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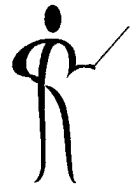

Oracle9i and 10g for Developers: What You Need to Know

Presented to:

OOUG DBA/Developer Day 2004

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Session Objectives

- Learn new Oracle9i features that are geared to developers
- Be ready to use ISO/ANSI standard SQL to make code more portable
- Know how existing database features have been improved in Oracle9i
- Become aware of some Oracle9i DBA oriented features that will impact developers

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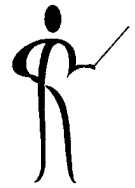
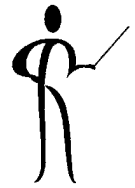
Where We Are Going



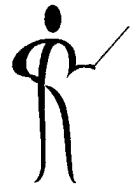
- New datatypes
- New functions
- New SQL statements
- Multi-table inserts
- New join and case syntax
- External tables
- PL/SQL “in-sync”
- Object improvements

New Datatypes



- Oracle9i provides a series of new and improved datatypes:
  - Date Related:
    - TIMESTAMP, TIMESTAMP WITH TIMEZONE, TIMESTAMP WITH LOCAL TIMEZONE
    - TIMEZONE_HOUR, TIMEZONE_MINUTE, TIMEZONE_REGION
    - INTERVAL YEAR TO MONTH
    - INTERVAL DAY TO SECOND
  - Character Related changes:
    - CHAR, VARCHAR2, NCHAR, NVARCHAR2
  - UROWID: Rowid for IOT rows
  - New Oracle-supplied datatypes
    - SYS.ANYTYPE, SYS.ANYDATA, SYS.ANYDATASET
    - XMLType
    - URIType, DBURIType, HTTPURIType, URIFactoryType
    - MDSYS.SDO_GEOMETRY
    - ORDSYS.ORDAudio, ORDSYS.ORDImage, ORDSYS.ORDVideo

New Date Datatypes

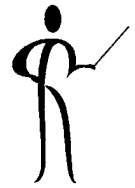


- Timestamps: Year, Month, Day, Hour, Minute, Second
  - TIMESTAMP or TIMESTAMP (n)
    - May specify second fraction used (0-9 decimals), 6 decimals is the default
  - TIMESTAMP WITH TIMEZONE or TIMESTAMP (n) WITH TIMEZONE
    - May specify second fraction used (0-9 decimals), 6 decimals is the default
  - TIMESTAMP WITH LOCAL TIMEZONE or TIMESTAMP (n) WITH LOCAL TIMEZONE
    - May specify second fraction used (0-9 decimals), 6 decimals is the default
- Intervals: Provide period of time
  - INTERVAL YEAR TO MONTH or INTERVAL YEAR (n) TO MONTH
    - Interval in Years and Months
    - May specify number of digits in year (0-9), 2 digits is the default
  - INTERVAL DAY TO SECOND or INTERVAL DAY(d) TO SECOND (s)
    - Interval in Days, House, Minutes, Seconds
    - May specify number of digits for days (0-9), 2 digits is the default
    - May specify second fraction used (0-9 decimals), 6 decimals is the default

Character Modifications

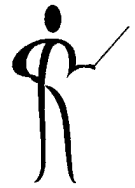
- CHAR, VARCHAR2, NCHAR, and NVARCHAR2 may specify additional size descriptor (BYTE or CHAR)
  - VARCHAR2(n)
  - VARCHAR2(n) BYTE
  - VARCHAR2(n) CHAR
  - CHAR(n)
  - CHAR(n) BYTE
  - CHAR (n) CHAR
- BYTE specifies that the size of the column is specified in bytes
- CHAR specifies that the size of the column is specified in characters
- Maximum size of VARCHAR2 is 4000 bytes (unchanged)
- Maximum size of CHAR is 2000 bytes (unchanged)

Oracle-Supplied “Any” Types



- Oracle supplies a datatype for use in creating tables and stored procedures when the actual type is not know, the so-called “any” types
  - SYS.ANYTYPE: May contain any known SQL datatype or an unnamed datatype
  - SYS.ANYDATA: May contain different types of data in columns of different rows
  - SYS.ANYDATASET: Allows sets of data to be passed

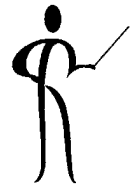
XMLtype Datatype



- SYS.XMLtype is an Oracle-defined datatype used to store XML data within the database as:
  - Entire document as CLOB/XMLType
  - Document elements as relational table rows and columns
- Member functions include:
  - createXML() Create XMLType instance
  - existsNode() Checks if XPath can find any valid nodes
  - extract() Uses XPath to return fragment as XMLType
  - isFragment() Checks to see if document is really a fragment
  - getClobVal() Gets document as a CLOB
  - getStringVal() Gets value as a string
  - getNumberVal() Gets numeric value as a number
- Lots of XML support is added in Oracle9i, check the reference manual:

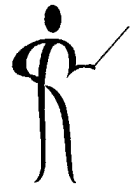
  “XML Database Developer's Guide”

SQL - XML Functions



- SQL provides several functions specifically for dealing with XML data including:
  - SYS_DBURIGEN(ts) Generate DBURITYPE URL used to obtain XML data from the database
  - SYS_XMLGEN(exp) Convert specified database row and column into an XML document
  - SYS_XMLAGG(exp) Generate single XML document from aggregate of XML data specified by “exp”
  - XMLELEMENT(name,exp) Generates XML element using name and exp as data
  - XMLATTRIBUTES(exp,list) Generates XML attributes using expression list
- XMLELEMENT and XMLATTRIBUTES reflect Oracle’s support for the upcoming ANSI/ISO SQLX standard

SYS_XMLGEN

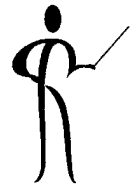


- SYS_XMLGEN
  - Uses a single input expression representing a particular row/column (scalar value or user-defined type)
    - For scalar value a single XML element representing the value is returned
    - For user-defined type XML elements representing each of the user-defined type's data items is returned
  - Returns an instance of SYS.XMLType data that is an XML document
  - The example on the next page displays using getStringVal since SYS.XMLType data returns as CLOB and is not displayable by SQL*Plus

SYS.XMLGEN Example

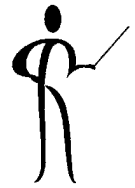
```
select sys_xmlgen(ename).getStringVal() Name
     from emp
     where job = 'ANALYST'

NAME
--------------------------------------------------
<?xml version="1.0"?>
 <ENAME>FORD</ENAME>

<?xml version="1.0"?>
 <ENAME>SCOTT</ENAME>
```

SYS_XMLAGG



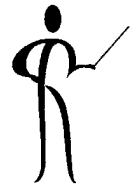
- SYS_XMLAGG aggregates all XML documents (or fragments of documents) for an expression and produces a single XML document
  - ROWSET is the default tag name
  - Use SYS.XMLGenFormatType to change tag name
- The example on the next page uses the SYS_XMLGEN function to generate an XML document for each dept 20 row of the sample EMP table
- The example on the next page displays using getClobVal since SYS.XMLType data returns as CLOB and is not displayable by SQL*Plus

SYS_XMLAGG Example



```
select sys_xmlagg(SYS_XMLGEN(Ename)).getClobVal() emps
     from emp
     where deptno = 10

EMPS
--------------------------------------------------
<?xml version="1.0"?>
<ROWSET>
<ENAME>KING</ENAME>
<ENAME>CLARK</ENAME>
<ENAME>MILLER</ENAME>
</ROWSET>
```

SYS_XMLAGG Example 2



```
select sys_xmlagg(SYS_XMLGEN(Ename)
   ,sys.XMLGENFORMATTYPE.createFormat('depts')).getClobVal() emps
from emp group by deptno
   EMPS
   ----------------------
   <?xml version="1.0"?>
   <depts>
   <ENAME>KING</ENAME>
   <ENAME>CLARK</ENAME>
   <ENAME>MILLER</ENAME>
   </depts>
   <?xml version="1.0"?>
   <depts>
   <ENAME>JONES</ENAME>
   <ENAME>ADAMS</ENAME>
   <ENAME>SCOTT</ENAME>
   <ENAME>SMITH</ENAME>
   <ENAME>FORD</ENAME>
   </depts>
```

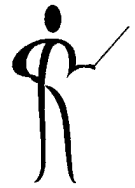
```
<?xml version="1.0"?>
<depts>
<ENAME>BLAKE</ENAME>
<ENAME>WARD</ENAME>
<ENAME>JAMES</ENAME>
<ENAME>MARTIN</ENAME>
<ENAME>ALLEN</ENAME>
<ENAME>TURNER</ENAME>
</depts>
```

XMLELEMENT

- XMLELEMENT(name,exp) Generates an XML element using name and exp as data

```
select xmlelement("employee",
       xmlelement("empid",empno),
       xmlelement("empname",ename)) myxml
from emp
<employee> <empid>7369</empid>
    <empname>SMITH</empname> </employee>
<employee> <empid>7499</empid>
    <empname>ALLEN</empname> </employee>
<employee> <empid>7521</empid>
    <empname>WARD</empname> </employee>
<employee> <empid>7566</empid>
    <empname>JONES</empname> </employee>
<employee> <empid>7654</empid>
    <empname>MARTIN</empname> </employee>
```

XMLATTRIBUTES



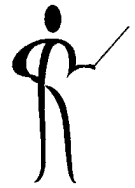
- XMLATTRIBUTES(exp,list) Generates XML attributes using expression list

```
select xmlelement("employee",
       xmlelement("emp",
                  xmlattributes(empno as "empno",
                                ename as "ename")),
       xmlelement("job",job),
       xmlelement("hiredate",hiredate),
       xmlelement("pay",
                  xmlattributes(nvl(sal,0) as "sal",
                                nvl(comm,0) as "comm"))
       ) as myxml
from emp
```

XMLATTRIBUTES Example

```
<employee>
  <emp empno="7369" ename="SMITH"/>
  <job>CLERK</job>
  <hiredate>17-DEC-80</hiredate>
  <pay sal="800" comm="0"/>
</employee>

<employee>
  <emp empno="7499" ename="ALLEN"/>
  <job>SALESMAN</job>
  <hiredate>20-FEB-81</hiredate>
  <pay sal="1600" comm="300"/>
</employee>
```

Other XML Functions



- XMLColattval — Creates series of XML fragments using an element name of “column” and column names and values as attributes
- XMLConcat — Concatenates a series of XMLType objects (opposite of XMLElement)
- XMLForest — Creates XML fragments from a list of arguments/parameters
- XMLSequence — Creates Varray of XMLType instances
- XMLTransform — Uses input XMLType and XSL style sheet (also XMLType) to create a new XMLType
- UpdateXML — Uses an XMLType and an XPATH reference and returns an updated XMLType

URI Datatypes

- Oracle9i provides a series of predefined types designed to help programmers work with web applications including:
  - SYS.URITYPE
  - SYS.DBURITYPE
  - SYS.HTTPURITYPE
  - SYS.URIFACTORYTYPE

UROWID

- UROWID allows manipulation of values used to identify the base-64 value representing the address of a row in an index-organized table (IOT)

```
mycol1 UROWID
mycol2 UROWID(nn)
```

  - nn Size of UROWID is optional:
    default size = 4000
    max = 4000

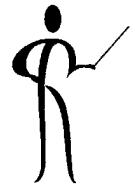
Misc. Oracle-Supplied Datatypes

- Oracle9i supplies a set of predefined types for working with multimedia:
  - ORDSYS.ORDAUDIO
  - ORDSYS.ORDIMAGE
  - ORDSYS.ORDVIDEO
- Finally, Oracle9i provides a spatial datatype:
  - MDSYS.SDO_GEOMETRY

Subqueries Almost Anywhere!

- Oracle8i allowed subqueries just about anywhere in the SQL statement, Oracle9i allows subqueries that return a single value anywhere **except** for the following:
  - default value for columns
  - check constraints
  - RETURNING clause
  - function-based indexes
  - when condition in CASE
  - GROUP BY
  - HAVING
  - START WITH
  - CONNECT BY

Silly Examples



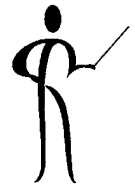
- Here are four oddball statements that would not be possible in earlier versions

```
select ename,job,sal,(select avg(sal) from emp where job = main.job) jobavgsal
                    from emp main;

select ename,sal from emp
  where sal between (select avg(sal) from emp where job = 'SALESMAN')
                and (select avg(sal) from emp where job = 'ANALYST');

select deptno from dept
      where (select avg(sal) from emp) > (select avg(sal) from emp
                                          where emp.deptno = dept.deptno);
select ename,sal from emp
  order by (select dname from dept where dept.deptno = emp.deptno),ename;
```

Misc. SQL Improvements

- Most variable-character functions now allow CLOB arguments (SUBSTR, etc…)
- New operators:
  - LIKEC, LIKE2, LIKE4 similar to LIKE with Unicode, UCS2, and UCS4 data respectively
  - IS OF xxx determines the type of an object instance
- WAIT option: SELECT … FOR UPDATE WAIT waits specified number of seconds for locked row
- DEFAULT keyword for INSERT and UPDATE
- When using CONNECT BY may use ORDER BY SIBLINGS to sort within hierarchy
- New sample tables!
- Scrollable cursor support (3GLs)
- Group by Grouping Sets
- New hints

New Functions



- Many (over 50!) new functions have been added to Oracle9i including:
  - ANSI-standard functions
  - Date and Time functions
  - Analytical functions (added to those from Oracle8i)
  - Unicode functions
  - Character conversion functions
  - XML functions
  - Object functions

ISO/ANSI-Standard Functions

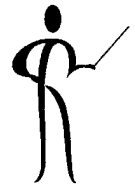
- COALESCE is similar to NVL, but, returns first non-null value:

```
COALESCE(qtr4,qtr3,qtr2,qtr1)
```

- NULLIF returns NULL if the specified value is matched

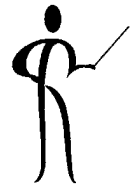
```
NULLIF(PREFCODE, 'N/A')
```

Date and Time Functions



- Oracle9i includes many date and time functions, among the more useful are:
  - CURRENT_DATE
  - CURRENT_TIMESTAMP
  - DBTIMEZONE
  - EXTRACT(timestamp)
  - SYSTIMESTAMP
  - TO_CHAR(timestamp)
  - TO_DSINTERVAL(instring)
  - TO_YMINTERVAL(instring)
  - TO_TIMESTAMP(instring)
- Several other functions that work with time zones have been added

Timezone Functions



- Several timezone-specific functions have also been added:
  - DBTIMEZONE — Get UTC offset from database
  - SESSIONTIMEZONE — Get UTC offset from current session (uses ORA_SDTZ env. variable)
  - FROM_TZ — Convert timestamp at timezone to timestamp with timezone value
  - TZ_OFFSET — Returns UTC offset for specified time zone
  - SYS_EXTRACT_UTC — Get UTC time from specified timestamp with time zone
  - DBTIMEZONE — Get UTC offset from database
  - TO_TIMESTAMP_TZ — Convert string to timestamp with timezone using normal formatting

Oracle 8.1.6 Analytic Functions

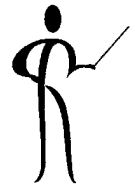
- Oracle 8.1.6 included a set of functions providing expanded support for data mining operations - (topic is too rich to cover in the context of this paper)
- The analytic functions are divided into four "families"
  - **Lag/Lead** - Compares values of rows to other rows in same table: LAG, LEAD
  - **Ranking** - Supports "top n" queries: CUME_DIST, DENSE_RANK, NTILE, PERCENT_RANK, RANK, ROW_NUMBER
  - **Reporting Aggregate -** Compares aggregates to non-aggregates (pct of total): RATIO_TO_REPORT
  - **Window Aggregate -** Moving average type queries: FIRST_VALUE, LAST_VALUE
- Analytic functions allow users to divide query result sets into ordered groups of rows called partitions (not the same as database partitions)

Example Analytical Function

- Rank may be used with GROUP aggregation:

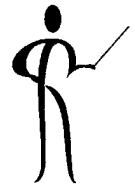
```
select dname,
       nvl(avg(sal),0) avg_sal,
       count(empno) nbr_emps,
       rank() over (order by nvl(avg(sal),0)) rank
   from emp right join dept using (deptno)
group by dname

DNAME              AVG_SAL   NBR_EMPS       RANK
-------------- ---------- ---------- ----------
OPERATIONS               0          0          1
TESTER                   0          0          1
SALES           1566.66667          6          3
RESEARCH              2175          5          4
ACCOUNTING      2916.66667          3          5
```

New Analytical Functions



- Oracle9i adds additional Analytical functions:
  - FIRST — Gets first sorted group row
  - LAST — Gets last sorted group row
  - GROUP_ID — Group Identifier for GROUP BY
  - GROUPING_ID — Number matching GROUPING
  - PERCENTILE_CONT — Pct. when continuous distribution
  - PERCENTILE_DISC — Pct. When discrete distribution
  - WIDTH_BUCKET — Use to create same-size intervals in histogram

Example FIRST/LAST



```
select dname,
       min(salary) keep (dense_rank first order by hire_date)
             "First Hired",
       max(salary) keep (dense_rank last order by hire_date)
             "Last Hired"
   from hr.employees right join dept
          on department_id = deptno
   group by dname

DNAME          First Hired Last Hired
-------------- ----------- ----------
ACCOUNTING            4400       4400
OPERATIONS            6500       6500
RESEARCH             13000       6000
SALES                11000       2500
```

GROUPING SETS

- Oracle 9i Release 2 adds the ability to created cube-type statistics on command

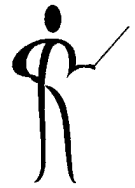
```
select deptno
       ,job
       ,count(empno) nbremps
       ,sum(sal)     totpay
     from emp
     group by grouping sets (deptno,job)

 DEPTNO JOB          NBREMPS     TOTPAY
------- --------- ---------- ----------
        CLERK              4       4150
        ANALYST            2       6000
        MANAGER            3       8275
        SALESMAN           4       5600
        PRESIDENT          1       5000
     10                    3       8750
     20                    5      10875
     30                    6       9400
```

ORDER SIBLINGS BY

- Sorting data returned by CONNECT BY has been an issue for years, Oracle 9i Release 2 changes things:

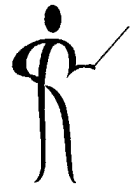
```
   select lpad(' ',level*2)||empno empid,ename,mgr,deptno,level
         from emp
         connect by prior empno = mgr
         start with mgr is null
         order siblings by (ename)
EMPID        ENAME                MGR     DEPTNO      LEVEL
------------ --------- ---------- ---------- ----------
  7839       KING                            10          1
    7698     BLAKE              7839         30          2
      7499   ALLEN              7698         30          3
      7900   JAMES              7698         30          3
      7654   MARTIN             7698         30          3
      7844   TURNER             7698         30          3
      7521   WARD               7698         30          3
    7782     CLARK              7839         10          2
      7934   MILLER             7782         10          3
```

TO_CHAR & New Dates



- TO_CHAR has been modified with attributes to describe desired TIMESTAMP components:
  - FF1-FF9 Fractional Seconds
  - TZD Abbrev. Timezone with Daylight time notation
  - TZH Timezone UTC offset hours
  - TZM Timezone UTC offset minutes
  - TZR Timezone Region
  - X Local radix operator

Using TO_CHAR



- Use the new TO_CHAR attributes in the same manner as other attributes:

```
select to_char(t4,'yyyy-mm-dd hh24:mi:ssxff tzh:tzm')
            t4_value
   from timetest1;

T4_VALUE
-----------------------------------------------
2002-10-28 16:23:50.9530000 -07:00
```

Extract Syntax

- EXTRACT is used to get specific parts of a TIMESTAMP of INTERVAL

```
EXTRACT ( YEAR  FROM  datetime   )
          MONTH       timestamp
          DAY         interval
          HOUR
          MINUTE
          SECOND
          TIMEZONE_HOUR
          TIMEZONE_MINUTE
          TIMEZONE_REGION
          TIMEZONE_ABBR
```

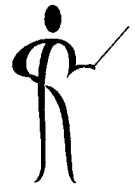
SYS_EXTRACT_UTC

- Query below extracts current UTC timestamp from provided timestamp with time timezone value

```
select sys_extract_utc(to_timestamp_tz(current_timestamp))
   from dual
SYS_EXTRACT_UTC(TO_TIMESTAMP_TZ(CURRENT_TIMESTAMP))
---------------------------------------------------
01-APR-02 08.56.15.013000 PM
```

Note: UTC (Coordinated Universal Time) was formerly known as GMT (Greenwich Mean Time)

Unicode Functions

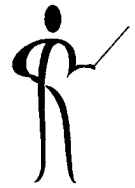


- Oracle9i Unicode-specific functions:
  - COMPOSE — Return string from Unicode
  - DECOMPOSE — Return Unicode for string
  - INSTRC — Search string for Unicode characters
  - LENGTHC — Length of Unicode string
  - SUBSTRC — Return partial Unicode string
  - UNISTR — Convert string to Unicode
- INSTRC, LENGTHC, AND SUBSTRC functions are replicated as INSTR2, INSTR4, LENGTH2, LENGTH4, SUBSTR2, and SUBSTR4 for data using UCS2 and UCS4 codepoints

Character Conversion Functions

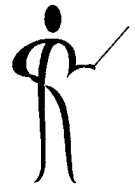
- Several functions have been added or improved:
  - ASCIISTR
  - BIN_TO_NUM
  - CAST
  - DECODE
  - NCHR
  - RAW_TO_HEX
  - ROWIDTONCHAR
  - TO_CHAR
  - TO_CLOB
  - TO_NCHAR
  - TO_NCLOB

New SQL Statements



- Oracle9i adds some new SQL statements:
  - CREATE PFILE — Export database parameters as text file
  - CREATE SPFILE — Create server parameters from external text file
  - MERGE — Combination INSERT and UPDATE, if row exists change it, otherwise build new row

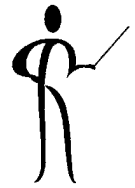
Merge



- MERGE uses a SELECT (table/view/subquery) to UPDATE or INSERT rows in another table/view

```
merge
    into bonus
    using emp
    on ( bonus.ename = emp.ename )
    when matched
    then  update  -- only one update match allowed!
          set bonus.sal = emp.sal,
          bonus.comm = emp.comm
    when not matched
        then insert
          (ename,job,sal,comm)
         values
          (emp.ename,emp.job,emp.sal,emp.comm)
```

External Tables

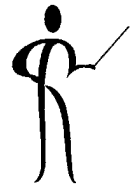


- Oracle9i allows access to an external sequential file as a read-only table
- Before Oracle9i external file access was:
  - SQL*Loader
  - UTL_FILE PL/SQL package
  - Pro* or OCI programs written in 3GLs
  - BFILE in Oracle8 and later for large objects

How Do External Tables Work?

- The CREATE TABLE statement uses a combination of standard syntax and field definition syntax from SQL*Loader
- CREATE TABLE has two parts:
  - Internal table description
    - Uses normal column definitions
    - Constraints are not valid
    - No indexes may be defined
  - External table description
    - Uses DIRECTORY objects to find files
    - Uses SQL*Loader-like syntax
- When an External Table is referenced in SQL, the file data is loaded and made available

External File Data



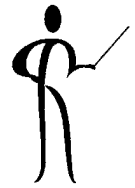
```
7402,LINCOLN,SALESMAN,7839,20-JAN-1980,2372.50,500.00,10
7418,MORRIS,CLERK,7782,01-APR-1982,1100.00,0,10
7422,LITTLE,CLERK,7782,12-NOV-1982,980.00,0,10
7437,BILLINGS,MANAGER,7839,23-FEB-1983,2923.75,0,20
7443,ALLEN,SALESMAN,7698,30-MAR-1982,1500.00,600.00,30
7456,GARCIA,ANALYST,7698,22-APR-1980,2312.50,0,30
7464,SOUK,ANALYST,7566,14-JUL-1981,3450.00,0,20
7473,CHANG,SALESMAN,7839,18-DEC-1982,2372.50,500.00,10
7484,SMITH,CLERK,7782,09-SEP-1982,925.50,0,10
7489,LIBUTTI,CLERK,7782,04-JUN-1980,1005.00,0,10
7495,HIPSON,MANAGER,7839,15-OCT-1982,3876.00,0,20
7498,MICHELL,SALESMAN,7698,16-NOV-1983,1600.00,750.00,30
7504,JORDAN,ANALYST,7698,21-APR-1982,2370.50,0,30
7518,SANCHEZ,ANALYST,7566,02-JAN-1981,3005.00,0,20
```

Create Table (Internal desc)

```
create table newemp
  ( empno       number(4)
   ,ename       char(10)
   ,job         char(9)
   ,mgr         number(4)
   ,hiredate    date
   ,sal         number(7,2)
   ,comm        number(7,2)
   ,deptno      number(2)
  )
  organization external
```

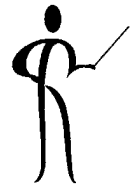
Rest of CREATE TABLE on next page!

Create Table (External desc.)



```
(type oracle_loader default directory ukoug_src
    access parameters
    ( records delimited by newline
      badfile ukoug_bad:'newemp.bad'
      discardfile ukoug_dis:'newemp.dis'
      logfile ukoug_log:'newemp.log'
      fields terminated by ','
      missing field values are null
     ( empno, ename, job, mgr,
        hiredate char date_format date mask "mm-dd-yyyy",
        sal, comm, deptno
      )
    )
   location ('personc.dat')
  )
  reject limit unlimited
;
```

Using External Table



```
SQL> select empno,ename,hiredate,sal from newemp
     EMPNO ENAME      HIREDATE          SAL
---------- ---------- --------- ----------
      7402 LINCOLN    20-JAN-80     2372.5
      7418 MORRIS     01-APR-82       1100
      7422 LITTLE     12-NOV-82        980
      7437 BILLINGS   23-FEB-83    2923.75
      7443 ALLEN      30-MAR-82       1500
      7456 GARCIA     22-APR-80     2312.5
      7464 SOUK       14-JUL-81       3450
      7473 CHANG      18-DEC-82     2372.5
      7484 SMITH      09-SEP-82      925.5
      7489 LIBUTTI    04-JUN-80       1005
      7495 HIPSON     15-OCT-82       3876
      7498 MICHELL    16-NOV-83       1600
      7504 JORDAN     21-APR-82     2370.5
      7518 SANCHEZ    02-JAN-81       3005
```

Multi-Table Insert

- Multi-table insert allows a single INSERT statement to insert rows into several tables:
  - ALL Unconditionally INSERT
  - WHEN Conditionally INSERT
- Rules
  - May only insert into local tables (no views)
  - RETURNING clause invalid
  - Insert subqueries may not use sequences

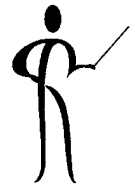
Unconditional Multi-Table Insert

```
insert all
  into emp
     (empno,ename,job,mgr,hiredate,sal,comm,deptno)
    values
     (empno,ename,job,mgr,hiredate,sal,comm,deptno)
  into bonus
     (ename,job,sal,comm)
    values
     (ename,job,sal,comm)
  select empno,ename,job,mgr,hiredate,sal,comm,deptno
         from newemp;
```

Conditional Multi-Table Insert

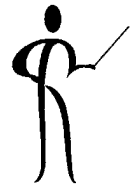
```
insert first
   when job = 'SALESMAN' then
     into emp
       (empno,ename,job,mgr,hiredate,sal,comm,deptno)
        values
       (empno,ename,job,mgr,hiredate,sal,comm,deptno)
     into bonus (ename,job,sal,comm)
         values (ename,job,sal,comm)
   else
     into emp
       (empno,ename,job,mgr,hiredate,sal,comm,deptno)
     values
       (empno,ename,job,mgr,hiredate,sal,comm,deptno)
  select empno,ename,job,mgr,hiredate,sal,comm,deptno
         from newemp;
```

New ISO/ANSI Join Syntax



- ISO/ANSI Join syntax has been used for several years in some non-Oracle SQL environments
- Oracle invented the original Outer-join syntax and was slow to accept the new style
- ISO/ANSI Join syntax is supported by many third party SQL tools
- The new semantics separate join criteria from other row selection criteria

Cross Join



- Cross Join is designed to provide a “Cartesion Product” type join. It works the same as a comma-delimited join, requiring specification of join conditions in the WHERE clause to avoid the Cartesian Product:

```
select ename,dname
  from emp cross join dept
  where emp.deptno = dept.deptno
```

Natural Join

- Natural joins indicate an equi-join automatically using any column names match to join
- Natural joins may also specify ISO/ANSI join types (INNER, LEFT, RIGHT, FULL; discussed later…)
- Additional criteria may be specified using the WHERE clause.

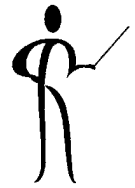
```
select ename,dname
   from emp natural join dept
```

Join Using

- When join column names are the same, the new syntax now allows the USING clause

```
select dname,ename
 from dept join newemp
 using (deptno)
```

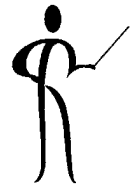
Inner Join



- Traditional Inner Joins match rows tables
- The older syntax names all tables in comma-delimited form and uses the WHERE clause to name Join criteria
- Note that in the example below Join criteria is mixed with row selection criteria:

```
select distinct nvl(dname,'No Dept'),
                count(empno) nbr_emps
     from many_emps emp,many_depts dept
     where emp.deptno = dept.deptno
       and emp.job in ('MANAGER','SALESMAN','ANALYST')
     group by dname;
```

ISO/ANSI Inner Join



- Use INNER JOIN (or simply JOIN) between the table(s) involved and specify one-or-more Join criteria with the ON/USING clause
- Correlation (alias) table names may be specified
- The WHERE clause names only non-Join criteria

```
select distinct nvl(dname,'No Dept'),
                count(empno) nbr_emps
    from many_emps emp join many_depts dept
      on emp.deptno = dept.deptno
    where emp.job in ('MANAGER','SALESMAN','ANALYST')
    group by dname;
```

Joining More Then Two

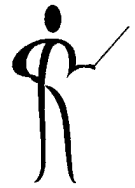
```
select distinct nvl(dname,'No Dept') dept
      ,count(empno) nbr_emps
      ,round(avg(grade),1) avg_paygrade
    from      many_emps emp
         join many_depts dept
              on emp.deptno = dept.deptno
         join salgrade
              on emp.sal between losal and hisal
    where emp.job in ('MANAGER','SALESMAN','ANALYST')
    group by dname
```

Oracle Outer Join Operator

- Oracle invented the first syntax for solving the outer Join issue years ago
- This is the “(+)” notation used on the side of the Join criteria WHERE clause where null rows are to be created to match the other table

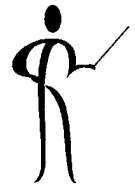
```
select distinct nvl(dname,'No Dept'),
       count(empno) nbr_emps
   from many_emps emp,many_depts dept
   where emp.deptno(+) = dept.deptno
   group by dname;
```

ISO/ANSI Outer Join



- The new ISO/ANSI Join syntax provides three separate capabilities: LEFT, RIGHT, and FULL OUTER JOIN (the word OUTER is redundant and usually omitted)
- With the new syntax, LEFT and RIGHT indicate which side of the join represents the complete set, the opposite side is where null rows will be created

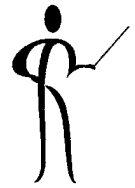
Left/Right Join



- The example below solves the same problem as the Oracle Outer Join operator example earlier:

```
select distinct nvl(dname,'No Dept'),
       count(empno) nbr_emps
  from many_emps emp right join many_depts dept
    on emp.deptno = dept.deptno
   group by dname;
```

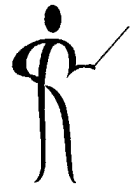
Full Outer Join (Union)



- To cause SQL to generate rows on both sides of the join required a UNION using the old Oracle Outer Join operator syntax:

```
select nvl(dname,'No Dept') deptname,
       count(empno) nbr_emps
   from many_emps emp,many_depts dept
   where emp.deptno(+) = dept.deptno
   group by dname
union
select nvl(dname,'No Dept') deptname,
       count(empno) nbr_emps
   from many_emps emp,many_depts dept
   where emp.deptno = dept.deptno(+)
   group by dname;
```

ISO/ANSI Full Outer Join



- The new ISO/ANSI Outer Join mechanism is simpler to code
- To cause rows to be created on either side of a Join as required to align the two tables use the FULL OUTER JOIN (FULL JOIN) syntax:

```
select distinct nvl(dname,'No Dept')
  deptname,count(empno) nbr_emps
  from many_emps emp full join many_depts dept
    on emp.deptno = dept.deptno
   group by dname;
```

Searched CASE Syntax

- Oracle8i added the CASE expression to allow more complex (ANSI/ISO standard) processing than DECODE
- CASE allows IF…THEN…ELSE logic to be placed anywhere in SQL that a column or literal can go
- CASE syntax is as follows:

```
CASE WHEN condition1   THEN expression1
     WHEN condition2   THEN expresssion2
      …
     WHEN conditionn   THEN expressionn
     ELSE expression
END
```

- One WHEN THEN pair is required, ELSE is optional (default is NULL), END is required
- The example on the next page shows CASE being used in three parts of the statement

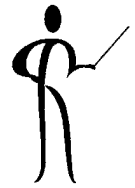
Searched CASE Example

```
select ename,sal,
       case when job = 'CLERK' then 'GLUE'
            when job = 'MANAGER' then 'SUPER'
            else job
       end job_x
   from emp
   where case when sal < 1000 then sal + 2000
              when sal < 2000 then sal + 1000
              else sal
              end    > 2900
      order by case when sal < 1000 then sal + 9000
                    when sal < 2000 then sal + 7000
                    else sal
                end
```

Output:

ENAME	SAL	JOB_X
JONES	2975	SUPER
FORD	3000	ANALYST
SCOTT	3000	ANALYST
KING	5000	PRESIDENT
JAMES	950	GLUE

Simple CASE Syntax



- New with Oracle9i, simple CASE syntax compares values to an expression

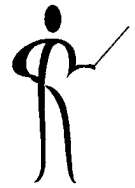
```
select ename,sal,
       case job when 'CLERK' then 'Producer'
                when 'ANALYST' then 'Producer'
                when 'PRESIDENT' then 'Overhead'
                when 'SALESMAN' then 'Producer'
                else 'Overhead'
       end emptype
   from emp;
```

WITH Subquery Reuse

- WITH allows a subquery to be named and reused

```
with SUMMARY as
   (SELECT dname
                , sum(sal) saltot
                , round(avg(sal),2) avgsal
                , count(distinct empno) nbremps
             from emp join dept
                     on emp.deptno = dept.deptno
                group by dname
   )
 select dname, nbremps, avgsal
   from SUMMARY
   where saltot > ( select sum(saltot) * .25
                           from SUMMARY )
   ORDER BY saltot DESC;
```

Nested Cursor Expressions



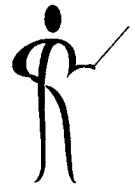
- Cursor expressions are new in Oracle9i
- If a cursor expression is used in a select (below), the cursor will be opened for each value fetched by the query
- Cursor expressions may also be used to provide a REFCURSOR value being passed to a procedure or function

```
SELECT dname,
   CURSOR(SELECT sal, comm FROM emp
          WHERE emp.deptno=dept.deptno)
               curval
FROM dept;
```

Scrollable Cursors

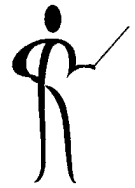
- Oracle9i adds support for scrollable cursors to provide compatibility with other database products
- Scrollable cursors are read-only and allow fetch of specific rows, or, previous rows
- So far, OCI programs and Java programs are the only place where these may be used

PL/SQL “In-Sync”



- Oracle9i provides a PL/SQL engine that uses the same SQL as the database!
- SQL inside PL/SQL may use the full SQL provided by the database
- This means that developers no longer need be concerned that some SQL capabilities supported by the database will not be available to PL/SQL code
- All new SQL features are supported by PL/SQL
- Bulk bind may now apply to EXECUTE IMMEDIATE statements

PL/SQL Native Compilation



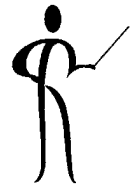
- Stored PL/SQL may now be compiled into native binary files to improve performance
  - This requires DBA involvement
  - System parameters must be set in the configuration file, using ALTER SYSTEM, or using ALTER SESSION to modify the PLSQL_COMPILER_FLAGS setting
    - Native Compile to native binary
    - Interpreted The default, the way it has always worked
- To the user of the PL/SQL procedure/function there is no difference other than speed of execution

Oracle C++ Call Interface

- The Oracle C++ Call Interface (OCCI) allows C++ programmers to create fast database applications
  - Speed of OCI
  - Object-oriented flavor of C++

King Training Resources

Object Improvements



- SQL type inheritance and synonyms
- Object view hierarchies
- Type evolution
- User-defined aggregate functions
- User-defined constructors
- Generic and transient data types
- Function-based index support
- Multi-level collections
- C++ interface to Oracle
- Java object storage

iSQL*Plus

- Oracle9i introduced the iSQL*Plus product allowing SQL*Plus testing from any browser
- No Oracle client required
- No Oracle Net (Net 8 / SQL*Net) connection required

iSQL*Plus Query Results

ORACLE iSQL*Plus

Logout New Session History Preferences Help

Work Screen

File or URL: Browse... Load Script

Enter statements:

```
select ename,sal,hiredate
  from
  emp
  order by hiredate
```

Execute Save Script Clear Screen Cancel

ENAME	SAL	HIREDATE
SMITH	800	17-DEC-80
ALLEN	1600	20-FEB-81
WARD	1250	22-FEB-81
JONES	2975	02-APR-81
BLAKE	2850	01-MAY-81
CLARK	2450	09-JUN-81

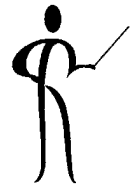
DBA-Oriented Features

- As developers, you should be aware of some of the new features at the DBA-level
  - Flashback Query, point-in-time queries
  - Cost-Based Optimizer improvements, new hints
  - Multiple block sizes in a single database
  - Constraints on views

Oracle 10g

- New and improved data types
- SQL and SQL*Plus improvements
- Enhancements to PL/SQL
- Java and XML improvements

10g Binary_double & Binary_float



- Oracle provides support for the IEEE754 floating-point specifcation
- BINARY_FLOAT is a 32-bit, single-precision floating-point number stored as 5 bytes, including a length byte
- BINARY_DOUBLE is a 64-bit, double-precision floating-point number stored as 9 bytes, including a length byte
- When processing a NUMBER column, floating point numbers have decimal precision. In a BINARY_
- FLOAT or BINARY_DOUBLE column, floating-point numbers have binary precision
- Both binary floating-point numbers support the special values infinity and NaN (not a number)

	Binary-Float	Binary-Double
Maximum finite value	1.79e308	3.4e38
Minimum finite value	-1.79e308	-3.4e38
Smallest positive value	2.3e-308	1.2e-38
Smallest negative value	-2.3e-308	-1.2e-38

10g Sgo_georaster & Si_stillimage

- SDO_GEORASTER is an object type defined as follows:

```
CREATE TYPE SDO_GEORASTER AS OBJECT (
         rasterType NUMBER,
         spatialExtent SDO_GEOMETRY,
         rasterDataTable VARCHAR2(32),
         rasterID NUMBER,
         metadata XMLType);
```

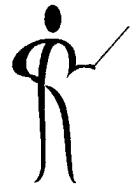
- SI_StillImage is an object type that represents digital images and metadata including height, width, and format

10g Limitless LOB

- Since first introduced the Oracle LOB type has been limited to 4GB (enough for most of us)
- Oracle 10g allows LOB data to be limited only by tablespace page size
- Current limit:
  - 8–128 terabytes
- Supported environments:
  - PL/SQL using DBMS_LOB
  - Java using JDBC
  - **C/C++** using OCI

Update

10g New Statistical Functions



- CORR returns the coefficient of correlation of a set of number pairs
- CORR_S calculates the Spearman's rho correlation coefficient
- CORR_K calculates the Kendall's tau-b correlation coefficient
- MEDIAN calculates the statistical median
- STATS_BINOMIAL_TEST an exact probability test
- STATS_CROSSTAB method used to analyze two nominal variables
- STATS_F_TEST tests whether two variances are significantly different
- STATS_KS_TEST compares two samples see if they are from the same population or from populations that have the same distribution
- STATS_MODE returns most frequently occurring value from a set
- STATS_MW_TEST this Mann Whitney test compares two independent samples to test the null
- hypothesis that two populations have the same distribution function against the
- alternative hypothesis that the two distribution functions are different
- STATS_ONE_WAY_ANOVA ANOVA) tests differences in means (for groups or variables) for statistical significance by comparing two different estimates of variance
- STATS_T_TEST_ONE is a one-sample *t*-test
- STATS_T_TEST_PAIRED two-sample, paired *t*-test (also known as a crossed *t*-test)
- STATS_T_TEST_INDEP is a *t*-test of two independent groups with the same variance (pooled variances)
- STATS_T_TEST_INDEPU A *t*-test of two independent groups with unequal variance (unpooled variances)
- STATS_WSR_TEST test of paired samples to determine whether the median of the differences between the samples is significantly different from zero

Example CORR Function


```
select  country,
        corr(sale,cnt)
  from sales_view
  group by country
```

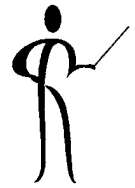
10g Fast Dual

- For years, developers have used the Dual table for “quick and dirty” queries only to find during performance tuning that scans involving dual could be expensive
- In Oracle 10g the optimizer knows about dual and implements an operation called “fast dual” greatly speeding access

10g Connect login.sql/glogin.sql

- The login.sql and glogin.sql files are automatically executed upon entering SQL*Plus,
- In Oracle 10g login.sql and glogin.sql are also executed upon execution of CONNECT
- This is either a blessing or a curse, just be aware that it is happening…

10g SQL*Plus Misc.



- SET SERVEROUTPUT ON now works immediately within block where executed
- Recycle Bin keeps deleted database objects until Purged
- DESCRIBE now validates before display
- White space now allowed in file names
- APPEND, CREATE, REPLACE extensions to SPOOL

10g Recycle Bin

- SQL*Plus now provides an “oops” capability for object drops (if database is running in “Flashback mode”
- After issuing “DROP ***object*** xyz” the user may issue the following SQL*Plus command to see “dropped objects:

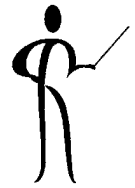
```
SHOW RECYCLEBIN
```

- Then, one of these SQL statements might be executed:

```
PURGE table xx|index yy |recyclebin|tablespace zz;
```

```
FLASHBACK TABLE xxx TO BEFORE DROP;
```

10g Using Recyclebin



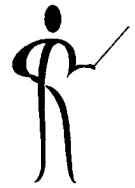
- Careful! Dropping tables no longer really drops them… This might be a problem for applications with lots of "temp"-type tables

```
drop table myTable;

show recyclebin

ORIGINAL     RECYCLEBIN NAME      TYPE  DROP TIME
myTable      RB$$41506$TABLE$0    TABLE 2004-04-01:22:11:13

flashback table myTable to before drop;

drop table myTable purge;
purge recyclebin;
```

iSqlPlus Changes

- Multi-page output
- Prompting for input values

10g Regular Expressions



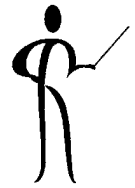
- Oracle now has three functions that allow the use of POSIX-compliant regular expressions in SQL
  - REGEXP_LIKE — Allows pattern matching
  - REGEXP_INSTR — Search for string matching pattern and return position
  - REGEXP_REPLACE — Find string matching pattern and replace it
  - REGEXP_SUBSTR — Search for string matching pattern and return substring

Regular Expression Examples


```
select employee_id,phone_number
    from hr.employees
    where REGEXP_LIKE(phone_number,
          '[[:digit:]]{3}[[:punct:]][[:digit:]]{2}[[:punct:]]');
```

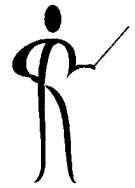
```
select first_name, last_name
    from hr.employees
    where REGEXP_LIKE (first_name, '^ste(v|ph)en$');
```

10g Model Clause



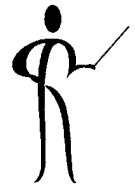
- The SQL MODEL clause is a powerful extension of the SELECT statement
- MODEL provides the ability to present the output of a SELECT in the form of multi-dimensional arrays and apply formulas to the array values
- The Model clause defines a multidimensional array by mapping the columns of a query into three groups: partitioning, dimension, and measure columns
  - Partitions define logical blocks of the result set in a way similar to the partitions of the analytical functions; each partition is viewed by the formulas as an independent array
  - Dimensions identify each measure cell within a partition; each column identifies characteristics such as date, region and product name
  - Measures are similar to the measures of a fact table in a star schema, they normally contain contain numeric values such as sales units or cost; each cell is accessed within its partition by specifying its full combination of dimensions

10g Model Syntax



```
SELECT
   -- rest of SELECT goes here –
   MODEL [main]
   [reference models]
   [PARTITION BY (<cols>)]
   DIMENSION BY (<cols>)
   MEASURES (<cols>)
   [IGNORE NAV] | [KEEP NAV]
   [RULES
   [UPSERT | UPDATE]
   [AUTOMATIC ORDER | SEQUENTIAL ORDER]
   [ITERATE (n) [UNTIL <condition>] ]
   ( <cell_assignment> = <expression> ... )
```

10g Model Example



```
SELECT SUBSTR(country,1,20) country, SUBSTR(prod,1,15) prod, year, sales
   FROM sales_view
   WHERE country IN ('Canada','Germany')
   MODEL RETURN UPDATED ROWS
         PARTITION BY (country)
         DIMENSION BY (prod, year)
         MEASURES (sale sales)
         RULES (
                 sales['Zoop Tube', 2002] = sales['Zoop Tube', 2001] +
                                            sales['Zoop Tube', 2000],
                 sales['Hula Twirl', 2002] = sales['Hula Twirl', 2001],
                 sales['HulaZoop Pkg', 2002] = sales['Zoop Tube', 2002] +
                                               sales['Hula Twirl', 2002])
   ORDER BY country, prod, year;

COUNTRY PROD YEAR SALES
-------------------- -------------- ---------- ----------
Canada HulaZoop Pkg 2002 92613.16
Canada Zoop Tube 2002 9299.08
Canada Hula Twirl 2002 83314.08
Germany HulaZoop Pkg 2002 103816.6
Germany Zoop Tube 2002 11631.13Germany Hula Twirl 2002 92185.47
```

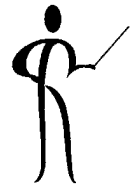
10g Model Example Explained

- The statement on the preceding page calculates sales values for two products and defines sales for a new product based upon the other two products
  - Statement partitions data by country, so formulas are applied to one country at a time, sales fact data ends with 2001, any rules defining values for 2002 or later will insert new cells
  - First rule defines sales of “Zoop Tube” game in 2002 as the sum of its sales in 2000 and 2001
  - The second rule defines sales for “Hula Twirl” in 2002 to be the same value they were for 2001
  - Third rule defines "HulaZoop Pkg" that is the sum of the Zoop Tube and Hula Twirl values for 2002 -- the rules for Zoop Tube and Hula Twirl must be executed before the HulaZoop Pkg rule

10g Merge Enhanced

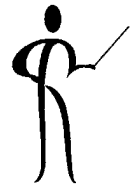
- MERGE now allows:
  - Specification of either update, or insert, or both
  - Deletion of rows during update

10g HTML DB



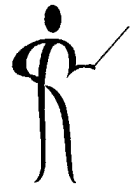
- Oracle HMTL DB is a complete web development and deployment environment built into Oracle 10g
- HTML DB is based upon the home-grown software that helped make Tom Kyte's "Ask Tom" website so powerful
- HTML DB is designed to make building web applications easy without compromising flexibility when building web applications
- Pre-built components are assembled using wizards and declarative programming eliminating most need to write code
- Some of the built-in features include:
  - Page Rendering and Processing Engine Rather than generating code, Oracle HTML DB stores user interface properties and data access and logic behaviors in an application definition; when an HTML DB application is run pages are rendered in real time based upon an application definition stored in the database
  - Logic to determine how a user flows from page to page, data validation and form handlers are all built in to the processing engine
  - Deployment is automatic, immediately after an application is built or changed users can start using it
- Pre-Built components are used with wizards, to assemble applications with forms, reports, and charts without writing code; the pre-built components include: navigational controls, authentication schemes and user interface themes

Oracle Documentation



- Oracle9i and Oracle10g
  - Oracle9i SQL Reference
  - Oracle9i PL/SQL User's Guide and Reference
  - Oracle9i Application Developer's Guide - Object-Relational Features
  - Oracle9i Concepts
  - XML DB Developer's Guide
- Oracle10g
  - Oracle10g SQL Reference
  - Oracle10g PL/SQL User's Guide and Reference
  - Oracle10g Application Developer's Guide - Object-Relational Features
  - Oracle10g Concepts
  - XML DB Developer's Guide
- Lots of papers and examples:
  http://technet.oracle.com
  http://tahiti.oracle.com

Wrapping it all Up

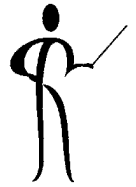


- Oracle9i adds significant new functionality to the already robust database environment; 10g goes even further
- While an emphasis is sometimes placed on the features of Oracle that support the Data Base Administrator, this paper shows many Developer-oriented features of great usefulness
- The importance of ISO/ANSI constructs cannot be underestimated, with the frequent use of third-party tools and occasional movement of applications; following an international standard makes sense

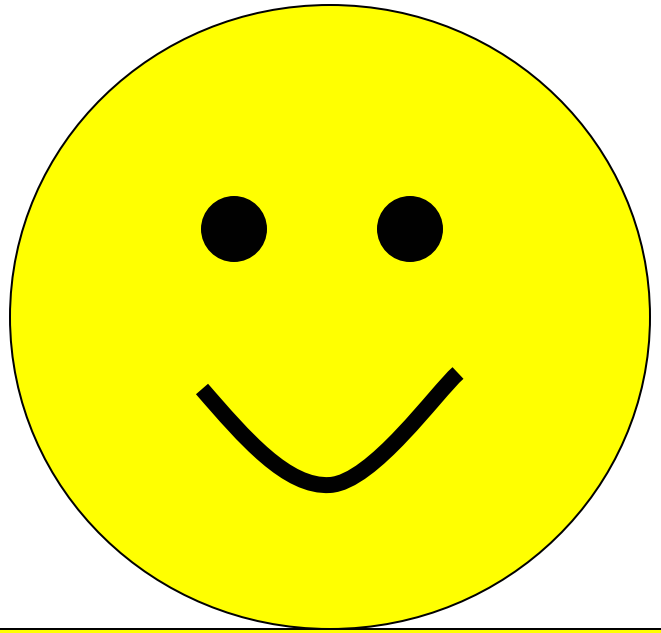
Training Days 2005

Mark your calendar for:

February 9-10, 2005!



King Training Resources



Thanks for your attention!

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