Database Management Systems (CSN-351)
Recovery and File Structure

BTech 3rd Year (CS) + Minor

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Failure Classification

Transaction failure due to **Logical Error**

Failure Classification

Transaction failure due to **Logical Error**

Transaction failure due to **System Error**

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Transaction failure due to **Logical Error**

Transaction failure due to **System Error**

System Crash

Failure Classification

Transaction failure due to **Logical Error**

Transaction failure due to **System Error**

System Crash

Disk Failure

Transactions and System Log

T_0:	T_1:
read(A);	
$A := A - 50$;	
write(A);	
read(B);	read(C);
$B := B + 50$;	$C := C - 100$;
write(B).	write(C).

Transactions and System Log

T_0: read(A);		$<T_0$ start$>$
$A := A - 50$;		$<T_0, A, 1000, 950>$
write(A);		$<T_0, B, 2000, 2050>$
read(B);		$<T_0$ commit$>$
$B := B + 50$;	T_1: read(C);	$<T_1$ start$>$
write(B).	$C := C - 100$;	$<T_1, C, 700, 600>$
	write(C).	$<T_1$ commit$>$

Storage

Organization of memory devices: Primary, Secondary, Tertiary

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Databases are stored in Disk because

- Databases are large
- Loss of data from disk is less frequent
- Cost-effective
- Only a small portion of the database is required at a time

File Structure

Organization of database in a storage device:

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- **Record Type:** A collection of field names and their corresponding data types
- BLOB and CLOB

Records

Records → Fixed-length records and Variable-length records.

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- Different record types
- Variable-length fields (`varchar`) in same record type
- Multi-valued attributes
- Optional fields

Blocking Factor

Number of records which can be stored in a block is called blocking factor (bfr).

$$B = \text{Block size}$$
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$$B = \text{Block size}$$
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Span Strategy: Records can be stored in more than one block. One record can span in multiple blocks.

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Then, number of blocks (b) required

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$$b = \left\lceil \frac{r}{bfr} \right\rceil$$

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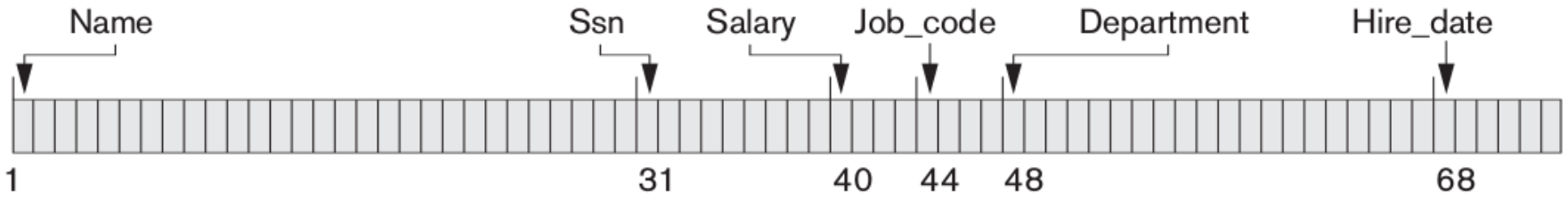
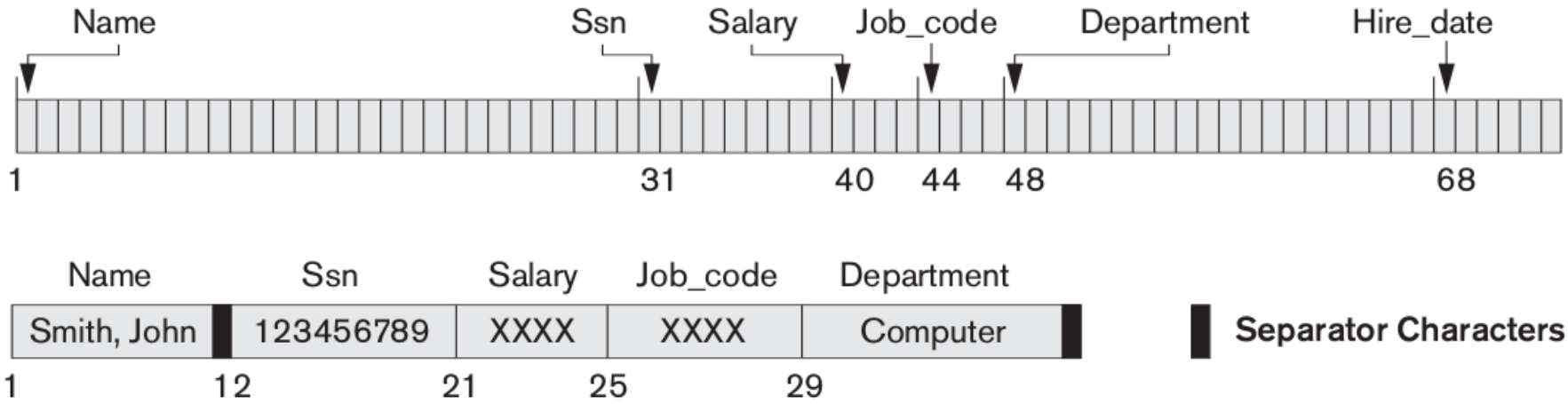
Variable-length records are usually stored with **spanned strategy** which additionally requires to store separator characters and field types.

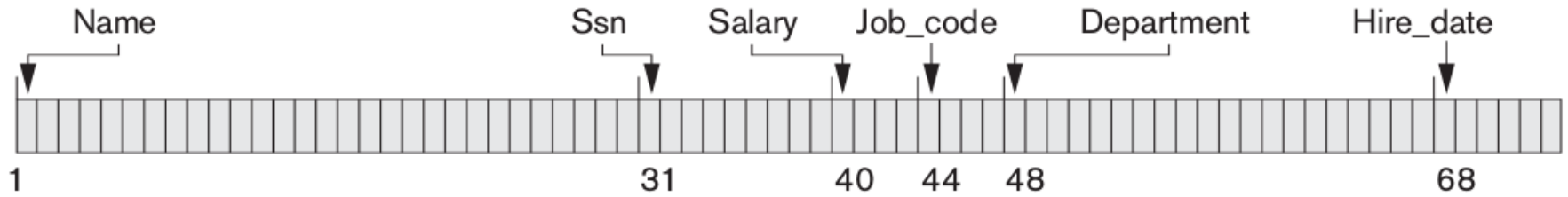
Example

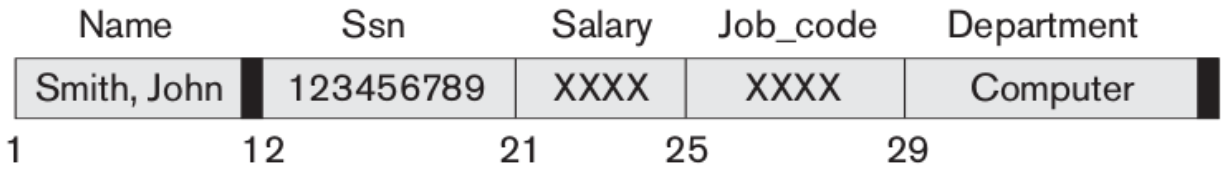


Example


Name
Ssn
Salary
Job_code
Department
Hire_date
1
31
40
44
48
68
Name
Ssn
Salary
Job_code
Department
Smith, John
123456789
XXXX
XXXX
Computer
1
12
21
25
29
Separator Characters

Example





Separator Characters

Separator Characters

= Separates field name from field value

Separates fields

Terminates record

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Records of each relation may be stored in a separate file. In a **multitable clustering file organization** records of several different relations can be stored in the same file. Related records are stored on the same block to minimize I/O.

Sequential File Organization

Suitable for applications that require **sequential processing** of the entire file.

10101	Srinivasan	Comp. Sci.	65000	
12121	Wu	Finance	90000	
15151	Mozart	Music	40000	
22222	Einstein	Physics	95000	
32343	El Said	History	60000	
33456	Gold	Physics	87000	
45565	Katz	Comp. Sci.	75000	
58583	Califieri	History	62000	
76543	Singh	Finance	80000	
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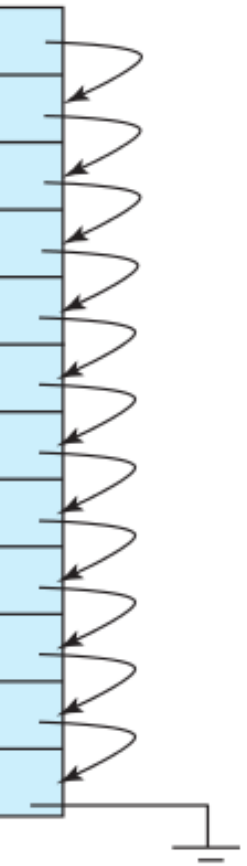
83821	Brandt	Comp. Sci.	92000	
98345	Kim	Elec. Eng.	80000	



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Insertion: locate the position where the record is to be inserted

- if there is free space insert there
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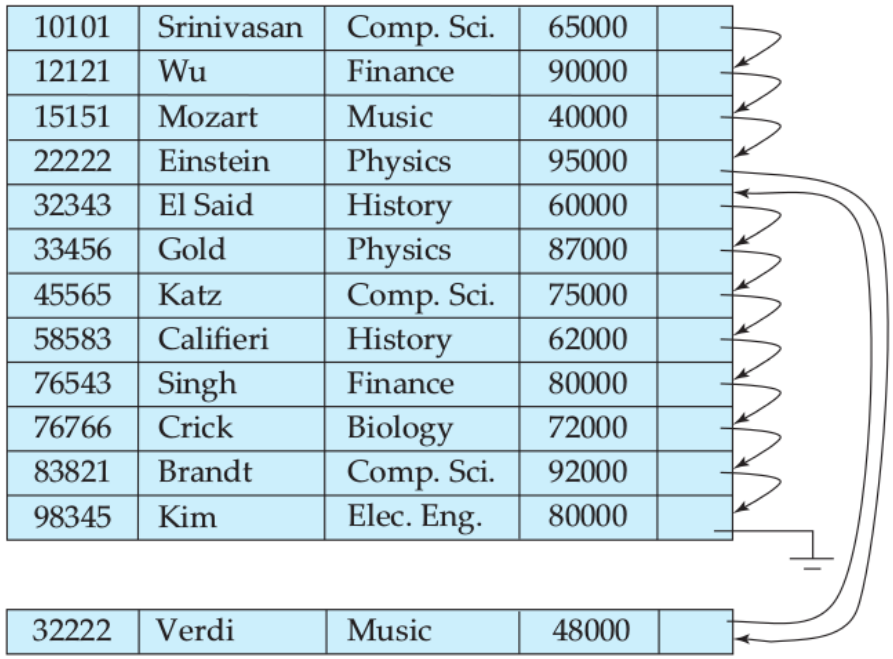
- In either case, pointer chain must be updated.



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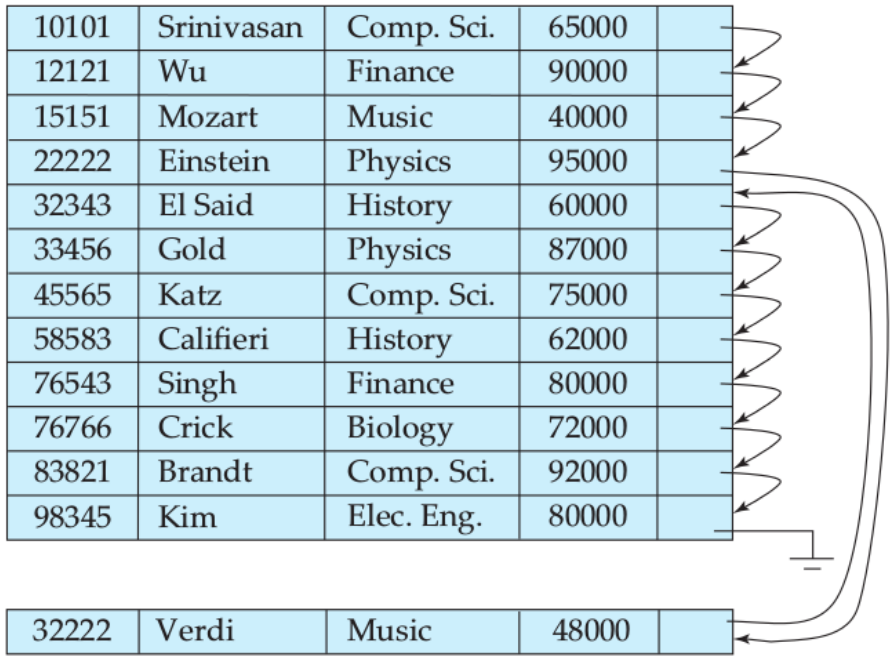

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Need to reorganize the file from time to time to restore sequential order

Multitable Clustering File Structure

dept_name	*building*	*budget*
Comp. Sci.	Taylor	100000
Physics	Watson	70000

ID	*name*	*dept_name*	*salary*
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select *dept_name, building, budget, ID, name, salary*
from *department* **natural join** *instructor;*

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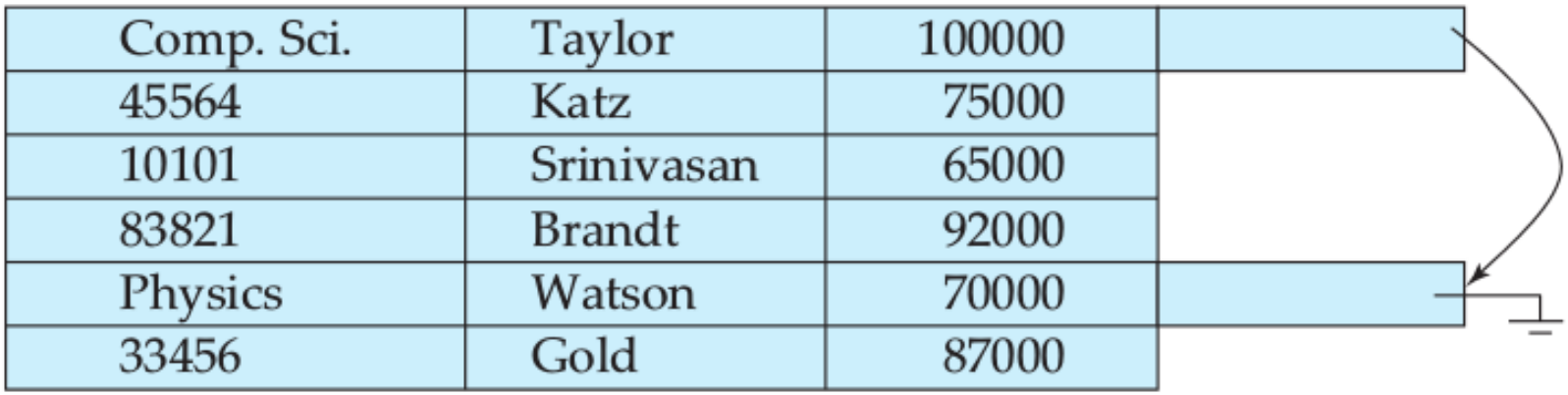
- Results in variable size records.
- Can add pointer chains to link records of a particular relation.



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Data Dictionary Storage

The **Data dictionary** (also called *system catalogue*) stores **metadata**; that is, data about data, such as

Information about relations:

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- names, types and lengths of attributes of each relation
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- integrity constraints

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Information about indices

Data Dictionary Storage