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Updates:

Database Foundations

1-5

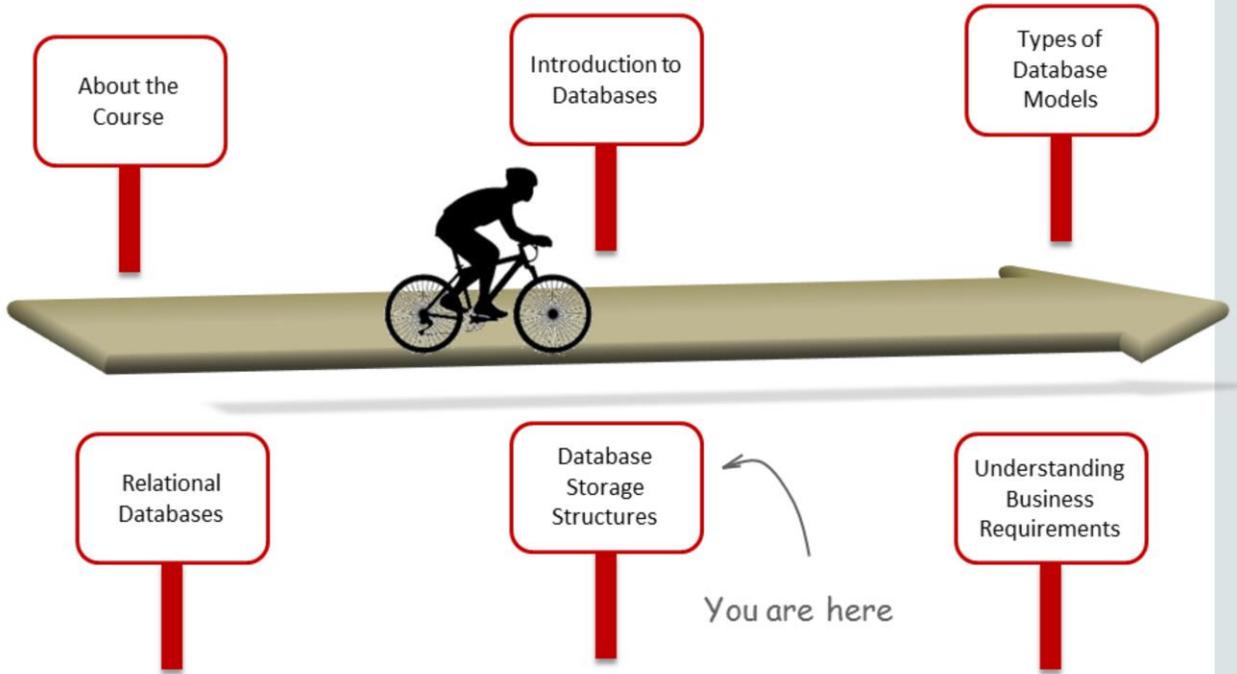
Database Storage Structures



ORACLE ACADEMY

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Roadmap



Objectives

This lesson covers the following objectives:

- Understand database data storage
- Define logical structures
 - Data blocks
 - Extents
 - Segments
 - Tablespaces



Objectives

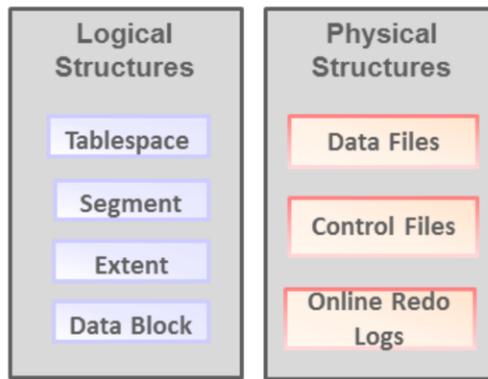
After completing this lesson, you should be able to:

- Define physical storage structures
 - Data files
 - Control files
 - Online redo log files



Database Data Storage

- Data storage is one of the essential tasks of the database.
- The database has physical structures and logical structures.



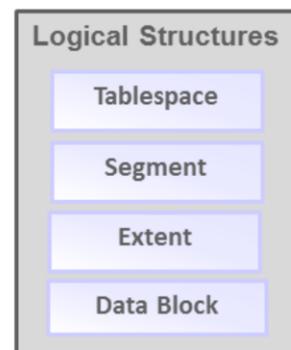
A database can be considered from both a physical and a logical perspective. Physical data is data viewable at the operating system level. Logical data, such as a table, is meaningful only for the database. A SQL statement can list the tables in an Oracle database, but an operating system utility cannot.

The physical storage of data can be managed without affecting access to logical storage structures because the physical and logical structures are separate.

Introduction to Logical Structures

- Oracle Database allocates logical space for all data in the database.
- There are four logical units of database space allocation:
 - Data blocks
 - Extents
 - Segments
 - Tablespaces

Finest level of granularity →



Data blocks are the smallest units of storage that Oracle Database can use or allocate. At the finest level of granularity, Oracle Database stores data in data blocks. One logical data block corresponds to a specific number of bytes of physical disk space.

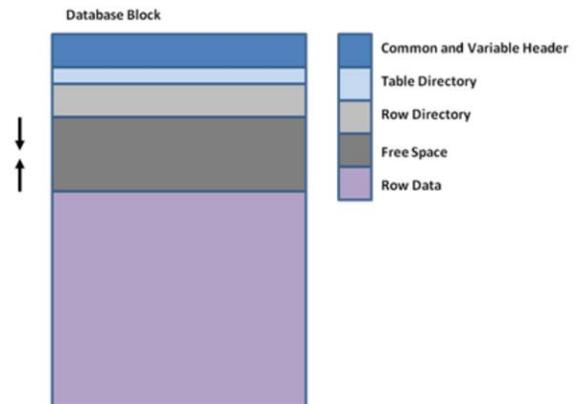
An extent is a set of logically contiguous data blocks allocated for storing a specific type of information.

A segment is a set of extents allocated for a specific database object, such as a table. For example, the data for the Employees table is stored in its own data segment. Every database object that consumes storage consists of a single segment.

Each segment belongs to one and only one tablespace. Thus, all extents for a segment are stored in the same tablespace.

Data Blocks

- A data block is the smallest logical storage unit of a database.
- A single data block represents a specific number of bytes on the physical hard disk.
- The size of a data block is generally a multiple of the operating system block size.



The Oracle Database manages the logical storage space in the data files of a database in units called data blocks, also called Oracle blocks or pages. A data block is the minimum unit of database I/O. At the physical level, database data is stored in disk files made up of operating system blocks. An operating system block is the minimum unit of data that the operating system can read or write. In contrast, an Oracle block is a logical storage structure whose size and structure are not known to the operating system.

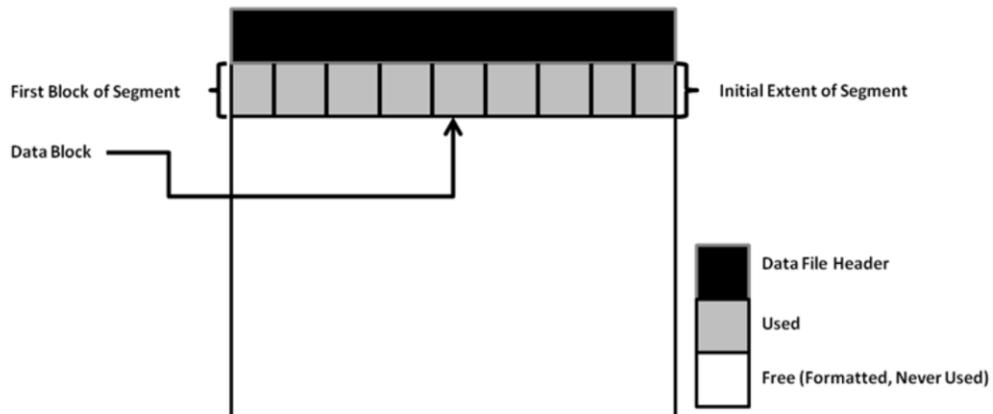
Data block consists of the following format:

- A Header that holds generic information like block address and type of segment
- A Table Directory that contains information about the table having rows in that block
- A Row Directory that contains information about the actual row contained in that block
- A Free Space that is the available free space in the data block
- A Row Data that contains table or index data

The first three components of a data block (Header, Table Directory, and Row Directory) are collectively known as Overhead.

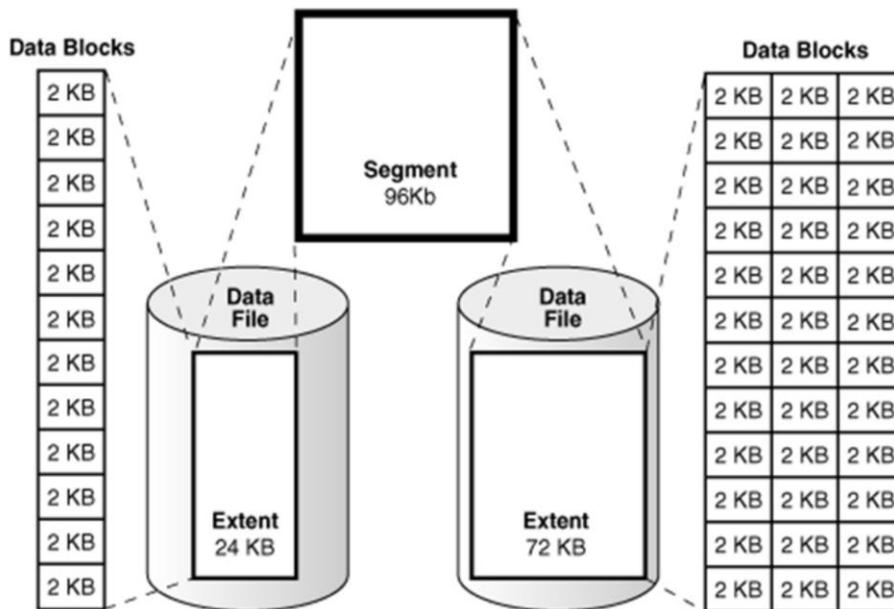
Extents

- An extent is a logical unit of database storage space allocation made up of contiguous data blocks.



Data blocks in an extent are logically contiguous, but can be physically spread out on disk. By default, the database allocates an initial extent for a data segment when the segment is created. The first data block of every segment contains a directory of the extents in the segment.

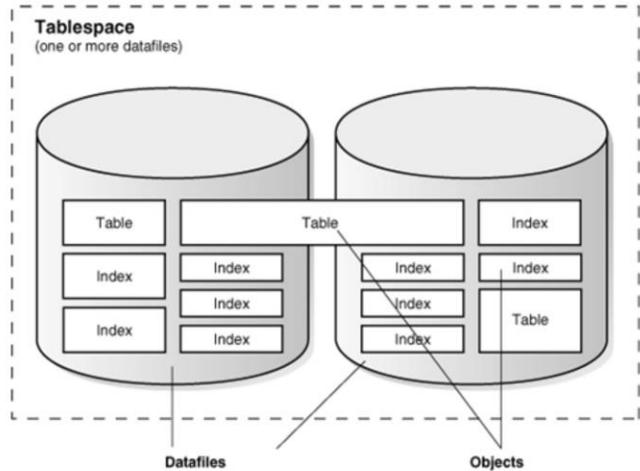
Segments



- A segment is a set of extents that have been allocated for a specific type of data structure and that are stored in the same tablespace. For example, each table's data is stored in its own data segment, while each query's data is stored in a temporary segment. Oracle allocates space for segments in extents.
- Oracle allocates another extent when the existing extents of a segment become full. The extents of a segment may or may not be contiguous on disk, because extents are allocated on an as-needed basis.

Tablespaces

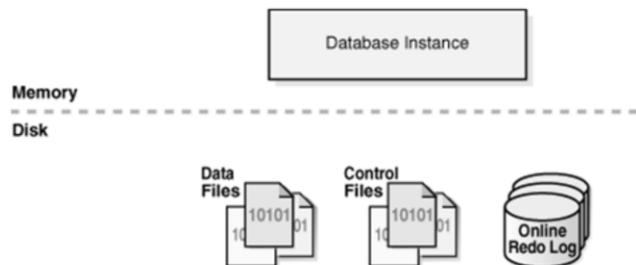
- Oracle Database stores data logically in tablespaces and physically in data files associated with the corresponding tablespace.



- Tablespaces are the primary logical storage structures of any Oracle database. The usable data of an Oracle database is logically stored in the tablespaces and physically stored in the data files associated with the corresponding tablespace.
- An Oracle database consists of one or more logical storage units called tablespaces. The database's data is collectively stored in the database's tablespaces. Each tablespace in an Oracle database consists of one or more files called data files, which are physical structures that conform to the operating system in which an Oracle database is running.

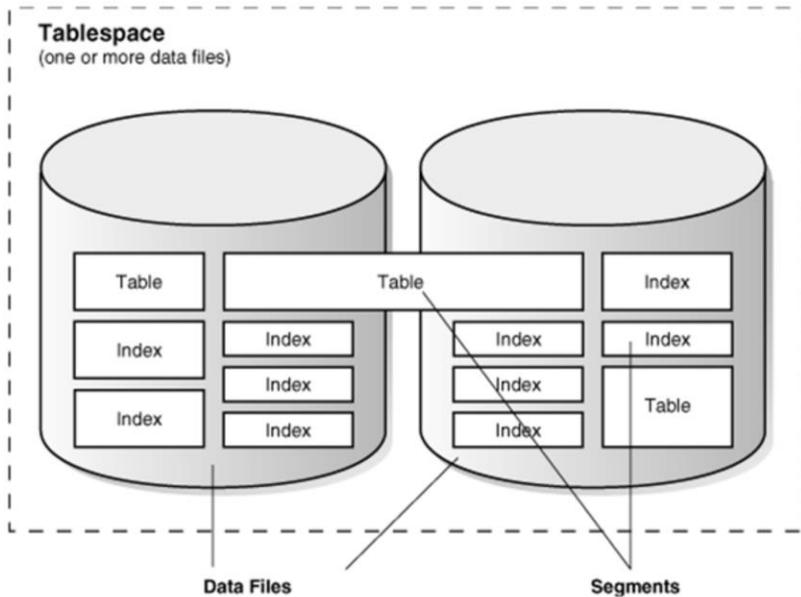
Introduction to Physical Storage Structures

- An Oracle database is a set of files that store Oracle data in persistent disk storage.
- The following database files are generated:
 - Data files and temp files
 - Control files
 - Online redo log files



- A data file is a physical file on disk that was created by Oracle Database and contains data structures, such as tables and indexes. A temp file is a data file that belongs to a temporary tablespace. The data is written to these files in an Oracle proprietary format that cannot be read by other programs.
- A control file is a root file that tracks the physical components of the database.
- The online redo log is a set of files containing records of changes made to data.
- A database instance is a set of memory structures that manage database files.

Data Files



Oracle Database stores database data in data files. Every database must have at least one data file. Oracle Database allocates space for user data in tablespaces, which, like segments, are logical storage structures. Each segment belongs to only one tablespace. Oracle Database physically stores tablespace data in data files. Tablespaces and data files are closely related, but they have important differences:

- Each tablespace consists of one or more data files, which conform to the operating system in which the Oracle database is running.
- The data for a database is collectively stored in the data files located in each tablespace of the database.
- A segment can span one or more data files, but it cannot span multiple tablespaces.
- A database must have the SYSTEM and SYSAUX tablespaces. Oracle Database automatically allocates the first data files of any database for the SYSTEM tablespace during database creation.
- The SYSTEM tablespace contains the data dictionary, a set of tables that contains database metadata. Generally, a database also has an undo tablespace and a temporary tablespace (usually named TEMP).

Control Files

- The database control file is a small binary file associated with only one database.
- A control file contains the following type of information:
 - Database name and database unique identifier (DBID)
 - Time stamp of database creation
 - Information about data files and online redo log files

Each database has one unique control file, although it may maintain identical copies of it. The control file is the root file that Oracle Database uses to find database files and to manage the state of the database generally. The control file of an Oracle database is created at the same time as the database.

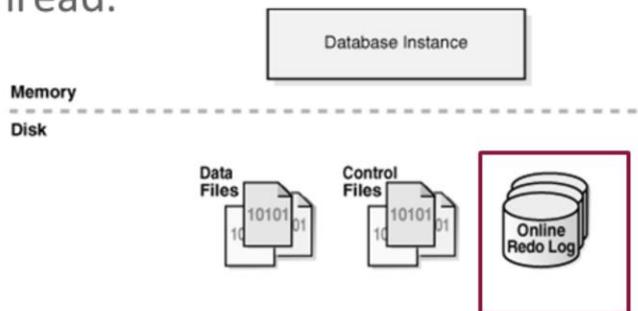
Control Files

- A control file contains the following type of information:
 - Tablespace information
 - Current log sequence number
 - Metadata that must be accessible when the database is not open

Each database has one unique control file, although it may maintain identical copies of it. The control file is the root file that Oracle Database uses to find database files and to manage the state of the database generally. The control file of an Oracle database is created at the same time as the database.

Online Redo Log Files

- Every instance of an Oracle database has an associated redo log to protect the database in case of an instance failure.
- The redo log for each database instance is also referred to as a redo thread.



Oracle Database uses the online redo log only for recovery.

Summary

In this lesson, you should have learned how to:

- Describe database data storage
- Define logical structures
 - Data blocks
 - Extents
 - Segments
 - Tablespaces



Summary

In this lesson, you should have learned how to:

- Define physical storage structures:
 - Data files
 - Control files
 - Online redo log files





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