OPERATING SYSTEM

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DISK ALLOCATION METHODS

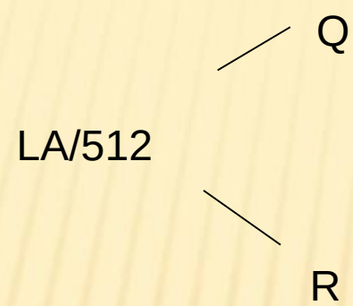
ALLOCATION METHODS - CONTIGUOUS

- An allocation method refers to how disk blocks are allocated for files:

- Contiguous allocation – each file occupies set of contiguous blocks
  - Best performance in most cases
  - Simple – only starting location (block #) and length (number of blocks) are required
  - Problems include finding space for file, knowing file size, external fragmentation, need for compaction off-line (downtime) or on-line

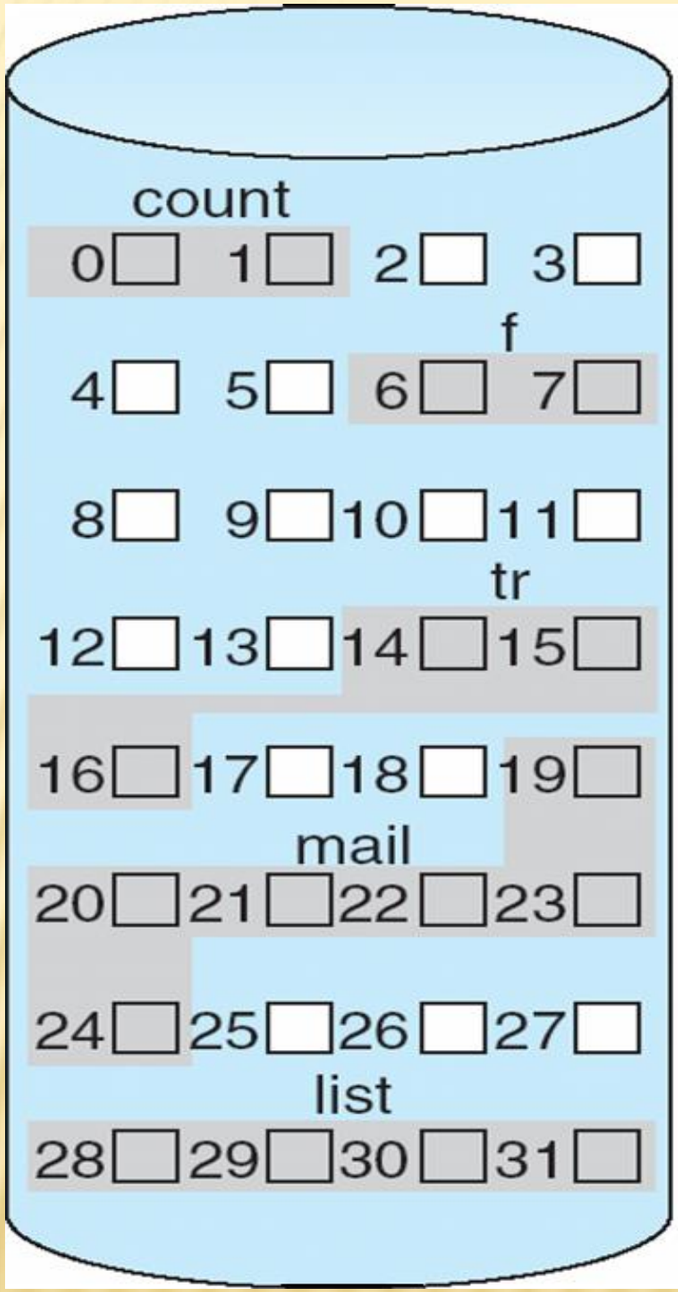
CONTIGUOUS ALLOCATION

- Mapping from logical to physical



Block to be accessed = Q + starting address
Displacement into block = R

CONTIGUOUS ALLOCATION OF DISK SPACE



directory

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

EXTENT-BASED SYSTEMS

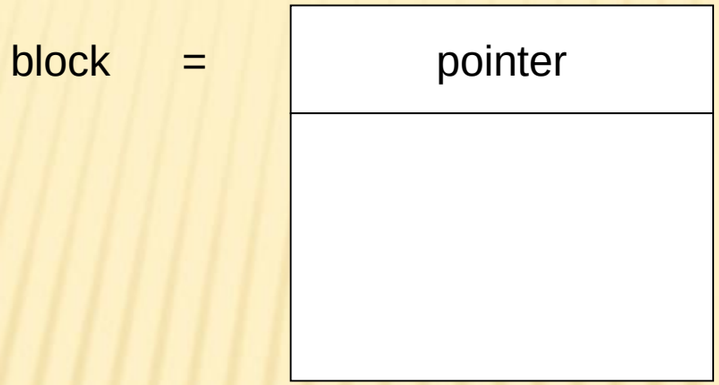
- Many newer file systems (i.e., Veritas File System) use a modified contiguous allocation scheme
- Extent-based file systems allocate disk blocks in extents
- An extent is a contiguous block of disks
  - Extents are allocated for file allocation
  - A file consists of one or more extents

ALLOCATION METHODS - LINKED

- Linked allocation – each file a linked list of blocks
  - File ends at nil pointer
  - No external fragmentation
  - Each block contains pointer to next block
  - No compaction, external fragmentation
  - Free space management system called when new block needed
  - Improve efficiency by clustering blocks into groups but increases internal fragmentation
  - Reliability can be a problem
  - Locating a block can take many I/Os and disk seeks
- FAT (File Allocation Table) variation
  - Beginning of volume has table, indexed by block number
  - Much like a linked list, but faster on disk and cacheable
  - New block allocation simple

LINKED ALLOCATION

- Each file is a linked list of disk blocks: blocks may be scattered anywhere on the disk



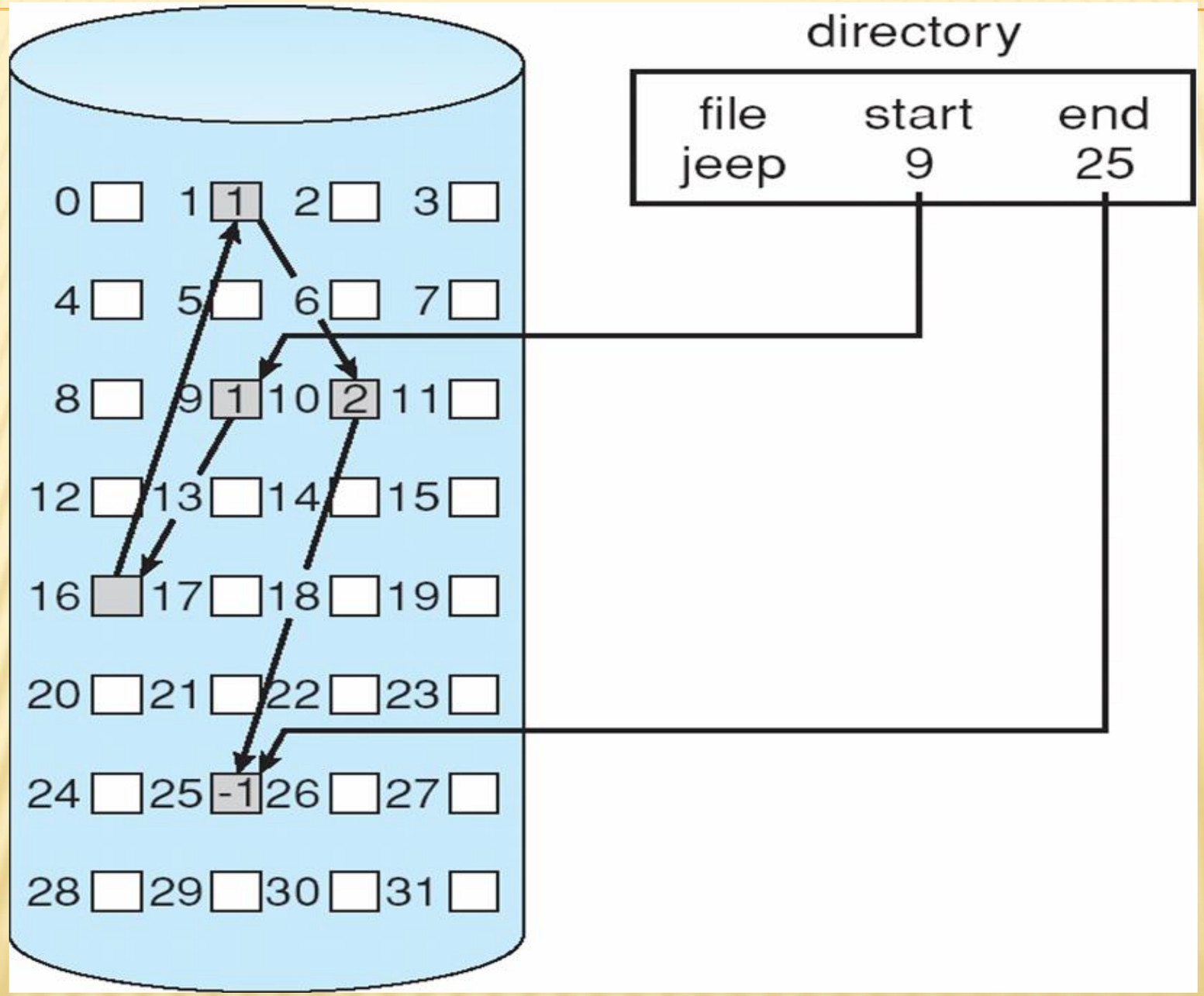
LINKED ALLOCATION

- Mapping

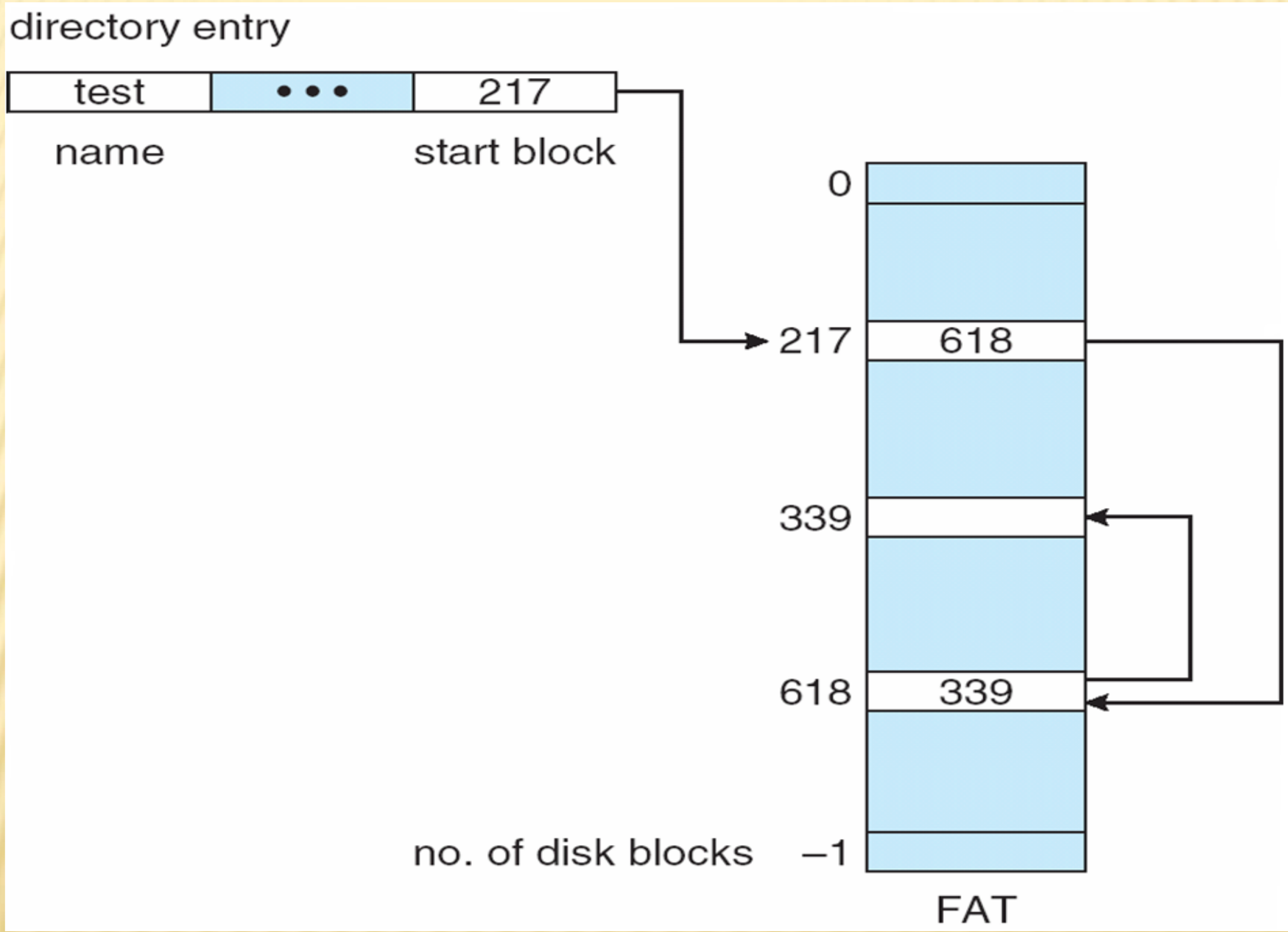
$$\frac{LA}{511} \begin{cases} Q \\ R \end{cases}$$

Block to be accessed is the Qth block in the linked chain of blocks representing the file.
Displacement into block = R + 1

LINKED ALLOCATION

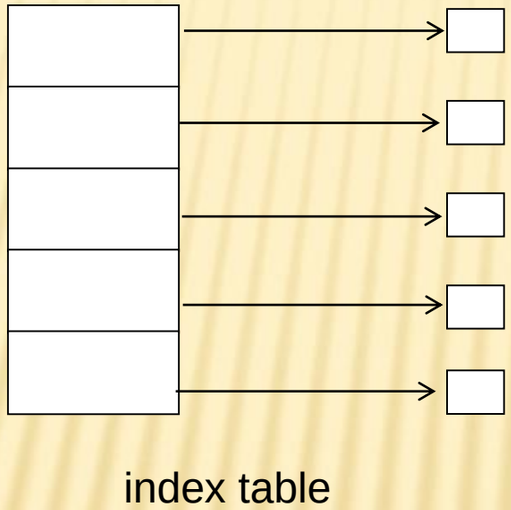


FILE-ALLOCATION TABLE

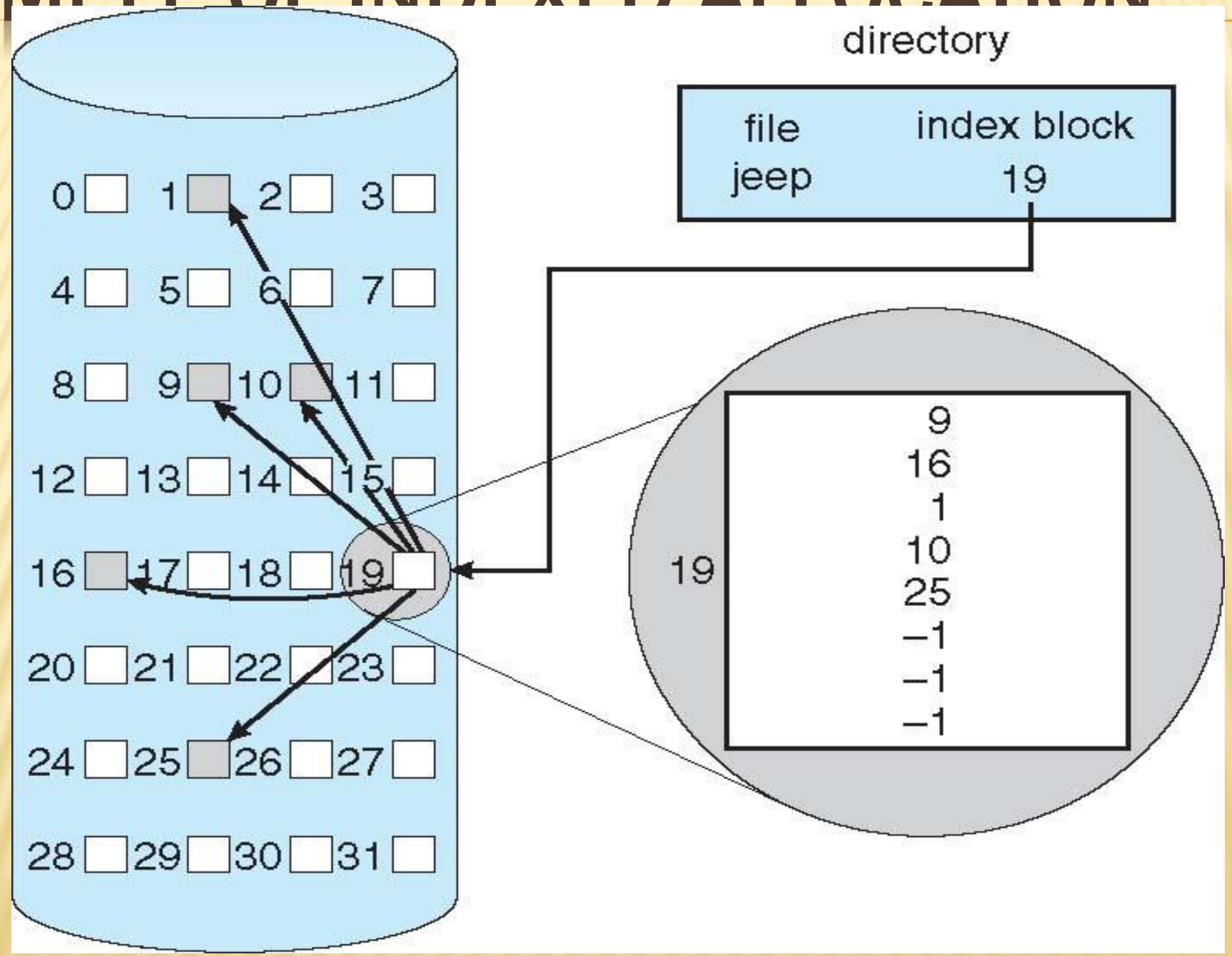


ALLOCATION METHODS - INDEXED

- Indexed allocation
  - Each file has its own index block(s) of pointers to its data blocks
- Logical view



EXAMPLE OF INDEXED ALLOCATION



INDEXED ALLOCATION (CONT.)

- Need index table
- Random access
- Dynamic access without external fragmentation, but have overhead of index block
- Mapping from logical to physical in a file of maximum size of 256K bytes and block size of 512 bytes. We need only 1 block for index table

LA/512 → Q, R

Q = displacement into index table
R = displacement into block

INDEXED ALLOCATION – MAPPING (CONT.)

- Mapping from logical to physical in a file of unbounded length (block size of 512 words)
- Linked scheme – Link blocks of index table (no limit on size)

$$LA / (512 \times 511) \begin{cases} Q_1 \\ R_1 \end{cases}$$

Q_1 = block of index table
R_1 is used as follows:

$$R_1 / 512 \begin{cases} Q_2 \\ R_2 \end{cases}$$

Q_2 = displacement into block of index table
R_2 displacement into block of file:

INDEXED ALLOCATION – MAPPING (CONT.)

- Two-level index (4K blocks could store 1,024 four-byte pointers in outer index -> 1,048,567 data blocks and file size of up to 4GB)

$$LA / (512 \times 512) \begin{cases} Q_1 \\ R_1 \end{cases}$$

Q_1 = displacement into outer-index
R_1 is used as follows:

$$R_1 / 512 \begin{cases} Q_2 \\ R_2 \end{cases}$$

Q_2 = displacement into block of index table
R_2 displacement into block of file:

INDEXED ALLOCATION – MAPPING (CONT.)