

fat32

Under Ubuntu

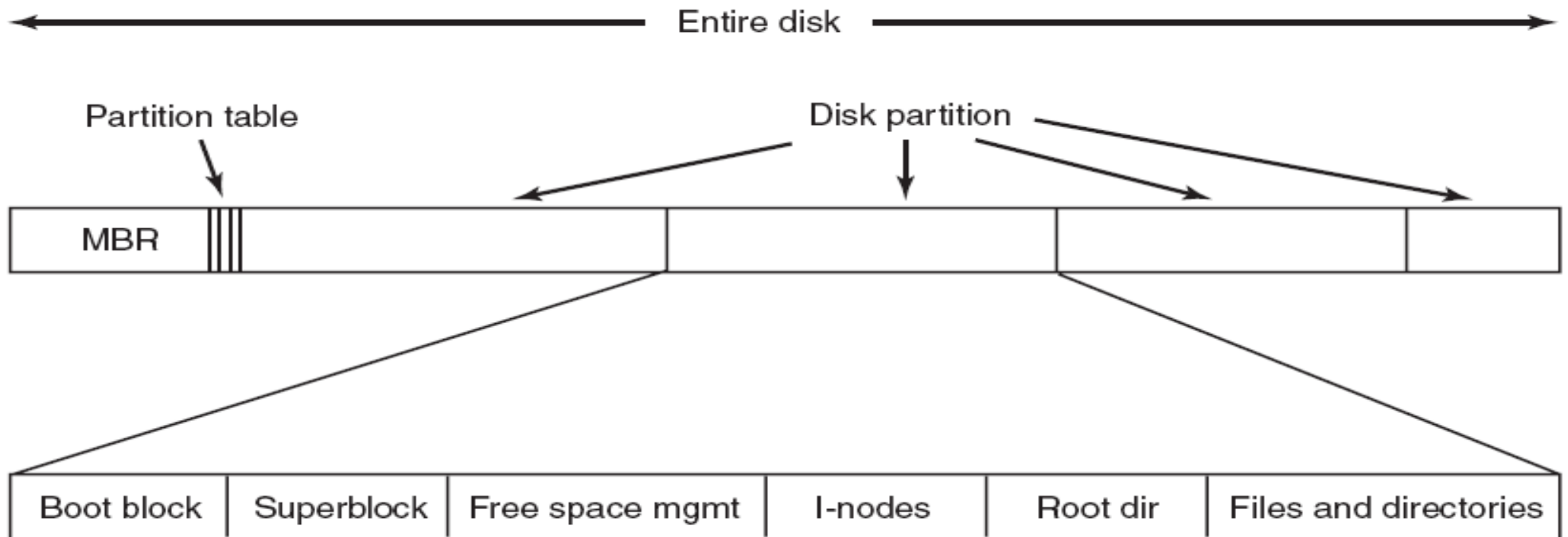
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Tools

- mkfs.vfat
 - `mkfs.vfat -n "OS2017FAT32" -F 32 -C fat32d.img 102400`
 - (default unit:1KB)
- mount
 - `sudo mount -t vfat -o defaults,users,loop,umask=000,icharset=utf8 fat32d.img /mnt`
 - `ls -l /mnt`
 - `sudo cp -r /etc/init.d /mnt`
 - `ls -l /mnt`
- umount
 - `sudo umount /mnt`
 - `ls -l /mnt`
- hexedit
 - `hexedit fat32d.img`

Disk & Partition



Windows' Partition

- 分区内的第一个扇区
 - 引导扇区
- 分区内的第二个扇区
 - 文件系统信息扇区 FSINFO
- 保留的其它扇区
- FAT1 表的若干扇区
- FAT2 表的若干扇区
- 数据区的若干扇区

The First Section of Partition

```
albert@alosvm: ~/jos2016falla/fat32
00000000 EB 58 90 6D 6B 66 73 2E 66 61 74 00 02 01 20 00 .X.mkfs.fat...
00000010 02 00 00 00 00 F8 00 00 20 00 40 00 00 00 00 00 .....@.....
00000020 00 90 01 00 14 03 00 00 00 00 00 00 02 00 00 00 .....
00000030 01 00 06 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000040 80 00 29 45 51 9E 71 4F 53 32 30 31 37 46 41 54 ..)EQ.q0S2017FAT
00000050 33 32 46 41 54 33 32 20 20 20 0E 1F BE 77 7C AC 32FAT32 ...w|.
00000060 22 C0 74 0B 56 B4 0E BB 07 00 CD 10 5E EB F0 32 ".t.V.....^..2
00000070 E4 CD 16 CD 19 EB FE 54 68 69 73 20 69 73 20 6E .....This is n
00000080 6F 74 20 61 20 62 6F 6F 74 61 62 6C 65 20 64 69 ot a bootable di
00000090 73 6B 2E 20 20 50 6C 65 61 73 65 20 69 6E 73 65 sk. Please inse
000000A0 72 74 20 61 20 62 6F 6F 74 61 62 6C 65 20 66 6C rt a bootable fl
000000B0 6F 70 70 79 20 61 6E 64 0D 0A 70 72 65 73 73 20 oppy and..press
000000C0 61 6E 79 20 6B 65 79 20 74 6F 20 74 72 79 20 61 any key to try a
000000D0 67 61 69 6E 20 2E 2E 2E 20 0D 0A 00 00 00 00 00 gain ...
000000E0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000000F0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000001A0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000001B0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000001C0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000001D0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000001E0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000001F0 00 00 00 00 00 00 00 00 00 00 00 00 00 55 AA .....U.
--- usbfat32d.img --0x0/0x320000-----
```

The First Section of Partition

0x00~0x02: 3字节, 跳转指令

0x03~0x0A: 8字节, 文件系统标志和版本号

*0x0B~0x0C: 2字节, 每扇区字节数, 512 (0x0200:512)

*0x0D~0x0D: 1字节, 每簇扇区数, 1 (0x01)

*0x0E~0x0F: 2字节, 保留扇区数, 32 (0x0020), 即FAT1的起始地址为相对第32扇区

*0x10~0x10: 1字节, FAT表个数, 2(0x02)

0x11~0x12: 2字节, FAT32必须等于0, FAT12/FAT16为根目录中目录的个数

0x13~0x14: 2字节, FAT32必须等于0, FAT12/FAT16为扇区总数

0x15~0x15: 1字节, 哪种存储介质, 0xF8标准值, 可移动存储介质, 常用的 0xF0

0x16~0x17: 2字节, FAT32必须为0, FAT12/FAT16为一个FAT表所占的扇区数

*0x18~0x19: 2字节, 每磁道扇区数, 只对由磁头和柱面每分割为若干磁道的存储介质有效, 32 (0x0020)

*0x1A~0x1B: 2字节, 磁头数, 只对特殊的介质才有效, 64 (0x0040)

*0x1C~0x1F: 4字节, EBR分区之前所隐藏的扇区数, 0, 与MBR中0x1C6开始的4个字节数值相等

The First Section of Partition

0x20~0x23: 4字节, 文件系统总扇区数, 102400 (0x 00 01 90 00) , $102400 * 512 = 50\text{MB}$

*0x24~0x27: 4字节, 每个FAT表占用扇区数, 788 (0x00000314)

0x28~0x29: 2字节, 标记, 此域FAT32 特有

*0x2A~0x2B: 2字节, FAT32版本号0.0, FAT32特有

***0x2C~0x2F: 4字节, 根目录所在第一个簇的簇号, 2 (0x00000002)**

*0x30~0x31: 2字节, FSINFO (文件系统信息扇区) 扇区号1 (0x0001), 该扇区为操作系统提供关于空簇总数及下一可用簇的信息

0x32~0x33: 2字节, 备份引导扇区的位置。备份引导扇区总是位于文件系统的6号扇区 (0x0006)

0x34~0x3F: 12字节, 用于以后FAT 扩展使用

0x40~0x40: 1字节, 与FAT12/16 的定义相同, 只不过两者位于启动扇区不同的位置而已

0x41~0x41: 1字节, 与FAT12/16 的定义相同, 只不过两者位于启动扇区不同的位置而已

0x42~0x42: 1字节, 扩展引导标志, 0x29。与FAT12/16 的定义相同, 只不过两者位于启动扇区不同的位置而已

0x43~0x46: 4字节, 卷序列号, 通常为一个随机值

*0x47~0x51: 11字节, 卷标 (ASCII码), 如果建立文件系统的时候指定了卷标

*0x52~0x59: 8字节, 文件系统格式的ASCII码, FAT32

0x5A~0x1FD: 90~509共410字节, 未使用

*0x1FE~0x1FF: 签名标志 "55 AA", 0x1FE:55 0x1FF:AA

分区内的第二个扇区： 文件系统信息扇区 FSINFO

```
albert@alosvm: ~/jos2016fallal/fat32
00000200  52 52 61 41 00 00 00 00 00 00 00 00 00 00 00 00 RRaA.....
00000210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000260  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000270  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000280  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000290  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000002A0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000002B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000002C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000002D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000002E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000002F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000300  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000310  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000320  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000330  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000340  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000350  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000360  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000370  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000380  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000390  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000003A0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000003B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000003C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000003D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000003E0  00 00 00 00 72 72 41 61 F3 2C 00 00 CE 5C 01 00 ....rrAa.,...\..
000003F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 55 AA .....U.
--- usbfat32d.img --0x218/0x3200000-----
```


分区内的第二个扇区： 文件系统信息扇区 FSINFO

0x00~0x03: 4 个字节, 扩展引导标志 " 0x52 0x52 0x61 0x41"RRaA

0x04~0x1E3: 480 个字节, 未使用

0x1E4~0x1E7: 4 个字节, FSINFO 签名 " 0x72 0x72 0x41 0x61" rrAa

*0x1E8~0x1EB: 4 个字节, 文件系统的空簇数, 11507 (0x00002CF3)

*0x1EC~0x1EF: 4 个字节, 下一可用簇号 89294 (0xCE 0x5C 0x01 0x00: 0x00015CCE)

0x1F0~0x1FD: 14 个字节, 未使用

0x1FE~0x1FF: 2 个字节, " 55 AA" 标志

保留的其它扇区

- （包括前面的扇区）一共有 32 （ 0x0020 ） 保留扇区。
- 见分区内的第一个扇区（即引导扇区）：
- *0x0E~0x0F： 2 字节，保留扇区数， 32 （ 0x0020 ） ， 即 FAT1 的起始地址为相对第 32 扇区

FAT1 表的若干扇区

```
albert@alosvm: ~/jos2016fall/fat32
00004000  F8 FF FF 0F FF FF FF 0F F8 FF FF 0F FF FF FF 0F .....
00004010  5C 8C 00 00 35 8C 00 00 FF FF FF 0F FF FF FF 0F \...5.....
00004020  FF FF FF 0F FF FF FF 0F FF FF FF 0F FF FF FF 0F .....
00004030  FF FF FF 0F FF FF FF 0F FF FF FF 0F FF FF FF 0F .....
00004040  FF FF FF 0F FF FF FF 0F 24 00 00 00 14 00 00 00 .....$.
00004050  FF FF FF 0F FF FF FF 0F 17 00 00 00 18 00 00 00 .....
00004060  FF FF FF 0F 1A 00 00 00 1B 00 00 00 1C 00 00 00 .....
00004070  1D 00 00 00 1E 00 00 00 1F 00 00 00 20 00 00 00 .....
00004080  FF FF FF 0F 22 00 00 00 23 00 00 00 FF FF FF 0F ...."....#.....
00004090  FF FF FF 0F 26 00 00 00 27 00 00 00 28 00 00 00 ....&...'....(
000040A0  29 00 00 00 2A 00 00 00 2B 00 00 00 2C 00 00 00 )...*...+...,.
000040B0  2D 00 00 00 2E 00 00 00 FF FF FF 0F FF FF FF 0F -.....
000040C0  31 00 00 00 32 00 00 00 33 00 00 00 FF FF FF 0F 1...2...3.....
000040D0  FF FF FF 0F FF FF FF 0F FF FF FF 0F FF FF FF 0F .....
000040E0  FF FF FF 0F 75 01 00 00 3B 00 00 00 3C 00 00 00 ....u...;...<...
000040F0  3D 00 00 00 3E 00 00 00 3F 00 00 00 40 00 00 00 =...>...?...@...
00004100  41 00 00 00 42 00 00 00 43 00 00 00 44 00 00 00 A...B...C...D...
00004110  45 00 00 00 46 00 00 00 47 00 00 00 48 00 00 00 E...F...G...H...
00004120  49 00 00 00 4A 00 00 00 4B 00 00 00 4C 00 00 00 I...J...K...L...
00004130  4D 00 00 00 4E 00 00 00 4F 00 00 00 50 00 00 00 M...N...O...P...
00004140  51 00 00 00 52 00 00 00 53 00 00 00 54 00 00 00 Q...R...S...T...
00004150  55 00 00 00 56 00 00 00 57 00 00 00 58 00 00 00 U...V...W...X...
00004160  59 00 00 00 5A 00 00 00 5B 00 00 00 5C 00 00 00 Y...Z...[... \...
00004170  5D 00 00 00 5E 00 00 00 5F 00 00 00 60 00 00 00 ]...^..._...`...
00004180  61 00 00 00 62 00 00 00 63 00 00 00 64 00 00 00 a...b...c...d...
00004190  65 00 00 00 66 00 00 00 67 00 00 00 68 00 00 00 e...f...g...h...
000041A0  69 00 00 00 6A 00 00 00 6B 00 00 00 6C 00 00 00 i...j...k...l...
000041B0  6D 00 00 00 6E 00 00 00 6F 00 00 00 70 00 00 00 m...n...o...p...
000041C0  71 00 00 00 72 00 00 00 73 00 00 00 74 00 00 00 q...r...s...t...
000041D0  75 00 00 00 76 00 00 00 77 00 00 00 78 00 00 00 u...v...w...x...
000041E0  79 00 00 00 7A 00 00 00 7B 00 00 00 7C 00 00 00 y...z...{...|...
000041F0  7D 00 00 00 7E 00 00 00 7F 00 00 00 80 00 00 00 }...~.....
--- usbfat32d.img --0x41F0/0x3200000-----
```

起始位置为：
保留的其它扇区的下一个扇区，
即
32 (0x0020)
扇区，也即
 $32 * 512 = 0x20 * 0x200 = 0x4000$ 字节偏移量

数据区之根目录

```
albert@alosvm: ~/jos2016fallal/fat32
000C9000  4F 53 32 30 31 37 46 41 54 33 32 08 00 00 72 57 0S2017FAT32...rW
000C9010  82 4B 82 4B 00 00 72 57 82 4B 00 00 00 00 00 00 .K.K..rW.K.....
000C9020  42 74 00 78 00 74 00 00 00 FF FF 0F 00 56 FF FF Bt.x.t.....V..
000C9030  FF FF FF FF FF FF FF FF FF FF 00 00 FF FF FF FF .....
000C9040  01 64 00 6F 00 77 00 6E 00 6C 00 0F 00 56 6F 00 .d.o.w.n.l...Vo.
000C9050  61 00 64 00 5F 00 78 00 76 00 00 00 36 00 2E 00 a.d._.x.v...6...
000C9060  44 4F 57 4E 4C 4F 7E 31 54 58 54 20 00 64 2A 18 DOWNLO~1TXT .d*.
000C9070  82 4B 82 4B 00 00 2A 18 82 4B 03 00 33 00 00 00 .K.K..*..K..3...
000C9080  41 78 00 76 00 36 00 2D 00 70 00 0F 00 B3 75 00 Ax.v.6.-.p....u.
000C9090  62 00 6C 00 69 00 63 00 00 00 00 00 FF FF FF FF b.l.i.c.....
000C90A0  58 56 36 2D 50 55 7E 31 20 20 20 10 00 00 2B 18 XV6-PU~1 ...+.
000C90B0  82 4B 82 4B 00 00 2B 18 82 4B 04 00 00 00 00 00 .K.K..+..K.....
000C90C0  41 78 00 76 00 36 00 2E 00 74 00 0F 00 0D 67 00 Ax.v.6...t....g.
000C90D0  7A 00 00 00 FF FF FF FF FF FF 00 00 FF FF FF FF z.....
000C90E0  58 56 36 20 20 20 20 20 54 47 5A 20 00 00 2B 18 XV6      TGZ ..+.
000C90F0  82 4B 82 4B 00 00 2B 18 82 4B 90 D2 64 8E 13 01 .K.K..+..K..d...
000C9100  41 62 00 69 00 6E 00 00 00 FF FF 0F 00 7F FF FF Ab.i.n.....
000C9110  FF FF FF FF FF FF FF FF FF FF 00 00 FF FF FF FF .....
000C9120  42 49 4E 20 20 20 20 20 20 20 20 10 00 64 A8 18 BIN      ..d..
000C9130  82 4B 82 4B 01 00 A8 18 82 4B 61 5C 00 00 00 00 .K.K.....Ka\....
000C9140  E5 45 4C 4C 4F 54 7E 31 53 57 50 20 00 64 44 18 .ELLOT~1SWP .dD.
000C9150  82 4B 82 4B 00 00 44 18 82 4B 00 00 00 00 00 00 .K.K..D..K.....
000C9160  41 68 00 65 00 6C 00 6C 00 6F 00 0F 00 F1 2E 00 Ah.e.l.l.o.....
000C9170  74 00 78 00 74 00 00 00 FF FF 00 00 FF FF FF FF t.x.t.....
000C9180  48 45 4C 4C 4F 20 20 20 54 58 54 20 00 64 48 18 HELLO  TXT .dH.
000C9190  82 4B 82 4B 01 00 48 18 82 4B 60 5C 0C 00 00 00 .K.K..H..K`\....
000C91A0  41 63 00 73 00 6F 00 6E 00 67 00 0F 00 1D 2E 00 Ac.s.o.n.g.....
000C91B0  74 00 78 00 74 00 00 00 FF FF 00 00 FF FF FF FF t.x.t.....
000C91C0  43 53 4F 4E 47 20 20 20 54 58 54 20 00 64 24 29 CSONG  TXT .d$)
000C91D0  82 4B 82 4B 01 00 24 29 82 4B CC 5C 2F 04 00 00 .K.K..$).K.\/...
000C91E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C91F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
--- usbfat32d.img          --0xC91F0/0x3200000-----
```

数据区之根目录

- 见分区内的第一个扇区 (即引导扇区) :
- *0x2C~0x2F : 4 字节, 根目录所在第一个簇的簇号, 2 (0x0x00000002)。(虽然在 FAT32 文件系统下, 根目录可以存放在数据区的任何位置, 但是通常情况下还是起始于 2 号簇)
- *0x0D~0x0D : 1 字节, 每簇扇区数, 1 (0x01)
- *0x24~0x27 : 4 字节, 每个 FAT 表占用扇区数, 788 (0x00000314)
- 根目录簇 (转换为扇区) 的计算:
 - $0x20(\text{保留}) + 0x0314(\text{fat1}) + 0x0314(\text{fat2}) = 0x648(\text{个扇区})$
 - $0x648 \times 0x200(512) = 0xc9000(\text{字节, 偏移量})$

目录文件的目录项

- 目录文件包含若干个目录项（Directory Entry），每个目录项的长度都是 32 Bytes，fat32短目录项：
 - 0x00~0x07:8 字节，文件名
 - 0x08~0x0A:3 字节，扩展名
 - 0x0B:1 字节，文件属性，0 读写，1 只读，00000010 隐藏，00000100 系统，00001000 卷标，00010000 子目录，00100000 归档
 - 0x0C:1 字节，保留
 - 0x0D:1 字节，10 毫秒位
 - 0x0E~0x0F:2 字节，文件创建时间
 - 0x10~0x11:2 字节，文件创建日期
 - 0x12~0x13:2 字节，文件最后访问日期
 - *0x14~0x15:2 字节，文件起始簇号的高 16 位
 - 0x16~0x17:2 字节，文件最后修改时间
 - 0x18~0x19:2 字节，文件最后修改日期
 - ×0x1A~0x1B:2 字节，文件起始簇号的低 16 位
 - ×0x1C~0x1F:4 字节，文件实际长度

目录文件的目录项：example

```
albert@alosvm: ~/jos2016fall/fat32
000C9000  4F 53 32 30 31 37 46 41 54 33 32 08 00 00 72 57 0S2017FAT32...rW
000C9010  82 4B 82 4B 00 00 72 57 82 4B 00 00 00 00 00 00 .K.K..rW.K.....
000C9020  42 74 00 78 00 74 00 00 00 FF FF 0F 00 56 FF FF Bt.x.t.....V..
000C9030  FF FF FF FF FF FF FF FF FF FF 00 00 FF FF FF FF .....
000C9040  01 64 00 6F 00 77 00 6E 00 6C 00 0F 00 56 6F 00 .d.o.w.n.l...Vo.
000C9050  61 00 64 00 5F 00 78 00 76 00 00 00 36 00 2E 00 a.d. .x.v...6...
000C9060  44 4F 57 4E 4C 4F 7E 31 54 58 54 20 00 64 2A 18 DOWNLO~1TXT .d*.
000C9070  82 4B 82 4B 00 00 2A 18 82 4B 03 00 33 00 00 00 .K.K..*..K..3...
000C9080  41 78 00 76 00 36 00 2D 00 70 00 0F 00 B3 75 00 Ax.v.6.-.p....u.
000C9090  62 00 6C 00 69 00 63 00 00 00 00 00 FF FF FF FF b.l.i.c.....
000C90A0  58 56 36 2D 50 55 7E 31 20 20 20 10 00 00 2B 18 XV6-PU~1 ...+.
000C90B0  82 4B 82 4B 00 00 2B 18 82 4B 04 00 00 00 00 00 .K.K..+..K.....
000C90C0  41 78 00 76 00 36 00 2E 00 74 00 0F 00 0D 67 00 Ax.v.6...t....g.
000C90D0  7A 00 00 00 FF FF FF FF FF FF 00 00 FF FF FF FF z.....
000C90E0  58 56 36 20 20 20 20 20 54 47 5A 20 00 00 2B 18 XV6      TGZ ...+.
000C90F0  82 4B 82 4B 00 00 2B 18 82 4B 90 D2 64 8E 13 01 .K.K..+..K..d...
000C9100  41 62 00 69 00 6E 00 00 00 FF FF 0F 00 7F FF FF Ab.i.n.....
000C9110  FF FF FF FF FF FF FF FF FF FF 00 00 FF FF FF FF .....
000C9120  42 49 4E 20 20 20 20 20 20 20 20 10 00 64 A8 18 BIN      .d..
000C9130  82 4B 82 4B 01 00 A8 18 82 4B 61 5C 00 00 00 00 .K.K.....Ka\....
000C9140  E5 45 4C 4C 4F 54 7E 31 53 57 50 20 00 64 44 18 .ELL0T~1SWP .dD.
000C9150  82 4B 82 4B 00 00 44 18 82 4B 00 00 00 00 00 00 .K.K..D..K.....
000C9160  41 68 00 65 00 6C 00 6C 00 6F 00 0F 00 F1 2E 00 Ah.e.l.l.o.....
000C9170  74 00 78 00 74 00 00 00 FF FF 00 00 FF FF FF FF t.x.t.....
000C9180  48 45 4C 4C 4F 20 20 20 54 58 54 20 00 64 48 18 HELLO  TXT .dH.
000C9190  82 4B 82 4B 01 00 48 18 82 4B 60 5C 0C 00 00 00 .K.K..H..K`\....
000C91A0  41 63 00 73 00 6F 00 6E 00 67 00 0F 00 1D 2E 00 Ac.s.o.n.g.....
000C91B0  74 00 78 00 74 00 00 00 FF FF 00 00 FF FF FF FF t.x.t.....
000C91C0  43 53 4F 4E 47 20 20 20 54 58 54 20 00 64 24 29 CSONG  TXT .d$)
000C91D0  82 4B 82 4B 01 00 24 29 82 4B CC 5C 2F 04 00 00 .K.K..$).K.\/...
000C91E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C91F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
---  usbfat32d.img  --0xC91F0/0x3200000-----
```

目录文件的目录项：example

- 0x000C9060: DOWNLO~1TXT 文件
 - *0x14~0x15:2 字节, 文件起始簇号的高 16 位:0x0000
 - x0x1A~0x1B:2 字节, 文件起始簇号的低 16 位:0x0003
 - 因此: DOWNLO~1TXT 文件的簇号: 0x00000003
 - $0x20(\text{保留}) + 0x0314(\text{fat1}) + 0x0314(\text{fat2}) + 0x3 * 0x1 - 0x2 * 0x1(\text{根簇号为 2}) = 0x649(\text{个扇区})$
 - 字节偏移量: $0x649 * 0x200 = 0xC9200$
 -
 - x0x1C~0x1F:4 字节, 文件实际长度:0x00000033, 即 51 字节

目录文件的目录项：example

```

albert@alosvm: ~/jos2016fall/fat32
000C9200  67 69 74 20 63 6C 6F 6E 65 20 67 69 74 3A 2F 2F git clone git://
000C9210  67 69 74 68 75 62 2E 63 6F 6D 2F 6D 69 74 2D 70 github.com/mit-p
000C9220  64 6F 73 2F 78 76 36 2D 70 75 62 6C 69 63 2E 67 dos/xv6-public.g
000C9230  69 74 0A 00 00 00 00 00 00 00 00 00 00 00 00 00 it.....
000C9240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9260  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9270  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9280  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9290  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C92A0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C92B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C92C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C92D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C92E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C92F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9300  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9310  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9320  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9330  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9340  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9350  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9360  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9370  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9380  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C9390  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C93A0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C93B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C93C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C93D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C93E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000C93F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
--- usbfat32d.img --0xC93FA/0x3200000-----

```

Task

- pwd
- cd
- ls
- ls -l
- touch XXX
- ed XXX
- cat XXX
- rm XXX
- mkdir YYY
- rmdir YYY
- cp XX YY
- cp -R XX YY
- import ZZ
- export XX
- 支持长文件名
 - file123456789.txt
- 支持 pdf 文档
- md5 XX
- tree YYY
- file XX

Q&A?

Advanced Topics

- Large file
- Long name
- Directory
- ...

End