Московский Авиационный Институт (Национальный Исследовательский Университет)

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

# Лабораторная работа №2 по курсу

**«Операционные системы»**

Группа: М8О-211Б-23

Студент: Косов В.В. Преподаватель: Бахарев В.Д. Оценка:

Дата: 09.12.24

Москва, 2024

**Цель работы:**

# Постановка задачи

**Целью является приобретение практических навыков в:**

* **Управление потоками в ОС**
* **Обеспечение синхронизации между потоками Задание:**

**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. В отчете привести исследование зависимости ускорения и эффективности алгоритма от входных данных и количества потоков. Получившиеся результаты необходимо объяснить.**

**Вариант 1) Отсортировать массив целых чисел при помощи битонической сортировки**

# Общий метод и алгоритм решения

Использованные системные вызовы:

* void exit(int status); – выполняет немедленное завершение программы. Все используемые программой потоки закрываются, и временные файлы удаляются, управление возвращается ОС или другой программе.
* int pthread\_create(pthread\_t \* restrict newthread, const pthread\_attr\_t \* restrict

attr, void \*(\* start\_routine)(void \*), void \* restrict arg) — создаёт поток с рутиной (стартовой функцией) и заданными аргументами

* int pthread\_join(pthread\_t th, void \*\* thread\_return) — дожидается завершения потока.
* pthread\_exit() - Функция pthread\_exit() завершает вызывающий поток и возвращает значение через retval, которое (если поток можно объединить) доступно другому потоку в том же процессе, который вызывает pthread\_join(3).

Программа получает на вход один аргумент - максимальное количество потоков

После создаётся нужное количество потоков, которые хранятся в массиве threads. Также, для каждого потока существует структура, которая указывает потоку на подмассив, который ему необходимо отсортировать. Структуры хранятся в массиве sort\_args.

Структура SortArgs:

* **arr** — указатель на массив, который нужно отсортировать.
* **low** — индекс массива, с которого потоку необходимо начать сортировку.
* **cnt** — количество элементов в подмассиве, который сортирует поток.
* **dir** — направление сортировки. 1 - возрастание, 0 - убывание
* **thread\_id** — id потока.

После считывания числа потоков, программа создает динамический массив с длиной 10^6, и заполняет его случайными целыми числами.

Потоки создаются в цикле, в этом же цикле заполняются поля структур.

Алгоритм битонической сортировки реализован в функциях bitonic\_sort и bitonic\_merge

Обе эти функции принимают следующие параметры:

1. **arr - указатель на массив, который надо отсортировать**
2. **low - индекс, с которого начинается сортировка массива**
3. **сnt - количество элементов массива**

**4) dir** — направление сортировки. 1 - возрастание, 0 - убывание

Bitonic\_sort рекурсивно делит массив на два подмассива, если количество элементов больше одного. Один из подмассивов должен быть упорядочен по возрастанию, по этому передается dir == 1, другой - по убыванию, соответственно, dir == 0. После деления на подмассивы, вызывается функция Bitonic\_merge, которая сливает два подмассива в один, меняя местами элементы попарно, индексы которых отличаются на к - половина количества элементов изначального массива.После первой попытки слияния, два подмассива являются отсортированнами относительно друг друга (сравниваются элементы, индексы которых отличаются на к). Может возникнуть случай, когда оба или один подмассив не отсортирован относительно самого себя. Для того, чтобы обработать этот случай, рекурсивно дважды вызывается функция Bitonic\_merge, для сортировки обоих подмассивов относительно себя.

Для реализации многопоточности, была написана функция Bitonic\_sort\_thread, которая запускает работу Bitonic\_sort в разных потоках, на основе структур этих потоков. Во время создания потоков с помощью функции pthread\_create, передается адрес функции Bitonic\_sort\_thread и структура потока в качестве аргумента этой функции.

Для того чтобы разграничить массив для разных потоков, используется переменная chunk\_size, на основе которой заполняются поля структуры low и cnt. Таким образом, массив равномерно разграничиваются для разных потоков, отчего потоки не могут обращаться к данным, к которым обращаются другие потоки, состояние гонки данных не наступает.

**После того, как потоки отсортировали свои подмассивы и завершились (основной поток дождался их завершения с помощью pthread\_join), основному потоку необходимо слиять все подмассивы в один (т.е. отсортировать подмассивы относительно их самих). Для этого основным потоком вызывается функция Bitonic\_merge.**

|  |  |  |  |
| --- | --- | --- | --- |
| Число потоков | Время исполнения (мс) | Ускорение | Эффективность |
| 1 | 312.377 | 1 | 1 |
| 2 | 162.673 | 1,92 | 0,96 |
| 3 | 110.759 | 2,82 | 0,94 |
| 4 | 95.703 | 3,26 | 0,815 |
| 5 | 91.703 | 3,4 | 0,68 |
| 6 | 84.689 | 3,68 | 0,613 |
| 7 | 79.231 | 3,94 | 0,56 |
| 16 | 49.671 | 6,28 | 0,39 |
| 17 | 63.640 | 4,9 | 0,28 |
| 18 | 72.746 | 4,29 | 0,23 |

# Код программы

**#include <unistd.h>**

**#include <fcntl.h>**

**#include <stdio.h>**

**#include <stdlib.h>**

**#include <pthread.h>**

**#include <time.h>**

**#include <sys/time.h>**

**typedef struct {**

**int \*arr;**

**int low;**

**int cnt;**

**int dir;**

**int thread\_id;**

**} SortArgs;**

**void bitonic\_merge(int arr[], int low, int cnt, int dir) {**

**if (cnt > 1) {**

**int k = cnt / 2;**

**for (int i = low; i < low + k; i++) {**

**if (dir == (arr[i] > arr[i + k])) {**

**int temp = arr[i];**

**arr[i] = arr[i + k];**

**arr[i + k] = temp;**

**}**

**}**

**bitonic\_merge(arr, low, k, dir);**

**bitonic\_merge(arr, low + k, k, dir);**

**}**

**}**

**void bitonic\_sort(int arr[], int low, int cnt, int dir) {**

**if (cnt > 1) {**

**int k = cnt / 2;**

**bitonic\_sort(arr, low, k, 1);**

**bitonic\_sort(arr, low + k, k, 0);**

**bitonic\_merge(arr, low, cnt, dir);**

**}**

**}**

**void\* bitonic\_sort\_thread(void \*args) {**

**SortArgs \*sort\_args = (SortArgs\*)args;**

**//printf("Thread %d started\n", sort\_args->thread\_id); // Выводим информацию о запуске потока**

**bitonic\_sort(sort\_args->arr, sort\_args->low, sort\_args->cnt, sort\_args->dir);**

**//printf("Thread %d finished\n", sort\_args->thread\_id); // Выводим информацию о завершении потока**

**return NULL;**

**}**

**// Функция для записи массива в файл**

**void write\_to\_file(int arr[], int n, const char \*filename) {**

**FILE \*file = fopen(filename, "w");**

**if (!file) {**

**perror("Error opening file");**

**exit(1);**

**}**

**fprintf(file, "Result: ");**

**for (int i = 0; i < n; i++) {**

**fprintf(file, "%d ", arr[i]);**

**}**

**fclose(file);**

**}**

**int main(int argc, char \*argv[]) {**

**if (argc != 2) {**

**fprintf(stderr, "Usage: %s <number\_of\_threads>\n", argv[0]);**

**return 1;**

**}**

**int num\_threads = atoi(argv[1]);**

**if (num\_threads <= 0) {**

**fprintf(stderr, "Invalid number of threads\n");**

**return 1;**

**}**

**int n = 1000000;**

**int \*arr = (int\*)malloc(n \* sizeof(int));**

**if (arr == NULL) {**

**perror("Memory allocation failed");**

**return 1;**

**}**

**srand(time(NULL));**

**for (int i = 0; i < n; i++) {**

**arr[i] = rand() % 1000;**

**}**

**struct timeval start\_time, end\_time;**

**gettimeofday(&start\_time, NULL);**

**pthread\_t \*threads = (pthread\_t\*)malloc(num\_threads \* sizeof(pthread\_t));**

**SortArgs \*sort\_args = (SortArgs\*)malloc(num\_threads \* sizeof(SortArgs));**

**int chunk\_size = n / num\_threads;**

**for (int i = 0; i < num\_threads; i++) {**

**sort\_args[i].arr = arr;**

**sort\_args[i].low = i \* chunk\_size;**

**sort\_args[i].cnt = (i == num\_threads - 1) ? n - (i \* chunk\_size) : chunk\_size;**

**sort\_args[i].dir = 1;**

**sort\_args[i].thread\_id = i;**

**pthread\_create(&threads[i], NULL, bitonic\_sort\_thread, &sort\_args[i]);**

**}**

**for (int i = 0; i < num\_threads; i++) {**

**pthread\_join(threads[i], NULL);**

**}**

**bitonic\_merge(arr, 0, n, 1);**

**gettimeofday(&end\_time, NULL);**

**double time\_taken = (end\_time.tv\_sec - start\_time.tv\_sec) +**

**(end\_time.tv\_usec - start\_time.tv\_usec) / 1000000.0;**

**write\_to\_file(arr, n, "output.txt");**

**printf("Time taken for sorting: %.6f seconds\n", time\_taken);**

**free(arr);**

**free(threads);**

**free(sort\_args);**

**return 0;**

**}**

**Протокол**

vsevolod@DESKTOP-K08EACJ:~/os\_labs/laba\_2$ strace ./a.out 3

execve("./a.out", ["./a.out", "3"], 0x7ffea1e0df18 /\* 36 vars \*/) = 0

brk(NULL) = 0x555cfb61f000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffc1c759450) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f5f81977000

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

newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=21167, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 21167, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f5f81971000

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\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\0I\17\357\204\3$\f\221\2039x\324\224\323\236S"..., 68, 896) = 68

newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=2220400, ...}, 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, 2264656, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f5f81748000

mprotect(0x7f5f81770000, 2023424, PROT\_NONE) = 0

mmap(0x7f5f81770000, 1658880, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x28000) = 0x7f5f81770000

mmap(0x7f5f81905000, 360448, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1bd000) = 0x7f5f81905000

mmap(0x7f5f8195e000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x215000) = 0x7f5f8195e000

mmap(0x7f5f81964000, 52816, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f5f81964000

close(3) = 0

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f5f81745000

arch\_prctl(ARCH\_SET\_FS, 0x7f5f81745740) = 0

set\_tid\_address(0x7f5f81745a10) = 4614

set\_robust\_list(0x7f5f81745a20, 24) = 0

rseq(0x7f5f817460e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7f5f8195e000, 16384, PROT\_READ) = 0

mprotect(0x555cd2392000, 4096, PROT\_READ) = 0

mprotect(0x7f5f819b1000, 8192, PROT\_READ) = 0

prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

munmap(0x7f5f81971000, 21167) = 0

getrandom("\xcf\x25\xc3\x23\xf0\xd2\x98\xa9", 8, GRND\_NONBLOCK) = 8

brk(NULL) = 0x555cfb61f000

brk(0x555cfb640000) = 0x555cfb640000

mmap(NULL, 4001792, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f5f81374000

rt\_sigaction(SIGRT\_1, {sa\_handler=0x7f5f817d9870, sa\_mask=[], sa\_flags=SA\_RESTORER|SA\_ONSTACK|SA\_RESTART|SA\_SIGINFO, sa\_restorer=0x7f5f8178a520}, 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) = 0x7f5f80b73000

mprotect(0x7f5f80b74000, 8388608, PROT\_READ|PROT\_WRITE) = 0

rt\_sigprocmask(SIG\_BLOCK, ~[], [], 8) = 0

**clone3({flags=CLONE\_VM|CLONE\_FS|CLONE\_FILES|CLONE\_SIGHAND|CLONE\_THREAD|CLONE\_SYSVSEM|CLONE\_SETTLS|CLONE\_PARENT\_SETTID|CLONE\_CHILD\_CLEARTID, child\_tid=0x7f5f81373910, parent\_tid=0x7f5f81373910, exit\_signal=0, stack=0x7f5f80b73000, stack\_size=0x7fff00, tls=0x7f5f81373640} => {parent\_tid=[4615]}, 88) = 4615**

**rt\_sigprocmask(SIG\_SETMASK, [], NULL, 8) = 0**

mmap(NULL, 8392704, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS|MAP\_STACK, -1, 0) = 0x7f5f80372000

mprotect(0x7f5f80373000, 8388608, PROT\_READ|PROT\_WRITE) = 0

rt\_sigprocmask(SIG\_BLOCK, ~[], [], 8) = 0

**clone3({flags=CLONE\_VM|CLONE\_FS|CLONE\_FILES|CLONE\_SIGHAND|CLONE\_THREAD|CLONE\_SYSVSEM|CLONE\_SETTLS|CLONE\_PARENT\_SETTID|CLONE\_CHILD\_CLEARTID, child\_tid=0x7f5f80b72910, parent\_tid=0x7f5f80b72910, exit\_signal=0, stack=0x7f5f80372000, stack\_size=0x7fff00, tls=0x7f5f80b72640} => {parent\_tid=[4616]}, 88) = 4616**

**rt\_sigprocmask(SIG\_SETMASK, [], NULL, 8) = 0**

mmap(NULL, 8392704, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS|MAP\_STACK, -1, 0) = 0x7f5f7fb71000

mprotect(0x7f5f7fb72000, 8388608, PROT\_READ|PROT\_WRITE) = 0

rt\_sigprocmask(SIG\_BLOCK, ~[], [], 8) = 0

**clone3({flags=CLONE\_VM|CLONE\_FS|CLONE\_FILES|CLONE\_SIGHAND|CLONE\_THREAD|CLONE\_SYSVSEM|CLONE\_SETTLS|CLONE\_PARENT\_SETTID|CLONE\_CHILD\_CLEARTID, child\_tid=0x7f5f80371910, parent\_tid=0x7f5f80371910, exit\_signal=0, stack=0x7f5f7fb71000, stack\_size=0x7fff00, tls=0x7f5f80371640} => {parent\_tid=[4617]}, 88) = 4617**

rt\_sigprocmask(SIG\_SETMASK, [], NULL, 8) = 0

**futex(0x7f5f81373910, FUTEX\_WAIT\_BITSET|FUTEX\_CLOCK\_REALTIME, 4615, NULL, FUTEX\_BITSET\_MATCH\_ANY) = 0**

openat(AT\_FDCWD, "output.txt", O\_WRONLY|O\_CREAT|O\_TRUNC, 0666) = 3

newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=0, ...}, AT\_EMPTY\_PATH) = 0

write(3, "Result: 0 0 0 0 0 0 0 0 0 0 0 0 "..., 4096) = 4096

write(3, "2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 "..., 4096) = 4096

write(3, "4 4 4 3 4 4 4 4 4 4 4 3 3 4 4 4 "..., 4096) = 4096

write(3, "6 6 6 6 6 6 6 5 5 6 5 6 6 6 6 6 "..., 4096) = 4096

write(3, " 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8"..., 4096) = 4096

write(3, "10 10 10 10 10 10 10 10 10 10 10"..., 4096) = 4096

write(3, "1 11 11 11 11 11 11 11 11 11 11 "..., 4096) = 4096

write(3, "12 12 12 13 13 12 13 12 12 12 12"..., 4096) = 4096

write(3, "4 14 14 14 14 14 14 14 14 14 14 "..., 4096) = 4096

write(3, " 15 15 15 15 15 15 15 15 15 15 1"..., 4096) = 4096

write(3, "17 17 17 17 17 17 17 17 17 17 17"..., 4096) = 4096

write(3, "8 18 18 18 18 18 18 18 18 18 18 "..., 4096) = 4096

write(3, " 19 19 19 19 19 19 19 19 19 19 1"..., 4096) = 4096

write(3, "21 21 21 21 21 21 21 21 21 21 20"..., 4096) = 4096

write(3, "2 22 21 22 22 22 22 22 22 22 22 "..., 4096) = 4096

write(3, " 23 23 23 23 23 24 24 23 24 23 2"..., 4096) = 4096

write(3, "25 25 25 25 25 25 25 25 25 25 25"..., 4096) = 4096

write(3, "6 26 26 26 26 26 26 26 26 26 26 "..., 4096) = 4096

write(3, " 27 27 27 27 27 27 27 27 27 27 2"..., 4096) = 4096

write(3, "27 28 27 28 28 28 28 28 28 28 28"..., 4096) = 4096

write(3, "0 30 30 30 30 30 30 30 30 30 30 "..., 4096) = 4096

write(3, " 31 31 31 31 31 31 32 32 32 32 3"..., 4096) = 4096

write(3, "33 33 33 33 33 33 33 33 33 33 33"..., 4096) = 4096

write(3, "4 34 34 34 34 34 34 34 34 34 34 "..., 4096) = 4096

write(3, " 36 36 36 36 36 36 33 34 34 35 3"..., 4096) = 4096

write(3, "37 37 37 37 37 37 37 37 37 37 37"..., 4096) = 4096

write(3, "8 38 38 38 38 38 38 38 38 38 38 "..., 4096) = 4096

write(3, " 39 39 39 39 39 39 39 40 39 40 4"..., 4096) = 4096

write(3, "41 41 41 41 41 41 41 41 41 41 41"..., 4096) = 4096

write(3, "3 43 43 44 43 43 43 43 43 44 46 "..., 4096) = 4096

write(3, " 44 44 44 44 44 44 44 44 44 44 4"..., 4096) = 4096

write(3, "45 45 45 45 45 45 45 45 45 45 45"..., 4096) = 4096

write(3, "6 46 46 46 46 46 46 46 46 46 46 "..., 4096) = 4096

write(3, " 48 48 48 48 48 48 48 48 48 48 4"..., 4096) = 4096

write(3, "50 50 50 50 50 50 50 50 50 50 50"..., 4096) = 4096

write(3, "1 51 51 50 51 50 51 51 50 50 51 "..., 4096) = 4096

write(3, " 52 52 52 52 52 52 52 52 52 52 5"..., 4096) = 4096

write(3, "53 53 53 53 53 53 53 53 53 53 53"..., 4096) = 4096

write(3, "4 54 54 54 54 54 54 54 54 54 54 "..., 4096) = 4096

write(3, " 56 56 56 56 56 56 56 56 56 56 5"..., 4096) = 4096

write(3, "58 57 58 58 58 58 58 58 58 58 58"..., 4096) = 4096

write(3, "9 59 59 59 58 58 58 59 59 58 58 "..., 4096) = 4096

write(3, " 60 60 59 60 60 60 60 60 60 60 6"..., 4096) = 4096

write(3, "61 61 61 61 61 61 61 61 61 61 61"..., 4096) = 4096

write(3, "3 63 63 63 63 63 63 63 63 63 63 "..., 4096) = 4096

write(3, " 64 64 64 64 64 64 64 64 64 64 6"..., 4096) = 4096

write(3, "65 66 66 66 65 66 66 66 66 66 66"..., 4096) = 4096

write(3, "7 67 67 67 67 67 67 67 67 67 67 "..., 4096) = 4096

write(3, " 68 68 68 68 68 68 68 68 68 68 6"..., 4096) = 4096

write(3, "70 71 71 70 71 70 70 70 70 70 70"..., 4096) = 4096

write(3, "1 71 71 71 71 71 71 71 71 71 71 "..., 4096) = 4096

write(3, " 72 72 72 72 72 72 72 70 70 71 7"..., 4096) = 4096

write(3, "72 73 72 73 73 73 72 73 74 73 73"..., 4096) = 4096

write(3, "5 75 75 75 75 75 75 75 75 75 75 "..., 4096) = 4096

write(3, " 76 77 76 77 77 76 77 77 77 77 7"..., 4096) = 4096

write(3, "77 78 78 78 78 78 78 78 78 77 77"..., 4096) = 4096

write(3, "0 79 79 79 79 79 79 79 79 80 79 "..., 4096) = 4096

write(3, " 80 80 80 80 80 81 80 80 80 80 8"..., 4096) = 4096

write(3, "82 82 81 81 81 81 82 81 81 82 82"..., 4096) = 4096

write(3, "4 84 84 84 84 84 84 84 84 83 84 "..., 4096) = 4096

write(3, " 85 85 84 85 84 85 85 84 85 85 8"..., 4096) = 4096

write(3, "86 86 86 86 86 86 86 86 86 86 86"..., 4096) = 4096

write(3, " 87 87 87 87 86 86 86 86 87 86 8"..., 4096) = 4096

write(3, "88 88 88 88 88 88 88 89 88 88 88"..., 4096) = 4096

write(3, "90 90 90 90 90 90 90 90 90 90 90"..., 4096) = 4096

write(3, "0 90 91 90 91 91 91 91 91 91 91 "..., 4096) = 4096

write(3, " 93 93 93 93 93 93 93 93 93 93 9"..., 4096) = 4096

write(3, "94 94 94 94 94 94 94 94 94 94 94"..., 4096) = 4096

write(3, "5 95 95 94 95 95 95 95 95 95 95 "..., 4096) = 4096

write(3, " 97 97 97 97 97 97 97 97 97 97 9"..., 4096) = 4096

write(3, "8 98 98 98 98 98 98 98 98 98 98 "..., 4096) = 4096

write(3, " 99 99 100 99 99 99 99 99 99 99 "..., 4096) = 4096

write(3, " 101 101 101 100 101 101 101 100"..., 4096) = 4096

write(3, " 102 102 102 102 102 102 102 101"..., 4096) = 4096

write(3, " 103 103 103 103 103 103 103 103"..., 4096) = 4096

write(3, "04 104 104 104 104 104 104 104 1"..., 4096) = 4096

write(3, "05 105 105 105 105 105 105 105 1"..., 4096) = 4096

write(3, "105 105 102 105 105 105 105 105 "..., 4096) = 4096

write(3, "106 106 106 106 106 106 106 106 "..., 4096) = 4096

write(3, "108 108 108 108 108 108 108 107 "..., 4096) = 4096

write(3, "108 108 108 108 108 108 108 108 "..., 4096) = 4096

write(3, "110 110 110 110 110 110 110 110 "..., 4096) = 4096

write(3, "111 110 110 110 106 106 106 110 "..., 4096) = 4096

write(3, "112 112 112 112 112 112 112 112 "..., 4096) = 4096

write(3, "112 112 112 113 113 112 113 113 "..., 4096) = 4096

write(3, "114 114 114 114 114 114 114 114 "..., 4096) = 4096

write(3, "115 115 115 115 115 115 115 115 "..., 4096) = 4096

write(3, "116 117 117 117 117 117 117 117 "..., 4096) = 4096

write(3, "116 117 117 117 117 117 116 117 "..., 4096) = 4096

write(3, "118 118 118 118 118 118 118 118 "..., 4096) = 4096

write(3, "119 119 119 119 119 119 119 119 "..., 4096) = 4096

write(3, "120 120 120 120 120 120 120 120 "..., 4096) = 4096

write(3, "121 121 121 121 121 121 121 121 "..., 4096) = 4096

write(3, "122 122 122 122 122 122 122 122 "..., 4096) = 4096

write(3, "123 123 123 123 123 123 123 123 "..., 4096) = 4096

write(3, "125 124 124 125 125 125 125 125 "..., 4096) = 4096

write(3, "25 125 125 125 126 125 126 126 1"..., 4096) = 4096

write(3, "27 127 127 127 127 127 127 127 1"..., 4096) = 4096

write(3, "27 127 127 127 127 127 126 126 1"..., 4096) = 4096

write(3, "27 127 127 127 127 127 127 127 1"..., 4096) = 4096

write(3, "29 129 129 129 129 129 129 129 1"..., 4096) = 4096

write(3, "30 130 130 130 130 130 130 130 1"..., 4096) = 4096

write(3, "31 131 131 131 131 131 131 131 1"..., 4096) = 4096

write(3, "32 131 132 132 131 132 132 132 1"..., 4096) = 4096

write(3, "33 133 133 133 133 133 133 133 1"..., 4096) = 4096

write(3, "34 134 134 134 134 134 134 134 1"..., 4096) = 4096

write(3, "35 135 136 135 136 136 136 135 1"..., 4096) = 4096

write(3, "36 136 136 136 136 136 136 136 1"..., 4096) = 4096

write(3, "37 137 137 137 137 137 137 137 1"..., 4096) = 4096

write(3, "38 138 138 138 138 138 138 138 1"..., 4096) = 4096

write(3, "39 139 139 139 139 139 139 139 1"..., 4096) = 4096

write(3, "40 140 140 140 140 140 140 140 1"..., 4096) = 4096

write(3, "41 141 141 141 141 141 141 142 1"..., 4096) = 4096

write(3, "42 142 142 142 142 142 142 142 1"..., 4096) = 4096

write(3, "43 144 144 144 144 144 144 144 1"..., 4096) = 4096

write(3, "44 144 144 144 145 145 145 145 1"..., 4096) = 4096

write(3, "46 146 146 146 146 146 146 146 1"..., 4096) = 4096

write(3, "46 147 147 147 147 147 146 146 1"..., 4096) = 4096

write(3, "80 149 154 179 152 142 142 141 1"..., 4096) = 4096

write(3, "48 148 148 148 148 148 148 148 1"..., 4096) = 4096

write(3, "49 149 149 149 149 149 149 149 1"..., 4096) = 4096

write(3, "50 150 150 150 150 150 150 150 1"..., 4096) = 4096

write(3, "51 151 151 151 151 151 151 151 1"..., 4096) = 4096

write(3, "52 152 152 152 153 152 153 153 1"..., 4096) = 4096

write(3, "53 153 153 153 153 153 154 153 1"..., 4096) = 4096

write(3, "54 154 154 155 155 154 154 154 1"..., 4096) = 4096

write(3, "55 155 155 156 155 156 155 155 1"..., 4096) = 4096

write(3, "57 157 157 157 157 156 156 157 1"..., 4096) = 4096

write(3, "58 158 158 158 158 158 158 158 1"..., 4096) = 4096

write(3, "59 159 159 159 159 159 159 159 1"..., 4096) = 4096

write(3, "60 160 160 160 160 160 160 160 1"..., 4096) = 4096

write(3, "60 161 161 161 161 161 161 161 1"..., 4096) = 4096

write(3, "62 162 162 162 162 162 162 162 1"..., 4096) = 4096

write(3, "63 163 163 163 163 163 163 163 1"..., 4096) = 4096

write(3, "64 164 164 164 164 164 164 164 1"..., 4096) = 4096

write(3, "65 165 165 165 165 165 165 165 1"..., 4096) = 4096

write(3, "66 166 166 166 166 166 166 166 1"..., 4096) = 4096

write(3, "67 167 167 167 167 167 167 167 1"..., 4096) = 4096

write(3, "68 168 168 168 168 168 168 168 1"..., 4096) = 4096

write(3, "68 168 168 168 168 168 168 168 1"..., 4096) = 4096

write(3, "69 169 170 169 169 170 170 170 1"..., 4096) = 4096

write(3, "70 170 170 170 170 170 171 170 1"..., 4096) = 4096

write(3, "72 171 172 172 172 172 172 172 1"..., 4096) = 4096

write(3, "72 172 173 172 172 173 172 173 1"..., 4096) = 4096

write(3, "74 174 174 174 174 174 174 174 1"..., 4096) = 4096

write(3, "75 175 175 175 175 175 175 175 1"..., 4096) = 4096

write(3, "77 177 177 176 176 176 177 177 1"..., 4096) = 4096

write(3, "77 177 177 177 177 177 177 177 1"..., 4096) = 4096

write(3, "79 179 179 179 179 179 179 179 1"..., 4096) = 4096

write(3, "78 177 179 179 179 178 179 179 1"..., 4096) = 4096

write(3, "81 180 181 181 181 181 181 181 1"..., 4096) = 4096

write(3, "81 181 181 181 182 182 182 182 1"..., 4096) = 4096

write(3, "83 183 183 183 183 183 183 183 1"..., 4096) = 4096

write(3, "84 184 184 184 184 184 184 183 1"..., 4096) = 4096

write(3, "85 185 186 185 185 184 184 185 1"..., 4096) = 4096

write(3, "86 185 185 185 185 185 185 185 1"..., 4096) = 4096

write(3, "87 187 187 187 187 187 187 187 1"..., 4096) = 4096

write(3, "87 187 187 187 187 188 188 187 1"..., 4096) = 4096

write(3, "89 189 189 189 189 189 189 189 1"..., 4096) = 4096

write(3, "90 190 190 190 190 190 190 190 1"..., 4096) = 4096

write(3, "90 189 189 190 190 190 190 190 1"..., 4096) = 4096

write(3, "91 191 191 191 191 191 191 191 1"..., 4096) = 4096

write(3, "92 192 192 192 192 192 192 192 1"..., 4096) = 4096

write(3, "94 194 194 194 194 193 194 194 1"..., 4096) = 4096

write(3, "94 194 194 194 194 194 194 194 1"..., 4096) = 4096

write(3, "96 196 196 196 196 196 196 196 1"..., 4096) = 4096

write(3, "97 196 196 196 196 197 196 196 1"..., 4096) = 4096

write(3, "98 198 198 198 198 198 198 198 1"..., 4096) = 4096

write(3, "99 199 199 199 199 199 199 199 1"..., 4096) = 4096

write(3, "00 200 200 200 200 200 200 200 2"..., 4096) = 4096

write(3, "00 201 201 201 201 201 201 201 2"..., 4096) = 4096

write(3, "02 202 202 202 202 202 202 202 2"..., 4096) = 4096

write(3, "03 203 203 203 203 203 203 202 2"..., 4096) = 4096

write(3, "04 204 204 204 204 204 204 204 2"..., 4096) = 4096

write(3, "05 205 205 205 205 205 205 205 2"..., 4096) = 4096

write(3, "06 206 206 206 206 206 206 206 2"..., 4096) = 4096

write(3, "06 206 207 207 207 207 207 207 2"..., 4096) = 4096

write(3, "08 208 208 208 208 208 208 208 2"..., 4096) = 4096

write(3, "09 209 209 209 209 209 209 209 2"..., 4096) = 4096

write(3, "10 210 210 210 210 210 210 210 2"..., 4096) = 4096

write(3, "11 211 211 211 211 211 211 211 2"..., 4096) = 4096

write(3, "12 212 212 212 212 212 212 211 2"..., 4096) = 4096

write(3, "13 213 213 213 213 213 213 213 2"..., 4096) = 4096

write(3, "14 214 214 212 214 214 213 214 2"..., 4096) = 4096

write(3, "15 215 215 215 215 215 215 215 2"..., 4096) = 4096

write(3, "15 215 215 215 216 215 215 216 2"..., 4096) = 4096

write(3, "17 217 217 217 217 217 217 217 2"..., 4096) = 4096

write(3, "18 218 217 218 218 218 218 218 2"..., 4096) = 4096

write(3, "19 219 219 219 219 219 219 219 2"..., 4096) = 4096

write(3, "20 220 220 220 220 220 220 220 2"..., 4096) = 4096

write(3, "21 222 222 222 221 223 221 220 2"..., 4096) = 4096

write(3, "22 222 222 222 222 222 222 222 2"..., 4096) = 4096

write(3, "23 223 223 223 223 223 223 223 2"..., 4096) = 4096

write(3, "24 224 224 224 224 224 224 224 2"..., 4096) = 4096

write(3, "25 225 225 225 225 225 225 225 2"..., 4096) = 4096

write(3, "26 226 226 226 226 226 226 226 2"..., 4096) = 4096

write(3, "27 227 227 227 227 227 227 227 2"..., 4096) = 4096

write(3, "28 228 228 228 228 228 228 228 2"..., 4096) = 4096

write(3, "29 229 229 229 229 229 229 229 2"..., 4096) = 4096

write(3, "30 230 231 231 230 230 230 230 2"..., 4096) = 4096

write(3, "31 231 231 231 231 231 231 231 2"..., 4096) = 4096

write(3, "32 232 232 232 232 232 232 232 2"..., 4096) = 4096

write(3, "33 232 233 232 232 232 232 233 2"..., 4096) = 4096

write(3, "35 233 233 233 233 234 233 233 2"..., 4096) = 4096

write(3, "35 234 235 235 234 235 235 236 2"..., 4096) = 4096

write(3, "36 236 237 236 237 237 237 237 2"..., 4096) = 4096

write(3, "37 236 236 237 237 237 237 237 2"..., 4096) = 4096

write(3, "38 238 238 238 238 238 238 238 2"..., 4096) = 4096

write(3, "39 239 239 239 239 240 240 240 2"..., 4096) = 4096

write(3, "40 240 240 240 240 240 240 240 2"..., 4096) = 4096

write(3, "42 242 241 241 241 242 242 241 2"..., 4096) = 4096

write(3, "42 242 242 242 242 242 242 242 2"..., 4096) = 4096

write(3, "43 243 243 243 243 243 243 243 2"..., 4096) = 4096

write(3, "44 244 244 244 244 244 244 244 2"..., 4096) = 4096

write(3, "45 245 245 245 245 245 246 246 2"..., 4096) = 4096

write(3, "46 246 246 246 247 247 247 247 2"..., 4096) = 4096

write(3, "47 247 247 247 247 247 247 247 2"..., 4096) = 4096

write(3, "49 249 249 249 249 249 248 248 2"..., 4096) = 4096

write(3, "9 250 250 249 249 249 249 250 24"..., 4096) = 4096

write(3, "1 251 251 251 251 251 251 251 25"..., 4096) = 4096

write(3, "2 252 252 251 251 251 252 252 25"..., 4096) = 4096

write(3, "8 232 247 248 235 249 252 245 25"..., 4096) = 4096

write(3, "3 253 253 253 253 253 253 253 25"..., 4096) = 4096

write(3, "4 254 254 254 253 254 254 254 25"..., 4096) = 4096

write(3, "5 255 255 255 255 255 255 255 25"..., 4096) = 4096

write(3, "6 256 257 257 256 257 257 257 25"..., 4096) = 4096

write(3, "8 258 258 259 258 258 258 258 25"..., 4096) = 4096

write(3, "8 259 259 259 259 258 258 258 25"..., 4096) = 4096

write(3, "0 260 260 260 260 260 260 260 26"..., 4096) = 4096

write(3, "1 261 260 260 260 260 261 261 26"..., 4096) = 4096

write(3, "2 262 262 262 262 262 262 262 26"..., 4096) = 4096

write(3, "3 263 263 263 263 263 263 263 26"..., 4096) = 4096

write(3, "3 264 264 263 264 264 264 264 26"..., 4096) = 4096

write(3, "5 265 265 264 265 265 265 265 26"..., 4096) = 4096

write(3, "6 266 266 266 266 266 266 266 26"..., 4096) = 4096

write(3, "7 267 267 267 267 267 267 267 26"..., 4096) = 4096

write(3, "9 268 269 269 268 268 268 268 26"..., 4096) = 4096

write(3, "9 269 269 269 269 268 268 269 26"..., 4096) = 4096

write(3, "0 270 270 270 270 270 270 270 27"..., 4096) = 4096

write(3, "1 271 271 271 271 271 271 271 27"..., 4096) = 4096

write(3, "2 273 273 273 273 272 273 273 27"..., 4096) = 4096

write(3, "4 274 274 274 274 274 274 274 27"..., 4096) = 4096

write(3, "3 274 274 273 274 274 274 274 27"..., 4096) = 4096

write(3, "5 275 275 275 275 275 275 275 27"..., 4096) = 4096

write(3, "6 276 276 276 276 276 276 275 27"..., 4096) = 4096

write(3, "7 277 277 277 277 277 277 277 27"..., 4096) = 4096

write(3, "9 279 278 279 278 278 278 278 27"..., 4096) = 4096

write(3, "9 279 279 279 279 279 279 279 27"..., 4096) = 4096

write(3, "0 280 280 279 279 279 279 280 27"..., 4096) = 4096

write(3, "0 281 280 281 281 280 281 281 28"..., 4096) = 4096

write(3, "2 282 282 282 282 282 282 282 28"..., 4096) = 4096

write(3, "4 284 284 283 284 284 284 284 28"..., 4096) = 4096

write(3, "4 283 283 284 284 284 284 284 28"..., 4096) = 4096

write(3, "5 285 285 285 286 285 285 285 28"..., 4096) = 4096

write(3, "7 287 287 287 287 287 287 286 28"..., 4096) = 4096

write(3, "8 288 288 288 288 287 288 287 28"..., 4096) = 4096

write(3, "9 289 289 289 288 289 289 289 28"..., 4096) = 4096

write(3, "0 290 289 289 289 289 290 289 28"..., 4096) = 4096

write(3, "1 291 291 291 291 291 291 291 29"..., 4096) = 4096

write(3, "2 292 292 292 292 292 292 292 29"..., 4096) = 4096

write(3, "3 293 293 293 293 293 293 293 29"..., 4096) = 4096

write(3, "4 294 294 294 294 294 294 294 29"..., 4096) = 4096

write(3, "5 295 295 299 300 301 300 298 29"..., 4096) = 4096

write(3, "5 296 295 295 296 296 295 295 29"..., 4096) = 4096

write(3, "7 297 297 297 297 297 297 297 29"..., 4096) = 4096

write(3, "8 298 298 297 298 296 297 296 29"..., 4096) = 4096

write(3, "9 299 299 298 299 298 299 299 29"..., 4096) = 4096

write(3, "0 299 300 299 300 300 299 300 30"..., 4096) = 4096

write(3, "1 301 301 301 301 301 301 301 30"..., 4096) = 4096

write(3, "1 301 301 301 301 301 302 302 30"..., 4096) = 4096

write(3, "3 303 303 303 303 303 303 303 30"..., 4096) = 4096

write(3, "4 304 304 304 304 304 304 304 30"..., 4096) = 4096

write(3, "5 305 305 305 305 305 305 305 30"..., 4096) = 4096

write(3, "6 306 306 306 305 306 304 305 30"..., 4096) = 4096

write(3, "7 307 307 307 307 307 307 307 30"..., 4096) = 4096

write(3, "8 308 308 307 308 308 307 308 30"..., 4096) = 4096

write(3, "9 309 309 309 309 309 309 309 30"..., 4096) = 4096

write(3, "0 310 310 310 310 310 310 310 31"..., 4096) = 4096

write(3, "1 311 311 311 311 311 311 311 31"..., 4096) = 4096

write(3, "2 312 312 311 312 312 312 312 31"..., 4096) = 4096

write(3, "3 313 314 313 313 314 314 314 31"..., 4096) = 4096

write(3, "4 314 315 314 315 315 315 314 31"..., 4096) = 4096

write(3, "6 316 316 316 316 316 315 316 31"..., 4096) = 4096

write(3, "6 316 316 316 312 316 316 316 31"..., 4096) = 4096

write(3, "7 317 315 289 315 316 315 316 31"..., 4096) = 4096

write(3, "7 317 318 318 318 318 318 318 31"..., 4096) = 4096

write(3, "8 318 318 318 319 319 318 319 31"..., 4096) = 4096

write(3, "0 320 320 320 320 320 320 320 32"..., 4096) = 4096

write(3, "0 321 321 319 321 321 320 321 32"..., 4096) = 4096

write(3, "2 322 322 322 322 322 322 323 32"..., 4096) = 4096

write(3, "3 323 323 323 323 323 323 322 32"..., 4096) = 4096

write(3, "4 324 325 325 324 324 324 324 32"..., 4096) = 4096

write(3, "6 326 326 326 325 325 325 325 32"..., 4096) = 4096

write(3, "7 327 328 326 326 326 326 326 32"..., 4096) = 4096

write(3, "7 327 326 327 326 327 327 326 32"..., 4096) = 4096

write(3, "8 328 328 328 329 328 328 328 32"..., 4096) = 4096

write(3, "9 329 329 330 329 329 330 330 33"..., 4096) = 4096

write(3, "1 331 331 331 331 331 331 331 33"..., 4096) = 4096

write(3, "1 332 332 332 332 332 332 332 33"..., 4096) = 4096

write(3, "3 333 333 333 333 333 333 333 33"..., 4096) = 4096

write(3, "4 334 335 335 334 335 334 334 33"..., 4096) = 4096

write(3, "6 336 335 336 335 335 335 335 33"..., 4096) = 4096

write(3, "6 336 336 336 336 336 336 336 33"..., 4096) = 4096

write(3, "7 337 338 338 337 338 338 337 33"..., 4096) = 4096

write(3, "7 337 337 337 337 337 337 337 33"..., 4096) = 4096

write(3, "7 337 337 338 337 337 338 338 33"..., 4096) = 4096

write(3, "8 339 338 338 339 340 340 340 34"..., 4096) = 4096

write(3, "1 340 341 341 341 341 341 341 34"..., 4096) = 4096

write(3, "2 342 342 342 342 342 342 342 34"..., 4096) = 4096

write(3, "2 342 343 342 343 343 342 342 34"..., 4096) = 4096

write(3, "4 344 344 344 344 344 344 344 34"..., 4096) = 4096

write(3, "5 345 345 345 344 343 344 344 34"..., 4096) = 4096

write(3, "6 346 346 346 346 346 346 346 34"..., 4096) = 4096

write(3, "7 346 347 346 347 347 346 347 34"..., 4096) = 4096

write(3, "8 348 348 348 348 348 348 348 34"..., 4096) = 4096

write(3, "8 348 348 349 348 349 349 348 34"..., 4096) = 4096

write(3, "0 350 350 351 351 351 351 351 35"..., 4096) = 4096

write(3, "0 351 351 351 352 352 351 352 35"..., 4096) = 4096

write(3, "2 352 353 353 353 353 352 352 35"..., 4096) = 4096

write(3, "3 353 353 353 352 353 352 352 35"..., 4096) = 4096

write(3, "5 355 354 354 354 355 354 355 35"..., 4096) = 4096

write(3, "5 355 355 355 355 355 355 355 35"..., 4096) = 4096

write(3, "7 357 357 357 357 357 357 357 35"..., 4096) = 4096

write(3, "8 357 357 358 358 357 358 358 35"..., 4096) = 4096

write(3, "8 348 356 357 350 348 351 358 35"..., 4096) = 4096

write(3, "9 358 358 359 359 359 359 359 35"..., 4096) = 4096

write(3, "0 359 360 360 360 360 360 360 36"..., 4096) = 4096

write(3, "1 361 361 361 361 361 361 361 36"..., 4096) = 4096

write(3, "2 362 362 362 362 362 362 361 36"..., 4096) = 4096

write(3, "3 363 363 363 363 361 363 361 36"..., 4096) = 4096

write(3, "4 364 364 364 364 364 364 364 36"..., 4096) = 4096

write(3, "5 365 365 365 365 365 365 365 36"..., 4096) = 4096

write(3, "5 366 366 366 366 366 366 366 36"..., 4096) = 4096

write(3, "7 367 367 367 367 367 368 367 36"..., 4096) = 4096

write(3, "8 368 368 368 368 368 369 369 36"..., 4096) = 4096

write(3, "9 369 369 369 369 369 369 369 36"..., 4096) = 4096

write(3, "0 370 370 370 370 370 370 370 36"..., 4096) = 4096

write(3, "1 371 371 371 371 371 371 371 37"..., 4096) = 4096

write(3, "3 373 373 372 372 372 372 372 37"..., 4096) = 4096

write(3, "4 374 374 374 374 374 374 375 37"..., 4096) = 4096

write(3, "5 375 373 374 374 374 375 374 37"..., 4096) = 4096

write(3, "5 376 375 376 376 375 376 376 37"..., 4096) = 4096

write(3, "6 376 376 377 376 375 377 377 37"..., 4096) = 4096

write(3, "8 378 378 378 378 378 378 378 37"..., 4096) = 4096

write(3, "8 379 379 379 379 379 379 379 37"..., 4096) = 4096

write(3, "8 379 379 378 379 379 379 379 37"..., 4096) = 4096

write(3, "0 380 380 380 380 380 380 379 37"..., 4096) = 4096

write(3, "1 381 381 381 381 381 379 379 38"..., 4096) = 4096

write(3, "2 382 382 382 382 382 382 382 38"..., 4096) = 4096

write(3, "3 383 383 383 383 383 383 383 38"..., 4096) = 4096

write(3, "4 384 384 384 385 385 384 385 38"..., 4096) = 4096

write(3, "3 383 383 385 383 383 385 385 38"..., 4096) = 4096

write(3, "7 385 387 387 387 387 387 387 38"..., 4096) = 4096

write(3, "7 387 387 387 387 387 387 387 38"..., 4096) = 4096

write(3, "9 389 389 389 390 389 390 389 38"..., 4096) = 4096

write(3, "8 389 389 389 389 389 388 389 38"..., 4096) = 4096

write(3, "1 391 391 391 391 391 390 390 39"..., 4096) = 4096

write(3, "2 391 392 392 390 391 390 391 39"..., 4096) = 4096

write(3, "4 393 392 393 392 393 393 393 39"..., 4096) = 4096

write(3, "3 392 393 392 393 393 393 393 39"..., 4096) = 4096

write(3, "5 394 395 395 394 395 395 395 39"..., 4096) = 4096

write(3, "5 395 396 395 395 395 396 396 39"..., 4096) = 4096

write(3, "7 397 397 398 398 398 398 398 39"..., 4096) = 4096

write(3, "7 398 398 398 399 399 398 399 39"..., 4096) = 4096

write(3, "0 399 400 400 400 400 399 399 39"..., 4096) = 4096

write(3, "0 411 412 400 411 401 399 399 39"..., 4096) = 4096

write(3, "0 400 399 399 398 399 398 399 40"..., 4096) = 4096

write(3, "2 402 401 401 401 401 402 401 40"..., 4096) = 4096

write(3, "3 401 401 401 402 402 401 401 40"..., 4096) = 4096

write(3, "3 403 403 404 403 403 404 404 40"..., 4096) = 4096

write(3, "4 405 405 404 405 405 405 405 40"..., 4096) = 4096

write(3, "6 405 405 405 406 406 406 406 40"..., 4096) = 4096

write(3, "7 406 407 407 407 407 407 407 40"..., 4096) = 4096

write(3, "8 408 408 408 408 408 408 408 40"..., 4096) = 4096

write(3, "9 409 409 409 409 409 409 408 40"..., 4096) = 4096

write(3, "0 410 410 410 410 410 410 410 41"..., 4096) = 4096

write(3, "1 411 411 410 410 410 410 411 41"..., 4096) = 4096

write(3, "2 411 412 411 412 412 411 412 41"..., 4096) = 4096

write(3, "2 413 413 412 413 413 412 412 41"..., 4096) = 4096

write(3, "4 414 414 414 414 414 414 414 41"..., 4096) = 4096

write(3, "5 415 415 415 415 415 415 415 41"..., 4096) = 4096

write(3, "7 416 416 417 417 417 417 417 41"..., 4096) = 4096

write(3, "7 417 417 417 417 417 417 417 41"..., 4096) = 4096

write(3, "9 419 419 419 419 419 418 419 41"..., 4096) = 4096

write(3, "0 420 420 420 419 419 420 419 42"..., 4096) = 4096

write(3, "1 421 421 421 421 421 421 421 42"..., 4096) = 4096

write(3, "9 421 419 419 419 419 421 419 41"..., 4096) = 4096

write(3, "2 421 421 421 421 422 421 421 42"..., 4096) = 4096

write(3, "3 423 423 423 423 423 423 423 42"..., 4096) = 4096

write(3, "3 424 423 422 424 424 424 424 42"..., 4096) = 4096

write(3, "5 425 425 425 425 425 425 425 42"..., 4096) = 4096

write(3, "2 426 426 426 426 426 426 425 42"..., 4096) = 4096

write(3, "7 427 427 427 427 427 427 427 42"..., 4096) = 4096

write(3, "8 428 428 428 428 427 428 427 42"..., 4096) = 4096

write(3, "9 429 429 429 429 429 429 429 42"..., 4096) = 4096

write(3, "0 431 430 430 430 430 431 430 43"..., 4096) = 4096

write(3, "1 431 431 431 431 431 431 431 43"..., 4096) = 4096

write(3, "2 431 432 432 431 432 432 432 43"..., 4096) = 4096

write(3, "3 433 433 433 433 433 433 433 43"..., 4096) = 4096

write(3, "4 434 434 434 434 434 435 435 43"..., 4096) = 4096

write(3, "6 436 436 436 436 436 436 436 43"..., 4096) = 4096

write(3, "7 437 437 437 437 437 437 437 43"..., 4096) = 4096

write(3, "8 438 438 438 438 438 438 438 43"..., 4096) = 4096

write(3, "0 439 440 439 438 439 438 439 43"..., 4096) = 4096

write(3, "0 440 440 440 440 440 440 440 44"..., 4096) = 4096

write(3, "1 441 441 441 441 441 441 441 44"..., 4096) = 4096

write(3, "2 442 443 444 443 443 444 443 45"..., 4096) = 4096

write(3, "2 442 442 442 442 442 442 442 44"..., 4096) = 4096

write(3, "3 442 443 443 443 443 443 443 44"..., 4096) = 4096

write(3, "4 445 445 445 445 445 445 445 44"..., 4096) = 4096

write(3, "5 445 446 446 445 445 445 445 44"..., 4096) = 4096

write(3, "7 447 447 447 447 447 447 447 44"..., 4096) = 4096

write(3, "8 448 447 447 447 447 447 447 44"..., 4096) = 4096

write(3, "9 449 449 449 449 449 449 449 44"..., 4096) = 4096

write(3, "0 449 449 449 449 450 449 449 45"..., 4096) = 4096

write(3, "1 451 451 451 451 451 451 451 45"..., 4096) = 4096

write(3, "2 452 452 452 452 452 452 452 45"..., 4096) = 4096

write(3, "3 453 453 453 453 453 453 453 45"..., 4096) = 4096

write(3, "4 454 454 454 454 454 454 454 45"..., 4096) = 4096

write(3, "6 456 456 456 456 456 455 455 45"..., 4096) = 4096

write(3, "6 456 456 456 456 456 456 456 45"..., 4096) = 4096

write(3, "7 457 457 457 457 457 457 457 45"..., 4096) = 4096

write(3, "8 458 458 458 458 458 458 458 45"..., 4096) = 4096

write(3, "9 459 459 459 459 459 459 459 45"..., 4096) = 4096

write(3, "0 460 460 461 460 460 460 461 46"..., 4096) = 4096

write(3, "2 462 461 462 462 462 462 462 46"..., 4096) = 4096

write(3, "3 463 463 463 463 463 463 463 46"..., 4096) = 4096

write(3, "0 462 462 463 463 463 463 463 46"..., 4096) = 4096

write(3, "4 464 464 464 464 464 464 464 46"..., 4096) = 4096

write(3, "5 465 465 465 465 465 465 465 46"..., 4096) = 4096

write(3, "6 466 466 466 466 466 466 466 46"..., 4096) = 4096

write(3, "7 467 467 467 466 467 466 467 46"..., 4096) = 4096

write(3, "8 468 466 467 466 468 468 467 46"..., 4096) = 4096

write(3, "9 469 469 469 469 469 469 469 46"..., 4096) = 4096

write(3, "0 470 471 470 470 471 471 471 47"..., 4096) = 4096

write(3, "1 472 471 471 471 472 472 472 47"..., 4096) = 4096

write(3, "3 473 473 473 473 473 473 473 47"..., 4096) = 4096

write(3, "4 474 474 474 474 474 474 474 47"..., 4096) = 4096

write(3, "5 475 475 475 475 475 474 475 47"..., 4096) = 4096

write(3, "6 476 476 476 476 475 475 475 47"..., 4096) = 4096

write(3, "7 477 477 476 477 477 476 477 47"..., 4096) = 4096

write(3, "8 478 477 478 477 477 478 478 47"..., 4096) = 4096

write(3, "9 479 479 479 479 479 479 479 47"..., 4096) = 4096

write(3, "0 480 480 480 479 480 480 480 48"..., 4096) = 4096

write(3, "1 482 481 482 482 482 482 482 48"..., 4096) = 4096

write(3, "2 482 482 482 482 482 482 482 48"..., 4096) = 4096

write(3, "4 484 484 484 484 484 484 484 48"..., 4096) = 4096

write(3, "5 485 485 485 485 485 484 484 48"..., 4096) = 4096

write(3, "4 485 485 485 485 485 483 484 48"..., 4096) = 4096

write(3, "6 486 486 486 485 486 485 485 48"..., 4096) = 4096

write(3, "7 487 487 485 486 485 486 487 48"..., 4096) = 4096

write(3, "8 488 488 488 488 488 488 488 48"..., 4096) = 4096

write(3, "9 489 489 489 489 489 489 489 48"..., 4096) = 4096

write(3, "0 490 490 490 490 490 490 490 49"..., 4096) = 4096

write(3, "0 490 490 490 492 490 492 492 49"..., 4096) = 4096

write(3, "3 493 493 493 493 493 493 493 49"..., 4096) = 4096

write(3, "4 494 494 494 494 494 494 493 49"..., 4096) = 4096

write(3, "5 495 495 495 495 495 495 495 49"..., 4096) = 4096

write(3, "5 495 495 495 495 495 495 495 49"..., 4096) = 4096

write(3, "7 497 496 496 496 496 497 496 49"..., 4096) = 4096

write(3, "6 497 497 496 497 497 496 497 49"..., 4096) = 4096

write(3, "9 499 499 499 498 499 499 499 49"..., 4096) = 4096

write(3, "0 500 500 500 499 500 500 500 50"..., 4096) = 4096

write(3, "1 501 500 501 501 501 501 501 50"..., 4096) = 4096

write(3, "1 502 502 502 502 502 502 502 50"..., 4096) = 4096

write(3, "4 504 504 504 504 504 503 504 50"..., 4096) = 4096

write(3, "4 504 504 504 504 504 504 504 50"..., 4096) = 4096

write(3, "6 506 506 506 506 506 506 506 50"..., 4096) = 4096

write(3, "7 510 506 504 504 504 504 504 50"..., 4096) = 4096

write(3, "5 505 506 505 506 507 507 506 50"..., 4096) = 4096

write(3, "8 507 508 508 508 508 508 508 50"..., 4096) = 4096

write(3, "7 508 509 509 508 509 509 509 50"..., 4096) = 4096

write(3, "0 510 509 510 510 510 510 510 51"..., 4096) = 4096

write(3, "1 511 511 511 511 511 511 511 51"..., 4096) = 4096

write(3, "2 512 512 512 512 512 511 511 51"..., 4096) = 4096

write(3, "3 513 513 513 513 512 512 512 51"..., 4096) = 4096

write(3, "4 514 514 514 514 514 514 514 51"..., 4096) = 4096

write(3, "5 515 515 515 514 514 515 515 51"..., 4096) = 4096

write(3, "6 516 516 516 516 516 516 516 51"..., 4096) = 4096

write(3, "7 517 517 517 517 517 517 517 51"..., 4096) = 4096

write(3, "8 518 518 518 518 518 518 518 51"..., 4096) = 4096

write(3, "9 519 519 519 519 519 519 519 51"..., 4096) = 4096

write(3, "0 521 521 521 521 521 521 521 52"..., 4096) = 4096

write(3, "1 521 521 521 521 521 521 521 52"..., 4096) = 4096

write(3, "3 523 523 523 523 523 522 523 52"..., 4096) = 4096

write(3, "3 523 523 523 522 522 522 523 52"..., 4096) = 4096

write(3, "5 525 525 524 525 524 525 525 52"..., 4096) = 4096

write(3, "6 526 526 526 526 526 526 526 52"..., 4096) = 4096

write(3, "7 527 527 527 527 527 527 527 52"..., 4096) = 4096

write(3, "6 526 527 526 526 527 527 527 52"..., 4096) = 4096

write(3, "6 527 526 527 527 528 528 528 52"..., 4096) = 4096

write(3, "9 529 529 529 529 529 529 529 52"..., 4096) = 4096

write(3, "9 530 530 530 530 530 530 530 53"..., 4096) = 4096

write(3, "1 531 532 532 531 531 531 531 53"..., 4096) = 4096

write(3, "2 532 532 532 532 531 531 531 53"..., 4096) = 4096

write(3, "3 533 533 533 532 532 532 532 53"..., 4096) = 4096

write(3, "4 534 533 533 534 534 534 534 53"..., 4096) = 4096

write(3, "5 535 535 535 535 535 535 535 53"..., 4096) = 4096

write(3, "6 536 536 537 536 536 537 537 53"..., 4096) = 4096

write(3, "7 537 537 537 537 537 537 538 53"..., 4096) = 4096

write(3, "8 538 538 538 538 538 538 538 53"..., 4096) = 4096

write(3, "0 540 540 540 540 540 540 540 53"..., 4096) = 4096

write(3, "0 540 540 540 540 540 540 540 54"..., 4096) = 4096

write(3, "2 542 542 542 542 542 542 542 54"..., 4096) = 4096

write(3, "3 543 543 543 541 542 542 542 54"..., 4096) = 4096

write(3, "4 543 544 544 544 544 544 544 54"..., 4096) = 4096

write(3, "5 545 545 545 545 545 545 545 54"..., 4096) = 4096

write(3, "6 546 547 546 546 547 547 547 54"..., 4096) = 4096

write(3, "7 547 547 547 547 547 547 547 54"..., 4096) = 4096

write(3, "9 549 549 549 549 549 549 550 54"..., 4096) = 4096

write(3, "8 549 549 548 549 549 549 549 54"..., 4096) = 4096

write(3, "9 549 549 549 549 549 549 549 54"..., 4096) = 4096

write(3, "1 551 551 551 550 551 549 550 54"..., 4096) = 4096

write(3, "2 552 551 551 551 550 551 551 55"..., 4096) = 4096

write(3, "3 553 553 553 553 553 553 553 55"..., 4096) = 4096

write(3, "3 553 553 553 553 553 553 553 55"..., 4096) = 4096

write(3, "4 555 555 555 555 554 555 555 55"..., 4096) = 4096

write(3, "5 555 556 555 555 556 556 556 55"..., 4096) = 4096

write(3, "7 557 557 558 557 557 558 557 55"..., 4096) = 4096

write(3, "8 558 558 558 558 558 558 558 55"..., 4096) = 4096

write(3, "9 559 559 559 559 559 559 558 55"..., 4096) = 4096

write(3, "0 560 560 560 560 560 559 559 55"..., 4096) = 4096

write(3, "1 561 561 561 561 561 561 561 56"..., 4096) = 4096

write(3, "2 562 562 562 562 562 562 562 56"..., 4096) = 4096

write(3, "4 563 564 564 563 564 564 563 56"..., 4096) = 4096

write(3, "3 564 563 564 564 564 564 564 56"..., 4096) = 4096

write(3, "5 565 566 565 565 566 566 566 56"..., 4096) = 4096

write(3, "7 566 566 567 567 567 567 567 56"..., 4096) = 4096

write(3, "8 568 568 568 568 568 568 568 56"..., 4096) = 4096

write(3, "9 569 569 569 569 569 569 569 56"..., 4096) = 4096

write(3, "9 566 567 569 569 569 567 567 56"..., 4096) = 4096

write(3, "0 570 570 570 566 570 570 570 57"..., 4096) = 4096

write(3, "1 571 569 570 570 571 571 571 57"..., 4096) = 4096

write(3, "2 571 571 572 572 572 572 571 57"..., 4096) = 4096

write(3, "2 573 571 573 573 573 573 573 57"..., 4096) = 4096

write(3, "4 574 574 574 572 574 574 574 57"..., 4096) = 4096

write(3, "5 575 575 575 575 575 575 575 57"..., 4096) = 4096

write(3, "6 577 577 577 577 577 577 577 57"..., 4096) = 4096

write(3, "7 578 578 577 578 578 578 578 57"..., 4096) = 4096

write(3, "9 579 579 579 579 579 579 578 57"..., 4096) = 4096

write(3, "0 580 580 580 580 580 577 577 57"..., 4096) = 4096

write(3, "1 581 581 580 581 580 581 581 58"..., 4096) = 4096

write(3, "1 581 581 581 581 581 581 581 58"..., 4096) = 4096

write(3, "2 583 582 583 583 582 582 583 58"..., 4096) = 4096

write(3, "3 583 583 584 583 583 584 584 58"..., 4096) = 4096

write(3, "5 585 585 585 585 585 585 585 58"..., 4096) = 4096

write(3, "5 585 586 586 586 586 586 586 58"..., 4096) = 4096

write(3, "7 587 587 587 587 587 587 587 58"..., 4096) = 4096

write(3, "8 588 588 588 588 588 588 588 58"..., 4096) = 4096

write(3, "0 590 590 590 590 590 590 590 59"..., 4096) = 4096

write(3, "0 590 590 590 590 590 590 590 59"..., 4096) = 4096

write(3, "0 590 590 590 590 590 590 590 59"..., 4096) = 4096

write(3, "1 591 591 592 592 591 591 592 59"..., 4096) = 4096

write(3, "0 590 592 592 593 592 590 593 59"..., 4096) = 4096

write(3, "4 594 594 594 594 594 594 594 59"..., 4096) = 4096

write(3, "5 595 593 595 595 595 595 595 59"..., 4096) = 4096

write(3, "6 596 596 596 596 596 596 596 59"..., 4096) = 4096

write(3, "7 597 597 597 597 597 597 596 59"..., 4096) = 4096

write(3, "8 598 598 598 598 598 597 597 59"..., 4096) = 4096

write(3, "9 599 599 599 599 599 599 599 60"..., 4096) = 4096

write(3, "1 600 600 600 600 600 601 600 60"..., 4096) = 4096

write(3, "0 599 599 600 600 601 600 599 60"..., 4096) = 4096

write(3, "1 601 601 602 601 601 602 602 60"..., 4096) = 4096

write(3, "3 603 603 603 603 603 603 603 60"..., 4096) = 4096

write(3, "4 605 604 605 605 605 605 605 60"..., 4096) = 4096

write(3, "5 605 606 605 605 606 605 606 60"..., 4096) = 4096

write(3, "6 606 606 606 606 606 606 605 60"..., 4096) = 4096

write(3, "8 608 608 608 608 607 607 607 60"..., 4096) = 4096

write(3, "0 610 609 608 609 609 609 609 60"..., 4096) = 4096

write(3, "0 610 610 609 610 610 609 610 61"..., 4096) = 4096

write(3, "1 610 611 610 611 611 611 611 61"..., 4096) = 4096

write(3, "0 611 610 611 611 610 610 611 61"..., 4096) = 4096

write(3, "0 610 612 610 609 612 612 612 61"..., 4096) = 4096

write(3, "3 611 612 613 613 613 613 613 61"..., 4096) = 4096

write(3, "3 613 613 614 614 614 614 614 61"..., 4096) = 4096

write(3, "5 615 615 615 615 615 615 615 61"..., 4096) = 4096

write(3, "6 617 617 617 617 617 617 610 61"..., 4096) = 4096

write(3, "8 618 618 618 617 618 617 618 61"..., 4096) = 4096

write(3, "9 619 619 617 619 617 619 619 61"..., 4096) = 4096

write(3, "0 620 620 620 620 620 620 620 62"..., 4096) = 4096

write(3, "9 619 619 619 620 619 619 620 62"..., 4096) = 4096

write(3, "2 622 621 622 622 622 622 622 62"..., 4096) = 4096

write(3, "3 623 622 622 623 623 623 623 62"..., 4096) = 4096

write(3, "4 624 624 624 624 625 624 625 62"..., 4096) = 4096

write(3, "3 625 625 625 625 625 625 625 62"..., 4096) = 4096

write(3, "6 626 626 626 626 626 626 626 62"..., 4096) = 4096

write(3, "7 627 627 627 627 627 627 627 62"..., 4096) = 4096

write(3, "8 628 628 628 628 628 628 628 62"..., 4096) = 4096

write(3, "9 629 629 629 629 629 629 629 62"..., 4096) = 4096

write(3, "0 630 629 630 630 630 630 630 63"..., 4096) = 4096

write(3, "1 631 631 631 631 631 631 632 63"..., 4096) = 4096

write(3, "4 633 633 633 634 634 634 634 63"..., 4096) = 4096

write(3, "0 630 631 633 632 633 633 633 63"..., 4096) = 4096

write(3, "2 634 634 634 634 634 634 634 63"..., 4096) = 4096

write(3, "5 635 635 635 635 635 635 635 63"..., 4096) = 4096

write(3, "6 636 636 636 636 634 635 634 63"..., 4096) = 4096

write(3, "7 637 637 637 637 637 637 637 63"..., 4096) = 4096

write(3, "8 638 638 638 638 638 638 638 63"..., 4096) = 4096

write(3, "9 639 639 639 639 639 639 639 63"..., 4096) = 4096

write(3, "8 640 640 640 640 638 640 640 64"..., 4096) = 4096

write(3, "1 641 641 641 641 641 641 641 64"..., 4096) = 4096

write(3, "2 642 642 642 642 642 642 642 64"..., 4096) = 4096

write(3, "2 643 643 643 643 643 643 643 64"..., 4096) = 4096

write(3, "4 644 644 644 644 644 644 644 64"..., 4096) = 4096

write(3, "5 646 646 645 645 645 645 646 64"..., 4096) = 4096

write(3, "6 646 646 646 646 646 646 646 64"..., 4096) = 4096

write(3, "0 648 648 648 648 648 648 648 64"..., 4096) = 4096

write(3, "8 643 646 642 647 648 647 643 64"..., 4096) = 4096

write(3, "0 650 650 650 650 650 651 650 65"..., 4096) = 4096

write(3, "1 651 651 651 651 651 651 651 65"..., 4096) = 4096

write(3, "2 652 652 652 654 654 654 654 65"..., 4096) = 4096

write(3, "3 653 653 653 653 653 653 653 65"..., 4096) = 4096

write(3, "5 672 677 681 655 679 671 652 65"..., 4096) = 4096

write(3, "4 654 654 654 654 654 654 654 65"..., 4096) = 4096

write(3, "5 656 656 655 654 652 652 653 65"..., 4096) = 4096

write(3, "6 656 656 655 655 655 656 656 65"..., 4096) = 4096

write(3, "7 657 656 657 657 657 657 657 65"..., 4096) = 4096

write(3, "9 659 659 659 659 659 659 660 66"..., 4096) = 4096

write(3, "7 657 659 657 657 659 660 659 66"..., 4096) = 4096

write(3, "1 659 659 660 661 661 661 661 66"..., 4096) = 4096

write(3, "2 661 661 662 662 662 662 662 66"..., 4096) = 4096

write(3, "3 664 663 664 664 663 663 663 66"..., 4096) = 4096

write(3, "4 664 664 664 664 664 663 664 66"..., 4096) = 4096

write(3, "5 665 665 664 664 664 664 664 66"..., 4096) = 4096

write(3, "6 666 666 665 666 665 666 666 66"..., 4096) = 4096

write(3, "7 667 667 667 667 667 667 667 66"..., 4096) = 4096

write(3, "8 668 668 668 668 668 668 668 66"..., 4096) = 4096

write(3, "9 669 669 669 669 670 670 670 67"..., 4096) = 4096

write(3, "0 670 670 670 670 670 670 670 67"..., 4096) = 4096

write(3, "1 671 672 671 671 672 672 672 67"..., 4096) = 4096

write(3, "2 672 672 672 672 673 672 672 67"..., 4096) = 4096

write(3, "4 674 674 674 674 674 673 674 67"..., 4096) = 4096

write(3, "4 674 674 675 675 674 674 674 67"..., 4096) = 4096

write(3, "5 675 668 675 672 672 672 672 67"..., 4096) = 4096

write(3, "6 676 674 674 674 674 676 674 67"..., 4096) = 4096

write(3, "6 677 676 677 677 676 677 677 67"..., 4096) = 4096

write(3, "8 678 678 678 678 678 678 679 67"..., 4096) = 4096

write(3, "9 679 678 679 679 679 679 679 67"..., 4096) = 4096

write(3, "3 679 680 680 680 680 680 680 68"..., 4096) = 4096

write(3, "2 682 682 682 682 682 682 682 68"..., 4096) = 4096

write(3, "3 683 683 683 683 683 683 683 68"..., 4096) = 4096

write(3, "4 684 684 684 684 681 682 682 68"..., 4096) = 4096

write(3, "5 685 685 683 685 685 684 685 68"..., 4096) = 4096

write(3, "6 686 681 684 680 685 685 682 68"..., 4096) = 4096

write(3, "6 686 686 686 686 686 686 686 68"..., 4096) = 4096

write(3, "6 687 687 688 687 686 688 688 68"..., 4096) = 4096

write(3, "9 689 689 688 689 689 689 689 68"..., 4096) = 4096

write(3, "0 689 689 690 690 690 690 690 69"..., 4096) = 4096

write(3, "1 691 691 691 691 691 691 691 69"..., 4096) = 4096

write(3, "2 692 692 692 692 692 692 691 69"..., 4096) = 4096

write(3, "3 693 693 693 693 693 693 693 69"..., 4096) = 4096

write(3, "4 694 694 694 694 694 694 694 69"..., 4096) = 4096

write(3, "5 695 695 695 695 695 695 695 69"..., 4096) = 4096

write(3, "6 696 696 696 696 696 696 696 69"..., 4096) = 4096

write(3, "5 696 696 696 696 695 696 696 69"..., 4096) = 4096

write(3, "7 697 697 696 697 697 697 697 69"..., 4096) = 4096

write(3, "8 697 695 698 698 698 698 698 69"..., 4096) = 4096

write(3, "0 700 700 700 700 700 700 700 70"..., 4096) = 4096

write(3, "1 701 701 701 701 701 701 700 70"..., 4096) = 4096

write(3, "2 702 702 702 702 702 702 702 70"..., 4096) = 4096

write(3, "2 703 703 702 702 700 700 700 70"..., 4096) = 4096

write(3, "4 704 704 702 703 703 703 704 70"..., 4096) = 4096

write(3, "5 705 705 705 705 705 705 705 70"..., 4096) = 4096

write(3, "6 706 706 706 706 706 706 707 70"..., 4096) = 4096

write(3, "6 706 707 706 706 706 707 707 70"..., 4096) = 4096

write(3, "8 708 708 708 708 708 708 708 70"..., 4096) = 4096

write(3, "9 709 709 709 709 709 709 709 70"..., 4096) = 4096

write(3, "0 711 711 711 711 710 710 710 71"..., 4096) = 4096

write(3, "1 711 711 711 711 711 710 711 71"..., 4096) = 4096

write(3, "2 712 712 712 712 712 712 712 71"..., 4096) = 4096

write(3, "3 713 713 713 713 713 713 713 71"..., 4096) = 4096

write(3, "4 714 714 714 715 715 714 715 71"..., 4096) = 4096

write(3, "5 715 715 715 716 715 715 715 71"..., 4096) = 4096

write(3, "7 717 717 717 717 718 717 717 71"..., 4096) = 4096

write(3, "6 714 714 716 717 716 717 717 71"..., 4096) = 4096

write(3, "4 715 718 718 718 718 718 718 71"..., 4096) = 4096

write(3, "9 720 719 720 720 720 720 720 71"..., 4096) = 4096

write(3, "0 720 720 720 720 720 720 720 72"..., 4096) = 4096

write(3, "2 722 722 722 722 721 721 721 72"..., 4096) = 4096

write(3, "3 723 723 723 716 719 716 719 71"..., 4096) = 4096

write(3, "4 722 723 722 723 724 722 723 72"..., 4096) = 4096

write(3, "4 724 724 724 725 724 724 725 72"..., 4096) = 4096

write(3, "6 725 726 726 725 726 726 726 72"..., 4096) = 4096

write(3, "6 727 725 726 727 727 727 727 72"..., 4096) = 4096

write(3, "8 728 728 728 728 728 728 728 72"..., 4096) = 4096

write(3, "8 729 729 729 729 729 728 729 72"..., 4096) = 4096

write(3, "0 730 730 730 730 730 729 730 72"..., 4096) = 4096

write(3, "1 731 731 731 731 730 730 730 73"..., 4096) = 4096

write(3, "2 732 732 731 732 732 731 732 73"..., 4096) = 4096

write(3, "3 733 733 733 733 733 733 733 73"..., 4096) = 4096

write(3, "4 734 734 734 734 734 734 734 73"..., 4096) = 4096

write(3, "4 734 734 735 735 734 735 735 73"..., 4096) = 4096

write(3, "6 736 736 736 736 737 736 736 73"..., 4096) = 4096

write(3, "7 737 737 737 737 737 737 737 73"..., 4096) = 4096

write(3, "9 739 738 739 739 739 739 739 73"..., 4096) = 4096

write(3, "8 738 738 738 738 738 738 737 73"..., 4096) = 4096

write(3, "0 740 740 740 739 740 739 739 73"..., 4096) = 4096

write(3, "1 741 741 741 740 740 740 740 74"..., 4096) = 4096

write(3, "2 742 740 742 742 740 742 742 74"..., 4096) = 4096

write(3, "2 743 743 742 743 743 742 743 74"..., 4096) = 4096

write(3, "3 743 743 744 743 744 744 744 74"..., 4096) = 4096

write(3, "5 745 745 745 745 745 745 745 74"..., 4096) = 4096

write(3, "3 746 746 746 746 746 746 746 74"..., 4096) = 4096

write(3, "7 748 747 747 748 748 747 747 74"..., 4096) = 4096

write(3, "8 748 748 748 748 748 748 748 74"..., 4096) = 4096

write(3, "9 749 749 749 749 749 749 749 74"..., 4096) = 4096

write(3, "0 750 750 748 749 748 748 748 74"..., 4096) = 4096

write(3, "2 751 751 751 751 751 751 751 75"..., 4096) = 4096

write(3, "2 752 752 752 752 752 752 752 75"..., 4096) = 4096

write(3, "3 753 753 753 753 753 753 753 75"..., 4096) = 4096

write(3, "3 753 754 754 754 754 754 754 75"..., 4096) = 4096

write(3, "5 755 755 756 757 756 757 757 75"..., 4096) = 4096

write(3, "6 756 756 756 756 756 756 756 75"..., 4096) = 4096

write(3, "9 758 759 759 759 759 757 757 75"..., 4096) = 4096

write(3, "9 758 759 759 758 758 758 758 75"..., 4096) = 4096

write(3, "1 761 760 759 757 755 755 754 75"..., 4096) = 4096

write(3, "0 759 759 760 760 759 760 760 76"..., 4096) = 4096

write(3, "8 758 759 758 759 761 761 760 76"..., 4096) = 4096

write(3, "1 761 761 762 762 761 762 762 76"..., 4096) = 4096

write(3, "2 763 763 763 763 763 763 763 76"..., 4096) = 4096

write(3, "4 764 764 765 765 765 765 765 76"..., 4096) = 4096

write(3, "3 763 765 765 765 765 765 765 76"..., 4096) = 4096

write(3, "6 766 766 766 767 766 766 766 76"..., 4096) = 4096

write(3, "8 768 768 768 768 768 767 768 76"..., 4096) = 4096

write(3, "9 769 769 769 769 769 769 769 76"..., 4096) = 4096

write(3, "0 770 770 770 770 770 770 770 77"..., 4096) = 4096

write(3, "0 770 770 770 770 771 770 770 77"..., 4096) = 4096

write(3, "2 772 772 772 772 772 772 772 77"..., 4096) = 4096

write(3, "3 773 773 773 773 773 773 773 77"..., 4096) = 4096

write(3, "4 774 774 774 774 774 774 774 77"..., 4096) = 4096

write(3, "5 775 775 775 775 775 775 775 77"..., 4096) = 4096

write(3, "6 776 776 776 776 776 776 776 77"..., 4096) = 4096

write(3, "8 777 778 778 777 777 777 777 77"..., 4096) = 4096

write(3, "8 778 778 778 778 778 778 777 77"..., 4096) = 4096

write(3, "9 779 779 779 779 779 779 779 77"..., 4096) = 4096

write(3, "0 780 780 780 780 780 780 780 78"..., 4096) = 4096

write(3, "6 778 778 778 778 779 779 778 78"..., 4096) = 4096

write(3, "1 781 781 781 781 781 781 781 78"..., 4096) = 4096

write(3, "2 782 782 782 782 783 782 783 78"..., 4096) = 4096

write(3, "3 783 784 784 784 784 784 784 78"..., 4096) = 4096

write(3, "2 785 785 785 785 785 785 785 78"..., 4096) = 4096

write(3, "6 786 786 786 786 786 785 785 78"..., 4096) = 4096

write(3, "7 787 787 787 787 787 786 786 78"..., 4096) = 4096

write(3, "9 788 788 788 788 788 788 788 78"..., 4096) = 4096

write(3, "9 789 787 789 787 789 789 788 78"..., 4096) = 4096

write(3, "0 790 790 790 790 790 790 790 79"..., 4096) = 4096

write(3, "0 790 790 791 791 790 791 791 79"..., 4096) = 4096

write(3, "2 792 792 792 792 792 792 793 79"..., 4096) = 4096

write(3, "2 792 793 793 793 793 793 793 79"..., 4096) = 4096

write(3, "4 795 794 794 795 794 795 794 79"..., 4096) = 4096

write(3, "5 795 795 795 795 795 795 795 79"..., 4096) = 4096

write(3, "9 799 798 798 797 796 796 796 79"..., 4096) = 4096

write(3, "8 797 798 797 797 797 797 797 79"..., 4096) = 4096

write(3, "9 799 798 799 799 799 799 799 79"..., 4096) = 4096

write(3, "9 799 799 799 800 800 800 799 80"..., 4096) = 4096

write(3, "1 801 801 801 801 801 801 801 80"..., 4096) = 4096

write(3, "2 803 802 803 803 803 803 805 80"..., 4096) = 4096

write(3, "2 802 801 802 802 802 802 802 80"..., 4096) = 4096

write(3, "2 803 803 803 803 803 803 803 80"..., 4096) = 4096

write(3, "4 804 804 804 804 804 804 802 80"..., 4096) = 4096

write(3, "5 806 805 805 805 805 804 804 80"..., 4096) = 4096

write(3, "6 806 806 806 806 806 806 806 80"..., 4096) = 4096

write(3, "8 807 808 808 808 808 808 808 80"..., 4096) = 4096

write(3, "8 807 807 808 808 808 808 807 80"..., 4096) = 4096

write(3, "9 810 810 810 810 810 810 810 81"..., 4096) = 4096

write(3, "1 811 811 811 811 811 811 811 81"..., 4096) = 4096

write(3, "2 812 812 812 812 812 812 812 81"..., 4096) = 4096

write(3, "2 812 812 812 812 812 812 812 81"..., 4096) = 4096

write(3, "3 813 813 813 814 813 814 813 81"..., 4096) = 4096

write(3, "5 814 815 815 814 815 814 814 81"..., 4096) = 4096

write(3, "6 816 816 816 816 816 816 816 81"..., 4096) = 4096

write(3, "7 817 817 816 817 817 817 817 81"..., 4096) = 4096

write(3, "8 818 818 818 818 818 818 818 81"..., 4096) = 4096

write(3, "9 819 819 819 819 819 819 819 81"..., 4096) = 4096

write(3, "0 820 820 820 820 821 821 821 82"..., 4096) = 4096

write(3, "1 821 821 821 821 821 821 821 82"..., 4096) = 4096

write(3, "2 822 822 823 823 823 823 823 82"..., 4096) = 4096

write(3, "2 822 822 822 822 822 822 822 82"..., 4096) = 4096

write(3, "3 823 824 824 823 824 823 822 82"..., 4096) = 4096

write(3, "5 825 825 825 824 824 824 824 82"..., 4096) = 4096

write(3, "6 826 825 825 825 825 825 826 82"..., 4096) = 4096

write(3, "7 827 827 827 827 827 827 827 82"..., 4096) = 4096

write(3, "8 827 827 827 827 827 827 827 82"..., 4096) = 4096

write(3, "9 829 829 829 829 829 829 829 82"..., 4096) = 4096

write(3, "0 830 830 830 830 830 830 830 83"..., 4096) = 4096

write(3, "1 831 831 831 831 831 831 831 83"..., 4096) = 4096

write(3, "2 832 832 832 832 832 832 832 83"..., 4096) = 4096

write(3, "3 833 834 834 833 833 833 833 83"..., 4096) = 4096

write(3, "4 834 834 834 834 834 834 834 83"..., 4096) = 4096

write(3, "5 836 835 835 835 835 835 835 83"..., 4096) = 4096

write(3, "6 836 836 836 836 836 836 836 83"..., 4096) = 4096

write(3, "7 837 837 837 837 837 837 837 83"..., 4096) = 4096

write(3, "8 838 839 838 838 838 838 838 83"..., 4096) = 4096

write(3, "9 839 839 839 839 839 839 840 84"..., 4096) = 4096

write(3, "0 840 840 840 840 840 840 840 84"..., 4096) = 4096

write(3, "1 842 842 842 842 842 842 841 84"..., 4096) = 4096

write(3, "3 843 843 843 843 842 842 842 84"..., 4096) = 4096

write(3, "4 844 844 843 844 844 844 844 84"..., 4096) = 4096

write(3, "4 844 844 844 843 843 843 843 84"..., 4096) = 4096

write(3, "5 845 843 843 843 843 845 845 84"..., 4096) = 4096

write(3, "6 845 845 846 846 846 846 845 84"..., 4096) = 4096

write(3, "7 847 847 847 847 847 847 847 84"..., 4096) = 4096

write(3, "8 848 848 848 848 848 848 848 84"..., 4096) = 4096

write(3, "9 849 848 849 849 849 849 849 84"..., 4096) = 4096

write(3, "0 850 850 850 850 850 850 850 85"..., 4096) = 4096

write(3, "1 851 851 852 851 851 851 851 85"..., 4096) = 4096

write(3, "2 853 853 853 852 852 852 852 85"..., 4096) = 4096

write(3, "4 854 854 854 853 854 853 854 85"..., 4096) = 4096

write(3, "4 854 854 854 854 854 854 854 85"..., 4096) = 4096

write(3, "5 855 855 855 855 855 855 855 85"..., 4096) = 4096

write(3, "6 856 857 857 856 857 857 857 85"..., 4096) = 4096

write(3, "7 858 858 857 858 858 858 858 85"..., 4096) = 4096

write(3, "9 858 859 859 859 859 859 859 85"..., 4096) = 4096

write(3, "9 859 859 859 859 859 860 860 85"..., 4096) = 4096

write(3, "1 861 861 861 861 861 860 860 86"..., 4096) = 4096

write(3, "2 862 862 862 862 862 861 862 86"..., 4096) = 4096

write(3, "3 863 863 863 863 863 863 863 86"..., 4096) = 4096

write(3, "4 864 864 864 864 864 864 864 86"..., 4096) = 4096

write(3, "5 865 863 863 863 863 864 863 86"..., 4096) = 4096

write(3, "5 865 865 865 865 865 865 865 86"..., 4096) = 4096

write(3, "5 866 866 866 866 866 866 866 86"..., 4096) = 4096

write(3, "7 867 867 867 868 868 868 868 86"..., 4096) = 4096

write(3, "8 868 868 869 869 869 869 869 86"..., 4096) = 4096

write(3, "0 870 870 870 870 870 870 870 86"..., 4096) = 4096

write(3, "1 871 871 871 871 871 870 871 87"..., 4096) = 4096

write(3, "2 872 872 872 871 872 872 871 87"..., 4096) = 4096

write(3, "3 873 873 872 873 872 873 873 87"..., 4096) = 4096

write(3, "4 874 874 874 874 874 874 874 87"..., 4096) = 4096

write(3, "5 875 875 875 875 875 875 875 87"..., 4096) = 4096

write(3, "6 876 876 876 876 876 876 876 87"..., 4096) = 4096

write(3, "7 877 877 877 877 877 877 877 87"..., 4096) = 4096

write(3, "8 878 878 878 878 878 878 878 87"..., 4096) = 4096

write(3, "9 879 879 879 879 879 879 879 87"..., 4096) = 4096

write(3, "1 881 881 881 880 880 880 880 88"..., 4096) = 4096

write(3, "1 881 881 881 881 881 881 881 88"..., 4096) = 4096

write(3, "2 882 882 882 882 882 882 882 88"..., 4096) = 4096

write(3, "3 883 883 883 883 883 883 883 88"..., 4096) = 4096

write(3, "4 884 884 884 884 884 884 885 88"..., 4096) = 4096

write(3, "5 885 885 885 885 885 885 885 88"..., 4096) = 4096

write(3, "5 885 885 885 885 885 885 885 88"..., 4096) = 4096

write(3, "6 886 886 886 886 887 887 886 88"..., 4096) = 4096

write(3, "7 888 887 888 888 888 888 888 88"..., 4096) = 4096

write(3, "9 889 889 889 889 889 888 888 88"..., 4096) = 4096

write(3, "0 890 890 890 890 890 889 889 89"..., 4096) = 4096

write(3, "1 891 891 891 890 890 890 890 89"..., 4096) = 4096

write(3, "2 892 892 891 891 892 892 892 89"..., 4096) = 4096

write(3, "3 893 893 893 893 893 893 893 89"..., 4096) = 4096

write(3, "4 894 894 894 894 894 894 894 89"..., 4096) = 4096

write(3, "5 895 895 895 895 896 896 896 89"..., 4096) = 4096

write(3, "5 896 895 896 896 895 896 896 89"..., 4096) = 4096

write(3, "7 897 897 897 897 897 897 897 89"..., 4096) = 4096

write(3, "9 899 899 899 899 899 898 898 89"..., 4096) = 4096

write(3, "0 900 900 900 899 899 899 899 90"..., 4096) = 4096

write(3, "1 901 901 901 900 901 900 901 90"..., 4096) = 4096

write(3, "2 902 901 901 901 901 901 901 90"..., 4096) = 4096

write(3, "2 902 902 902 902 902 902 902 90"..., 4096) = 4096

write(3, "4 904 904 904 904 904 904 904 90"..., 4096) = 4096

write(3, "5 905 905 904 905 905 905 905 90"..., 4096) = 4096

write(3, "6 906 906 907 906 906 907 906 90"..., 4096) = 4096

write(3, "7 907 908 908 908 908 908 908 90"..., 4096) = 4096

write(3, "7 907 907 907 907 907 907 907 90"..., 4096) = 4096

write(3, "8 908 908 908 908 908 908 908 90"..., 4096) = 4096

write(3, "9 909 909 909 909 909 909 909 90"..., 4096) = 4096

write(3, "0 910 910 910 910 910 910 910 91"..., 4096) = 4096

write(3, "1 911 911 911 911 911 911 911 91"..., 4096) = 4096

write(3, "2 912 912 913 913 912 912 913 91"..., 4096) = 4096

write(3, "4 914 914 914 913 914 914 914 91"..., 4096) = 4096

write(3, "5 915 915 915 915 915 915 915 91"..., 4096) = 4096

write(3, "6 916 916 916 916 916 916 916 91"..., 4096) = 4096

write(3, "8 917 917 918 917 918 917 917 91"..., 4096) = 4096

write(3, "8 918 918 918 918 918 917 918 91"..., 4096) = 4096

write(3, "9 919 919 919 919 919 919 919 91"..., 4096) = 4096

write(3, "0 920 920 919 920 919 920 920 92"..., 4096) = 4096

write(3, "1 921 921 921 921 921 921 921 92"..., 4096) = 4096

write(3, "2 922 922 922 922 922 922 922 92"..., 4096) = 4096

write(3, "3 923 923 923 923 923 923 923 92"..., 4096) = 4096

write(3, "4 924 924 924 924 924 925 924 92"..., 4096) = 4096

write(3, "5 925 926 926 926 927 926 926 92"..., 4096) = 4096

write(3, "6 926 926 926 926 926 926 926 92"..., 4096) = 4096

write(3, "8 929 929 928 929 927 927 927 92"..., 4096) = 4096

write(3, "8 928 928 928 927 927 927 927 92"..., 4096) = 4096

write(3, "9 929 929 929 928 929 928 929 92"..., 4096) = 4096

write(3, "0 930 930 930 930 930 930 930 93"..., 4096) = 4096

write(3, "1 931 931 931 931 931 931 931 93"..., 4096) = 4096

write(3, "2 932 932 932 932 932 932 932 93"..., 4096) = 4096

write(3, "3 933 933 931 933 933 933 933 93"..., 4096) = 4096

write(3, "4 934 935 935 935 935 935 935 93"..., 4096) = 4096

write(3, "5 935 935 935 935 936 936 935 93"..., 4096) = 4096

write(3, "7 936 937 937 936 936 936 936 93"..., 4096) = 4096

write(3, "8 938 938 938 938 937 937 937 93"..., 4096) = 4096

write(3, "9 940 939 938 938 938 938 938 93"..., 4096) = 4096

write(3, "9 939 939 939 939 939 939 939 93"..., 4096) = 4096

write(3, "0 940 940 940 940 940 940 940 94"..., 4096) = 4096

write(3, "1 941 941 941 941 941 941 942 94"..., 4096) = 4096

write(3, "3 943 943 943 943 943 943 943 94"..., 4096) = 4096

write(3, "4 944 944 944 944 944 944 944 94"..., 4096) = 4096

write(3, "4 945 945 945 945 945 945 944 94"..., 4096) = 4096

write(3, "6 946 946 946 946 946 946 946 94"..., 4096) = 4096

write(3, "7 948 947 948 947 947 947 947 94"..., 4096) = 4096

write(3, "9 949 948 948 948 948 948 948 94"..., 4096) = 4096

write(3, "9 949 949 949 949 950 949 950 95"..., 4096) = 4096

write(3, "9 949 949 949 949 949 949 949 94"..., 4096) = 4096

write(3, "0 950 950 950 950 950 950 950 95"..., 4096) = 4096

write(3, "1 951 951 951 951 951 952 952 95"..., 4096) = 4096

write(3, "3 953 952 953 953 953 953 953 95"..., 4096) = 4096

write(3, "4 954 954 954 954 954 954 954 95"..., 4096) = 4096

write(3, "5 955 955 955 955 955 955 955 95"..., 4096) = 4096

write(3, "6 956 956 956 956 956 956 956 95"..., 4096) = 4096

write(3, "7 957 957 957 957 957 957 957 95"..., 4096) = 4096

write(3, "8 958 958 958 958 958 958 958 95"..., 4096) = 4096

write(3, "9 959 959 959 959 959 959 959 95"..., 4096) = 4096

write(3, "0 960 960 960 960 960 960 960 96"..., 4096) = 4096

write(3, "1 961 961 961 961 961 961 961 96"..., 4096) = 4096

write(3, "2 962 962 963 962 962 963 962 96"..., 4096) = 4096

write(3, "3 963 963 964 963 964 964 963 96"..., 4096) = 4096

write(3, "5 964 965 965 965 965 964 964 96"..., 4096) = 4096

write(3, "5 965 965 965 965 965 965 965 96"..., 4096) = 4096

write(3, "6 967 966 966 966 966 966 966 96"..., 4096) = 4096

write(3, "8 967 967 967 967 967 967 967 96"..., 4096) = 4096

write(3, "8 968 968 968 969 968 968 968 96"..., 4096) = 4096

write(3, "9 969 969 969 969 969 969 969 97"..., 4096) = 4096

write(3, "0 969 970 970 969 970 970 970 97"..., 4096) = 4096

write(3, "1 971 971 971 971 972 971 972 97"..., 4096) = 4096

write(3, "2 972 972 972 972 972 972 972 97"..., 4096) = 4096

write(3, "3 973 974 973 974 974 973 973 97"..., 4096) = 4096

write(3, "4 975 974 975 975 975 974 974 97"..., 4096) = 4096

write(3, "6 976 976 976 976 975 975 975 97"..., 4096) = 4096

write(3, "7 976 976 976 976 976 976 976 97"..., 4096) = 4096

write(3, "7 977 977 978 978 978 978 978 97"..., 4096) = 4096

write(3, "8 978 978 978 978 978 978 978 97"..., 4096) = 4096

write(3, "0 980 980 980 980 980 980 980 98"..., 4096) = 4096

write(3, "1 981 981 981 981 981 981 981 98"..., 4096) = 4096

write(3, "1 981 982 982 981 982 982 981 98"..., 4096) = 4096

write(3, "3 983 983 983 983 983 983 982 98"..., 4096) = 4096

write(3, "4 983 984 984 983 983 983 984 98"..., 4096) = 4096

write(3, "5 985 985 985 985 984 985 985 98"..., 4096) = 4096

write(3, "6 986 986 986 986 986 986 986 98"..., 4096) = 4096

write(3, "7 987 987 987 987 987 987 987 98"..., 4096) = 4096

write(3, "8 988 988 988 988 988 988 988 98"..., 4096) = 4096

write(3, "9 989 989 989 989 989 989 989 98"..., 4096) = 4096

write(3, "0 990 990 990 990 990 990 990 99"..., 4096) = 4096

write(3, "1 991 991 991 991 991 991 991 99"..., 4096) = 4096

write(3, "2 992 992 992 992 992 992 992 99"..., 4096) = 4096

write(3, "3 993 993 993 993 993 993 992 99"..., 4096) = 4096

write(3, "4 994 994 994 994 994 993 994 99"..., 4096) = 4096

write(3, "5 995 995 995 995 995 995 995 99"..., 4096) = 4096

write(3, "6 996 996 996 996 996 996 996 99"..., 4096) = 4096

write(3, "7 997 997 997 997 997 997 997 99"..., 4096) = 4096

write(3, "8 998 998 998 998 998 998 998 99"..., 4096) = 4096

write(3, "9 999 999 999 999 999 999 999 99"..., 2494) = 2494

close(3) = 0

newfstatat(1, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0x4), ...}, AT\_EMPTY\_PATH) = 0

write(1, "Time taken for sorting: 0.114340"..., 41Time taken for sorting: 0.114340 seconds

) = 41

munmap(0x7f5f81374000, 4001792) = 0

exit\_group(0) = ?

+++ exited with 0 +++

# Вывод

В ходе написания данной лабораторной работы я научился создавать программы,

работающие с несколькими потоками, а также синхронизировать их между собой. В результате тестирования программы, я проанализировал каким образом количество потоков влияет на

эффективность и ускорение работы программы. Оказалось, что большое количество потоков даёт хорошее ускорение на больших количествах входных данных, но эффективность использования ресурсов находится на приемлемом уровне только на небольшом количестве потоков, не превышающем количества логических ядер процессора. Лабораторная работа была довольно интересна, так как я впервые работал с многопоточностью и синхронизацией на СИ.