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Высшая школа информатики и вычислительной техники

**Лабораторная работа № 4**

**Дисциплина**: Низкоуровневое программирование

**Тема:** Раздельная компиляция

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«30» ноября 2022 г.

Санкт-Петербург

2022

Оглавление

Техническое задание

1. Программа на языке C

2. Сборка программы «по шагам»

Препроцессирование

Компиляция

Ассемблирование

Компоновка

3. Создание статической библиотеки и make-файлов

Вывод

Техническое задание

1. **Формулировка задачи**

1) На языке C разработать функцию, реализующую определенную вариантом задания функциональность. Поместить определение функции в отдельный исходный файл, оформить заголовочный файл. Разработать тестовую программу на языке C.

2) Собрать программу «по шагам». Проанализировать выход препроцессора и компилятора. Проанализировать состав и содержимое секций, таблицы символов, таблицы перемещений и отладочную информацию, содержащуюся в объектных файлах и исполняемом файле.

3) Выделить разработанную функцию в статическую библиотеку. Разработать make-файлы для сборки библиотеки и использующей ее тестовой программы. Проанализировать ход сборки библиотеки и программы, созданные файлы зависимостей.

1. **Вариант задания**

Циклический сдвиг массива чисел на заданное количество разрядов вправо

1. **Ход решения**

Листинг 1.1. Заголовочный файл shift.h

#ifndef SHIFT\_H

#define SHIFT\_H

void shift(int n, int \*mass);

#endif

Листинг 1.2. Основной файл shift.c

#include "shift.h"

void array\_enter(int size, int\* array) {

int i = 0;

for(i; i < size; i++){

printf("enter array[%d] =", i);

scanf("%d",&array[i]);

}

}

void array\_read(int size, int\* array) {

int j = 0;

printf("Array\n");

printf("[ ");

for(j; j < size; j++){

if(j<(size - 1)) {

printf("%d,\t",array[j]);

}else{

printf("%d ]\n",array[j]);

}

}

}

void array\_shift(int size, int\* array, int delta){

int current\_element;

while(delta > 0){

int i = 0;

int prev\_element = 0;

for(i; i < size; i++){

current\_element = array[i];

array[i] = prev\_element;

prev\_element = current\_element;

}

array[0] = current\_element;

delta--;

}

}

Листинг 1.3. Тестовая программа main.c

#include <stdio.h>

#include <stdlib.h>

#include "shift.h"

int main() {

int delta;

int array\_size;

printf("Enter delta = :");

scanf("%d",&delta);

printf("Enter array size = :");

scanf("%d",&array\_size);

const int getSize(int n){

return array\_size \* sizeof(int);

}

int constantExpressionArray[getSize(0)];

array\_enter(array\_size, &constantExpressionArray);

array\_read(array\_size, &constantExpressionArray);

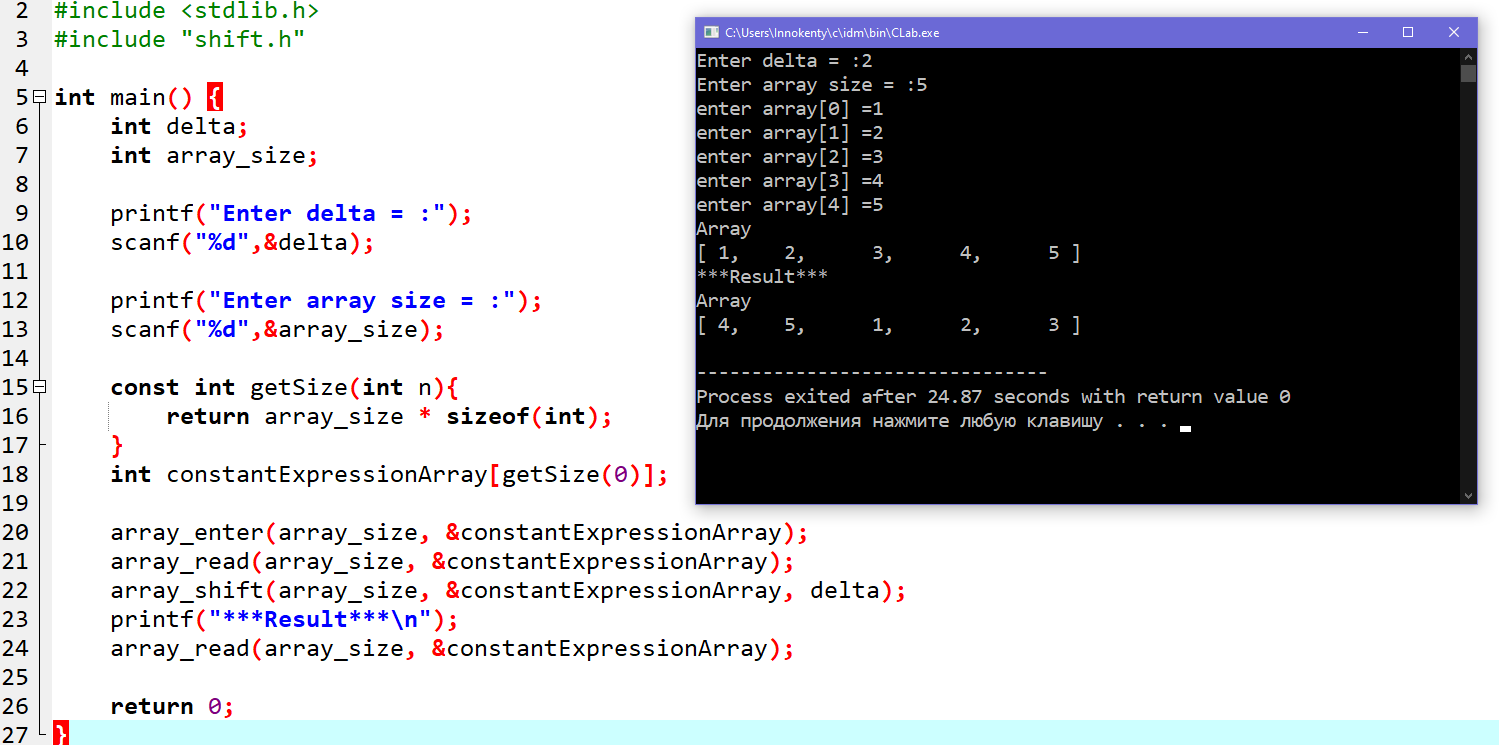
array\_shift(array\_size, &constantExpressionArray, delta);

printf("\*\*\*Result\*\*\*\n");

array\_read(array\_size, &constantExpressionArray);

return 0;

}



**2. Сборка программы по шагам**

Препроцессирование, компиляция и ассемблирование

riscv64-unknown-elf-gcc --save-temps -march=rv32i -mabi=ilp32 -O1 -v main.c >log 2>&1

riscv64-unknown-elf-gcc --save-temps -march=rv32i -mabi=ilp32 -O1 -v shift.c >log 2>&1

В файлах main.i и shift.i содержится результат препроцессирования

Листинг 2.1. Файл main.i

# 1 "main.c"

# 1 "<built-in>"

# 1 "<command-line>"

# 1 "main.c"

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 1 3

# 29 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\\_ansi.h" 1 3

# 10 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\\_ansi.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\newlib.h" 1 3

# 14 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\newlib.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\\_newlib\_version.h" 1 3

# 15 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\newlib.h" 2 3

# 11 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\\_ansi.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\config.h" 1 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\ieeefp.h" 1 3

# 5 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\config.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\features.h" 1 3

# 6 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\config.h" 2 3

# 12 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\\_ansi.h" 2 3

# 30 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\cdefs.h" 1 3

# 45 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\cdefs.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 1 3

# 41 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

# 41 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef signed char \_\_int8\_t;

typedef unsigned char \_\_uint8\_t;

# 55 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef short int \_\_int16\_t;

typedef short unsigned int \_\_uint16\_t;

# 77 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef long int \_\_int32\_t;

typedef long unsigned int \_\_uint32\_t;

# 103 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef long long int \_\_int64\_t;

typedef long long unsigned int \_\_uint64\_t;

# 134 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef signed char \_\_int\_least8\_t;

typedef unsigned char \_\_uint\_least8\_t;

# 160 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef short int \_\_int\_least16\_t;

typedef short unsigned int \_\_uint\_least16\_t;

# 182 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef long int \_\_int\_least32\_t;

typedef long unsigned int \_\_uint\_least32\_t;

# 200 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef long long int \_\_int\_least64\_t;

typedef long long unsigned int \_\_uint\_least64\_t;

# 214 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_default\_types.h" 3

typedef long long int \_\_intmax\_t;

typedef long long unsigned int \_\_uintmax\_t;

typedef int \_\_intptr\_t;

typedef unsigned int \_\_uintptr\_t;

# 46 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\cdefs.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 1 3 4

# 216 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 3 4

typedef unsigned int size\_t;

# 48 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\cdefs.h" 2 3

# 36 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 1 3 4

# 149 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 3 4

typedef int ptrdiff\_t;

# 328 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 3 4

typedef int wchar\_t;

# 426 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 3 4

typedef struct {

long long \_\_max\_align\_ll \_\_attribute\_\_((\_\_aligned\_\_(\_\_alignof\_\_(long long))));

long double \_\_max\_align\_ld \_\_attribute\_\_((\_\_aligned\_\_(\_\_alignof\_\_(long double))));

# 437 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 3 4

} max\_align\_t;

# 37 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stdarg.h" 1 3 4

# 40 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stdarg.h" 3 4

typedef \_\_builtin\_va\_list \_\_gnuc\_va\_list;

# 41 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 2 3

typedef \_\_gnuc\_va\_list va\_list;

# 60 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 1 3

# 13 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\\_ansi.h" 1 3

# 14 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 1 3 4

# 15 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 1 3

# 24 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 1 3 4

# 357 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 3 4

typedef unsigned int wint\_t;

# 25 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_types.h" 1 3

# 28 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 2 3

typedef long \_\_blkcnt\_t;

typedef long \_\_blksize\_t;

typedef \_\_uint64\_t \_\_fsblkcnt\_t;

typedef \_\_uint32\_t \_\_fsfilcnt\_t;

typedef long \_off\_t;

typedef int \_\_pid\_t;

typedef short \_\_dev\_t;

typedef unsigned short \_\_uid\_t;

typedef unsigned short \_\_gid\_t;

typedef \_\_uint32\_t \_\_id\_t;

typedef unsigned short \_\_ino\_t;

# 90 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 3

typedef \_\_uint32\_t \_\_mode\_t;

\_\_extension\_\_ typedef long long \_off64\_t;

typedef \_off\_t \_\_off\_t;

typedef \_off64\_t \_\_loff\_t;

typedef long \_\_key\_t;

typedef long \_fpos\_t;

# 131 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 3

typedef unsigned int \_\_size\_t;

# 147 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 3

typedef signed int \_ssize\_t;

# 158 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_types.h" 3

typedef \_ssize\_t \_\_ssize\_t;

typedef struct

{

int \_\_count;

union

{

wint\_t \_\_wch;

unsigned char \_\_wchb[4];

} \_\_value;

} \_mbstate\_t;

typedef void \*\_iconv\_t;

typedef unsigned long \_\_clock\_t;

typedef \_\_int\_least64\_t \_\_time\_t;

typedef unsigned long \_\_clockid\_t;

typedef unsigned long \_\_timer\_t;

typedef \_\_uint8\_t \_\_sa\_family\_t;

typedef \_\_uint32\_t \_\_socklen\_t;

typedef int \_\_nl\_item;

typedef unsigned short \_\_nlink\_t;

typedef long \_\_suseconds\_t;

typedef unsigned long \_\_useconds\_t;

typedef \_\_builtin\_va\_list \_\_va\_list;

# 16 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 2 3

typedef unsigned long \_\_ULong;

# 34 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\lock.h" 1 3

# 11 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\lock.h" 3

typedef int \_LOCK\_T;

typedef int \_LOCK\_RECURSIVE\_T;

# 35 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 2 3

typedef \_LOCK\_RECURSIVE\_T \_flock\_t;

struct \_reent;

struct \_\_locale\_t;

struct \_Bigint

{

struct \_Bigint \*\_next;

int \_k, \_maxwds, \_sign, \_wds;

\_\_ULong \_x[1];

};

struct \_\_tm

{

int \_\_tm\_sec;

int \_\_tm\_min;

int \_\_tm\_hour;

int \_\_tm\_mday;

int \_\_tm\_mon;

int \_\_tm\_year;

int \_\_tm\_wday;

int \_\_tm\_yday;

int \_\_tm\_isdst;

};

struct \_on\_exit\_args {

void \* \_fnargs[32];

void \* \_dso\_handle[32];

\_\_ULong \_fntypes;

\_\_ULong \_is\_cxa;

};

# 98 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

struct \_atexit {

struct \_atexit \*\_next;

int \_ind;

void (\*\_fns[32])(void);

struct \_on\_exit\_args \_on\_exit\_args;

};

# 122 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

struct \_\_sbuf {

unsigned char \*\_base;

int \_size;

};

# 186 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

struct \_\_sFILE {

unsigned char \*\_p;

int \_r;

int \_w;

short \_flags;

short \_file;

struct \_\_sbuf \_bf;

int \_lbfsize;

void \* \_cookie;

\_ssize\_t (\*\_read) (struct \_reent \*, void \*,

char \*, int);

\_ssize\_t (\*\_write) (struct \_reent \*, void \*,

const char \*,

int);

\_fpos\_t (\*\_seek) (struct \_reent \*, void \*, \_fpos\_t, int);

int (\*\_close) (struct \_reent \*, void \*);

struct \_\_sbuf \_ub;

unsigned char \*\_up;

int \_ur;

unsigned char \_ubuf[3];

unsigned char \_nbuf[1];

struct \_\_sbuf \_lb;

int \_blksize;

\_off\_t \_offset;

struct \_reent \*\_data;

\_flock\_t \_lock;

\_mbstate\_t \_mbstate;

int \_flags2;

};

# 292 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

typedef struct \_\_sFILE \_\_FILE;

struct \_glue

{

struct \_glue \*\_next;

int \_niobs;

\_\_FILE \*\_iobs;

};

# 324 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

struct \_rand48 {

unsigned short \_seed[3];

unsigned short \_mult[3];

unsigned short \_add;

};

# 613 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

struct \_reent

{

int \_errno;

\_\_FILE \*\_stdin, \*\_stdout, \*\_stderr;

int \_inc;

char \_emergency[25];

int \_unspecified\_locale\_info;

struct \_\_locale\_t \*\_locale;

int \_\_sdidinit;

void (\*\_\_cleanup) (struct \_reent \*);

struct \_Bigint \*\_result;

int \_result\_k;

struct \_Bigint \*\_p5s;

struct \_Bigint \*\*\_freelist;

int \_cvtlen;

char \*\_cvtbuf;

union

{

struct

{

unsigned int \_unused\_rand;

char \* \_strtok\_last;

char \_asctime\_buf[26];

struct \_\_tm \_localtime\_buf;

int \_gamma\_signgam;

\_\_extension\_\_ unsigned long long \_rand\_next;

struct \_rand48 \_r48;

\_mbstate\_t \_mblen\_state;

\_mbstate\_t \_mbtowc\_state;

\_mbstate\_t \_wctomb\_state;

char \_l64a\_buf[8];

char \_signal\_buf[24];

int \_getdate\_err;

\_mbstate\_t \_mbrlen\_state;

\_mbstate\_t \_mbrtowc\_state;

\_mbstate\_t \_mbsrtowcs\_state;

\_mbstate\_t \_wcrtomb\_state;

\_mbstate\_t \_wcsrtombs\_state;

int \_h\_errno;

} \_reent;

struct

{

unsigned char \* \_nextf[30];

unsigned int \_nmalloc[30];

} \_unused;

} \_new;

struct \_atexit \*\_atexit;

struct \_atexit \_atexit0;

void (\*\*(\_sig\_func))(int);

struct \_glue \_\_sglue;

\_\_FILE \_\_sf[3];

};

# 819 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\reent.h" 3

extern struct \_reent \*\_impure\_ptr ;

extern struct \_reent \*const \_global\_impure\_ptr ;

void \_reclaim\_reent (struct \_reent \*);

# 61 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 1 3

# 28 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 3

typedef \_\_uint8\_t u\_int8\_t;

typedef \_\_uint16\_t u\_int16\_t;

typedef \_\_uint32\_t u\_int32\_t;

typedef \_\_uint64\_t u\_int64\_t;

typedef \_\_intptr\_t register\_t;

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_stdint.h" 1 3

# 20 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_stdint.h" 3

typedef \_\_int8\_t int8\_t ;

typedef \_\_uint8\_t uint8\_t ;

typedef \_\_int16\_t int16\_t ;

typedef \_\_uint16\_t uint16\_t ;

typedef \_\_int32\_t int32\_t ;

typedef \_\_uint32\_t uint32\_t ;

typedef \_\_int64\_t int64\_t ;

typedef \_\_uint64\_t uint64\_t ;

typedef \_\_intmax\_t intmax\_t;

typedef \_\_uintmax\_t uintmax\_t;

typedef \_\_intptr\_t intptr\_t;

typedef \_\_uintptr\_t uintptr\_t;

# 47 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\endian.h" 1 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\\_endian.h" 1 3

# 7 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\endian.h" 2 3

# 50 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\select.h" 1 3

# 14 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\select.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_sigset.h" 1 3

# 41 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_sigset.h" 3

typedef unsigned long \_\_sigset\_t;

# 15 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\select.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_timeval.h" 1 3

# 35 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_timeval.h" 3

typedef \_\_suseconds\_t suseconds\_t;

typedef \_\_int\_least64\_t time\_t;

# 52 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_timeval.h" 3

struct timeval {

time\_t tv\_sec;

suseconds\_t tv\_usec;

};

# 16 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\select.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\timespec.h" 1 3

# 38 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\timespec.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_timespec.h" 1 3

# 45 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_timespec.h" 3

struct timespec {

time\_t tv\_sec;

long tv\_nsec;

};

# 39 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\timespec.h" 2 3

# 58 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\timespec.h" 3

struct itimerspec {

struct timespec it\_interval;

struct timespec it\_value;

};

# 17 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\select.h" 2 3

typedef \_\_sigset\_t sigset\_t;

# 34 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\select.h" 3

typedef unsigned long fd\_mask;

typedef struct \_types\_fd\_set {

fd\_mask fds\_bits[(((64)+(((sizeof (fd\_mask) \* 8))-1))/((sizeof (fd\_mask) \* 8)))];

} \_types\_fd\_set;

# 60 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\select.h" 3

int select (int \_\_n, \_types\_fd\_set \*\_\_readfds, \_types\_fd\_set \*\_\_writefds, \_types\_fd\_set \*\_\_exceptfds, struct timeval \*\_\_timeout)

;

int pselect (int \_\_n, \_types\_fd\_set \*\_\_readfds, \_types\_fd\_set \*\_\_writefds, \_types\_fd\_set \*\_\_exceptfds, const struct timespec \*\_\_timeout, const sigset\_t \*\_\_set)

;

# 51 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 2 3

typedef \_\_uint32\_t in\_addr\_t;

typedef \_\_uint16\_t in\_port\_t;

typedef \_\_uintptr\_t u\_register\_t;

typedef unsigned char u\_char;

typedef unsigned short u\_short;

typedef unsigned int u\_int;

typedef unsigned long u\_long;

typedef unsigned short ushort;

typedef unsigned int uint;

typedef unsigned long ulong;

typedef \_\_blkcnt\_t blkcnt\_t;

typedef \_\_blksize\_t blksize\_t;

typedef unsigned long clock\_t;

# 119 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 3

typedef long daddr\_t;

typedef char \* caddr\_t;

typedef \_\_fsblkcnt\_t fsblkcnt\_t;

typedef \_\_fsfilcnt\_t fsfilcnt\_t;

typedef \_\_id\_t id\_t;

typedef \_\_ino\_t ino\_t;

# 157 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 3

typedef \_\_off\_t off\_t;

typedef \_\_dev\_t dev\_t;

typedef \_\_uid\_t uid\_t;

typedef \_\_gid\_t gid\_t;

typedef \_\_pid\_t pid\_t;

typedef \_\_key\_t key\_t;

typedef \_ssize\_t ssize\_t;

typedef \_\_mode\_t mode\_t;

typedef \_\_nlink\_t nlink\_t;

typedef \_\_clockid\_t clockid\_t;

typedef \_\_timer\_t timer\_t;

typedef \_\_useconds\_t useconds\_t;

# 220 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 3

typedef \_\_int64\_t sbintime\_t;

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_pthreadtypes.h" 1 3

# 23 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_pthreadtypes.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\sched.h" 1 3

# 48 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\sched.h" 3

struct sched\_param {

int sched\_priority;

# 61 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\sched.h" 3

};

# 24 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_pthreadtypes.h" 2 3

# 32 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_pthreadtypes.h" 3

typedef \_\_uint32\_t pthread\_t;

# 61 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_pthreadtypes.h" 3

typedef struct {

int is\_initialized;

void \*stackaddr;

int stacksize;

int contentionscope;

int inheritsched;

int schedpolicy;

struct sched\_param schedparam;

int detachstate;

} pthread\_attr\_t;

# 154 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_pthreadtypes.h" 3

typedef \_\_uint32\_t pthread\_mutex\_t;

typedef struct {

int is\_initialized;

# 168 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\\_pthreadtypes.h" 3

int recursive;

} pthread\_mutexattr\_t;

typedef \_\_uint32\_t pthread\_cond\_t;

typedef struct {

int is\_initialized;

clock\_t clock;

} pthread\_condattr\_t;

typedef \_\_uint32\_t pthread\_key\_t;

typedef struct {

int is\_initialized;

int init\_executed;

} pthread\_once\_t;

# 224 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\types.h" 1 3

# 225 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\types.h" 2 3

# 62 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 2 3

typedef \_\_FILE FILE;

typedef \_fpos\_t fpos\_t;

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\sys\\stdio.h" 1 3

# 80 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 2 3

# 181 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

char \* ctermid (char \*);

FILE \* tmpfile (void);

char \* tmpnam (char \*);

char \* tempnam (const char \*, const char \*) \_\_attribute\_\_((\_\_malloc\_\_)) \_\_attribute\_\_((\_\_warn\_unused\_result\_\_));

int fclose (FILE \*);

int fflush (FILE \*);

FILE \* freopen (const char \*restrict, const char \*restrict, FILE \*restrict);

void setbuf (FILE \*restrict, char \*restrict);

int setvbuf (FILE \*restrict, char \*restrict, int, size\_t);

int fprintf (FILE \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

int fscanf (FILE \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 3)));

int printf (const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 1, 2)));

int scanf (const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 1, 2)));

int sscanf (const char \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 3)));

int vfprintf (FILE \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int vprintf (const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 1, 0)));

int vsprintf (char \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int fgetc (FILE \*);

char \* fgets (char \*restrict, int, FILE \*restrict);

int fputc (int, FILE \*);

int fputs (const char \*restrict, FILE \*restrict);

int getc (FILE \*);

int getchar (void);

char \* gets (char \*);

int putc (int, FILE \*);

int putchar (int);

int puts (const char \*);

int ungetc (int, FILE \*);

size\_t fread (void \*restrict, size\_t \_size, size\_t \_n, FILE \*restrict);

size\_t fwrite (const void \*restrict , size\_t \_size, size\_t \_n, FILE \*);

int fgetpos (FILE \*restrict, fpos\_t \*restrict);

int fseek (FILE \*, long, int);

int fsetpos (FILE \*, const fpos\_t \*);

long ftell ( FILE \*);

void rewind (FILE \*);

void clearerr (FILE \*);

int feof (FILE \*);

int ferror (FILE \*);

void perror (const char \*);

FILE \* fopen (const char \*restrict \_name, const char \*restrict \_type);

int sprintf (char \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

int remove (const char \*);

int rename (const char \*, const char \*);

# 257 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

int fseeko (FILE \*, off\_t, int);

off\_t ftello (FILE \*);

int snprintf (char \*restrict, size\_t, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int vsnprintf (char \*restrict, size\_t, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int vfscanf (FILE \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 0)));

int vscanf (const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 1, 0)));

int vsscanf (const char \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 0)));

# 284 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

int asiprintf (char \*\*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

char \* asniprintf (char \*, size\_t \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

char \* asnprintf (char \*restrict, size\_t \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int diprintf (int, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

int fiprintf (FILE \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

int fiscanf (FILE \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 3)));

int iprintf (const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 1, 2)));

int iscanf (const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 1, 2)));

int siprintf (char \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

int siscanf (const char \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 3)));

int sniprintf (char \*, size\_t, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int vasiprintf (char \*\*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

char \* vasniprintf (char \*, size\_t \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

char \* vasnprintf (char \*, size\_t \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int vdiprintf (int, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int vfiprintf (FILE \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int vfiscanf (FILE \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 0)));

int viprintf (const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 1, 0)));

int viscanf (const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 1, 0)));

int vsiprintf (char \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int vsiscanf (const char \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 0)));

int vsniprintf (char \*, size\_t, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

# 339 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

FILE \* fdopen (int, const char \*);

int fileno (FILE \*);

int pclose (FILE \*);

FILE \* popen (const char \*, const char \*);

void setbuffer (FILE \*, char \*, int);

int setlinebuf (FILE \*);

int getw (FILE \*);

int putw (int, FILE \*);

int getc\_unlocked (FILE \*);

int getchar\_unlocked (void);

void flockfile (FILE \*);

int ftrylockfile (FILE \*);

void funlockfile (FILE \*);

int putc\_unlocked (int, FILE \*);

int putchar\_unlocked (int);

# 374 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

int dprintf (int, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

FILE \* fmemopen (void \*restrict, size\_t, const char \*restrict);

FILE \* open\_memstream (char \*\*, size\_t \*);

int vdprintf (int, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int renameat (int, const char \*, int, const char \*);

# 396 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

int \_asiprintf\_r (struct \_reent \*, char \*\*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

char \* \_asniprintf\_r (struct \_reent \*, char \*, size\_t \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 5)));

char \* \_asnprintf\_r (struct \_reent \*, char \*restrict, size\_t \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 5)));

int \_asprintf\_r (struct \_reent \*, char \*\*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int \_diprintf\_r (struct \_reent \*, int, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int \_dprintf\_r (struct \_reent \*, int, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int \_fclose\_r (struct \_reent \*, FILE \*);

int \_fcloseall\_r (struct \_reent \*);

FILE \* \_fdopen\_r (struct \_reent \*, int, const char \*);

int \_fflush\_r (struct \_reent \*, FILE \*);

int \_fgetc\_r (struct \_reent \*, FILE \*);

int \_fgetc\_unlocked\_r (struct \_reent \*, FILE \*);

char \* \_fgets\_r (struct \_reent \*, char \*restrict, int, FILE \*restrict);

char \* \_fgets\_unlocked\_r (struct \_reent \*, char \*restrict, int, FILE \*restrict);

int \_fgetpos\_r (struct \_reent \*, FILE \*, fpos\_t \*);

int \_fsetpos\_r (struct \_reent \*, FILE \*, const fpos\_t \*);

int \_fiprintf\_r (struct \_reent \*, FILE \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int \_fiscanf\_r (struct \_reent \*, FILE \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 4)));

FILE \* \_fmemopen\_r (struct \_reent \*, void \*restrict, size\_t, const char \*restrict);

FILE \* \_fopen\_r (struct \_reent \*, const char \*restrict, const char \*restrict);

FILE \* \_freopen\_r (struct \_reent \*, const char \*restrict, const char \*restrict, FILE \*restrict);

int \_fprintf\_r (struct \_reent \*, FILE \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int \_fpurge\_r (struct \_reent \*, FILE \*);

int \_fputc\_r (struct \_reent \*, int, FILE \*);

int \_fputc\_unlocked\_r (struct \_reent \*, int, FILE \*);

int \_fputs\_r (struct \_reent \*, const char \*restrict, FILE \*restrict);

int \_fputs\_unlocked\_r (struct \_reent \*, const char \*restrict, FILE \*restrict);

size\_t \_fread\_r (struct \_reent \*, void \*restrict, size\_t \_size, size\_t \_n, FILE \*restrict);

size\_t \_fread\_unlocked\_r (struct \_reent \*, void \*restrict, size\_t \_size, size\_t \_n, FILE \*restrict);

int \_fscanf\_r (struct \_reent \*, FILE \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 4)));

int \_fseek\_r (struct \_reent \*, FILE \*, long, int);

int \_fseeko\_r (struct \_reent \*, FILE \*, \_off\_t, int);

long \_ftell\_r (struct \_reent \*, FILE \*);

\_off\_t \_ftello\_r (struct \_reent \*, FILE \*);

void \_rewind\_r (struct \_reent \*, FILE \*);

size\_t \_fwrite\_r (struct \_reent \*, const void \*restrict, size\_t \_size, size\_t \_n, FILE \*restrict);

size\_t \_fwrite\_unlocked\_r (struct \_reent \*, const void \*restrict, size\_t \_size, size\_t \_n, FILE \*restrict);

int \_getc\_r (struct \_reent \*, FILE \*);

int \_getc\_unlocked\_r (struct \_reent \*, FILE \*);

int \_getchar\_r (struct \_reent \*);

int \_getchar\_unlocked\_r (struct \_reent \*);

char \* \_gets\_r (struct \_reent \*, char \*);

int \_iprintf\_r (struct \_reent \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

int \_iscanf\_r (struct \_reent \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 3)));

FILE \* \_open\_memstream\_r (struct \_reent \*, char \*\*, size\_t \*);

void \_perror\_r (struct \_reent \*, const char \*);

int \_printf\_r (struct \_reent \*, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 3)));

int \_putc\_r (struct \_reent \*, int, FILE \*);

int \_putc\_unlocked\_r (struct \_reent \*, int, FILE \*);

int \_putchar\_unlocked\_r (struct \_reent \*, int);

int \_putchar\_r (struct \_reent \*, int);

int \_puts\_r (struct \_reent \*, const char \*);

int \_remove\_r (struct \_reent \*, const char \*);

int \_rename\_r (struct \_reent \*,

const char \*\_old, const char \*\_new);

int \_scanf\_r (struct \_reent \*, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 3)));

int \_siprintf\_r (struct \_reent \*, char \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int \_siscanf\_r (struct \_reent \*, const char \*, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 4)));

int \_sniprintf\_r (struct \_reent \*, char \*, size\_t, const char \*, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 5)));

int \_snprintf\_r (struct \_reent \*, char \*restrict, size\_t, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 5)));

int \_sprintf\_r (struct \_reent \*, char \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 4)));

int \_sscanf\_r (struct \_reent \*, const char \*restrict, const char \*restrict, ...)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 4)));

char \* \_tempnam\_r (struct \_reent \*, const char \*, const char \*);

FILE \* \_tmpfile\_r (struct \_reent \*);

char \* \_tmpnam\_r (struct \_reent \*, char \*);

int \_ungetc\_r (struct \_reent \*, int, FILE \*);

int \_vasiprintf\_r (struct \_reent \*, char \*\*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

char \* \_vasniprintf\_r (struct \_reent\*, char \*, size\_t \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 0)));

char \* \_vasnprintf\_r (struct \_reent\*, char \*, size\_t \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 0)));

int \_vasprintf\_r (struct \_reent \*, char \*\*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int \_vdiprintf\_r (struct \_reent \*, int, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int \_vdprintf\_r (struct \_reent \*, int, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int \_vfiprintf\_r (struct \_reent \*, FILE \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int \_vfiscanf\_r (struct \_reent \*, FILE \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 0)));

int \_vfprintf\_r (struct \_reent \*, FILE \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int \_vfscanf\_r (struct \_reent \*, FILE \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 0)));

int \_viprintf\_r (struct \_reent \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int \_viscanf\_r (struct \_reent \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 0)));

int \_vprintf\_r (struct \_reent \*, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 2, 0)));

int \_vscanf\_r (struct \_reent \*, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 2, 0)));

int \_vsiprintf\_r (struct \_reent \*, char \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int \_vsiscanf\_r (struct \_reent \*, const char \*, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 0)));

int \_vsniprintf\_r (struct \_reent \*, char \*, size\_t, const char \*, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 0)));

int \_vsnprintf\_r (struct \_reent \*, char \*restrict, size\_t, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 4, 0)));

int \_vsprintf\_r (struct \_reent \*, char \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_printf\_\_, 3, 0)));

int \_vsscanf\_r (struct \_reent \*, const char \*restrict, const char \*restrict, \_\_gnuc\_va\_list)

\_\_attribute\_\_ ((\_\_format\_\_ (\_\_scanf\_\_, 3, 0)));

int fpurge (FILE \*);

ssize\_t \_\_getdelim (char \*\*, size\_t \*, int, FILE \*);

ssize\_t \_\_getline (char \*\*, size\_t \*, FILE \*);

void clearerr\_unlocked (FILE \*);

int feof\_unlocked (FILE \*);

int ferror\_unlocked (FILE \*);

int fileno\_unlocked (FILE \*);

int fflush\_unlocked (FILE \*);

int fgetc\_unlocked (FILE \*);

int fputc\_unlocked (int, FILE \*);

size\_t fread\_unlocked (void \*restrict, size\_t \_size, size\_t \_n, FILE \*restrict);

size\_t fwrite\_unlocked (const void \*restrict , size\_t \_size, size\_t \_n, FILE \*);

# 577 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

int \_\_srget\_r (struct \_reent \*, FILE \*);

int \_\_swbuf\_r (struct \_reent \*, int, FILE \*);

# 601 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

FILE \*funopen (const void \*\_\_cookie,

int (\*\_\_readfn)(void \*\_\_cookie, char \*\_\_buf,

int \_\_n),

int (\*\_\_writefn)(void \*\_\_cookie, const char \*\_\_buf,

int \_\_n),

fpos\_t (\*\_\_seekfn)(void \*\_\_cookie, fpos\_t \_\_off, int \_\_whence),

int (\*\_\_closefn)(void \*\_\_cookie));

FILE \*\_funopen\_r (struct \_reent \*, const void \*\_\_cookie,

int (\*\_\_readfn)(void \*\_\_cookie, char \*\_\_buf,

int \_\_n),

int (\*\_\_writefn)(void \*\_\_cookie, const char \*\_\_buf,

int \_\_n),

fpos\_t (\*\_\_seekfn)(void \*\_\_cookie, fpos\_t \_\_off, int \_\_whence),

int (\*\_\_closefn)(void \*\_\_cookie));

# 687 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

static \_\_inline\_\_ int \_\_sputc\_r(struct \_reent \*\_ptr, int \_c, FILE \*\_p) {

if (--\_p->\_w >= 0 || (\_p->\_w >= \_p->\_lbfsize && (char)\_c != '\n'))

return (\*\_p->\_p++ = \_c);

else

return (\_\_swbuf\_r(\_ptr, \_c, \_p));

}

# 741 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

static \_\_inline int

\_getchar\_unlocked(void)

{

struct \_reent \*\_ptr;

\_ptr = \_impure\_ptr;

return ((--(((\_ptr)->\_stdin))->\_r < 0 ? \_\_srget\_r(\_ptr, ((\_ptr)->\_stdin)) : (int)(\*(((\_ptr)->\_stdin))->\_p++)));

}

static \_\_inline int

\_putchar\_unlocked(int \_c)

{

struct \_reent \*\_ptr;

\_ptr = \_impure\_ptr;

return (\_\_sputc\_r(\_ptr, \_c, ((\_ptr)->\_stdout)));

}

# 797 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdio.h" 3

# 2 "main.c" 2

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 1 3

# 10 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\ieeefp.h" 1 3

# 11 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\lib\\gcc\\riscv64-unknown-elf\\8.3.0\\include\\stddef.h" 1 3 4

# 17 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\machine\\stdlib.h" 1 3

# 21 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 2 3

# 1 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\alloca.h" 1 3

# 23 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 2 3

# 33 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 3

typedef struct

{

int quot;

int rem;

} div\_t;

typedef struct

{

long quot;

long rem;

} ldiv\_t;

typedef struct

{

long long int quot;

long long int rem;

} lldiv\_t;

typedef int (\*\_\_compar\_fn\_t) (const void \*, const void \*);

int \_\_locale\_mb\_cur\_max (void);

void abort (void) \_\_attribute\_\_ ((\_\_noreturn\_\_));

int abs (int);

\_\_uint32\_t arc4random (void);

\_\_uint32\_t arc4random\_uniform (\_\_uint32\_t);

void arc4random\_buf (void \*, size\_t);

int atexit (void (\*\_\_func)(void));

double atof (const char \*\_\_nptr);

float atoff (const char \*\_\_nptr);

int atoi (const char \*\_\_nptr);

int \_atoi\_r (struct \_reent \*, const char \*\_\_nptr);

long atol (const char \*\_\_nptr);

long \_atol\_r (struct \_reent \*, const char \*\_\_nptr);

void \* bsearch (const void \*\_\_key,

const void \*\_\_base,

size\_t \_\_nmemb,

size\_t \_\_size,

\_\_compar\_fn\_t \_compar);

void \*calloc(size\_t, size\_t) \_\_attribute\_\_((\_\_malloc\_\_)) \_\_attribute\_\_((\_\_warn\_unused\_result\_\_))

\_\_attribute\_\_((\_\_alloc\_size\_\_(1, 2))) ;

div\_t div (int \_\_numer, int \_\_denom);

void exit (int \_\_status) \_\_attribute\_\_ ((\_\_noreturn\_\_));

void free (void \*) ;

char \* getenv (const char \*\_\_string);

char \* \_getenv\_r (struct \_reent \*, const char \*\_\_string);

char \* \_findenv (const char \*, int \*);

char \* \_findenv\_r (struct \_reent \*, const char \*, int \*);

extern char \*suboptarg;

int getsubopt (char \*\*, char \* const \*, char \*\*);

long labs (long);

ldiv\_t ldiv (long \_\_numer, long \_\_denom);

void \*malloc(size\_t) \_\_attribute\_\_((\_\_malloc\_\_)) \_\_attribute\_\_((\_\_warn\_unused\_result\_\_)) \_\_attribute\_\_((\_\_alloc\_size\_\_(1))) ;

int mblen (const char \*, size\_t);

int \_mblen\_r (struct \_reent \*, const char \*, size\_t, \_mbstate\_t \*);

int mbtowc (wchar\_t \*restrict, const char \*restrict, size\_t);

int \_mbtowc\_r (struct \_reent \*, wchar\_t \*restrict, const char \*restrict, size\_t, \_mbstate\_t \*);

int wctomb (char \*, wchar\_t);

int \_wctomb\_r (struct \_reent \*, char \*, wchar\_t, \_mbstate\_t \*);

size\_t mbstowcs (wchar\_t \*restrict, const char \*restrict, size\_t);

size\_t \_mbstowcs\_r (struct \_reent \*, wchar\_t \*restrict, const char \*restrict, size\_t, \_mbstate\_t \*);

size\_t wcstombs (char \*restrict, const wchar\_t \*restrict, size\_t);

size\_t \_wcstombs\_r (struct \_reent \*, char \*restrict, const wchar\_t \*restrict, size\_t, \_mbstate\_t \*);

char \* mkdtemp (char \*);

int mkstemp (char \*);

int mkstemps (char \*, int);

char \* mktemp (char \*) \_\_attribute\_\_ ((\_\_deprecated\_\_("the use of `mktemp' is dangerous; use `mkstemp' instead")));

char \* \_mkdtemp\_r (struct \_reent \*, char \*);

int \_mkostemp\_r (struct \_reent \*, char \*, int);

int \_mkostemps\_r (struct \_reent \*, char \*, int, int);

int \_mkstemp\_r (struct \_reent \*, char \*);

int \_mkstemps\_r (struct \_reent \*, char \*, int);

char \* \_mktemp\_r (struct \_reent \*, char \*) \_\_attribute\_\_ ((\_\_deprecated\_\_("the use of `mktemp' is dangerous; use `mkstemp' instead")));

void qsort (void \*\_\_base, size\_t \_\_nmemb, size\_t \_\_size, \_\_compar\_fn\_t \_compar);

int rand (void);

void \*realloc(void \*, size\_t) \_\_attribute\_\_((\_\_warn\_unused\_result\_\_)) \_\_attribute\_\_((\_\_alloc\_size\_\_(2))) ;

void \*reallocarray(void \*, size\_t, size\_t) \_\_attribute\_\_((\_\_warn\_unused\_result\_\_)) \_\_attribute\_\_((\_\_alloc\_size\_\_(2, 3)));

void \*reallocf(void \*, size\_t) \_\_attribute\_\_((\_\_warn\_unused\_result\_\_)) \_\_attribute\_\_((\_\_alloc\_size\_\_(2)));

char \* realpath (const char \*restrict path, char \*restrict resolved\_path);

int rpmatch (const char \*response);

void srand (unsigned \_\_seed);

double strtod (const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR);

double \_strtod\_r (struct \_reent \*,const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR);

float strtof (const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR);

long strtol (const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

long \_strtol\_r (struct \_reent \*,const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

unsigned long strtoul (const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

unsigned long \_strtoul\_r (struct \_reent \*,const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

# 191 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 3

int system (const char \*\_\_string);

long a64l (const char \*\_\_input);

char \* l64a (long \_\_input);

char \* \_l64a\_r (struct \_reent \*,long \_\_input);

int on\_exit (void (\*\_\_func)(int, void \*),void \*\_\_arg);

void \_Exit (int \_\_status) \_\_attribute\_\_ ((\_\_noreturn\_\_));

int putenv (char \*\_\_string);

int \_putenv\_r (struct \_reent \*, char \*\_\_string);

void \* \_reallocf\_r (struct \_reent \*, void \*, size\_t);

int setenv (const char \*\_\_string, const char \*\_\_value, int \_\_overwrite);

int \_setenv\_r (struct \_reent \*, const char \*\_\_string, const char \*\_\_value, int \_\_overwrite);

# 224 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 3

char \* \_\_itoa (int, char \*, int);

char \* \_\_utoa (unsigned, char \*, int);

char \* itoa (int, char \*, int);

char \* utoa (unsigned, char \*, int);

int rand\_r (unsigned \*\_\_seed);

double drand48 (void);

double \_drand48\_r (struct \_reent \*);

double erand48 (unsigned short [3]);

double \_erand48\_r (struct \_reent \*, unsigned short [3]);

long jrand48 (unsigned short [3]);

long \_jrand48\_r (struct \_reent \*, unsigned short [3]);

void lcong48 (unsigned short [7]);

void \_lcong48\_r (struct \_reent \*, unsigned short [7]);

long lrand48 (void);

long \_lrand48\_r (struct \_reent \*);

long mrand48 (void);

long \_mrand48\_r (struct \_reent \*);

long nrand48 (unsigned short [3]);

long \_nrand48\_r (struct \_reent \*, unsigned short [3]);

unsigned short \*

seed48 (unsigned short [3]);

unsigned short \*

\_seed48\_r (struct \_reent \*, unsigned short [3]);

void srand48 (long);

void \_srand48\_r (struct \_reent \*, long);

char \* initstate (unsigned, char \*, size\_t);

long random (void);

char \* setstate (char \*);

void srandom (unsigned);

long long atoll (const char \*\_\_nptr);

long long \_atoll\_r (struct \_reent \*, const char \*\_\_nptr);

long long llabs (long long);

lldiv\_t lldiv (long long \_\_numer, long long \_\_denom);

long long strtoll (const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

long long \_strtoll\_r (struct \_reent \*, const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

unsigned long long strtoull (const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

unsigned long long \_strtoull\_r (struct \_reent \*, const char \*restrict \_\_n, char \*\*restrict \_\_end\_PTR, int \_\_base);

void cfree (void \*);

int unsetenv (const char \*\_\_string);

int \_unsetenv\_r (struct \_reent \*, const char \*\_\_string);

int posix\_memalign (void \*\*, size\_t, size\_t) \_\_attribute\_\_((\_\_nonnull\_\_ (1)))

\_\_attribute\_\_((\_\_warn\_unused\_result\_\_));

char \* \_dtoa\_r (struct \_reent \*, double, int, int, int \*, int\*, char\*\*);

void \* \_malloc\_r (struct \_reent \*, size\_t) ;

void \* \_calloc\_r (struct \_reent \*, size\_t, size\_t) ;

void \_free\_r (struct \_reent \*, void \*) ;

void \* \_realloc\_r (struct \_reent \*, void \*, size\_t) ;

void \_mstats\_r (struct \_reent \*, char \*);

int \_system\_r (struct \_reent \*, const char \*);

void \_\_eprintf (const char \*, const char \*, unsigned int, const char \*);

# 312 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 3

void qsort\_r (void \*\_\_base, size\_t \_\_nmemb, size\_t \_\_size, void \*\_\_thunk, int (\*\_compar)(void \*, const void \*, const void \*))

\_\_asm\_\_ ("" "\_\_bsd\_qsort\_r");

# 322 "c:\\users\\innokenty\\c\\idm\\riscv64-unknown-elf\\include\\stdlib.h" 3

extern long double \_strtold\_r (struct \_reent \*, const char \*restrict, char \*\*restrict);

extern long double strtold (const char \*restrict, char \*\*restrict);

void \* aligned\_alloc(size\_t, size\_t) \_\_attribute\_\_((\_\_malloc\_\_)) \_\_attribute\_\_((\_\_alloc\_align\_\_(1)))

\_\_attribute\_\_((\_\_alloc\_size\_\_(2))) \_\_attribute\_\_((\_\_warn\_unused\_result\_\_));

int at\_quick\_exit(void (\*)(void));

\_Noreturn void

quick\_exit(int);

# 3 "main.c" 2

# 1 "shift.h" 1

# 3 "shift.h"

void shift(int n, int \*mass);

# 4 "main.c" 2

int main() {

int delta;

int array\_size;

printf("Enter delta = :");

scanf("%d",&delta);

printf("Enter array size = :");

scanf("%d",&array\_size);

const int getSize(int n){

return array\_size \* sizeof(int);

}

int constantExpressionArray[getSize(0)];

array\_enter(array\_size, &constantExpressionArray);

array\_read(array\_size, &constantExpressionArray);

array\_shift(array\_size, &constantExpressionArray, delta);

printf("\*\*\*Result\*\*\*\n");

array\_read(array\_size, &constantExpressionArray);

return 0;

}

Листинг 2.2. Файл shift.i

# 1 "shift.c"

# 1 "<built-in>"

# 1 "<command-line>"

# 1 "shift.c"

# 1 "shift.h" 1

void shift(int n, int \*mass);

# 2 "shift.c" 2

void array\_enter(int size, int\* array) {

int i = 0;

for(i; i < size; i++){

printf("enter array[%d] =", i);

scanf("%d",&array[i]);

}

}

void array\_read(int size, int\* array) {

int j = 0;

printf("Array\n");

printf("[ ");

for(j; j < size; j++){

if(j<(size - 1)) {

printf("%d,\t",array[j]);

}else{

printf("%d ]\n",array[j]);

}

}

}

void array\_shift(int size, int\* array, int delta){

int current\_element;

while(delta > 0){

int i = 0;

int prev\_element = 0;

for(i; i < size; i++){

current\_element = array[i];

array[i] = prev\_element;

prev\_element = current\_element;

}

array[0] = current\_element;

delta--;

}

}

Компиляция

В файле main.s, так как в нем можно заметить обращение к подпрограмме shift.

.file "main.c"

.option nopic

.attribute arch, "rv32i2p0"

.attribute unaligned\_access, 0

.attribute stack\_align, 16

.text

.align 2

.globl main

.type main, @function

main:

addi sp,sp,-32

sw ra,28(sp)

sw s0,24(sp)

sw s1,20(sp)

addi s0,sp,32

sw s0,-20(s0)

lui a0,%hi(.LC0)

addi a0,a0,%lo(.LC0)

call printf

addi a1,s0,-28

lui s1,%hi(.LC1)

addi a0,s1,%lo(.LC1)

call scanf

lui a0,%hi(.LC2)

addi a0,a0,%lo(.LC2)

call printf

addi a1,s0,-24

addi a0,s1,%lo(.LC1)

call scanf

lw a0,-24(s0)

slli a5,a0,4

sub sp,sp,a5

mv s1,sp

mv a1,s1

call array\_enter

mv a1,s1

lw a0,-24(s0)

call array\_read

lw a2,-28(s0)

mv a1,s1

lw a0,-24(s0)

call array\_shift

lui a0,%hi(.LC3)

addi a0,a0,%lo(.LC3)

call puts

mv a1,s1

lw a0,-24(s0)

call array\_read

li a0,0

addi sp,s0,-32

lw ra,28(sp)

lw s0,24(sp)

lw s1,20(sp)

addi sp,sp,32

jr ra

.size main, .-main

.section .rodata.str1.4,"aMS",@progbits,1

.align 2

.LC0:

.string "Enter delta = :"

.LC1:

.string "%d"

.zero 1

.LC2:

.string "Enter array size = :"

.zero 3

.LC3:

.string "\*\*\*Result\*\*\*"

.ident "GCC: (SiFive GCC 8.3.0-2020.04.1) 8.3.0"

Листинг 2.3. Файл shift.s

.file "shift.c"

.option nopic

.attribute arch, "rv32i2p0"

.attribute unaligned\_access, 0

.attribute stack\_align, 16

.text

.align 2

.globl array\_enter

.type array\_enter, @function

array\_enter:

ble a0,zero,.L6

addi sp,sp,-32

sw ra,28(sp)

sw s0,24(sp)

sw s1,20(sp)

sw s2,16(sp)

sw s3,12(sp)

sw s4,8(sp)

mv s2,a0

mv s1,a1

li s0,0

lui s4,%hi(.LC0)

lui s3,%hi(.LC1)

.L3:

mv a1,s0

addi a0,s4,%lo(.LC0)

call printf

mv a1,s1

addi a0,s3,%lo(.LC1)

call scanf

addi s0,s0,1

addi s1,s1,4

bne s2,s0,.L3

lw ra,28(sp)

lw s0,24(sp)

lw s1,20(sp)

lw s2,16(sp)

lw s3,12(sp)

lw s4,8(sp)

addi sp,sp,32

jr ra

.L6:

ret

.size array\_enter, .-array\_enter

.align 2

.globl array\_read

.type array\_read, @function

array\_read:

addi sp,sp,-32

sw ra,28(sp)

sw s0,24(sp)

sw s1,20(sp)

sw s2,16(sp)

sw s3,12(sp)

sw s4,8(sp)

sw s5,4(sp)

mv s2,a0

mv s1,a1

lui a0,%hi(.LC2)

addi a0,a0,%lo(.LC2)

call puts

lui a0,%hi(.LC3)

addi a0,a0,%lo(.LC3)

call printf

ble s2,zero,.L9

li s0,0

addi s3,s2,-1

lui s5,%hi(.LC5)

lui s4,%hi(.LC4)

j .L13

.L11:

lw a1,0(s1)

addi a0,s5,%lo(.LC5)

call printf

.L12:

addi s0,s0,1

addi s1,s1,4

beq s2,s0,.L9

.L13:

ble s3,s0,.L11

lw a1,0(s1)

addi a0,s4,%lo(.LC4)

call printf

j .L12

.L9:

lw ra,28(sp)

lw s0,24(sp)

lw s1,20(sp)

lw s2,16(sp)

lw s3,12(sp)

lw s4,8(sp)

lw s5,4(sp)

addi sp,sp,32

jr ra

.size array\_read, .-array\_read

.align 2

.globl array\_shift

.type array\_shift, @function

array\_shift:

ble a2,zero,.L16

mv t1,a1

slli a6,a0,2

add a6,a6,a1

li a7,0

j .L18

.L20:

sw a4,0(a1)

addi a2,a2,-1

beq a2,zero,.L16

.L18:

mv a5,t1

mv a3,a7

ble a0,zero,.L20

.L19:

lw a4,0(a5)

sw a3,0(a5)

addi a5,a5,4

mv a3,a4

bne a6,a5,.L19

j .L20

.L16:

ret

.size array\_shift, .-array\_shift

.section .rodata.str1.4,"aMS",@progbits,1

.align 2

.LC0:

.string "enter array[%d] ="

.zero 2

.LC1:

.string "%d"

.zero 1

.LC2:

.string "Array"

.zero 2

.LC3:

.string "[ "

.zero 1

.LC4:

.string "%d,\t"

.zero 3

.LC5:

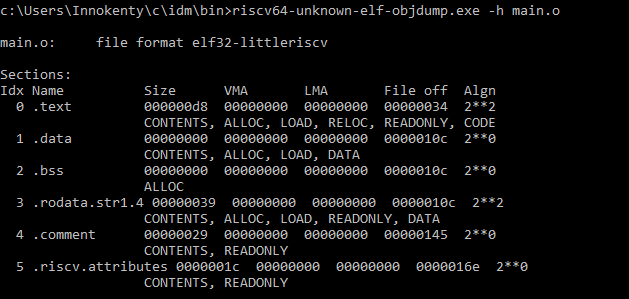
.string "%d ]\n"

.ident "GCC: (SiFive GCC 8.3.0-2020.04.1) 8.3.0"

Ассемблирование

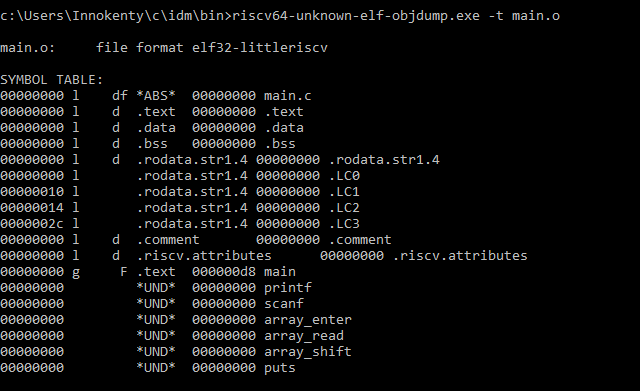
Листинг 2.4. Заголовки секций файла main.o

riscv64-unknown-elf-objdump.exe -h main.o



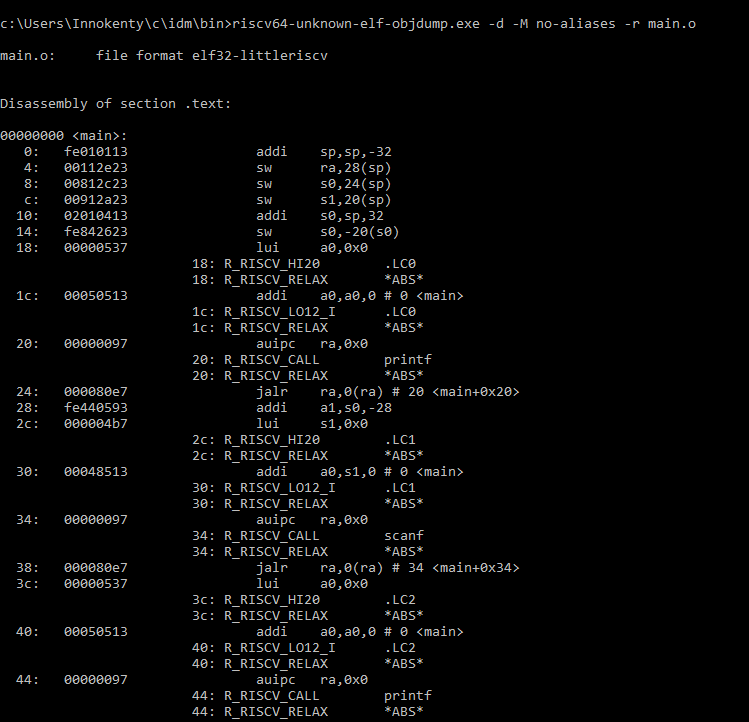
Листинг 2.5. Таблица символов файла main.o

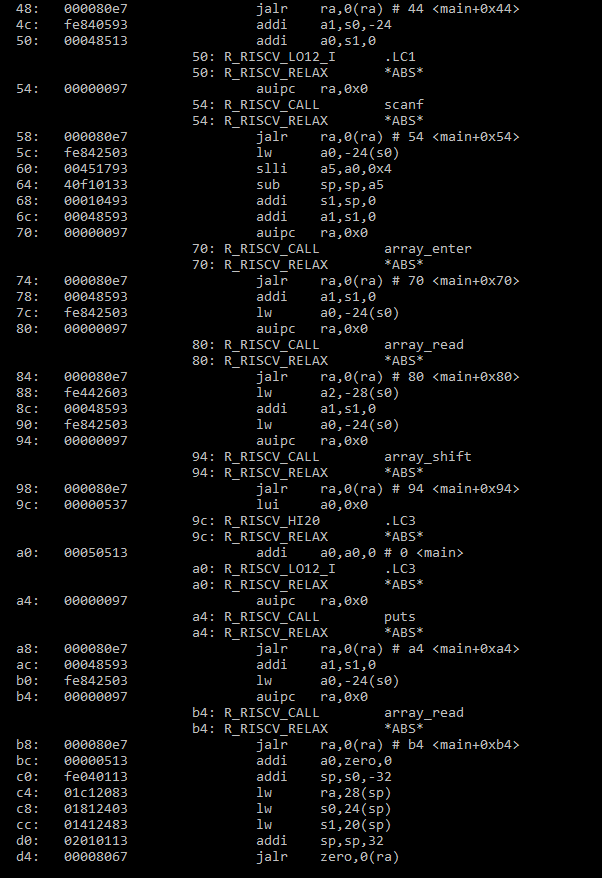
riscv64-unknown-elf-objdump.exe –t main.o



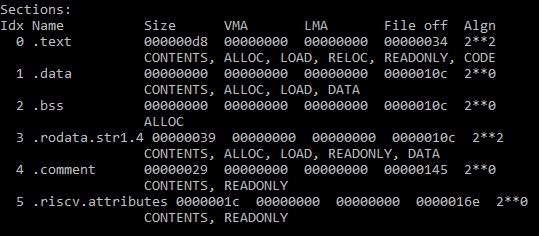
Листинг 2.6. Таблица перемещений файла main.o

riscv64-unknown-elf-objdump.exe -d -M no-aliases -r main.o

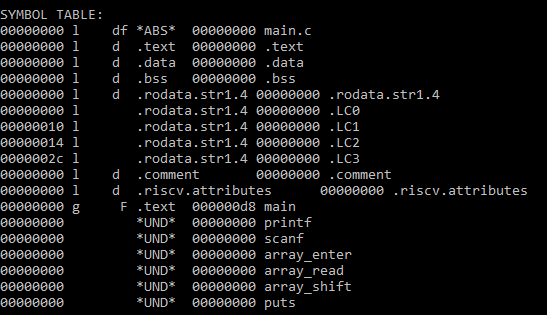




Листинг 2.7. Заголовки секций файла shift.o

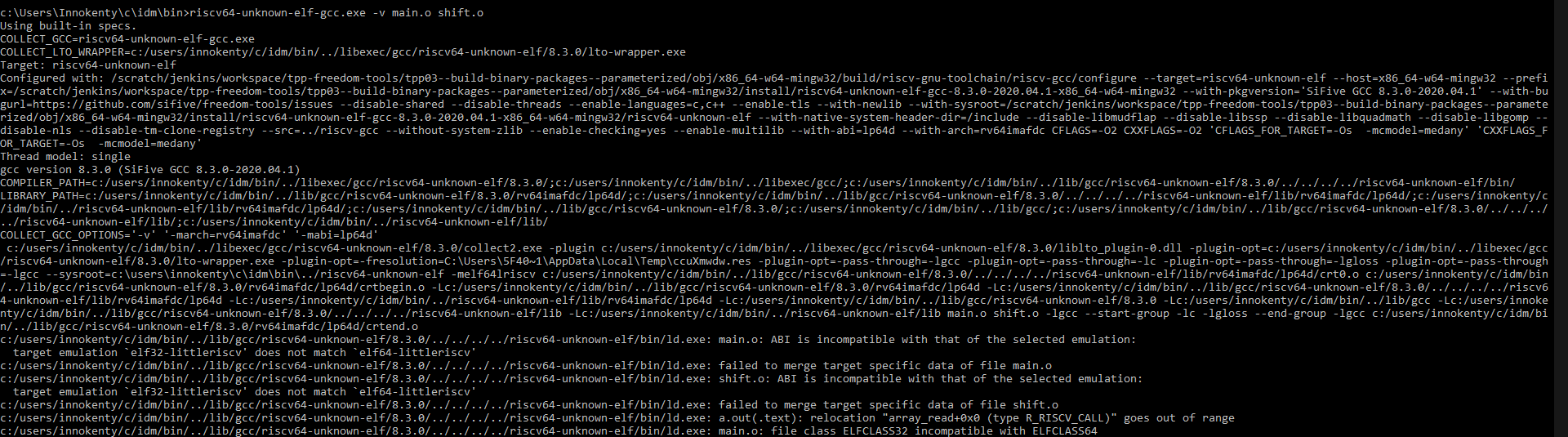


Листинг 2.8. Таблица символов файла shift.o



Компановка

riscv64-unknown-elf-gcc.exe -v main.o shift.o



Листинг 2.9. Исполняемый файл a.out

riscv64-unknown-elf-objdump.exe –j .text –d –M no-aliases a.out >a.ds

a.out: file format elf64-littleriscv

0000000000010158 <main>:

10158: 715d c.addi16sp sp,-80

1015a: e486 c.sdsp ra,72(sp)

1015c: e0a2 c.sdsp s0,64(sp)

1015e: fc26 c.sdsp s1,56(sp)

10160: f84a c.sdsp s2,48(sp)

10162: 67f1 c.lui a5,0x1c

10164: 11078793 addi a5,a5,272 # 1c110 <\_\_clzdi2+0x30>

10168: 638c c.ld a1,0(a5)

1016a: 6790 c.ld a2,8(a5)

1016c: 6b94 c.ld a3,16(a5)

1016e: 6f98 c.ld a4,24(a5)

10170: 739c c.ld a5,32(a5)

10172: e42e c.sdsp a1,8(sp)

10174: e832 c.sdsp a2,16(sp)

10176: ec36 c.sdsp a3,24(sp)

10178: f03a c.sdsp a4,32(sp)

1017a: f43e c.sdsp a5,40(sp)

1017c: 002c c.addi4spn a1,sp,8

1017e: 4529 c.li a0,10

10180: 02a000ef jal ra,101aa <shift>

10184: 0020 c.addi4spn s0,sp,8

10186: 03010913 addi s2,sp,48

1018a: 64f1 c.lui s1,0x1c

1018c: 400c c.lw a1,0(s0)

10186: 03010913 addi s2,sp,48

1018a: 64f1 c.lui s1,0x1c

1018c: 400c c.lw a1,0(s0)

10186: 03010913 addi s2,sp,48

1018a: 64f1 c.lui s1,0x1c

1018c: 400c c.lw a1,0(s0)

1018e: 13848513 addi a0,s1,312 # 1c138 <\_\_clzdi2+0x58>

10192: 204000ef jal ra,10396 <printf>

10196: 0411 c.addi s0,4

10198: ff241ae3 bne s0,s2,1018c <main+0x34>

1019c: 4501 c.li a0,0

1019e: 60a6 c.ldsp ra,72(sp)

101a0: 6406 c.ldsp s0,64(sp)

101a2: 74e2 c.ldsp s1,56(sp)

101a4: 7942 c.ldsp s2,48(sp)

101a6: 6161 c.addi16sp sp,80

101a8: 8082 c.jr ra

00000000000101aa <shift>:

101aa: 4785 c.li a5,1

101ac: 04a7d663 bge a5,a0,101f8 <shift+0x4e>

101b0: 00458813 addi a6,a1,4

101b4: fff5031b addiw t1,a0,-1

101b8: 4881 c.li a7,0

101ba: 557d c.li a0,-1

101bc: a809 c.j 101ce <shift+0x24>

101be: 0785 c.addi a5,1

101c0: 078a c.slli a5,0x2

101c2: 97ae c.add a5,a1

101c4: c390 c.sw a2,0(a5)

101c6: 2885 c.addiw a7,1

101c8: 0811 c.addi a6,4

101ca: 02688763 beq a7,t1,101f8 <shift+0x4e>

101ce: 00082603 lw a2,0(a6)

101d2: 0008879b addiw a5,a7,0

101d6: fe07c4e3 blt a5,zero,101be <shift+0x14>

101da: ffc82683 lw a3,-4(a6)

101de: fed650e3 bge a2,a3,101be <shift+0x14>

101e2: 8742 c.mv a4,a6

101e4: c314 c.sw a3,0(a4)

101e6: 37fd c.addiw a5,-1

101e8: fca78be3 beq a5,a0,101be <shift+0x14>

101ec: 1771 c.addi a4,-4

101ee: ffc72683 lw a3,-4(a4)

101f2: fed649e3 blt a2,a3,101e4 <shift+0x3a>

101f6: b7e1 c.j 101be <shift+0x14>

101f8: 8082 c.jr ra

**3. Создание статической библиотеки и make-файлов**

Сделаем из shift.c статическую библиотеку shi, тестовую программу main.c оставим без изменений.

получим объектный файл shift.o

riscv64-unknown-elf-gcc.exe -O1 -c shift.c -o shi.o

из получившегося файла делаем библиотеку

riscv64-unknown-elf-ar.exe -rsc shi.a shift.o

собираем исполняющий файл

riscv64-unknown-elf-gcc.exe -O1 --save-temps main.c shi.a

Листинг 3.1. Таблица символов исполняемого файла



Листинг 3.2. Makefile для создания статической библиотеки

# Цели

.PHONY: all clean

# Исходные файлы для сборки библиотеки

OBJS= shift.c

#Вызываемые приложения

AR = riscv64-unknown-elf-ar.exe

CC = riscv64-unknown-elf-gcc.exe

# Файл библиотеки

MYLIBNAME = shi.a

# Параметры компиляции

CFLAGS= -O1

# файлы искать в данном каталоге

INCLUDES+= -I .

# Make ищет файлы ... .h и ... .c в текущей директории

vpath %.h .

vpath %.c .

# $< = %.c

# $@ = %.o

%.o: %.c

$(CC) -MD $(CFLAGS) $(INCLUDES) -c $< -o $@

# Для того чтобы выполнить задачу "all", требуется построить библиотеку

all: $(MYLIBNAME)

# $^ = (shift.o)

$(MYLIBNAME): shift.o

$(AR) -rsc $@ $^

Листинг 3.3. Makefile для сборки исполняемого файла

# Цели

.PHONY: all clean

# Исходные файлы для сборки библиотеки

OBJS= main.c \

shi.a

#Вызываемые приложения

CC = riscv64-unknown-elf-gcc.exe

# Компиляция

CFLAGS= -O1 --save-temps

#файлы искать в данном каталоге

INCLUDES+= -I .

# Make ищет файлы … .c и … .a в текущей директории

vpath %.c .

vpath %.a .

# Для того чтобы выполнить задачу "all", требуется построить библиотеку

all: a.out

# Сборка файла

a.out: $(OBJS)

$(CC) $(CFLAGS) $(INCLUDES) $^

del \*.o \*.i \*.s \*.d

Листинг 3.4. Запуск Makefile

Запускаем Makefile.win, потом Makefile1.win со сборкой исполняемого файла.

mingw32-make.exe -f Makefile.win Makefile1.win

Листинг 3.5. Таблица символов исполняемого файла, созданного с помощью Makefile



Созданный файл идентичен файлу созданному ранее

Вывод

В ходе выполнения данной лабораторной работы была разработана программа на языке C, программа соответствует заданному варианту «Циклический сдвиг массива чисел на заданное количество разрядов вправо»

Определение функции было помещено в отдельный исходный файл, также был оформлен заголовочный файл. Была разработана тестовая программа на языке C.

В ходе лабораторной работы были изучены особенности каждого этапа пошаговой сборки набора программ, а также инструменты, позволяющие выделить разработанные программы в статическую библиотеку и автоматизировать сборку этой библиотеки.

Также проанализированы ход сборки библиотеки и программы, созданные файлы зависимостей.