


# 1. Introduction to Oracle9i

- What is Oracle?
- Principal Features
- Editions
- Releases
- Related Products

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## What is the Oracle Database?...

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- Oracle is a relational database management system
  - Reliably store large amounts of data in tables
  - Concurrent query and update access by many users
  - Built-in security
  - Recovery capabilities
- Competes with
  - Sybase from Sybase
  - SQL Server and Access from Microsoft
  - DB2, Informix from IBM


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The Oracle Database is the flagship product of Oracle Corporation. First released in 1979, it is a multi-user relational database management system for small or large systems.

All multi-user database products generally provide the following functionality:

- Reliably store large amounts of data in tables
- Concurrent query and update access by many users
- Built-in security
- Recovery capabilities

Oracle is in the same market space as DB2, Sybase, SQL Server and a few other products.



1.3

## ...What is the Oracle Database?


- Very scalable
  - Single processor PC to MPP and mainframes
- Very portable
  - Support for 90 + platforms
  - Code base is same for all platforms
- Many add-on features for “specialized” needs
  - Data Warehouse (CUBE, ROLLUP)
  - OLAP (Analytic functions such as DENSE\_RANK)
  - Much more...

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The Oracle database is very scalable. Oracle applications can scale from a mobile computing device to a massively parallel system running the new Oracle9i feature Real Application Clusters (formerly called Oracle Parallel Server).

Since the code base is the same across all platforms, applications written on one Oracle platform are easily ported to another platform. Oracle is provided on over 90 hardware/software platforms including Unix, Linux, Windows, and mainframe.

Oracle Corp has bundled many built-in and optional (extra cost) features that extend the usability of the database into specialized areas such as Data Warehousing and OLAP.

1.4

## Principal Features...


- ANSI compliant SQL support
  - Extensions provided
- PL/SQL procedural language
  - Procedures, functions, triggers
  - Procedural language
    - Conditional logic
    - Variable definition, etc
- SQL\*Plus, iSQL\*Plus
  - Utility for ad-hoc query, PL/SQL development, database administration

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As with most relational database vendors, Oracle supports ANSI standard SQL, but adds its' own proprietary extensions. Even the standard SQL `SELECT` statement has its' extensions. For example, Oracle provides `CONNECT BY` for reporting-type queries against hierarchical data and the `NOWAIT` option to avoid waiting for exclusive lock access.

An important extension is PL/SQL, formally called Procedural Language Extensions to SQL. It is a 4th generation language that we use to write database procedures, functions and triggers. (Note that Oracle8i and up also supports Java for this purpose.) As a 4GL, it provides conditional logic (e.g. IF statement), variable definition and assignment, looping and branching constructs.

One of the standard tools that is provided with Oracle is SQL\*Plus. It is used for ad-hoc query, database administration and PL/SQL development. SQL\*Plus is often called the "query tool", though it supports all SQL statements. It is a ubiquitous "free" utility (shipped with all editions and releases of the Oracle database), and thus is required learning. Its use is covered in detail in the SkillBuilders Introduction to Oracle for Developers course. iSQL\*Plus is a new browser-based version of SQL\*Plus, introduced with Oracle9i.



1.5

## ...Principal Features...

- Oracle Objects
  - Similar to Java, C++ classes
  - User-defined object types
    - Attributes (data)
    - Methods (related PL/SQL or Java code)
  - Collection support
    - VARRAYS, Associative Arrays, Nested Tables
  - Object Views
    - Object model on top of existing relational tables

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In the late 1990's, Oracle released Oracle8 (8.0). The highly visible and aggressively marketed feature in this release was support for objects. Oracle now had a Object-Relational Database (ORDBMS) to offer the marketplace.

Oracle objects are roughly similar to classes in Java and C++ languages. An Oracle object contains attributes (data) and methods (program code tied to the object that acts upon the object). An example of a method would be a constructor method that adds a new instance of the object.

Oracle also supports three types of collections: associative arrays, varrays and nested tables.

Using Oracle objects is not an all or nothing proposition. You can choose to build an object model on top of an existing relational model. Object views is designed for this purpose; I.e creating a view of an Object model on top of an existing relational table.

However, support for objects is limited, though better with the release of Oracle9i.



1.6

## ...Principal Features...

- **Concurrency and Transaction Support**
  - Row locks to protect transaction integrity
  - Transaction is any number of DML statements
    - INSERT, UPDATE, DELETE
  - Transaction starts with first DML operation
    - No `BEGIN TRANSACTION` command in Oracle
  - Changes are saved permanently with `COMMIT`
  - `ROLLBACK` undoes all changes up to the last `COMMIT`

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A single Oracle database can support hundreds or even thousands of users, all requesting updates to data. Oracle provides row-level locking to protect one transaction from another transaction.


A transaction is a set of recoverable DML operations. For example, a transaction may include:

- `INSERT` (start of transaction)
- `UPDATE`
- `UPDATE`
- `DELETE`
- `INSERT`

To end the transaction, we issue:

- `COMMIT` to make the changes permanent, or
- `ROLLBACK` to undo all the changes since the start of the transaction.

Note that, in Oracle, a transaction begins with a DML statement; there is no `BEGIN TRANSACTION` command.

1.7

## ...Principal Features...

- Security
  - Logon ID's password protected
  - Limits on disk and resource usage
  - Table access requires privilege via GRANT
  - Fine grained Auditing at session or object level
  - Data encryption


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As we would expect in a multi-user database environment, Oracle provides many standard security features.

All logon users are protected against unauthorized access either by an Oracle password or by the operating system.

Disk and system resources such as CPU time are protected. Disk usage is governed by assigning `QUOTA` on a tablespace; CPU resources are governed with profiles or with the Database Resource Manager.

Once logged into the database, privileges are needed to do anything. For example, to query a table created by another user, you will require `SELECT` privilege on that object. That can be granted by the object owner with a `GRANT` statement. Conversely, it can be taken away with the `REVOKE` statement.



1.8


## ...Principal Features...

- High Availability Features
  - Multiplexed Redo Log files
  - Recovery Manager (RMAN)
    - Utility for server-managed backup and recovery
  - Online reorganization
  - Logminer
  - Flashback Query
    - Execute query at previous point in time
    - “Self-Service” error correction
  - Partitioning

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Oracle provides many standard high availability features. These include:

- Multiplexed Redo Log files – All committed transactions are secure in the redo log file. Database (instance) failure is recoverable by applying committed transactions from the redo log files.
- Recovery Manager – RMAN is a built-in utility for server-managed backup and recovery.
- Online reorganization – Oracle has been providing limited online operations since release 8.0. 9i provides an advance in this area with the introduction of `DBMS_REDEFINITION` for complete online table redefinition.
- Logminer – Logminer is another built-in utility that provides the ability to “look inside” the redo logs, to see activity that has transpired in the database. Both `REDO` and `UNDO SQL` can be mined from the logs using Logminer.
- Flashback Query – This feature allows you to execute a query at previous point in time. By loading a table from a query run while in flashback query mode, we are provided “self-service” error correction capability.
- Partitioning – By dividing up large logical tables into smaller physical partitions (transparent to applications), we gain the ability to maintain pieces of the object, while leaving other partitions available for general use.

1.9

## ...Principal Features...


- High performance features
  - Cost based optimization
    - Access data based on database statistics
  - Indexes
    - Several types designed to improve query response time and throughput
  - Parallel Query
    - Spawn multiple processes to create query result
  - Parallel DML
    - Spawn multiple processes to perform update
  - Real Application Clusters
- Transparent Distributed Support
  - Transparent access to remote data

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Oracle will support query and update activity on very large databases. In order to accomplish this, many high performance features are built-in. These include:

- Cost Based Optimization – Oracle comes with a query optimizer that automatically and transparently optimizes the query access path based on database statistics such as object size.
- Indexes – Much like the index in a text book helps you find a specific item in the book, a database index is an object that helps find a row in a table. Oracle provides several index types, each designed for a different type of access or type of data. These include B-Tree, bitmap and function-based indexes.
- Parallel Query and Parallel DML – Parallel Query allows a single SQL statement to be processed by several server processes, thus reducing overall response time. This is excellent for I/O intensive operations.
- Real Application Clusters – This feature, formerly called Oracle Parallel Server, allows many servers (instances) to access the same set of database files, allowing the processing load to be distributed across many machines.

Oracle supports distributed database, meaning that one can access a table (query or update) on a remote server. Transparency is achieved via database objects called `SYNONYMS` and `DATABASE LINKS`.



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## ...Principal Features...

- Support for Web applications
  - Built-in Web Server (from Apache)
    - Use PL/SQL to generate HTML web pages
- Java Virtual Machine built-in to database
  - Write procedures in Java
- Multimedia support
  - *interMedia* Text, Audio, Video, Image

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After releasing Oracle8 (8.0), Oracle Corp indicated that the Internet was the key to its' future success. Since then the company has added new features and products designed for Internet and Web application support.

Oracle9i provides a built-in Web server from Apache. This means that PL/SQL can be used to generate dynamic Web pages that access data in the database.

Oracle also added support for Java in the database (via a Java Virtual Machine, JVM, installed in the database) and created an application server that also contained a Java virtual machine. (Large applications typically require a middle tier application server to support the business logic. Oracle provides this in the form of iAS. Note that Oracle Corp's first application server - OAS - was not very popular and has been rewritten and re-released as iAS.)

Developers can now write enterprise-strength Java applications using the Oracle product suite – Oracle9i database and iAS. These two products together will support Servlets and JSP (version 1.1 compliant - includes custom tag libraries) for the web-based front end, CORBA and EJB support in iAS, and JDBC, SQLJ and stored procedures (Java or PL/SQL) for database access (data management).

The *interMedia* product provides indexing and searching of text data. The *interMedia* Audio Image and Video product provides the storage, retrieval, management, and manipulation of multimedia data.



1.11


## ...Principal Features...

- XML support
  - Collectively called “XML DB”
  - XMLType datatype
    - Store and query XML document in column
  - New SQL operators, PL/SQL packages
  - XML Developers Kit
    - Parsers, XSLT Processor, more...
- Large object support
  - CLOB, BLOB, BFILE

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XML support is also provided in a set of features collectively called “XML DB”. XML can be stored natively in a table column defined with the datatype `XMLType`. SQL extensions and new PL/SQL packages have been added. An XML SQL Utility is provided for generating XML output from SQL or JDBC calls; an XML developers kit for Java, C++ and other languages is available. The XDK contains parsers, XSLT processors and much more.

Since Internet applications often involve multimedia datatypes, Oracle created new, more efficient built-in datatype support for character-based large objects (`CLOBs`) and binary large objects (`BLOBs`).



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## ...Principal Features

- Utilities
  - Export
    - Extract object definition and data from database
    - Excellent for moving objects to another DB
      - Even on different platform
    - Also use for secondary backup
  - Import
    - Insert exported definitions and data into DB
  - SQL\*Loader
    - Load ASCII fixed or variable data into table(s)

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All editions of the Oracle database come with three utilities. They are:

- Export – The export utility is used to extract object definitions (metadata) and data from a database. This is useful when you need to move or copy an object to another database (even on an entirely different platform) or as a secondary means of backup (consider RMAN as a primary backup utility).
- Import – The import utility can read the files created by the export utility and is used to insert objects (e.g. tables) and object data into a database.
- SQL\*Loader – The SQL\*Loader utility can read ASCII files containing fixed field or delimited records and load them into database tables.



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## DDL Statements


- CREATE TABLE
  - Creates a table
- CREATE INDEX
  - Creates an index
- DROP INDEX
  - Drops an index
- DROP TABLE
  - Drops a table from the database
- GRANT
  - Grants privileges or roles to a user or another role
- REVOKE
  - Removes privileges from a user or database role
- ALTER TABLE
  - Adds a column, redefines a column, changes storage allocation

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### Partial List of DDL Statements

There are numerous DDL (data definition language) statements. Each DDL statement effects the definition of some object in the database.

*It is important to note that DDL statements cannot be rolled back!*



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## DML Statements

- INSERT
  - Add rows of data to a table
- DELETE
  - Delete rows of data from a table
- UPDATE
  - Change data in a table
- SELECT
  - Retrieve rows of data from one or more tables or views

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DML statements manipulate the data within the database. All changes are made as part of a transaction and are tentative until a COMMIT is executed.

Numerous examples of all these SQL commands can be found throughout the course.



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## Enterprise Edition

- Full featured edition of Oracle database
- Contains features not provided in Standard Edition:
  - Multiple archive destinations, Transportable Tablespaces, etc
- Additional options can be purchased:
  - Real Application Clusters (formerly Oracle Parallel Server)
  - Partitioning
  - OLAP
  - Spatial
  - Advanced Security
  - Label Security

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There are several different editions of the Oracle database. They are all compatible in the sense that they all support the same SQL, PL/SQL, Java and XML, but they support different scalability features and options.

The Enterprise Edition is the grand-daddy. It supports all scalability, security and performance options such as Parallel Server, Partitioning and the Advanced Security Option (for network encryption and authentication). These options will be discussed in greater detail later in this unit.

**Real Application Clusters** - This allows multiple instances (server processes and associated memory; see definition in next chapter) to access a single set of database files. This is useful for load balancing and failover.

**Partitioning** - Tables and indexes can be partitioned, meaning that a single logical table consists of more than one physical underlying object. Useful for large objects that require too much resource to query, manipulate and/or manage. Divide and conquer! This feature was introduced in Oracle 8.0.

Source: [www.oracle.com/ip/deploy/database/8i/index.html](http://www.oracle.com/ip/deploy/database/8i/index.html)



## Standard & Personal Editions

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- Standard Edition
  - Does not support parallel server, partitioning
  - License permits maximum 4 processors
- Personal Edition
  - Single user desktop edition for Windows NT, 2000 and XP
  - SQL and PL/SQL compatibility with other editions
    - Exceptions where features are tied to EE add-on
    - e.g. OLAP, Data Mining

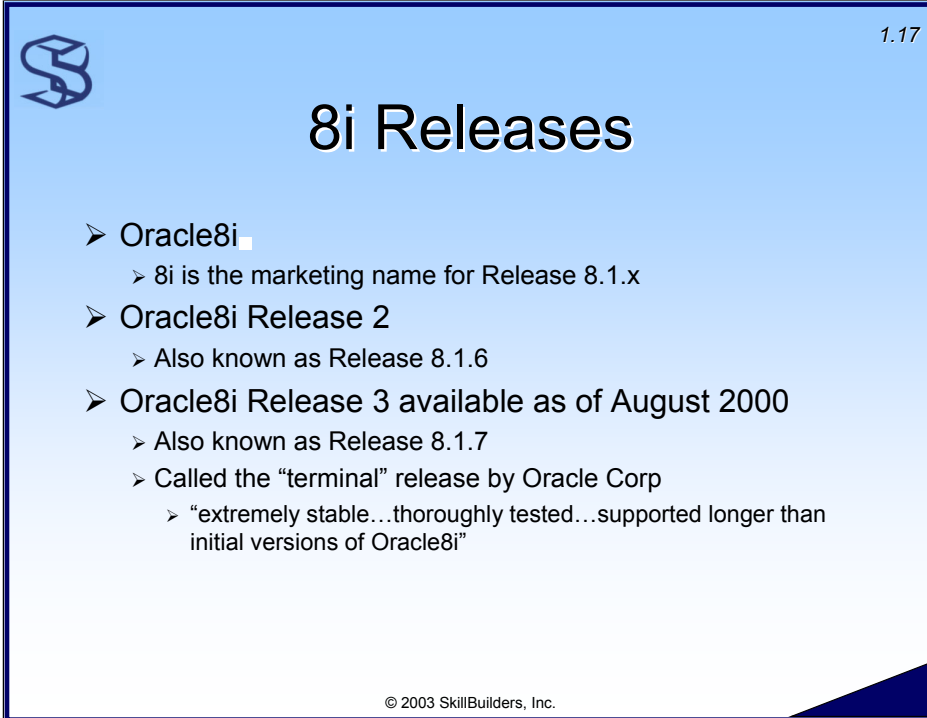
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Standard Edition will not scale up as much as Enterprise Edition because it will not support Parallel Server and Partitioning. An abbreviated list of other features that Standard Edition does not support:

- Online table redefinition
- Online index coalesce
- Parallel Query
- Parallel DML
- Parallel index build
- Parallel index scans

Personal Edition is a *single-user* license for desktops – Windows NT, XP and 2000. Excellent for application development and learning Oracle. Applications built with this platform can be migrated to Standard or Enterprise Edition without code changes.

Read the Oracle White Paper “Oracle9i Database: A Family of Database Products” found at [http://otn.oracle.com/products/oracle9i/pdf/9idb\\_rel2\\_prod\\_fam.pdf](http://otn.oracle.com/products/oracle9i/pdf/9idb_rel2_prod_fam.pdf) for a complete list of features that can be found with each edition of the database.



1.17


## 8i Releases

- Oracle8i
  - 8i is the marketing name for Release 8.1.x
- Oracle8i Release 2
  - Also known as Release 8.1.6
- Oracle8i Release 3 available as of August 2000
  - Also known as Release 8.1.7
  - Called the “terminal” release by Oracle Corp
    - “extremely stable...thoroughly tested...supported longer than initial versions of Oracle8i”

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“Oracle8i” is really just Oracle Release 8.1. The “i” stands for “internet” and was added for marketing purposes; “Oracle8i is an Internet ready database!”

Release 8.1.6 is also called Release 2 - certainly only to confuse us! 8.1.7 is also called Release 3, and is said by Oracle Corp to be very stable. It is the last release in the 8 series, hence the “terminal release”. Oracle will drop support for earlier versions shortly.




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## 9i Releases

- Oracle9i
  - 9i is the marketing name for Release 9.0.x and later
- Release 1 (9.0.1) released June 2001
- Oracle9i Release 2 (9.2.x)
  - Current release as of December 2002

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Oracle9i, like Oracle8i, focuses on the internet with continued support for XML and Java.



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## Oracle9i New Features

- Some of the new developer-related features:
  - External Tables
  - Flashback Query
  - Pipelined Functions
  - Resumable Space Management
  - ANSI Join Support
  - Enhanced OO Support
  - Time zone support
  - XML data type, XMLType

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**External Tables** provides for read only access of flat files as if they were an Oracle table. An access driver called `ORACLE_LOADER` makes this possible.

**Flashback Query** lets you run a query as if it were being run in the past. You can get results as if the data were in a state at a given point in time – in the past. The `UNDO_RETENTION` parameter to make this possible.

**Pipelined Functions** provides the means to start returning rows (piping rows) back to the caller before the function even completes.


With **Resumable Space Management**, a transaction that has encountered a space allocation error is suspended for a period of time - allowing you to fix the suspend condition and eventually allowing the transaction to resume.

**ANSI JOIN Support** allows one to write joins conformant to SQL92 syntax. They also allow one to write 'full outer joins' something that was not easily done up to now using the old syntax.

**Enhanced OO Support** provides more OO support including support for type evolution and inheritance.

**Time zone support** is available in timestamp datatypes and functions. Oracle maintains a db and session timezone for each session.

**XML datatype support** provides the means to hold native XML in a column of a table.



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## Related Products...

- Oracle Programmer
  - Set of pre-compilers for C, C++, COBOL, etc
  - Allows embedded SQL
- Oracle Developer
  - Develop robust custom client/server or Web applications with Oracle Forms, Reports
  - Analogous to Visual Basic
- JDeveloper
  - Java IDE based on Inprise JBuilder


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Oracle Corp provides several tools for developers (and end-users) that assist with the creation of applications.

Oracle Programmers is a set of precompilers that allow SQL statements to be directly embedded within 3<sup>rd</sup> generation languages such as C, C++ COBOL and more.

Oracle Developer (formerly called Developer 2000) is a development tool set designed for programmers. The tool set includes Form Builder (formerly Oracle Forms) and Report Builder (formerly Oracle Reports).

JDeveloper is a Java IDE based on Inprise's JBuilder.



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## ...Related Products

- 9iAS ■
  - Internet Application Server
  - Application server provides middle tier infrastructure
  - EJB and CORBA support
  - Competes with Weblogic, Websphere
  - Comes with Oracle Portal (formerly WebDB)
    - Easy to use tool for building HTML-based interfaces to database data
    - Also can use to manage DBs

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To support large Internet applications, Oracle also created a middleware component. (The middle tier supports business logic, removing that overhead from the database server and/or the display tier.) Oracle's first attempt was a product called Oracle Application Server (OAS). This product was overshadowed by competitors BEA Systems Weblogic and IBM's Websphere. Oracle has since rewritten the product; its' new name is Internet Application Server, or iAS.

Oracle Portal (formerly called WebDB) provides an HTML interface that end-users, programmers and database administrators can use to build Web-based database applications. End-users can build simple interfaces to their data. Programmers can create more robust interfaces while administrators can use Portal to view and manage database objects.



1.22

## Summary...

- Oracle9i is a relational database management system
- ANSI compliant SQL is supported
- SQL extensions such as PL/SQL are provided
- 3GL applications can access the database with Oracle Programmer (3GL precompilers or OCI)

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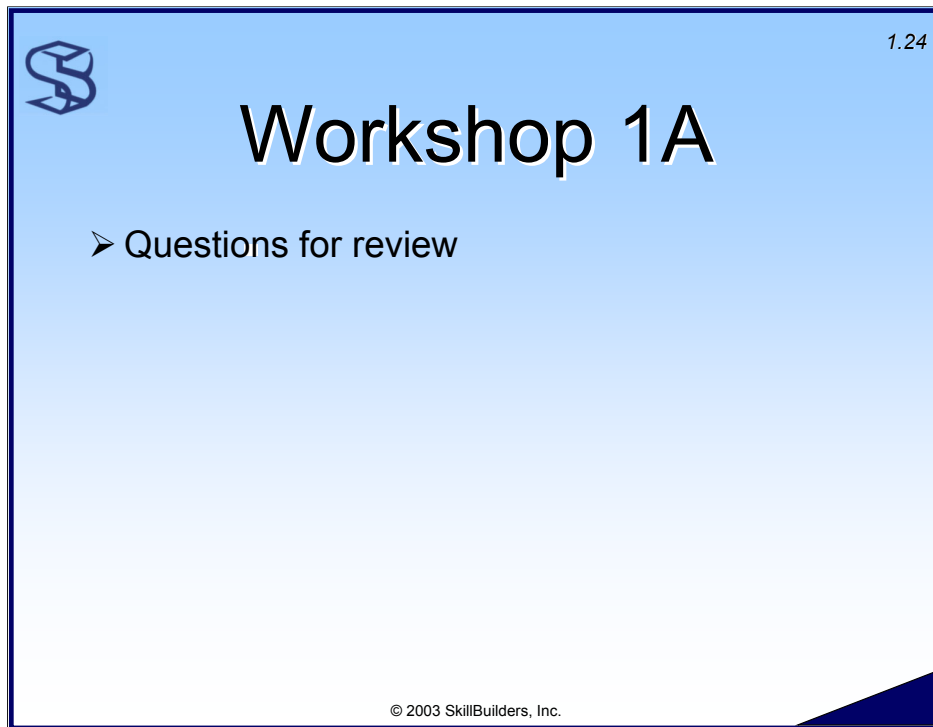


1.23

## ...Summary

- Enterprise Edition is the full-scale product
  - Many scalability features such as Real Application Clusters and partitioning are available


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### Workshop 1A

1. Oracle is a relational database management system, with an optional object support layer on top.  
TRUE or FALSE
2. SQL\*Plus is a Java IDE.  
TRUE or FALSE
3. Oracle userids are password protected.  
TRUE or FALSE
4. What command is used to give a user privileges?
5. The Flashback Query feature can allow me to see a table as it existed 15 minutes ago.  
TRUE or FALSE
6. I can use PL/SQL to generate dynamic Web pages directly from the database.  
TRUE or FALSE
7. Enterprise Edition provides the most scalability of all available editions of Oracle.  
TRUE or FALSE

8. DDL statements can be rolled back.  
TRUE or FALSE
  
9. INSERT, UPDATE, DELETE and SELECT statements are considered data manipulation language statements.  
TRUE or FALSE
  
10. I have a comma-delimited ASCII text file that I need to load into a table. What utility should I use?
  - A. IMPORT
  - B. EXPORT
  - C. SQL\*Loader
  - D. It cannot be done.



1.26

## Oracle Architecture...

- Database
  - Disk-based files that contain system and user data
- Instance
  - Processes
  - Memory
    - System Global Area – Shared memory including buffer cache
    - Cache for recently used data blocks
    - Many more memory areas...
  - Facilitates access to the database
- Can not access database unless instance is started

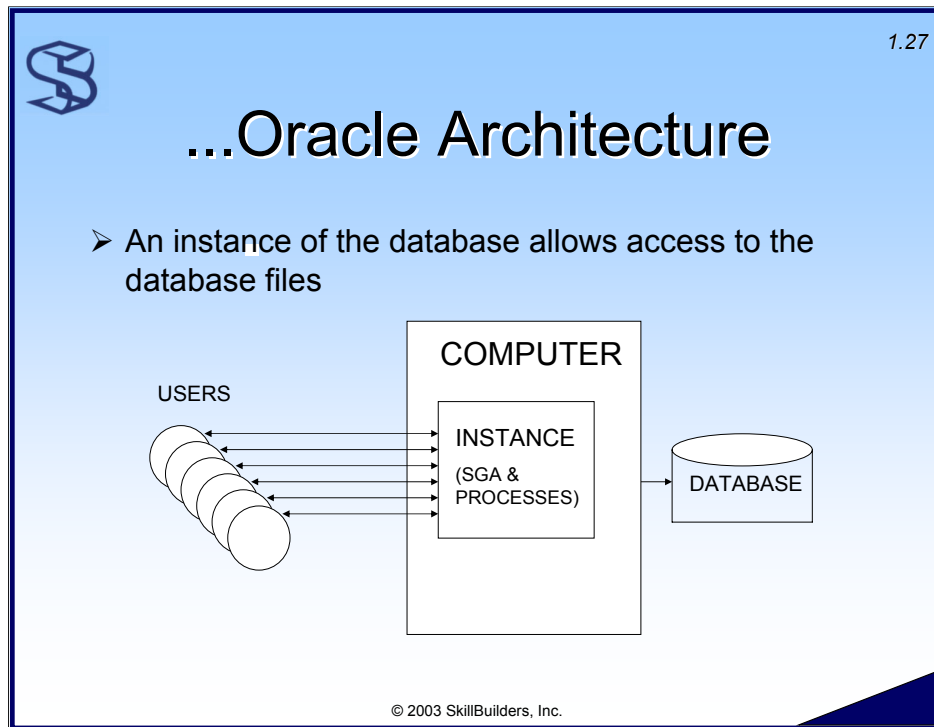
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Oracle makes a distinction between database files that contain database data and the memory and process required to access those files. A **database** is the disk-based files that contain the system and user data. An **instance** is the active processes and memory areas that facilitate access the the database.

Instance and database each are assigned a name. They often have the same name (but not always true; in a Real Application Cluster environment, multiple instances can access the same database - the instances will not have the exact same name.)

The instance name is called the System Identifier (SID). It is stored in the environment variable `$ORACLE_SID`. It can also be seen by querying the dynamic performance table `v$instance`. When you connect to the database with the `CONNECT` command, the current `$ORACLE_SID` (or the database alias explicitly specified in the `CONNECT` command) determines which instance you connect to and thus what database you are connected to. You cannot be connected to more than one database at a time.


The database name is assigned with the `CREATE DATABASE` command and is stored in a control file. Query `v$database` to see the database name.



A picture is worth a thousand words. Here we see that in order to access the database, we must have an **instance** started.

Note that an *instance* provides access to one database (plus other databases via Distributed Database). However, a single database can be accessed by more than one *instance*; this is accomplished by using the Oracle Parallel Server (OPS) architecture in Oracle releases prior to Oracle9i and is accomplished by using Real Application Clusters (RAC) in Oracle9i and later.

Note also that a single computer can run more than one *instance*, or more than one **database/instance**. (A single machine running more than one instance is typically a unit testing computer in the development environment. A production database/instance normally runs on a dedicated machine.)



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## Common Objects

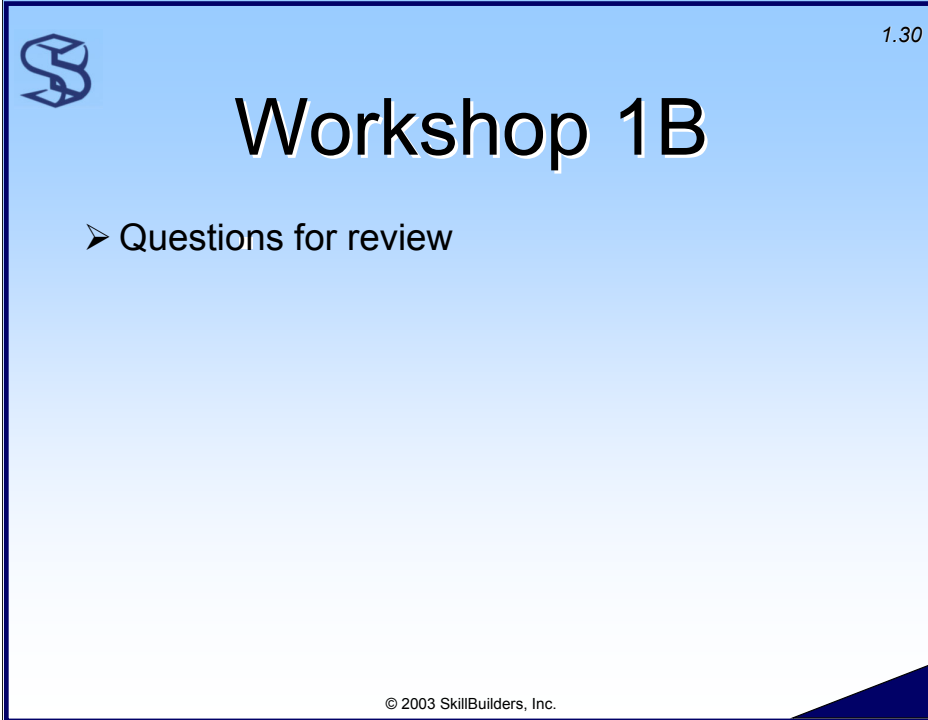
- Schema
  - Logical group of objects
  - All owned by the same user
- Table
  - Simple structure of columns and rows
  - Optional OO support
- Tablespace
  - Repository for tables, indexes
- Index
  - Pointer to table data
  - Improve performance
- View
  - Logical alternate view of one or more tables
- Sequence
  - Number generator
- Synonym
  - Alternate name for an object

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As an application developer, you will need to know about several objects that can be created. These include:

- Schema – A schema is a logical group of objects all owned by the same user. So, when user `DAVE` is first created, the schema is empty. If `DAVE` executes a `CREATE TABLE` command, the schema has one object.
- Table – A table is the basic unit of storage in Oracle. Most tables are simple structures of columns and rows. However, with the advent of object support, a table can contain objects (complex user-defined datatypes that model real-world objects) or even be an object table (contains objects rather than columns and rows). A table is identified by a schema name and a table name, for example `DAVE.CUSTOMER`.
- Tablespace – A tablespace is a logical repository of other objects such as tables and indexes. A tablespace points to one or more datafiles – actual disk files that contain the blocks that make up our database. We often group related tables and indexes in the same tablespace for administrative reasons. For example, you can take an entire tablespace offline with one simple command.
- Index – An index is an object that contains pointers to table data and is created to improve the performance of access to a table. Once created, an index is automatically and transparently maintained by Oracle as inserts, updates and deletes occur against the related table.

- View – A view is a logical and alternate representation of one or more underlying tables (or views).
- Sequence – An Oracle sequence is an object that produces numbers. It is often used as a primary key generator.
- Synonym – A synonym is an alternate name for an object. Often used to eliminate the need for a schema name. For example, rather than user GEOFF querying “DAVE . CUSTOMER”, user GEOFF can, after creating a synonym, query “CUSTOMER”.

A presentation slide with a light blue background and a dark blue border. In the top left corner is a stylized 'S' logo. In the top right corner is the number '1.30'. The main title 'Workshop 1B' is centered in a large, bold, black font. Below the title is a bullet point '➤ Questions for review'. At the bottom center, there is a small copyright notice: '© 2003 SkillBuilders, Inc.'

1.30

# Workshop 1B

➤ Questions for review

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## Workshop 1B

1. What is an *instance*?
2. The SGA is a shared memory area that contains the buffer cache.  
TRUE or FALSE
3. The buffer cache increase database performance by keeping recently used data blocks in memory, lowering physical I/O counts.  
TRUE or FALSE
4. The database can be accessed even if the instance is not started.  
TRUE or FALSE
5. What object can be created to eliminate the need to include the schema name in a reference to another user's object?
6. What object can be created to improve the performance of a query?

Workshop continues on the next page...

7. What object generates numbers?
  
8. When a table is created, it is created in a \_\_\_\_\_?  
View  
Tablespace  
Index  
Synonym