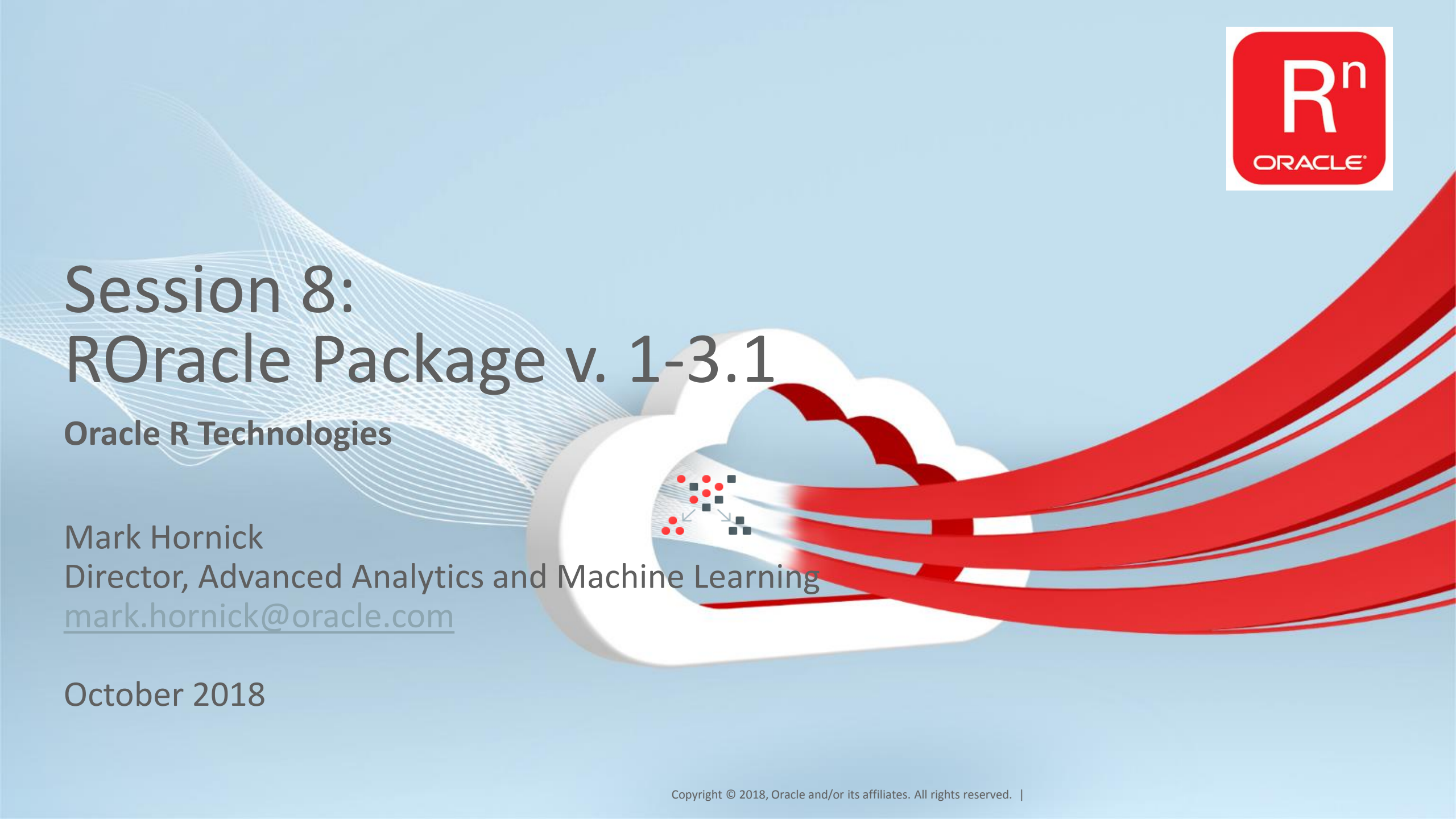

Session 8: ROracle Package v. 1-3.1

Oracle R Technologies

Mark Hornick
Director, Advanced Analytics and Machine Learning
mark.hornick@oracle.com

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Agenda

1. What is ROracle?
2. Using ROracle
3. Summary

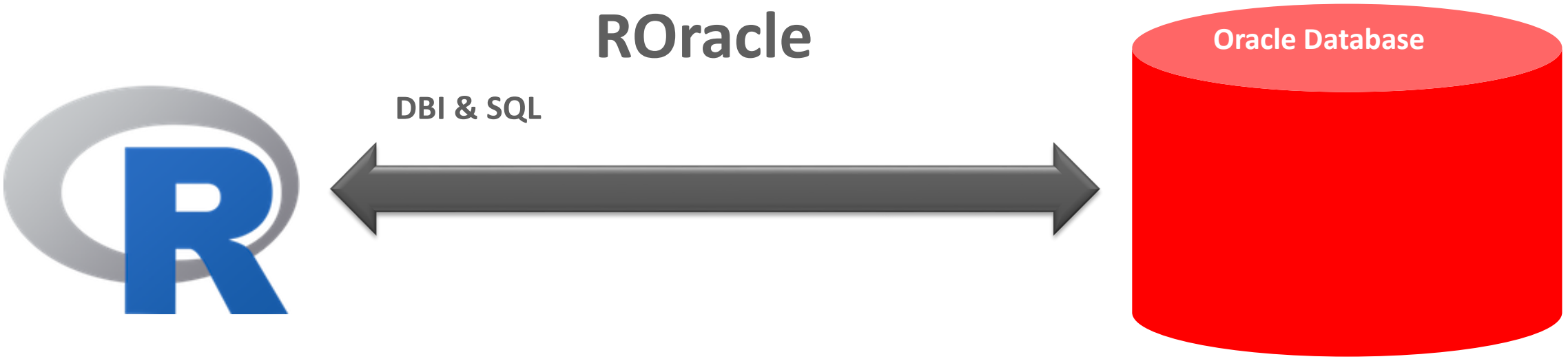
What is ROracle?

ROracle

- R package enabling connectivity to Oracle Database
  - Open source
  - Publically available on CRAN
- Execute SQL statements from R interface
- Oracle Database Interface (DBI) for R
- DBI –compliant Oracle driver based on OCI
- Requirements
  - Oracle Instant Client or Oracle Database Client

Examples from ROracle package documentation http://cran.r-project.org/web/packages/ROracle/ROracle.pdf

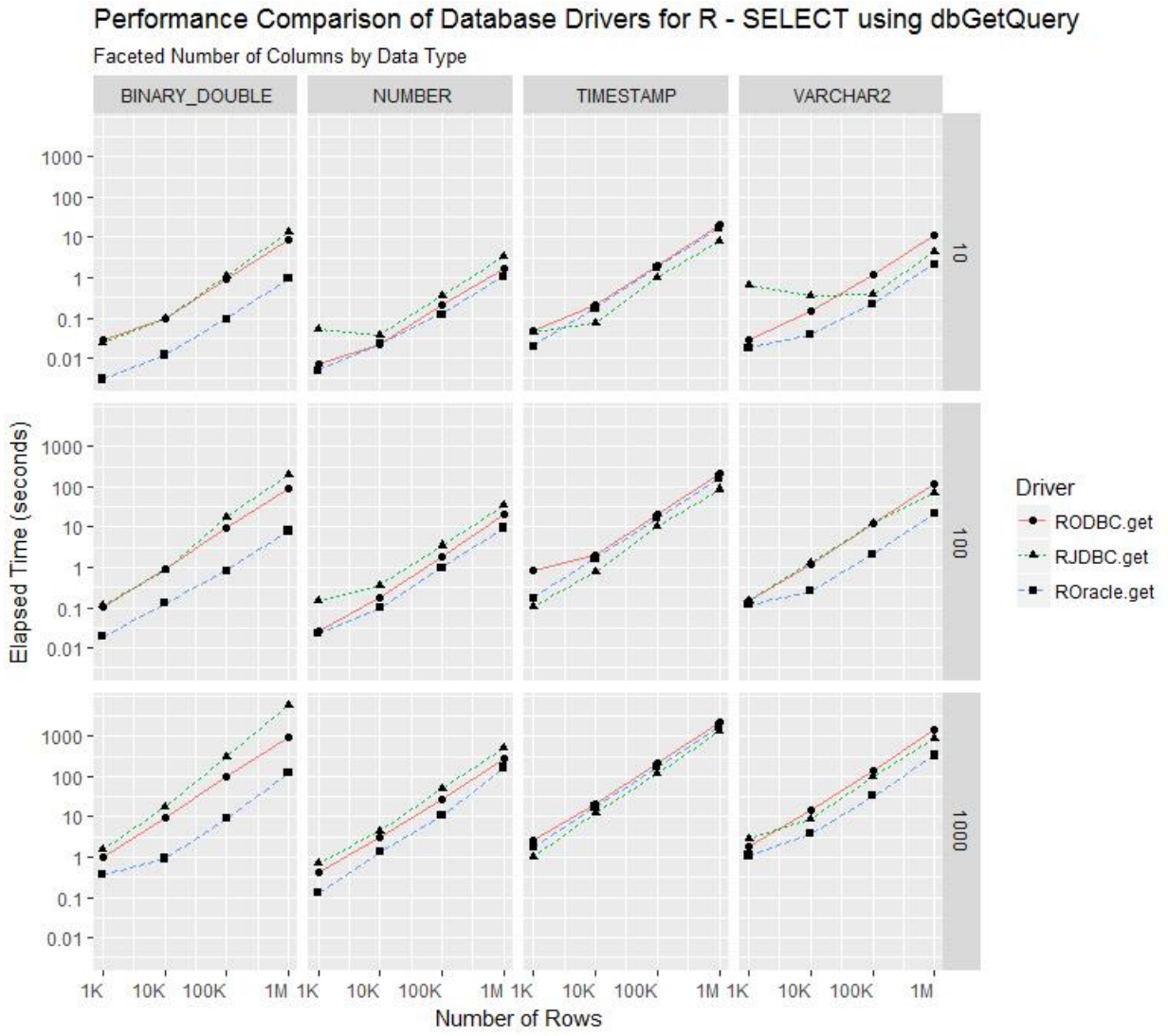
ROracle



- R package enabling connectivity to Oracle Database
  - Open source, publicly available on CRAN, free to R community
- Execute SQL statements from R interface
- Execute PLSQL procedures and functions from R interface
- Oracle Database Interface (DBI) for R based on OCI for high performance
- Supports **Oracle R Enterprise** database connectivity

Comparison reading database table to R data.frame

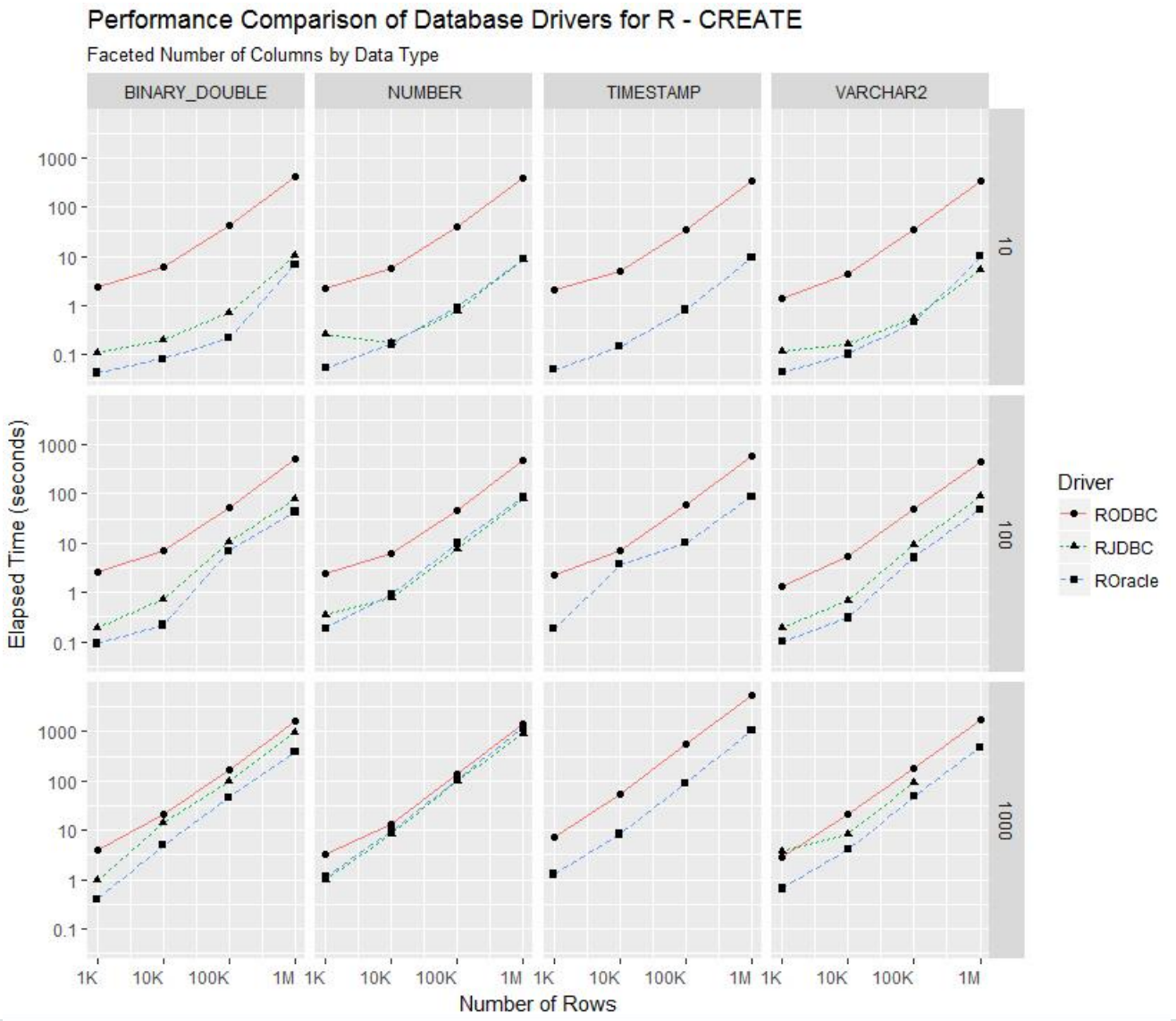
- ROracle
  - Up to 48X faster than RJDBC
  - Up to 11X faster than RODBC
  - Scales across NUMBER, BINARY_DOUBLE, VARCHAR2, TIMESTAMP data types



See https://blogs.oracle.com/R

Comparison writing database table from R data.frame

- ROracle
  - Up to 198X faster than RODBC (mean of 23X and median 9X)
  - Up to 6X faster than RJDBC (mean and median approaching 2X)
  - Scales across the remaining data types



ROracle 1-3.1 Enhancements

- Handles upper and lower cases in ora.type, ora.parameter_mode and ora.encoding attributes
- Support for OCIBindByName added for SQL and PL/SQL calls by specifying ora.parameter_name attribute; bind variables used in SQL or PL/SQL calls must be bound by the name specified in ora.parameter_name
- PL/SQL stored procedure/function and REF cursors supported
- OUT bind parameter must be initialized with 'NA' or 'NA' coerced to any other vector type
- Use OCIArrayDescriptorAlloc instead of OCIDescriptorAlloc for performance improvements with Oracle client release 11.1 or higher to build and run ROracle
- Removed functions (dbSetDataMappings and dbCallProc) that will not be available in 0.3.1 DBI specifications

ROracle 1-2.1 Enhancements

- Support for NATIVE, UTF8 and LATIN1 encoded data in query and results
- enhancement 20603162 - CLOB/BLOB enhancement on ROracle
- bug 15937661 – mapping of dbWriteTable BLOB, CLOB, NCLOB, NCHAR AND NVARCHAR columns. Data frame mapping to Oracle Database type is provided
- bug 16017358 – proper handling of NULL extproc context when passed to in ORE embedded R execution
- bug 16907374 - ROracle creates time stamp column for R Date with dbWriteTable
- ROracle now displays NCHAR, NVARCHAR2 and NCLOB data types defined for columns in the server using dbColumnInfo and dbGetInfo

ROracle 1-1.12 Enhancements

- Add bulk_write parameter to specify number of rows to bind at a time to improve performance for dbWriteTable and DML operations
- Date, Timestamp, Timestamp with time zone and Timestamp with local time zone data are maintained in R and Oracle's session time zone. Oracle session time zone environment variable ORA_SDTZ and R's environment variable TZ must be the same otherwise an error is reported when operating on any of these data types
- Performance improvements surrounding fetch

ROracle 1-1.11 Enhancements

- Performance enhancements for RAW data types and large result sets
- Cache resultset in memory before transferring to R to avoid unnecessary alloc and free using allocVector when result exceeds bulk_read rows
- Added session mode to connect as SYSDBA or using external authentication
- bug 17383542: Enhanced dbWritetable() & dbRemoveTable() to work on global schema

Using ROracle

Example – rolling back transactions

```
drv <- dbDriver("Oracle")

# Create the connection string
host <- "localhost"
port <- 1521
sid <- "orcl"
connect.string <- paste(
  "(DESCRIPTION=",
  "(ADDRESS=(PROTOCOL=tcp)(HOST=", host, ")(PORT=", port, "))",
  "(CONNECT_DATA=(SID=", sid, ")))", sep = "")

con <- dbConnect(drv, username = "scott",
                 password = "tiger",dbname=connect.string)
con
```

Example – rolling back transactions

```
dbReadTable(con, "EMP")

rs <- dbSendQuery(con, "delete from emp where deptno = 10")

dbReadTable(con, "EMP")
if(dbGetInfo(rs, what = "rowsAffected") > 1){
   warning("dubious deletion -- rolling back transaction")
   dbRollback(con)
}

dbReadTable(con, "EMP")
```

Example – username/password authentication

```
## create an Oracle instance and create one connection
drv <- dbDriver("Oracle")

## use username/password authentication - if using local database
con <- dbConnect(drv, username = "scott", password = "tiger")

## run a SQL statement by first creating a resultSet object
rs <- dbSendQuery(con, "select * from emp where deptno = 10")

## fetch records from the resultSet into a data.frame
data <- fetch(rs)
## extract all rows
dim(data)
data
```

Example – connect to an extproc for use within ORE ERE

```
## connect to an extproc (this assumes that driver has already
## been initialized in the embedded code by passing an external
## pointer representing extproc context)
con <- dbConnect(Extproc())

## run a SQL statement by first creating a resultSet object
rs <- dbSendQuery(con, "select * from dual")

## we now fetch records from the resultSet into a data.frame
data <- fetch(rs)   ## extract all rows
dim(data)
```

Example – unload driver

```
# create an Oracle instance
drv <- dbDriver("Oracle")
con <- dbConnect(drv, "scott", "tiger", dbname=connect.string)
res <- dbSendQuery(con, "select * from emp")
fetch(res, n = 5)
fetch(res)

# free resources occupied by result set
dbClearResult(res)
dbUnloadDriver(drv)
```

Example – getInfo methods

```
drv <- dbDriver("Oracle")
con <- dbConnect(drv, "scott", "tiger", dbname=connect.string)
rs <- dbSendQuery(con, "select * from emp")
dbGetStatement(rs)
dbHasCompleted(rs)
dbGetInfo(rs)

# DBIDriver info
names(dbGetInfo(drv))

# DBIConnection info
names(dbGetInfo(con))

# DBIResult info
names(dbGetInfo(rs))
```

Example – getInfo methods

```
drv  <- dbDriver("Oracle")
con1 <- dbConnect(drv, "scott", "tiger", dbname=connect.string)
res1 <- dbSendQuery(con1, "select * from emp where deptno = 10")
res2 <- dbSendQuery(con1, "select * from emp where deptno = 20")
con2 <- dbConnect(drv, "scott", "tiger")
res3 <- dbSendQuery(con2, "select * from dept")

## get all active statements
for(con in dbListConnections(drv))
  for (res in dbListResults(con))
    print(dbGetStatement(res))
```

Example – read/write table methods

```
con <- dbConnect(Oracle(), "scott", "tiger", dbname=connect.string)
if (dbExistsTable(con, "FOO", "SCOTT"))
dbRemoveTable(con, "FOO")
foo <- dbReadTable(con, "EMP")
row.names(foo) <- foo$EMPNO
foo <- foo[,-1]
dbWriteTable(con, "FOO", foo, row.names = TRUE)
dbWriteTable(con, "FOO", foo, row.names = TRUE, overwrite = TRUE)
dbReadTable(con, "FOO", row.names = 1)
dbGetQuery(con, "delete from foo")
dbWriteTable(con, "FOO", foo, row.names = TRUE, append = TRUE)
dbReadTable(con, "FOO", row.names = 1)
dbRemoveTable(con, "FOO")
dbListTables(con)
dbListFields(con, "EMP")
if (dbExistsTable(con, "RORACLE_TEST", "SCOTT"))
dbRemoveTable(con, "RORACLE_TEST")
```

Example – using attributes to map NCHAR, CLOB, BLOB, NCLOB columns correctly with dbWriteTable

```
str1           <- paste(letters, collapse="")
lstr1          <- paste(rep(str1, 200), collapse="")
raw.lst        <- vector("list",1)
lraw.lst       <- vector("list",1)
raw.lst[[1L]]  <- charToRaw(str1)
lraw.lst[[1L]] <- rep(charToRaw(str1), 200)
test.df <-
  data.frame(char=str1,nchar=str1,varchar=str1,
      clob=lstr1,nclob=lstr1, stringsAsFactors=FALSE)
test.df$raw.typ    <- raw.lst
test.df$blob       <- lraw.lst
test.df$char_max   <- str1
test.df$raw_max.typ <- raw.lst
test.df$nvchar     <- str1
test.df$nvchar_max <- str1
a <- as.POSIXct("2014-01-01 14:12:09.0194733")
b <- as.POSIXct("2014-01-01 14:12:09.01947")

# adding attributes
attr(test.df$clob, "ora.type") <- "clob"
attr(test.df$blob, "ora.type") <- "blob"
```

```
attr(test.df$nclob, "ora.type") <- "clob"
attr(test.df$nclob, "ora.encoding") <- "UTF-8"
attr(test.df$char_max, "ora.maxlength") <- 3000
attr(test.df$raw_max.typ, "ora.maxlength") <- 1000
attr(test.df$nvchar, "ora.encoding") <- "UTF-8"
attr(test.df$nvchar_max, "ora.encoding") <- "UTF-8"
attr(test.df$nvchar_max, "ora.maxlength") <- 1500
attr(test.df$char, "ora.type") <- "char"
attr(test_max.df$char, "ora.type") <- "char"
attr(test_max.df$char, "ora.maxlength") <- 0
attr(test.df$date_tz, "ora.type") <- "timestamp with time zone"
attr(test.df$date_ltz, "ora.type") <- "timestamp with local time
  zone"
attr(test.df$nchar, "ora.type") <- "char"
attr(test.df$nchar, "ora.encoding") <- "UTF-8"
attr(test.df$date_tz, "ora.fractional_seconds_precision") <- 9
attr(test_max.df$clob, "ora.type") <- "clob"
attr(test_max.df$blob, "ora.type") <- "blob"

dbWriteTable(con, name="TEST_TAB", value=test.df)
res <- dbReadTable(con, name="TEST_TAB")
```

Example – working with NaN

```
df <- data.frame(A=c(0,1,NaN,4), B=c(NA, 2,3,NaN))
con <- dbConnect(Oracle(), "scott", "tiger")
dbWriteTable(con,"TEST", df, row.names = FALSE,
  ora.number=FALSE)
```

Example – read/write table methods

```
# example of POSIXct usage
# A table is created using:
createTab <- "create table RORACLE_TEST(row_num number, id1 date,
                  id2 timestamp, id3 timestamp with time zone,
                  id4 timestamp with local time zone )"
dbGetQuery(con, createTab)

# Insert statement
insStr <- "insert into RORACLE_TEST values(:1, :2, :3, :4, :5)";

# Select statement
selStr <- "select * from RORACLE_TEST";

# Insert time stamp without time values in POSIXct form
x <- 1;
y <- "2012-06-05";
y <- as.POSIXct(y);
dbGetQuery(con, insStr, data.frame(x, y, y, y, y));
```

Example – read/write table methods

```
# Create a table
createStr <- "create table RORACLE_TEST2(row_num number, col1 varchar2(40))"
dbGetQuery(con, createStr)

# Insert data
insStr <- "insert into RORACLE_TEST2 values(:1, :2)"
x <- c(1, 2, 3, 4, 5, 6, 7, 8, 9)
y <- c("A","B","C","D","E","F","G","H","I")
dbGetQuery(con, insStr, data.frame(x, y))

# View data
selStr <- "select * from RORACLE_TEST2"
dbGetQuery(con, selStr)

# Update statement
updStr <- 'update RORACLE_TEST2 set col1 = :1 where row_num > :2'
dbGetQuery(con, updStr, data.frame(x="NEW",y= 5))
dbGetQuery(con, selStr)
```

Example – read/write table methods

```
# Insert date & times tamp with time values in POSIXct form
x <- 2;
y <- "2012-01-05 07:15:02";
y <- as.POSIXct(y);
z <- "2012-01-05 07:15:03.123";
z <- as.POSIXct(z);
dbGetQuery(con, insStr, data.frame(x, y, z, z, z));
# Insert list of date objects in POSIXct form
x <- c(3, 4, 5, 6);
y <- c('2012-01-05', '2011-01-05', '2018-01-05', '2020-01-05');
y <- as.POSIXct(y);
dbGetQuery(con, insStr, data.frame(x, y, y, y, y));
dbCommit (con)
# Select data and display it
res <- dbGetQuery(con, selStr)
res[,1]
res[,2]
res[,3]
res[,4]
res[,5]
```

Example – send query methods

```
drv <- dbDriver("Oracle")
con <- dbConnect(drv, "scott", "tiger")
res <- dbSendQuery(con, "select * from emp where deptno = :1",
                   data = data.frame(deptno = 10))
data <- fetch(res, n = -1)
res2 <- dbSendQuery(con, "select * from emp where deptno = :1",
                    data = data.frame(deptno = 10), prefetch=TRUE, bulk_read=2L)
data1 <- fetch(res2, n = -1)
res3 <- dbSendQuery(con, "select * from emp where deptno = :1",
                    data = data.frame(deptno = 10), bulk_read=10L)
data2 <- fetch(res3, n = -1)
res4 <- dbSendQuery(con, "select * from emp where ename = :1",
                    data = data.frame(ename = 'SMITH'))
data3 <- fetch(res4, n = -1)
```

Example – Oracle method

```
## create a Oracle instance and create one connection.
ora <- Oracle() ## or dbDriver("Oracle")
con <- dbConnect(ora, username = "scott", password = "tiger", dbname = "inst1")

## if you are connecting to a local database
con <- dbConnect(ora, username = "scott", password = "tiger")

## execute a statement and fetch output in chunks <= 5000 rows at a time
rs <- dbSendQuery(con, "select * from emp where deptno = 10")
while (!dbHasCompleted(rs)) {
  df <- fetch(rs, n = 5000)
  ## process df
}
dbClearResult(rs) ## done with this query
```

Example – Oracle method

```
## execute and fetch a statement with bind data
df <- dbGetQuery(con,
                 "select * from emp where deptno = :1", data = data.frame(depno = 10))

## create a copy of emp table
dbGetQuery(con, "create table foo as select * from emp")

## execute and bind an INSERT statement
my.data   = data.frame(empno = c(8001, 8002), ename = c('MUKHIN', 'ABOYOUN'))
more.data = data.frame(empno = c(8003), ename = c('JAMES'))
rs <- dbSendQuery(con, "insert into foo (empno, ename) values (:1, :2)",data = my.data)

## execute with more data
execute(rs, data = more.data)
df <- dbGetQuery(con, "select * from foo")
dbClearResult(rs) ## done with this query

dbCommit(con)     ## ok, everything looks fine
summary(ora)      ## a concise description of the driver
dbDisconnect(con) ## done with this connection
```

Invoking a stored procedure

```
dbGetQuery(con, 'create or replace
  PROCEDURE findMin(x IN number, y IN number, z OUT number) IS
  BEGIN
     IF x < y THEN
        z:= x;
     ELSE
        z:= y;
     END IF;
  END;')


  a <- 23
  b <- 45
  c <- 10
  df <- data.frame(a, b, c)
  dbGetQuery(con,  'BEGIN findMin(:1, :2, :3); END;', df)
```

NOTE: that the OUT variable z will not be populated. ROracle does not support record or table types and REF cursor. But one can execute stored procedures, compute results, store those results in a table and then query that table

Summary

- R package enabling connectivity to Oracle Database
  - Open source
  - Publically available on CRAN
- Execute SQL statements from R interface
- Oracle Database Interface (DBI) for R
- DBI –compliant Oracle driver based on OCI
- Requirements
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