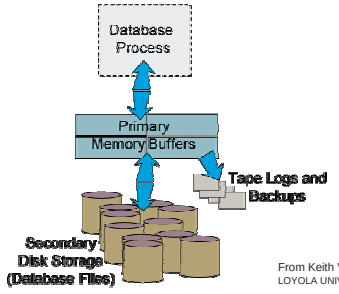
Storage and File Structure II

Big Picture



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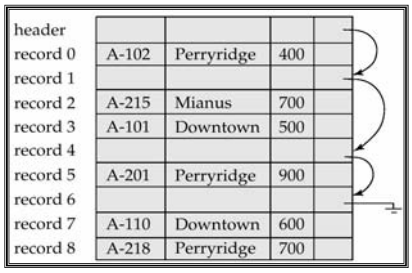
File Organization

- The database is stored as a collection of *files*. Each file is a sequence of *records*. A record is a sequence of fields.
- Two cases:
  - Fixed length record
  - Variable length record

Fixed-Length Records

record 0	A-102	Perryridge	400
record 1	A-305	Round Hill	350
record 2	A-215	Mianus	700
record 3	A-101	Downtown	500
record 4	A-222	Redwood	700
record 5	A-201	Perryridge	900
record 6	A-217	Brighton	750
record 7	A-110	Downtown	600
record 8	A-218	Perryridge	700

Free Lists



Variable-Length Records

- Variable-length records arise in database systems in several ways:
  - Storage of multiple record types in a file.
  - Record types that allow variable lengths for one or more fields.
  - Record types that allow repeating fields (used in some older data models).

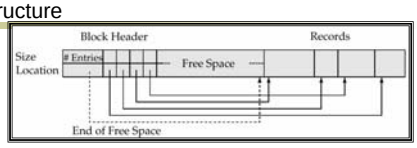
Byte String Representation

0	Perryridge	A-102	400	A-201	900	⊥
1	Round Hill	A-305	350	⊥		
2	Mianus	A-215	700	⊥		
3	Downtown	A-101	500	A-110	600	⊥
4	Redwood	A-222	700	⊥		
5	Brighton	A-217	750	⊥		

Dealing with Variable-Length Record

- By introducing pointers
- Stuff empty fields

Variable-Length Records: Slotted Page Structure



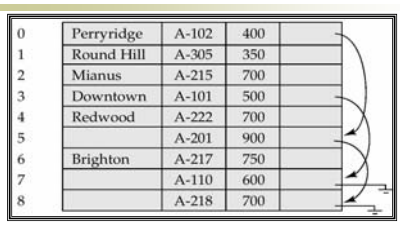
- Slotted page header contains:
  - number of record entries
  - end of free space in the block
  - location and size of each record

Compare and contrast Slotted Page Structure with Byte String Representation

Variable-Length Records - Fixed-length Representation

0	Perryridge	A-102	400	A-201	900	A-218	700
1	Round Hill	A-305	350	⊥	⊥	⊥	⊥
2	Mianus	A-215	700	⊥	⊥	⊥	⊥
3	Downtown	A-101	500	A-110	600	⊥	⊥
4	Redwood	A-222	700	⊥	⊥	⊥	⊥
5	Brighton	A-217	750	⊥	⊥	⊥	⊥

Pointer Method

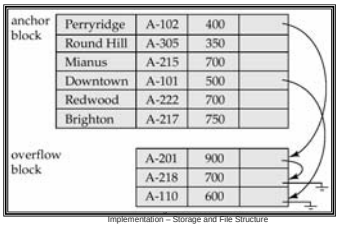


0	Perryridge	A-102	400
1	Round Hill	A-305	350
2	Mianus	A-215	700
3	Downtown	A-101	500
4	Redwood	A-222	700
5		A-201	900
6	Brighton	A-217	750
7		A-110	600
8		A-218	700

- Pointer method
  - A variable-length record is represented by a list of fixed-length records, chained together via pointers.
  - Can be used even if the maximum record length is not known

Pointer Method (Cont.)

- Waste space
- Solution is to allow two kinds of block in file:
  - Anchor block – contains the first records of chain
  - Overflow block – contains records other than those that are the first records of chains.

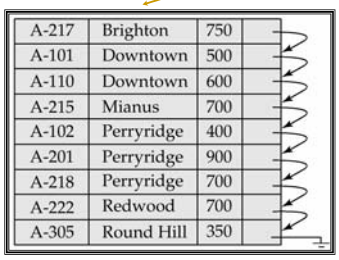


Organization of Records in Files

- **Heap** – no order
- **Sequential** – sequential order based on search key
- **Hashing** – a hash function computed on some attribute of each record; the result specifies in which block of the file the record should be placed
- **Clustering file organization** – records of several different relations can be stored in the same file
  - Motivation: store related records on the same block to minimize I/O

Sequential File Organization

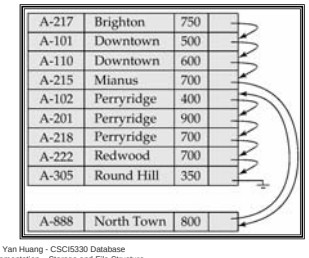
Search key



A-217	Brighton	750	
A-101	Downtown	500	
A-110	Downtown	600	
A-215	Mianus	700	
A-102	Perryridge	400	
A-201	Perryridge	900	
A-218	Perryridge	700	
A-222	Redwood	700	
A-305	Round Hill	350	

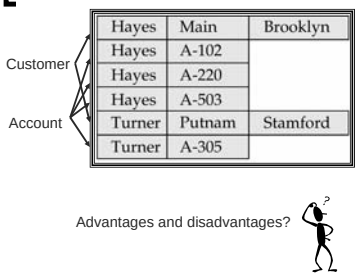
Sequential File Organization (Cont.)

- Deletion – use pointer chains
- Insertion – may need buffer
- Need to reorganize the file from time to time to restore sequential order



A-217	Brighton	750	
A-101	Downtown	500	
A-110	Downtown	600	
A-215	Mianus	700	
A-102	Perryridge	400	
A-201	Perryridge	900	
A-218	Perryridge	700	
A-222	Redwood	700	
A-305	Round Hill	350	
A-888	North Town	800	

Clustering File Organization



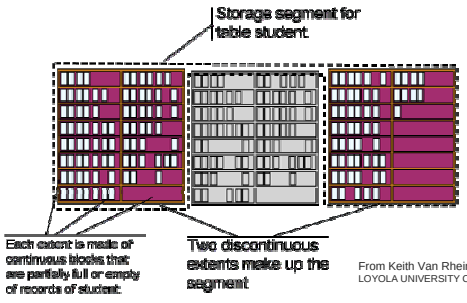
Advantages and disadvantages?

Clusters in Oracle

- **Cluster**
  CREATE CLUSTER personnel (department NUMBER(4));
  CREATE CLUSTER personnel_hash (department NUMBER(4)) HASH is department HASHKEYS 200;
- **Cluster Keys**
  CREATE INDEX idx_personnel ON CLUSTER personnel;
- **Adding Tables to a Cluster**

```
CREATE TABLE dept(
    department number(4),
    name char(60),
    adresss char(40))
    CLUSTER personnel (department);
CREATE TABLE faculty (
    name char(60),
    adresss char(40),
    department number(4))
    CLUSTER personnel (department);
```


Oracle's Data Blocks, Extents and Segments



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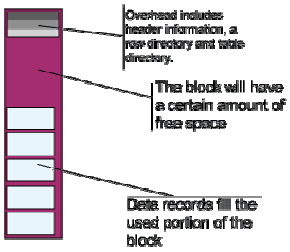
Oracle Block Structure



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Storage option in Oracle

- create table student (
  student_id number,
  name char(60),
  adresss char(40))
  storage (
  initial 50K
  next 50K
  maxextents 10
  pctincrease 25);

Data Dictionary Storage

Data dictionary (also called system catalog) stores metadata

- Information about relations
- User and accounting information, including passwords
- Statistical and descriptive data
  - number of tuples in each relation
- Physical file organization information
- Information about indices

Oracle Demo

Data Dictionary Storage (Cont.)

- Catalog structure: can use either
  - specialized data structures designed for efficient access
  - a set of relations, with existing system features used to ensure efficient access

  The latter alternative is usually preferred