CRITICAL SKILLS

1.1 Define a Database
1.2 Learn the Oracle Database 10g Architecture
1.3 Learn the Basic Oracle Database 10g Data Types
1.4 Work with Tables
1.5 Work with Stored Objects
1.6 Become Familiar with Other Important Items in the Oracle Database 10g
1.7 Work with Object and System Privileges
1.8 Introduce Yourself to the Grid
1.9 Tie It All Together
This chapter is your first one on your Oracle Database 10g journey. From here on out, we will walk you through the skills that you need to begin working with the Oracle Database 10g. We’ll begin at the core of this product, with the fundamentals of a database. This chapter will also help you form an understanding of the contents of your database and prepare you to move into the complex areas of Oracle Database 10g technology.

**CRITICAL SKILL 1.1**

**Define a Database**

Oracle Database 10g—the latest offering from a software giant in northern California. Perhaps you have heard a lot of hype about Oracle Database 10g, perhaps not. Regardless of your experience, 10g is a rich, full-featured software intended to revolutionize the way many companies do their database business. Database you say—now there’s a word you hear all the time! In a nutshell, a database is an electronic collection of information designed to meet a handful of needs:

1. Databases provide one-stop shopping for all your data storage requirements, be they in diverse areas such as human resources, finance, inventory, or sales and then some. The database contains any amount of data, from the small to the huge. Data volumes in excess of many hundreds of gigabytes are commonplace in this day and age, where a gigabyte is 1,073,741,824 bytes.

2. Databases must provide mechanisms to retrieve data quickly as applications interact with their contents. It is one thing to store tax information for the 300 million citizens of a country, but it’s another kettle of fish to retrieve that data, as required, in a short time period.

3. Databases allow the sharing of corporate data such that personnel data is shared amongst one’s payroll, benefits, and pension systems. A familiar adage in the database industry is “write once, read many.” Databases are a manifestation of that saying—one’s name, address, and other tombstone personnel information are stored in one place and read by as many systems requiring these details.

There is a great deal of academic interest in the database industry, the theory of the relational database being founded in relational algebra. As data is entered into and stored in the Oracle Database 10g, the relationships it has to other data are defined as well. This allows the assembling of required data as applications run. These relationships can be described in plain English for a fictitious computer parts store as follows:

- Each geographical location within which the store does business is uniquely identified by a `quad_id`.
Each manufacturer that supplies parts is uniquely identified by a ten-character manufacturer_id. When a new manufacturer is registered with the system, it is assigned a quad_id based on its location.

Each item in the store’s inventory is uniquely identified by a ten-character part_id, and must be associated with a valid manufacturer_id.

Based on these three points, practitioners commonly develop statements similar to the following to describe the relationships between locations, manufacturers, and parts:

- There is a one-to-many relationship between locations and manufacturers—more than one manufacturer can reside in a specified location.
- There is a one-to-many relationship between manufacturers and computer parts—the store purchases many different parts from each manufacturer.

These two relationships are established as data is captured in the store’s database and other relationships can be deduced as a result—for example, one can safely say “parts are manufactured in one or more locations based on the fact that there are many manufacturers supplying many different products.” Oracle has always been a relational database product, commanding a significant percentage of market share compared to its major competition. Let’s get started and look at the Oracle Database 10g architecture.

**CRITICAL SKILL 1.2**

Learn the Oracle Database 10g Architecture

As with many new software experiences, there is some jargon that we should get out of the way before starting this section.

- Oracle Database 10g is said to be started when the appropriate commands have been invoked to make it accessible on a day-to-day basis to applications.
- The act of stopping Oracle Database 10g is called shutdown. When Oracle Database 10g is shut down, nobody can access the data in its files.
- An instance is a set of processes that run in a computer’s memory and provide access to the many files that come together to define themselves as Oracle Database 10g.
- A background process supports access to a started Oracle Database 10g, playing a vital role in Oracle’s database implementation. Various background processes are spawned when starting the database and each performs a handful of tasks until a database is shut down.

Let’s now look at the assortment of files and background processes that support the Oracle Database 10g.
NOTE
In order to work with the code snippets and the sample schemas we discuss throughout this book, you will need to have the Oracle Database 10g software installed and the first database successfully created. The Database Configuration Assistant (dbca) is the fastest way to set up your first database. Most of the time you simply accept the defaults suggested on the dbca screens. If you have any problems with either the software installation or the dbca, please consult either a more senior colleague or surf MetaLink (http://metalink.oracle.com) to get assistance, after supplying appropriate login credentials.

The Control Files
These are binary files containing information about the assortment of files that come together to support the Oracle Database 10g. They contain information that describes the names, locations, and sizes of the database files. Oracle insists there is one control file, but savvy technicians have two or three and sometimes more. As the Oracle Database 10g is started, the control files are read and the files described therein are opened to support the running database.

The Online Redo Logs
As sessions interact with the Oracle Database 10g, the details of their activities are recorded in the online redo logs. Many think of these as the transaction logs. A transaction is a unit of work, passed to the database for processing. The following shows a few activities that can be referred to as two transactions.

```
-- Begin of transaction #1
create some new information
update some existing information
create some more new information
delete some information
save all the work that has been accomplished
-- End of transaction #1
-- Begin transaction #2
update some information
back out the update by not saving the changed data
-- End transaction #2
```

Oracle Database 10g insists that there are at least two online redo logs to support the instance. In fact, most databases have two or more redo log groups with each group having the same number of equally sized members.
Chapter 1: Database Fundamentals

The SYSTEM Tablespace

Tablespace is a fancy Oracle Database 10g name for a database file. Think of it as a space where a table resides. As an Oracle Database 10g is created, a system tablespace is built that contains Oracle’s data dictionary. As Oracle Database 10g operates, it continually gets operational information out of its data dictionary and, as records are created, this system tablespace defines attributes of the data it stores, such as:

- The data type of pieces of information. Are they numeric, alphanumeric, or perhaps binary of some video or audio format?
- The maximum allowable size of fields as they are populated by the applications. This is where, for example, a country description is defined as from one to 30 characters long, and containing only letters.
- Who owns the information as the database data files are populated?
- Who is allowed to look at each other’s data and what types of activities each user of the database can perform on that data?

The system tablespace is a very close cousin of the sysaux tablespace discussed next.

The SYSAUX Tablespace

Many of the tools and options that support the Oracle Database 10g activities store their objects in this sysaux tablespace. This is mandatory as a database is created. The Oracle Enterprise Manager (OEM) Grid Control repository used to go in its own oem_repository tablespace, but with Oracle Database 10g its objects now reside in sysaux.

Default Temporary Tablespace

As the dbca does its thing, a tablespace is created that serves as the default location for intermediary objects Oracle Database 10g builds as it processes SQL statements. SQL stands for the structured query language, an industry standard in the database arena, used to retrieve, create, change, and update data. Most of the work Oracle does to assemble a result set for a query operation is done in memory. A result set is a collection of data that qualifies for inclusion in a query passed to Oracle. If the amount of memory allocated for query processing is insufficient to accommodate all the activities required to assemble data, Oracle uses this default temporary tablespace as its secondary work area for many activities including sorting.

Undo Tablespace

As sessions interact with the Oracle Database 10g, they create, change, and delete data. Undo is the act of restoring data to a previous state. Suppose one’s address is changed from 123 Any Street to 456 New Street via a screen in the personnel application.
The user who is making the change has not yet saved the transaction. Until that transaction is saved (referred to as committed in the world of Oracle Database 10g) or abandoned (referred to as rolled back in the same world), Oracle maintains a copy of the changed row in its undo tablespace.

**The System Parameter File**

Oracle Database 10g sometimes calls the system parameter file its spfile. This is where its startup parameters are defined and values in this file determine the environment within which the database operates. As one starts an Oracle instance, the spfile is read and various memory structures are allocated based on its contents.

**Background Processes**

Essentially, background processes facilitate access to the Oracle Database 10g and support the instance while it is running. These are the main background processes, many of their names not having changed over the past few releases prior to Oracle Database 10g.

- **Database writer (dbwr)** processes are responsible for writing the contents of database buffers to disk. As sessions interact with the Oracle Database 10g, all the information they use passes through Oracle’s database buffers, a segment of memory allocated for this activity.

- **The log writer (lgwr) process** manages the writing of information to the online redo logs. A log buffer area is set aside in memory where information destined for the online redo logs is staged. The transfer of this information from memory to disk is handled by the lgwr process.

- **The checkpoint process (ckpt)** is responsible for updating information in Oracle Database 10g’s files during a checkpoint activity. A checkpoint is the activity of writing information from memory to the appropriate locations in the Oracle Database 10g. Think of a checkpoint as a stake in the ground allowing the restoration of a system to a specific point in time. The checkpoint process may trigger lgwr and dbwr to do their specialized tasks.

- **The system monitor (smon) process** is the gatekeeper of consistency as the Oracle Database 10g runs. Consistency defines the interrelatedness of the database components with one another. A consistent instance must be established every time the Oracle Database 10g starts and it is smon’s job to continually enforce and reestablish this consistency. Plainly put—an inconsistent database is trouble!

- **The process monitor (pmon) process** is responsible for cleaning up any resources that may have been tied up by aborted sessions interacting with the database. The famous CTRL-ALT-DEL that people tend to use to reboot a personal computer can leave resources tied up in the Oracle Database 10g. It is pmon’s job to free up these resources.
The job queue coordination (cjq0) process is responsible for spawning job processes from Oracle Database 10g’s internal job queue. Oracle Database 10g does some self-management using its job queue, and users of the database can create jobs and have them submitted to this cjq0 coordinator.

The archiver (arc0) process is responsible for copying online redo logs to a secondary storage location before they are reused by the next set of transactions. In the “Online Redo Logs” section of this chapter, we discuss how Oracle Database 10g insists there are at least two online redo logs. Suppose we call these groups A and B. Oracle Database 10g uses these two groups in a cyclical fashion, moving back and forth from A to B to A to B and so on. The arc0 process, when and if instructed, will make a copy of a file from log group A before allowing it to be reused.

Figure 1-1 illustrates the way the architecture components we have described come together to support the Oracle Database 10g. The Oracle Database 10g is started, the control files are read to get its bearings. Then the online redo logs and the assortment of tablespaces listed in the control files are acquired. As the instance comes to life, the background processes take over and manage the operations of the database from there.

FIGURE 1-1. The Oracle Database 10g architecture
Project 1-1  Reviewing the Oracle Database 10g Architecture

There are many types of files that come together to support the Oracle Database 10g. In this section, we have discussed control files, online redo logs, the system tablespace, and an assortment of tablespaces that support the database. As well, we have looked at the series of background processes that allow users to interact with Oracle Database 10g. In this brief project, you will apply what you have learned about the processes that support the Oracle Database 10g. As you descend into the land of Oracle Database 10g, this information is crucial to your understanding of this remarkable software solution.

Step by Step

1. There are a few pieces missing in the following diagram of the infrastructure of files that support the Oracle Database 10g. Fill in the missing text where required. You can confirm your answers by reviewing BEGP1-1a.tif online.

2. The second diagram shows a partial makeup of the background processes with Oracle Database 10g. Complete the missing text where indicated by broken lines. Again, you can check your answers online by viewing BEGP1-2a.tif.
Project Summary

The reader need not master the Oracle Database 10g architecture to become fluent with the software. Just as an electrician needs the assistance of a good set of blueprints, the Oracle Database 10g technical person should understand some of the inner workings of the software. A peek under the covers, as brief as it may have been in this section, is a good path to follow while becoming familiar with what Oracle Database 10g is all about.

Before moving on to discuss Oracle Database 10g data types, let’s spend a minute looking at the database administrator, the ultimate director of the operations of the database.

The Database Administrator

This privileged user of the Oracle Database 10g is commonly the most experienced technician in the shop, with some exceptions. Often, recent adopters of the Oracle technology have little or no in-house experience, and one or more employees may find themselves targets of the familiar directive “So, you’re the new Oracle Database 10g DBA!” One scrambles to find sources for technical knowledge when thrust into this role and, what better place to be than reading Oracle Database 10g: A Beginner’s Guide?

The following list outlines common responsibilities of the Oracle Database 10g DBA:

- Install and configure the Oracle Database 10g software.
- Create tablespaces within which application data will reside.
- Create and manage accounts.
- Tweak the environment within which the Oracle Database 10g operates by adjusting initialization parameters using the system parameter file.
- Configure backups and carry out recovery tests to ensure the usability and integrity of system backups.
- Work with developers to ensure the code they write is optimal, and use the server’s resources as efficiently as possible.
- Keep abreast of the emerging technology and be involved in scoping out future direction based on enhancements delivered with new software releases.
- Work with Oracle Support Services, initiating technical assistance requests (iTARs) to engage support analysts in problem-solving endeavors. The front-end to the iTAR creation process is called MetaLink.
- Tune the Oracle Database 10g so applications can coexist with one another on the same server and share that machine’s resources efficiently.
- Work with the system administrators to ensure the appropriate disk space and processor power are available and properly utilized.
As with most lists, after reading the preceding bullet points, you may wonder what else DBAs do with their time. As you work with the Oracle Database 10g, you will experience other activities that will plug the loopholes that may exist in the previous list.

**CRITICAL SKILL 1.3**

Learn the Basic Oracle Database 10g Data Types

Very early in one’s journey through the world of Oracle Database 10g, it becomes time to learn its common data types. Regardless of one’s past experiences in information technology, data types are nothing new. Let’s look at the most common type of data that can be stored in the Oracle Database 10g, keeping in mind that the list is much longer than the one we present here.

**varchar2**

By far the most common data type, varchar2 allows storage of just about any character that can be entered from a computer keyboard. In earlier software solutions, we commonly referred to this as alphanumeric data. The maximum length of varchar2 is 4000 bytes or characters. It is possible to store numeric data in this data type. This is a variable length character string, with no storing of trailing insignificant white space. Thus, if “Turkey       “ is passed to a column defined as varchar2, it will store the text as “Turkey”. The following listing shows a few sample varchar2 data definitions.

```sql
create table ... ( 
    name        varchar2(30),
    city        varchar2(30),
    ... 
    state       varchar2(2));
```

If a program or SQL statement tries to store a set of characters in a varchar2 field that is longer than the field’s specification, an error is returned and the statement abends.

**number**

The number data type allows the storing of integer as well as integer/decimal digits. When noninteger data is stored, the portion to the left of the decimal is referred to as precision, and that to the right as scale. The maximum precision is 38 and the maximum scale is 127. The confusing part of the specification of number data type comes into play when storing noninteger information. Table 1-1 illustrates this concept.
Chapter 1: Database Fundamentals

The secret here is that the integer portion of a number data type where decimal places are specified is the difference between the two numbers. As Table 1-1 illustrates, the specification (9,4) allows for five, not nine, integer digits. If more decimal digits are received than the column definition permits, it rounds the value before storage.

**date**

The date data type stores time and date information, with the time component rounded to the nearest full second. There are many, many functions performed on date fields as they are extracted from an Oracle Database 10g. Even though we supposedly learned something during the millennium issues associated with the year 2000, we still commonly use a two-digit year designator.

As date columns are extracted from the Oracle Database 10g, it is common to perform a function on their values to make them more readable. By default, the time component of a date column is not displayed without manipulating its contents using a to_char function described in Chapter 2.

**timestamp**

The timestamp data type is a close relative of date. There is a time component in this data type, displayed with the data without the need for the to_char function. This listing illustrates this concept:

```
SQL> create table timestamp_test (ts timestamp);
Table created.
SQL> insert into timestamp_test values (sysdate);
1 row created.
SQL> select * from timestamp_test;
TS
---------------------------------------------
14-DEC-06 05.25.07.000000 PM
```

### Table 1-1. Number Data Type Specification

<table>
<thead>
<tr>
<th>Number Specification</th>
<th>Column Length</th>
<th>Decimal Digits</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3,2)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>(6,3)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>(17,12)</td>
<td>17</td>
<td>12</td>
</tr>
</tbody>
</table>
12 Oracle Database 10g: A Beginner’s Guide

```
SQL> select * from date_test;
TS
--------
14-DEC-06
```

clob
The clob data type allows storage of very large objects in excess of four gigabytes in size. Since this is a true character data type, it is very similar to the varchar2 data type except for its much larger maximum size.

blob
The blob data type permits storage of large unstructured binary objects. Sound and video are examples of blob data.

It’s now time to have a look at the most common object in the Oracle Database 10g—the table. After that, we will have a look at a few types of programming units written using SQL, which a person can store in the Oracle Database 10g.

**CRITICAL SKILL 1.4**

**Work with Tables**

The best way to think of a table in a relational database such as Oracle Database 10g is to see it as a spreadsheet with rows and columns. With this in mind, note the following:

- Rows are often referred to as *records*.
- Each column has a name unique to the table within which it resides.
- The intersection of each row and column, referred to as a cell in a spreadsheet, is called a *field* in Oracle Database 10g.

Picture the following SQL statement that creates a table (the line numbers are not part of the code):

```
1- create table part_master (  
2-   id                   number(8) not null,  
3-   manufacturer_code    number(4) not null,  
4-   inception            date not null,  
5-   description          varchar2(60) not null,  
6-   unit_price           number(6,2) not null,  
7-   in_stock             varchar2(1));
```

Let’s pick apart the code and highlight the main points in Table 1-2.

Table 1-2 mentions the concept of a relational database. Let’s inspect a few other tables and see how they are related to one another.
The manufacturer_code column in part_master points to a record in manufacturer. As well, some columns in manufacturer may end up being related to column values in other tables. Figure 1-2 illustrates these relationship concepts, the heart of the Oracle Database 10g implementation.

### TABLE 1-2. part_master Table Definitions

**Line** | **Important Points**
--- | ---
1 | The table has a unique name, from one to 30 characters. It is stored in Oracle Database 10g’s data dictionary in uppercase.
2 | The ID column is numeric with anywhere from one to eight digits. The application that creates and keeps track of parts may insist that the first character of the ID be a digit between 1 and 9. Since the field is defined as numeric, if the leading digit were a 0, the part ID would only be seven digits long.
3 | The manufacturer_code is the only manufacturer information stored in part_master. Further information about who made the product is in a related table—hence, the terminology relational database.
4 | inception, being a date field, contains a date and time specification, though it will display with a default month abbreviation and a two-character year unless some manual manipulation is performed (for example, 12-NOV-05).
5 | description is a free form field with a variable length of up to 30 characters.
6 | unit_price can accommodate up to four integer and two decimal digits.
7 | in_stock is a one-character flag of sorts—thus, the system designers can decide to use an indicator like a “1” or “X” to represent items that are in stock. Notice how this is the only one of seven fields in the PART_MASTER table that can be left blank.

**Tables Related to part_master**

The manufacturer_code column in part_master points to a record in manufacturer. As well, some columns in manufacturer may end up being related to column values in other tables. Figure 1-2 illustrates these relationship concepts, the heart of the Oracle Database 10g implementation.
Suppose someone wanted to know where in the country a certain part was manufactured. By looking at Figure 1-2, that information is not readily available in part_master. However, part_master has a manufacturer_code. So, a person would traverse to manufacturer using manufacturer_code to get a location_id. Armed with that value, one then proceeds to location to get a quadrant column value. After this navigation is complete, a person would know where a specific part is built. Table 1-3 maps out this journey.

As illustrated in Table 1-3, we can deduce that part 33499909 comes from the Pacific Northwest—a deduction that is made by following the relationships between matching columns in the three tables in question.

**CRITICAL SKILL 1.5**

**Work with Stored Objects**

Oracle Database 10g offers the ability to store user-defined programming units in the data dictionary, called stored objects. These programming units are written in PL/SQL, the topic of Chapter 7. Without worrying about what goes inside these objects, let’s do an overview of what they are all about.

<table>
<thead>
<tr>
<th>Table</th>
<th>Part Number</th>
<th>Column Value</th>
<th>Related Column Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>part_master</td>
<td>33499909</td>
<td>manufacturer_code</td>
<td>3490</td>
</tr>
<tr>
<td>manufacturer</td>
<td>3490</td>
<td>location_id</td>
<td>5</td>
</tr>
<tr>
<td>location</td>
<td>5</td>
<td>quadrant</td>
<td>Pacific Northwest</td>
</tr>
</tbody>
</table>

**TABLE 1-3. Following Relationships Between Tables**
Views

Views are predefined subsets of data from an Oracle Database 10g table. The SQL query that builds the view is stored in the data dictionary and need not be reassembled every time the view is used. Suppose a personnel application stores the location of all employees in its EMPLOYEE_MASTER table in the loc_id column. With Oracle Database 10g, you can define a view called emp_hq as follows:

```
create or replace view emp_hq
as select * from employee_master
where loc_id = '2';
```
EMP_HQ becomes a valid object of the select statement just as if it were a table of its own.

**Triggers**

Just as their name implies, triggers are stored objects that fire based on the execution of certain events. Suppose a payroll application wants to audit salary increases. A trigger is created that fires when the `salary` column in `hr_master` is updated. The trigger could do the following:

1. Create a record in `sal_audit`.
2. Trap the time and date of the transaction.
3. Place the user's login ID in the `doer` column.
4. Place the old salary value in the `old_sal` column.
5. Place the new salary value in `new_sal` column.

Code in the trigger traps the event by specifying `on update`. While triggers are commonly used for auditing, the types of activities they can initiate are endless.

**NOTE**

*Triggers cannot exist independent of an Oracle Database 10g table. They are associated with one and only one table and, if a table is dropped, so is the trigger.*

Triggers, as well as procedures, packages, and functions described next, are most commonly written using PL/SQL. The PL/SQL programming language is the topic of Chapter 6.

**Procedures**

Procedures perform specific tasks as applications interact with the Oracle Database 10g. If there are a number of interrelated activities to carry out in one place, a procedure is an ideal way to do this. Procedures can accept parameters when invoked and can interact with objects in the Oracle Database 10g. They encapsulate related activities into single programming units that simplify logic and share data values as they perform various activities. They offer extremely flexible features, many of which are not available with triggers.

**Functions**

Functions are very close relatives of procedures, except that they return a value to the code that called them. Oracle Database 10g delivers many functions out of the box and...
developers create their own functions to augment what is delivered with the software. Suppose one wants to strip all the vowels out of a name with a function. One passes in a name (for instance, Bellissimo) and gets back the text “Blslsm” when the function completes its work. Let’s look at the get_age function which operates based on the following logic:

given a date of birth (format DD-MON-YYYY) 
using an SQL function 
get the months between today’s date and the date passed in divide the number of months by 12 truncate the results (giving the span in years between the 2 dates) pass integer back

Packages

Packages roll functions and procedures together into a cohesive programming unit. Often, developers like to bundle like functionality together since it makes logical sense to call one larger unit and have it perform a series of tasks. Let’s look at the CREATE_EMPLOYEE package in Table 1-4.

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Type</th>
<th>Work Accomplished</th>
</tr>
</thead>
<tbody>
<tr>
<td>give_holidays</td>
<td>Procedure</td>
<td>Creates the default holiday quota based on the new person’s rank in the company.</td>
</tr>
<tr>
<td>notify_benefits</td>
<td>Procedure</td>
<td>Creates a record in the BEN_QUEUE table to alert the benefits people of the new employee.</td>
</tr>
<tr>
<td>is_under_25</td>
<td>Function</td>
<td>Returns a “1” if the new employee is under 25 years old as of December 31 of the year they were hired.</td>
</tr>
<tr>
<td>is_over_59</td>
<td>Function</td>
<td>Returns a “1” if the new employee is 60 years old or older as of the calendar date of hire.</td>
</tr>
</tbody>
</table>

TABLE 1-4. Members of the CREATE_EMPLOYEE Package
Progress Check

1. Oracle Database 10g is referred to as a relational database. Why is the word relational used?

2. What is the maximum length of a varchar2 data type that can be stored in the Oracle Database 10g?

3. What is data consistency when referred to as a feature of the Oracle Database 10g? Give an example.

4. What types of stored objects can be encapsulated into an Oracle Database 10g package?

5. What is the fundamental difference between a procedure and a function in the Oracle Database 10g?

6. Data in the system tablespace is often referred to as metadata—data about data. Name at least two types of metadata in the system tablespace.

7. What is the difference between the timestamp and date data types?

8. What type of information and data ends up being stored in the SYSAUX tablespace?

Progress Check Answers

1. The word relational is used since Oracle Database 10g defines the relationships between tables. It is these relationships that allow applications to navigate an assortment of tables and assemble results from more than one table.

2. The varchar2 data type can accommodate up to 4000 characters.

3. Data consistency refers to the ability to ensure that related items of information are manipulated in a similar fashion. Suppose an application assigns a department to a new employee as a two-digit number field. Sometime down the road, due to company growth, the department identifier is changed to three digits. All the data where this used-to-be two-character identifier is stored must be changed to reflect the expansion of the department codes.

4. Packages can contain a mixture of one or more functions and procedures.

5. A procedure receives from zero to many parameters as it is invoked, and goes about its business until the end of its code segment. A function, on the other hand, accepts one or more parameters as it is called and returns a value to the code from where it was invoked. The procedure passes nothing back to its caller.

6. Metadata defines items such as the names of tables in the database, who owns the tables, the data types of the columns in each table, and who is allowed to look at what data.

7. When columns are displayed, they use the date data type, containing a day/month/year component, whereas, by default, the timestamp data type columns contain a time-of-day component as well.

8. The SYSAUX tablespace contains tables required to manage the Oracle Database 10g, such as the items required to support OEM Grid Control.
CRITICAL SKILL 1.6

Become Familiar with Other Important Items in the Oracle Database 10g

So far, we have had a brief look at tables, views, tablespaces, and a handful of stored objects—views, triggers, procedures, packages, and functions. Let’s round out this introduction to Oracle Database 10g architecture by covering a few other items commonly encountered from day one. This discussion is a hodge-podge of things that are necessary for a person’s understanding of the Oracle Database 10g architecture and operations. We must spend a bit of time first looking at the database administrator, affectionately called the DBA, the gatekeeper of the database and the person responsible for its smooth operation. There is a more detailed look at the DBA in Chapter 3, with more information on how DBAs go about carrying out their administrative chores.

Indexes

Tables are made up of rows and columns, being the baseline of all objects in the Oracle Database 10g. As applications interact with the database, they often retrieve vast amounts of data. Suppose MyYP, a fictitious Internet company, provided Yellow Pages listings for North America, and the data was stored primarily in a table called YP_MASTER. Each row in the YP_MASTER table is uniquely identified by a combination of company name, municipality, and geographic location (state or province). As words are retrieved from the database to satisfy online queries, indexes would provide a quick access path to the qualifying data. These characteristics about indexes are relevant to the power they deliver in the Oracle Database 10g. For instance:

- They are built on one or more columns in a table using simple SQL statements.
- They are separate from the tables upon which they are built, and can be dropped without affecting the data in the table itself. On the contrary, when a table is dropped, any indexes it has disappear with the table.
- The function they perform can be likened to the index in a book. If one were looking for a specific topic in a textbook, the best place to start would be the index—it provides a shortcut to the information being sought. If one imagined that YP_MASTER were a book rather than a table, finding Y&M Plumbing in Pensacola, Florida would be faster using the index than reading the book from the start into the entries for the 25th letter of the alphabet. The names on the corner of the pages in a phone book are like an index.
- Indexes occupy space in the database and, even though there are ways to keep their space to a minimum, extra space is required and must be preallocated.
20 Oracle Database 10g: A Beginner’s Guide

Users
Most of us are familiar with accounts’ usernames and passwords from our experience logging into corporate networks and other secure systems. Oracle Database 10g implements the same mechanism with login credentials and privileges given out by the database administrator. Once accounts are created, people initiate connections to the Oracle Database 10g and work with their own data and other users’ data where the appropriate privileges have been given out. We discuss object privileges in the “Work with Object and System Privileges” section immediately following this one.

**NOTE**
*With Oracle Database 10g, the terminology user, account, and schema are used synonymously.*

Once an account is created, it is often given the rights to occupy space in one or more Oracle Database 10g tablespaces. This is discussed next.

Tablespace Quotas
As additional non-system tablespaces are created, the database administrator gives out quotas that allow users to occupy space therein. Tablespace quotas are given out using an SQL statement with three parts:

- The username to whom the quota is being given.
- The name of the tablespace within which the username is being permitted to create tables.
- The amount of that quota—be it mentioned in absolute bytes (for example, 500,000) or more commonly in quantities of megabytes (500MB, for instance). Unlimited quotas can be allowed using the keyword *unlimited.*

Regardless of how a quota is given out, the SQL statement passed to Oracle Database 10g resembles the following:

```
Copyright (c) 1982, 2003, Oracle. All rights reserved.
Connected to:
Oracle10g Enterprise Edition Release 10.1.0.1.0 - Production
With the Partitioning, OLAP and Data Mining options

SQL> alter user hr quota 500m on hr_data;
User altered.
SQL> alter user ap quota unlimited on ap_idx;
User altered.
```
Synonyms
Remember in the “Work with Tables” section where we discussed creating tables that the key was passing Oracle Database 10g the create table keywords? In a nutshell, table creation is undertaken after establishing a successful connection to the database, and then, with appropriate privileges in place, defining a table. One of the key concepts with all database management systems is sharing data. Since it is key to only have one copy of a table and have its contents shared amongst applications, synonyms are a way to reference other people’s data.

Suppose we wanted to use the PART_MASTER table in an application owned by a user other than the owner. That owner would permit us to work with the table’s data, and then we would create a synonym to reference its contents. The code would resemble the following:

```
Copyright (c) 1982, 2003, Oracle.  All rights reserved.
Connected to: Oracle10g Enterprise Edition Release 10.1.0.1.0 - Production
With the Partitioning, OLAP and Data Mining options
SQL> create synonym part_master for inv.part_master;
Synonym created.
SQL> select count(*)
2  from part_master
3  where in_stock is not null;
COUNT(*)
-------------
13442
```

The preceding SQL statement references an object called `part_master`. The owner of the table references it using its name, and others using their synonym. There are actually two kinds of synonyms:

- **Private synonyms** are created in one account and are only usable by the creator.
- **Public synonyms** are created by a central privileged user and are available to anyone able to connect to the Oracle Database 10g.

**NOTE**
One needs the appropriate object privileges to be able to work with someone else’s data using a private or public synonym. The synonym itself does not imply that the appropriate privileges can be circumvented.
Roles

Often it makes sense to group similar users together somehow to streamline the organization of people who use the Oracle Database 10g. Using roles, the DBA can logically lump personnel together and give out object privileges to roles rather than individual users. Roles can be password protected, though in most implementations they do not have this level of complexity.

Default User Environments

As accounts are created by the DBA, users are given a default environment to use unless some specifics are coded as they interact with the Oracle Database 10g. Users are commonly set up with the following default environment settings:

- The default tablespace is where tables are placed unless the `create table` statement explicitly points at a nondefault tablespace upon which the user has a quota.
- `Temporary tablespaces` are the tablespaces where users perform sort and merge operations while the Oracle Database 10g engine is processing queries.

Users can be given membership in one or more roles and have their default profile changed as well. As users are created, they do not automatically inherit a default tablespace; one must be manually given out during or following the user creation statement. Users do automatically point at a temporary tablespace, as discussed in the “Default Temporary Tablespace” section of this chapter, unless manually pointed elsewhere.

Progress Check

1. Name at least four tasks handled by the Oracle Database 10g administrator?
2. What is the difference between `public` and `private` synonyms?
3. What is meant by a user’s default tablespace?
4. What two units of measurement are commonly used to specify a tablespace quota?
5. Where do DBAs go to create iTARs where assistance is requested from Oracle’s support organization?
6. Which of the following—`procedures`, `packages`, and `triggers`—cannot exist independent of a table to which they belong?
CRITICAL SKILL 1.7

Work with Object and System Privileges

It’s next to impossible to work with data in the Oracle Database 10g without looking at object privileges. In this section, we are going to look at these privileges as well as a suite of system privileges closely related to managing the Oracle Database 10g. The four main object privileges are select, insert, update, and delete, discussed in the next four sections. Oracle Database 10g uses the term grant when referring to giving out both object and system privileges.

Select

This is the primary and most commonly used privilege, permitting other users to view your data. There are three parts to grant statements:

1. The keywords grant select on.
2. The name of the object upon which the privileges are being given out.
3. The recipient of the grant.

Once the select privilege has been given out, the recipients, using a private or public synonym as described earlier in the “Synonyms” section of this chapter, can reference your objects in their SQL statements.

Insert

This privilege allows users to create rows in tables belonging to other users. The creator of new rows in other users’ objects is bound by the same rules used if they owned the objects themselves. They must adhere to the boundaries defined by the data types of the columns in the rows they create. For example, when rows are inserted into a table that has a column defined as type DATE, they must ensure that valid date type data is placed in the column so defined. As rows are created in an Oracle Database 10g table, the transaction must be committed to the database before the row becomes part of the information available to other users. With Oracle Database 10g, we use the term commit synonymously with save with other types of software.

Progress Check Answers

1. Installation, upgrades, tuning, and environment setup are four of many tasks performed by the DBA.
2. A private synonym can only be referenced in an SQL statement by the account who created and owns the synonym. A public synonym, created by a centralized user such as a DBA, is available to all users.
3. The default tablespace is the one within which users occupy space by default, unless another tablespace is mentioned as a table is created.
4. Quota on tablespaces is usually given out using bytes or megabytes as units of measurement.
5. The DBA goes to MetaLink to request assistance from Oracle’s support organization.
6. Triggers cannot exist on their own without association with an Oracle Database 10g table.
Update
This privilege allows a person to change the contents of columns in rows belonging to other tables. The SQL `update` statement can change the value of data in one or more columns. As with `insert` activity, the `update` transactions need to commit their work to make it permanent in the Oracle Database 10g files.

Delete
Delete operations interact with one or more rows in Oracle Database 10g tables and must be followed by a commit as well to write the results of the transaction to the database files.

We will see more in Chapter 2 about how SQL statements are constructed using the four keywords in the previous sections. SQL statements are subject to rigorous syntax requirements which, if not followed, return an assortment of Oracle errors. Just as with other programming languages you may be familiar with, the SQL statement processing engine is very strict with reserved words and the placement of the pieces that come together to form an SQL transaction. Let's briefly discuss system privileges that allow certain users of the Oracle Database 10g to perform secure activities.

System Privileges
We have mentioned the database administrator in a number of places in this introductory chapter. Classically, secure operations are performed by the DBAs, however one can grant system privileges to specified users so they can perform selected activities themselves. The following list illustrates a few examples of these secure operations of which we speak.

- There are a number of modes within which the Oracle Database 10g can operate. The modes are toggled using the `alter system` command. This privilege can be given out to Jane by issuing the command `grant alter system to jane;`.

- Often, the DBA wants to partition some of the user creation activities between a handful of users of the Oracle Database 10g. This is done by giving out the `create user` system privilege. Once new users are created, we often want to tweak their environment, along the lines of what we spoke about in a few places around this chapter. This can be accomplished by issuing the `grant alter user` statement to one or more users of the database.

- Sometimes when new users are created, they are given the `create session` system privilege which allows them to connect to the Oracle Database 10g. In many cases, depending on how new users are created, they are not allowed to build any objects until they receive the `create table` system privilege. As well, many users are not capable of defining triggers until they receive the `create trigger` system privilege.
CRITICAL SKILL 1.8

Introduce Yourself to the Grid

As many have heard, the “g” in Oracle Database 10g stands for *grid*. Grid computing is a technology that allows for seamless and massively scalable access to a distributed network of diverse yet homogenous computer types. Oracle Database 10g is the glue...
permitting different vendors’ computers to work together providing a seemingly endless supply of shared computer resources. Oracle sees the grid as revolutionizing the way companies go about doing their business. Grid computing targets the delivery of information as a utility, similar to the way electrical and telephone services are currently delivered to the public—hence the term grid. The industry as a whole, but Oracle in particular, sees a delivery method from the grid such that consumers will only pay for what they use. Interlaced computers will allow idle capacity to be leveraged by the grid to provide for a form of parallel processing on steroids. The following are the major players that enable the Oracle grid technology:

- **Real Application Clusters (RAC)** Involves a suite of networked computers sharing a common Oracle Database 10g and running platform independent clusterware, the glue that makes the interconnect between the clustered nodes so transparent.

- **Automatic Storage Management (ASM)** A front-end management system that can group disks from an assortment of manufacturers together to form a suite of disks that is available to all computers on the grid. ASM encapsulates the complete life cycle of disk management and allocation into a centralized GUI interface.

- **Oracle Resource Manager** Provides a framework within which administrators can control the computing resources of nodes on the grid.

- **Oracle Scheduler** Allows the handing out of jobs to members of the grid to facilitate the execution of business tasks anywhere and everywhere where idle resources exist.

- **Oracle Streams** Assists the processing requirements where copies of data need to be streamed between nodes in the grid and provide the mechanisms to keep data in sync on one database with the database from which the data originated. Oracle Stream’s tight integration with the Oracle Database 10g engine facilitates this synchronization and delivers a preferred method of replication.

Figure 1-3 illustrates the primary differences between grid computing and traditional approaches to providing computer services.

The following points reinforce the details of the two scenarios depicted in Figure 1-3:

- The three applications at the top each have a dedicated server, each with their own dedicated disk. If the Linux server were to go out of service, the pension application would grind to a halt. There is no built-in mechanism for pension system processing to carry on another server.
Chapter 1: Database Fundamentals

The three applications at the bottom are interlaced with one another. The benefits application can be hosted on from one to three of the available servers. As well, the database files that support these three applications can reside upon, and be read from, any of the nine disks in the grid’s disk farm.

The browser-based OEM Grid Control holds the whole thing together. With the implementation of the ASM component of Oracle Database 10g, disks are managed by OEM, database instances are managed by OEM, clusterware is managed through OEM, and the list is endless. Figure 1-4 shows the first OEM screen that appears after entering appropriate login credentials.

NOTE
There is an OEM configuration program (called emca) that must be successfully run before you can access the browser-based OEM. The screen shown in your version of Oracle Database 10g may be somewhat different than that shown in Figure 1-4. The look and feel of the OEM Grid Control screens can change significantly between minor releases of the software.
CRITICAL SKILL 1.9

Tie It All Together

Now that was quite a journey! We have covered database fundamentals, with an Oracle Database 10g flavor. Relational database management systems have been around for a few decades, and the release of Oracle Database 10g is a landmark in the industry. There have been many academic discussions about the grid technology—some claim Oracle Database 10g is a grid implementation, some don’t. Regardless of which side of the fence you’re on, Oracle Database 10g is a big step. Let’s pull it all together and spend a bit of time on the big picture.

Oracle Database 10g is a collection of special files created using its database configuration assistant, then completing the work using OEM Grid Control. Access to these database files is facilitated by a set of shared memory processes referred to
as an instance. Many technicians use this term synonymously with database. There is nothing wrong with that since, even though they are technically different pieces, they cannot survive without each other.

Relationships between objects in the database are defined in the data dictionary—hence the familiar term relational database. It is these relationships that provide the power and allow Oracle Database 10g to store vast amounts of data. Storing that data is one thing—retrieving it for applications in a quick and complete fashion is another story. Data retrieval is one of the strengths of the Oracle Database 10g engine.

Over the next eight chapters, we will be delving into more details of the Oracle Database 10g offering, paying specific attention to the following:

- **SQL—Structured Query Language** This is the way we communicate with the Oracle Database 10g. Whatever the programming language (from COBOL to Java), SQL is all the database engine understands.

- **The Database Administrator** The person who is the gatekeeper of the Oracle Database 10g and the one responsible for its smooth operation and optimal performance.

- **Networking** The glue that holds many systems together and allows computers to communicate with one another in widely diverse and separated locations.

- **Backup and Recovery** Two areas intimate to the smooth operation of the Oracle Database 10g. Oracle Database 10g’s Recovery Manager (referred to as RMAN) is the fundamental building block in its disaster recovery implementation.

- **PL/SQL** A programming language native to the Oracle Database 10g engine, providing more procedural capabilities that amplify and enhance the functionality of SQL.

- **Java** An increasingly popular development environment which, according to the likes of Sun Microsystems, powers the Internet. Many of the “sexy” features you enjoy on the Internet are courtesy of this.

- **XML** Extensible Markup Language (XML) which offers a flexible way to format text. The Oracle Database 10g stores XML objects in their native format. XML has become an industry standard; very popular when exchanging information on the Internet and other electronic information exchange media.

- **Large Database Features** Oracle Database 10g expands on an already solid offering in this area. With Oracle9i, they boasted the ability to support a database of up to 500 petabytes. Oracle Database 10g expands that upper limit to many exabytes, a staggering number, to say the least—where an exabyte is 1,152,921,504,606,846,976 bytes—or about one trillion million!
Chapter 1 Mastery Check

1. The ________ background process is primarily responsible for writing information to the Oracle Database 10g files.

2. How many online redo log groups are required to start an Oracle Database 10g?
   A. 3
   B. 2
   C. 4
   D. 1

3. Of the following four items of information, which one is not stored in Oracle Database 10g's control files?
   A. The name of the database files
   B. The creator of the database
   C. The location of the database files
   D. The sizes of the database files

4. What is the function of a default temporary tablespace in the support of the Oracle Database 10g?

5. Differentiate between an Oracle Database 10g and instance.

6. Activities such as allocating space in the database and user management are commonly performed by the DBA. What feature in the Oracle Database 10g allows some of these secure operations to be carried out by non-DBA users? How are these rights given out?

7. As a user of the Oracle Database 10g is created, we often specify a default tablespace. In this context, default tablespace means?
   A. The system tablespace
   B. A tablespace the user can occupy space in without a private or public synonym
   C. The tablespace within which objects are created if a location (tablespace) is not explicitly mentioned as a table is created

8. The ________ GUI interface is used to create a new database.
9. What happens when one tries to store the text “Madagascar” in a field with a specification of varchar2(8)?

10. What is the most common way one uses triggers in the Oracle Database 10g? Give an example of this activity.

11. What programming language, native to the Oracle Database 10g, is used to create stored objects such as triggers and functions?
   A. SQL*Plus
   B. OEM Grid Control
   C. Basic
   D. PL/SQL

12. What is the role of the sysaux tablespace in the Oracle Database 10g?

13. The clob and blob data types differ in all but one of the following three ways. Which one does not apply to the differences between the two data types?
   A. The clob holds standard alphanumeric data, whereas the blob may store binary information.
   B. The blob contains a time (hour/minute) component, but the clob does not.
   C. The blob contains unstructured free-form data, whereas the rules governing the type of information that can be stored in the clob are more stringent.

14. There are many ways to replicate data from one node to another. What main feature does Oracle Streams provide that is missing from many other methods?

15. What does the acronym SQL stand for?
   A. Structured Query Language
   B. Simple Query Language
   C. Straightforward Question-based Learning