# 操 作 系 统 原 理

# 实

# 验

# 报

# 告

学　　院 智能与计算学部

年　　级 2019 级

班　　级 留学生班

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天津大学

# 操作系统原理实验报告

题目：Bigger files for xv6

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# 目　录

# Homework: bigger files for xv6

## 1. 实验目的

Modify bmap() so that it implements a doubly-indirect block, in addition to direct blocks and a singly-indirect block. You'll have to have only 11 direct blocks, rather than 12, to make room for your new doubly-indirect block; you're not allowed to change the size of an on-disk inode. The first 11 elements of ip->addrs[] should be direct blocks; the 12th should be a singly-indirect block (just like the current one); the 13th should be your new doubly-indirect block.

You don't have to modify xv6 to handle deletion of files with doubly-indirect blocks.

If all goes well, big will now report that it can write 16523 sectors. It will take big a few dozen seconds to finish.

## 2. 实验内容

### Preliminaries

Modify your Makefile's CPUS definition so that it reads:

```
CPUS := 1
```

Add

```
QEMUEXTRA = -snapshot
```

right before QEMUOPTS

The above two steps speed up qemu tremendously when xv6 creates large files.

mkfs initializes the file system to have fewer than 1000 free data blocks, too few to show off the changes you'll make. Modify param.h to set FSSIZE to:

```
#define FSSIZE       20000  // size of file system in blocks
```

Download big.c into your xv6 directory, add it to the UPROGS list, start up xv6, and run big. It creates as big a file as xv6 will let it, and reports the resulting size. It should say 140 sectors.

### What to Look At

The format of an on-disk inode is defined by struct dinode in fs.h. You're particularly interested in NDIRECT, NINDIRECT, MAXFILE, and the addrs[] element of struct dinode. Look here for a diagram of the standard xv6 inode.

The code that finds a file's data on disk is in bmap() in fs.c. Have a look at it and make sure you understand what it's doing. bmap() is called both when reading and writing

a file. When writing, `bmap()` allocates new blocks as needed to hold file content, as well as allocating an indirect block if needed to hold block addresses.
`bmap()` deals with two kinds of block numbers. The `bn` argument is a "logical block" -- a block number relative to the start of the file. The block numbers in `ip->addrs[]`, and the argument to `bread()`, are disk block numbers. You can view `bmap()` as mapping a file's logical block numbers into disk block numbers.

## Your Job

Modify `bmap()` so that it implements a doubly-indirect block, in addition to direct blocks and a singly-indirect block. You'll have to have only 11 direct blocks, rather than 12, to make room for your new doubly-indirect block; you're not allowed to change the size of an on-disk inode. The first 11 elements of `ip->addrs[]` should be direct blocks; the 12th should be a singly-indirect block (just like the current one); the 13th should be your new doubly-indirect block.
You don't have to modify xv6 to handle deletion of files with doubly-indirect blocks.
If all goes well, `big` will now report that it can write 16523 sectors. It will take `big` a few dozen seconds to finish.

## Hints

Make sure you understand `bmap()`. Write out a diagram of the relationships between `ip->addrs[]`, the indirect block, the doubly-indirect block and the singly-indirect blocks it points to, and data blocks. Make sure you understand why adding a doubly-indirect block increases the maximum file size by 16,384 blocks (really 16383, since you have to decrease the number of direct blocks by one).
Think about how you'll index the doubly-indirect block, and the indirect blocks it points to, with the logical block number.
If you change the definition of `NDIRECT`, you'll probably have to change the size of `addrs[]` in `struct inode` in `file.h`. Make sure that `struct inode` and `struct dinode` have the same number of elements in their `addrs[]` arrays.
If you change the definition of `NDIRECT`, make sure to create a new `fs.img`, since `mkfs` uses `NDIRECT` too to build the initial file systems. If you delete `fs.img`, `make` on Unix (not xv6) will build a new one for you.
If your file system gets into a bad state, perhaps by crashing, delete `fs.img` (do this from Unix, not xv6). `make` will build a new clean file system image for you.
Don't forget to `brelse()` each block that you `bread()`.
You should allocate indirect blocks and doubly-indirect blocks only as needed, like the original `bmap()`.

## 3. 实验步骤与分析（要细化如何实现的思路或流程图）

In this assignment you'll increase the maximum size of an xv6 file. Currently xv6 files are limited to 140 sectors, or 71,680 bytes. This limit comes from the fact that an xv6 inode contains 12 "direct" block numbers and one "singly-indirect" block number, which refers to a block that holds up to 128 more block numbers, for a total of 12+128=140. You'll change the xv6 file system code to support a "doubly-indirect" block in each inode, containing 128 addresses of singly-indirect blocks, each of which can contain up to 128 addresses of data blocks. The result will be that a file will be able to consist of up to 16523 sectors (or about 8.5 megabytes).

## Preliminaries

Modify your Makefile's CPUS definition so that it reads:

CPUS := 1

And then we have to add

**QEMUEXTRA = -snapshot** right before QEMUOPTS and then don't forget to add **_big** in Makefile

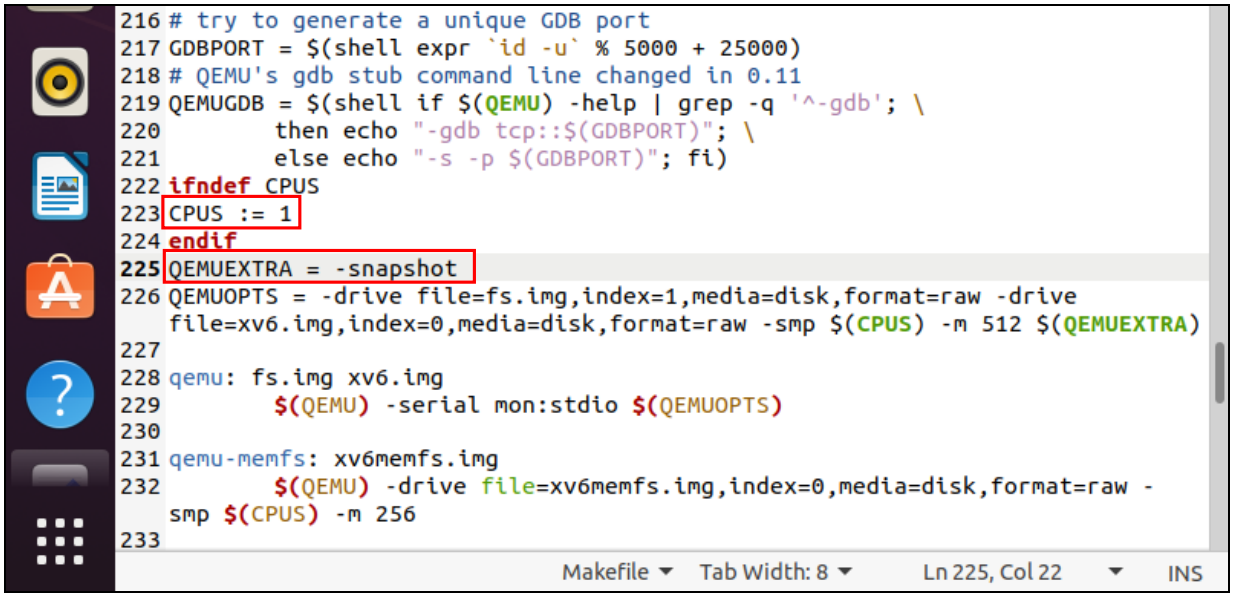



Figure 1：Use only one CPU

Modify **param.h** to set FSSIZE to:

```
#define FSSIZE       20000  // size of file system in blocks
```

## What to Look At

The format of an on-disk inode is defined by struct dinode in fs.h. You're particularly interested in NDIRECT, NINDIRECT, MAXFILE, and the addrs[] element of struct dinode.Look for diagram

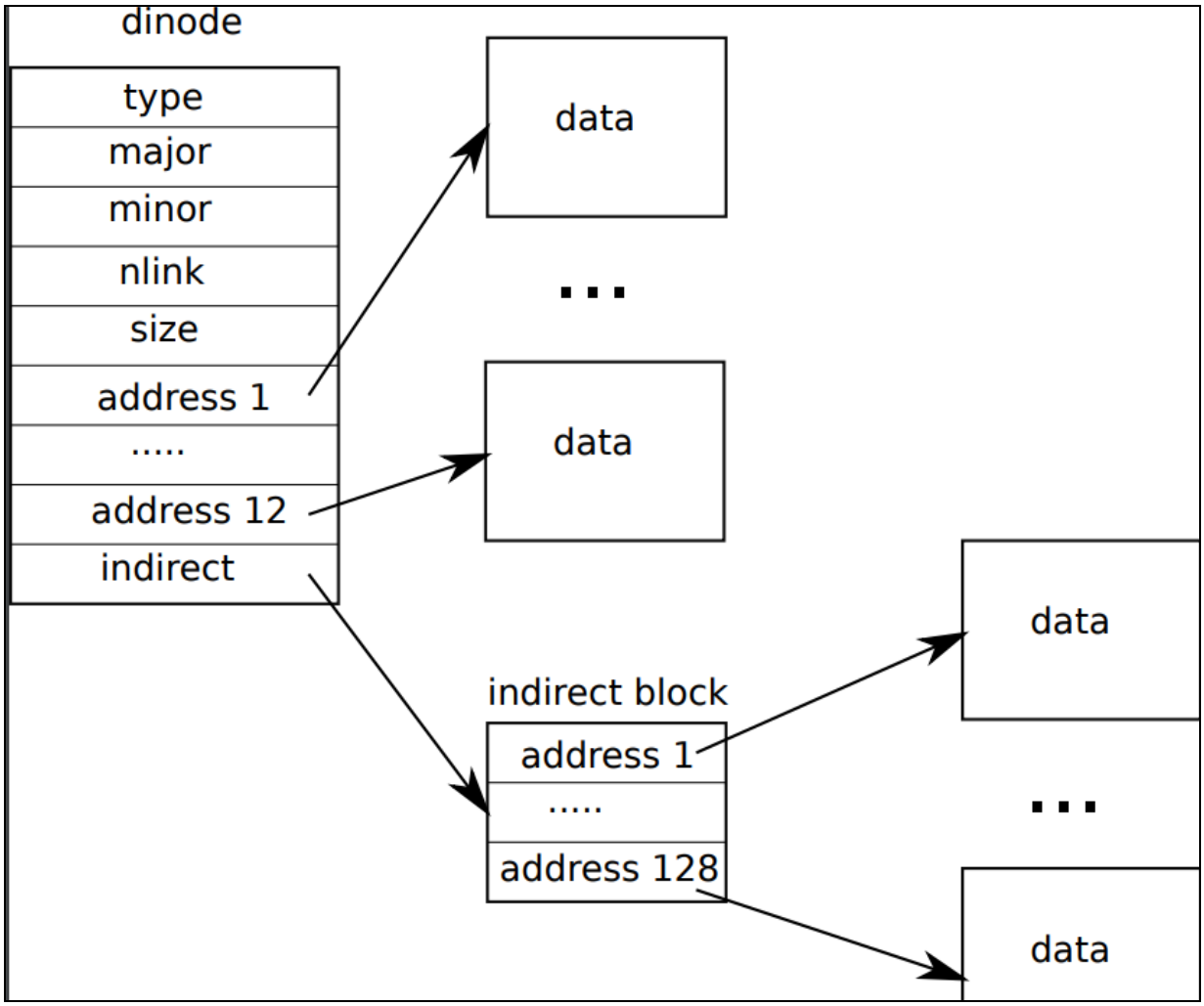



Figure 2:Struct Dinode

The code that finds a file's data on disk is in bmap() in fs.c. Have a look at it and make sure you understand what it's doing. bmap() is called both when reading and writing a file. When writing, bmap() allocates new blocks as needed to hold file content, as well as allocating an indirect block if needed to hold block addresses.

bmap() deals with two kinds of block numbers. The bn argument is a "logical block" -- a block number relative to the start of the file. The block numbers in ip->addrs[], and the argument to bread(), are disk block numbers. You can view bmap() as mapping a file's logical block numbers into disk block numbers.

## Your Job

Modify bmap() so that it implements a doubly-indirect block, in addition to direct blocks and a singly-indirect block. You'll have to have only 11 direct blocks, rather than 12, to make room for your new doubly-indirect block; you're not allowed to change the size of an on-disk inode. The first 11 elements of ip->addrs[] should be direct blocks; the 12th should be a singly-indirect block (just like the current one); the 13th should be your new doubly-indirect block.

1/First step,We have to add some codes in the file **fs.h** like below:

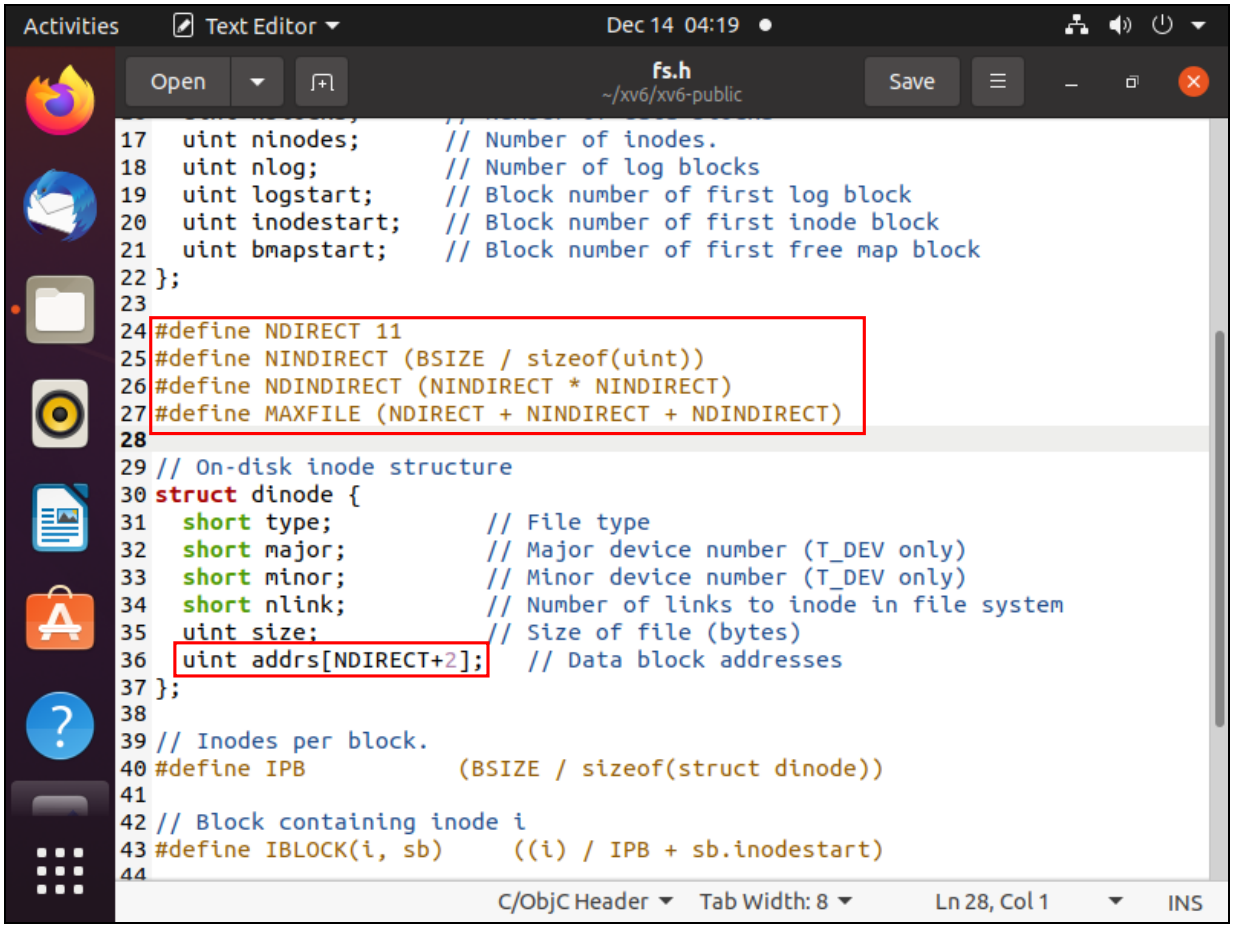
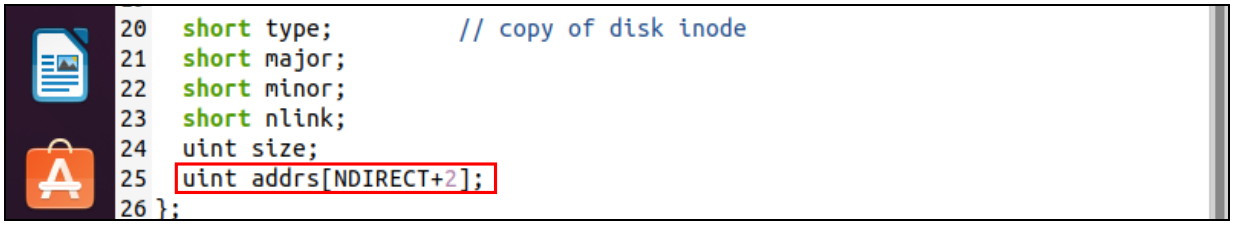



Figure 3:Define in fs.h file

2/We also have to change some code in **file.h** in struct inode section:



3/Now we have to go to **fs.c** to add some codes there. We have to add this code in **to static unit bmap()** section.

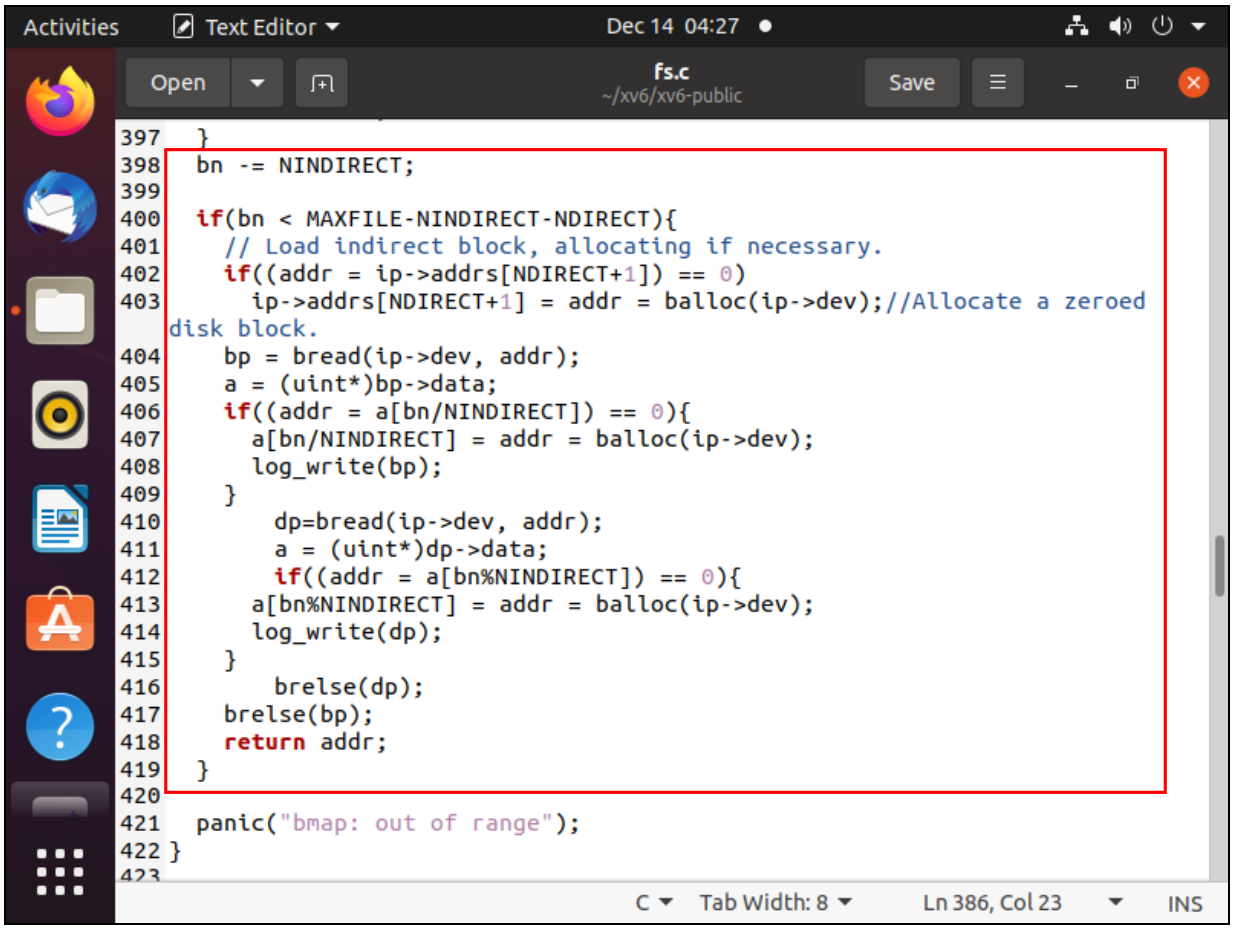



Figure 4:Add code in fs.c file

4/The last step we have to delete the **fs.img** file. Make sure you delete **fs.img** make on Unix (not xv6). If your file system gets into a bad state, perhaps by crashing, delete fs.img (do this from Unix, not xv6). make will build a new clean file system image for you. After that We have to make qemu in terminal and then write command **big** to see the result below:

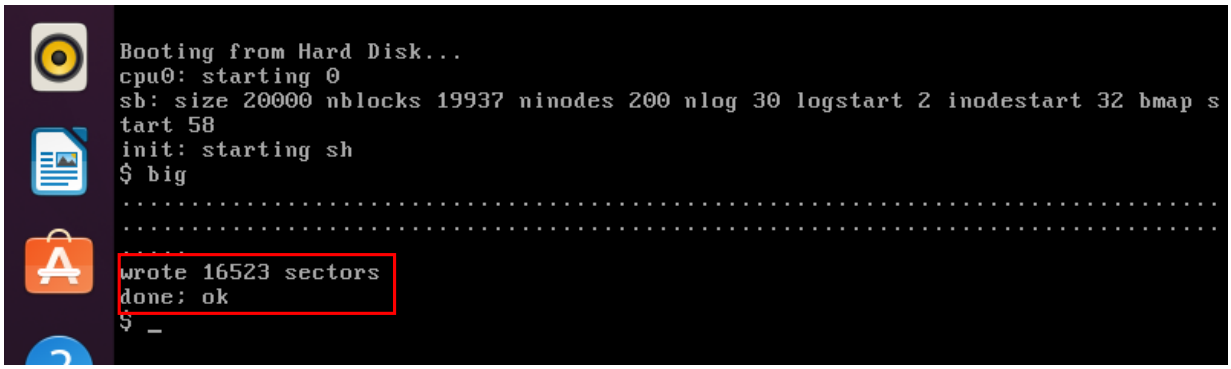



Figure 5:Final answer

## 4. 实验结论与心得体会

This experiment is good and fun though because the hint and tip that they gave you is just too much and you can easily to find the answer of the experiment just like in the first part we have to change CPU to 1 and then just follow the tip it' ll be completed easily. And the hardest part is that we have to add some code in the fs.c file to modify bmap() so that it implements a doubly-indirect block, in addition to direct blocks and a singly-indirect block. You'll have to have only 11 direct blocks, rather than 12.Finally,We got the correct answer and this experiment is done.