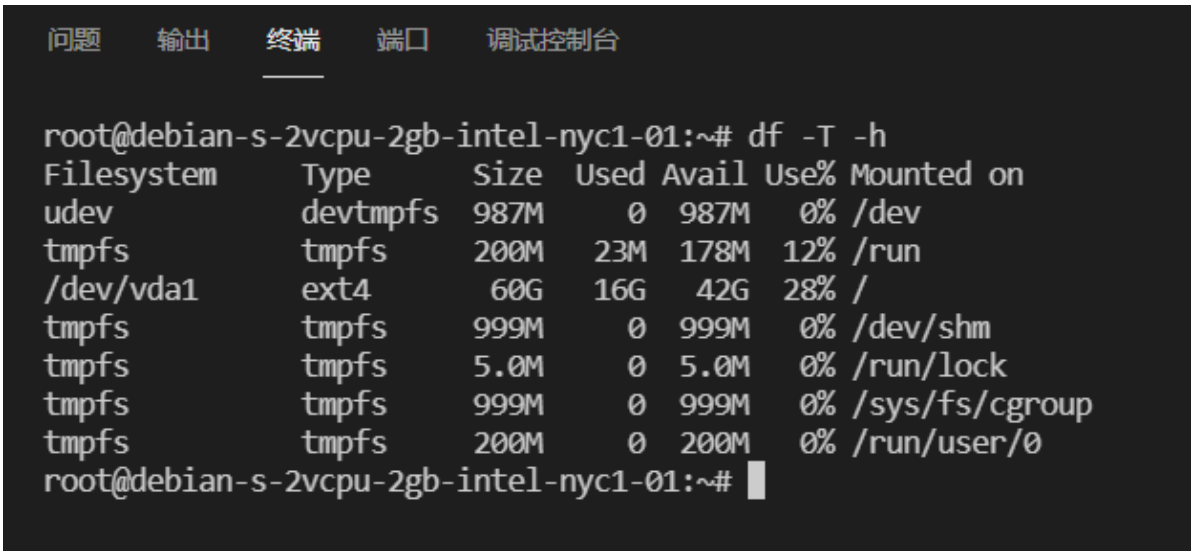
191180164 杨茂琛 实验4

查看文件系统

使用命令：

```
$ df -T -h
```

显示如下：



可以看到使用的是ext4文件系统

阅读源码

inode数据结构位于/include/linux/fs.h中：

```
struct inode {
    umode_t         i_mode;
    unsigned short      i_opflags;
    kuid_t          i_uid;
    kgid_t          i_gid;
    unsigned int        i_flags;

#ifdef CONFIG_FS_POSIX_ACL
    struct posix_acl    *i_acl;
    struct posix_acl    *i_default_acl;
#endif

    const struct inode_operations   *i_op;
    struct super_block  *i_sb;
    struct address_space    *i_mapping;

#ifdef CONFIG_SECURITY
    void            *i_security;
#endif

    /* Stat data, not accessed from path walking */
    unsigned long       i_ino;
```

```
    /*
     * Filesystems may only read i_nlink directly.  They shall use the
     * following functions for modification:
     *
     *    (set|clear|inc|drop)_nlink
     *    inode_(inc|dec)_link_count
     */
    union {
        const unsigned int i_nlink;
        unsigned int __i_nlink;
    };
    dev_t           i_rdev;
    loff_t          i_size;
    struct timespec64   i_atime;
    struct timespec64   i_mtime;
    struct timespec64   i_ctime;
    spinlock_t      i_lock; /* i_blocks, i_bytes, maybe i_size */
    unsigned short          i_bytes;
    unsigned int        i_blkbits;
    enum rw_hint        i_write_hint;
    blkcnt_t        i_blocks;

#ifdef __NEED_I_SIZE_ORDERED
    seqcount_t      i_size_seqcount;
#endif

    /* Misc */
    unsigned long       i_state;
    struct rw_semaphore i_rwsem;

    unsigned long       dirtied_when;   /* jiffies of first dirtying */
    unsigned long       dirtied_time_when;

    struct hlist_node   i_hash;
    struct list_head    i_io_list;  /* backing dev IO list */
#ifdef CONFIG_CGROUP_WRITEBACK
    struct bdi_writeback    *i_wb;      /* the associated cgroup wb */

    /* foreign inode detection, see wbc_detach_inode() */
    int         i_wb_frn_winner;
    u16         i_wb_frn_avg_time;
    u16         i_wb_frn_history;
#endif
    struct list_head    i_lru;      /* inode LRU list */
    struct list_head    i_sb_list;
    struct list_head    i_wb_list;  /* backing dev writeback list */
    union {
        struct hlist_head   i_dentry;
        struct rcu_head     i_rcu;
    };
    atomic64_t      i_version;
    atomic_t        i_count;
    atomic_t        i_dio_count;
    atomic_t        i_writecount;
#ifdef CONFIG_IMA
    atomic_t        i_readcount; /* struct files open RO */
#endif
```

```
    const struct file_operations    *i_fop; /* former ->i_op->default_file_ops
*/
    struct file_lock_context    *i_flctx;
    struct address_space    i_data;
    struct list_head    i_devices;
    union {
        struct pipe_inode_info  *i_pipe;
        struct block_device *i_bdev;
        struct cdev     *i_cdev;
        char            *i_link;
        unsigned        i_dir_seq;
    };

    __u32           i_generation;

#ifdef CONFIG_FSNOTIFY
    __u32           i_fsnotify_mask; /* all events this inode cares about */
    struct fsnotify_mark_connector __rcu    *i_fsnotify_marks;
#endif

#if IS_ENABLED(CONFIG_FS_ENCRYPTION)
    struct fscrypt_info *i_crypt_info;
#endif

    void            *i_private; /* fs or device private pointer */
} __randomize_layout;
```

比较需要关注的是超级块和地址空间：

```
    const struct inode_operations   *i_op;
    struct super_block  *i_sb;
    struct address_space    *i_mapping;
```

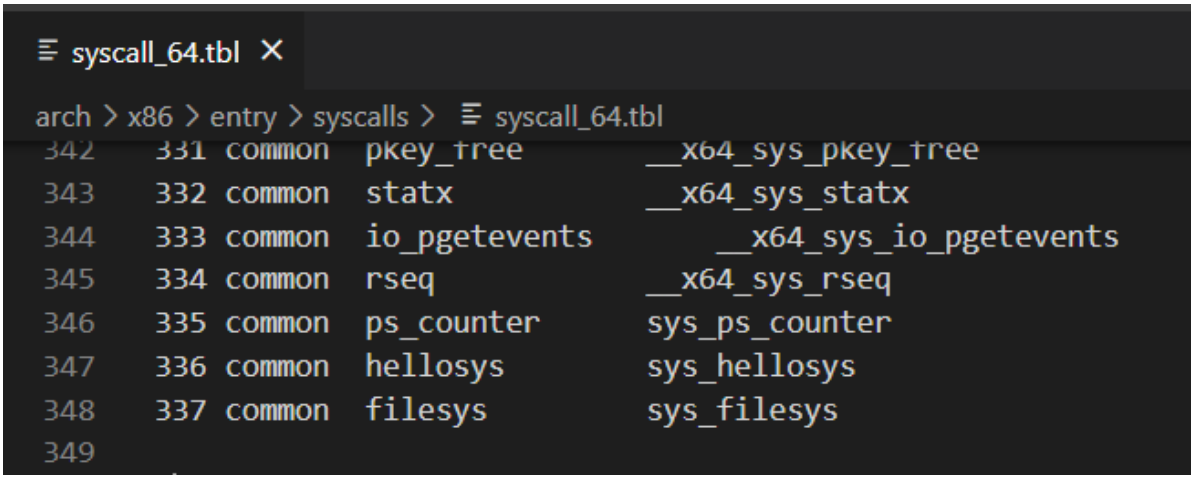
块大小、块数等：

```
    spinlock_t      i_lock; /* i_blocks, i_bytes, maybe i_size */
    unsigned short          i_bytes;
    unsigned int        i_blkbits;
    enum rw_hint        i_write_hint;
    blkcnt_t        i_blocks;
```

系统调用

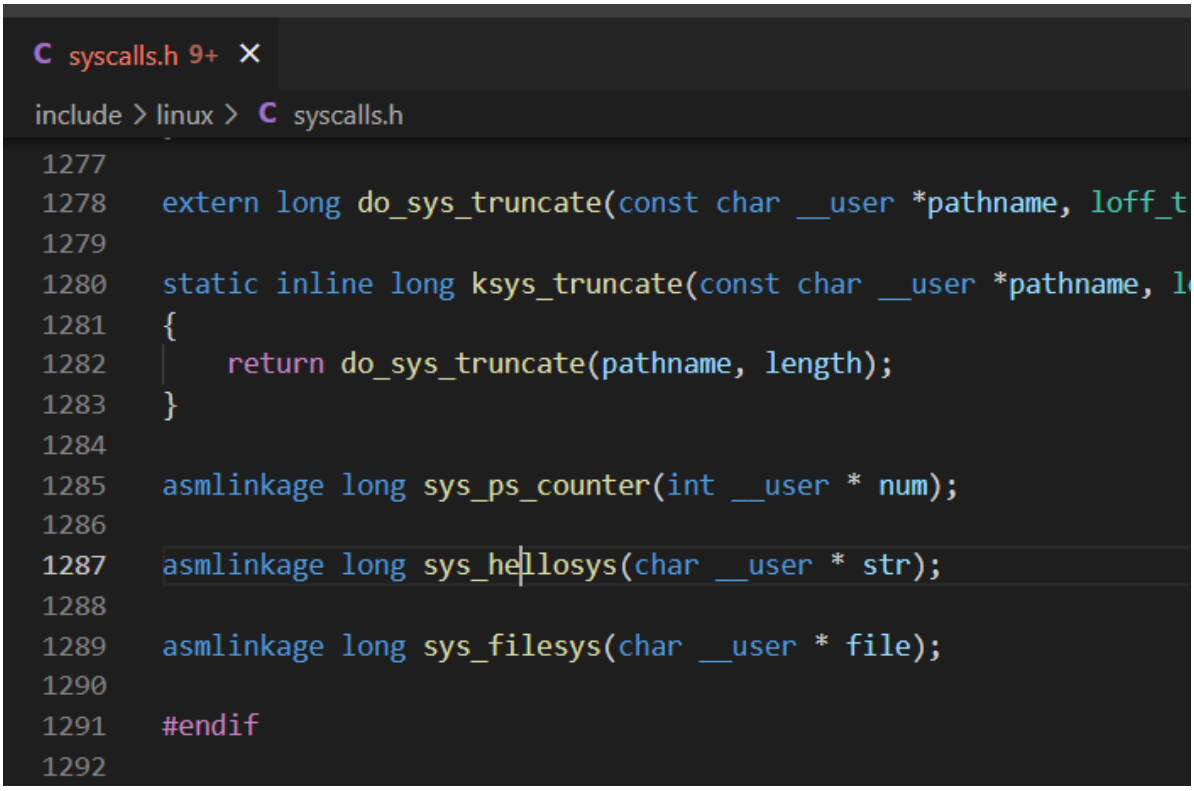
添加

在系统调用表添加：



这里我也选的common，但是应该没影响

声明调用：



实现调用：

```
SYSCALL_DEFINE1(sys_filesys, char __user *, file) {
    int ret = 0;
    loff_t pos = 0;

    struct inode *inode;
    struct file *filePointer;
    struct address_space *mapping;
    int blocks;
    int size;
    int blockCount;
    int i;

    filePointer = filp_open(file, O_RDONLY, 0);
    if (IS_ERR(filePointer)) {
        printk("is err\n");
        ret = PTR_ERR(filePointer);
```

```
    }
    else {
        inode = fp->f_path.dentry->d_inode;
        blocks = inode->i_blocks;
        size = inode->i_size;
        blockCount = (size + (3 << inode->i_blkbits) - 1) / inode->i_bytes;
        printk("%s\n", file);
        mapping = filePointer->f_mapping;
        for(i = 0; i < blockCount; i++) {
            printk("%d %d\n", i, mapping->a_ops->bmap(mapping, i));
        }
        filp_close(filePointer, NULL);
    }

    return ret;
}
```

编译内核

无需修改配置，直接`make deb-pkg`即可

为加快速度，可以使用多线程参数`-j 4`

系统调用测试

编写测试代码`test2.c`：

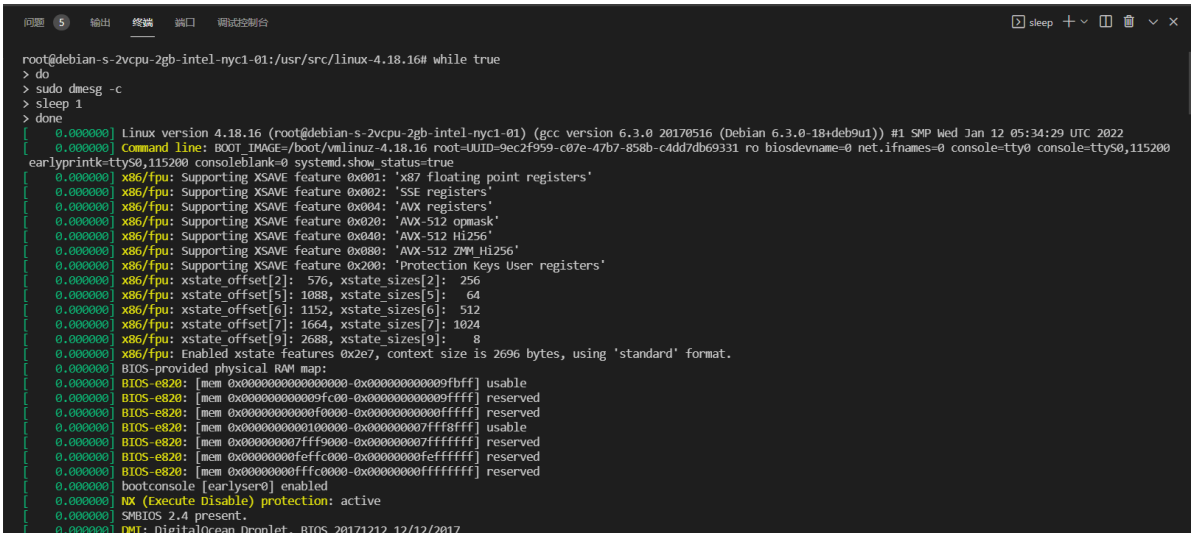
```
#include <linux/unistd.h>
#include <sys/syscall.h>
#include <syscall.h>
#include <stdio.h>
#include <unistd.h>
int main(void)
{
    char* str = "/tmp/hellosys";
    syscall(337, str);
    return 0;
}
```

接着用gcc编译，同样需要使用静态参数：

```
gcc -static -o test2 test2.c
```

怎么查看printk的输出呢，使用dmesg命令：

```
while true
do
sudo dmesg -c
sleep 1
done
```



此处在我尝试 `./test2` 运行时，终端会卡死然后断开ssh连接。尝试许多次修改代码重新编译内核重新测试仍然如此。

内核态和用户态程序相差较远，我也没法用平时的断点调试等方式测试，网上找到的测试方法又过于庞大让我无从下手。

非常抱歉，这次实验没有完成全部内容。

总结&致歉

再次对老师、助教说一声抱歉，没有正确地完成全部实验内容。

Linux不是第一次接触，但是确实是第一次深入系统内部。通过对操作系统的修改感受到了它的庞大性，再次产生了由衷的敬畏。

lab3、4从12月份以来都在我的烦恼清单中。一方面，缺少资料让我有些难以下手，内核编译耗时太长试错成本太高；另一方面，恰逢学期末，需要准备各个科目的书面考试，即使在复习最后一科os的书面考试的时候我也会时不时想到“lab怎么办啊”。缓慢的进度和些微的成果一定程度上培养了我在焦虑中工作的能力，也是一种成长。

最后，再次向老师们说一声对不起。感谢老师和助教一学期的用心付出，衷心希望操作系统课程越办越好。