Lecture 11 – Directories and Access Management

Karl R. Wilcox
Karl@cs.rhul.ac.uk

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Objectives

- In this class we will discuss:
  - Directories
  - Sharing and access
  - File allocation
  - Example file systems

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File Directories

- **Contains information about files**
  - **Attributes**
  - **Location**
  - **Ownership**
- **Directory itself is a file owned by the operating system**
- **Provides mapping between file names and the files themselves**

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Simple Structure for a Directory

- List of entries, one for each file
- Sequential file with the name of the file serving as the key
- Provides no help in organizing the files
- Forces user to be careful not to use the same name for two different files

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Two-level Scheme for a Directory

- One directory for each user and a master directory
- Master directory contains entry for each user
  - Provides address and access control information
- Each user directory is a simple list of files for that user
- Still provides no help in structuring collections of files

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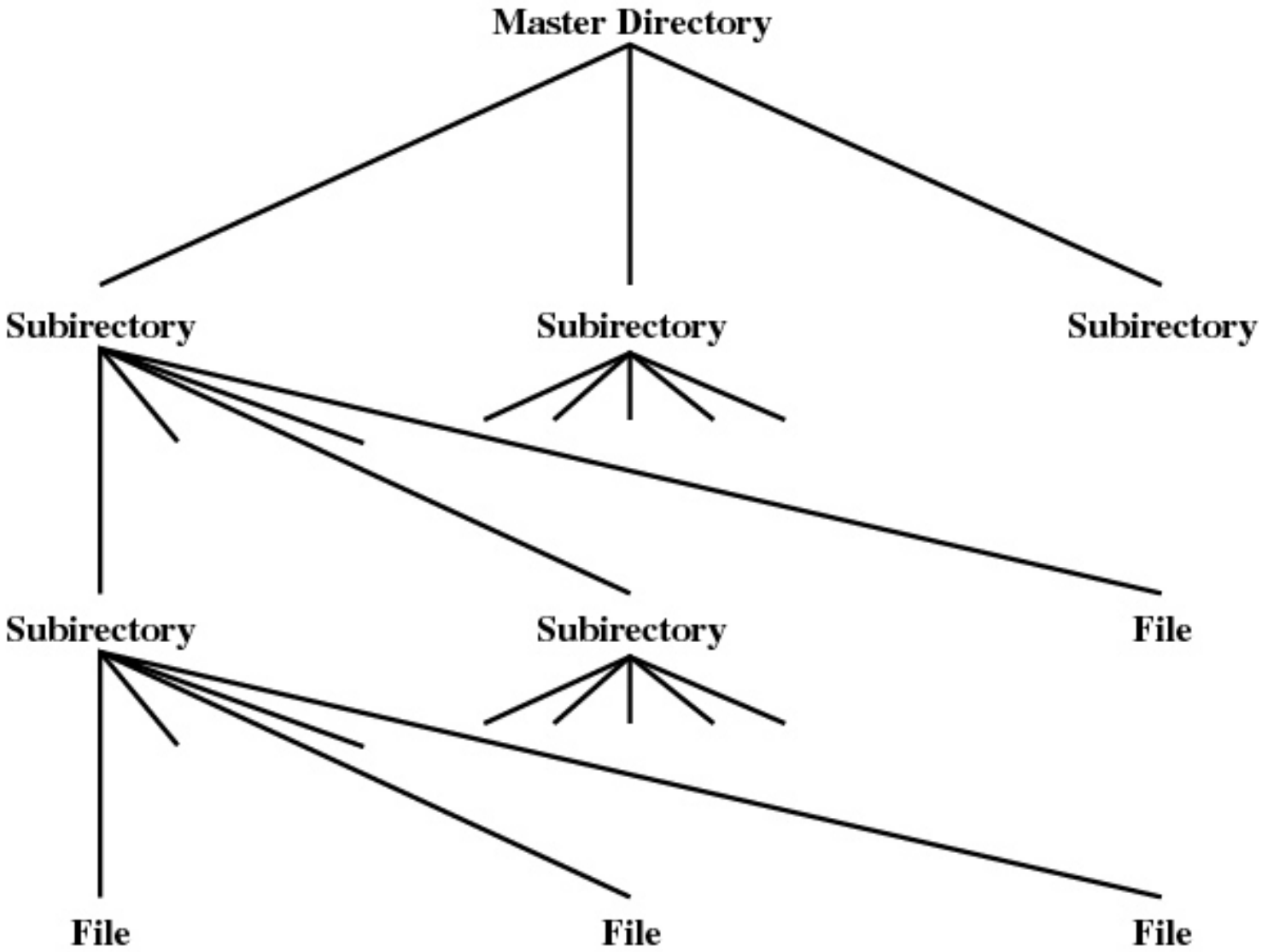
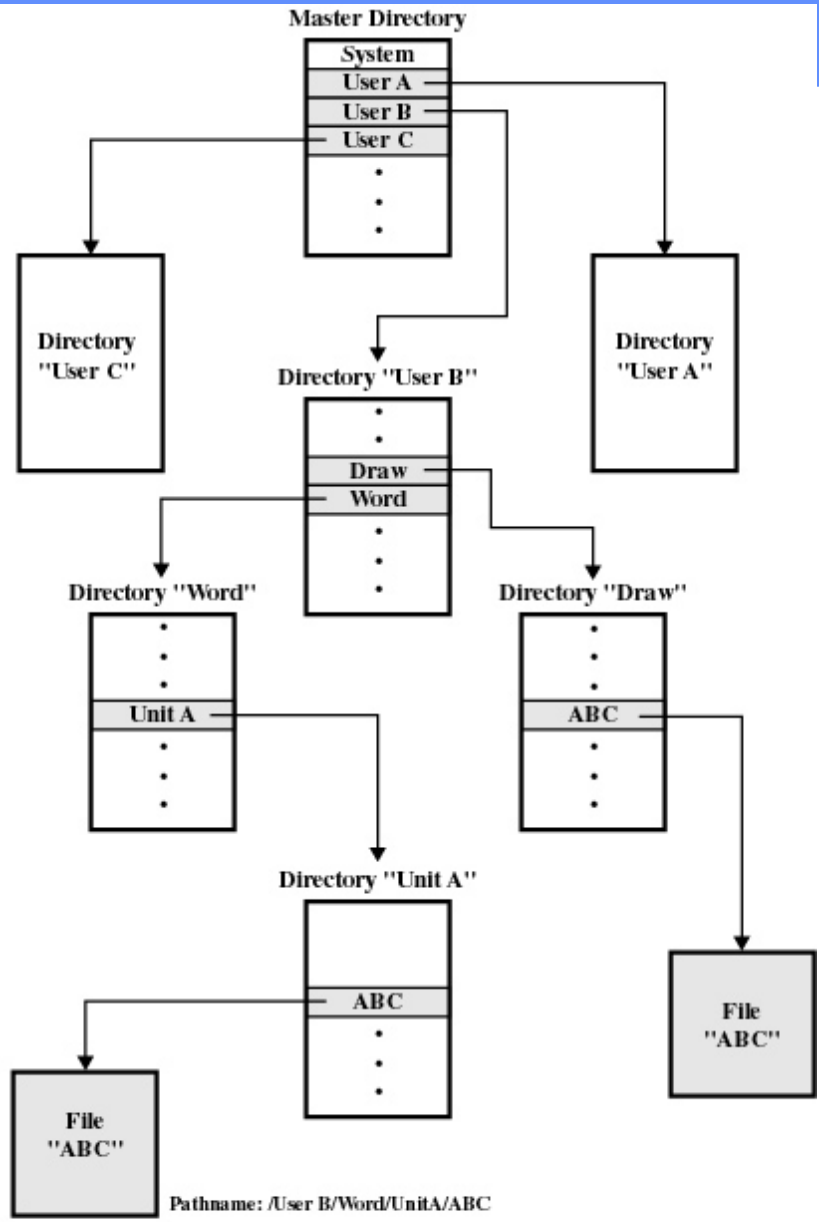
Hierarchical, or Tree-Structured Directory

- **Master directory with user directories underneath it**
- **Each user directory may have subdirectories and files as entries**


Master Directory
Subirectory
Subirectory
Subirectory
Subirectory
Subirectory
File
File
File
File

Tree Structured Directory



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Hierarchical, or Tree-Structured Directory

- **Files can be located by following a path from the root, or master, directory down various branches**
  - **This is the pathname for the file**
- **Can have several files with the same file name as long as they have unique path names**

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Hierarchical, or Tree-Structured Directory

- **Current directory is the working directory**
- **Files are referenced relative to the working directory**

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File Sharing

- In multiuser system, allow files to be shared among users
- Two issues
  - Access rights
  - Management of simultaneous access

Access Rights

- **None**
  - **User may not know of the existence of the file**
  - **User is not allowed to read the user directory that includes the file**
- **Knowledge**
  - **User can only determine that the file exists and who its owner is**

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Access Rights

- **Execution**
  - **The user can load and execute a program but cannot copy it**
- **Reading**
  - **The user can read the file for any purpose, including copying and execution**
- **Appending**
  - **The user can add data to the file but cannot modify or delete any of the file's contents**

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Access Rights

- **Updating**
  - **The user can modify, deleted, and add to the file's data. This includes creating the file, rewriting it, and removing all or part of the data**
- **Changing protection**
  - **User can change access rights granted to other users**
- **Deletion**
  - **User can delete the file**

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Access Rights

- **Owners**
  - **Has all rights previously listed**
  - **May grant rights to others using the following classes of users**
    - **Specific user**
    - **User groups**
    - **All for public files**

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Simultaneous Access

- User may lock entire file when it is to be updated
- User may lock the individual records during the update
- Mutual exclusion and deadlock are issues for shared access

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Secondary Storage Management

- **Space must be allocated to files**
- **Must keep track of the space available for allocation**

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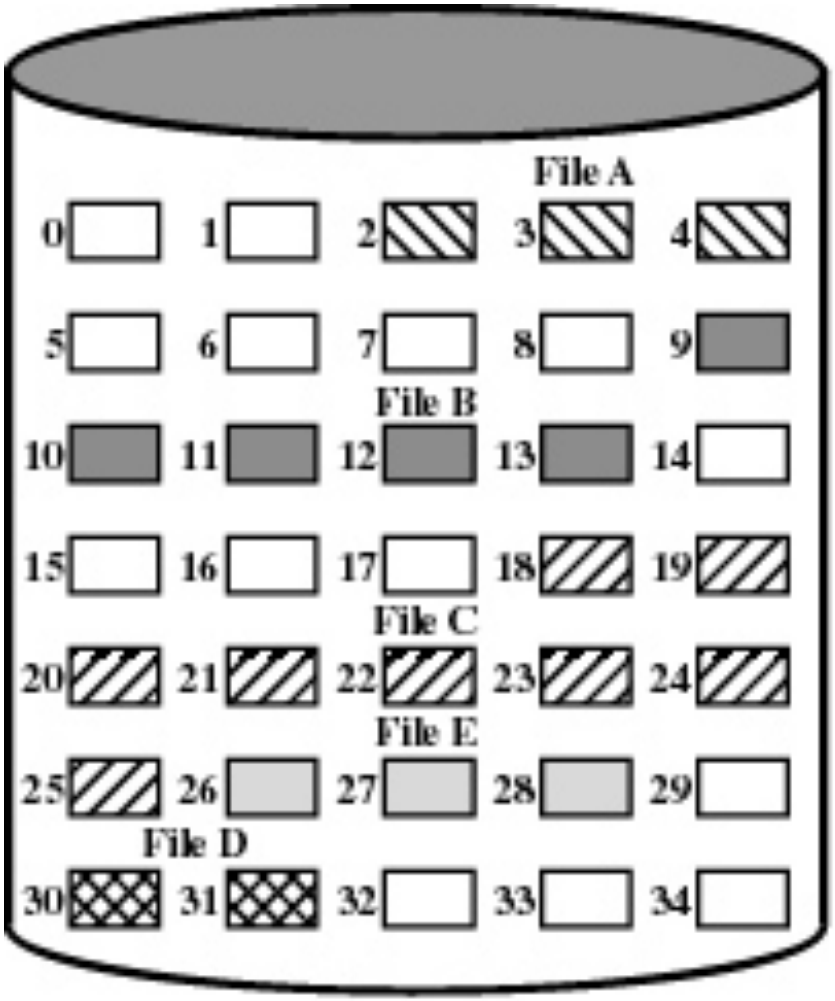
Preallocation

- **Need the maximum size for the file at the time of creation**
- **Difficult to reliably estimate the maximum potential size of the file**
- **Tend to overestimated file size so as not to run out of space**

Methods of File Allocation

- **Contiguous allocation**
  - **Single set of blocks is allocated to a file at the time of creation**
  - **Only a single entry in the file allocation table**
    - **Starting block and length of the file**
- **External fragmentation will occur**

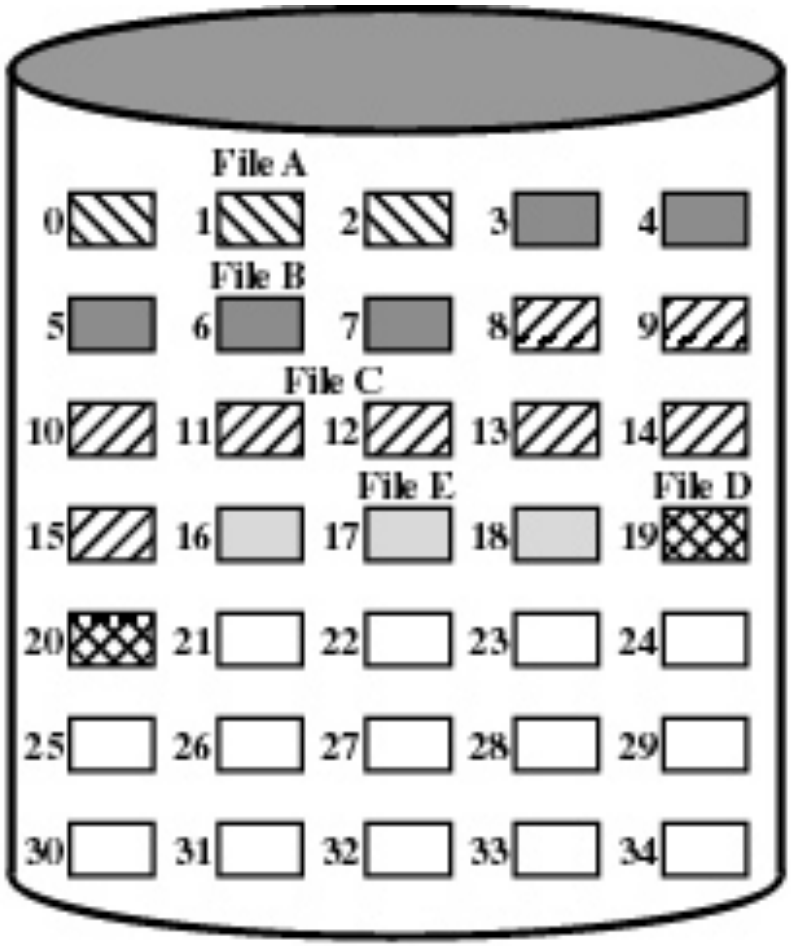
Contiguous File Allocation



File Allocation Table

File Name	Start Block	Length
File A	2	3
File B	9	5
File C	18	8
File D	30	2
File E	26	3

After Compaction



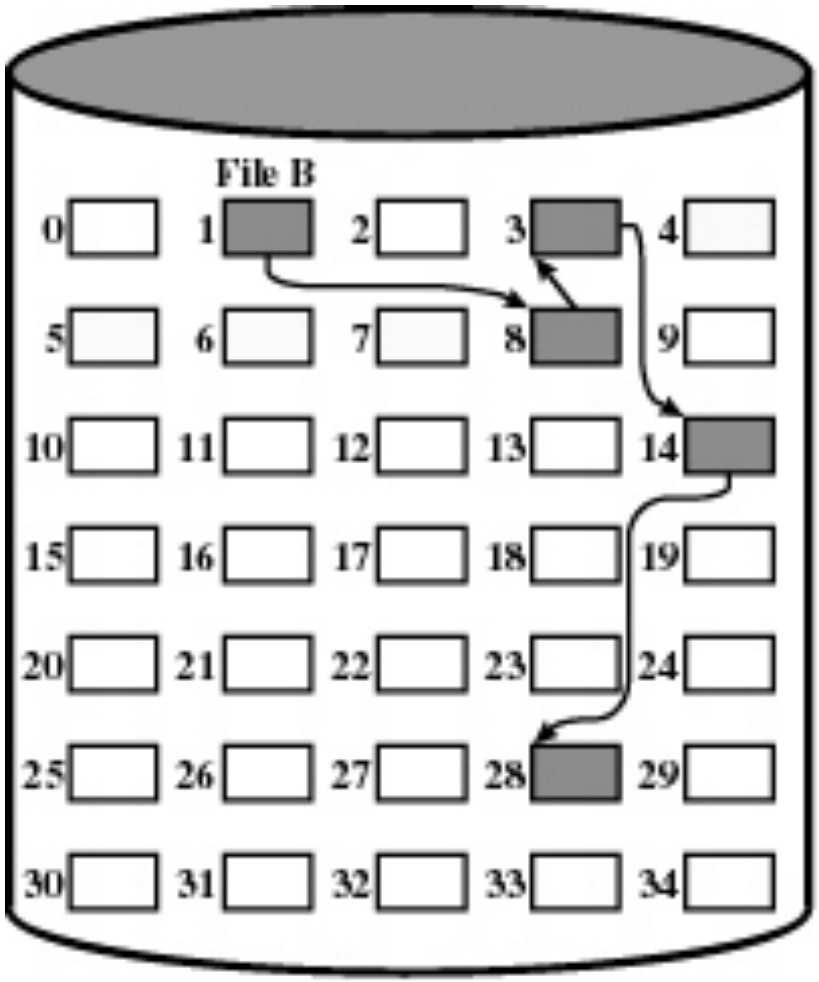
File Allocation Table

File Name	Start Block	Length
File A	0	3
File B	3	5
File C	8	8
File D	19	2
File E	16	3

Methods of File Allocation

- **Chained allocation**
  - **Allocation on basis of individual block**
  - **Each block contains a pointer to the next block in the chain**
  - **Only single entry in the file allocation table**
    - **Starting block and length of file**
- **No external fragmentation**
- **Best for sequential files**
- **No accommodation of the principle of locality**

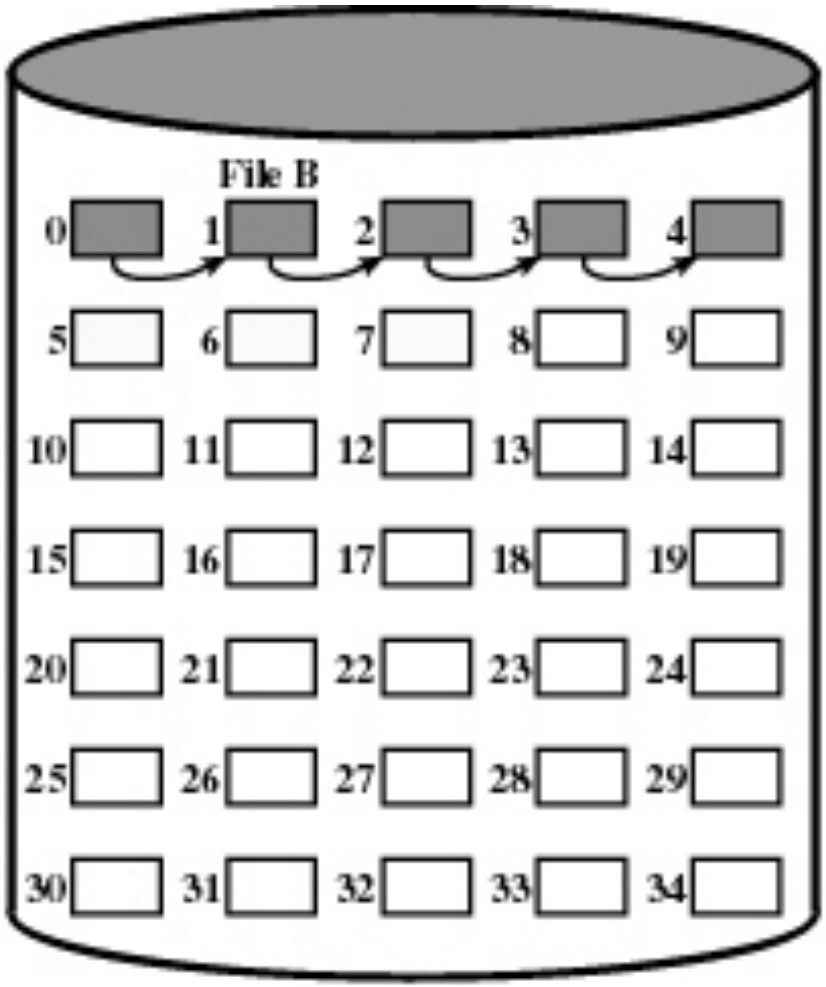
Chained Allocation



File Allocation Table

File Name	Start Block	Length
...	...	...
File B	1	5
...	...	...

After Consolidation



File Allocation Table

File Name	Start Block	Length
...	...	...
File B	0	5
...	...	...

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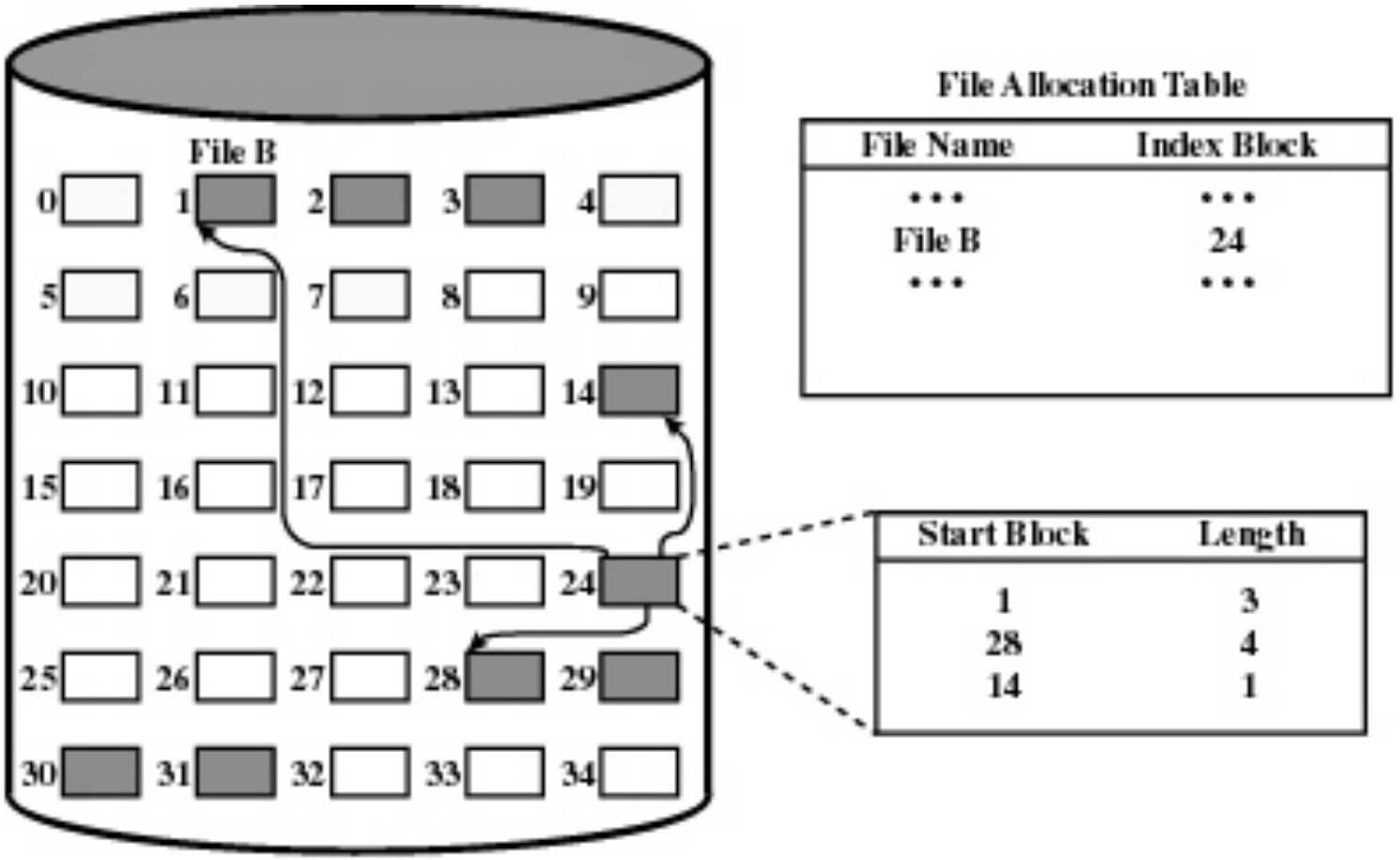
Methods of File Allocation

- **Indexed allocation**
  - **File allocation table contains a separate one-level index for each file**
  - **The index has one entry for each portion allocated to the file**
  - **The file allocation table contains block number for the index**

Indexed Allocation with variable length portions



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UNIX File Management

- **Types of files**
  - **Ordinary**
  - **Directory**
  - **Special**
  - **Named**

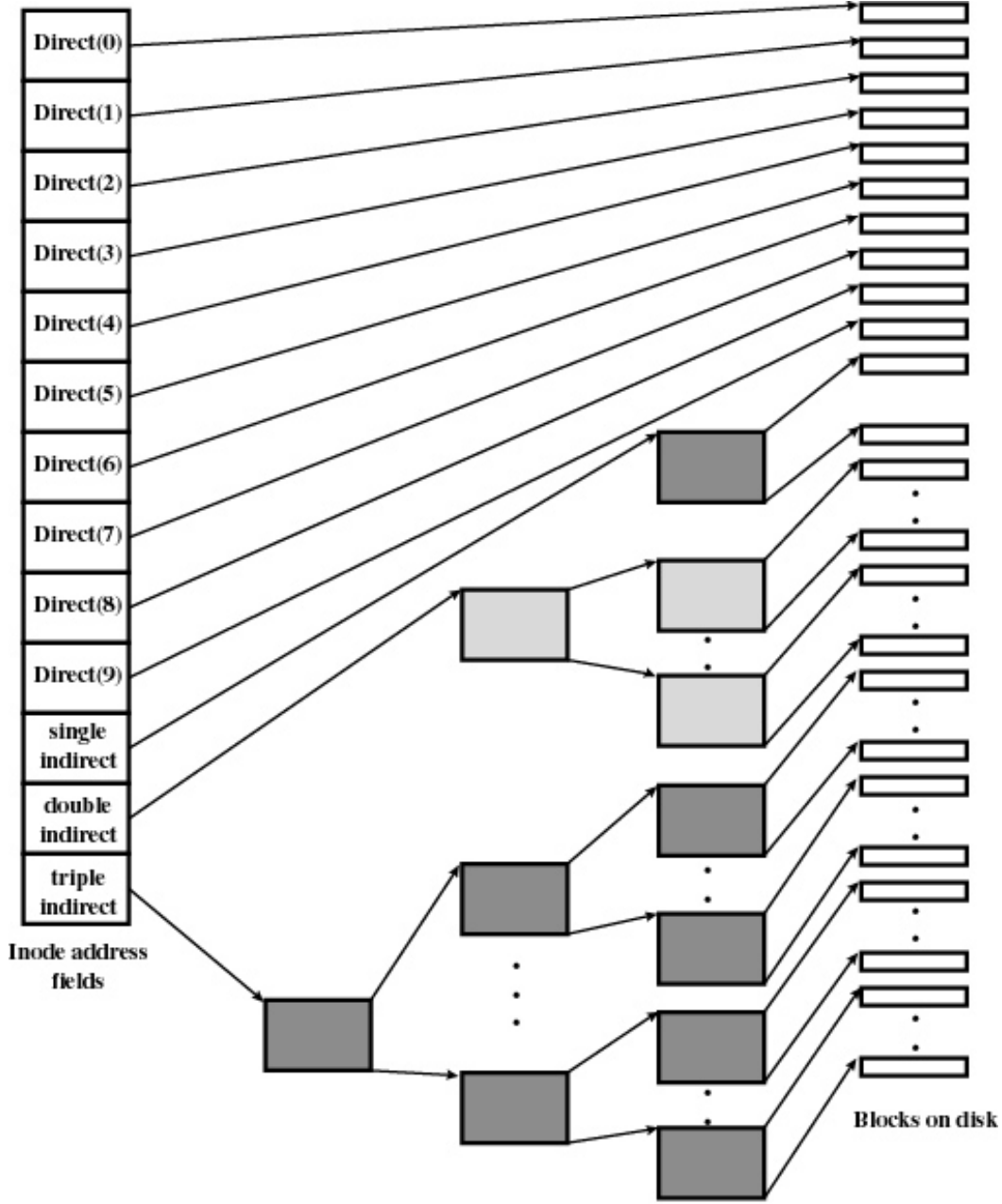
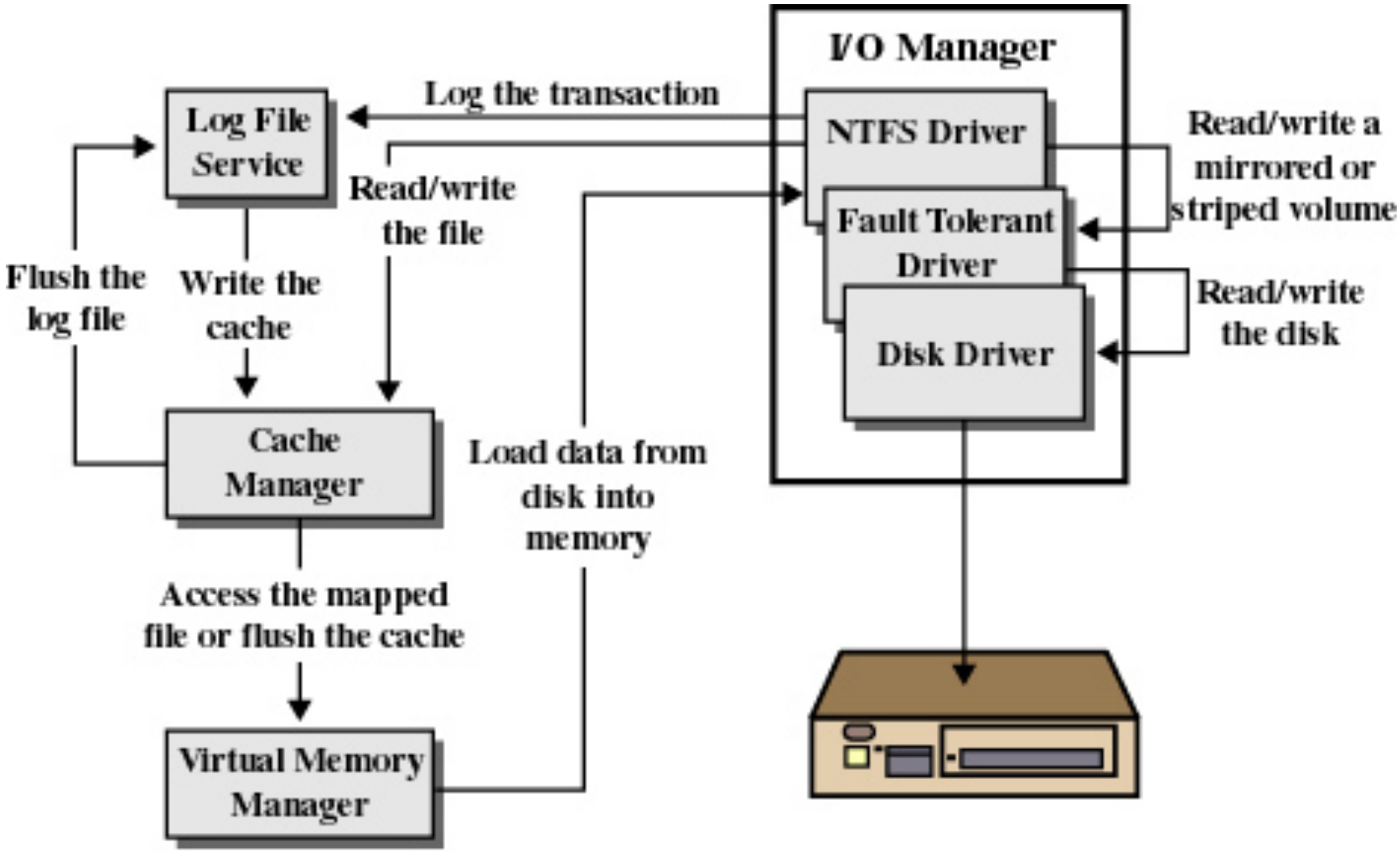


Figure 12.13 UNIX Block Addressing Scheme

Windows 2000 File System

- **Key features of NTFS**
  - **Recoverability**
  - **Security**
  - **Large disks and large files**
  - **Multiple data streams**
  - **General indexing facility**

Windows NTFS Components



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Summary

- **We have covered**
  - Directories
  - Sharing and access
  - File allocation
  - Unix and Windows file systems

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Next Lecture

- **We will talk about deadlock**
- **Lecture Notes: http://www.cs.rhul.ac.uk/~karl**