Oracle 11g/10g for Developers: What You Need to Know

Session S300195

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Session Objectives

- Learn new Oracle 11g and Oracle 10g features that are geared to developers
- Know how existing database features have been improved in Oracle
- Become aware of some DBA-oriented features that impact developers

Oracle 10g

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

Oracle 11g

- Environment changes
- XML enhancements
- New/improved SQL statements
- New features in PL/SQL
- Java, JDBC, and SQLJ improvements
- Pro* and OCI enhancements

10g Binary_double & Binary_float

- Oracle supports the IEEE754 floating-point specification
  - BINARY_FLOAT: 32-bit single-precision floating-point value stored as 5 bytes including a length byte
  - BINARY_DOUBLE: 64-bit double-precision floating-point value stored as 9 bytes, including a length byte
- When processing NUMBER columns, floating point numbers have decimal precision.
- With BINARY_FLOAT or BINARY_DOUBLE columns, floating-point numbers have binary precision
- Both binary floating-point numbers support the special values infinity and NaN (not a number)
- binary_double and binary_float should significantly speed ***some*** calculations

	Binary-Float	Binary-Double
Maximum finite value	3.40282E+38F	1.7976931348623 1E+308
Minimum finite value	1.17549E-38F	2.2250738585072 0E-308

10g Limitless LOB

- Since first introduced the Oracle LOB type has been limited to 4GB (enough for most uses)
- 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

New “Scalar” Functions, 1

- CARDINALITY — Returns number of elements in nested tables
- CV — Current value of dimension in model clause
- ITERATION_NUMBER — Returns iteration number in model rule
- LNNVL — Returns TRUE if condition is FALSE or UNKNOWN
- NANVL — Return alternate value if floating-point is NAN (Not A Number)
- ORA_HASH — Computes hash value for given expression
- POWERMULTISET — Return nested table of non-empty sets in nested table
- POWERMULTISET_BY_CARDINALITY — Returns POWERMULTISET for given cardinality
- PRESENTNNV — Present Value of cell in model clause (nulls converted)
- PRESENTV — Present Value of cell in model clause
- PREVIOUS — Returns cell value at beginning of model clause iteration

New “Scalar” Functions, 2

• REGEXP_INSTR	INSTR using regular expression syntax
• REGEXP_REPLACE	REPLACE using regular expression
• REGEXP_SUBSTR	SUBSTR using regular expression
• REMAINDER	Returns remainder after expression is evaluated
• SCN_TO_TIMESTAMP	Returns timestamp for given SCN
• SESSIONTIMEZONE	Timezone of current session
• SET	Converts nested table to set by removing duplicates
• TIMESTAMP_TO_SCN	Returns SCN for given timestamp
• TO_BINARY_DOUBLE	Return binary_double for given char, number, binary
• TO_BINARY_FLOAT	Return binary_float for given char, number, binary

Useful10g Addition

- Oracle 10g adds two exciting changes to the ALTER SYSTEM statement
- When testing and tuning statements, the values returned by tuning tools are impacted by the actions of Oracle's shared SQL area and buffer cache – take a look!!!

```
ALTER SYSTEM FLUSH BUFFER_CACHE
ALTER SYSTEM FLUSH SHARED_POOL
```

(should probably be used in test systems only)

Statistical Group Functions, 1

- 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

Statistical Group Functions, 2

• STATS_MW_TEST	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	Tests differences in means (for groups or variables) for statistical significance by comparing two different variance estimates
• STATS_T_TEST_ONE	Is a one-sample *t*-test
• STATS_T_TEST_PAIRED	Is a 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 Median Function

- Given the following data:

ENAME	SAL
SMITH	800
JAMES	950
ADAMS	1100
WARD	1250
MARTIN	1250
MILLER	1300
TURNER	1500
ALLEN	1600
CLARK	2450
BLAKE	2850
JONES	2975
SCOTT	3000
FORD	3000
KING	5000

- Note the difference between AVG and MEDIAN

```
select avg(sal) average,median(sal) median
      from emp;

      AVERAGE       MEDIAN
---------- ----------
2073.21429          1550
```

10g R1: XML Enhancements

- Oracle 10g Release 1 improved support for XML data and the XMLtype datatype including:
  - Export/Import support
  - SQL*Loader support for both stuctured and unstructured XMLtype data
  - DBMS_AQ support, globalization support
  - C and C++ APIs allow XML modification
  - DBMS_XMLGEN allows turning off "pretty print“
  - Hierarchical queries (CONNECT) via DBMS_XMLGEN.newContextFromHierarchy
  - Schema evolution via DBMS_XMLSCHEMA (see next page)

Schema Evolution

- Schema evolution via DBMS_XMLSCHEMA
  - Before Oracle 10g XML registered schemas could not be modified (evolved)
  - Oracle 10g schema "evolution" uses a PL/SQL procedure named CopyEvolve() which is part of the DBMS_XMLSCHEMA package
  - CopyEvolve() copies an XMLType document to temporary tables, drops and re-registers the XML schema, then copies the XMLType data into the new XMLTypes
  - CopyEvolve() has some limits: indexes, triggers, and constraints dependent upon the schemas are lost and must be recreated
  - Changing a top-level element involves additional processing detailed in the Oracle documentation

10g R2: XML Enhancements

- Oracle 10g Release 2 further enhances support for XML:
  - XMLtype is fully supported in Java, C, and C++
  - Supports XSLT 2.0 with XPath functions and operators
  - Built-in XML support includes a JAXB compiler and XQuery support
  - XMLQUERY and XMLTABLE functions support XQuery
    - XMLQUERY builds XML data, queries XML data and relational data using XQuery
    - XMLTABLE creates relational tables and columns from the results of XQuery (COLUMN_VALUE pseudo-column used to retrieve data from XMLTABLE values)
  - XPATH processing has been improved enhancing speed
  - UpdateXML() function is joined by InsertXML(), AppendChildXML(), InsertXMLBefore(), and DeleteXML()

10g R2: XML Enhancements, 2

- 10g Release 2 further enhances support for XML (cont):
  - SOAP services are supported in C and C++
  - More SQL/XML (SQX) 2003 functions added including: XMLPI(), XMLComment(), XMLRoot(), XMLSerialize(), XMLCDATA(), and XMLParse()
  - Enterprise Manager Web Console includes the ability to work with XMLType objects
  - Oracle HTTPS server supports XML DB
  - Oracle XML Developers Kit (XDK) PL/SQL packages have been deprecated: XMLDOM(), XMLPARSER(), and XSL_PROCESSOR() have been replaced by DBMS_XMLDOM(), DBMS_XMLPARSER(), and DBMS_XSLPROCESSOR()

BI (XML) Publisher

- BI Publisher is a powerful report generation tool allowing creation of standardized reports containing Oracle (and other) data quickly and easily (replacement for SQL*Reports?)
- BI Publisher supports:
  - Creating Reports and Report Standardization
  - Report, Data, and Translation Templates
  - Support for regular files, XML files, and database data
  - Online Report Editor, Query Builder, and Analyzer
  - Simple Charts & Formatting Options
  - Row, Column, and Cell formatting
  - Number and Date formatting (e.g internationalization)
  - Advanced reporting via XSL, SQL, and XSL-FO (including PDF)
- Originally intended to support Oracle‘s various ERP tools BI Publisher is now available as a separate product

10g R2 DML Error Logging

- Insert, Update, Delete, and Merge add ERROR logging allowing you to capture DML errors and log them

```
INSERT …  /* or UPDATE, DELETE, MERGE */
  LOG ERRORS
     [ INTO [schema.] table ]
     [ (simple_expression) ]
     [ REJECT LIMIT { integer | UNLIMITED }
```

  - Default error table defined by DBMS_ERRLOG package: ERR$_ followed by first 25 characters of DML target table
  - Simple expression is value to be used as statement tag (may be result of SQL function call)
  - Reject limit default is zero

Creating the Error Log Table

- Oracle provides a PL/SQL packaged procedure to create the logging table (for each table to be logged)

```
execute DBMS_ERRLOG.CREATE_ERROR_LOG('myemp', 'myemplog');
```

  - myemp — Table DML is being applied to
  - myemplog — Logging table for rejected rows

- Creates a database table containing:
  - ORA_ERR_NUMBER$ — Error number
  - ORA_ERR_MESG$ — Error message
  - ORA_ERR_ROWID$ — Rowid of impacted rows
  - ORA_ERR_OPTYP$ — Operation type (I,U,D,M)
  - ORA_ERR_TAG$ — Text from LOG_ERRORS
  - All column values (good & bad) as varchar2(4000)

Error Log Output

```
insert into emp
        select * from myempbig
           log errors into myemplog ('Log test3')
             reject limit unlimited;
0 rows created.
```

```
ORA_ERR_NUMBER$   12899
ORA_ERR_MESG$     ORA-12899: value too large for column
                  "JOHN"."EMP"."JOB" (actual: 13, maximum: 9)
ORA_ERR_ROWID$
ORA_ERR_OPTYP$    I
ORA_ERR_TAG$             Log test3
EMPNO             6543
ENAME             STEPHENSON
JOB               WEB DEVELOPER
MGR               7369
HIREDATE          03-SEP-06
SAL               3000
COMM
DEPTNO            40
```

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
- Here is the “Explain” output from a simple query:

```
select sysdate from dual;

-------------------------------------------------------------------
|Id | Operation         | Name | Rows  | Cost (%CPU)| Time     |
-------------------------------------------------------------------
|  0| SELECT STATEMENT  |      |     1 |     2   (0)| 00:00:01 |
|  1|  FAST DUAL        |      |     1 |     2   (0)| 00:00:01 |
-------------------------------------------------------------------
```

Connect login.sql/glogin.sql

- The login.sql and glogin.sql files are automatically executed upon entering SQL*Plus,
- Starting with 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 PL/SQL block where executed
- DBMS_OUTPUT.PUT_LINE text line maximum increased from 255 to 32767 bytes
- Recycle Bin keeps deleted objects until Purged
- DESCRIBE automatically attempts to validate invalid objects before display
- White space now allowed in file names
- Substitution variables allowed in SET PROMPT
- Three pre-defined SQL*Plus variables added:
  - _DATE Current date or a user defined fixed string.
  - _PRIVILEGE Privilege level (AS SYSDBA, AS SYSOPER or blank)
  - _USER Currently connected userid
- APPEND, CREATE, REPLACE added to SPOOL

SET SERVEROUTPUT ON

- It is common for PL/SQL developers to use the DBMS_OUTPUT.PUT_LINE procedure to write to the console during testing and debugging
- To enable output from DBMS_OUTPUT.PUT_LINE you must enable SERVEROUTPUT
- In Oracle 10g this command has been enhanced to include a default of UNLIMITED buffer size eliminating the need to specify a buffer size
- You may also specify “WORD_WRAPPED” to cause DBMS_OUTPUT.PUT_LINE output to be wrapped at clear word breaks

```
set serveroutput on size 1000000   -- size limited
set serveroutput on size unlimited -- size unlimited
set serveroutput on     -- size unlimited (default)
set serveroutput on size unlimited format word_wrapped
```

10g Recycle Bin

- SQL*Plus now provides an “oops” capability for object drops (RECYCLEBIN ON/OFF system or session setting)
- 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;
```

```
FLASHBACK TABLE BIN$yAbqlZrXBhfgMIgBGQfgRC==$3
  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 (consider drop … purge)

```
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;
```

Interesting Recyclebin Artifacts

- Dropping a table:
  - Removes indexes on the dropped table
  - Invalidates views, procedures, functions, and other objects dependent upon the table
- After using “FLASHBACK TABLE”
  - Indexes are restored with different names
  - Primary key constraints are restored using a different name
  - Foreign key constraints are not restored
  - Views, procedures, functions, and other objects dependent upon the table will work once validated (may be done manually or automatically)

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$');
```

LIKE vs REGEXP_LIKE

- Here are two statements that generate exactly the same output and nearly the same execution plan

```
select prod_id
     , substr(prod_name,1,20) prod_name
     , substr(prod_desc,1,30) prod_desc
    from sh.products
    where prod_name like ('E%')
       or prod_name like ('P%')
    order by prod_id;

select prod_id
     , substr(prod_name,1,20) prod_name
     , substr(prod_desc,1,30) prod_desc
    from sh.products
    where regexp_like (prod_name,'^E|^P')
    order by prod_id;
```

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 measures
  - Partitions define logical result set blocks similar to partitions in 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 fact table measures in a star schema; they normally contain numeric values (e.g. sales units,); 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['ZooperT',2002] = sales['ZooperT',2001]
                                     + sales['ZooperT',2000],
             sales['HulaWhirl',2002] = sales['HulaWhirl',2001],
             sales['HulaZoop Pkg',2002] = sales['ZooperT',2002]
                                     + sales['HulaWhirl',2002])
   ORDER BY country, prod, year;
```

COUNTRY	PROD	YEAR	SALES
Canada	HulaZoop Pkg	2002	92613.16
Canada	ZooperT	2002	9299.08
Canada	HulaWhirl	2002	83314.08
Germany	HulaZoop Pkg	2002	103816.6
Germany	ZooperT	2002	11631.13
Germany	HulaWhirl	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 “ZooperT” game in 2002 as the sum of its sales in 2000 and 2001
  - The second rule defines sales for “HulaWhirl” in 2002 to be the same value they were for 2001
  - Third rule defines "HulaZoop Pkg" that is the sum of the ZooperT and HulaWhirl values for 2002 -- the rules for ZooperT and HulaWhirl 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

```
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
          delete
           where bonus.sal > 3999  -- values after
  merge
    when not matched
        then insert (ename,job,sal,comm)
          values
           (emp.ename,emp.job,emp.sal,emp.comm);
```

FROM Clause SEED

- For years Oracle SQL has allowed “sampling” to occur using randomized value
- Beginning with Oracle 10g you may now use a SEED to get the same (pretty close anyway) randomized value each time

```
select count(*) nbr_rows
   from sh.sales;                          NBR_ROWS = 918843
select count(*) * 10 nbr_rows
   from sh.sales sample(10);               NBR_ROWS = 921400
select count(*) * 10 nbr_rows
   from sh.sales sample(10);               NBR_ROWS = 917400
select count(*) * 10 nbr_rows
   from sh.sales sample(10) seed(1); NBR_ROWS = 913280
select count(*) * 10 nbr_rows
   from sh.sales sample(10) seed(1); NBR_ROWS = 913280
```

King Training Resources

PL/SQL Conditional Compile

- Oracle 10g R2 added the ability to conditionally include PL/SQL code at compile time
- PL/SQL conditional compilation occurs before the rest of PL/SQL compilation
- Using the “$” delimiter PL/SQL may include:
  - **Conditional directives** tell the compiler to choose between different code fragments using: $IF, $THEN, $ELSE, $END, and $ELSIF
  - **Inquiry directives** use environment values to determine whether something should be included such as: PL/SQL compile parameters and flags (two predefined: PLSQL_Unit & PLSQL_Line)
  - **Error Directives** allow a developer to force a compile error using the specified VARCHAR2 string (may be concatenation)

PL/SQL Conditional Example

- The plsql_ccflags session variable may be set to include name/value pairs

```
alter session set plsql_ccflags = 'hoohah:true';
```

- Conditional code may test plsql_ccflags as shown below

```
begin
  $if $$hoohah $then
     dbms_output.put_line('hoo hah!');
  $end
  dbms_output.put_line('testing');
end;
/
```

Oracle Application Express

- Oracle Application Express (APEX; formerly HMTL DB) is a complete web development and deployment environment built into Oracle 10g
- APEX/HTML DB is based upon the home-grown software that helped make Tom Kyte's "Ask Tom" website so powerful
- APEX 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
- 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

Application Express Features

- Some of the built-in features in Oracle Application Express 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

Oracle SQL Developer

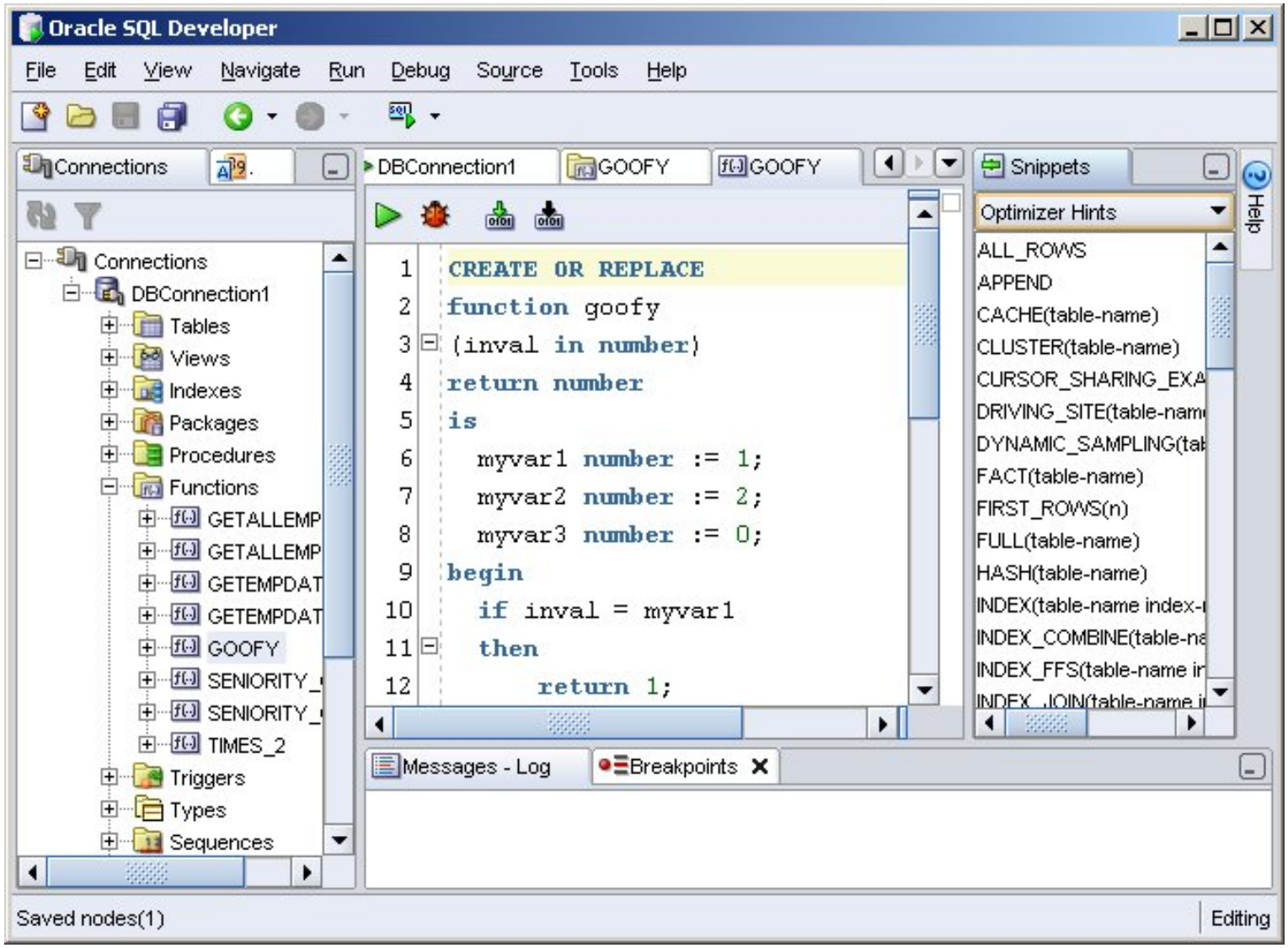
- Oracle provides a free tool named SQL Developer
- This tool will feel familiar to those used to IDEs plus it has features to support Oracle 11g and 10g too!
- SQL Developer is a Java-based GUI tool (works in Windows, Unix, and Linux)
  - Power of SQL*Plus without a local Oracle client installation
  - Intuitive software
  - Provides features often found only in expensive third-party software including:
    - GUI browsing of database objects
    - Debugging complete with breakpoints
    - Query execution
    - Database reporting
    - Multiple connections

How Do I Get It?

- SQL Developer is freely downloadable from Oracle using the following URL:

http://www.oracle.com/technology/products/database/sql_developer/index.html

SQL Developer Screen



Careful About Assumptions!

- ORDER BY has always been the only way to guarantee output sequence
- Some developers have been "sloppy" and ***assumed*** that since some statements seemed to be solved via sort that an additional sort was not needed...
- Oracle 11g/10g DOES NOT always return rows in the same way earlier releases did
- The two simple statements below would have shown sorted output in Oracle 9i, 8i, or earlier; without an ORDER BY you might get surprised!

```
select distinct ename from emp;
select deptno,count(*) from emp
    group by deptno;
```

Oracle 11 Preview

- iSqlPlus and SQLPLUSW gone
  (SQL*Plus & SQL Developer still there)
- Virtual Columns
- XML DB Binary XMLTYPE
- SQL Pivot/Unpivot
- REGEXP_COUNT
- PL/SQL compiler enhancement
- Assign sequence numbers in PL/SQL
- PL/SQL CONTINUE
- Trigger improvements
- New JDBC driver support Java 5 (1.5) & 6

Goodbye iSQL*Plus & sqlplusw

- Oracle11g does not include iSQL*Plus
- Oracle 11g does not include the windows version of SQL*Plus (sqlplusw.exe)
- Oracle 11g does still include SQL*Plus (command line)
- Oracle 11g fully supports Oracle SQL Developer (introduced in Oracle 10g)
- Oracle SQL Developer is Oracle's suggested mechanism for SQL and PL/SQL development
- SQL*Plus has been enhanced to deal with BLOB, CLOB, and BFILE data more effectively

Binary XML

- Oracle continues its XML leadership in Oracle 11g
- Biggest change is the addition of a new “binary” XMLType
  - “binary xml” is a third method for storing XML data in the database
  - “structured” and “unstructured” XMLType still supported
  - Oracle 11g’s XML processors includes a binary XML encoder, decoder, and token manager
  - XML 1.0 text may be parsed via SAX events with or without a corresponding schema into “binary” XML form
  - “binary” XMLType allows optimization of some XML applications by reducing memory and CPU expense

Next-Gen. LOB: Securefile

- Oracle 11g provides a new, more-secure, faster mechanism for storing Large Objects (e.g. XMLType data)
- LOB column specifications in CREATE TABLE or ALTER TABLE include STORE AS SECUREFILE
- SECUREFILE provides compression and encryption for Large OBjects (LOBs)
  - Oracle 11g will detect duplicate LOB data and conserve space by only storing one copy ("de-duplication" if SECUREFILE is specified).
  - PL/SQL packages and OCI functions have been added to take advantage of SECUREFILE LOBs
  - SECUREFILE lobs provide higher performance through reduced size and resource use.

XML Indexes

- Replaces CTXSYS.CTXXPATH indexes
- XML-specific index type, indexes document XML structure
- Designed to improve indexing unstructured and hybrid XML
- Determines XPath expressions for a document's XML tags
- Indexes singleton (scalar) nodes and items that occur multiple times
- XMLIndex record document child, descendant, and attribute axes (hierarchy) information
- XMLIndex is be design general (like CTXXPATH) rather than specific like B-tree indexes
- XMLIndex applies to all possible XPath targeting of a document
- XMLIndex may be used for XMLQuery, XMLTable, XMLExists, XMLCast, extract, extractValue, and existsNode
- XMLIndex helps anywhere in the query, not just in the WHERE clause

Creating XMLIndex

- The syntax to create an XMLIndex looks a little different from non-XML indexes; it is made up of three parts:
  - Path index — Indexes XML tags and identifies document fragments
  - Order index — Indexes the hierarchy of nodes
  - Value index — Values to match WHERE clauses (may be exact match or range)
- XMLIndex uses a “Path Table” to store the various node paths in an XML document; if not specified in the CREATE INDEX statement Oracle will generate a name for you

```
CREATE INDEX po_xmlindex_ix
   ON po_clob (OBJECT_VALUE)
   INDEXTYPE IS XDB.XMLIndex
   PARAMETERS ('PATH TABLE my_path_table');
```

Introducing Virtual Columns

- Beginning with Oracle 11g tables may now include virtual columns (dynamic values; not stored)
- Virtual columns obtain their value by evaluating an expression that might use:
  - Columns from the same table
  - Constants
  - Function calls (user-defined functions or SQL functions)
- Virtual columns might be used to:
  - Eliminate some views
  - Control table partitioning (DBA stuff)
  - Manage the new "binary" XMLType data
- Virtual columns may be indexed!

Creating Virtual Column

```
CREATE TABLE NEWEMP
       (EMPNO NUMBER(4) NOT NULL,
        ENAME VARCHAR2(10),
        JOB VARCHAR2(9),
        MGR NUMBER(4),
        HIREDATE DATE,
        SAL NUMBER(7, 2),
        COMM NUMBER(7, 2),
        INCOME NUMBER(9,2)
           GENERATED ALWAYS
           AS (NVL("SAL",0)+NVL("COMM",0))
                        VIRTUAL,
        DEPTNO NUMBER(2));
```

- Datatype defaults if not specified (based upon expression)
- Expression result appears as data in table but is "generated always" (whether or not specified in table definition)
- " VIRTUAL" is not required, but adds clarity

Adding Virtual Columns

- Oracle 11g also allows specification of Virtual Columns via ALTER TABLE

```
alter table myemp
    add (totpay as
         (nvl(sal,0)+nvl(comm,0)));
```

SELECT PIVOT/UNPIVOT

- Oracle joins other vendors by adding the PIVOT clause to the SELECT statement
- Adding a PIVOT clause to a SELECT allows rotation of rows into columns while performing aggregation to create cross-tabulation queries
- The PIVOT clause:
  - Computes aggregations (implicit GROUP BY of all columns not in PIVOT clause)
  - Output of all implicit grouping columns followed by new columns generated by PIVOT
- UNPIVOT performs the same activity but converts columns into ROWS (does not “undo” PIVOT)
- Clever developers have used PL/SQL and/or CASE to achieve PIVOT results before, but now it is part of Oracle's standard SQL

PIVOT Example

```
select * from
  (select job,deptno,income from newemp) query1
    pivot (avg(income)
    for deptno in (10 AS ACCOUNTING,
                   20 AS RESEARCH,
                   30 AS SALES))
    order by job;

Job       ACCOUNTING  RESEARCH    SALES
ANALYST          30000
CLERK            13000     9500     9500
MANAGER          24500    29750    28500
PRESIDENT        50000
SALESMAN                   19500
```

UNPIVOT Example

```
select * from pivot_emp_table
  unpivot include nulls
    (avgpay for dept in (ACCOUNTING,RESEARCH,SALES))
  order by job;

JOB                 DEPT                AVGPAY
ANALYST             ACCOUNTING
ANALYST             RESEARCH            30000
ANALYST             SALES
   /*** more rows ***/
SALESMAN            ACCOUNTING
SALESMAN            RESEARCH
SALESMAN            SALES               19500
```

New SQL Functions

- New functions have also been added to Oracle 11g including:
  - CUBE_TABLE — Extracts two-dimensional table from a cube or dimension
  - REGEXP_COUNT — Count occurrences of string
  - XMLCAST — Cast XML data to SQL datatype
  - XMLEXISTS — Determine if XQuery returns values
  - XMLDIFF — Used to compare two XMLType documents
  - XMLPATCH — Used to patch an XMLType document

PL/SQL Enhancements

- Oracle 11g's changes to PL/SQL are very interesting to the developer:
  - PL/SQL has been improved to include all of the XMLType, BLOB, Regular Expression, and other functionality added to SQL
  - Improvements have been made to the compiler
  - New PL/SQL data types
  - Sequence number use is easier
  - "continue" added for loop control
  - CALL syntax has improved

Compiler Enhancement

- In previous releases, the PL/SQL compiler required a standalone “C” compiler
- Oracle 11g now provides a native compiler for PL/SQL eliminating the need for a separate compiler

```
CREATE…
  COMPILE PLSQL_CODE_TYPE=NATIVE …
CREATE…
  COMPILE PLSQL_CODE_TYPE=INTERPRETED …
```

Compound Triggers

- Compound triggers allow the same code to be shared across timing points

  (previously accomplished using packages most of the time)

- Compound triggers have unique declaration and code sections for timing point

- All parts of a compound trigger share a common state that is initiated when the triggering statement starts and is destroyed when the triggering statement completes (even if an error occurs)

Compound Trigger Syntax

```
CREATE TRIGGER compound_trigger
  FOR UPDATE OF sal ON emp
    COMPOUND TRIGGER
  -- Global Declaration Section
  BEFORE STATEMENT IS
  BEGIN …
  BEFORE EACH ROW IS
  BEGIN …
  AFTER EACH ROW IS
  BEGIN …
END compound_trigger;
/
```

TRIGGER … FOLLOWS

- Oracle 11g adds the “FOLLOWS” clause to trigger creation allowing control over the sequence of execution when multiple triggers share a timing point
- FOLLOWS indicates that including trigger should happen after the named trigger(s)

How FOLLOWS Works

- FOLLOWs only distinguishes between triggers at the same timing point:
  - BEFORE statement
  - BEFORE row
  - AFTER row
  - AFTER statement
  - INSTEAD OF
- In the case of a compound trigger, FOLLOWS applies only to portions of triggers at the same timing point

FOLLOWS Syntax

```
CREATE OR REPLACE TRIGGER myTrigger
    BEFORE/AFTER/INSTEAD OF  someEvent
    FOR EACH ROW
    FOLLOWS someschema.otherTrigger
    WHEN (condition=true)
    /* trigger body */
```

- FOLLOWS may specify a list (and designate sequence)

```
FOLLOWS otherTrigger1, otherTrigger2, etc
```

New PL/SQL Datatypes

- Oracle 11g adds three new PL/SQL datatypes: Simple_integer, Simple_float, Simple_double
  - The three new datatypes take advantage of native compilation features providing faster arithmetic via direct hardware implementation
  - SIMPLE_INTEGER provides a binary integer that is neither checked for nulls nor overflows
  - SIMPLE_INTEGER values may range from -2147483648 to 2147483647 and is always NOT NULL
  - Likewise, SIMPLE_FLOAT and SIMPLE_DOUBLE provide floating point without null or overflow checks

Example SIMPLE_INTEGER

```
declare
--  mytestvar pls_integer := 2147483645;
  mytestvar simple_integer := 2147483645;
begin
   loop
      mytestvar := mytestvar + 1;
      dbms_output.put_line('Value of mytestvar is now '
                           || mytestvar);
      exit when mytestvar < 10;
  end loop;
end;
Results in:
Value of mytestvar is now 2147483646
Value of mytestvar is now 2147483647
Value of mytestvar is now -2147483648
```

Without SIMPLE_INTEGER

- If the “mytestvar” variable is switched to PLS_INTEGER, an ORA-1426 NUMERIC OVERFLOW exception occurs

```
Error report:
   ORA-01426: numeric overflow
   ORA-06512: at line 7
   01426. 00000 -  "numeric overflow"
   *Cause:    Evaluation of an value expression causes
   an overflow/underflow.
   *Action:   Reduce the operands.
   Value of mytestvar is now 2147483646
   Value of mytestvar is now 2147483647
```

Sequences in PL/SQL

- Sequence values NEXTVAL and CURRVAL may be use in PL/SQL assignment statement

```
myvar := myseq.nextval;
```

CONTINUE

- CONTINUE “iterates” a loop; branching over the rest of the code in the loop and returning to the loop control statement

```
begin
    dbms_output.put_line('Counting down to blastoff!');
    for loopctr in reverse 1 .. ctr loop
      if loopctr in (4,2) then
          continue;
      end if;
      dbms_output.put_line(to_char(loopctr));
    end loop;
    dbms_output.put_line('Blast Off!');
end;
Counting down to blastoff!
6
5
3
1
Blast Off!
```

<-Values “4” and “2” do not appear in the output

REGEXP_COUNT

- REGEXP_COUNT counts the number of times a pattern occurs in a source string

```
select ename,regexp_count(ename,'l',1,'i') from emp;
SMITH    0
ALLEN    2
WARD     0
JONES    0
MARTIN   0
BLAKE    1
/** more rows ***/
MILLER   2
```

  - string expression and/or column to match pattern
  - Regular Expression pattern
  - Beginning position in the source string (default=1)
  - Match parameters (i = case insensitive, c = case sensitive, m = multiple line source delimited by '^' or '$', n = matches '.' newline characters (default no), and x = ignore whitespace characters (default is to match)

CALL with Mixed Parameters

- PL/SQL allows function and procedure parameters to be specified in two ways; by position and by name
- With Oracle 11g SQL, parameter types may now be mixed
- Given the following function:

```
CREATE OR REPLACE
FUNCTION TEST_CALL (inval1 IN NUMBER, inval2 IN
  NUMBER,
    inval3 IN NUMBER) RETURN NUMBER AS
BEGIN
  RETURN inval1 + inval2 + inval3;
END TEST_CALL;
```

- The following calls all now work:

```
test_call(vara,varb,varc)
test_call(inval3=>varc,inval1=>vara,inval2=>varb)
test_call(vara,inval3=>varc,inval2=>varb)
```

Non-PL/SQL Development

- Pro*C++ and Pro*COBOL improvements include:
  - Supports DB2-style array INSERT and SELECT syntax
  - Client-Side Query Cache
  - Use Oracle's Outline to fix execution plans
- Oracle 11g Java Enhancements include:
  - Java SE 5 (JDK 1.5) is new base level
  - JIT enabled by default; automatic native compile
  - JDBC 4.0 supported
- Microsoft .NET and Visual Studio .NET 2005
  - PL/SQL Debugging in Visual Studio .NET 2005
  - Designer and integration using Data Windows via Visual Studio .NET 2005 DDEX
  - Oracle Data Provider for .NET (ODP.NET)
- PHP Enhancements
  - Zend Technologies collaboration; Zend Core for Oracle may be downloaded from OTN

Wrapping it all Up

- Both Oracle 11g and Oracle 10g add significant new functionality to the already robust database environment
- 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

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Session S300195

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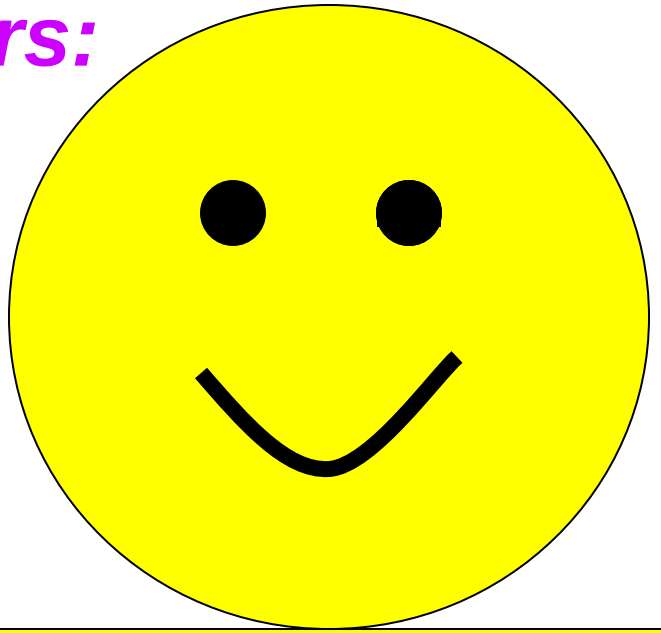

Thanks for your attention!

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