

Managing Database Storage Structures

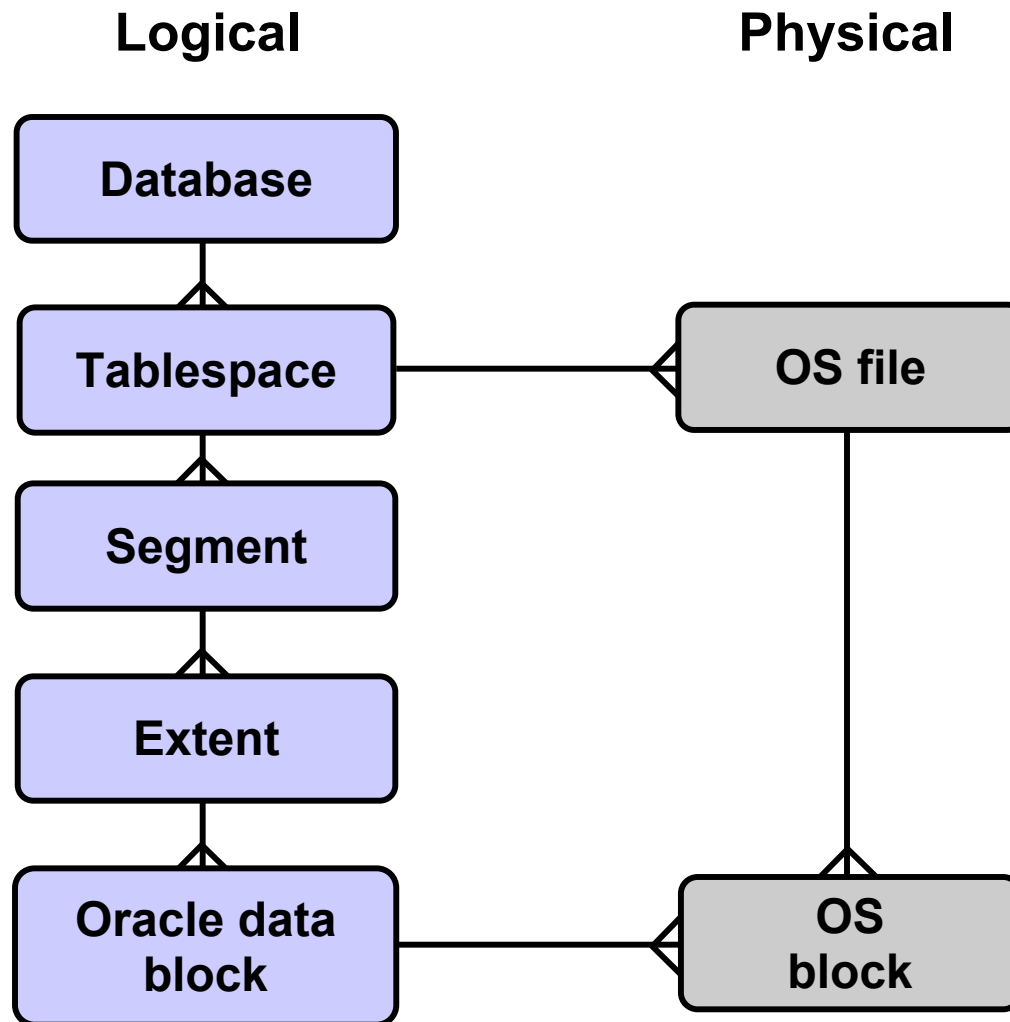


Objectives

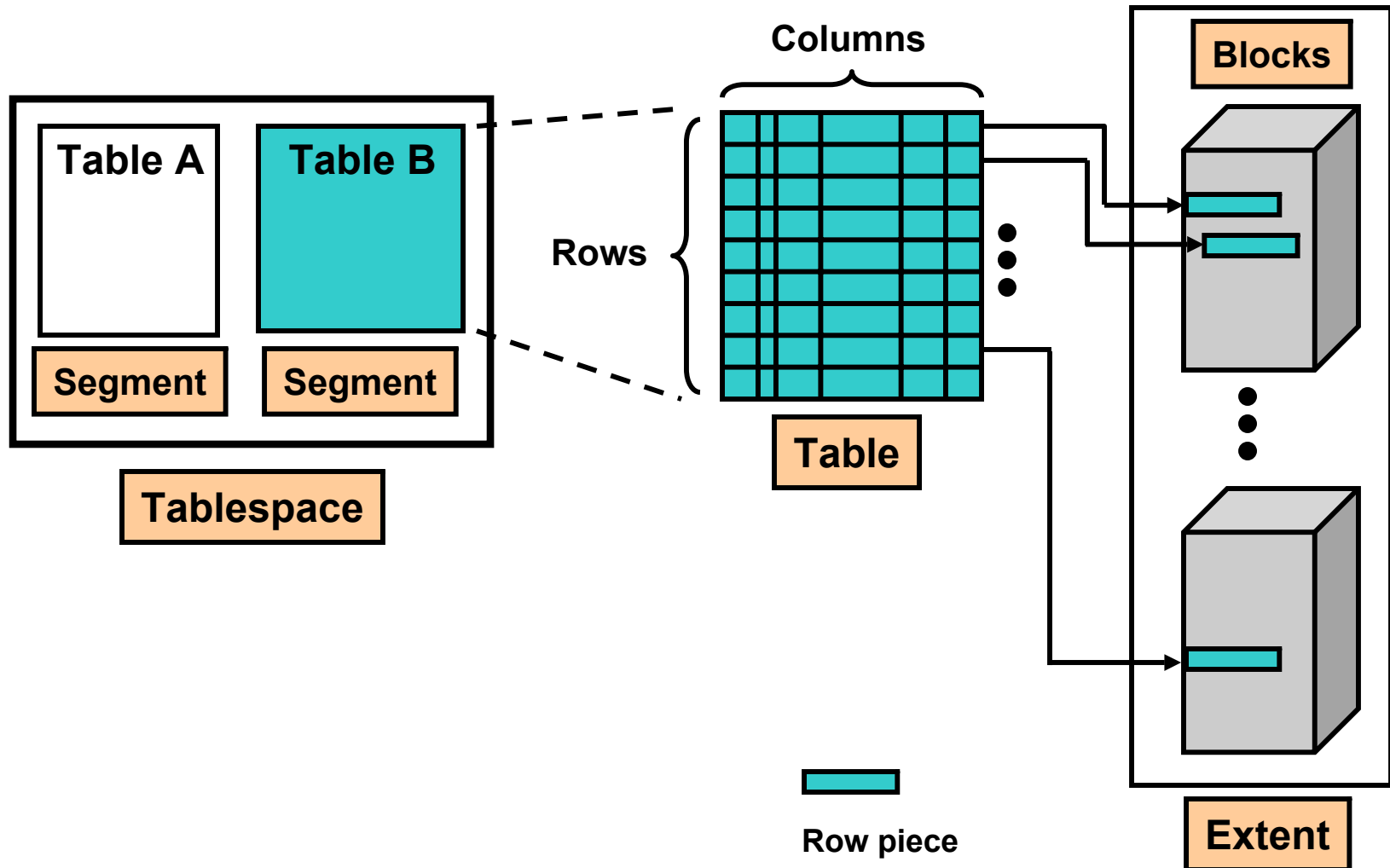
After completing this lesson, you should be able to do the following:

- **Describe how table row data is stored in blocks**
- **Define the purpose of tablespaces and data files**
- **Create and manage tablespaces**
- **Obtain tablespace information**
- **Describe the main concepts and functionality of Automatic Storage Management (ASM)**

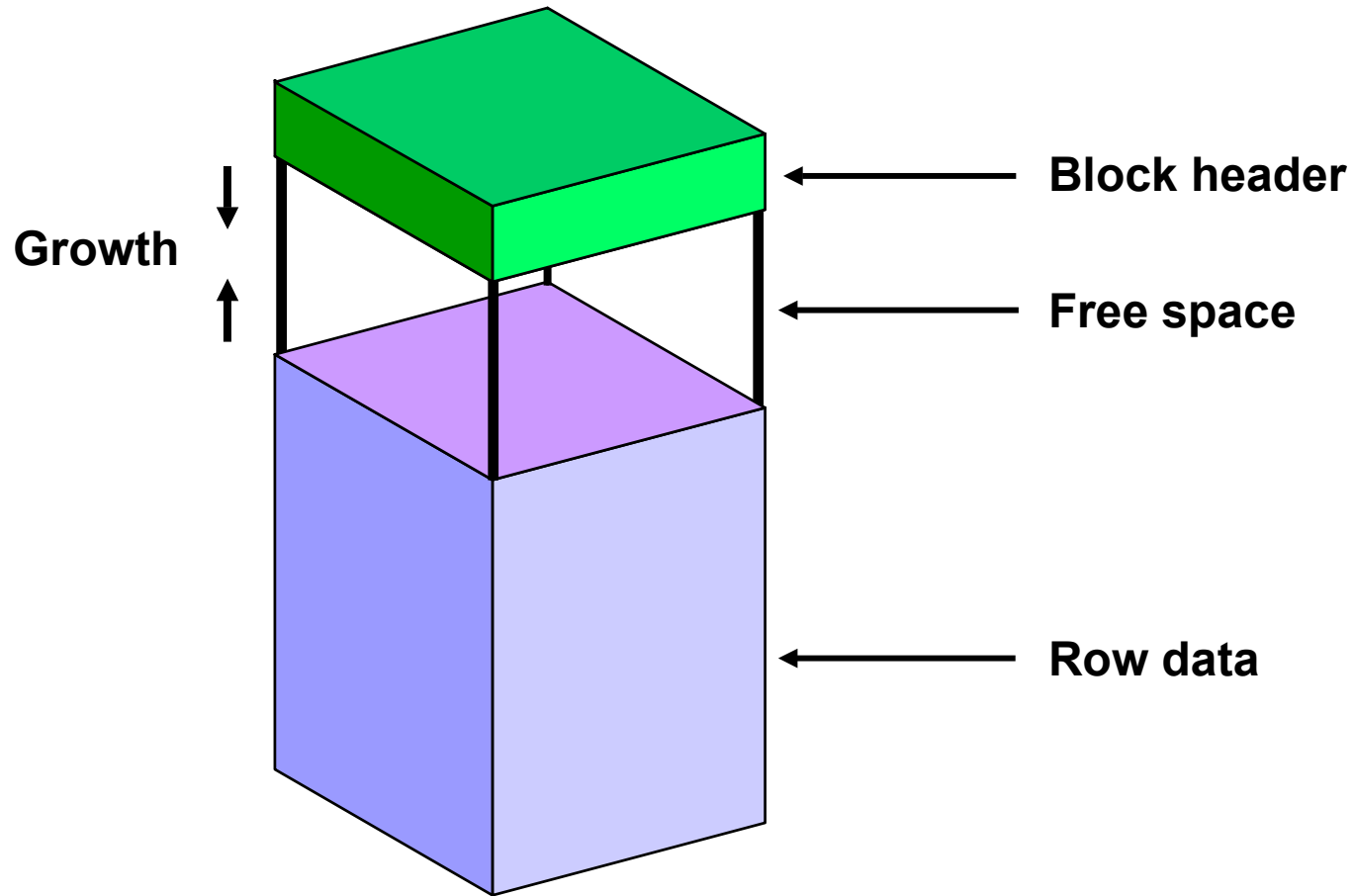
Storage Structures



How Table Data Is Stored



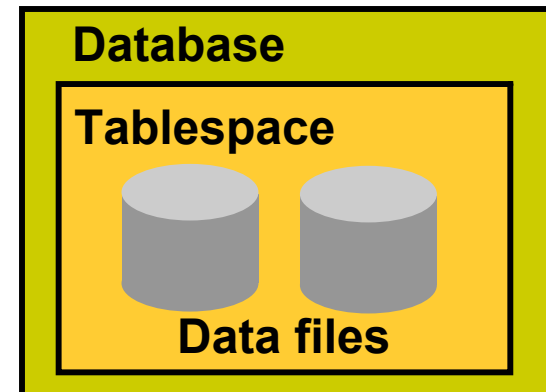
Anatomy of a Database Block



Tablespaces and Data Files

The Oracle database stores data logically in tablespaces and physically in data files.

- **Tablespaces:**
 - Can belong to only one database
 - Consist of one or more data files
 - Are further divided into logical units of storage
 - Are a repository for schema object data
- **Data files:**
 - Can belong to only one tablespace and one database
 - Are the underlying files that make up a tablespace



Oracle Managed Files (OMF)

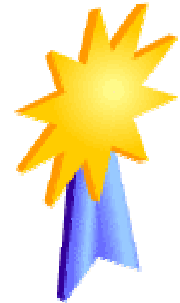
Specify file operations in terms of database objects rather than file names.

Parameter	Description
<code>DB_CREATE_FILE_DEST</code>	Defines the location of the default file system directory for data files and temporary files
<code>DB_CREATE_ONLINE_LOG_DEST_n</code>	Defines the location for redo log files and control file creation
<code>DB_RECOVERY_FILE_DEST</code>	Defines the location for RMAN backups

Example:

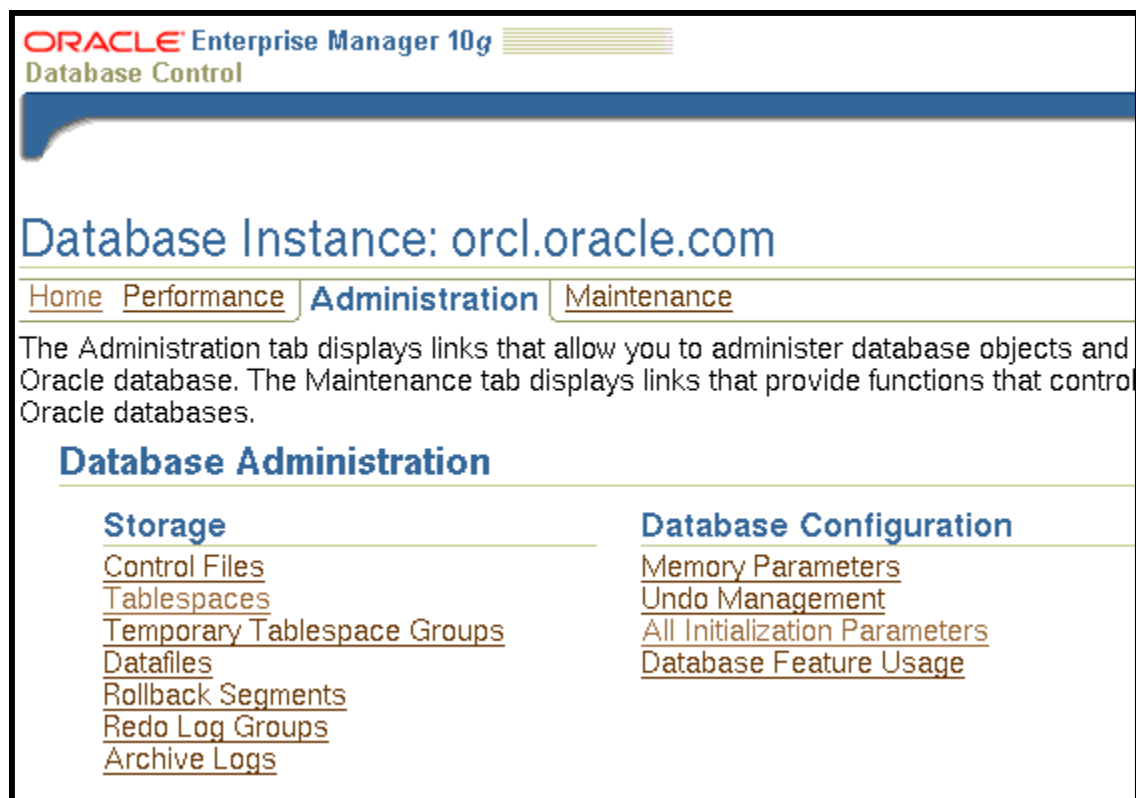
```
SQL> ALTER SYSTEM SET DB_CREATE_FILE_DEST = '/u01/oradata';  
SQL> CREATE TABLESPACE tbs_1;
```

Space Management in Tablespaces



- **Locally managed tablespace:**
 - Free extents are managed in the tablespace.
 - A bitmap is used to record free extents.
 - Each bit corresponds to a block or group of blocks.
 - The bit value indicates free or used extents.
 - The use of locally managed tablespaces is recommended.
- **Dictionary-managed tablespace:**
 - Free extents are managed by the data dictionary.
 - Appropriate tables are updated when extents are allocated or unallocated.
 - These tablespaces are supported only for backward compatibility.

Exploring the Storage Structure



ORACLE® Enterprise Manager 10g
Database Control

Database Instance: orcl.oracle.com

[Home](#) [Performance](#) **[Administration](#)** [Maintenance](#)

The Administration tab displays links that allow you to administer database objects and Oracle database. The Maintenance tab displays links that provide functions that control Oracle databases.

Database Administration

Storage <ul style="list-style-type: none">Control FilesTablespacesTemporary Tablespace GroupsDatafilesRollback SegmentsRedo Log GroupsArchive Logs	Database Configuration <ul style="list-style-type: none">Memory ParametersUndo ManagementAll Initialization ParametersDatabase Feature Usage
---	--

Click the links to view detailed information.

Creating a New Tablespace

Create Tablespace

Show SQLCancelOK

GeneralStorage

* NameINVENTORY

Extent Management

☒ Locally Managed

☐ Dictionary Managed

Type

☒ Permanent

☐ Set as default permanent tablespace

☐ Temporary

☐ Set as default temporary tablespace

☐ Undo

Undo Retention Guarantee

☐ Yes☒ No

Status

☒ Read Write

☐ Read Only

☐ Offline

Datafiles

☐ Use bigfile tablespace
Tablespace can have only one datafile with no practical size limit.

Add

EditRemove

Select	Name	Directory	Size (MB)
<input checked="" type="radio"/>	inventory01.dbf	/u01/app/oracle/oradata/orcl/	50.00

GeneralStorage

Storage for Locally Managed Tablespaces

Extent Allocation

☒ Automatic

☐ Uniform

Size KB

Segment Space Management

☒ Automatic

Objects in the tablespace automatically manage their free space. It offers high performance for free space management.

☐ Manual

Objects in the tablespace will manage their free space using free lists. It is provided for backward compatibility.

Enable logging

☒ Yes

Generate redo logs for creation of tables, indexes and partitions, and for subsequent inserts. Recoverable

☐ No

Redo log entries are smaller, the above operations are not logged and not recoverable.

Block information







Block Size (B) **8192**

Tablespaces in the Preconfigured Database

- **SYSTEM**
- **SYSAUX**
- **TEMP**
- **UNDOTBS1**
- **USERS**
- **EXAMPLE**

Selection Mode Single ▼ Create

Edit View Delete Actions Add Datafile ▼ Go

Select	Name ▲	Size (MB)	Used (MB)	Used (%)	Free (MB)	Status	Datafiles	Type	Extent Management	Segment Management
<input checked="" type="radio"/>	EXAMPLE	100.0	68.2		68.2	31.8	✓	1 PERMANENT	LOCAL	AUTO
<input type="radio"/>	SYSAUX	370.0	361.4		97.7	8.6	✓	1 PERMANENT	LOCAL	AUTO
<input type="radio"/>	SYSTEM	490.0	484.8		98.9	5.2	✓	1 PERMANENT	LOCAL	MANUAL
<input type="radio"/>	TEMP	20.0	0.0		0.0	20.0	✓	1 TEMPORARY	LOCAL	MANUAL
<input type="radio"/>	UNDOTBS1	35.0	12.3		35.2	22.7	✓	1 UNDO	LOCAL	MANUAL
<input type="radio"/>	USERS	40.0	38.4		95.9	1.6	✓	1 PERMANENT	LOCAL	AUTO

Total Size (MB) **1,055.0** ✓ Online ✗ Offline 🔒 Read Only
 Total Used (MB) **965.1**
 Total Free (MB) **89.9**

Altering a Tablespace

Database Instance: orcl.oracle.com > Tablespaces > Edit Tablespace: EXAMPLE Logged in As DBA1

Edit Tablespace: EXAMPLE

Actions Add Datafile Go Show SQL Revert Apply

General Storage Thresholds

Name

Bigfile tablespace **No**

Extent Management

- ☒ Locally Managed
- ☐ Dictionary Managed

Type

- ☒ Permanent
 - ☐ Set as default permanent tablespace
- ☐ Temporary
 - ☐ Set as default temporary tablespace
- ☐ Undo

Status

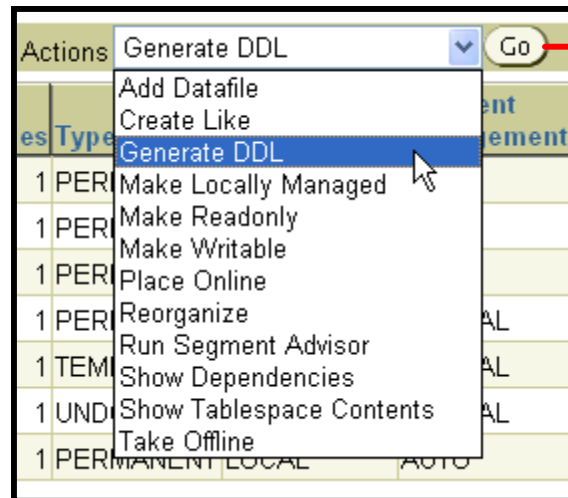
- ☒ Read Write
- ☐ Read Only
- ☐ Offline
 - Offline Mode Normal
 - Normal
 - Temporary
 - Immediate
 - For Recover

Datafiles

AddEditRemove

Select	Name	Directory	Size (MB)	Used (MB)
<input checked="" type="checkbox"/>	example01.dbf	/u01/app/oracle/oradata/orcl/	100.00	<div><div></div></div> 68.25


Actions with Tablespaces



Show DDL

```
CREATE SMALLFILE TABLESPACE "EXAMPLE" DATAFILE
'/u01/app/oracle/oradata/orcl/example01.dbf' SIZE 100M REUSE AUTOEXTEND ON
NEXT 640K MAXSIZE 32767M NOLOGGING EXTENT MANAGEMENT LOCAL SEGMENT SPACE
MANAGEMENT AUTO
```

Dropping Tablespaces

 **Warning**


No

Yes

Once a tablespace has been dropped, the objects and data in it will no longer be available. To recover them can be a time consuming process. Oracle recommends a backup before and after dropping a tablespace.

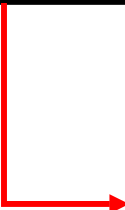
Are you sure you want to delete Tablespace EXAMPLE?

☒ Delete associated datafiles from the OS

Edit View Delete Actions Generate DDL Go											
Select	Name 	Size (MB)	Used (MB)	Used (%)	Free (MB)	Status	Datafiles	Type	Extent Management	Segment Management	
<input checked="" type="radio"/>	EXAMPLE	100.0	68.2	<div><div></div></div>	68.2	31.8 ✓	1	PERMANENT	LOCAL	AUTO	
<input type="radio"/>	INVENTORY	5.0	0.1	<div><div></div></div>	1.2	4.9 ✓	1	PERMANENT	LOCAL	AUTO	
<input type="radio"/>	SYSAUX	240.0	237.2	<div><div></div></div>	98.8	2.8 ✓	1	PERMANENT	LOCAL	AUTO	
<input type="radio"/>	SYSTEM	470.0	468.1	<div><div></div></div>	99.6	1.9 ✓	1	PERMANENT	LOCAL	MANUAL	
<input type="radio"/>	TEMP	20.0	0.0	<div><div></div></div>	0.0	20.0 ✓	1	TEMPORARY	LOCAL	MANUAL	
<input type="radio"/>	UNDOTBS1	35.0	9.6	<div><div></div></div>	27.3	25.4 ✓	1	UNDO	LOCAL	MANUAL	
<input type="radio"/>	USERS	5.0	3.0	<div><div></div></div>	60.0	2.0 ✓	1	PERMANENT	LOCAL	AUTO	


Viewing Tablespace Information

```
SELECT tablespace_name, status, contents, logging, extent_management,  
allocation_type, segment_space_management  
FROM dba_tablespaces
```



TABLESPACE_NAME	STATUS	CONTENTS	LOGGING	EXTENT_MAN	ALLOCATION	SEGMENT
SYSTEM	ONLINE	PERMANENT	LOGGING	LOCAL	SYSTEM	MANUAL
UNDOTBS1	ONLINE	UNDO	LOGGING	LOCAL	SYSTEM	MANUAL
SYSAUX	ONLINE	PERMANENT	LOGGING	LOCAL	SYSTEM	AUTO
TEMP	ONLINE	TEMPORARY	NOLOGGING	LOCAL	UNIFORM	MANUAL
USERS	ONLINE	PERMANENT	LOGGING	LOCAL	SYSTEM	AUTO
EXAMPLE	ONLINE	PERMANENT	NOLOGGING	LOCAL	SYSTEM	AUTO
INVENTORY	ONLINE	PERMANENT	LOGGING	LOCAL	SYSTEM	AUTO

```
SELECT ts#, name FROM v$tablespace
```



TS#	NAME
0	SYSTEM
1	UNDOTBS1
2	SYSAUX
4	USERS
3	TEMP
6	EXAMPLE
7	INVENTORY

Gathering Storage Information

Tablespaces

Object Type Tablespace

Search

Select an object type and optionally enter an object name to filter the data that is displayed in your results set.

Object Name

By default, the search returns all uppercase matches beginning with the string you entered. To run an exact or case-sensitive match, double quote the search string. You can use the wildcard symbol (%) in a double quoted string.

Selection Mode Single

Edit View Delete Actions

Select	Name	Size (MB)	Used (MB)	Used (%)	Free (MB)	Status	Datafiles	Type	nt
	EXAMPLE	100.0	68.2	68.2	31.8	✓	1	PERMAN	
	SYSAUX	550.0	542.4	98.6	7.6	✓	1	PERMAN	
	SYSTEM	500.0	492.3	98.5	7.7	✓	1	PERMAN	
	TEMP	20.0	0.0	0.0	20.0	✓	1	TEMPOR	
	UNDOTBS1	110.0	1.4		108.6	✓	1	UNDO	LOCAL MANUAL

Add Datafile

Add Datafile
Create Like
Generate DDL
Make Locally Managed
Make Readonly
Make Writable
Place Online
Reorganize
Run Segment Advisor
Show Dependencies
Show Tablespace Contents
Take Offline

Actions

Viewing Tablespace Contents

Database Instance: [EDRSR10P1_orcl.us.oracle.com](#) > [Tablespaces](#) > [View Tablespace: EXAMPLE](#) > Show Tablespace Contents

Show Tablespace Contents

Size (MB) **100.0** Used (MB) **68.3** Extent Mgmt **LOCAL** Auto Extend **Yes**
 Block Size (KB) **8** Used (%) **68.3** Segment Mgmt **AUTO** Extents **836**

Segments

Search

Segment Name Type Minimum Size (KB) Minimum Extents

You can use the wildcard symbol (%) in the segment name.

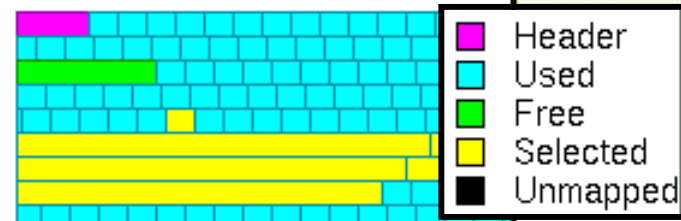
Previous 1-10 of 418 Next 10

Segment Name	Type	Size (KB)	Extents
SH.CUSTOMERS	TABLE	12,288	27
SH.SUPPLEMENTARY_DEMOGRAPHICS	TABLE	4,096	19
OE.PRODUCT_DESCRIPTIONS	TABLE	3,072	18
SH.SALES.SALES_Q4_2001	TABLE PARTITION	2,048	17
SH.SALES.SALES_Q3_2001		1,024	16
SH.SALES.SALES_Q1_1999		1,024	16
SH.CUSTOMERS_PK		1,024	16
SH.SALES.SALES_Q2_2001		960	15
SH.SALES.SALES_Q1_2001		960	15
SH.SALES.SALES_Q1_2000		960	15

[Extent Map](#)

Extent Map

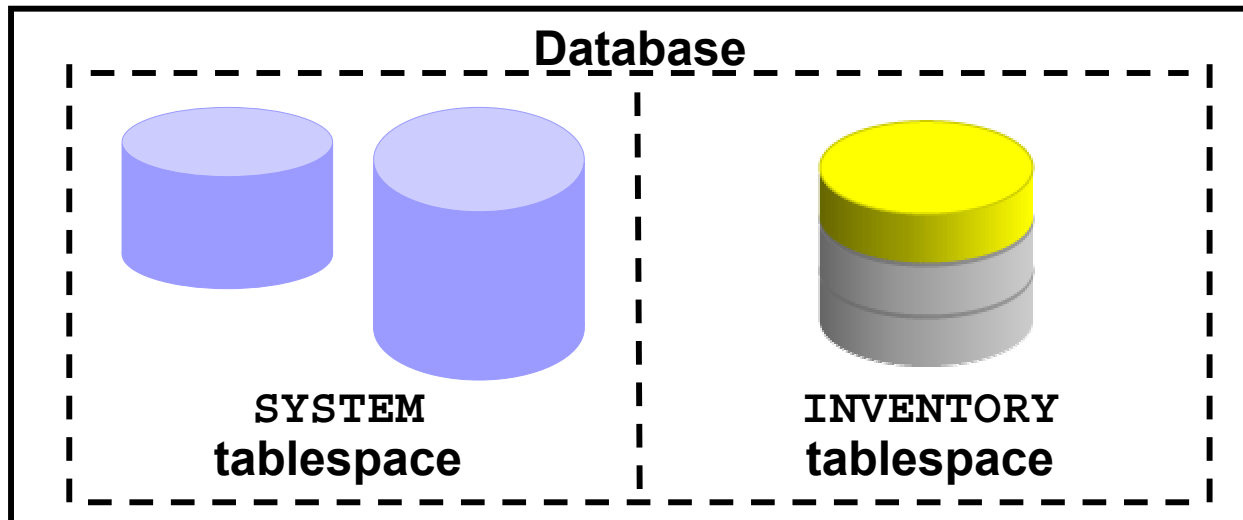
Clicking the Highlight Extents button
 Map. Clicking on a used extent in



Enlarging the Database

You can enlarge the database in the following ways:

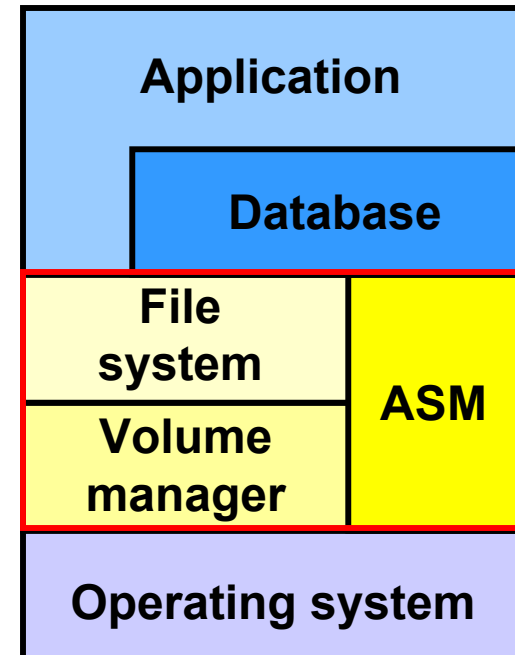
- **Creating a new tablespace**
- **Adding a data file to an existing tablespace**
- **Increasing the size of a data file**
- **Providing for the dynamic growth of a data file**



What Is Automatic Storage Management?

Automatic Storage Management

- Is a portable and high-performance cluster file system
- Manages Oracle database files
- Spreads data across disks to balance load
- Mirrors data
- Solves many storage management challenges

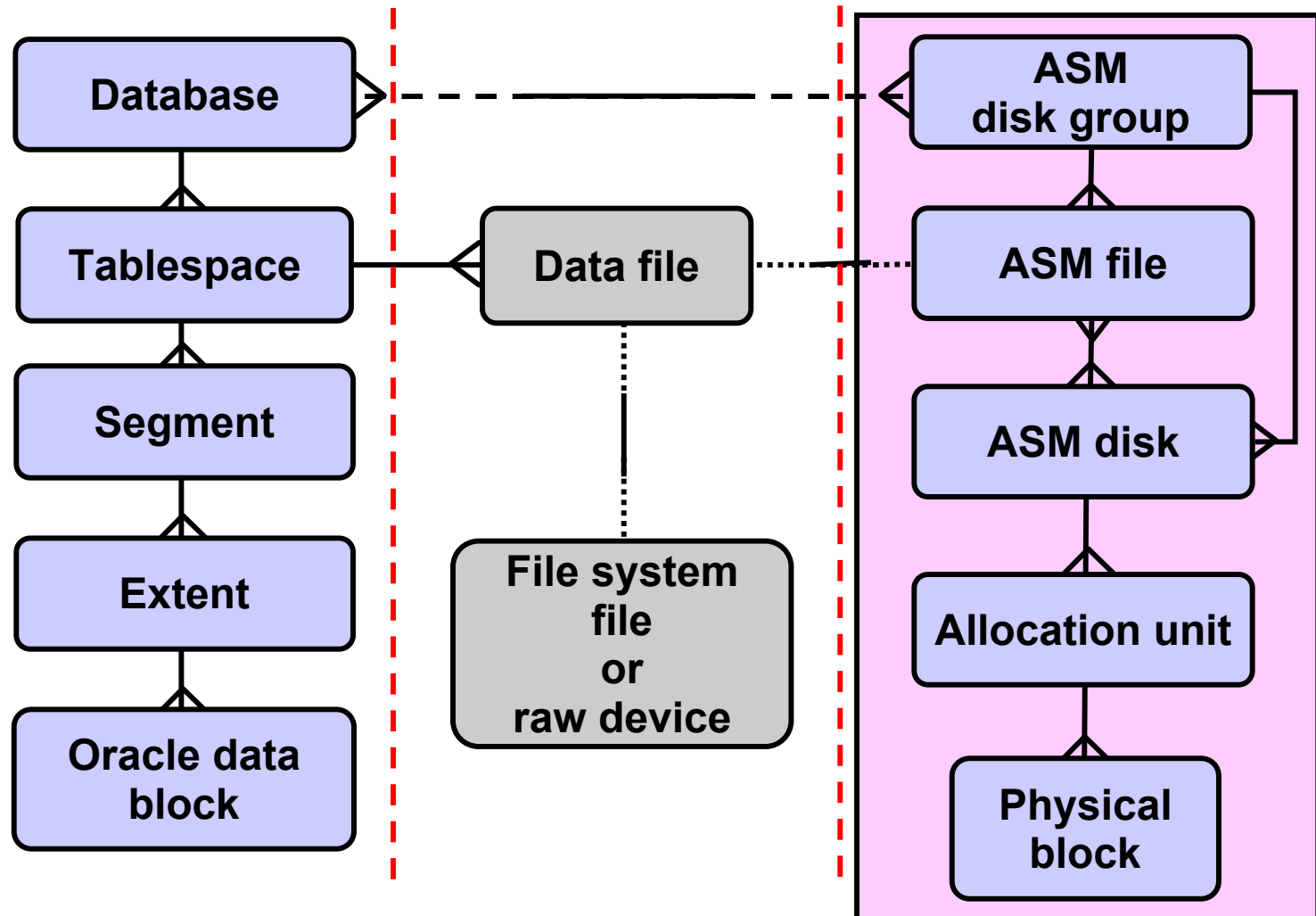


ASM: Key Features and Benefits

ASM

- **Stripes files, but not logical volumes**
- **Provides online disk reconfiguration and dynamic rebalancing**
- **Allows for adjustable rebalancing speed**
- **Provides redundancy on a per-file basis**
- **Supports only Oracle database files**
- **Is cluster aware**
- **Is automatically installed**

ASM: Concepts



Summary

In this lesson, you should have learned how to:

- **Describe how table row data is stored in blocks**
- **Define the purpose of tablespaces and data files**
- **Create and manage tablespaces**
- **Obtain tablespace information**
- **Describe the main concepts and functionality of Automatic Storage Management (ASM)**

Practice Overview: Managing Database Storage Structures

This practice covers the following topics:

- **Creating tablespaces**
- **Gathering information about tablespaces**