Лекция 2

Введение (продолжение)

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Введение в конкретную операционную систему: Unix/Linux (продолжение)

- Аутентификация и авторизация в *Linux*.
- Файловая система *Linux*.
- Средства разработки: редактор *vim*, компилятор *gcc*, отладчик *gdb*.

Пользователи и группы

```
malkov@192:~> sudo groupadd GrTest1
malkov@192:~> sudo useradd -m -G  GrTest1 dummy
malkov@192:~> sudo passwd dummy
malkov@192:~> sudo usermod -aG GrTest1 tatiana
malkov@192:~> vim /etc/group
```

```
.....
video:x:482:gdm,malkov
vnc:x:461:
wheel:x:493:
www:x:459:wwwrun
wwwrun:!:457:
users:x:100:
GrTest1:x:1000:dummy,tatiana
```

```
malkov@192:~> su - dummy
Пароль:
dummy@192:~> ls -l
total 0
drwxr-xr-x 2 dummy users 6 Mar 23  2021 bin
dummy@192:~> newgrp GrTest1
dummy@192:~> touch testfile
dummy@192:~> ls -l
total 0
drwxr-xr-x 2 dummy users   6 Mar 23  2021 bin
-rw-r--r--    1 dummy GrTest1 0 Sep  8 15:52 testfile
dummy@192:~> chmod 660 testfile
```

```
dummy@192:~> su tatiana
tatiana@192:/home/dummy> ll
total 0
drwxr-xr-x 2 dummy users   6 Mar 23  2021 bin
-rw-rw---- 1 dummy GrTest1 0 Sep  8 15:52 testfile
tatiana@192:/home/dummy> echo “You see it!” > testfile; cat testfile
You see it!
tatiana@192:/home/dummy> su malkov
Password:
malkov@192:/home/dummy> cat testfile
cat: testfile: Permission denied
```

```
malkov@192:/home/dummy> sudo setfacl -m u:malkov:r testfile
malkov@192:/home/dummy> cat testfile
You see it!
```

Файловая система Linux (разметка дисков)

malkov@192:~> **sudo fdisk -l**

Диск /dev/sda: 238.5 GiB, 256060514304 байт, 500118192 секторов
Disk model: SPCC Solid State
Единицы: секторов по 1 * 512 = 512 байт
Размер сектора (логический/физический): 512 байт / 512 байт
Размер I/O (минимальный/оптимальный): 512 байт / 512 байт
Тип метки диска: gpt
Идентификатор диска: CA445F78-3ACB-4287-9E28-3EAD79D5A656

Устр-во	начало	Конец	Секторы	Размер	Тип
/dev/sda1	2048	206847	204800	100M	EFI
/dev/sda2	206848	239615	32768	16M	Зарезервированный раздел Microsoft
/dev/sda3	239616	498070158	497830543	237.4G	Microsoft basic data
/dev/sda4	498071552	500117503	2045952	999M	Среда для восстановления Microsoft

Диск /dev/sdb: 931.5 GiB, 1000204886016 байт, 1953525168 секторов
Disk model: WDC WD10EZEX-08W
Единицы: секторов по 1 * 512 = 512 байт
Размер сектора (логический/физический): 512 байт / 4096 байт
Размер I/O (минимальный/оптимальный): 4096 байт / 4096 байт
Тип метки диска: dos
Идентификатор диска: 0x29761d8b

Устр-во	Загрузочный	начало	Конец	Секторы	Размер	Идентификатор	Тип
/dev/sdb1	*	2048	734005247	734003200	350G	83	Linux
/dev/sdb2		734005248	767559679	33554432	16G	82	Linux своп / Solaris
/dev/sdb3		767559680	1927200767	1159641088	553G	83	Linux
/dev/sdb4		1927200768	1929297919	2097152	1G	c	W95 FAT32 (LBA)

Диск /dev/sdc: 1.8 TiB, 2000398933504 байт, 3907029167 секторов
Disk model: Expansion Desk
Единицы: секторов по 1 * 512 = 512 байт
Размер сектора (логический/физический): 512 байт / 4096 байт
Размер I/O (минимальный/оптимальный): 4096 байт / 4096 байт
Тип метки диска: dos
Идентификатор диска: 0x909c3ab4

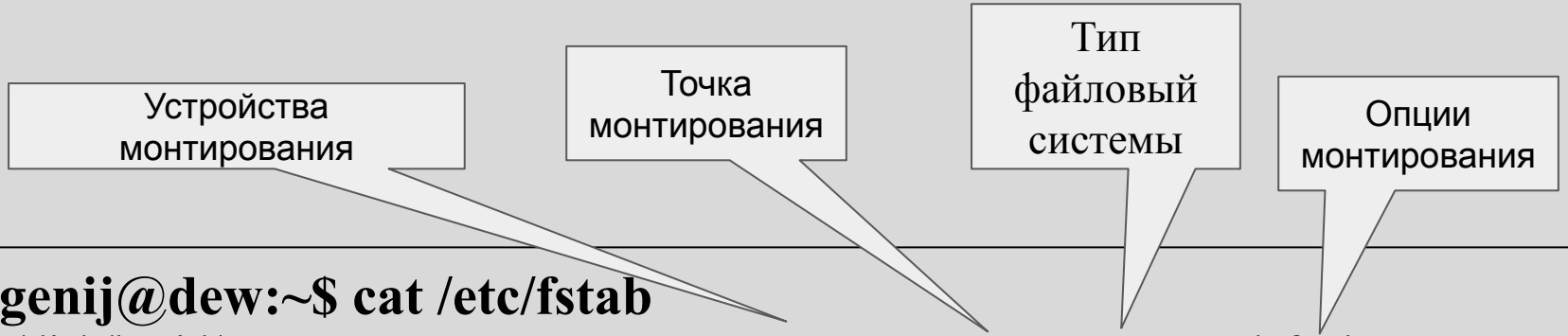
Устр-во	Загрузочный	начало	Конец	Секторы	Размер	Идентификатор	Тип
/dev/sdc1		2048	3907029163	3907027116	1.8T	7	HPFS/NTFS/exFAT

Файловая система Linux (монтирование)

```
malkov@192:~> ls -l /
итого 0
drwxr-xr-x   1 root root   1856 Dec  7  2022 bin
drwxr-xr-x   1 root root   1424 Dec  7  2022 boot
drwxr-xr-x  21 root root   4600 Sep  9 13:17 dev
drwxr-xr-x   1 root root   6150 Sep  8 16:04 etc
drwxr-xr-x   5 root root     48 Sep  8 15:00 home
drwxr-xr-x   1 root root   1930 Dec  7  2022 lib
drwxr-xr-x   1 root root   3640 Dec  7  2022 lib64
drwxr-xr-x   1 root root      0 Mar 23  2021 mnt
```

```
drwxr-xr-x   1 root root     32 Mar 23  2021 opt
dr-xr-xr-x 328 root root      0 Sep  9  2023 proc
drwx------   1 root root    740 Sep  8 14:02 root
drwxr-xr-x  42 root root   1120 Sep  9 13:16 run
drwxr-xr-x   1 root root   4272 Dec 20  2022 sbin
drwxr-xr-x   1 root root      0 Mar 23  2021 selinux
drwxr-xr-x   1 root root      6 Dec  1  2022 snap
drwxr-xr-x   1 root root     52 Jan  3  2023 srv
dr-xr-xr-x  13 root root      0 Sep  9  2023 sys
drwxrwxrwt   1 root root 345918 Sep  9 13:23 tmp
drwxr-xr-x   1 root root    124 Mar 23  2021 usr
drwxr-xr-x   1 root root    124 Dec  7  2022 var
```

Монтирование при загрузке




```
ewgenij@dew:~$ cat /etc/fstab
/dev/disk/by-id/ata-ST31000524AS_9VPGD772-part1 swap      swap    defaults            0 0
/dev/disk/by-id/ata-ST31000524AS_9VPGD772-part2 /         ext4    acl,user_xattr      1 1
/dev/disk/by-id/ata-ST31000524AS_9VPGD772-part3 /home     ext4    acl,user_xattr      1 2
proc                                            /proc     proc    defaults            0 0
sysfs                                           /sys      sysfs   noauto              0 0
debugfs                                         /sys/kernel/debug debugfs noauto      0 0
devpts                                          /dev/pts  devpts  mode=0620,gid=5     0 0
```

Другой формат *fstab*

```
malkov@192:~> cat /etc/fstab
UUID=fbc31785-ea37-40c8-9dc2-928b1d9cd03f  /           btrfs  defaults                0  0
UUID=fbc31785-ea37-40c8-9dc2-928b1d9cd03f  /var        btrfs  subvol=/@/var           0  0
UUID=fbc31785-ea37-40c8-9dc2-928b1d9cd03f  /usr/local  btrfs  subvol=/@/usr/local     0  0
UUID=fbc31785-ea37-40c8-9dc2-928b1d9cd03f  /tmp        btrfs  subvol=/@/tmp           0  0
UUID=fbc31785-ea37-40c8-9dc2-928b1d9cd03f  /srv        btrfs  subvol=/@/srv           0  0
UUID=fbc31785-ea37-40c8-9dc2-928b1d9cd03f  /root       btrfs  subvol=/@/root          0  0
UUID=fbc31785-ea37-40c8-9dc2-928b1d9cd03f  /opt        btrfs  subvol=/@/opt           0  0
UUID=e3ebe36f-a638-462e-b93b-fdd504b6e500  /home       xfs    defaults                0  0
UUID=9525-6B4D                             /boot/efi   vfat   defaults                0  2
UUID=a2ae30f3-112d-4a13-8e28-0277e29a9205  swap        swap   defaults                0  0
```

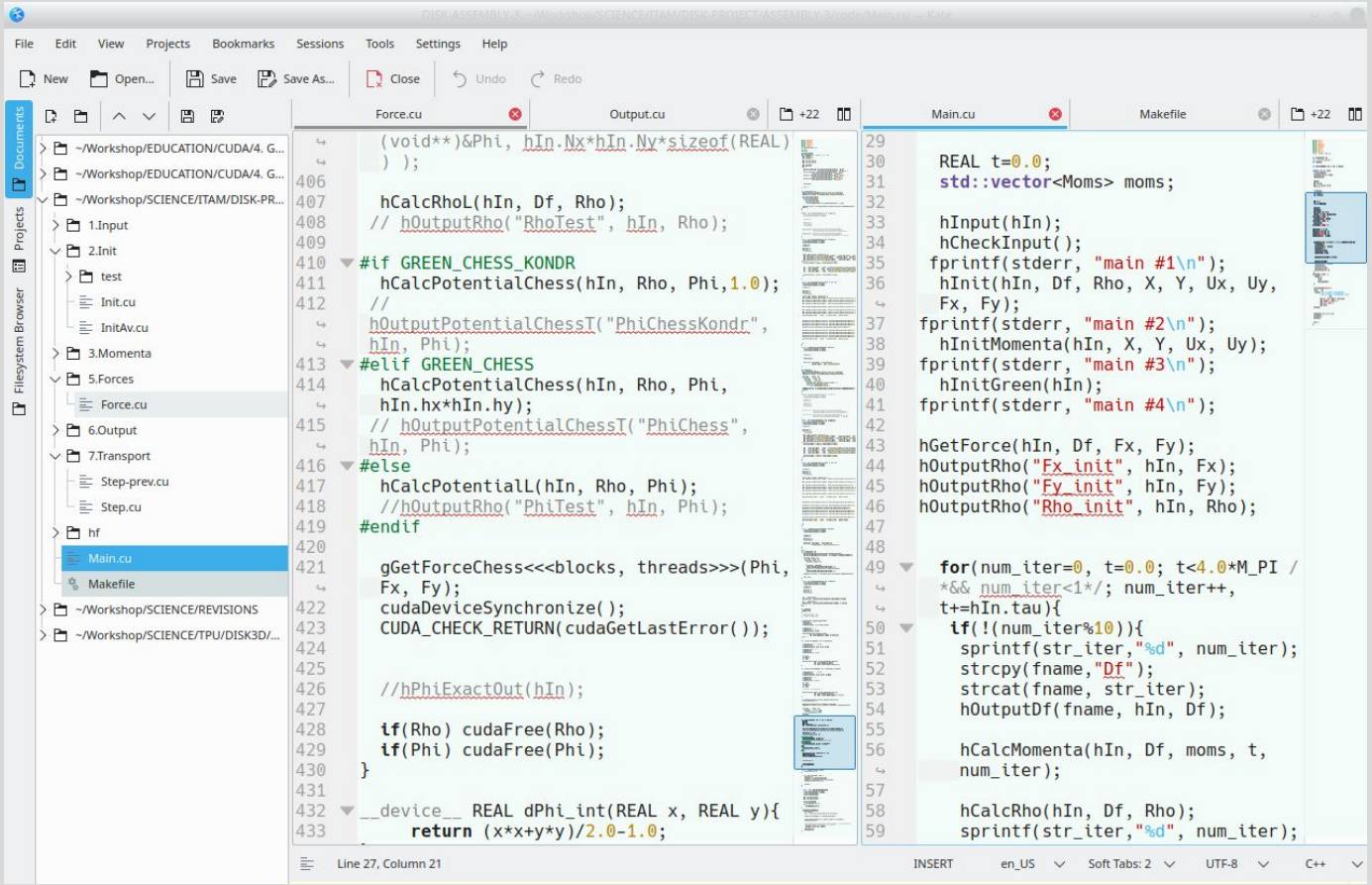
Команда *mount*

```
malkov@192:~> mkdir win10
malkov@192:~> sudo mount -o ro  -t ntfs-3g  /dev/sda3 win10
malkov@192:~> ls -l win10
итого 19285304
lrwxrwxrwx 2 root root         24 Oct 21  2019 Documents and Settings ->
/home/malkov/win10/Users
……..
drwxrwxrwx 1 root root       8192 Sep 15  2021 ProgramData
drwxrwxrwx 1 root root      20480 Jul 27 00:10 Program Files
drwxrwxrwx 1 root root      12288 Apr 26 18:09 Program Files (x86)
drwxrwxrwx 1 root root       4096 Feb 24  2021 Recovery
……..
drwxrwxrwx 1 root root       4096 May  7 21:07 Users
drwxrwxrwx 1 root root      16384 Aug 23 18:18 Windows
```

```
malkov@192:~> sudo umount win10
[sudo] пароль для root:
(base) malkov@192:~> ls -l win10
итого 0
```

```
malkov@192:~> mkdir EDUCATION
malkov@192:~>sudo mount -B /home/malkov/Workshop/EDUCATION/   EDUCATION
malkov@192:~> ls -l EDUCATION/
итого 12
drwxr-xr-x  4 malkov users  172 Feb 27  2022 2021-2022
drwxr-xr-x 17 malkov users 4096 Jun 18 12:25 2022-2023
drwxr-xr-x  6 malkov users   56 Sep  7 18:55 2023-2024
drwxr-xr-x  7 malkov users  163 Mar 10  2023 CUDA
drwxr-xr-x  4 malkov users   31 Feb  4  2021 workspace
malkov@192:~> sudo umount EDUCATION
malkov@192:~> ls -l EDUCATION/
итого 0
```

Инструменты разработки



Редактор
kate

Редактор ***vim*** (“ESC :q!” 😄)

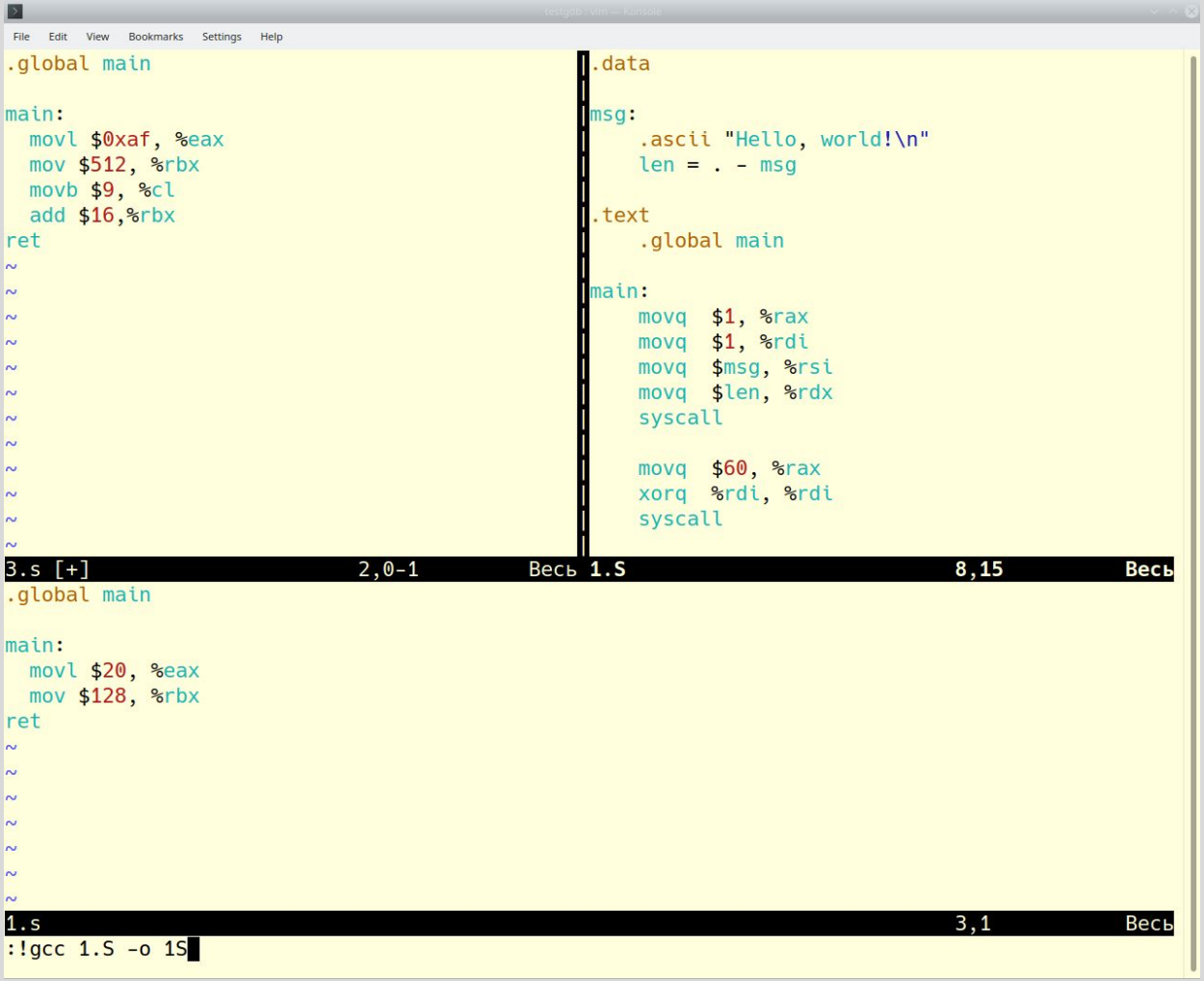
malkov@192:~> vimtutor

```
=  W e l c o m e  t o  t h e  V I M  T u t o r  -  Version 1.7    =
===============================================================================

                Lesson 1.1:  MOVING THE CURSOR


  ** To move the cursor, press the h,j,k,l keys as indicated. **
          ^
          k               Hint:  The h key is at the left and moves left.
     < h      l >                The l key is at the right and moves right.
          j                  The j key looks like a down arrow.
          v

...............................................................................
```




```
~> vim 1.s
:split 2.s
:set splitright
:vsplit
CTRL+w w
:!gcc 1.S -o 1S
:!./1S
```

Hello, world!
Нажмите ENTER или введите команду для продолжения

```
:wa
:qa
```

NAME

gcc - GNU project C and C++ compiler

SYNOPSIS

gcc [**-c**|**-S**|**-E**] [**-std**=standard]
[**-g**] [**-pg**] [**-O**level]
[**-W**warn...] [**-Wpedantic**]
[**-I**dir...] [**-L**dir...]
[**-D**macro[=defn]...] [**-U**macro]
[**-f**option...] [**-m**machine-option...]
[**-o** outfile] [@file] infile...

Only the most useful options are listed here; see below for the remainder. **g++** accepts mostly
the same options as **gcc**.

Отладчик ***gdb***

```
.global main

main:
  movl $0xaf, %eax
  mov $512, %rbx
  movb $9, %cl
  add $16,%rbx
ret
```

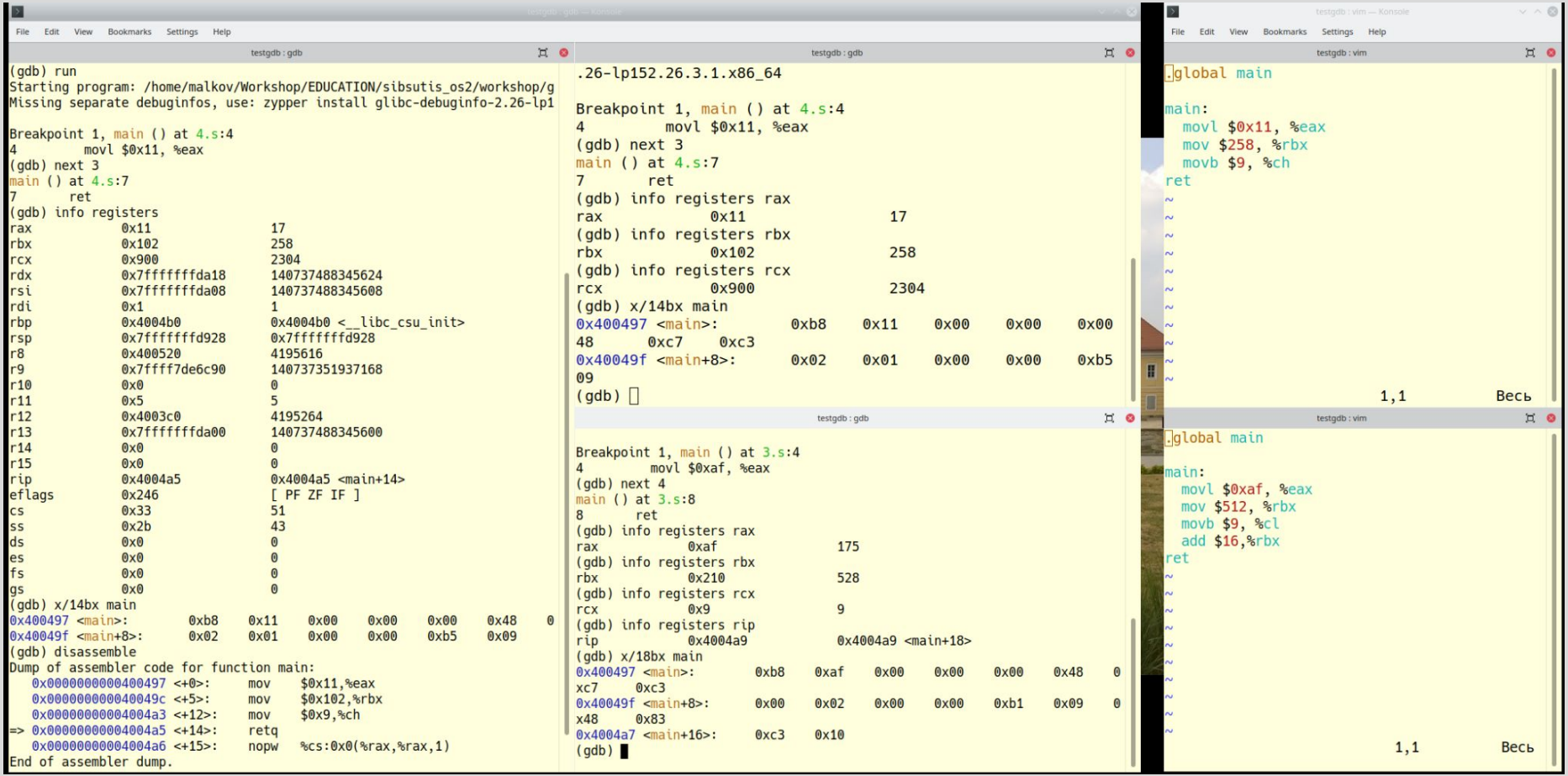
```
> gcc 3.s  -g -o 3
```

```
> gdb 3
```

```
> (gdb) break 1
```

```
> (gdb) run
```

https://www.opennet.ru/base/dev/from_c_to_asm.txt.html


testgdb : gdb — Konsole
File Edit View Bookmarks Settings Help
testgdb : gdb
(gdb) run
Starting program: /home/malkov/Workshop/EDUCATION/sibsutis_os2/workshop/g
Missing separate debuginfos, use: zypper install glibc-debuginfo-2.26-lp1
Breakpoint 1, main () at 4.s:4
4 movl $0x11, %eax
(gdb) next 3
main () at 4.s:7
7 ret
(gdb) info registers
rax 0x11 17
rbx 0x102 258
rcx 0x900 2304
rdx 0x7fffffffda18 140737488345624
rsi 0x7fffffffda08 140737488345608
rdi 0x1 1
rbp 0x4004b0 0x4004b0 <__libc_csu_init>
rsp 0x7fffffffd928 0x7fffffffd928
r8 0x400520 4195616
r9 0x7ffff7de6c90 140737351937168
r10 0x0 0
r11 0x5 5
r12 0x4003c0 4195264
r13 0x7fffffffda00 140737488345600
r14 0x0 0
r15 0x0 0
rip 0x4004a5 0x4004a5 <main+14>
eflags 0x246 [PF ZF IF]
cs 0x33 51
ss 0x2b 43
ds 0x0 0
es 0x0 0
fs 0x0 0
gs 0x0 0
(gdb) x/14bx main
0x400497 <main>: 0xb8 0x11 0x00 0x00 0x00 0x48 0
0x40049f <main+8>: 0x02 0x01 0x00 0x00 0xb5 0x09
(gdb) disassemble
Dump of assembler code for function main:
0x0000000000400497 <+0>: mov $0x11,%eax
0x000000000040049c <+5>: mov $0x102,%rbx
0x00000000004004a3 <+12>: mov $0x9,%ch
=> 0x00000000004004a5 <+14>: retq
0x00000000004004a6 <+15>: nopw %cs:0x0(%rax,%rax,1)
End of assembler dump.
testgdb : gdb
.26-lp152.26.3.1.x86_64
Breakpoint 1, main () at 4.s:4
4 movl $0x11, %eax
(gdb) next 3
main () at 4.s:7
7 ret
(gdb) info registers rax
rax 0x11 17
(gdb) info registers rbx
rbx 0x102 258
(gdb) info registers rcx
rcx 0x900 2304
(gdb) x/14bx main
0x400497 <main>: 0xb8 0x11 0x00 0x00 0x00
48 0xc7 0xc3
0x40049f <main+8>: 0x02 0x01 0x00 0x00 0xb5
09
(gdb)
testgdb : gdb
Breakpoint 1, main () at 3.s:4
4 movl $0xaf, %eax
(gdb) next 4
main () at 3.s:8
8 ret
(gdb) info registers rax
rax 0xaf 175
(gdb) info registers rbx
rbx 0x210 528
(gdb) info registers rcx
rcx 0x9 9
(gdb) info registers rip
rip 0x4004a9 0x4004a9 <main+18>
(gdb) x/18bx main
0x400497 <main>: 0xb8 0xaf 0x00 0x00 0x00 0x48 0
xc7 0xc3
0x40049f <main+8>: 0x00 0x02 0x00 0x00 0xb1 0x09 0
x48 0x83
0x4004a7 <main+16>: 0xc3 0x10
(gdb)
testgdb : vim — Konsole
File Edit View Bookmarks Settings Help
testgdb : vim
.global main
main:
movl $0x11, %eax
mov $258, %rbx
movb $9, %ch
ret
1,1 Весь
testgdb : vim
.global main
main:
movl $0xaf, %eax
mov $512, %rbx
movb $9, %cl
add $16,%rbx
ret
1,1 Весь

```
> gdb 3
(gdb) break main
Breakpoint 1 at 0x400497: file 3.s, line 4.
(gdb) run
Breakpoint 1, main () at 3.s:4
4         movl $0xaf, %eax
(gdb) next 4
main () at 3.s:8
8       ret
(gdb) info registers rax
rax            0xaf                175
```

```
(gdb) info registers rbx
rbx            0x210              528
(gdb) info registers rcx
rcx            0x9                9
(gdb) info registers rip
rip            0x4004a9           0x4004a9 <main+18>
(gdb) x/18bx main
0x400497 <main>:       0xb8   0xaf   0x00   0x00   0x00   0x48   0xc7   0xc3
0x40049f <main+8>:     0x00   0x02   0x00   0x00   0xb1   0x09   0x48   0x83
0x4004a7 <main+16>:    0xc3   0x10
```

```
(gdb) disassemble
Dump of assembler code for function main:
   0x0000000000400497 <+0>:     mov    $0xaf,%eax
   0x000000000040049c <+5>:     mov    $0x200,%rbx
   0x00000000004004a3 <+12>:    mov    $0x9,%cl
   0x00000000004004a5 <+14>:    add    $0x10,%rbx
=> 0x00000000004004a9 <+18>:    ret
   0x00000000004004aa <+19>:    nopw   0x0(%rax,%rax,1)
End of assembler dump.
(gdb)
```

(gdb) help
List of classes of commands:

aliases -- User-defined aliases of other commands.
breakpoints -- Making program stop at certain points.
data -- Examining data.
files -- Specifying and examining files.
internals -- Maintenance commands.
obscure -- Obscure features.
running -- Running the program.
stack -- Examining the stack.
status -- Status inquiries.
support -- Support facilities.
text-user-interface -- TUI is the GDB text based interface.
tracepoints -- Tracing of program execution without stopping the program.
user-defined -- User-defined commands.

Type "help" followed by a class name for a list of commands in that class.
Type "help all" for the list of all commands.
Type "help" followed by command name for full documentation.
Type "apropos word" to search for commands related to "word".
Type "apropos -v word" for full documentation of commands related to "word".
Command name abbreviations are allowed if unambiguous.

```
(gdb) list main
6       void hTest(int N, int* a, int* b){
7        for(int i=0; i<N;i++)
8           a[i]+=b[i];
9       }
10
11      int main(int argc, char** argv){
12       if(argc<2){
13         fprintf(stderr, "USAGE: lab2 <N>\n");
14         return -1;
15       }

(gdb) b 6
Breakpoint 1 at 0x4007a6: file lab2c.c, line 7.
```

```
(gdb) run 1024
Breakpoint 1, hTest (N=1024, a=0x4032a0,
   b=0x4042b0) at lab2c.c:7
7       for(int i=0; i<N;i++)

(gdb) step
8           a[i]+=b[i];
(gdb) info local
i = 0
(gdb) n 16
8           a[i]+=b[i];
(gdb) info local
i = 8
(gdb) n 16
8           a[i]+=b[i];
(gdb) info local
i = 8
```

```
(gdb) break 8 if i==64
(gdb) c
Continuing.
Breakpoint 2, hTest (N=1024, a=0x4032a0,
   b=0x4042b0) at lab2c.c:8
8           a[i]+=b[i];
(gdb) print i
$1 = 64
(gdb) x/68d a
0x4032a0:       1       5       9       13
0x4032b0:       17      21      25      29
.....................................................................................
0x403390:       241     245     249     253
0x4033a0:       128     130     132     134
(gdb) c
Continuing.
(gdb) q
```

```
~/Lecture2> gcc -pg  lab2c.c -o lab2c
/Lecture2> ./lab2c 0
Elapsed time: 2545.74 ms
Lecture2> ls -ltr
-rwxr-xr-x 1 malkov users 15232 сен 17 18:19 lab2c
-rw-r--r-- 1 malkov users  1650 сен 17 18:19 gmon.out
/Lecture2> gprof lab2c  gmon.out > lab2c.prof
/Lecture2> ls -ltr
-rw-r--r-- 1 malkov users  1650 сен 17 18:19 gmon.out
-rw-r--r-- 1 malkov users  5849 сен 17 18:19 lab2c.prof
```

```
/Lecture2> vim lab2c.prof
.....................................................................
index   %time    self    children    called     name
[1]     100.0    3.67      2.55                main [1]
                 2.55      0.00       1/1        hTest [2]
---------------------------------------------------------------------
                 2.55      0.00       1/1          main [1]
[2]      41.0    2.55      0.00       1        hTest [2]
-----------------------------------------
```

СПАСИБО ЗА ВНИМАНИЕ!