1
2	37	1.72	0.86
3	31	2.06	0.68
4	30	2.13	0.53

Strace:

strace -f ./a.out abababab b 5

```
execve("./lab2", ["./lab2", "abababab", "b", "5"], 0x7fff49bc4c30 /* 60 vars */) = 0
brk(NULL)                               = 0x56395400a000
arch_prctl(0x3001 /* ARCH_??? */, 0x7ffd838c5510) = -1 EINVAL (Недопустимый аргумент)
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f6d5e20b000
access("/etc/ld.so.preload", R_OK)      = -1 ENOENT (Нет такого файла или каталога)
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=88411, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 88411, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f6d5e1f5000
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\0P\237\2\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
pread64(3, "\4\0\0\0 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"..., 48, 848) = 48
pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\244;\374\204(\337f#\315I\214\234\f\256\271\32"..., 68, 896) = 68
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2216304, ...}, AT_EMPTY_PATH) = 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, 2260560, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f6d5de00000
mmap(0x7f6d5de28000, 1658880, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f6d5de28000
mmap(0x7f6d5dfbd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7f6d5dfbd000
mmap(0x7f6d5e015000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x214000) = 0x7f6d5e015000
```

mmap(0x7f6d5e01b000, 52816, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f6d5e01b000
close(3) = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f6d5e1f2000
arch_prctl(ARCH_SET_FS, 0x7f6d5e1f2740) = 0
set_tid_address(0x7f6d5e1f2a10) = 3462
set_robust_list(0x7f6d5e1f2a20, 24) = 0
rseq(0x7f6d5e1f30e0, 0x20, 0, 0x53053053) = 0
mprotect(0x7f6d5e015000, 16384, PROT_READ) = 0
mprotect(0x5639524c9000, 4096, PROT_READ) = 0
mprotect(0x7f6d5e245000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
munmap(0x7f6d5e1f5000, 88411) = 0
getrandom("\x3f\x46\xa9\xe3\x66\x8c\xfc\x79", 8, GRND_NONBLOCK) = 8
brk(NULL) = 0x56395400a000
brk(0x56395402b000) = 0x56395402b000
rt_sigaction(SIGRT_1, {sa_handler=0x7f6d5de91870, sa_mask=[],
sa_flags=SA_RESTORER|SA_ONSTACK|SA_RESTART|SA_SIGINFO,
sa_restorer=0x7f6d5de42520}, NULL, 8) = 0
rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x7f6d5d5ff000
mprotect(0x7f6d5d600000, 8388608, PROT_READ|PROT_WRITE) = 0
rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_TH
READ|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHIL
D_CLEARTID, child_tid=0x7f6d5ddff910, parent_tid=0x7f6d5ddff910, exit_signal=0,
stack=0x7f6d5d5ff000, stack_size=0x7fff00, tls=0x7f6d5ddff640}strace: **Process 3463
attached**
=> {parent_tid=[3463]}, 88) = 3463
[pid 3463] rseq(0x7f6d5ddfffe0, 0x20, 0, 0x53053053 <unfinished ...>
[pid 3462] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3463] <... rseq resumed>) = 0
[pid 3462] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3463] set_robust_list(0x7f6d5ddff920, 24 <unfinished ...>
[pid 3462] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 3463] <... set_robust_list resumed>) = 0
[pid 3462] <... mmap resumed>) = 0x7f6d5cdfe000
[pid 3463] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3462] mprotect(0x7f6d5cdff000, 8388608, PROT_READ|PROT_WRITE
<unfinished ...>

[pid 3463] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3462] <... mprotect resumed>) = 0
[pid 3463] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC
<unfinished ...>
[pid 3462] futex(0x7f6d5e247a98, FUTEX_WAIT_PRIVATE, 2, NULL <unfinished ...>
[pid 3463] <... openat resumed>) = 3
[pid 3463] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=88411, ...},
AT_EMPTY_PATH) = 0
[pid 3463] mmap(NULL, 88411, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f6d5e1f5000
[pid 3463] close(3) = 0
[pid 3463] mmap(NULL, 134217728, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_NORESERVE, -1, 0) = 0x7f6d54dfe000
[pid 3463] munmap(0x7f6d54dfe000, 52436992) = 0
[pid 3463] munmap(0x7f6d5c000000, 14671872) = 0
[pid 3463] mprotect(0x7f6d58000000, 135168, PROT_READ|PROT_WRITE) = 0
[pid 3463] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1",
O_RDONLY|O_CLOEXEC) = 3
[pid 3463] 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
[pid 3463] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...},
AT_EMPTY_PATH) = 0
[pid 3463] mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3,
0) = 0x7f6d5e1d2000
[pid 3463] mmap(0x7f6d5e1d5000, 94208, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7f6d5e1d5000
[pid 3463] mmap(0x7f6d5e1ec000, 16384, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1a000) = 0x7f6d5e1ec000
[pid 3463] mmap(0x7f6d5e1f0000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1d000) = 0x7f6d5e1f0000
[pid 3463] close(3) = 0
[pid 3463] mprotect(0x7f6d5e1f0000, 4096, PROT_READ) = 0
[pid 3463] futex(0x7f6d5e247a98, FUTEX_WAKE_PRIVATE, 1) = 1
[pid 3462] <... futex resumed>) = 0
[pid 3462] futex(0x7f6d5e247a98, FUTEX_WAKE_PRIVATE, 1 <unfinished ...>
[pid 3463] munmap(0x7f6d5e1f5000, 88411 <unfinished ...>
[pid 3462] <... futex resumed>) = 0
[pid 3462] rt_sigprocmask(SIG_BLOCK, ~[], <unfinished ...>
[pid 3463] <... munmap resumed>) = 0
[pid 3462] <... rt_sigprocmask resumed>[], 8) = 0
[pid 3463] futex(0x7f6d5e1f1210, FUTEX_WAKE_PRIVATE, 2147483647
<unfinished ...>
[pid 3462]
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_TH
READ|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHIL

D_CLEARTID, child_tid=0x7f6d5d5fe910, parent_tid=0x7f6d5d5fe910, exit_signal=0, stack=0x7f6d5cdfe000, stack_size=0x7fff00, tls=0x7f6d5d5fe640} <unfinished ...>
[pid 3463] <... futex resumed>) = 0
strace: Process 3464 attached
[pid 3463] rt_sigprocmask(SIG_BLOCK, ~[RT_1], <unfinished ...>
[pid 3462] <... clone3 resumed> => {parent_tid=[3464]}, 88) = 3464
[pid 3464] rseq(0x7f6d5d5fefe0, 0x20, 0, 0x53053053 <unfinished ...>
[pid 3462] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3463] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3462] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3464] <... rseq resumed>) = 0
[pid 3462] mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 3463] madvise(0x7f6d5d5ff000, 8368128, MADV_DONTNEED <unfinished ...>
[pid 3462] <... mmap resumed>) = 0x7f6d5c5fd000
[pid 3464] set_robust_list(0x7f6d5d5fe920, 24 <unfinished ...>
[pid 3462] mprotect(0x7f6d5c5fe000, 8388608, PROT_READ|PROT_WRITE <unfinished ...>
[pid 3463] <... madvise resumed>) = 0
[pid 3464] <... set_robust_list resumed>) = 0
[pid 3462] <... mprotect resumed>) = 0
[pid 3463] exit(0 <unfinished ...>
[pid 3464] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3462] rt_sigprocmask(SIG_BLOCK, ~[], <unfinished ...>
[pid 3463] <... exit resumed>) = ?
[pid 3462] <... rt_sigprocmask resumed>[], 8) = 0
[pid 3464] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3462]
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, child_tid=0x7f6d5cdfd910, parent_tid=0x7f6d5cdfd910, exit_signal=0, stack=0x7f6d5c5fd000, stack_size=0x7fff00, tls=0x7f6d5cdfd640} <unfinished ...>
[pid 3463] +++ exited with 0 +++
[pid 3464] rt_sigprocmask(SIG_BLOCK, ~[RT_1], NULL, 8) = 0
strace: Process 3465 attached
[pid 3464] madvise(0x7f6d5cdfe000, 8368128, MADV_DONTNEED <unfinished ...>
[pid 3462] <... clone3 resumed> => {parent_tid=[3465]}, 88) = 3465
[pid 3465] rseq(0x7f6d5cdfdfe0, 0x20, 0, 0x53053053 <unfinished ...>
[pid 3462] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3464] <... madvise resumed>) = 0
[pid 3462] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3465] <... rseq resumed>) = 0
[pid 3462] mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>

[pid 3464] exit(0 <unfinished ...>
[pid 3462] <... mmap resumed>) = 0x7f6d577ff000
[pid 3465] set_robust_list(0x7f6d5cdfd920, 24 <unfinished ...>
[pid 3462] mprotect(0x7f6d57800000, 8388608, PROT_READ|PROT_WRITE <unfinished ...>
[pid 3464] <... exit resumed>) = ?
[pid 3462] <... mprotect resumed>) = 0
[pid 3465] <... set_robust_list resumed>) = 0
[pid 3462] rt_sigprocmask(SIG_BLOCK, ~[], <unfinished ...>
[pid 3464] +++ exited with 0 +++
[pid 3462] <... rt_sigprocmask resumed>[], 8) = 0
[pid 3465] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3462] **clone3**({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, child_tid=0x7f6d57fff910, parent_tid=0x7f6d57fff910, exit_signal=0, stack=0x7f6d577ff000, stack_size=0x7fff00, tls=0x7f6d57fff640} <unfinished ...>
[pid 3465] <... rt_sigprocmask resumed>NULL, 8) = 0
strace: Process 3466 attached
[pid 3465] rt_sigprocmask(SIG_BLOCK, ~[RT_1], <unfinished ...>
[pid 3462] <... clone3 resumed> => {parent_tid=[3466]}, 88) = 3466
[pid 3466] rseq(0x7f6d57ffffe0, 0x20, 0, 0x53053053 <unfinished ...>
[pid 3462] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3465] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3462] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3466] <... rseq resumed>) = 0
[pid 3462] mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 3465] madvise(0x7f6d5c5fd000, 8368128, MADV_DONTNEED <unfinished ...>
[pid 3462] <... mmap resumed>) = 0x7f6d56ffe000
[pid 3466] set_robust_list(0x7f6d57fff920, 24 <unfinished ...>
[pid 3462] mprotect(0x7f6d56fff000, 8388608, PROT_READ|PROT_WRITE <unfinished ...>
[pid 3465] <... madvise resumed>) = 0
[pid 3462] <... mprotect resumed>) = 0
[pid 3466] <... set_robust_list resumed>) = 0
[pid 3465] exit(0 <unfinished ...>
[pid 3462] rt_sigprocmask(SIG_BLOCK, ~[], <unfinished ...>
[pid 3466] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3462] <... rt_sigprocmask resumed>[], 8) = 0
[pid 3465] <... exit resumed>) = ?
[pid 3462] **clone3**({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHIL

D_CLEARTID, child_tid=0x7f6d577fe910, parent_tid=0x7f6d577fe910, exit_signal=0,
stack=0x7f6d56ffe000, stack_size=0x7fff00, tls=0x7f6d577fe640} <unfinished ...>
[pid 3466] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3465] +++ exited with 0 +++
[pid 3466] rt_sigprocmask(SIG_BLOCK, ~[RT_1], **strace: Process 3467 attached**
NULL, 8) = 0
[pid 3462] <... clone3 resumed> => {parent_tid=[3467]}, 88) = 3467
[pid 3467] rseq(0x7f6d577fefe0, 0x20, 0, 0x53053053 <unfinished ...>
[pid 3466] madvise(0x7f6d577ff000, 8368128, MADV_DONTNEED <unfinished ...>
[pid 3462] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3467] <... rseq resumed>) = 0
[pid 3462] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3466] <... madvise resumed>) = 0
[pid 3467] set_robust_list(0x7f6d577fe920, 24 <unfinished ...>
[pid 3462] futex(0x7f6d57fff910, FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,
3466, NULL, FUTEX_BITSET_MATCH_ANY <unfinished ...>
[pid 3467] <... set_robust_list resumed>) = 0
[pid 3466] exit(0 <unfinished ...>
[pid 3467] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
[pid 3466] <... exit resumed>) = ?
[pid 3467] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3462] <... futex resumed>) = 0
[pid 3467] rt_sigprocmask(SIG_BLOCK, ~[RT_1], <unfinished ...>
[pid 3466] +++ exited with 0 +++
[pid 3462] futex(0x7f6d577fe910, FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME,
3467, NULL, FUTEX_BITSET_MATCH_ANY <unfinished ...>
[pid 3467] <... rt_sigprocmask resumed>NULL, 8) = 0
[pid 3467] madvise(0x7f6d56ffe000, 8368128, MADV_DONTNEED) = 0
[pid 3467] exit(0) = ?
[pid 3462] <... futex resumed>) = 0
[pid 3467] +++ exited with 0 +++
munmap(0x7f6d5d5ff000, 8392704) = 0
newfstatat(1, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...},
AT_EMPTY_PATH) = 0
write(1, "\320\236\320\261\321\211\320\265\320\265
\320\272\320\276\320\273\320\270\321\207\320\265\321\201\321\202\320\262\320\276 "...,
56Общее количество совпадений: 4
) = 56
exit_group(0) = ?
+++ exited with 0 +++

Вывод

Я реализовал многопоточность в своей программе и теперь могу использовать эту фишку в следующих своих программах. Когда происходит работа с гигантскими объемами данных, многопотность в программе — это очень выгодная вещь, позволяющая сократить время выполнения программы. Однако, нужно уметь грамотно описывать многопотность в коде, понимать, когда она требуется, а когда она бессмысленная.