Database Management System – 44 (Physical Data Storage Organization)

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Outline

- Introduction
- Records
- Fixed length and variable length records
- Record blocking
- Spanned vs unspanned records
- Heap files
- Sorted files

Introduction

- Collection of data that makes up a computerized database must be stored physically on some computer **storage medium**
- Primary storage
- Secondary storage
- Tertiary storage

Records

- Record consists of a collection of related data values or items
- Value is formed of one or more bytes and corresponds to a particular field of the record
- Records describe entities and their attributes
- Example - EMPLOYEE record represents an employee entity
  - Name, Birth_date, Salary, or Supervisor.
- Data types – Numeric, String, Boolean, Date/time
- Binary large objects (BLOBs)
  - Unstructured objects

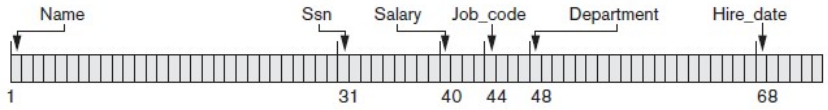
Files, Fixed-Length Records, and Variable-Length Records

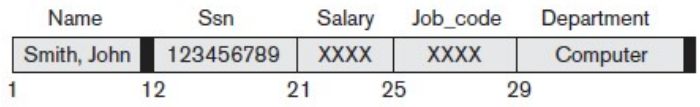
- ***File*** is a sequence of records
- If every record in the file has exactly the same size (in bytes), the file is said to be made up of ***fixed-length records***
- If different records in the file have different sizes, the file is said to be made up of ***variable-length records***

Reasons for variable-length records

- One or more fields have variable length
- One or more fields are repeating
- One or more fields are optional
- File contains records of different types

Fixed and variable length records



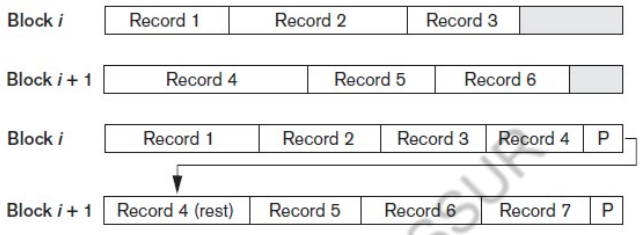


Record Blocking

- Records of a file must be allocated to disk blocks
- When the block size is larger than the record size, each block will contain numerous records
- Block size is B bytes
- Fixed-length records of size R bytes, with $B \geq R$
- We can fit $bfr = \lfloor B/R \rfloor$ records per block
- **Blocking factor**
- Unused space in each block = $B - (bfr * R)$ bytes
- number of blocks b needed for a file of r records:
  $b = \lceil (r/bfr) \rceil$ blocks

Spanned Versus Unspanned Records

- Spanned records
  - Larger than a single block
  - Pointer at end of first block points to block containing remainder of record
- Unspanned
  - Records not allowed to cross block boundaries



Allocating File Blocks on Disk

- Contiguous allocation
- Linked allocation
- Indexed allocation

File Organization

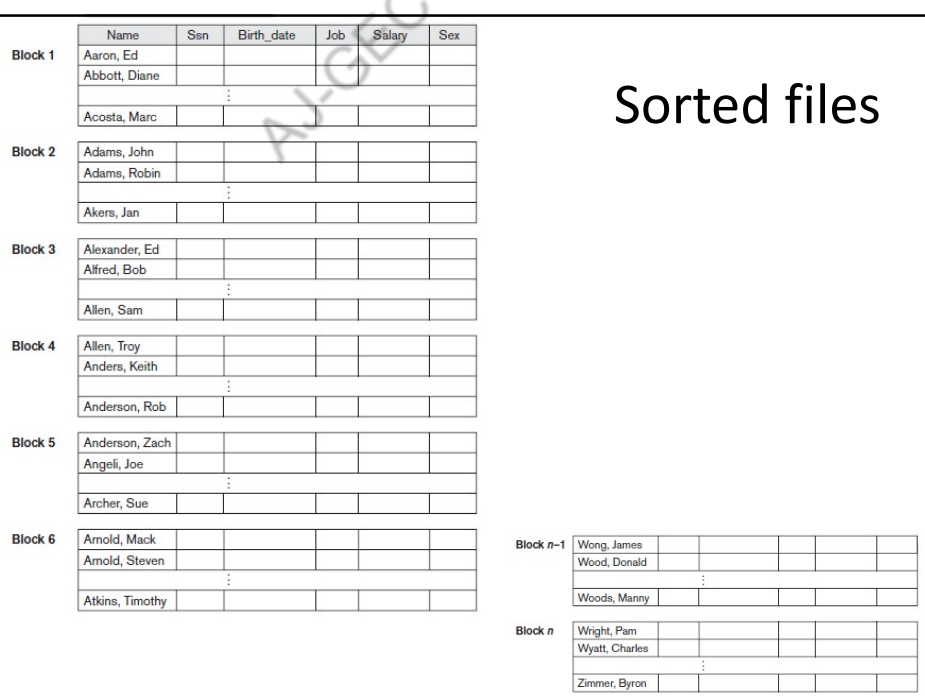
- Refers to the organization of the data of a file into records, blocks, and access structures
- Includes the way records and blocks are placed on the storage medium and interlinked

Files of Unordered Records (Heap Files)

- Heap (or pile) file
  - Records placed in file in order of insertion
- Inserting a new record is very efficient
- Searching for a record requires linear search
- Deletion techniques
  - Rewrite the block
  - Use deletion marker

Files of Ordered Records (Sorted Files)

- Ordered (sequential) file
  - Records sorted by ordering field
    - Called ordering key if ordering field is a key field
- Advantages
  - Reading records in order of ordering key value is extremely efficient
  - Finding next record
  - Binary search technique



Sorted files

Average Access Times for Various File Organizations

Type of Organization	Access/Search Method	Average Blocks to Access a Specific Record
Heap (unordered)	Sequential scan (linear search)	$b/2$
Ordered	Sequential scan	$b/2$
Ordered	Binary search	$\log_2 b$

Reference

- Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education 6th edition and 7th edition

Thank you