

1. Пишем простой модуль

```
#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/fs.h>
#include <linux/rwlock.h>
#include <linux/uaccess.h>

static int major = 0;
static rwlock_t lock;
static char test_string[15] = "Hello\n\n0";

static ssize_t test_read(struct file *fd, char __user *buff,
                        size_t size, loff_t *off)
{
    size_t rc;
    read_lock(&lock);
    rc = simple_read_from_buffer(buff, size, off, test_string, 15);
    read_unlock(&lock);
    return rc;
}

static ssize_t test_write(struct file *fd, const char __user *buff,
                        size_t size, loff_t *off)
{
    size_t rc = 0;
    if (size > 15)
        return -EINVAL;
    write_lock(&lock);
    rc = simple_write_to_buffer(test_string, 15, off, buff, size);
    write_unlock(&lock);
    return rc;
}

static struct file_operations fops = {
    .owner = THIS_MODULE,
    .read = test_read,
    .write = test_write
}
```

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```
};

int init_module(void)
{
    pr_info("Test module is loaded.\n");
    rwlock_init(&lock);
    major = register_chrdev(major, "test2", &fops);
    if (major < 0)
        return major;
    pr_info("Major number is %d.\n", major);
    return 0;
}

void cleanup_module(void)
{
    pr_info("Test module is unloaded.\n");
    unregister_chrdev(major, "test2");
}

MODULE_LICENSE("GPL");
```

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2. Пишем для него, для упрощенной сборки, Makefile.

```
obj-m += test2.o
```

```
all:
```

```
clean:
```

QUESTION

3. Собираем модуль.

```
root@ubuntu20:/home/vboxuser/test# make
make -C /lib/modules/5.15.0-139-generic/build M=/home/vboxuser/test modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-139-generic'
  CC [M] /home/vboxuser/test/test2.o
  MODPOST /home/vboxuser/test/Module.symvers
  CC [M] /home/vboxuser/test/test2.mod.o
  LD [M] /home/vboxuser/test/test2.ko
  BTF [M] /home/vboxuser/test/test2.ko
Skipping BTF generation for /home/vboxuser/test/test2.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-139-generic'
root@ubuntu20:/home/vboxuser/test# _
```

4. Загружаем модуль, проверяем что он загрузился. Проверяем что корректно присвоился мажорный номер для нашего модуля.

```
root@ubuntu20:/home/vboxuser/test# insmod test2.ko
root@ubuntu20:/home/vboxuser/test# lsmod | grep test
test2                16384  0
root@ubuntu20:/home/vboxuser/test# dmesg | tail -n10
[ 1263.826011] rfkill: input handler disabled
[ 1283.767422] rfkill: input handler enabled
[ 1284.549462] rfkill: input handler disabled
[ 1286.080758] rfkill: input handler enabled
[ 1434.213347] Test module is unloaded.
[ 1749.051793] Test module is loaded.
[ 1749.051802] Major number is 237.
[ 1788.430184] Test module is unloaded.
[ 1798.299068] Test module is loaded.
[ 1798.299077] Major number is 237.
root@ubuntu20:/home/vboxuser/test#
```

5. Создаем символичный файл устройств в директории dev. Меняем для него права и проверяем через команду ls.

```
root@ubuntu20:/home/vboxuser/test# insmod test2.ko
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[ 1798.299077] Major number is 237.
root@ubuntu20:/home/vboxuser/test#
root@ubuntu20:/dev# mknod test2 c 237 0
root@ubuntu20:/dev# ls -la test
ls: cannot access 'test': No such file or directory
root@ubuntu20:/dev# ls -la test2
crw-r--r-- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev# chmod +0666 test2
root@ubuntu20:/dev# ls -la test2
crw-rw-rw- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev#
```

6. Пробуем прочитать из файла строку

```
root@ubuntu20:/home/vboxuser/test# insmod test2.ko
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test2                16384  0
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root@ubuntu20:/home/vboxuser/test#
root@ubuntu20:/dev# mknod test2 c 237 0
root@ubuntu20:/dev# ls -la test
ls: cannot access 'test': No such file or directory
root@ubuntu20:/dev# ls -la test2
crw-r--r-- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev# chmod +0666 test2
root@ubuntu20:/dev# ls -la test2
crw-rw-rw- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev# cat test2
Hello
root@ubuntu20:/dev# _
```

7. Пробуем изменить строку через файл и сразу проверяем содержимое.

```
root@ubuntu20:/home/vboxuser/test# insmod test2.ko
root@ubuntu20:/home/vboxuser/test# lsmod | grep test
test2                16384  0
root@ubuntu20:/home/vboxuser/test# dmesg | tail -n10
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[ 1798.299077] Major number is 237.
root@ubuntu20:/home/vboxuser/test#
root@ubuntu20:/dev# mknod test2 c 237 0
root@ubuntu20:/dev# ls -la test
ls: cannot access 'test': No such file or directory
root@ubuntu20:/dev# ls -la test2
crw-r--r-- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev# chmod +0666 test2
root@ubuntu20:/dev# ls -la test2
crw-rw-rw- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev# cat test2
Hello
root@ubuntu20:/dev# echo "QWERT123" > test2
root@ubuntu20:/dev# cat test2
QWERT123
root@ubuntu20:/dev#
```

8. Убедившись, что все работает, удаляем файл устройств. Выгружаем модуль и очищаем директорию от лишних файлов.

```
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root@ubuntu20:/home/vboxuser/test# lsmod | grep test
test2                16384  0
root@ubuntu20:/home/vboxuser/test# dmesg | tail -n10
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root@ubuntu20:/home/vboxuser/test#
root@ubuntu20:/dev# mknod test2 c 237 0
root@ubuntu20:/dev# ls -la test
ls: cannot access 'test': No such file or directory
root@ubuntu20:/dev# ls -la test2
crw-r--r-- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev# chmod +0666 test2
root@ubuntu20:/dev# ls -la test2
crw-rw-rw- 1 root root 237, 0 дек 28 20:15 test2
root@ubuntu20:/dev# cat test2
Hello
root@ubuntu20:/dev# echo "QWERT123" > test2
root@ubuntu20:/dev# cat test2
QWERT123
root@ubuntu20:/dev# rm test2
root@ubuntu20:/dev#
root@ubuntu20:/home/vboxuser/test# rmmod test2
root@ubuntu20:/home/vboxuser/test# make clean
make -C /lib/modules/5.15.0-139-generic/build M=/home/vboxuser/test clean
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-139-generic'
CLEAN /home/vboxuser/test/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-139-generic'
root@ubuntu20:/home/vboxuser/test# _
```