lab7_pin_page 实验说明

本实验是为了验证和学习如何去 pin 一个 page，也就是熟悉 get_user_pages()和 get_user_pages_fast()的使用。这两个接口函数在内核代码或者驱动代码中很常见。

基本实验步骤

1. 进入 runninglinuxkernel_4.0/rlk_lab/rlk_basic/chapter_7_mm/lab7_pin_page 目录。

```
# export ARCH=arm
# export CROSS_COMPILE=arm-linux-gnueabi-
# make BASEINCLUDE=/home/figo/work/runninglinuxkernel/runninglinuxkernel_4.0
```

这里 BASEINCLUDE 指定你当前 runninglinuxkernel_4.0 的目录路径。

编译 test 测试 app。

```
# arm-linux-gnueabi-gcc test_ok.c -o test_ok
```

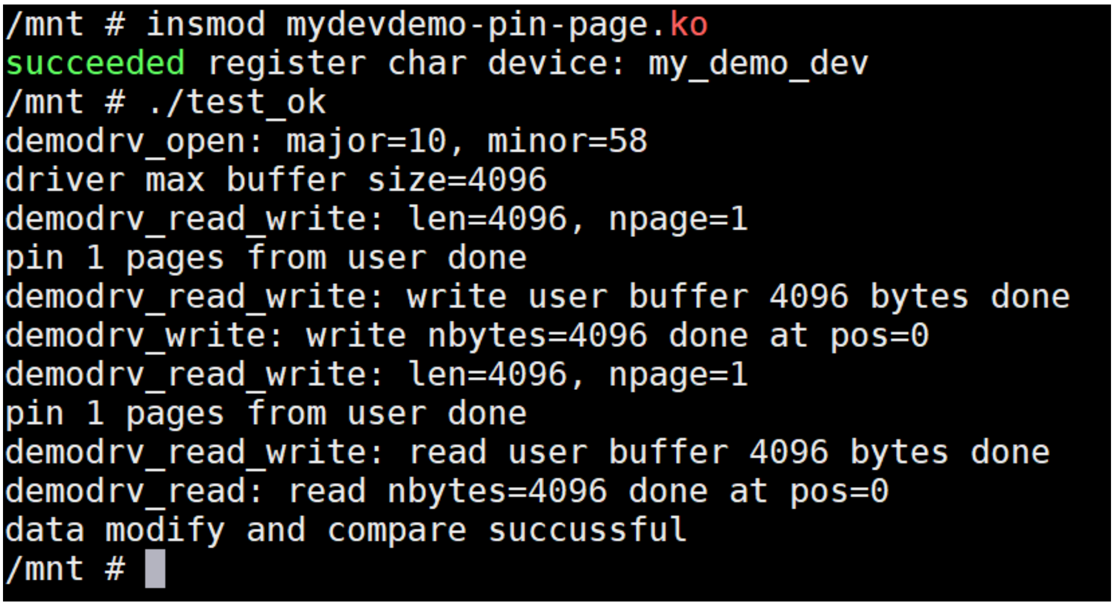
然后把 mydevdemo-pin-page.ko 和 test_ok 拷贝到 runninglinuxkernel_4.0/kmodules 目录下面。

运行如下脚本启动 Qemu。

```
#cd runninglinuxkernel_4.0
# sh run.sh arm32    #启动虚拟机
```

在 Qemu 虚拟机:

```
#cd /mnt
# insmod mydevdemo-pin-page.ko
#./test_ok
```



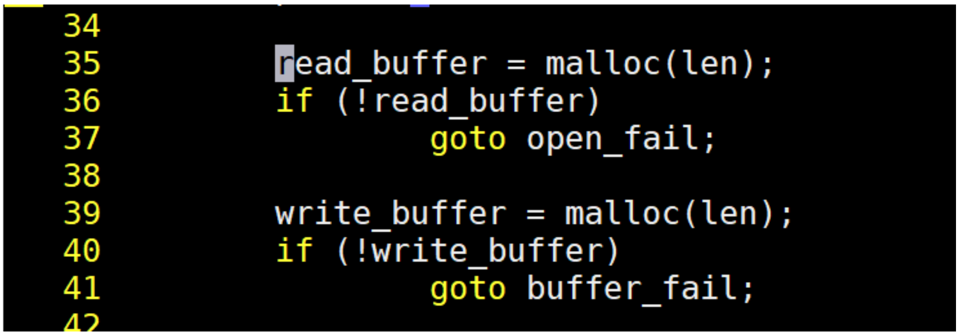
```
/mnt # insmod mydevdemo-pin-page.ko
succeeded register char device: my_demo_dev
/mnt # ./test_ok
demodrv_open: major=10, minor=58
driver max buffer size=4096
demodrv_read_write: len=4096, npage=1
pin 1 pages from user done
demodrv_read_write: write user buffer 4096 bytes done
demodrv_write: write nbytes=4096 done at pos=0
demodrv_read_write: len=4096, npage=1
pin 1 pages from user done
demodrv_read_write: read user buffer 4096 bytes done
demodrv_read: read nbytes=4096 done at pos=0
data modify and compare successful
/mnt #
```

可以看到测试成功了！

进阶思考

笨叔在实验里，设置一个进阶思考的问题。

代码里有一个 test_issue.c 文件，最大的不同就是使用 malloc 来分配 user buffer，而不是通过 mmap 来分配的匿名页面。

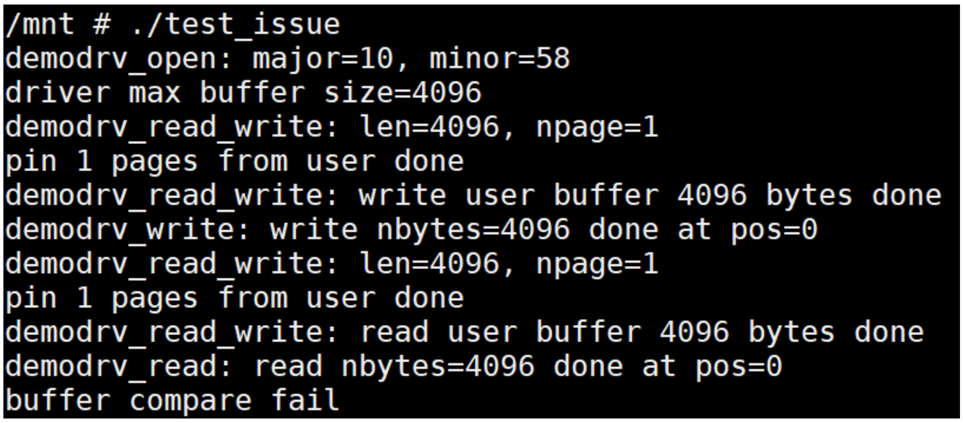


```

        read_buffer = malloc(len);
        if (!read_buffer)
                goto open_fail;

        write_buffer = malloc(len);
        if (!write_buffer)
                goto buffer_fail;
```

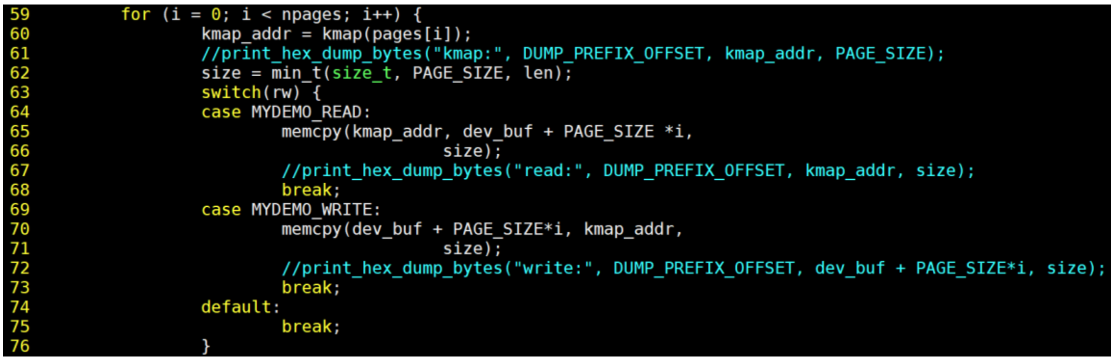
运行 test_issue 程序，得到如下结果：



```
/mnt # ./test_issue
demodrv_open: major=10, minor=58
driver max buffer size=4096
demodrv_read_write: len=4096, npage=1
pin 1 pages from user done
demodrv_read_write: write user buffer 4096 bytes done
demodrv_write: write nbytes=4096 done at pos=0
demodrv_read_write: len=4096, npage=1
pin 1 pages from user done
demodrv_read_write: read user buffer 4096 bytes done
demodrv_read: read nbytes=4096 done at pos=0
buffer compare fail
```

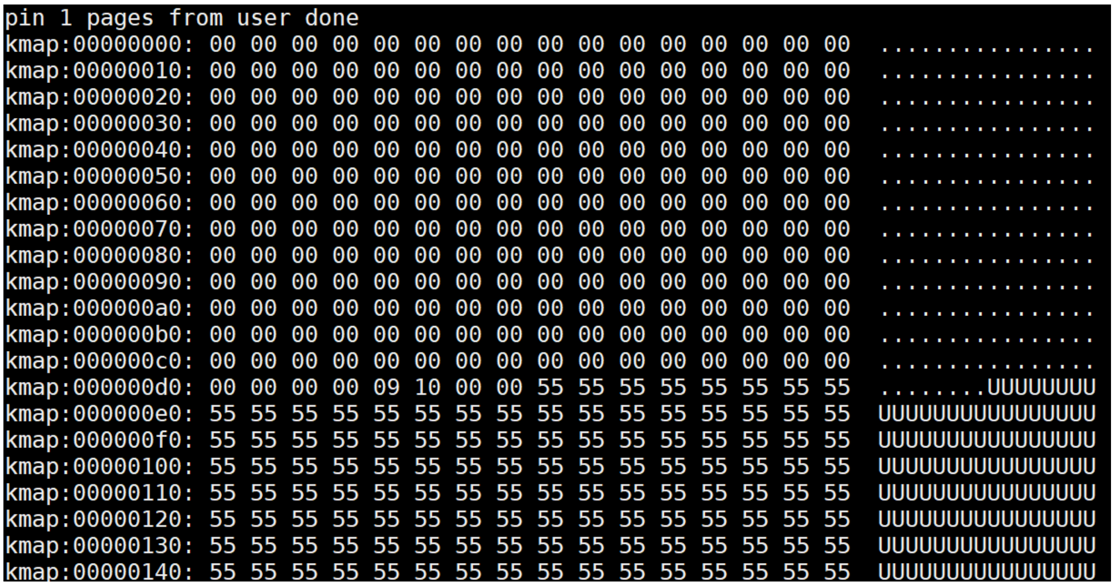
程序的最后结果是“buffer compare fail”，说明程序运行有问题，也就是 read buffer 和 write buffer 数据不对，究竟怎么回事呢？

遇到这种问题，我们最简单最粗暴也是最有效的调试办法就是把 buffer 打印出来看看。在内核里，可以使用 print_hex_dump_bytes()函数。比如在 demodrv_read_write()函数的第 61,67,72 行添加打印语句。



```
59          for (i = 0; i < npages; i++) {
60                  kmap_addr = kmap(pages[i]);
61                  //print_hex_dump_bytes("kmap:", DUMP_PREFIX_OFFSET, kmap_addr, PAGE_SIZE);
62                  size = min_t(size_t, PAGE_SIZE, len);
63                  switch(rw) {
64                  case MYDEMO_READ:
65                          memcpy(kmap_addr, dev_buf + PAGE_SIZE *i,
66                                          size);
67                          //print_hex_dump_bytes("read:", DUMP_PREFIX_OFFSET, kmap_addr, size);
68                          break;
69                  case MYDEMO_WRITE:
70                          memcpy(dev_buf + PAGE_SIZE*i, kmap_addr,
71                                          size);
72                          //print_hex_dump_bytes("write:", DUMP_PREFIX_OFFSET, dev_buf + PAGE_SIZE*i, size);
73                          break;
74                  default:
75                          break;
76                  }
```

打印结果如下：



```
pin 1 pages from user done
kmap:00000000: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000010: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000020: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000070: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000080: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:00000090: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:000000a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:000000b0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:000000c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
kmap:000000d0: 00 00 00 00 09 10 00 00 55 55 55 55 55 55 55 55  ........UUUUUUUU
kmap:000000e0: 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55  UUUUUUUUUUUUUUUU
kmap:000000f0: 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55  UUUUUUUUUUUUUUUU
kmap:00000100: 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55  UUUUUUUUUUUUUUUU
kmap:00000110: 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55  UUUUUUUUUUUUUUUU
kmap:00000120: 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55  UUUUUUUUUUUUUUUU
kmap:00000130: 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55  UUUUUUUUUUUUUUUU
kmap:00000140: 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55  UUUUUUUUUUUUUUUU
```

发现 pin 的 page，开头的数据都是 0，而不是 0x55，这是为什么呢？理论上这个 page 应该全部都是 0x55 才对。

这是为什么呢？

如果大家对这个问题感兴趣，可以关注笨叔的第一季旗舰篇视频，笨叔会在视频中和大家详细解答。

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