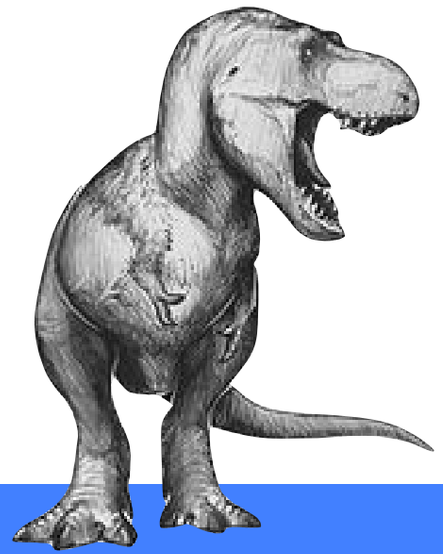
2020春

LINUX OPERATING SYSTEM

YANG

LINUX操作系统（双语）

双语课→课件内容中英混排



Lecture 18

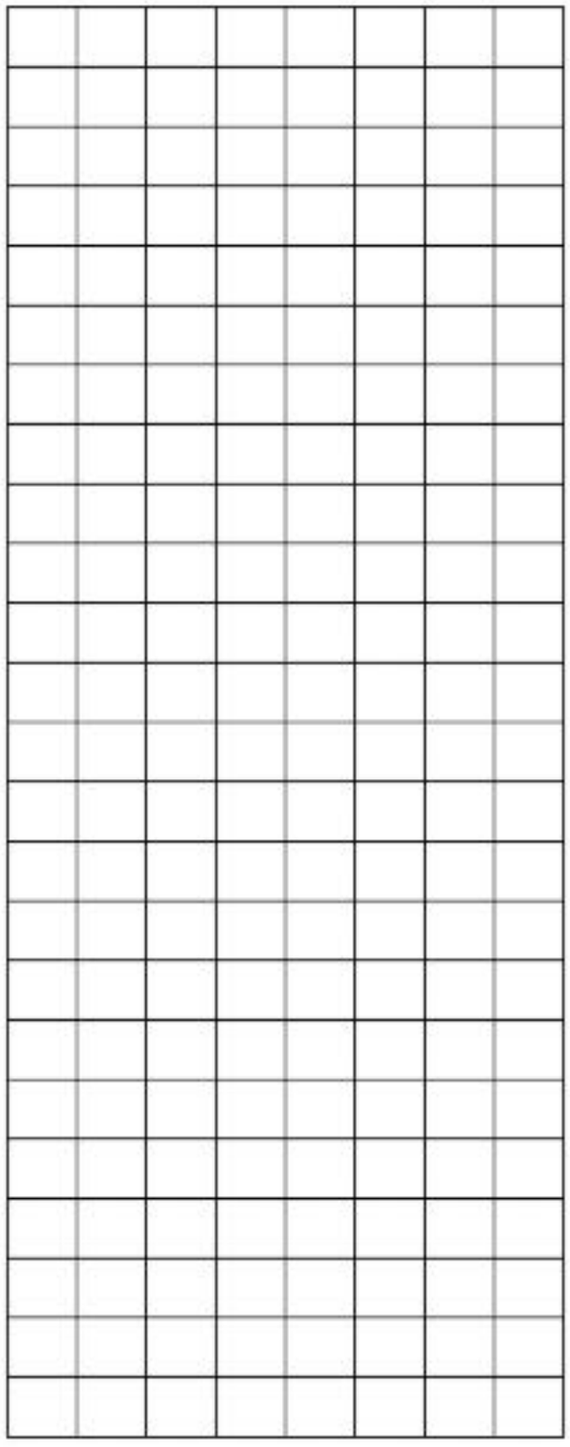
File-System Implementation

本讲内容

- 文件系统实现
  - 文件目录
  - 分配方法
  - 空闲空间管理
- 文件系统结构

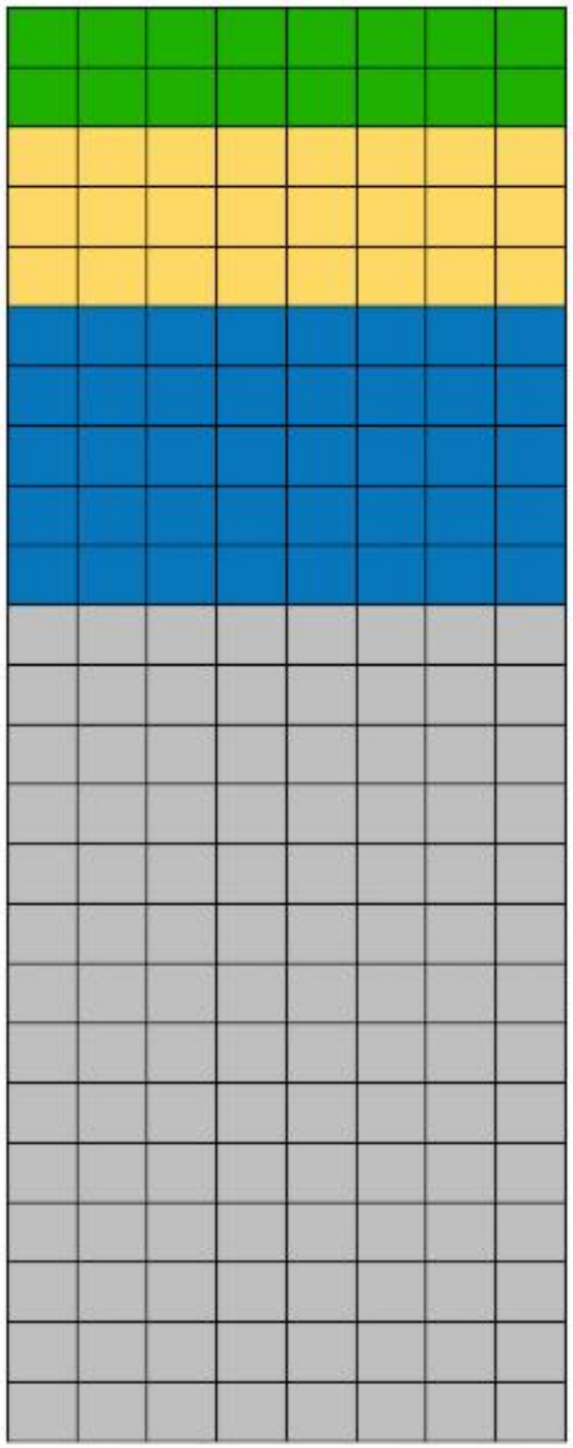
文件系统实现

文件系统要实现什么？



disk

文件系统要实现什么？



disk

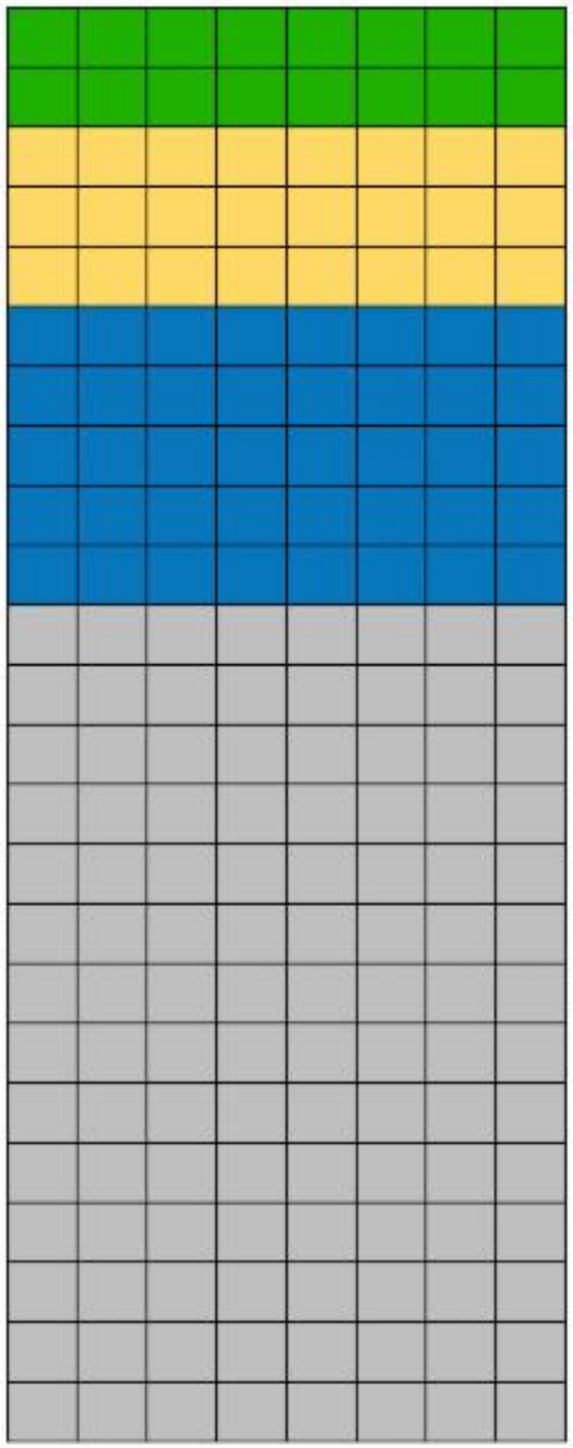
partition table

free blocks map

directory entry 1
directory entry 2
directory entry...
directory entry n

File Control Block
- file name
- permission
- date&time
- owner/group/ACL
- file size
- pointer to file data

文件系统要实现什么？



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- 文件目录
- 空间分配方法
- 空闲空间管理

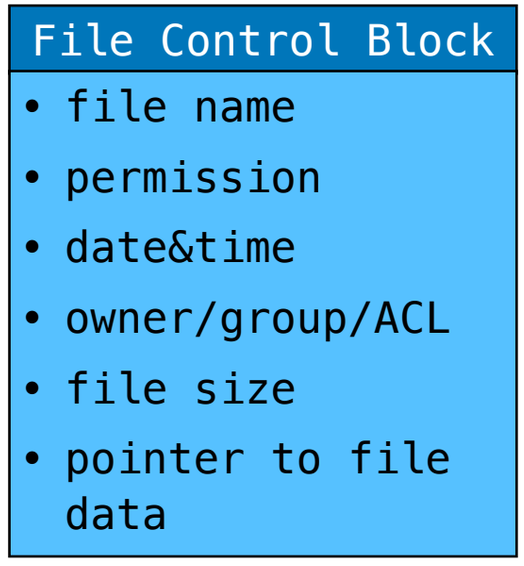
COMMON FILE SYSTEMS

- Many file systems are in use today, and most operating systems support more than one.
  - For example, most CD-ROMs are written in the ISO 9660 format, a standard format agreed on by CD-ROM manufacturers. In addition to removable-media file systems, each operating system has one or more disk-based file systems.
    - UNIX uses the UNIX file system (UFS), which is based on the Berkeley Fast File System (FFS).
    - Windows supports disk file-system formats of FAT, FAT32, and NTFS.
    - Although Linux supports over forty different file systems, the standard Linux file system is known as the extended file system, with the most common versions being ext3 and ext4.
- Another interesting project is the FUSE file system, which allows a user can add a new file system to a variety of operating systems and can use that file system to manage her files.

文件目录

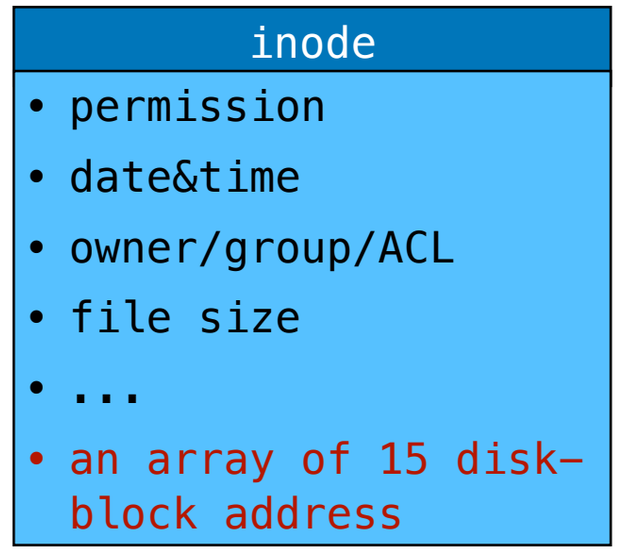
文件控制块

- 文件系统通过文件控制块（File Control Blcok）来维护文件结构，FCB包含有关文件的信息，包括所有得、权限、文件内容的位置等。
- 文件目录用于组织文件，每个目录项对应一个FCB。
  - 文件目录实现的关键
    - FCB与文件内容的关联方法
    - 在目录中“按名”搜索的效率



INODES

- UFS中的FCB被称作索引结点inode，每个inode都有一个唯一的编号，包含的内容有：
  - The type of the file
  - The mode of the file (ACL)
  - The number of hard links to the file
  - The user ID of the owner of the file
  - The group ID to which the file belongs
  - The number of bytes in the file
  - An array of 15 disk-block addresses
  - The date and time the file was last accessed
  - The date and time the file was last modified
  - The date and time the file was created



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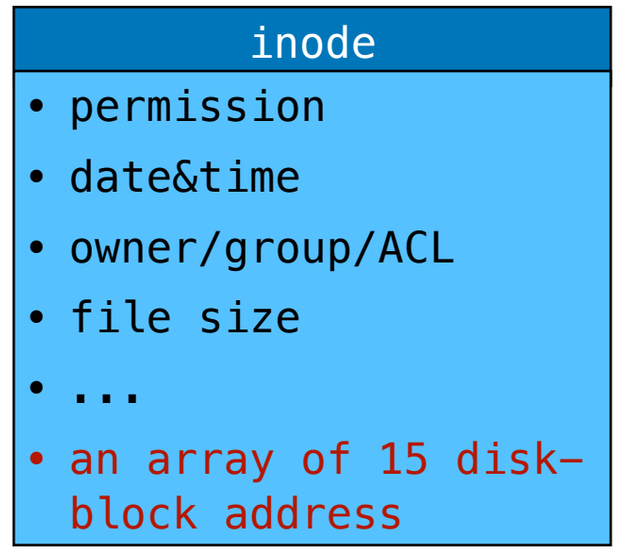
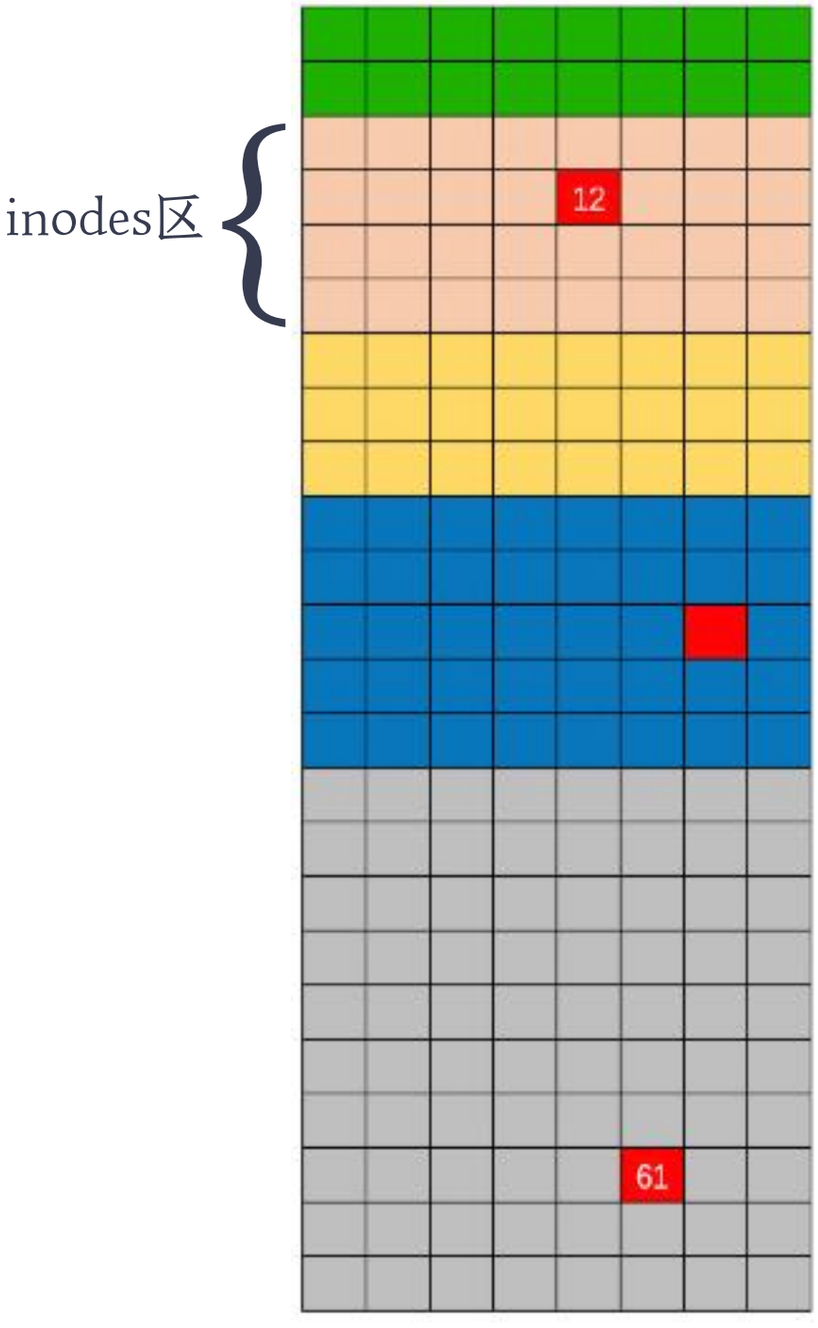


UFS dentry

INODES区



disk

directory

A.file	13
B.file	11
C.file	12

inode-12

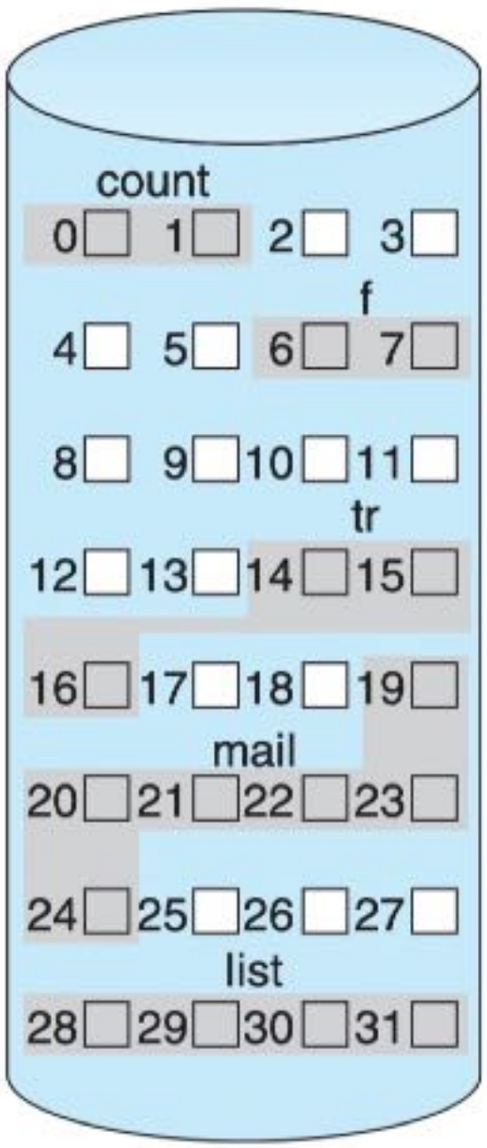
- permission
- date&time
- owner/group/ACL
- file size
- ...
- 61(disk-block address)

分配方法

分配方法

- 这里我们讨论如何给文件分配磁盘空间，常用方法有三种：
  - 连续分配
  - 链接分配
  - 索引分配

连续分配

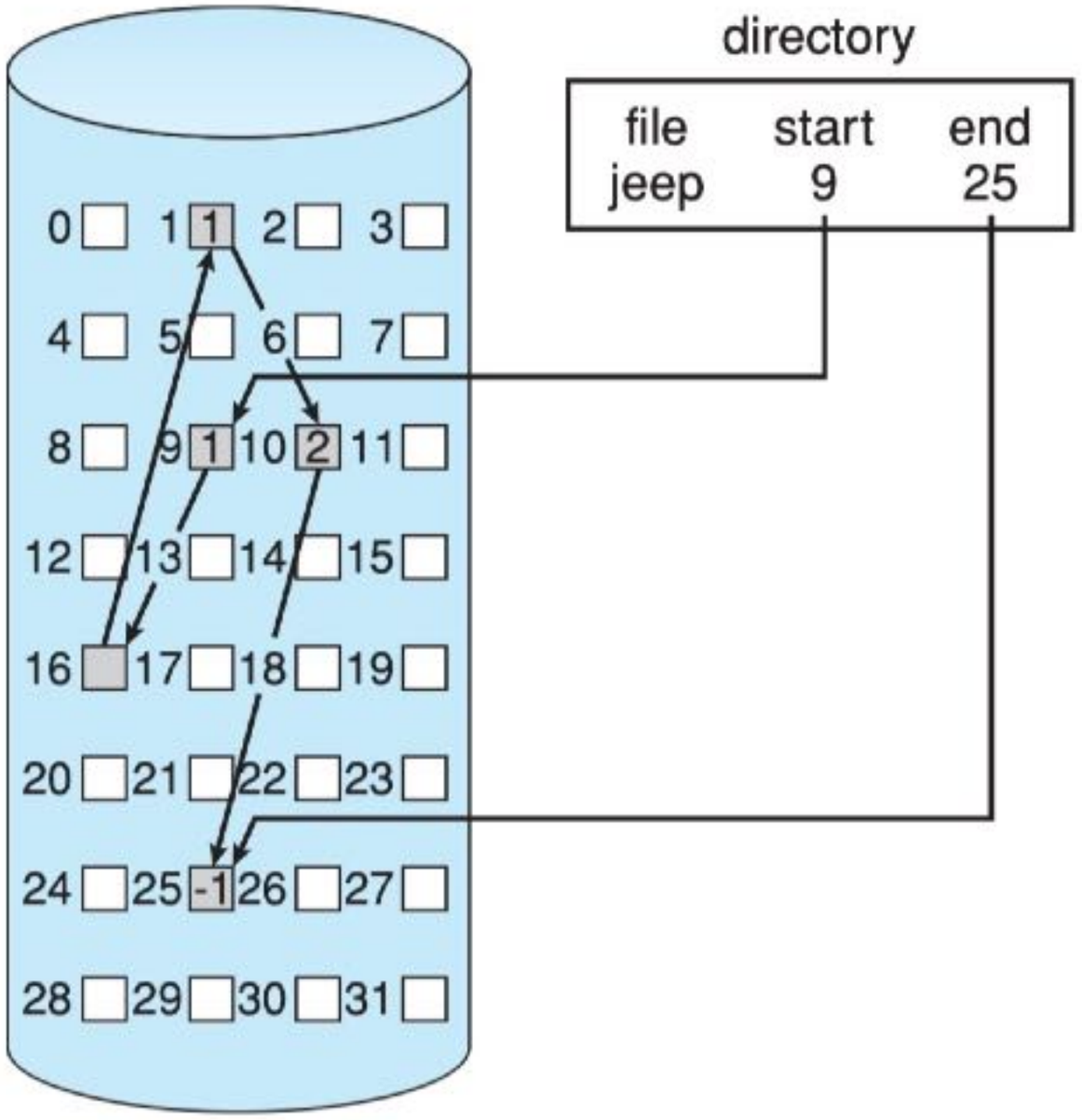


directory

file	start	length
count	0	2
tr	14	3
mail	19	6
list	28	4
f	6	2

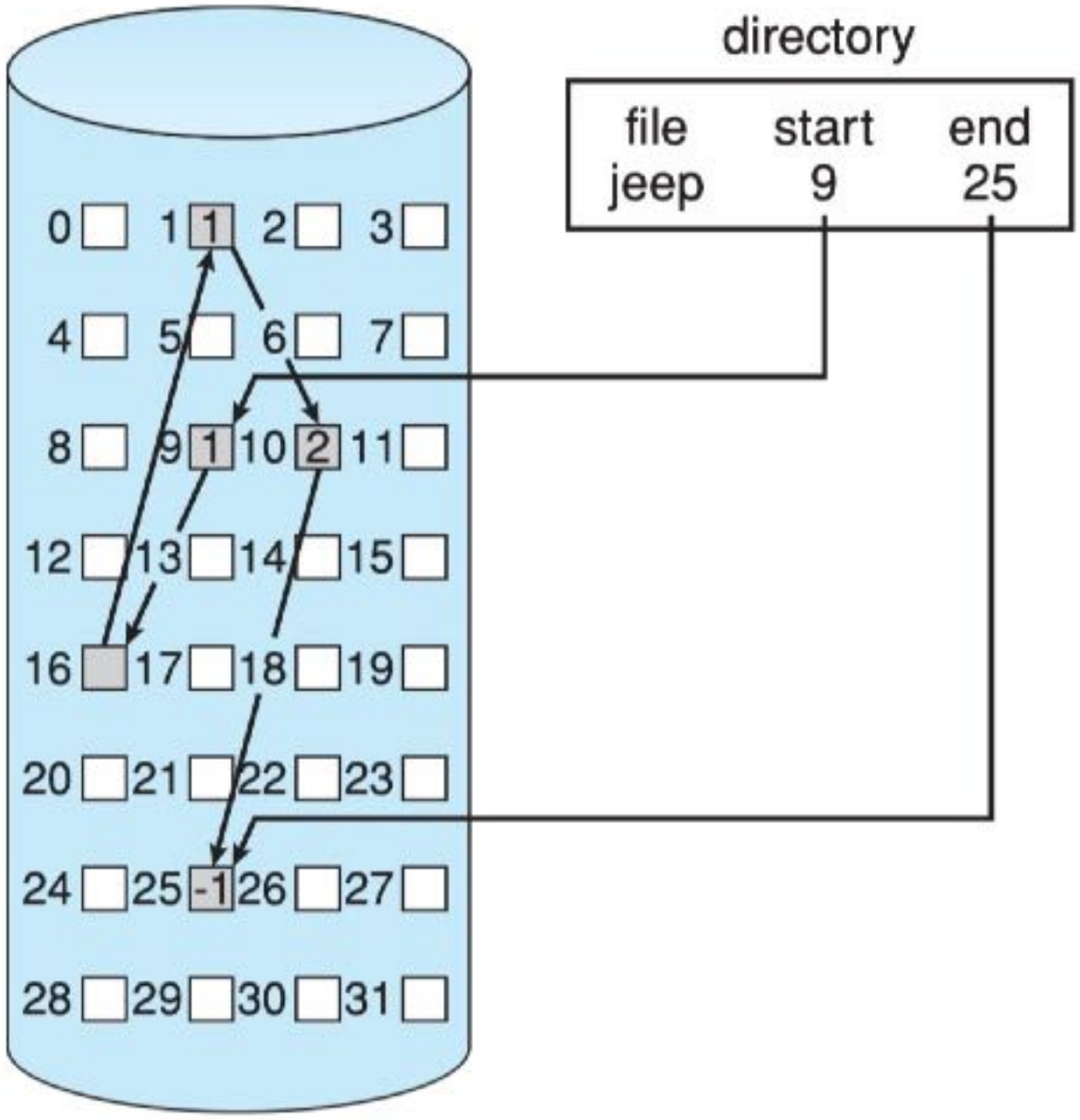
- 每个文件在磁盘上占用连续的物理块
  - 优点
  - 缺点

链接分配



- 文件所占用的物理块分散在磁盘的不同位置，通过指针将它们链接起来。
  - 优点
  - 缺点

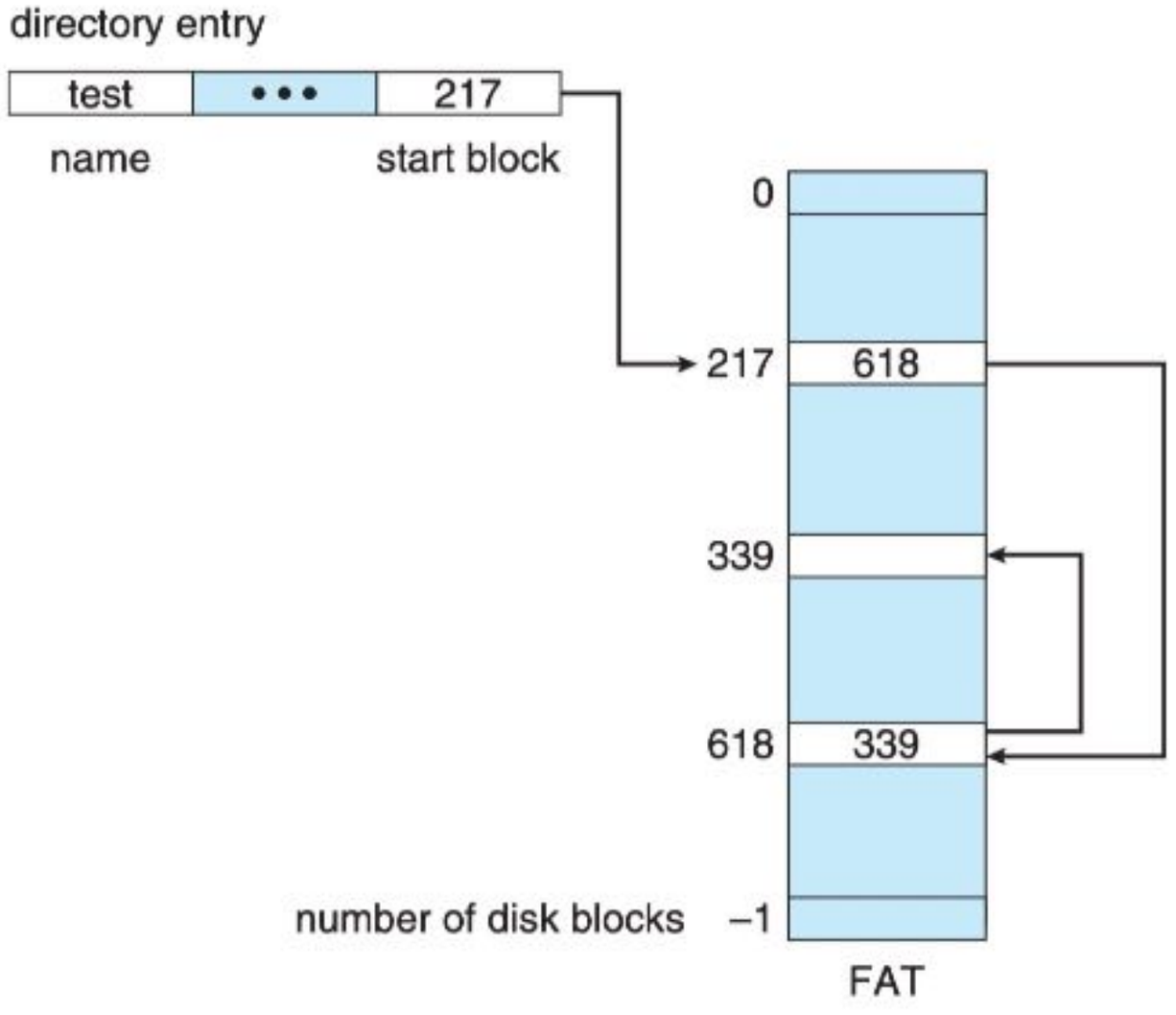
簇CLUSTER



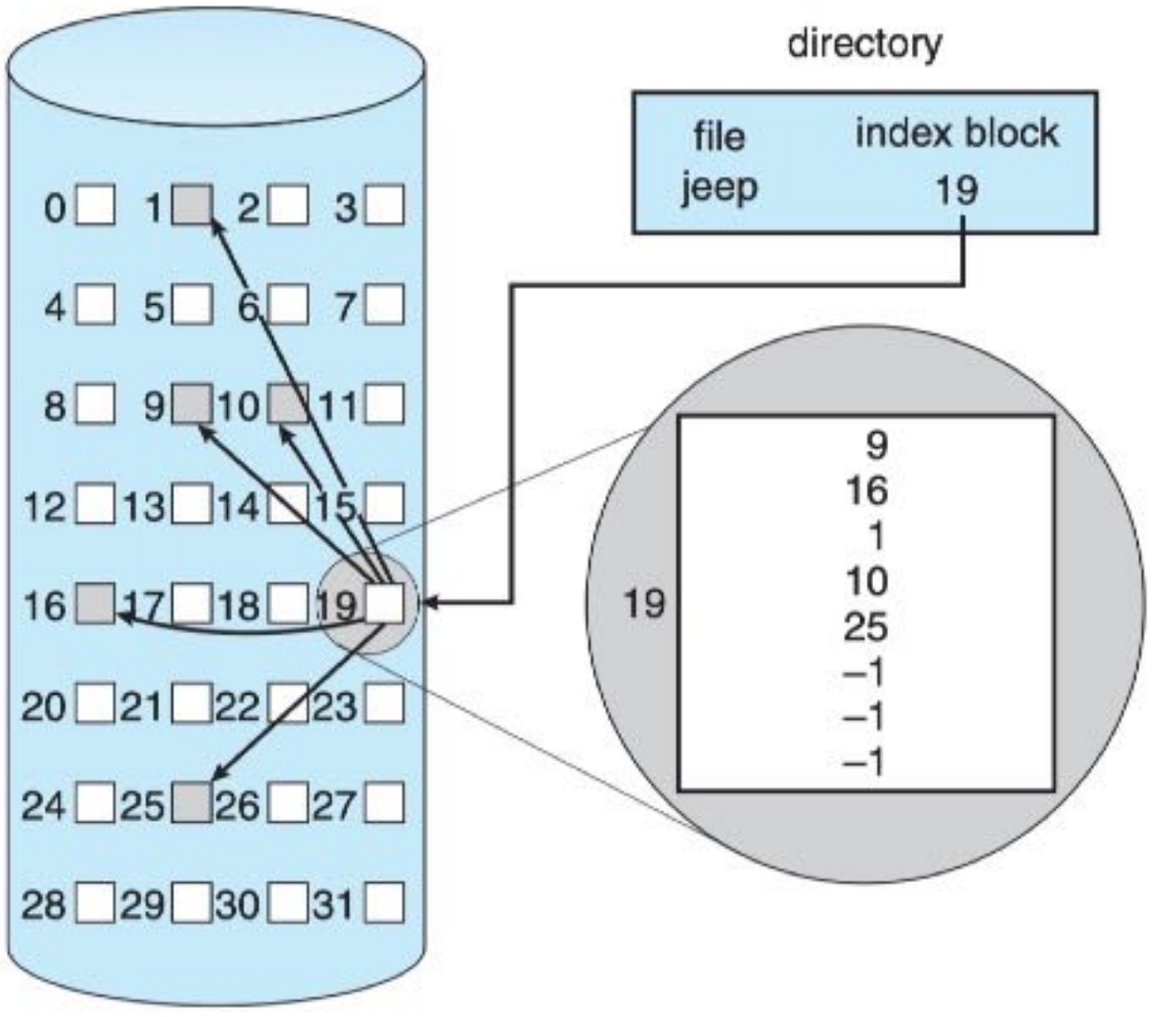
- 簇（Cluster）指一组物理块的集合。如果以簇作为分配单位，可以节省指针占用的空间比例。

FILE ALLOCATION TABLE

- 文件分配表FAT是一个典型的链接分配方案，不过它没有在物理块或簇的尾部加入指针，而是用一张表来记录文件占用物理块号的顺序。

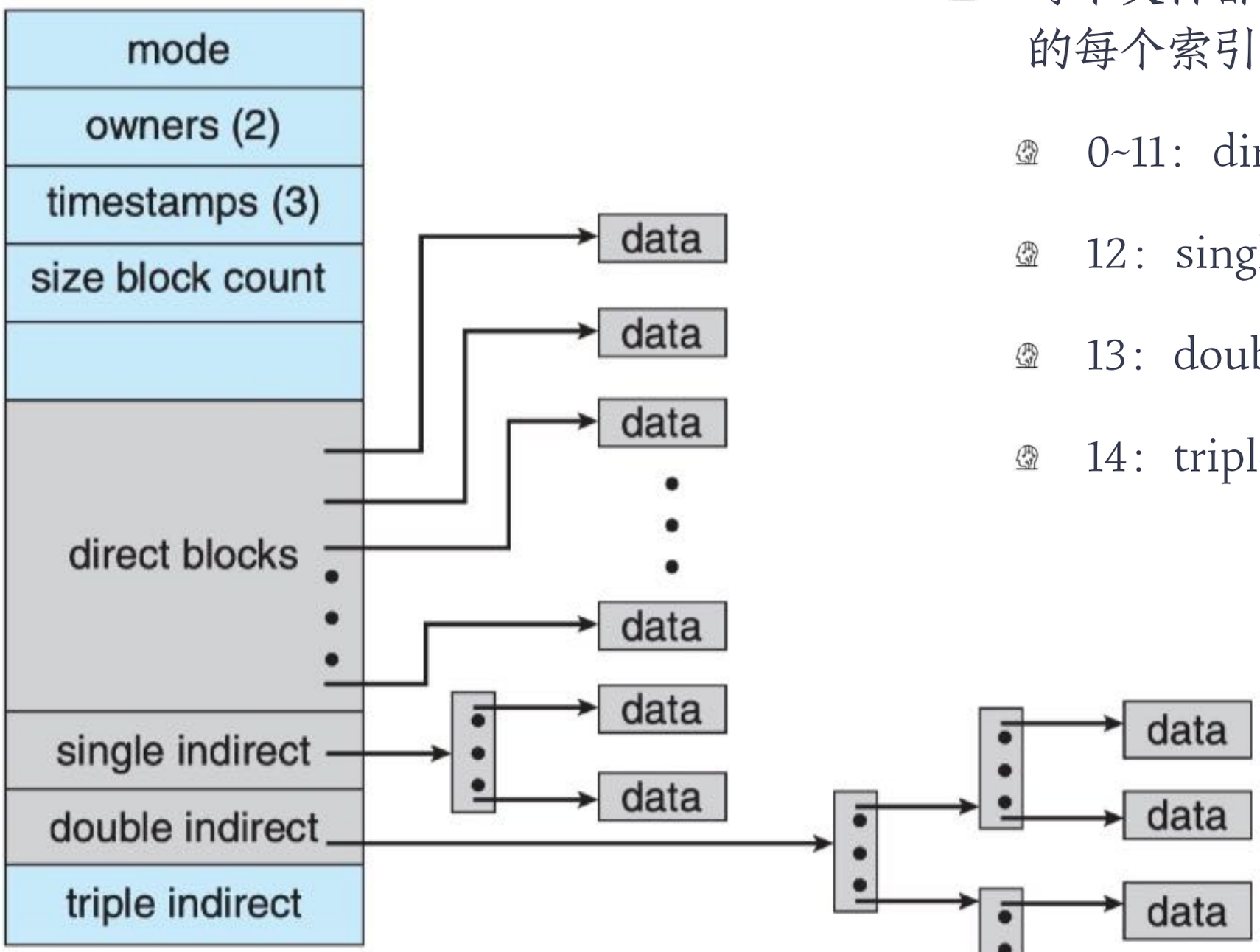


索引分配



- 将文件占用的所有物理块号按逻辑顺序保存在一张索引表中，存有索引表的物理块称索引块（index block）
  - 优点
  - 缺点

UFS的索引块



- 每个文件都要有一个索引块，UFS的每个索引块有15个物理块地址
  - 0~11：direct block
  - 12：single indirect block
  - 13：double indirect block
  - 14：triple indirect block

空闲空间管理

BIT MAP

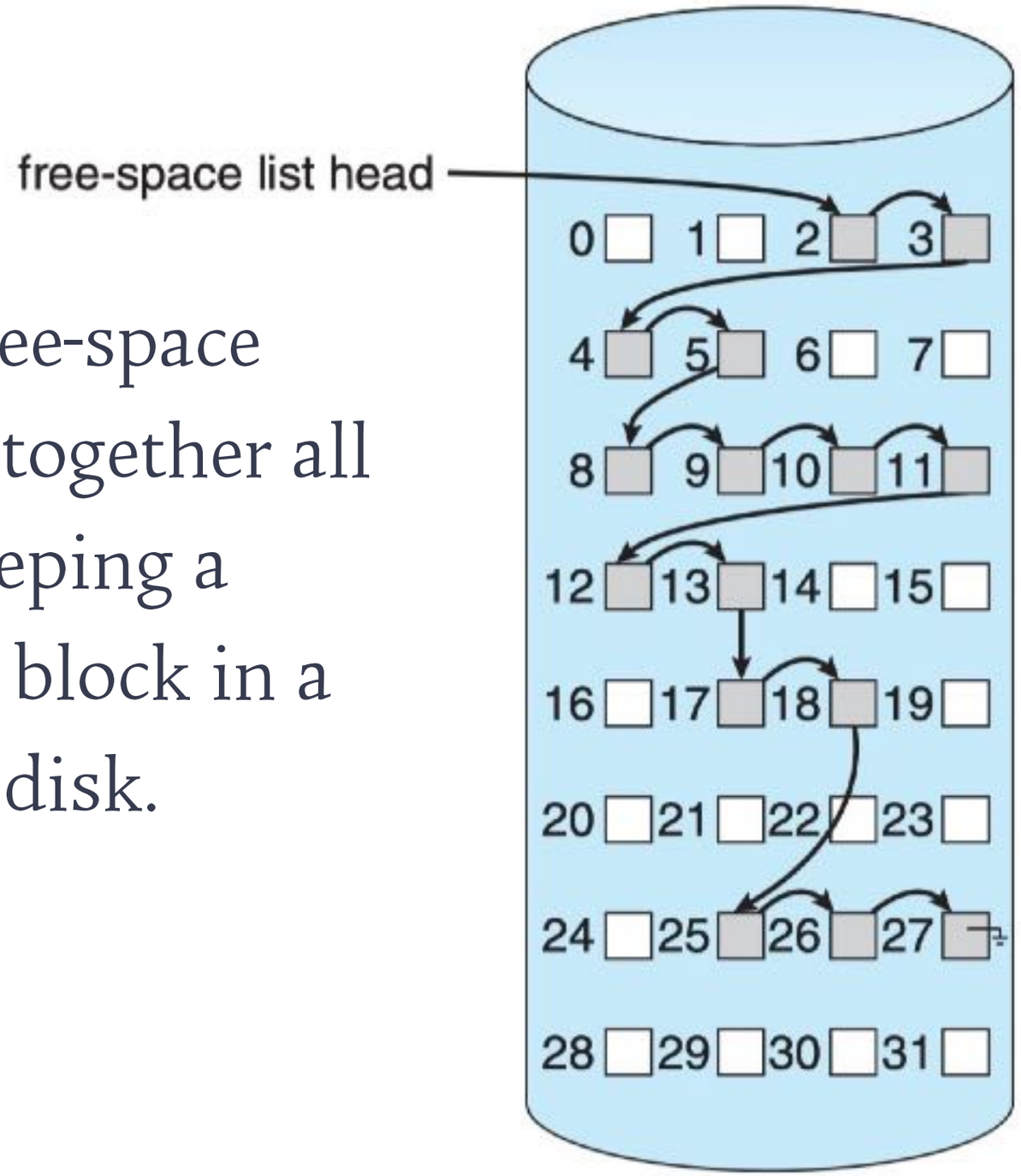
- Frequently, the free-space list is implemented as a bit map or bit vector. Each block is represented by 1 bit. If the block is free, the bit is 1; if the block is allocated, the bit is 0.

- A bit map sample is following:

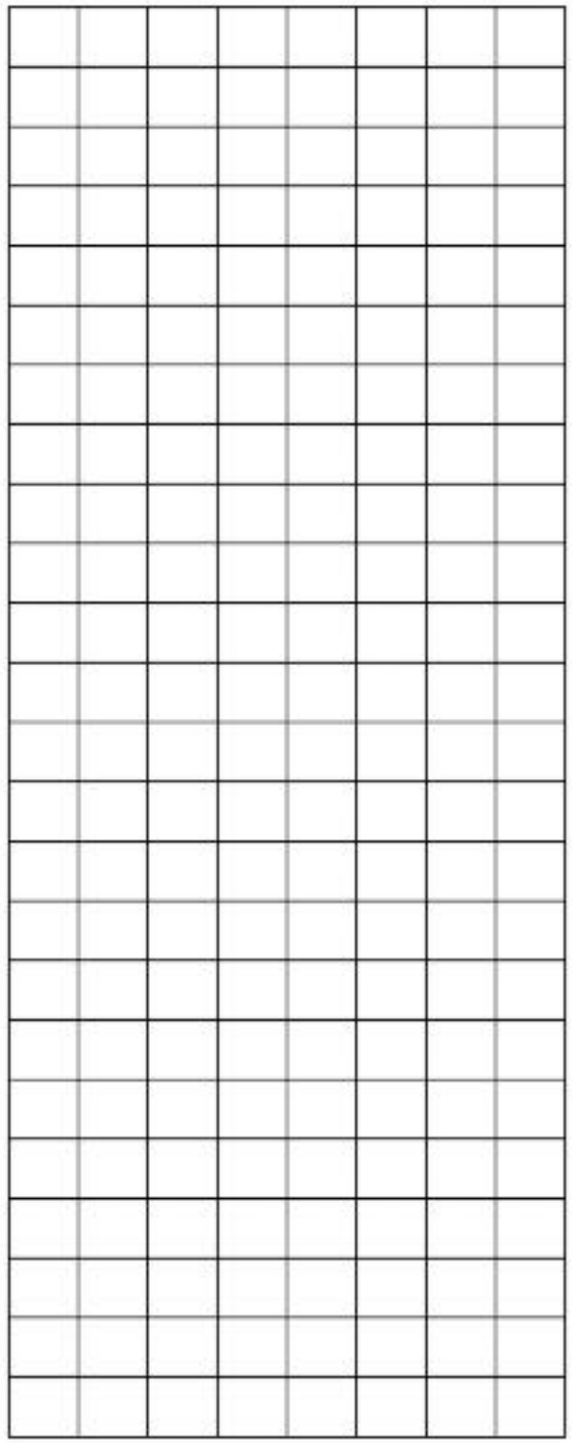
  001111001111110001100000011100000 ...

LINKED LIST

- Another approach to free-space management is to link together all the free disk blocks, keeping a pointer to the first free block in a special location on the disk.



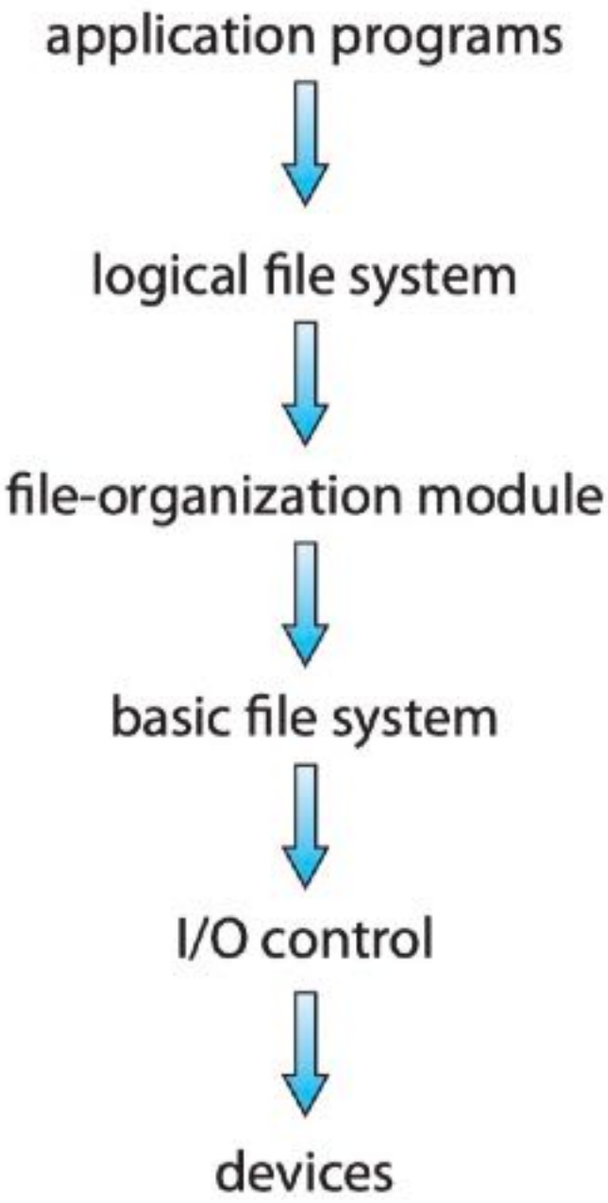
文件系统的实现工作



disk

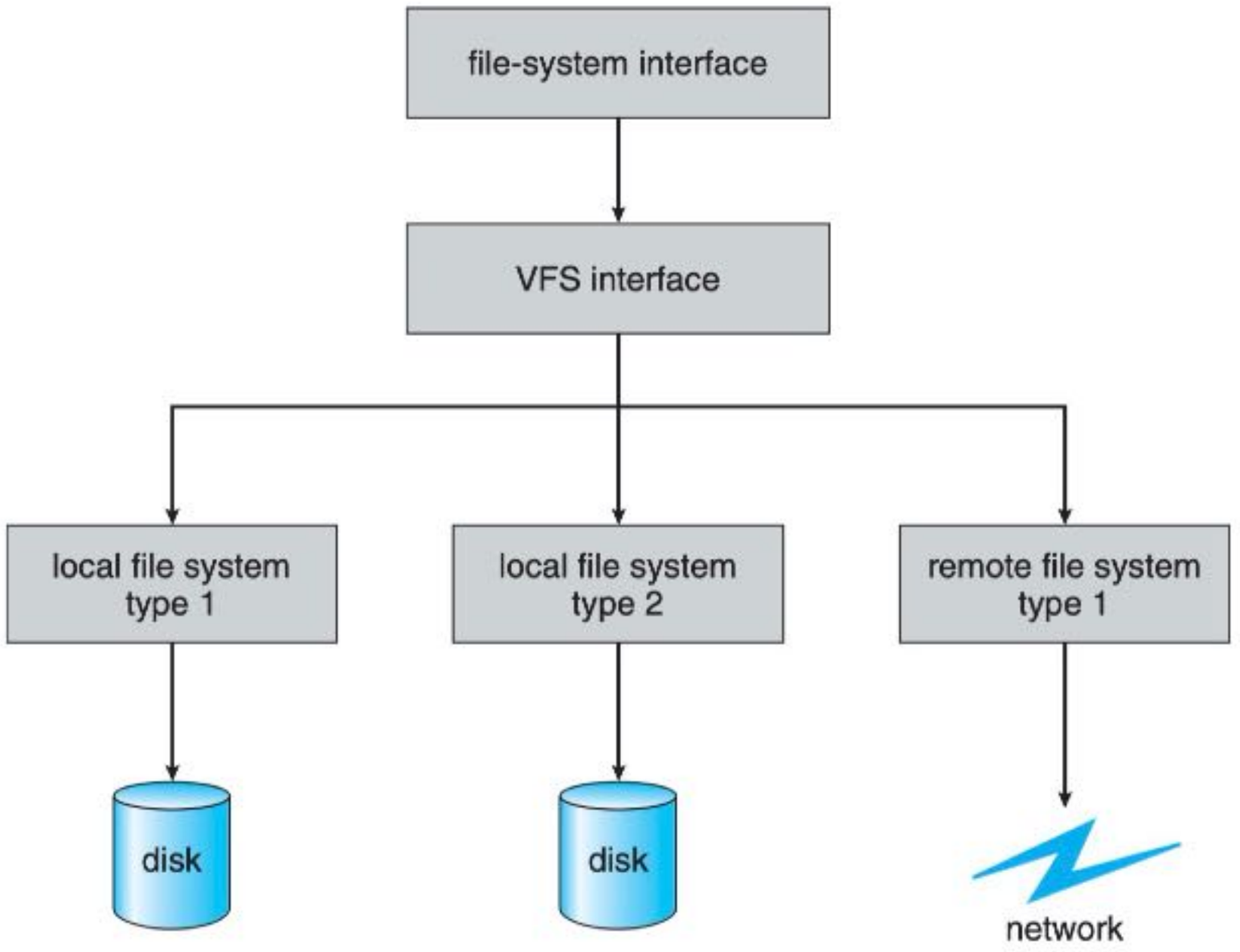
文件系统结构

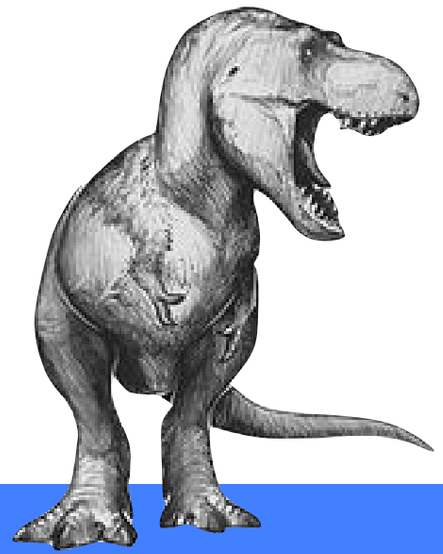
LAYERED FILE SYSTEM



- 你发出一个读写A文件X位置数据的请求，系统从目录中找到这个文件并读出相应的FCB，按照既有的分配方案计算X位置所在的物理块号，编制一个对该物理块号的读写请求，然后发给磁盘控制器。

VIRTUAL FILE SYSTEM





Lecture 18

The End

实践5 文件链接

硬链接和软链接

- 硬链接
  - 输入命令：ln file1 file1Hardlink，为file1文件创建一个硬链接，使用ls -il命令观察file1和file1Hardlink有什么联系
- 软链接
  - 输入命令：ln -s file2 file2Softlink，为file1文件创建一个软链接（符号链接），使用ls -il命令观察这两个文件有什么联系