Oracle® Machine Learning for R

Installation and Administration Guide

Release 2.0 for Oracle Database 23ai
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Oracle Machine Learning for R Installation and Administration Guide, Release 2.0 for Oracle Database 23ai

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Preface

This document explains how to install and administer Oracle Machine Learning for R (OML4R) Release 2.0.

- Technology Rebrand
  Oracle R Enterprise is now Oracle Machine Learning for R (OML4R).
- Audience
  This document is intended for anyone who is responsible for installing or administering Oracle Machine Learning for R.
- Related Documents
  The Oracle Machine Learning for R documentation set includes the following publications.
- Documentation Accessibility
- Conventions
  The following text conventions are used in this document.

Technology Rebrand

Oracle R Enterprise is now Oracle Machine Learning for R (OML4R).

Oracle has rebranded the suite of products and components that support machine learning with Oracle Database and Big Data. This technology is now known as Oracle Machine Learning (OML).

The OML application programming interface for R, previously under the name Oracle R Enterprise, is now named Oracle Machine Learning for R (OML4R). The package, class, and function names are not rebranded. They remain ORE, OREbase, ore.frame, ore.connect, and so on.

The OML application programming interfaces for SQL include PL/SQL packages, SQL functions, and data dictionary views. Using these APIs is described in publications, previously under the name Oracle Data Mining, that are now named Oracle Machine Learning for SQL (OML4SQL). The PL/SQL package and database view names are not rebranded. They remain DBMS_DATA_MINING, ALL_MINING_MODELS, and so on.

For more information, see Oracle Machine Learning.

Audience

This document is intended for anyone who is responsible for installing or administering Oracle Machine Learning for R.

Installation of OML4R requires knowledge of R and knowledge of Oracle Database.

Related Documents

The Oracle Machine Learning for R documentation set includes the following publications.

- *Oracle Machine Learning for R Release Notes*
- *Oracle Machine Learning for R Licensing Information User Manual*
- *Oracle Machine Learning for R User's Guide*

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

Access to Oracle Support

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Conventions

The following text conventions are used in this document.

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

Changes in Oracle Machine Learning for R Installation and Administration Guide

Changes for *Oracle Machine Learning for R Installation and Administration Guide* Release 2.0.

Oracle has rebranded the suite of products and components that support machine learning with Oracle Database and Big Data. This technology is now known as Oracle Machine Learning (OML).

The OML application programming interface for R, previously under the name Oracle R Enterprise, is now named Oracle Machine Learning for R (OML4R). The package, class, and function names are not renamed. They remain `ORE`, `OREbase`, `ore.frame`, `ore.connect`, and so on.

Changes in this Guide for Release 2.0

Installation changes for Oracle Machine Learning for R Release 2.0.

For information about other new features in OML4R Release 2.0, see Changes in This Release for Oracle Machine Learning for R in *Oracle Machine Learning for R User's Guide*.

Installation Script for OML4R Server

The OML4R server installation procedure depends on your database version. For more information, see Install Oracle Machine Learning for R Server for Oracle Database 23ai.

Supporting Packages

The supporting packages are `DBI` and `ROracle`.

The OML4R supporting packages for Oracle R Distribution 4.0.5 are:

```
Cairo 1.5-15
DBI 1.1.2
R6 2.5.1
ROracle 1.4-1
arules 1.7-3
assertthat 0.2.1
cli 3.3.0
crayon 1.5.1
dplyr 1.0.9
ellipsis 0.3.2
fansi 1.0.3
generics 0.1.2
glue 1.6.2
```

```
lazyeval 0.2.2
lifecycle 1.0.1
magrittr 2.0.3
pillar 1.7.0
pkgconfig 2.0.3
png 0.1-8
purrr 0.3.4
rlang 1.0.2
statmod 1.5.0
tibble 3.1.7
tidyselect 1.1.2
utf8 1.2.2
vctrs 0.4.1
```

> **See Also:**
>
> Install Oracle Machine Learning for R Client for details about the supporting packages

R-4.0.5 Requirement

OML4R 2.0 requires R-4.0.5. As with earlier releases of OML4R, Oracle recommends that you use Oracle R Distribution.

> **Note:**
>
> Each version of Oracle R Distribution (ORD) is compatible with the OML4R binary built under that specific R version.
>
> For example, ORD 4.0.5 has an OML4R 2.0 binary built against 4.0.5 and is not compatible with OML4R binaries built against another R version.

Oracle R Distribution Installation

You can install the Oracle R Distribution Linux RPMs in a directory other than the default Linux `R_HOME`.

> **See Also:**
>
> Install Oracle R Distribution on Linux in a Non-Default R_HOME

1

Overview of Oracle Machine Learning for R Installation

This chapter introduces the OML4R installation process. This chapter contains the following topics:

- Oracle Machine Learning for R on Autonomous Database
  OML4R is pre-installed on the Oracle Autonomous Database. OML4R is available through the R interpreter in Oracle Machine Learning Notebooks in Oracle Autonomous Database.
- Oracle Machine Learning for R Installation on On-Premises Oracle Database
  This chapter introduces the OML4R installation process.

1.1 Oracle Machine Learning for R on Autonomous Database

OML4R is pre-installed on the Oracle Autonomous Database. OML4R is available through the R interpreter in Oracle Machine Learning Notebooks in Oracle Autonomous Database.

> **Note:**
>
> The connection to OML4R is automatic through OML Notebooks. There is no explicit connection required or allowed in OML Notebooks.

1.2 Oracle Machine Learning for R Installation on On-Premises Oracle Database

This chapter introduces the OML4R installation process.

This chapter contains these topics:

- Oracle Machine Learning for R Architecture for Oracle Database
  OML4R has a client/server architecture based on Oracle Database and Oracle Client.
- Client and Server Components of Oracle Machine Learning for R for On-Premises Database
  Lists the client and server components of OML4R for On-Premises database.
- Oracle Machine Learning for R Installation Steps
  These steps and this roadmap illustrate a typical OML4R installation.
- Oracle Machine Learning for R System Requirements for On-Premises Database
  OML4R runs on 64-bit platforms only.

1.2.1 Oracle Machine Learning for R Architecture for Oracle Database

OML4R has a client/server architecture based on Oracle Database and Oracle Client.

R engines run on the server computer and on each client computer. OML4R supports three key capabilities:

- **R Transparency**

  OML4R packages on the client support R transparency, which enables Oracle tables to appear "transparently" as native R objects. OML4R packages provide transparent access to Oracle Database tables and views, enabling users to invoke standard R functions, which are translated into SQL transparently to the user for in-database execution.

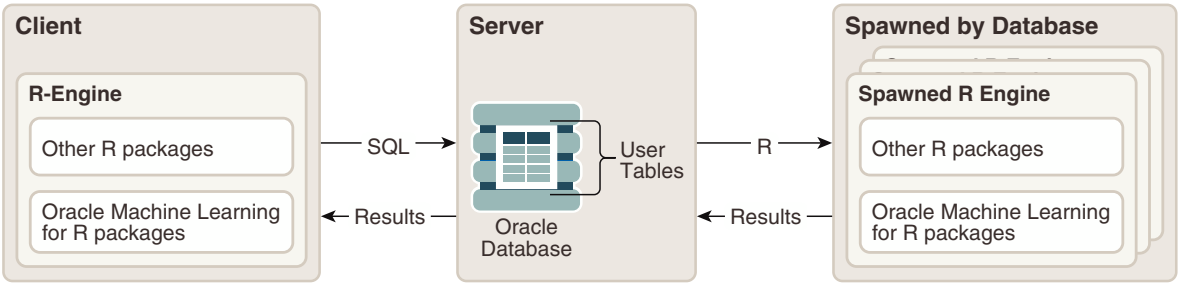
- **Predictive Analytics and Machine Learning**

  OML4R supports a wide range of parallel and distributed algorithms supporting predictive analytics and machine learning. This enables both scalability and improved performance, while leveraging a convenient R interface to in-database and database server-side algorithms.

- **Embedded R Execution**

  OML4R packages, libraries, and R and SQL APIs on the server support the execution of user-defined R functions within SQL queries and PL/SQL statements. Embedded R execution spawns R engines that can run in parallel, for data-parallel and task-parallel execution. With embedded R execution, you can run user-defined R functions, possibly leveraging third-party packages. With facilities like the `DBMS_SCHEDULER` database package, you can schedule the execution of user-defined R functions for lights-out processing.

Figure 1-1 Client/Server Architecture of OML4R



1.2.2 Client and Server Components of Oracle Machine Learning for R for On-Premises Database

Lists the client and server components of OML4R for On-Premises database.

- **OML4R Client Components**:
  - Oracle Database Client
  - OML4R packages and supporting packages
- **OML4R Server Components:**
  - Oracle Database with schema objects and shared libraries for supporting OML4R clients
  - OML4R packages and supporting packages

1.2.3 Oracle Machine Learning for R Installation Steps

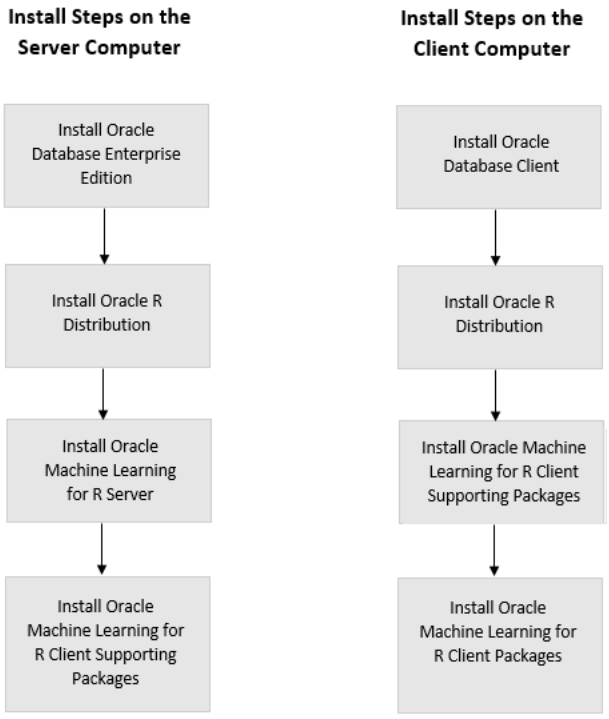
These steps and this roadmap illustrate a typical OML4R installation.

> **Note:**
>
> If you intend to use both client and server components of OML4R on the computer that is hosting Oracle Database, then you do not need to perform a separate client installation. A local installation of Oracle Database Client is automatically included in the installation of Oracle Database.

Illustration of the Installation Steps

Figure 1-2 OML4R Client and Server Installation Steps

This figure illustrates the OML4R client and server installation steps.



OML4R Installation Roadmap

This roadmap provides the steps required to install and configure a typical OML4R environment. To install OML4R, do the following:

1. Verify that your system meets the basic requirements
2. Obtain the correct installation software
3. Perform and validate the installations

Table 1-1 Tasks for Installing OML4R

Task	Description	Documentation
1. Review the OML4R sample installation.	Review the steps for a typical installation of OML4R on a Linux server and a Windows client. **Note:** All the supported configurations are listed in Oracle Machine Learning for R System Requirements for On-Premises Database.	A Sample Installation of Oracle Machine Learning for R
2. Verify supported platforms and system requirements.	Use the Platform Requirements table and Server Support Matrix to verify your environment meets the requirements for installation.	Oracle Machine Learning for R System Requirements for On-Premises Database
3. Identify installation users for Oracle R Distribution and OML4R.	The user executing the installation and configuration on your system requires sufficient permissions and privileges. For Oracle R Distribution, the installation user is root (Unix/Linux) or Administrator (Windows).	User Requirements for OML4R Server
4. Download the product installers.	Oracle R Distribution is available from Oracle's public yum or the Oracle download site. Oracle Database and Oracle Machine Learning for R are available on the Oracle download site. For Oracle Database 18c and later, the OML4R installers are shipped with Oracle Database.	Oracle Database Software Downloads Oracle R Distribution Downloads Oracle Machine Learning for R Downloads
5. Install and configure Oracle Database.	OML4R requires the 64-bit version of Oracle Database Enterprise Edition.	Install and Configure the Database for Oracle Machine Learning for R
6. Install and configure R.	OML4R requires an installation of R on each node of the server and on each client computer that interacts with the server. Oracle R Distribution is recommended. The OML4R Server components must be installed on the database server.	Install R for Oracle Machine Learning for R on On-Premises Oracle Database
7. Install and configure OML4R Server.	OML4R includes several components on the server. Together these components enable an OML4R client to interact with an OML4R server.	Install Oracle Machine Learning for R Server Install Oracle Machine Learning for R on Exadata
8. Install Open Source R packages on the OML4R server.	Embedded R execution with OML4R allows the use of CRAN or other third-party R packages in user-defined R functions executed on the Oracle Database server.	About R Package Installation for Oracle Machine Learning for R

Table 1-1 (Cont.) Tasks for Installing OML4R

Task	Description	Documentation
9. Install and configure the OML4R client.	If a physical client is configured, then you must install the following OML4R components separately on each client computer: • R • Oracle Instant Client • OML4R Client packages • OML4R Client Supporting packages If you wish to run the OML4R client through a web browser, then install RStudio Server on the database server (Linux only).	Install Oracle Machine Learning for R Client Installing RStudio
10. Install Open Source R packages on the OML4R client.	R packages installed on the OML4R server must also be installed on the OML4R client.	R Package Installation Basics
11. Verify the OML4R Installation.	Test the OML4R installation by connecting to the OML4R client to the server and executing some OML4R functions.	Verify the OML4R Server Installation

1.2.4 Oracle Machine Learning for R System Requirements for On-Premises Database

OML4R runs on 64-bit platforms only.

Both client and server components are supported on each of the platforms described in this topic.

Table 1-2 Oracle Machine Learning for R Platform Requirements

Operating System	Hardware Platform	Description
Linux x86-64	Intel and AMD	• 64-bit Oracle Linux Releases 7 and 8 • 64-bit Red Hat Enterprise Linux Releases 7 and 8 **Note:** Oracle R Distribution 4.0.5 is supported on Linux 7 and 8. You may need to install `libpng16.so.16` on Oracle Linux 7. Oracle Linux may be running on Oracle Exadata Database Machine.

The following table shows the supported configurations of OML4R Server components. Oracle provides Oracle R Distribution, Oracle's free distribution of R, for use with OML4R. You should install Oracle R Distribution before installing OML4R.

Table 1-3 Oracle Machine Learning for R Configuration Requirements and Server Support Matrix

OML4R Version	Open Source R or Oracle R Distribution	Oracle Database Release
2.0	4.0.5	19c, 21c, 23c
1.5.1	3.6.1	12.2.0.1, 18c, 19c, 21c
1.5.1	3.3.0	11.2.0.4, 12.1.0.1, 12.1.0.2, 12.2.0.1
1.5	3.2.0	11.2.0.4, 12.1.0.1, 12.1.0.2
1.4.1	3.0.1, 3.1.1	11.2.0.3, 11.2.0.4, 12.1.0.1, 12.1.0.2
1.4	2.15.2, 2.15.3, 3.0.1	11.2.0.3, 11.2.0.4, 12.1.0.1
1.3.1	2.15.1, 2.15.2, 2.15.3	11.2.0.3, 11.2.0.4, 12.1.0.1
1.3	2.15.1	11.2.0.3, 11.2.0.4, 12.1.0.1
1.2	2.15.1	11.2.0.3, 11.2.0.4, 12.1.0.1
1.1	2.13.2	11.2.0.3, 11.2.0.4, 12.1.0.1
1.0	2.13.2	11.2.0.3, 11.2.0.4, 12.1.0.1

Note:

The version of R must be the same on the server and on each client computer. Also, the version of OML4R must be the same on the server and on each client computer.

Note:

Each version of Oracle R Distribution (ORD) is compatible with the OML4R binary built under that specific R version. For example, ORD 4.0.5 has an OML4R 2.0 binary incompatible with OML4R binaries built under another R version.

Note:

After upgrading the database from 21c to 23c, plug-in violations are observed.

2

Install and Configure the Database for Oracle Machine Learning for R

This chapter explains how to install and configure Oracle Database to support OML4R Server.

This chapter contains these topics:

- Install Oracle Database for Oracle Machine Learning for R
  Installation instructions for Oracle Database.
- Using EXTPROC with Embedded R Execution
  Oracle Database uses an external procedure agent named `extproc` to support external procedures.

2.1 Install Oracle Database for Oracle Machine Learning for R

Installation instructions for Oracle Database.

OML4R requires the 64-bit version of Oracle Database Enterprise Edition or Standard Edition 2. For the supported platforms, see Oracle Machine Learning for R System Requirements for On-Premises Database.

To install Oracle Database, follow the installation instructions for your supported platform:

1. Go to the Oracle Database Documentation page in Oracle Help Center.
2. Select the version of Oracle Database to install.
3. In the Topics section, select **Install and Upgrade**.
4. In the section for your operating system, select the appropriate installation guide.

> **Note:**
>
> You can install OML4R Server in a pluggable database (PDB) within a multitenant container database (CDB). The database may not be installed in the root database in the multitenant environment.
>
> For information about managing a multitenant environment, see *Oracle Database Administrator's Guide*.

2.2 Using EXTPROC with Embedded R Execution

Oracle Database uses an external procedure agent named `extproc` to support external procedures.

An external procedure is a procedure invoked from a program that is written in a different language. OML4R uses `extproc` to support embedded R execution.

- About EXTPROC
  When an application invokes an external procedure, Oracle Database starts an `extproc` agent.
- About EXTPROC Configuration for OML4R
  OML4R uses the default configuration of `extproc`.
- Troubleshooting EXTPROC
  Calling an OML4R embedded R function may result in an error if a database configuration problem exists.

2.2.1 About EXTPROC

When an application invokes an external procedure, Oracle Database starts an `extproc` agent.

The application uses the network connection established by Oracle Database to pass instructions to the agent for executing the procedure. The agent loads a DLL or shared library, runs the external procedure, and passes back to the application any values returned by the external procedure.

2.2.2 About EXTPROC Configuration for OML4R

OML4R uses the default configuration of `extproc`.

The `extproc` agent is spawned directly by Oracle Database, and no configuration changes are required to either `listener.ora` or `tnsnames.ora`. If `extproc` is configured on the database listener, it overrides the default settings.

The `extproc` agent is spawned directly by Oracle Database, and the configuration changes are not required for `listener.ora` and `tnsnames.ora`. If `extproc` is configured on the database listener, it overrides the default settings and prevents the functioning of OML4R external procedures.

By default, `extproc` supports external procedure calls if the libraries used are in $ORACLE_HOME/bin or $ORACLE_HOME/lib.

The following statement on a Linux system sets `EXTPROC_DLLS` to run only external procedures for OML4R:

```
SET EXTPROC_DLLS=ONLY:$ORACLE_HOME/lib/ore.so
```

To allow `extproc` to service any external procedure, set `EXTPROC_DLLS` to `ANY` or simply leave it blank (the default).

Enable `extproc` tracing by doing the following:

1. To your `/extproc.ora` file, add the following statement:

   ```
   SET TRACE_LEVEL=ON
   ```

2. Restart the database.
   Traces for all `extproc` operations are now recorded in the log files in the `$ORACLE_HOME/hs/log` directory.

> **See Also:**
>
> "Default Configuration for External Procedures" in *Oracle Database Net Services Administrator's Guide* for details

2.2.3 Troubleshooting EXTPROC

Calling an OML4R embedded R function may result in an error if a database configuration problem exists.

If an attempt to call an OML4R embedded R function results in the following error, then the external procedure did not succeed:

```
ORA-28575: unable to open RPC connection to external procedure agent.
```

This error is often a database configuration problem. It may be caused by any of the following:

- The OML4R user has not been granted RQADMIN role.
- The Oracle listener configuration is incorrect, which may occur if the default external procedure configuration (which is recommended) is not being used.
- Networking layer restrictions or issues exist.
- Restrictions on external procedure calls are in force.

3

Install R for Oracle Machine Learning for R on On-Premises Oracle Database

This chapter explains how to install R for OML4R on On-Premises Oracle Database.

This chapter contains these topics:

- About R and Oracle Machine Learning for R for On-Premises Database
  OML4R requires an installation of R on the server computer and on each client computer that interacts with the server.
- Install Oracle R Distribution on Linux
  Instructions for installing Oracle R Distribution on Oracle Linux and on Redhat Enterprise Linux.
- Configure Oracle R Distribution to Use MKL on the Client
  Instructions for configuring Oracle R Distribution to use MKL on a Linux client.
- Uninstall Oracle R Distribution
  Instructions for uninstalling Oracle R Distribution.

3.1 About R and Oracle Machine Learning for R for On-Premises Database

OML4R requires an installation of R on the server computer and on each client computer that interacts with the server.

R is third-party, open source software. Open source R is governed by GNU General Public License (GPL) and not by Oracle licensing.

> **Note:**
>
> The version of R must be the same on the server and on each client computer. Also, the version of OML4R must be the same on the server and on each client computer.

- About ROracle
  ROracle is an open source R package that enables interaction between R and an Oracle database.
- Oracle R Distribution and OML4R
  Oracle recommends that you use Oracle R Distribution, Oracle's free distribution of R, with OML4R.

> **See Also:**
>
> - *Oracle Machine Learning for R Licensing Information User Manual*
> - R Project for Statistical Computing

3.1.1 About ROracle

ROracle is an open source R package that enables interaction between R and an Oracle database.

ROracle is maintained and supported by Oracle.

ROracle is one of the open source supporting packages that is used by Oracle Machine Learning for R. The supporting packages are introduced in Client and Server Components of Oracle Machine Learning for R for On-Premises Database and described in Table 6-2.

3.1.2 Oracle R Distribution and OML4R

Oracle recommends that you use Oracle R Distribution, Oracle's free distribution of R, with OML4R.

Oracle R Distribution offers significant advantages for OML4R.

Why Oracle R Distribution?

- Oracle R Distribution simplifies the installation of R for OML4R.
- Oracle R Distribution is supported by Oracle for Oracle Linux customers, and Oracle Machine Learning on Oracle Database and Oracle Autonomous Database.
- Oracle R Distribution simplifies integration with the **Intel Math Kernel Library** (MKL). MKL greatly improves the performance of many mathematical computations in R, including highly vectorized and threaded Linear Algebra, Fast Fourier Transforms (FFT), Vector Math, and Statistics functions. (See Enable MKL Support for Oracle R Distribution on a Linux Client.)

3.2 Install Oracle R Distribution on Linux

Instructions for installing Oracle R Distribution on Oracle Linux and on Redhat Enterprise Linux.

Before you begin the installation, verify that your Linux version is supported by Oracle Machine Learning for R, as described in the table of platform requirements in Oracle Machine Learning for R System Requirements for On-Premises Database. You can use this command to verify the Linux version:

```
# uname -r
```

> **Note:**
>
> For Oracle Linux systems that have access to the internet, Oracle recommends installing Oracle R Distribution from the Oracle Linux Yum Server.

The following topics describe installing Oracle R Distribution:

- Install Oracle R Distribution on Oracle Linux 8 Using Dnf
  Oracle recommends using dnf to install Oracle R Distribution on Linux 8.
- Install Oracle R Distribution on Oracle Linux 7 Using Yum
  Oracle recommends using yum to install Oracle R Distribution on Linux 7.
- Install Oracle R Distribution on Oracle Linux Using RPMs
  If yum is not available due to lack of internet access, then you can install the RPMs directly and resolve the dependencies manually.
- Install Oracle R Distribution on Red Hat Enterprise Linux
  Instructions on rebuilding the Oracle R Distribution RPMs on a Red Hat Linux system.

3.2.1 Install Oracle R Distribution on Oracle Linux 8 Using Dnf

Oracle recommends using dnf to install Oracle R Distribution on Linux 8.

Dnf simplifies the installation of Oracle R Distribution by automatically resolving RPM dependencies.

To install Oracle R Distribution on Oracle Linux 8 Using Dnf:

1. Log in to the Linux server as root and change to the `/etc/yum.repos.d` directory:

   ```
   cd /etc/yum.repos.d
   ```

2. For Oracle Linux 8, in addition to the Oracle Linux 8 main repository, the appstream, codereadybuilder, and addons repositories are required. As root, create the repository `/etc/yum.repos.d/oracle-linux-ol8.repo` and specify `enabled=1` for `ol8_baseos_latest`, `ol8_appstream`, `ol8_codereadybuilder` and `ol8_addons`.

   The result looks similar to the following:

   ```
   [ol8_baseos_latest]
   name=Oracle Linux $releasever BaseOS ($basearch)
   baseurl=https://yum.oracle.com/repo/OracleLinux/OL8/baseos/latest/$basearch
   gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-oracle
   gpgcheck=1
   enabled=1

   [ol8_appstream]
   name=Oracle Linux $releasever Application Stream ($basearch)
   baseurl=https://yum.oracle.com/repo/OracleLinux/OL8/appstream/$basearch
   gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-oracle
   gpgcheck=1
   enabled=1

   [ol8_codereadybuilder]
   name=Oracle Linux $releasever Code Ready Builder ($basearch)
   baseurl=https://yum.oracle.com/repo/OracleLinux/OL8/codeready/
   builder/$basearch
   gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-oracle
   gpgcheck=1
   enabled=1

   [ol8_addons]
   ```

```
name=Oracle Linux $releasever Add ons ($basearch)
baseurl=https://yum.oracle.com/repo/OracleLinux/OL8/addons/$basearch/
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-oracle
gpgcheck=1
enabled=1
```

3. As root, install R-4.0.5 for Linux 8 using the dnf command. Run the `dnf` command to install R.

```
dnf install R-4.0.5
```

.

> **Note:**
>
> In newer Oracle Linux versions, the yum package manager has been replaced by dnf package manager.

3.2.2 Install Oracle R Distribution on Oracle Linux 7 Using Yum

Oracle recommends using yum to install Oracle R Distribution on Linux 7.

Yum simplifies the installation of Oracle R Distribution by automatically resolving RPM dependencies. If you install the RPMs directly, then you must resolve dependencies manually.

To install Oracle R Distribution on Oracle Linux 7 Using Yum:

1. Log in to the Linux server as root and change to the `/etc/yum.repos.d` directory:

```
# cd /etc/yum.repos.d
```

2. List the contents of the directory to determine if the Oracle Linux 7 yum configuration file is present. The name of the configuration file is `public-yum-ol7.repo`.

   If the Oracle Linux 7 yum configuration file is not present, then download it from Oracle public yum by executing the `wget` command for your Linux platform:

```
# wget https://public-yum.oracle.com/public-yum-ol7.repo
```

3. Open `public-yum-ol7.repo` in a text editor and specify `enabled=1` for `ol7_latest`, `ol7_addons` and `ol7_optional_latest`:

```
[ol7_latest]
enabled=1

[ol7_addons]
enabled=1

[ol7_optional_latest]
enabled = 1
```

The location of the Oracle R Distribution packages is specified in `ol7_addons`. The location of the dependencies for the Oracle R Distribution RPMs is specified in `ol7_latest` and several dependencies are in `optional_latest`.

The URLs for the Oracle R Distribution RPMs in the addons repository are shown in the example at the end of this topic.

> **Note:**
>
> If you are not using the most recent version of Oracle Linux and you want to install dependent packages that are specific to your version, then you must enable the corresponding Oracle Linux repository.
>
> For example, to enable the Oracle Linux 7 base repository open `public-yum-ol7.repo` in a text editor and specify `enabled=1` for `ol7_latest`:
>
> ```
> [ol7_base]
> enabled=1
> ```
>
> The output will look similar to the following:
>
> ```
> [ol7_base]
> name=Oracle Linux $releasever installation media copy ($basearch)
> baseurl=https://public-yum.oracle.com/repo/OracleLinux/OL7/
> base/$basearch/
> gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-oracle
> gpgcheck=1
> enabled=1
> ```

4. Run the `yum install` command to install R. Specify the version number to install for *Rversion*. For example, to install R-3.6.1, use the command `yum install R-3.6.1`.

   ```
   # yum install R-Rversion
   ```

   To install the most recent version of R that is available on Oracle public yum:

   ```
   # yum install R.x86_64
   ```

   > **Note:**
   >
   > Do not assume that the most recent version of R on Oracle public yum is supported by your version of Oracle Machine Learning for R. Consult the table of configuration requirements and server support in Oracle Machine Learning for R System Requirements for On-Premises Database to determine which version of R you should use.

3.2.3 Install Oracle R Distribution on Oracle Linux Using RPMs

If yum is not available due to lack of internet access, then you can install the RPMs directly and resolve the dependencies manually.

However, Oracle recommends that you use yum to install Oracle R Distribution, because yum automatically resolves RPM dependencies.

To download and install the RPMs, log in as root and run the command `rpm -Uvh` *`rpm_name`* for each RPM listed in the following sections:

- Oracle R Distribution 4.0.5 RPMs for Oracle Linux 8
  Lists the Oracle R Distribution RPMs for Oracle Linux 8.
- Oracle R Distribution 4.0.5 RPMs for Oracle Linux 7
  Lists the Oracle R Distribution RPMs for Oracle Linux 7.

3.2.3.1 Oracle R Distribution 4.0.5 RPMs for Oracle Linux 8

Lists the Oracle R Distribution RPMs for Oracle Linux 8.

The Oracle R Distribution RPMs for Oracle Linux 8 are listed as follows:

```
https://yum.oracle.com/repo/OracleLinux/OL8/addons/x86_64/getPackage/
R-4.0.5-1.0.1.el8.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL8/addons/x86_64/getPackage/R-
core-4.0.5-1.0.1.el8.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL8/addons/x86_64/getPackage/R-
devel-4.0.5-1.0.1.el8.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL8/addons/x86_64/getPackage/
libRmath-4.0.5-1.0.1.el8.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL8/addons/x86_64/getPackage/libRmath-
devel-4.0.5-1.0.1.el8.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL8/addons/x86_64/getPackage/libRmath-
static-4.0.5-1.0.1.el8.x86_64.rpm
```

3.2.3.2 Oracle R Distribution 4.0.5 RPMs for Oracle Linux 7

Lists the Oracle R Distribution RPMs for Oracle Linux 7.

The Oracle R Distribution RPMs for Oracle Linux 7 are listed as follows:

```
https://yum.oracle.com/repo/OracleLinux/OL7/addons/x86_64/getPackage/
R-4.0.5-1.el7.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL7/addons/x86_64/getPackage/R-
core-4.0.5-1.el7.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL7/addons/x86_64/getPackage/R-
devel-4.0.5-1.el7.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL7/addons/x86_64/getPackage/
libRmath-4.0.5-1.el7.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL7/addons/x86_64/getPackage/libRmath-
devel-4.0.5-1.el7.x86_64.rpm
https://yum.oracle.com/repo/OracleLinux/OL7/addons/x86_64/getPackage/libRmath-
static-4.0.5-1.el7.x86_64.rpm
```

3.2.4 Install Oracle R Distribution on Red Hat Enterprise Linux

Instructions on rebuilding the Oracle R Distribution RPMs on a Red Hat Linux system.

The Oracle Linux RPMs can be installed on Red Hat Linux systems. However, if you want to rebuild the Oracle R Distribution RPMs on a Red Hat Linux system, follow these instructions.

To install Oracle R Distribution on Red Hat Enterprise Linux:

1. Create an RPM build directory structure:

   ```
   mkdir -p /rpmbuild/{BUILD,RPMS,SOURCES,SPECS,SRPMS}
   ```

2. Set up RPM tools to use your own build tree (to avoid `root`):

   ```
   echo '%_topdir %(echo $HOME)/rpmbuild' > /.rpmmacros
   ```

3. From Oracle public yum, download the source RPM (*Rversion*.ol*x*.src.rpm where Rversion is the R version you are using and *x* is the Oracle Linux version you are using).

   Save the source RPM to the `rpmbuild/SRPMS` directory.

4. Rebuild Red Hat Enterprise Linux using `rpmbuild`.

   ```
   rpmbuild --rebuild /rpmbuild/SRPMS/R-Rversion.elx.src.rpm
   ```

   > **Note:**
   >
   > If any dependencies are missing, install them as root.

   The binary RPMs are built and saved under `/rpmbuild/RPMS`.

5. Log in as root and run these commands to install R:

   ```
   rpm -i path/rpmbuild/RPMS/R-Rversion.elx.x86_64.rpm
   rpm -i path/rpmbuild/RPMS/R-core-Rversion.elx.x86_64.rpm
   rpm -i path/rpmbuild/RPMS/libRmath-Rversion.elx.x86_64.rpm
   rpm -i path/rpmbuild/RPMS/libRmath-devel-Rversion.elx.x86_64.rpm
   rpm -i path/rpmbuild/RPMS/libRmath-static-Rversion.elx.x86_64.rpm
   rpm -i path/rpmbuild/RPMS/R-devel-Rversion.elx.x86_64.rpm
   ```

   For example, this command installs R-4.0.5 on Red Hat Enterprise Linux x86-64 version 7, where the path to `rpmbuild` is `/user/home/`.

   ```
   rpm -i /user/home/rpmbuild/RPMS/x86_64/R-core-4.0.5-1.el7.x86_64.rpm
   ```

3.3 Configure Oracle R Distribution to Use MKL on the Client

Instructions for configuring Oracle R Distribution to use MKL on a Linux client.

With this simple configuration step, Oracle R Distribution dynamically uses MKL if it is installed on your system.

This topic contains these sections:

- Enable MKL Support for Oracle R Distribution on a Linux Client
  Follow these steps to enable MKL for Oracle R Distribution on a Linux Client.

3.3.1 Enable MKL Support for Oracle R Distribution on a Linux Client

Follow these steps to enable MKL for Oracle R Distribution on a Linux Client.

1. Install MKL. You can download MKL from the Intel® Math Kernel Library website.

   Note: To install MKL on your computer, you must have an MKL license.

2. Add `libmkl_rt.so`, `$RHOME/lib`, and `$ORACLE_HOME/lib` to the `LD_LIBRARY_PATH` system environment variable. For example, in the Bash shell:

   ```
   export LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:
                          /path_to/libmkl_rt.so:
                          ${RHOME}/lib:
                          ${ORACLE_HOME}/lib
   ```

3. Start R and run the `Sys.BlasLapack` function:

   ```
   Sys.BlasLapack()
        $vendor
        [1] "Intel Math Kernel Library (Intel MKL)"
        $nthreads
        [1] -1
   ```

The returned value of `$vendor` indicates that MKL has replaced the `BLAS` and `LAPACK` that are native to R.

The returned value of `nthreads` indicates the number of threads to be used by MKL. By default all available threads are used (`$nthreads`= -1).

- Modifying the Number of Threads for MKL on Linux

3.3.1.1 Modifying the Number of Threads for MKL on Linux

You can change the number of threads to be used by MKL by editing the system environment variable `MKL_NUM_THREADS`. For example, the following statement in the Bash shell, causes MKL to use 3 threads:

```
export MKL_NUM_THREADS=3
```

After setting `MKL_NUM_THREADS` to 3, the output of `Sys.BlasLapack` shows a value of 3 for `$nthreads`.

```
R> Sys.BlasLapack()
     $vendor
     [1] "Intel Math Kernel Library (Intel MKL)"
     $nthreads
     [1] 3
```

3.4 Uninstall Oracle R Distribution

Instructions for uninstalling Oracle R Distribution.

To uninstall Oracle R Distribution, follow the instructions in the following sections:

- Uninstall Oracle R Distribution on Linux
  Instructions for uninstalling Oracle R Distribution on Linux.

3.4.1 Uninstall Oracle R Distribution on Linux

Instructions for uninstalling Oracle R Distribution on Linux.

To uninstall Oracle R Distribution on Linux, log in as root and run the commands in the example in the order shown. This example uninstalls R-4.0.5. To uninstall a different version of R, replace the R version in the example with the number of the version you want to uninstall.

Example 3-1 Linux Commands for Uninstalling Oracle R Distribution

Run the `rpm -e rpmname` command, where *rpmname* is the name of the RPM you want to remove.

For example, to remove R-4.0.5 on Oracle Linux 7:

```
rpm -e R-4.0.5-1.el7
rpm -e R-devel
rpm -e R-core
rpm -e R-core-extra
rpm -e libRmath-devel
rpm -e libRmath
rpm -e libRmath-static
```

4

Install Oracle Machine Learning for R Server

This chapter explains how to install and administer OML4R Server. This chapter includes these topics:

- About Oracle Machine Learning for R Server
  OML4R includes components on the Oracle Database server that enable an OML4R client to interact with OML4R Server.
- Oracle Machine Learning for R Server Requirements
  Before installing OML4R Server, verify your system environment, and ensure that your user ID has the proper permissions.
- Install Oracle Machine Learning for R Server for Oracle Database 23ai
  Instructions for installing the OML4R Server on both the Container Database Root (CDB$ROOT) and Pluggable Databases (PDBs) within your Oracle Database 23ai environment.
- Verify the OML4R Server Installation
  To verify the success of an OML4R Server installation, you can view the log files created by the spool command above and run the following commands.

4.1 About Oracle Machine Learning for R Server

OML4R includes components on the Oracle Database server that enable an OML4R client to interact with OML4R Server.

> **Note:**
>
> The version of OML4R must be the same on the server and on each client computer. Also, the version of R must be the same on the server and on each client computer.

The components are:

- OML4R Server
  - The RQSYS schema
  - Metadata and executable code in `sys`
  - OML4R Server libraries in `$ORACLE_HOME/lib`
  - OML4R R packages in `$ORACLE_HOME/R/library`

    The OML4R packages and supporting packages on the server support embedded R execution. These same packages must be installed separately on each client computer. (See About the OML4R Packages).

See the following topics for additional information:

See Also:

- Table 1-3 for a list of supported R and OML4R versions.
- Figure 1-2 for an illustration of the server and client components of OML4R.
- About the RQSYS Schema
  The RQSYS schema is the system account for Oracle Machine Learning for R in Oracle Database.
- Security Best Practices for OML4R
  To minimize the risk of compromising the security of an OML4R Server in Oracle Database, Oracle recommends the following security best practices.

4.1.1 About the RQSYS Schema

The RQSYS schema is the system account for Oracle Machine Learning for R in Oracle Database.

It contains metadata, PL/SQL packages, and other executable code that is used internally by OML4R Server.

The OML4R Server installation process creates RQSYS as a locked account with an expired password. The `rqsys` user does not have the `CREATE SESSION` privilege.

4.1.2 Security Best Practices for OML4R

To minimize the risk of compromising the security of an OML4R Server in Oracle Database, Oracle recommends the following security best practices.

OML4R Server components in an Oracle Database instance include the locked and password-expired RQSYS schema, which contains and manages OML4R metadata. Users connect to OML4R Server through their database connection credentials. The RQADMIN role grants a user the privilege of creating R functions as scripts in the OML4R R script repository; those scripts can be ran using OML4R embedded R execution.

Oracle recommends the following security best practices.

- Do not unlock the RQSYS schema or enable its login.
- Grant the RQADMIN role only to database users who are responsible for creating and managing the R script repository.
- Create private R scripts and grant access to other users as needed. Global R scripts are visible to and can be ran by any OML4R user.
- Use parameters or the OML4R datastore to transfer data between embedded R execution scripts and Oracle Database. R scripts should not interact with the server file system or the network.
- Set the OML4R embedded R execution memory limit properly based upon the Oracle Database server resources and usage patterns. The default value is 2 GB per connection.
- Use the auto-connect feature (`connect=TRUE`) instead of providing explicit database credentials when connecting back to the Oracle Database server in an R script that uses embedded R execution.

- Do not allow unauthorized R packages or C libraries to be loaded on the Oracle Database server for use in embedded R execution.
- Load dependent shared libraries from the `$ORACLE_HOME/lib` directory to prevent the use of unauthorized libraries.

4.2 Oracle Machine Learning for R Server Requirements

Before installing OML4R Server, verify your system environment, and ensure that your user ID has the proper permissions.

You should also have installed the OML4R Server prerequisites: Oracle Database and Oracle R Distribution or open source R.

- System Requirements
  Lists the system requirements for OML4R Server.
- Environment Variables
  Lists the environment variables required by OML4R Server.
- User Requirements
  Lists the requirements for the operating system user who installs OML4R Server.

Related Topics

- Install and Configure the Database for Oracle Machine Learning for R
- Install R for Oracle Machine Learning for R on On-Premises Oracle Database

4.2.1 System Requirements

Lists the system requirements for OML4R Server.

- The operating system must conform to the requirements specified in Oracle Machine Learning for R System Requirements for On-Premises Database.
- Oracle Database must be installed and configured as described in Install and Configure the Database for Oracle Machine Learning for R.

> **Note:**
>
> You can install OML4R Server in a pluggable database (PDB) in a multitenant environment. See *Oracle Database Administrator's Guide*.

- R must be installed as described in Install R for Oracle Machine Learning for R on On-Premises Oracle Database.

4.2.2 Environment Variables

Lists the environment variables required by OML4R Server.

Table 4-1 Environment Variable Requirements for Oracle Machine Learning for R Server

Platform	Environment Variable Requirement
Linux	**$ORACLE_SID** must specify the Service Identifier (SID) of the database that supports OML4R. **$ORACLE_HOME** must specify the home directory of the database identified by ORACLE_SID. **$PATH** must include `$ORACLE_HOME/bin`.

4.2.3 User Requirements

Lists the requirements for the operating system user who installs OML4R Server.

Table 4-2 User Requirements for OML4R Server Installer

Platform	User Requirement
Linux	• Member of the `dba` and `oinstall` group • Has write access to `$ORACLE_HOME/lib`

See the following topics for additional information:

- About Operating System Authentication
  Describes the operating system authentication used by OML4R Server.
- Verify the Group Membership of Your User ID
  Describes how to determine the group memberships required by OML4R Server.

4.2.3.1 About Operating System Authentication

Describes the operating system authentication used by OML4R Server.

The OML4R Server installation script uses **system authentication** to connect to the database identified by `ORACLE_HOME` and `ORACLE_SID`. System authentication is based on the operating system credentials of the user instead of the database credentials.

For example, on a Linux system, the OML4R installation script uses this statement to start SQL*Plus without a password:

```
$ORACLE_HOME/bin/sqlplus / as sysdba
```

Membership in a special operating system group enables system authentication for Oracle Database. The operating system group is created during installation of the database, and the identity of the installer is automatically assigned to the group. The generic name for the group is OSDBA. On Linux, the name for OSDBA is `dba`.

The user that installs OML4R Server must belong to OSDBA.

> **See Also:**
>
> - "Using Operating System Authentication" in *Oracle Database Administrator's Guide*

4.2.3.2 Verify the Group Membership of Your User ID

Describes how to determine the group memberships required by OML4R Server.

As described in "About Operating System Authentication", the Linux user ID that runs the OML4R Server installation script must belong to the `dba` group. Membership in the `dba` group is also required for running other OML4R scripts on the server.

To determine the group membership of your Linux user ID, type this command:

```
% groups
dba  oinstall
```

4.3 Install Oracle Machine Learning for R Server for Oracle Database 23ai

Instructions for installing the OML4R Server on both the Container Database Root (CDB$ROOT) and Pluggable Databases (PDBs) within your Oracle Database 23ai environment.

> **Note:**
>
> The OML4R server must be installed on CDB$ROOT followed by the PDB.

The OML4R 2.0 binaries are shipped with Oracle Database 23ai. To install the OML4R 2.0 server components, use `$ORACLE_HOME/R/server/rqcfg.sql` script. You need to download and install the OML4R 2.0 supporting libraries separately.

The `rqcfg.sql` script enables the OML4R Server components that are part of the database, configures some aspects of the server, and installs some OML4R database objects.

Before installing OML4R Server, install R, as described in Install R for Oracle Machine Learning for R on On-Premises Oracle Database.

To install OML4R 2.0 server components for Oracle Database 23ai, do the following:

1. Install OML4R Server on CDB$ROOT:
   a. Start SQL*Plus and connect as `SYSDBA`.

      ```
      cd $ORACLE_HOME/R/server
      sqlplus / as sysdba
      ```

   b. Create a file and capture installation output in the file.

      ```
      SQL> spool install_root.txt
      ```

c. Verify your current connection with `show con_name`. This should confirm you are connected to `CDB$ROOT`.

```
SQL> show con_name
CON_NAME
------------------------------
CDB$ROOT
```

d. Run the rqcfg.sql script.

> **Note:**
>
> The first parameter is the tablespace for the RQSYS schema, the second parameter is the temporary tablespace for the RQSYS schema, the third parameter is the hard-coded value for ORACLE_HOME, and the fourth parameter is the hard-coded value for R_HOME.

```
SQL> @rqcfg.sql
```

The output appears as follows:

```
Enter value for 1: SYSAUX
Enter value for 2: TEMP
Enter value for 3: /u01/app/oracle/product/23.4/dbhome_1
Enter value for 4: /usr/lib64/R
```

e. Review the `install_root.txt` log file for any errors that may have occurred during installation.

2. Install OML4R Server on PDBs
To install the OML4R Server on PDBs, run the below commands:

a. Exit and restart SQLPlus. Then navigate to the pluggable database and run the following command.

```
$ sqlplus / as sysdba
SQL> alter session set container=ORCLPDB;
```

b. Verify your current connection with `SHOW CON_NAME`. This should confirm you are connected to `ORCLPDB`.

```
SQL> show con_name
```

The output appears as follows:

```
CON_NAME
------------------------------
ORCLPDB
```

c. Create a file and capture installation output in the file.

```
SQL> spool install_pdb.txt
```

d. Run the rqcfg.sql script in the PDB.

> **Note:**
>
> The first parameter is the tablespace for the RQSYS schema, the second parameter is the temporary tablespace for the RQSYS schema, the third parameter is the hard-coded value for ORACLE_HOME, and the fourth parameter is the hard-coded value for R_HOME.

```
SQL> @rqcfg.sql
```

The output appears as follows:

```
Enter value for 1: SYSTEM
Enter value for 2: TEMP
Enter value for 3: /u01/app/oracle/product/23.4/dbhome_1
Enter value for 4: /usr/lib64/R
```

e. Review the `install_pdb.txt` log file for any errors that may have occurred during installation.

f. To ensure secure access to OML4R features within the PDB, either create a new user and grant the required privileges, or configure an existing user with the least necessary permissions. To create a database user, see Create a Database User for Oracle Machine Learning for R.

3. To install OML4R supporting packages, see Install the OML4R Supporting Packages.

4.4 Verify the OML4R Server Installation

To verify the success of an OML4R Server installation, you can view the log files created by the spool command above and run the following commands.

For any installation, you can run some functions to verify a successful installation.

Example 4-1 Run Examples to Verify the Server Installation

First run these commands from an R instance directly on the database server and then run them from the OML4R client.

Start R using the `ORE` script and load the `ORE` library.

```
$ ORE
> library(ORE)
```

Connect to the server. This example connects as the user OMLUSER.

```
ore.connect("RQUSER", password="RQUSER", service_name="ORCLPDB",
host="<host name>", all=TRUE)
```

Run some functions.

```
## Is the OML4R client connected to the OML4R server?
## The output of this function should be TRUE.
ore.is.connected()

## List the available database tables.
ore.ls()

## Push an R dataframe to a database table.
df <- data.frame(a="abc",
                 b=1.456,
                 c=TRUE,
                 d=as.integer(1))
of <- ore.push(df)

## Run the self-contained example code in the help files associated with the
following functions.
## The examples should not return any errors.
example("ore.odmAI")     ## Builds an OML4SQL attribute importance model.
example("ore.doEval")    ## Runs an embedded R execution function.
```

5

Install Oracle Machine Learning for R on Exadata

This chapter explains how to install Oracle R Distribution and OML4R Server on Oracle Exadata Database Machine. This chapter includes these topics:

- About Oracle Machine Learning for R on Exadata
  Exadata is an ideal platform for OML4R.
- Install Oracle Machine Learning for R on Exadata Using DCLI
  Using DCLI can simplify the installation of OML4R on Exadata.
- Install Oracle Machine Learning for R for Oracle RAC Without DCLI
  How to install OML4R for an Oracle Real Application Clusters (Oracle RAC) database if DCLI is unavailable.

5.1 About Oracle Machine Learning for R on Exadata

Exadata is an ideal platform for OML4R.

The parallel resources of R computations in OML4R take advantage of the massively parallel grid infrastructure of Exadata.

> **Note:**
>
> The version of OML4R must be the same on the server and on each client computer. Also, the version of R must be the same on the server and on each client computer. See the Table 1-3 for supported configurations.

To install OML4R on Exadata:

1. On the first node:
   - Install the OML4R server components
2. On each node:
   - Install Oracle R Distribution
   - Verify and configure the environment
   - Install the OML4R supporting packages
3. On the *first* node only, create an OML4R user, if desired. Alternatively, configure an existing database user to use OML4R. See Create a Database User for Oracle Machine Learning for R.

You can simplify the process of installing OML4R on Exadata by using the **Distributed Command Line Interface** (DCLI).

Related Topics

- Install R for Oracle Machine Learning for R on On-Premises Oracle Database
  This chapter explains how to install R for OML4R on On-Premises Oracle Database.
- Oracle Machine Learning for R Server Requirements
  Before installing OML4R Server, verify your system environment, and ensure that your user ID has the proper permissions.
- Create a Database User for Oracle Machine Learning for R
  In Database 23ai, the `rquser.sql` script shipped with Oracle Database 23ai resides in the `$ORACLE_HOME/R/server` directory. The script installs creates a new OML4R user, and the script `rqgrant.sql` in the same directory applies the required grants to the new user.
- Install Oracle Machine Learning for R on Exadata Using DCLI
  Using DCLI can simplify the installation of OML4R on Exadata.

5.2 Install Oracle Machine Learning for R on Exadata Using DCLI

Using DCLI can simplify the installation of OML4R on Exadata.

With DCLI, you can use a single command to install Oracle R Distribution and OML4R Server across multiple Exadata compute nodes. The following example shows the output of the DCLI help option, which explains the basic syntax of the utility.

> **See Also:**
>
> For more details about DCLI, go to the My Oracle Support website, log in with your Customer Support Identifier, and type `DCLI` in the search box.

Example 5-1 DCLI Help Option Output

```
$ dcli -h

Distributed Shell for Oracle Storage

This script runs commands on multiple cells in parallel threads.
The cells are referenced by their domain name or ip address.
Local files can be copied to cells and ran on cells.
This tool does not support interactive sessions with host applications.
Use of this tool assumes ssh is running on local host and cells.
The -k option should be used initially to perform key exchange with
cells.  User may be prompted to acknowledge cell authenticity, and
may be prompted for the remote user password.  This -k step is serialized
to prevent overlayed prompts.  After -k option is used once, then
subsequent commands to the same cells do not require -k and will not require
passwords for that user from the host.
Command output (stdout and stderr) is collected and displayed after the
copy and command execution has finished on all cells.
Options allow this command output to be abbreviated.

Return values:
 0 -- file or command was copied and ran successfully on all cells
 1 -- one or more cells could not be reached or remote execution returned
      non-zero status.
 2 -- An error prevented any command execution

Examples:
```

```
 dcli -g mycells -k
 dcli -c stsd2s2,stsd2s3 vmstat
 dcli -g mycells cellcli -e alter iormplan active
 dcli -g mycells -x reConfig.scl

usage: dcli [options] [command]

options:
 --version           show program's version number and exit
 -c CELLS            comma-separated list of cells
 -d DESTFILE         destination directory or file
 -f FILE             file to be copied
 -g GROUPFILE        file containing list of cells
 -h, --help          show help message and exit
 -k                  push ssh key to cell's authorized_keys file
 -l USERID           user to login as on remote cells (default: celladmin)
 -n                  abbreviate non-error output
 -r REGEXP           abbreviate output lines matching a regular expression
 -s SSHOPTIONS       string of options passed through to ssh
 --scp=SCPOPTIONS    string of options passed through to scp if different from
                     sshoptions
 --serial            serialize execution over the cells
 -t                  list target cells
 --unkey             drop keys from target cells' authorized_keys file
 -v                  print extra messages to stdout
 --vmstat=VMSTATOPS  vmstat command options
 -x EXECFILE         Copies and runs the file
```

The following topics describe installing OML4R components using DCLI:

- Install Oracle R Distribution Across Exadata Compute Nodes Using DCLI
  How to run DCLI to install Oracle R Distribution across multiple Exadata Linux compute nodes.
- Install OML4R Server Across Exadata Compute Nodes Using DCLI for 23ai
  How to use DCLI to install OML4R Server across multiple Exadata Linux compute nodes for Oracle Database 23ai.
- DCLI Commands Summary for Oracle Machine Learning for R Server
  The DCLI commands used to install OML4R and the supporting packages on a Linux Exadata system are listed in the following example.

5.2.1 Install Oracle R Distribution Across Exadata Compute Nodes Using DCLI

How to run DCLI to install Oracle R Distribution across multiple Exadata Linux compute nodes.

The commands are summarized in DCLI Command Summary for Oracle R Distribution installation on Exadata .

> **Important:**
>
> Before beginning the installation, review the instructions for installing Oracle R Distribution in Install R for Oracle Machine Learning for R on On-Premises Oracle Database.

To install Oracle R Distribution on Exadata using DCLI, follow these steps:

1. Configure the Exadata environment to enable automatic authentication for DCLI on each compute node.
   a. Generate an SSH public-private key for the root user. Run the following command as root on any node:

      ```
      $ ssh-keygen -N '' -f /.ssh/id_dsa -t dsa
      ```

      This command generates public and private key files in the `.ssh` subdirectory of the home directory of the root user.

   b. In a text editor, create a file that contains the names of all the compute nodes in the rack. Specify each node name on a separate line. For example, the `nodes` file for a 2-node cluster could contain entries like the following:

      ```
      $ cat nodes
      exadb01
      exadb02
      ```

   c. Run the DCLI command with the `-k` option to establish SSH trust across all the nodes. The `-k` option causes DCLI to contact each node sequentially (not in parallel) and prompts you to enter the password for each node.

      ```
      $ dcli -t -g nodes -l root -k -s "\-o StrictHostkeyChecking=no"
      ```

      DCLI with `-k` establishes SSH Trust and User Equivalence. Subsequent DCLI commands will not prompt for passwords.

2. Install Oracle R Distribution using yum if an internet connection is available. Otherwise, install the Oracle R Distribution and operating system dependencies manually. Request the file `ord-linux-x86_64-`*`Rversion`*`-`*`Exadataversion`*`.tar.gz` from Oracle Support, where *`Rversion`* is the version of Oracle R Distribution to install and *`Exadataversion`* is the Exadata version output from running the imageinfo command..
   a. Log in to My Oracle Support.
   b. Click **Contact Us**.
   c. If yum and internet access are unavailable, request access to this file through My Oracle Support.

      ```
      ord-linux-x86_64-Rversion-Exadataversion.tar.gz
      ```

   d. When permission is granted, log in as root to any compute node and download the file.

3. Create a directory and replicate the downloaded file in this directory across all nodes. For example, the following commands create the directory `/home/oracle/ORD` and replicate the file `ord-linux-x86_64-`*`Rversion`*`-`*`Exadataversion`*`.tar.gz` in this directory.

   ```
   $ dcli -t -g nodes -l root mkdir -p /home/oracle/ORD
   $ dcli -t -g nodes -l root -f
           ord-linux-x86_64-Rversion-Exadataversion.tar.gz -d
           /home/oracle/ORD/ord-linux-x86_64-Rversion-Exadataversion.tar.gz
   ```

4. Uncompress and untar the file to replicate the dependent RPMs across all nodes.

   ```
   $ dcli -t -g nodes -l root tar xvfz
           /home/oracle/ORD/ord-linux-x86_64-Rversion-Exadataversion.tar.gz
           -C /home/oracle/ORD
   $ ls /home/oracle/ORD/ord-linux-x86_64-Rversion-Exadataversion.tar.gz
   ```

Alternatively, you can download these RPMs from the Oracle public yum server. The locations of the RPMs are listed in "Install Oracle R Distribution on Oracle Linux Using RPMs".

5. To install the new RPMs and update existing RPMs across nodes, run the following RPM command:

```
$ dcli -t -g nodes -l root rpm -i --force
        /home/oracle/ORD/ord-linux-x86_64-Rversion-Exadataversion/*.rpm
```

The `--force` flag prevents errors from circular dependencies.

6. Verify the R installations on each node by first returning to the location where R is installed and then starting R.

```
$ dcli -g nodes -l oracle R RHOME
exadb01: /usr/lib64/R
exadb02: /usr/lib64/R
```

For each node, the following command returns the output shown.

```
$ dcli -g nodes -l oracle R --vanilla
...
exadb01: R is free software and comes with ABSOLUTELY NO WARRANTY.
exadb01: You are welcome to redistribute it under certain conditions.
exadb01: Type 'license()' or 'licence()' for distribution details.
exadb01:
exadb01: Natural language support but running in an English locale
exadb01:
exadb01: R is a collaborative project with many contributors.
exadb01: Type 'contributors()' for more information and
exadb01: 'citation()' on how to cite R or R packages in publications.
exadb01:
exadb01: Type 'demo()' for some demos, 'help()' for on-line help, or
exadb01: 'help.start()' for an HTML browser interface to help.
exadb01: Type 'q()' to quit R.
exadb01:
exadb01: You are using Oracle's distribution of R. Please contact
exadb01: Oracle Support for any problems you encounter with this
exadb01: distribution.
```

- DCLI Command Summary for Oracle R Distribution installation on Exadata
  The DCLI commands used to install Oracle R Distribution on a Linux Exadata system are listed in the following example.

5.2.1.1 DCLI Command Summary for Oracle R Distribution installation on Exadata

The DCLI commands used to install Oracle R Distribution on a Linux Exadata system are listed in the following example.

Replace `version` with the version number of the Oracle R Distribution that you are using.

Example 5-2 DCLI Command Summary for Oracle R Distribution

```
ssh-keygen -N " -f ~/.ssh/id_dsa -t dsa
vi nodes # enter node names
dcli -t -g nodes -l root -k -s "\-o StrictHostkeyChecking=no"
dcli -t -g nodes -l root mkdir -p /home/oracle/ORD
dcli -t -g nodes -l root -f ord-linux-x86_64-version.tar.gz -d
          /home/oracle/ORD/ord-linux-x86_64-version.tar.gz
dcli -t -g nodes -l root tar xvfz /home/oracle/ORD
          /ord-linux-x86_64-version.tar.gz -C /home/oracle/ORD
dcli -t -g nodes -l root rpm -i --force
```

```
          /home/oracle/ORD/ord-linux-x86_64-version/*.rpm
dcli -g nodes -l root R RHOME
dcli -g nodes -l root R --vanilla
```

5.2.2 Install OML4R Server Across Exadata Compute Nodes Using DCLI for 23ai

How to use DCLI to install OML4R Server across multiple Exadata Linux compute nodes for Oracle Database 23ai.

To install OML4R Server on Exadata using DCLI for Oracle Database 23ai, follow these steps:

1. Get a list of the compute nodes in the rack.

   In the following example, the `cat nodes` command lists the nodes for a two-node cluster.

   ```
   $ cat nodes
   exadb01
   exadb02
   ```

2. In a text editor, create a file that contains the names of all of the compute nodes in the rack. Specify each node name on a separate line. For example, the nodes file for a two-node cluster would contain entries such as the following:

   ```
   exadb01
   exadb02
   ```

3. Ensure that the `ORACLE_HOME`, `ORACLE_SID`, `R_HOME`, `PATH`, and `LD_LIBRARY_PATH` environment variables are properly set on each node, and are defined in the same shell in which you will run the DCLI script. For example, you could specify values like the following in a bashrc file:

   ```
   export ORACLE_HOME=/u01/app/oraclecle/product/release_number/dbhome_1
   export ORACLE_SID=ORCL
   export R_HOME=/usr/lib64/R
   export PATH=$PATH:$R_HOME/bin:$ORACLE_HOME/bin
   export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$ORACLE_HOME/
   lib:$RHOME_lib:$R_HOME/port/Linux-X64/lib
   ```

4. Option 1: On the first database node only, run as sysdba the `rqcfg.sql` script from your PDB.

   ```
   $ sqlplus / as sysdba;
   SQL> alter session set container=PDBNAME;
   SQL> @$ORACLE_HOME/R/server/rqcfg.sql
   ```

> **Note:**
>
> The `rqcfg.sql` script ships with Oracle Database 23ai and resides in the `$ORACLE_HOME/R/server` directory. The script installs the OML4R Server components in the database and you need to run it only once.

The `rqcfg.sql` script prompts you for the following input parameters:

```
define permtbl = permanent tablespace name for RQSYS schema
define temptbl = temporary tablespace name for RQSYS schema
define orahome = ORACLE_HOME path
define rhome = R_HOME path
```

Option 2: Run the `rqcfg.sql` script from the Linux command line.

In the example, the user is `system` with the password `apassword`, the RQSYS schema is in SYSAUX and SYSAUX is assigned the temporary tablespace `TEMP`. The value for `ORACLE_HOME` is `/u01/app/oracle/product/23c/dbhome_1` and the value for `R_HOME` is the Linux default path, `/usr/lib64/R`:

```
$ sqlplus -L -S system/apassword @$ORACLE_HOME/R/server/rqcfg.sql SYSAUX
TEMP /u01/app/oracle/product/23c/dbhome_1 /usr/lib64/R
```

5. Download and install the OML4R supporting packages.

   To download ths supporting packages, go to the Oracle Machine Learning for R Downloads website. Select **Supporting** in the column for your version of the database, accept the license agreement, and download the `ore-supporting-linux-x86-64-version.zip` file.

   Log in as root and copy the installers for the supporting packages across the nodes. For example:

   ```
   $ dcli -g nodes -l oracle mkdir -p /home/oracle/OML4R

   $ dcli -g nodes -l oracle -f ore-supporting-linux-x86-64-version.zip -d
        /home/oracle/OML4R/ore-supporting-linux-x86-64-version.zip
   ```

   Unzip the supporting packages on each node:

   ```
   $ dcli -t -g nodes -l oracle unzip
        /home/oracle/OML4R/ore-supporting-linux-x86-64-version.zip -d
        /my_destination_directory/
   ```

   Install the OML4R supporting packages, as in the following example:

   ```
   $ dcli -t -g nodes -l oracle R CMD INSTALL /my_destination_directory/
   supporting/* -l $ORACLE_HOME/R/library/
   ```

   > **Note:**
   >
   > The `rqcfg.sql` script creates an OML4R user. By default, the script does not grant the RQADMIN role to the user.
   >
   > Any OML4R user can use an embedded R execution function, but only those with the RQADMIN role can create and drop the R scripts in the OML4R script repository in the database. Use caution when granting the RQADMIN role.

6. Verify the OML4R loads.

```
$ ORE

> library(ORE)
Loading required package: OREbase
Attaching package: OREbase
The following objects are masked from âpackage:baseâ:
    cbind, data.frame, eval, interaction, order, paste, pmax, pmin,
    rbind, table
Loading required package: OREembed
Loading required package: OREstats
Loading required package: MASS
Loading required package: OREgraphics
Loading required package: OREeda
Loading required package: OREmodels
Loading required package: OREdm
Loading required package: lattice
Loading required package: OREpredict
Loading required package: ORExml
```

5.2.3 DCLI Commands Summary for Oracle Machine Learning for R Server

The DCLI commands used to install OML4R and the supporting packages on a Linux Exadata system are listed in the following example.

Example 5-3 DCLI Command Summary for OML4R Server

```
dcli -g nodes -l oracle mkdir -p /home/oracle/ORE
dcli -g nodes -l oracle -f ore-server-linux-x86-64-version.zip -d
     /home/oracle/ORE/ore-server-linux-x86-64-version.zip
dcli -g nodes -l oracle -f ore-supporting-linux-x86-64-version.zip -d
     /home/oracle/ORE/ore-supporting-linux-x86-64-version.zip
dcli -t -g nodes -l oracle unzip
     /home/oracle/ORE/ore-server-linux-x86-64-version.zip -d
     /home/oracle/ORE/
dcli -t -g nodes -l oracle /home/oracle/ORE/server.sh
sqlplus / as sysdba
grant RQADMIN to OML_USER;
exit;
dcli -t -g nodes -l oracle ORE -e "library(ORE)"
```

5.3 Install Oracle Machine Learning for R for Oracle RAC Without DCLI

How to install OML4R for an Oracle Real Application Clusters (Oracle RAC) database if DCLI is unavailable.

If the Distributed Command Line Interface (DCLI) is not available, you must install each of the following components individually on each database instance in the Oracle RAC cluster.

- R or Oracle R Distribution
- OML4R Server
- OML4R supporting packages

The below section contains installation instructions for Oracle Database 23ai.

Install OML4R in an Oracle 23ai RAC Environment

Following these step to install Oracle R Distribution, OML4R, and the OML4R supporting packages.

1. Install Oracle R Distribution. See Install R for Oracle Machine Learning for R on On-Premises Oracle Database.
2. Start SQL*Plus, log in to your PDB directly and run the `rqcfg.sql` script. The following example uses the PDB `PDB1` and gives example values for the script arguments.

```
SQL> sqlplus / as sysdba
SQL> alter session set container=PDB1;
SQL> ALTER PROFILE DEFAULT LIMIT PASSWORD_VERIFY_FUNCTION NULL;
SQL> @$ORACLE_HOME/R/server/rqcfg.sql

define permtbl = SYSAUX
define temptbl = TEMP
define orahome = /u01/app/oracle/product/23.4.0.0/dbhome_1
define rhome = /usr/lib64/R
```

3. At your operating system prompt, go to the `ORACLE_HOME/bin` directory and grant read and run permission to all users to the `ORE` directory.

```
cd  $ORACLE_HOME/bin
chmod 755 ORE
```

4. Create a directory to contain the OML4R 2.0 supporting packages for your system and change directories to it. To that directory, download the supporting package zip file as described in Install the OML4R Supporting Packages.
5. Extract the supporting packages.
6. For each package, at your operating system command prompt, run the following command.

```
ORE CMD INSTALL package
```

6

Install Oracle Machine Learning for R Client

This chapter explains how to install OML4R Client. This chapter includes these topics:

- About OML4R Client
  Lists the components of OML4R Client.
- Install Oracle Database Instant Client
  OML4R requires Oracle Database client software.
- Install the Oracle Machine Learning for R Packages
  Install the OML4R packages on each client computer.
- Install the OML4R Supporting Packages
  Install the OML4R supporting packages on each client computer and on the server that hosts OML4R Server.
- Connect OML4R Client to OML4R Server
  Instructions for connecting to an OML4R server.

6.1 About OML4R Client

Lists the components of OML4R Client.

OML4R includes several components that must be installed separately on each client computer.

> **Note:**
>
> The version of OML4R must be the same on the server and on each client computer. Also, the version of R must be the same on the server and on each client computer.

Components of OML4R Client

- R (See Install R for Oracle Machine Learning for R on On-Premises Oracle Database)
- Oracle Database Client Software
- OML4R packages
- OML4R supporting packages

The OML4R Client components can be installed in any order.

The following sections have information about the components.

- About Oracle Database Client Software
  ROracle requires an installation of Oracle Database client.
- About the OML4R Packages
  The OML4R packages are a set of Oracle proprietary packages that support OML4R.

- About the OML4R Supporting Packages
  The supporting packages are a set of open source packages that support the OML4R packages.

> **See Also:**
>
> - Table 1-3 for a list of supported R and OML4R versions.
> - Figure 1-2 for an illustration of the client and server components of OML4R

6.1.1 About Oracle Database Client Software

ROracle requires an installation of Oracle Database client.

ROracle is one of the supporting packages used by OML4R. It requires an installation of Oracle Database client software to enable communication between an R client and an Oracle Database instance. The database client can be either Oracle Database Client or Oracle Database Instant Client:

- **Oracle Database Client** is distributed with Oracle Database and is based in the Oracle home of the database.
- **Oracle Database Instant Client** is a free, standalone implementation of Oracle Database Client. Oracle Instant Client is not based in an Oracle home directory and requires less disk space than Oracle Database Client.

6.1.2 About the OML4R Packages

The OML4R packages are a set of Oracle proprietary packages that support OML4R.

These packages are required on each client computer and on the server computer that hosts OML4R Server. On the server, the OML4R packages are installed automatically by the OML4R Server installation script.

> **Note:**
>
> The version of the OML4R packages on the client must match the version of the OML4R packages on the server.

Table 6-1 OML4R Packages

Package Name	Description
`ORE`	The top-level package for OML4R.
`OREbase`	Corresponds to the open source R `base` package.
`OREcommon`	Contains common low-level functionality for OML4R.
`OREdm`	Exposes Oracle Data Mining algorithms through R.
`OREdplyr`	Transparently implements `dplyr` data manipulation functions for `ore.frame` and `ore.numeric` objects.
`OREds`	Contains functions for datastore operations.

Table 6-1 (Cont.) OML4R Packages

Package Name	Description
OREeda	Contains functions for exploratory data analysis.
OREembed	Supports embedded R.
OREgraphics	Corresponds to the open source R graphics package.
OREmodels	Contains functions for advanced analytical modeling.
OREpredict	Enables scoring data in Oracle Database using R models.
OREstats	Corresponds to the open source R stats package.
ORExml	Supports XML translation between R and Oracle Database.

6.1.3 About the OML4R Supporting Packages

The supporting packages are a set of open source packages that support the OML4R packages.

Table 6-2 OML4R Supporting Packages

Package Name	Description
arules	Provides the infrastructure for representing, manipulating, and analyzing transactional data and patterns (frequent itemsets and association rules).
Cairo	Supports graphic rendering on an OML4R server.
DBI	A database interface definition for communication between R and Oracle Database.
png	Supports the reading and writing of PNG images for OML4R objects.
ROracle	Oracle Database interface for R-based OCI.
statmod	Provides statistical modeling functions, including growth curve comparisons, limiting dilution analysis, mixed linear models, heteroscedastic regression, Tweedie family generalized linear models, the inverse-Gaussian distribution and Gauss quadrature.
dplyr	Provides fast, consistent tool for working with data frame like objects, both in memory and out of memory
assertthat	Provides the assertion functions that should return a single TRUE or FALSE: any other result is an error.
cli	Provides the functions to create a consistent and convenient command line interface
crayon	With crayon it is easy to add color to terminal output, create styles for notes, warnings, errors; and combine styles.
ellipsis	Provides a collection of functions to catch problems and alert the user.
fansi	Counterparts to R string manipulation functions that account for the effects of some ANSI X3.64 (a.k.a. ECMA-48, ISO-6429) control sequences.
generics	These are generic functions that can be used to minimize package dependencies when multiple packages have the same method.
glue	Expressions enclosed by braces will be evaluated as R code. Long strings are broken by line and concatenated together. Leading whitespace and blank lines from the first and last lines are automatically trimmed.
lazyeva	Provides the tools necessary to do non-standard evaluation (NSE) "right" in R

Table 6-2 (Cont.) OML4R Supporting Packages

Package Name	Description
lifecycle	Manage the life cycle of your exported functions with shared conventions, documentation badges, and user-friendly deprecation warnings.
magrittr	The magrittr package offers a set of operators which promote semantics that will improve your code by structuring sequences of data operations left-to-right (as opposed to from the inside and out), avoiding nested function calls, minimizing the need for local variables and function definitions, and making it easy to add steps anywhere in the sequence of operations.
pillar	Creates an object that formats a vector. The output uses one row for a title (if given), one row for the type, and 'vec_size(x)' rows for the data.
pkgconfig	This package is meant to be used in other packages, and provides configuration options for them.
png	Graphics devices for BMP, JPEG, PNG and TIFF format bitmap files.
purrr	A complete and consistent functional programming toolkit for R.
rlang	A toolbox for working with base types, core R features like the condition system, and core 'Tidyverse' features like tidy evaluation.
tibble	Provides utilities for handling tibbles, where "tibble" is a colloquial term for the S3 tbl_df class.
tidyselect	A backend for the selecting functions of the 'tidyverse'. It makes it easy to implement select-like functions in your own packages in a way that is consistent with other 'tidyverse' interfaces for selection.
utf	Provides functions for manipulating and printing UTF-8 text that fixes multiple bugs in R's UTF-8 handling.
vctrs	Defines new notions of prototype and size that are used to provide tools for consistent and well-founded type-coercion and size-recycling, and are in turn connected to ideas of type- and size-stability useful for analysing function interfaces.

6.2 Install Oracle Database Instant Client

OML4R requires Oracle Database client software.

Oracle Instant Client is suitable for most configurations of OML4R.

This topic includes these sections:

- Install Oracle Database Instant Client on Linux
  You can install Oracle Database Instant Client from a zip file on Linux system.

6.2.1 Install Oracle Database Instant Client on Linux

You can install Oracle Database Instant Client from a zip file on Linux system.

On Linux, you can also install from RPMs.

This topic includes these sections:

- Install Oracle Instant Client from a Zip File
  Instructions for installing Oracle Instant Client from a zip file.
- Install Oracle Instant Client on Linux from RPMs
  Instructions for installing Oracle Instant Client from RPMs.

6.2.1.1 Install Oracle Instant Client from a Zip File

Instructions for installing Oracle Instant Client from a zip file.

1. Create an installation directory for the OML4R client components. For example:

   ```
   mkdir oml4rclient_install_dir
   ```

2. Go to the Oracle Database Instant Client page on the Oracle Technology Network.
3. On the Instant Client Downloads page, select the Instant Client for your platform.
4. Accept the license agreement and select the **Instant Client Package - Basic** RPM for your version of Oracle Database.
5. Save the file in the installation directory that you created in Step 1. For example:

   ```
   \oml4rclient_install_dir\instantclient-basic-linux.x64-23.5.0.24.07.zip
   ```

6. Unzip the file. The files are extracted into a subdirectory called `instantclient_version`, where *version* is your version of Oracle Database. For example:

   ```
   unzip instantclient-basic-linux.x64-23.5.0.24.07.zip
   ls
     instantclient_23_5/
     instantclient-basic-linux.x64-23.5.0.24.07.zip
   ```

7. Return to the Oracle Database Instant Client page for your platform.
8. Select the Instant Client for your platform.
9. On the Instant Client Downloads page for your platform, accept the license agreement and select **Instant Client Package - SDK** for your version of Oracle Database.
10. Save the file in the installation directory that you created in Step 1. For example:

    ```
    \oml4rclient_install_dir\instantclient-sdk-linux.x64-23.5.0.24.07.zip
    ```

11. Unzip the file. The contents are extracted into the `instantclient_version` subdirectory.

    ```
    unzip instantclient-sdk-linux.x64-23.5.0.24.07.zip
    ls
      /instantclient_23_5
      instantclient-basic-linux.x64-23.5.0.24.07.zip
      instantclient-sdk-linux.x64-23.5.0.24.07.zip
    cd instantclinet_23_5
    ls
      /help
      /sdk
      /vc10
      /vc11
    ```

6.2.1.2 Install Oracle Instant Client on Linux from RPMs

Instructions for installing Oracle Instant Client from RPMs.

1. Create an installation directory for the OML4R client components. For example:

   ```
   mkdir oml4rclient_install_dir
   ```

2. Go to the Oracle Database Instant Client page on the Oracle Technology Network:
3. Choose **See Instant Client downloads for all platforms**.
4. On the Instant Client Downloads page, choose **Instant Client for Linux x86-64**.

5. On the Instant Client Downloads page for Linux, accept the license agreement and select the RPM for **Instant Client Package - Basic**.
6. As the root user, install the RPM:

   ```
   rpm -i oracle-instantclient-basic-23.5.0.24.07-1.el8.x86_64.rpm
   ```

7. Return to the Instant Client Downloads page for Linux x86-64.
8. Accept the license agreement and download the RPM for **Instant Client Package - SDK** for your version of Oracle Database. As root, install the RPM:

   ```
   rpm -i oracle-instantclient-devel-23.5.0.24.07-1.el8.x86_64.rpm
   ```

9. The RPMs place the files in standard locations that the ROracle configuration script can find. For example, Oracle Instant Client 12.1 is installed in `/usr/lib/oracle/23.5/client64/lib`.
10. After installing Oracle Instant Client, add the path of the Oracle Instant Client libraries to `LD_LIBRARY_PATH`. For example:

    ```
    export LD_LIBRARY_PATH=/usr/lib/oracle/23.5/client64/lib:$LD_LIBRARY_PATH
    ```

6.3 Install the Oracle Machine Learning for R Packages

Install the OML4R packages on each client computer.

The OML4R packages are automatically included in the installation on the server.

This topic includes these sections:

- Install the OML4R Packages on Linux
  Instructions for installing the OML4R packages on Linux.

6.3.1 Install the OML4R Packages on Linux

Instructions for installing the OML4R packages on Linux.

1. Download the OML4R packages from the Oracle Machine Learning for R Downloads page on the Oracle Technology Network.
2. Accept the license agreement and select the OML4R packages for your platform. Download the zip file to the installation directory that you created for Oracle Instant Client. For example:

   ```
   /oml4rclient_install_dir/ore-client-platform-arch-version.zip
   ```

   NOTE: Choose the same installation directory for all OML4R client components.
3. Unzip the file:

   ```
   % unzip ore-client-platform-arch-version.zip
   ```

   When you unzip the file, the `/client` directory is created and these files are extracted.

   ```
   /client/ORE_version_R_arch-unknown-platform-gnu.tar.gz
   /client/OREbase_version_R_arch-unknown-platform-gnu.tar.gz
   /client/OREcommon_version_R_arch-unknown-platform-gnu.tar.gz
   /client/OREdm_version_R_arch-unknown-platform-gnu.tar.gz
   /client/OREdplyr_version_R_arch-unknown-platform-gnu.tar.gz
   /client/OREds_version_R_arch-unknown-platform-gnu.tar.gz
   /client/OREeda_version_R_arch-unknown-platform-gnu.tar.gz
   ```

```
/client/OREembed_version_R_arch-unknown-platform-gnu.tar.gz
/client/OREgraphics_version_R_arch-unknown-platform-gnu.tar.gz
/client/OREmodels_version_R_arch-unknown-platform-gnu.tar.gz
/client/OREpredict_version_R_arch-unknown-platform-gnu.tar.gz
/client/OREstats_version_R_arch-unknown-platform-gnu.tar.gz
/client/ORExml_version_R_arch-unknown-platform-gnu.tar.gz
```

4. Change to */oml4rclient_install_dir*/client.
5. Run the following commands:

```
R --vanilla CMD INSTALL ORE_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL OREbase_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL OREcommon_version_R_arch-unknown-platform-
gnu.tar.gz
R --vanilla CMD INSTALL OREdm_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL OREdplyr_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL OREds_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL OREeda_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL OREembed_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL OREgraphics_version_R_arch-unknown-platform-
gnu.tar.gz
R --vanilla CMD INSTALL OREmodels_version_R_arch-unknown-platform-
gnu.tar.gz
R --vanilla CMD INSTALL OREpredict_version_R_arch-unknown-platform-
gnu.tar.gz
R --vanilla CMD INSTALL OREstats_version_R_arch-unknown-platform-gnu.tar.gz
R --vanilla CMD INSTALL ORExml_version_R_arch-unknown-platform-gnu.tar.gz
```

6.4 Install the OML4R Supporting Packages

Install the OML4R supporting packages on each client computer and on the server that hosts OML4R Server.

This topic includes these sections:

- Install the Supporting Packages on Linux
  Instructions for installing the supporting packages on Linux.

6.4.1 Install the Supporting Packages on Linux

Instructions for installing the supporting packages on Linux.

1. Download the OML4R supporting packages from the Oracle Machine Learning for R Downloads website.
2. Accept the license agreement and select the **Supporting** packages for your platform. Download the zip file to the installation directory to an accessible directory. For example:

   ```
   oml4r-supporting-linux-x86-64-2.0.zip
   ```

3. Unzip the file:

   ```
   unzip oml4r-supporting-linux-x86-64-2.0.zip
   ```

When you unzip the file, the `/supporting` directory is created and these files are extracted.

```
/supporting/arules_1.7-3_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/assertthat_0.2.1_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/Cairo_1.5-15_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/cli_3.3.0_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/crayon_1.5.1_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/DBI_1.1.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/dplyr_1.0.9_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/ellipsis_0.3.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/fansi_1.0.3_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/generics_0.1.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/glue_1.6.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/lazyeval_0.2.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/lifecycle_1.0.1_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/magrittr_2.0.3_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/pillar_1.7.0_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/pkgconfig_2.0.3_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/png_0.1-8_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/purrr_0.3.4_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/R6_2.5.1_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/rlang_1.0.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/ROracle_1.4-1_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/statmod_1.4.36_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/tibble_3.1.7_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/tidyselect_1.1.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/utf8_1.2.2_R_x86_64-unknown-linux-gnu.tar.gz
/supporting/vctrs_0.4.1_R_x86_64-unknown-linux-gnu.tar.gz
```

4. Change to the supporting directory `cd supporting`
5. Run the following commands to install the supporting packages on the database server. When you install on the server, use the `ORE` command. This installs the packages to `$ORACLE_HOME/R/library` instead of the default location, which is `/usr/lib64/R/library` on Linux.

   ```
   ORE CMD INSTALL *
   ```

6. Run the following commands to install the supporting packages on the client:

   ```
   R --vanilla CMD INSTALL *
   ```

For Linux, Verify Cairo and png Dependencies

The `Cairo` and `png` packages require the presence of these operating system dependencies:

- `Cairo` requires the `cairo-devel` package.
- `png` requires the `libpng-devel` package.

To verify the presence of these dependencies, do the following.

1. Run the following commands:

   ```
   $ rpm -qa libpng-devel
   $ rpm -qa cairo-devel
   ```

If the RPMs are installed, then the name of the RPM is returned.

```
$ rpm -qa cairo-devel
cairo-devel-1.15.12-3.el7.x86_64

$ rpm -qa libpng-devel
libpng-devel-1.5.13-7.el7_2.x86_64
```

2. If that output is not returned, the RPMs are not installed. To install them, run the following commands as root:

```
$ yum install cairo-devel
$ yum install libpng-devel
```

6.5 Connect OML4R Client to OML4R Server

Instructions for connecting to an OML4R server.

To connect an OML4R client to an OML4R server, start R using the `ORE` script:

```
$ ORE
R> library(ORE)
```

The following examples connect as user `OMLUSER` with password `OMLUSERpsw`:

- For a remote database, specify the Oracle Database service identifier (SID), the host name, and the port for the connection.

```
ore.connect(user="OMLUSER", sid="orcl", host="severname", password="OMLUSERpsw",
              port=1521, all=TRUE)
```

> **Note:**
>
> To avoid specifying the password and other connection details in embedded R scripts, you can use Oracle Wallet. See Create an Oracle Wallet for an Oracle Machine Learning for R Connection.

- For a local database, specify the connection as follows:

```
ore.connect("OMLUSER", password="OMLUSERpsw", conn_string="", all=TRUE)
```

> **See Also:**
>
> *Oracle Machine Learning for R User's Guide* for details about connecting to an OML4R server

7

Administrative Tasks for Oracle Machine Learning for R

This chapter describes administrative tasks for maintaining and optimizing OML4R.

This chapter contains these topics:

- Install Oracle R Distribution on Linux in a Non-Default R_HOME
  The Linux RPMs can be installed to a directory other than the default Linux `R_HOME`, `/usr/lib64/R`.
- Upgrade Oracle Machine Learning for R
  You can upgrade OML4R from the previous release 1.5.1 to the current release 2.0.
- Migrate Oracle Machine Learning for R Data
  OML4R Server includes migration scripts that you can run to migrate the RQSYS schema and OML4R user data from a source database to a target database
- Uninstall Oracle Machine Learning for R
  Instructions for uninstalling OML4R
- Install Additional R Packages on Linux
  On Linux platforms, the OML4R Server installation provides the `ORE` script, which you can run from the operating system prompt to install additional R packages.
- Create a Database User for Oracle Machine Learning for R
  In Database 23ai, the `rquser.sql` script shipped with Oracle Database 23ai resides in the `$ORACLE_HOME/R/server` directory. The script installs creates a new OML4R user, and the script `rqgrant.sql` in the same directory applies the required grants to the new user.
- Create an Oracle Wallet for an Oracle Machine Learning for R Connection
  An Oracle wallet is a password-protected container for storing security credentials in Oracle Database.
- Control Memory Used by Embedded R
  How to control the memory used by embedded R execution.

7.1 Install Oracle R Distribution on Linux in a Non-Default R_HOME

The Linux RPMs can be installed to a directory other than the default Linux `R_HOME`, `/usr/lib64/R`.

The procedure in the following example installs the Oracle R Distribution 4.0.5 RPMs to a non-default location and still allows the user to invoke the previously installed version, R-3.6.1.

The example installs the RPMs into the directory `/opt/R405`. It installs the following RPMs:

```
R-4.0.5-1.el7.x86_64.rpm
R-core-4.0.5-1.el7.x86_64.rpm
R-devel-4.0.5-1.el7.x86_64.rpm
libRmath-4.0.5-1.el7.x86_64.rpm
```

```
libRmath-devel-4.0.5-1.el7.x86_64.rpm
libRmath-static-4.0.5-1.el7.x86_64.rpm
```

1. From the directory that contains the RPMs, install the Oracle R Distribution 4.0.5 RPMs to a non-default location using the `--prefix` flag:

   > **Note:**
   >
   > Run the following command as root.

   ```
   # rpm -i *.rpm --prefix=/opt/R405
   ```

2. Set `R_HOME` to the R-4.0.5 location and add `$R_HOME/bin` to `PATH`:

   ```
   # export R_HOME=/opt/R405/lib64/R
   ```

   ```
   # export PATH=$R_HOME/bin:$PATH
   ```

3. Invoke the newly installed R-4.0.5.

   ```
   # R

   Oracle Distribution of R version 4.0.5  (--) -- "Shake and Throw"
   Copyright (C) The R Foundation for Statistical Computing
   Platform: x86_64-pc-linux-gnu (64-bit)...
   ```

If you still want to use the previous version of R, rename the default R executable `/usr/bin/R` to the old R version; for example, `/usr/bin/R-3.6.1`:

```
# mv /usr/bin/R /usr/bin/R-3.6.1
```

Now you can invoke R 3.6.1:

```
# R-3.6.1
Oracle Distribution of R version 3.6.1  (--) -- "Full of Ingredients"
Copyright (C)  The R Foundation for Statistical Computing
Platform: x86_64-unknown-linux-gnu (64-bit)...
```

7.2 Upgrade Oracle Machine Learning for R

You can upgrade OML4R from the previous release 1.5.1 to the current release 2.0.

To upgrade OML4R and migrate your data:

1. Ensure that you have the version of R that is required for the release of OML4R that you are upgrading to. OML4R requires R 4.0.5.

   See the table of configuration requirements and server support in Oracle Machine Learning for R System Requirements for On-Premises Database for the R requirement.

   To upgrade R, do the following:

   a. Back up your OML4R user schema, data store objects, R scripts, and the RQSYS schema.

   b. Remove the Oracle R Distribution RPMs or open source R components.

   c. Install the required R version, then proceed to Step 2.

2. To upgrade OML4R Server for Oracle Database Release 23ai, run the `server.sh` script to perform an upgrade.

   Instructions for upgrading from OML4R 1.5.1 to 2.0.

   a. Prepare the upgrade scripts

      i. Go to the Oracle Machine Learning for R Downloads page, accept the license agreement, and download the OML4R 2.0 Server packages to an installation directory, such as /oml4rserver_2.0_install_dir/.

      ii. Go to the 2.0 installation directory and unzip the downloaded file.

```
$ cd /oml4rserver_2.0_install_dir/

$ unzip ore-server-platform-arch-2.0.zip
```

3. Run the OML4R 2.0 `rqcfg.sql` script. When the earlier version of OML4R server is detected, you are asked to confirm if you want to upgrade. Type **Yes** to start the upgrade or Type **No** to stop the process.

```
$ cd /oml4rserver_2.0_install_dir/

$ ./server.sh

Oracle R Enterprise 2.0 Server.

Copyright (c) 2012, 2022 Oracle and/or its affiliates. All rights reserved.

Checking platform .................. Pass

Checking R ......................... Pass

Checking R libraries ............... Pass

Checking ORACLE_HOME ............... Pass

Checking ORACLE_SID ................ Pass

Checking sqlplus ................... Pass

Checking ORACLE instance ........... Pass

Checking CDB/PDB ................... Fail

ERROR: cannot install ORE in a root container

PDB to use for ORE installation [list]: <PDB_NAME>

Checking CDB/PDB ................... Pass

Checking ORE ....................... Pass

Current configuration

R Version ....................... Oracle Distribution of R version 4.0.5 (--)

R_HOME ..........................<R_HOME>

R_LIBS_USER .....................<R_LIBS_USER>

ORACLE_HOME .....................<ORACLE_HOME>

ORACLE_SID ......................<ORACLE_SID>

PDB .............................<PDB_NAME>

Existing R Version ..............Oracle Distribution of R version 4.0.5 (--)

Existing R_HOME .................<R_HOME>

Existing ORE data ................ 1.5.1

Existing ORE code ................ 1.5.1
```

```
Existing ORE libraries ........... 1.5.1

RQSYS PERMANENT tablespace .......<PERM_TABLESPACE>

RQSYS TEMPORARY tablespace ......<TEMP_TABLESPACE>

Operation .....................Install/Upgrade Proceed? [yes] yes

Removing R libraries ..............Pass

Removing ORE libraries ............. Pass

Installing R libraries ............. Pass

Installing ORE libraries ........... Pass

Upgrading RQSYS 1.5.1 .............. Pass

Configuring ORE ..................... Pass

Removing ORE packages ............... Pass

Installing ORE packages ............. Pass

Removing ORE script ................. Pass

Creating ORE script ................. Pass

Installing supporting packages ..... Pass

Done
```

4. To upgrade OML4R Client, install the OML4R 2.0 client packages and supporting packages to overwrite the old packages.

   See Install the Oracle Machine Learning for R Packages and Install the OML4R Supporting Packages for instructions.

7.3 Migrate Oracle Machine Learning for R Data

OML4R Server includes migration scripts that you can run to migrate the RQSYS schema and OML4R user data from a source database to a target database

The source and target must have the same version of the Oracle Database and of OML4R Server.

To locate the scripts, navigate to the `server` directory and change to the `migration` subdirectory.

/oreserver_install_dir/server/migration

The `migration` subdirectory contains a README and the following subdirectories:

- `exp` — contains the script `ore_srcexport.pl` for exporting the RQSYS schema and all OML4R user data to a dump file.
- `imp` — contains the script `ore_destimport.pl` for importing the RQSYS schema and all OML4R user data from the dump file created by `ore_screxport.pl`.
- `oreuser` — contains scripts for exporting and importing data for a specific OML4R user.

Instructions for running the migration scripts are provided in the README.

7.4 Uninstall Oracle Machine Learning for R

Instructions for uninstalling OML4R

This topic contains these sections:

- Uninstall OML4R Server from Oracle Database 23ai
  Follow the below steps to uninstall OML4R from Oracle Database Release 23ai.
- Uninstall OML4R Client
  Instructions for uninstalling OML4R Client.

7.4.1 Uninstall OML4R Server from Oracle Database 23ai

Follow the below steps to uninstall OML4R from Oracle Database Release 23ai.

The `rquncfg.sql` script uninstalls the database functions and procedures that are associated with OML4R. It does not remove the OML4R libraries in `$ORACLE_HOME/lib` because these are shipped with Oracle Database. Also, it does not remove the OML4R packages in `$ORACLE_HOME/R/library`.

To uninstall OML4R Server components, run the `rquncfg.sql` script.

1. Change directories to `$ORACLE_HOME/R/server`.

   ```
   cd $ORACLE_HOME/R/server
   ```

2. If you are using a PDB, connect to it.

   ```
   SQL> ALTER SESSION SET CONTAINER = pdbname;
   ```

3. In SQL, run the uninstall script. The script takes a single input, which is the `$ORACLE_HOME` location. In the following example, the value of the `ORACLE_HOME` environment variable is `/u01/app/oracle/product/23.4.0/dbhome_1`.

   ```
   SQL> @rquncfg.sql
   Session altered.
   Enter value for 1: /u01/app/oracle/product/23.4.0/dbhome_1
   ```

7.4.2 Uninstall OML4R Client

Instructions for uninstalling OML4R Client.

To uninstall the OML4R packages and supporting packages, start R and type the commands listed in the following example.

Example 7-1 R Commands for Uninstalling OML4R Packages

```
remove.packages("arules")
remove.packages("assertthat")
remove.packages("Cairo")
remove.packages("Cli")
remove.packages("crayon")
remove.packages("DBI")
remove.packages("dplyr")
remove.packages("ellipsis")
remove.packages("fansi")
remove.package("generics")
remove.packages("glue")
remove.packages("lazyeval")
remove.packages("lifecycle")
remove.packages("magrittr")
```

```
remove.packages("pillar")
remove.packages("pkgconfig")
remove.packages("png")
remove.packages("purrr")
remove.packages("R6")
remove.packages("rlang")
remove.packages("ROracle")
remove.packages("statmod")
remove.packages("tibble")
remove.packages("tidyselect")
remove.packages("utf8")
remove.packages("vctrs")
```

7.5 Install Additional R Packages on Linux

On Linux platforms, the OML4R Server installation provides the `ORE` script, which you can run from the operating system prompt to install additional R packages.

The `ORE` script is a wrapper for the R installation command: `R CMD INSTALL`.

By default, R packages are installed in /`usr/lib64/R/library`. The OML4R Server installation provides the ORE script, which is executed from the operating system shell to install R packages and to start R. The ORE script is a wrapper for the default R script, a shell wrapper for the R executable. It can be used to start R, run batch scripts, and build or install R packages. Unlike the default R script, the ORE script installs packages to a location writable by the oracle user and accessible by all OML4R users: `$ORACLE_HOME/R/library`. All R packages installed with the ORE script are installed to this location.

To run the script:

```
ORE CMD INSTALL R_package_name
```

7.6 Create a Database User for Oracle Machine Learning for R

In Database 23ai, the `rquser.sql` script shipped with Oracle Database 23ai resides in the `$ORACLE_HOME/R/server` directory. The script installs creates a new OML4R user, and the script `rqgrant.sql` in the same directory applies the required grants to the new user.

Example 7-2 Creating an OML4R User

```
$ORACLE_HOME/R/server/rquser.sql
```

Example 7-3 Creating an OML4R User in SQL*Plus

You can create an OML4R user in SQL*Plus by following these steps: You can create an OML4R user with the following commands or by running the rquser.sql script. You can apply the required grants to an OML4R user with the following commands or by running the rqgrant.sql script.

Log in using system privilege and navigate to the PDB, if applicable:

1. `SQLPLUS / AS SYSDBA;`
2. `alter session set container=<PDBNAME>;`
3. Provide the following arguments to the `rquser.sql` script:
   - Argument 1: User name (e.g., RQUSER)
   - Argument 2: User password

- Argument 3: Default tablespace (e.g., USERS)
- Argument 4: Temporary tablespace (e.g., TEMP)
- Argument 5: Quota on default tablespace (e.g., unlimited)

argument 1 - user name (RQUSER)argument 2 - user passwordargument 3 - default tablespace (USERS)argument 4 - temporary tablespace (TEMP)argument 5 - quota on default tablespace (unlimited)

- About the RQADMIN Role
  The `server` script installation process creates a database role called RQADMIN.

7.6.1 About the RQADMIN Role

The `server` script installation process creates a database role called RQADMIN.

When the RQADMIN role is granted to an OML4R user, the user can create and drop R scripts for embedded R execution. By default, the `server` script does *not* grant the RQADMIN role to the OML4R user.

> **Note:**
>
> Any OML4R user can run embedded R, but only OML4R users with the RQADMIN role can create and drop the R scripts.

If you choose to grant the RQADMIN role in SQL*Plus, then log in with system privileges and run a statement like the following:

```
SQLPLUS / AS SYSDBA
GRANT RQADMIN TO oml_username;
```

> **Caution:**
>
> Use caution when granting the RQADMIN role. Only users that require OML4R administrative privileges should have this role.

7.7 Create an Oracle Wallet for an Oracle Machine Learning for R Connection

An Oracle wallet is a password-protected container for storing security credentials in Oracle Database.

Wallets provide a secure mechanism for specifying connection details in embedded R scripts.

To create a wallet for an OML4R connection:

1. Start Oracle Wallet Manager:
   - (Linux) At the command line, enter `owm`.
2. To create the wallet, follow the instructions in the Oracle Database documentation for your supported platform:

a. For Oracle Database 12*c* and later, go to the Oracle Database Documentation page in Oracle Help Center.

b. Select your version of Oracle Database.

c. In the Topics section, select **Security**.

d. In the Centralized User Management section, select *Oracle Database Enterprise User Security Administrator's Guide*.

e. See the chapter Using Oracle Wallet Manager.

For Oracle Database 11*c*, Release 11.2.0.4, see `Using Oracle Wallet Manager` in *Oracle Database Advanced Security Guide*.

3. Locate the connection string for the OML4R database in `tnsnames.ora`. For example:

```
mydb_test =
      (DESCRIPTION =
         (ADDRESS =
            (PROTOCOL = TCP)
            (HOST = myserver)
            (PORT = 1521)
         )
         (CONNECT_DATA = (sid=ORCL))
      )
```

4. Specify the connection information in the wallet. Follow the instructions in the Oracle Database security documentation referenced in Step 2.

5. After you configure the wallet, you can connect to the OML4R server database by simply specifying the connection identifier. For example:

```
ore.connect(conn_string = "mydb_test", all = TRUE)
```

To learn more about `ore.connect`, use the R help command:

```
help(ore.connect)
```

To Configure an Oracle Wallet for Use with External Procedures

1. Create a wallet store.

```
$ mkstore -create -wrl /home/oracle/wallet
```

When prompted to do so, assign a username and password. This example uses the database user OML_USER with the password `apassword` and the PDB ORCL.

2. Assign wallet credentials.

```
$ mkstore -wrl /home/oracle/wallet -createCredential ORCL oml_user
 apassword
```

3. In SQL*Plus, log in as OML_USER using the wallet.

```
$ sqlplus /@ORCL
```

4. Show the user.

```
SQL> show user;
USER is "OML_USER"
```

Example 7-4 Testing the Wallet Connection

This example tests using embedded R execution in the wallet connection in an OML4R session. The example uses the `iris` data set that is in the `datasets` package that is included in an R distribution.

```
ore.doEval(function(){print("TEST")})

TEST_WALLET_DF
 function() {
                return(as.data.frame(length(iris)))
            }

ore.scriptLoad("TEST_WALLET_DF")

ore.doEval(FUN.NAME="TEST_WALLET_DF")
   length(iris)
```

Listing for This Example

```
> ore.doEval(function(){print("TEST")})
[1] "TEST"
>
> TEST_WALLET_DF
  function() {
                return(as.data.frame(length(iris)))
             }
>
> ore.scriptLoad("TEST_WALLET_DF")
>
> ore.doEval(FUN.NAME="TEST_WALLET_DF")
>    length(iris)
1 5
```

> **Note:**
>
> In embedded R execution, an R function that creates a database connection will fail because Oracle Database does not support recursive external procedures. To connect an embedded R execution function to a database, use the `ore.connect` special control argument.

7.8 Control Memory Used by Embedded R

How to control the memory used by embedded R execution.

You can control the memory used by embedded R execution by limiting the heap memory (vector and cons in R terminology) that is automatically managed by the R `gc` mechanism. To limit the size of heap memory in the database, use the `sys.rqconfigset` utility. The keyword arguments for `sys.rqconfigset` are described in the following table.

Table 7-1 SYS.RQCONFIGSET Keyword Arguments

Keyword	Default	Description
MIN_VSIZE	32M	Minimum R vector heap memory
MAX_VSIZE	4G	Maximum R vector heap memory
MIN_NSIZE	1M	Minimum number of R cons cells
MAX_NSIZE	20M	Maximum number of R cons cells

Example 7-5 SQL Commands for Controlling Memory Used by Embedded R

```
-- Set the minimum R vector heap memory to 20M
EXEC sys.rqconfigset('MIN_VSIZE', '20M');

-- Set the maximum R vector heap memory to 100M
EXEC sys.rqconfigset('MAX_VSIZE', '100M')

-- Set the minimum number of R cons cells to 500x1024
EXEC sys.rqconfigset('MIN_NSIZE', '500K');

-- Set the maximum number of R cons cells to 10x10x1024
EXEC sys.rqconfigset('MAX_NSIZE', '10M');

-- Set maximum vector heap memory and maximum cons cells to unlimited
EXEC sys.rqconfigset('MAX_VSIZE', NULL);
EXEC sys.rqconfigset('MAX_NSIZE', NULL);
```

> **Note:**
>
> The `sys.rqconfigset` procedure does not control the C type memory that may be allocated by Calloc, Realloc, calloc, or malloc. Such C type memory is mainly created to hold temporary values used by R functions that are implemented in C. Under normal circumstances, C type memory is limited in size and does not significantly affect the memory usage of R.

The `sys.rqconfigset` procedure edits settings in a configuration table called `sys.rq_config`. You can view the contents of this table to verify various environment settings for OML4R. Among the settings stored in `sys.rq_config` are the memory limits for embedded R. If necessary, you can modify these memory limits, however in most cases you should not modify the values in `sys.rq_config`.

The following query shows sample values stored in `sys.rq_config`.

```
SQL> SELECT * FROM sys.rq_config;

NAME                      VALUE
------------------------- -----------------------------------------------------
R_HOME                    /usr/lib64/R
R_LIBS_USER               /dbhome_1/R/library
VERSION                   2.0
MIN_VSIZE                 32M
MAX_VSIZE                 4G
MIN_NSIZE                 2M
MAX_NSIZE                 20M
```

A

A Sample Installation of Oracle Machine Learning for R

Steps in a typical installation of OML4R Server on a Linux server running Oracle Database 12c, Release 12.1.0.2, and OML4R Client on a Windows system.

> **Note:**
>
> This appendix describes an initial installation of OML4R. If OML4R components already exist on your client or server, refer to Upgrade Oracle Machine Learning for R.

This appendix contains these topics:

- About the Oracle Machine Learning for R Sample Installation Environment
- Install Oracle Machine Learning for R on the Server
  Instructions for installing OML4R on the server.
- Install Oracle Machine Learning for R on the Client
  To install OML4R on the client computer, first verify that the Microsoft Windows environment meets the requirements.
- Verifying the Oracle Machine Learning for R Installation
  To verify that the basic functionality of OML4R is working, establish a connection to an OML4R server and run several basic functions.

A.1 About the Oracle Machine Learning for R Sample Installation Environment

About the server computer:

- The server is running Oracle Linux 6.
- The server has access to the internet and to Oracle public yum.
- Oracle Database Enterprise Edition 12.1.0.2 is installed on the server.
- Environment variables:
  - `$ORACLE_SID` specifies the identifier (SID) of the database.
  - `$ORACLE_HOME` specifies the home directory of the database.
  - `$LD_LIBRARY_PATH` includes `$ORACLE_HOME/lib`.
  - `$PATH` includes `$ORACLE_HOME/bin`.
- The Linux user ID of the installer:
  - Has sudo rights or root access for installing Oracle R Distribution.

  - Is a member of the dba group for installing and using OML4R.
  - Has write access to `$ORACLE_HOME/lib`.

About the client computer:

- The client is running 64-bit Windows.
- The client has access to the internet.

A.2 Install Oracle Machine Learning for R on the Server

Instructions for installing OML4R on the server.

To install OML4R on the server computer, first verify that Oracle Database is installed and that the environment is configured as specified in About the Oracle Machine Learning for R Sample Installation Environment. Next, complete these steps in the specified order:

1. Verify the environment.
2. Install Oracle R Distribution
3. Install Oracle Machine Learning for R Server

These steps are described in the following topics:

- Verify the Environment
  A checklist for the OML4R Server requirements.
- Install Oracle R Distribution
  Example of installing Oracle R Distribution.
- Install Oracle Machine Learning for R Server
  OML4R Server includes the RQSYS schema in Oracle Database and OML4R packages and shared libraries.

A.2.1 Verify the Environment

A checklist for the OML4R Server requirements.

Table A-1 Checklist for Oracle Machine Learning for R Server Requirements

Question	Sample Answer
What is the Linux version?	`% cat /etc/redhat-release` `Enterprise Linux Server release 6.4`
Do you have access to the internet?	Start a browser

Can you log in as root?	`% sudo -su`
	`Password: ---------`
	`#`
	`# exit`
	`%`

Table A-1 (Cont.) Checklist for Oracle Machine Learning for R Server Requirements

Question	Sample Answer

Is Oracle Database installed?	`% SQLPLUS / as sysdba`
	`Copyright (c) 1982, 2017, Oracle. All rights reserved.`
	`Connected to: Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bitProduction`
	`With the Partitioning, OLAP, Advanced Analytics and Real Application Testing options`
	`> exit`
	`%`

What is the value of `$ORACLE_HOME`?	`% echo $ORACLE_HOME` `/myhome/product/12.1.0.2/dbhome_1`
What is the value of `$ORACLE_SID`?	`% echo $ORACLE_SID` `orcl`
Does `$LD_LIBRARY_PATH` include `$ORACLE_HOME/lib`?	`% echo $LD_LIBRARY_PATH` `/myhome/product/12.1.0.2/dbhome_1/lib:....`
Does `$PATH` include `$ORACLE_HOME/bin`?	`% echo $PATH` `/myhome/product/12.1.0.2/dbhome_1/bin:.......`
Are you a member of the dba group?	`% groups` `g102 dba`
Can you write to `$ORACLE_HOME/lib`?	`% ls -ld $ORACLE_HOME/lib` `drwxr-xr-x 3 myuser g102 12288 Jan 27 15:31 /myhome/product/12.1.0.2/dbhome_1/lib/ ...`

A.2.2 Install Oracle R Distribution

Example of installing Oracle R Distribution.

To install Oracle R Distribution on the server from Oracle public yum, follow these steps:

1. Log in as root and change to the `/etc/yum.repos.d` directory:

   ```
   cd /etc/yum.repos.d
   ```

2. List the contents of the directory to determine if the yum configuration file is present. The yum configuration file for Oracle Linux 6 is called `public-yum-el6.repo`.

   If `public-yum-el6.repo` is not present, then run the following command to download it from Oracle public yum:

   ```
   wget https://public-yum.oracle.com/public-yum-el6.repo
   ```

3. Open `public-yum-el6.repo` in a text editor and specify `enabled=1` for `latest` and `addons`:

   ```
   [el6_latest]
   enabled=1
   ```

```
[el6_addons]
enabled=1
```

4. Install Oracle R Distribution 3.3 by executing these commands:

```
yum install R-3.3.0
yum install R-core-extra
```

5. Set `LD_LIBRARY_PATH` to the location of the files installed by the R-core-extra RPM:
6. Exit the root user.

```
exit
```

A.2.3 Install Oracle Machine Learning for R Server

OML4R Server includes the RQSYS schema in Oracle Database and OML4R packages and shared libraries.

To install OML4R Server:

1. Verify the environment according to Table A-1.
2. Create an installation directory for the OML4R Server components. The directory can have any name. For example:

```
/myhome/myomlserver/
```

3. Download the OML4R Server installation files and supporting packages from the Oracle Machine Learning for R Downloads website.
   a. Accept the license agreement and download the OML4R **Server** files for your platform to your installation directory.
   b. Accept the license agreement and download the OML4R **Supporting** packages for your platform to your installation directory.

   The installation directory now contains two zip files.

```
ore-server-linux-x86-64-1.5.1.zip
ore-supporting-linux-x86-64-1.5.1.zip
```

4. Unzip the files.

```
unzip ore-server-linux-x86-64-1.5.1.zip
unzip ore-supporting-linux-x86-64-1.5.1.zip
```

   The installation directory looks like this after you unzip both files:

```
/myhome/myomlserver
     ore-server-linux-x86-64-1.5.1.zip
     ore-supporting-linux-x86-64-1.5.1.zip
     server.sh
     /server
     /supporting
```

5. Run `server.sh` to perform a default installation of OML4R Server as shown in the following example. In this example, the script runs interactively. User input is shown in bold.

> **Note:**
>
> When the script displays `[list]` in a prompt, you can press **Enter** to obtain a list of available items for your choice.

6. On Oracle Linux 6, set `LD_LIBRARY_PATH` to the location of the files installed by the R-core-extra RPM:

```
export LD_LIBRARY_PATH=/usr/lib64/R/port/Linux-X64/lib
```

Example A-1 A Default, First-Time Installation of OML4R Server

```
[oml4rserver_install_dir]$ ./server.sh

Oracle R Enterprise 2.0 Server.

Copyright (c) 2012, 2022 Oracle and/or its affiliates.
All rights reserved.

Checking platform .................. Pass
Checking R ......................... Pass
Checking R libraries ............... Pass
Checking ORACLE_HOME ............... Pass
Checking ORACLE_SID ................ Pass
Checking sqlplus ................... Pass
Checking ORACLE instance ........... Pass
Checking CDB/PDB ................... Pass
Checking ORE ....................... Pass

Choosing RQSYS tablespaces
PERMANENT tablespace to use for RQSYS [list]:
SYSAUX
SYSEXT
SYSTEM
PERMANENT tablespace to use for RQSYS [list]: SYSAUX
TEMPORARY tablespace to use for RQSYS [list]:
TEMP
TEMPORARY tablespace to use for RQSYS [list]: TEMP

Current configuration
R Version ......................... Oracle Distribution of R version 4.0.5 (--)
R_HOME ............................ /usr/lib64/R
R_LIBS_USER ....................... /product/19.1.0/dbhome_1/R/library
ORACLE_HOME ...................../product/19.1.0/dbhome_1
ORACLE_SID ........................ x19

 Existing R Version ............... None
 Existing R_HOME .................. None
 Existing ORE data ................ None
 Existing ORE code ................ None
 Existing ORE libraries ........... None

 RQSYS PERMANENT tablespace ..... SYSAUX
 RQSYS TEMPORARY tablespace ..... TEMP

 Operation ........................ Install/Upgrade

Proceed? [yes] y
```

```
Removing R libraries ............... Pass
Installing R libraries ............. Pass
Installing ORE libraries ........... Pass
Installing RQSYS data .............. Pass
Configuring ORE .................... Pass
Installing RQSYS code .............. Pass
Installing ORE packages ............ Pass
Creating ORE script ................ Pass
Installing supporting packages ..... Pass

Done
```

A.3 Install Oracle Machine Learning for R on the Client

To install OML4R on the client computer, first verify that the Microsoft Windows environment meets the requirements.

The requirements are specified in About the Oracle Machine Learning for R Sample Installation Environment.

Next, complete these steps:

1. Install Oracle R Distribution on the Windows client
2. Install Oracle Instant Client
3. Install the OML4R packages
4. Install the OML4R supporting packages

These steps are described in the following topics:

- Install Oracle R Distribution on the Windows Client
  Before installing Oracle R Distribution, verify that your version of Microsoft Windows is supported by Oracle Machine Learning for R and that you have access to the internet.
- Install Oracle Instant Client
  Oracle Machine Learning for R requires Oracle Database Client.
- Install the Oracle Machine Learning for R Packages
  Example of installing the Oracle Machine Learning for R packages.
- Install the Oracle Machine Learning for R Supporting Packages
  Example of installing the OML4R supporting packages.

A.3.1 Install Oracle R Distribution on the Windows Client

Before installing Oracle R Distribution, verify that your version of Microsoft Windows is supported by Oracle Machine Learning for R and that you have access to the internet.

To install Oracle R Distribution on Windows:

1. Go to the Oracle R Distribution downloads page.
2. Under **R 3.3.0 Downloads**, select **R Distribution** for **Windows 64 bit**. Save the file on your computer.

   ```
   ORD-3.3.0-win.zip
   ```

3. When you unzip the file, the executable file is extracted.

   ```
   ORD-3.3.0-win.exe
   ```

4. Double-click the executable file to start the installation of Oracle R Distribution.

5. Follow the instructions to complete the installation.

A.3.2 Install Oracle Instant Client

Oracle Machine Learning for R requires Oracle Database Client.

Instead of installing the full Database Client, which must be installed in an Oracle home directory, you can install Oracle Instant Client.

To download and install Oracle Instant Client:

1. Create an installation directory for the OML4R client components. The directory can have any name. For example:

   ```
   c:\myoml4rclient
   ```

2. Navigate to the Oracle Database Instant Client website.
3. Click the **Download Now** button.
4. On the Oracle Instant Client Downloads page, select **Instant Client for Microsoft Windows (x64)**.
5. Under **Version 12.1.0.2.0**, select **Instant Client Package - Basic** for Oracle Database 12.1.
6. Save the file in the installation directory that you created in Step 1. For example, if you choose the basic package, the following file is downloaded:

   ```
   c:\myoml4rclient\instantclient-basic-windows.x64-12.1.0.2.0.zip
   ```

7. Unzip the file.

   When you unzip the file, the `instantclient_12_1` subdirectory is created. The contents of the installation directory are shown as follows:

   ```
   myoml4rclient
     instantclient_12_1
       vc10
       vc11
       vc12
   ```

8. Return to the Instant Client Downloads for Microsoft Windows (x64) page.
9. Accept the license agreement and select **Instant Client Package - SDK**. Save the file in the directory that you created in Step 1.

   ```
   c:\myoml4rclient\instantclient-sdk-windows.x64-12.1.0.2.0.zip
   ```

10. Unzip the file.

    When you unzip the file, the `sdk` subdirectory is created. The contents of the installation directory are shown as follows:

    ```
    myoml4rclient
      instantclient_12_1
        help
        sdk
        vc10
        vc11
        vc12
    ```

11. Add the full path of the Instant Client to the environment variables `OCI_LIB64` and `PATH`. The following steps set the variables to the path used in this example, `c:\myoml4rclient\instantclient_12_1`:

a. In Windows Control Panel, choose **System**.

b. Click **Advanced systems settings**.

c. On the **Advanced** tab, click **Environment Variables**.

d. Under **System variables**, create `OCI_LIB64` if it does not already exist. Set the value of `OCI_LIB64` to `c:\oml4rclient\instantclient_12_1`.

e. Under **System variables**, edit `PATH` to include `c:\myoml4rclient\instantclient_12_1`.

> **Note:**
>
> The graphical user interface for creating environment variables may vary slightly, depending on your version of Windows.
>
> To be able to load the ROracle package, you must first add the full path of the Oracle Instant Client to the PATH and the OCI_LIB64 environment variables. For troubleshooting tips, refer to the Troubleshooting section in the ROracle INSTALL file on CRAN at ROracle INSTALL.

A.3.3 Install the Oracle Machine Learning for R Packages

Example of installing the Oracle Machine Learning for R packages.

Follow these steps to download and install the OML4R packages:

To download the OML4R packages:

1. Go to the Oracle Machine Learning for R Downloads website.
2. Accept the License Agreement.
3. Select the **Client** packages for Windows. Save the file in the installation directory that you created in Install Oracle Instant Client.

   ```
   c:\myoml4rclient\ore-client-win-x86_64-1.5.1.zip
   ```

4. Unzip the file.

   When you unzip the file, the `client` subdirectory is created. The contents of the installation directory are shown as follows:

   ```
   ORE_1.5.1.zip
   OREbase_1.5.1.zip
   OREcommon_1.5.1.zip
   OREdm_1.5.1.zip
   OREdplyr_1.5.1.zip
   OREeda_1.5.1.zip
   OREembed_1.5.1.zip
   OREgraphics_1.5.1.zip
   OREmodels_1.5.1.zip
   OREpredict_1.5.1.zip
   OREstats_1.5.1.zip
   ORExml_1.5.1.zip
   ```

To install the OML4R packages from the R Console:

1. Start R from the Windows Start menu. If you have installed both 32 and 64-bit R, be sure to choose 64-bit R.

2. In the R Console window, install the packages as follows:

```
install.packages("c:/myoml4rclient/client/ORE_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREbase_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREcommon_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREdm_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREdplyr_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREeda_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREembed_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREgraphics_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREmodels_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREpredict_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/OREstats_1.5.1.zip", repos=NULL)
install.packages("c:/myoml4rclient/client/ORExml_1.5.1.zip", repos=NULL)
```

Each successful package installation produces this message in the R console:

```
package 'package_name' successfully unpacked and MD5 sums checked
```

A.3.4 Install the Oracle Machine Learning for R Supporting Packages

Example of installing the OML4R supporting packages.

Follow these steps to download and install the OML4R supporting packages:

To download the OML4R supporting packages:

1. Go to the Oracle Machine Learning for R Downloads website.
2. Accept the License Agreement and select the **Supporting** packages for Windows. Save the file in the installation directory that you created in Install Oracle Instant Client.

   ```
   c:\myoml4rclient\ore-supporting-win-x86_64-1.5.1.zip
   ```

3. Unzip the file.

   When you unzip the file, the `supporting` subdirectory is created. The contents of the installation directory are shown as follows:

   ```
   arules_1.1-9.zip
   Cairo_1.5-8.zip
   DBI_0.5.zip
   png_0.1-7.zip
   randomForest_4.6-10.zip
   ROracle_1.3-1.zip
   statmod_1.4.21.zip
   ```

To install the supporting packages from the R Console:

1. Start R from the Windows Start menu. If you have installed both 32 and 64-bit R, be sure to choose 64-bit R.

   The R Console window is displayed.

2. Install the packages as follows:

   ```
   install.packages("c:/myoml4rclient/supporting/ROracle_1.3-1.zip", repos=NULL)
   install.packages("c:/myoml4rclient/supporting/DBI_0.5.zip", repos=NULL)
   install.packages("c:/myoml4rclient/supporting/png_0.1-7.zip", repos=NULL)
   install.packages("c:/myoml4rclient/supporting/Cairo_1.5-8.zip", repos=NULL)
   install.packages("c:/myoml4rclient/supporting/arules_1.1-9.zip", repos=NULL)
   install.packages("c:/myoml4rclient/supporting/randomForest_4.6-10.zip", repos=NULL)
   install.packages("c:/myoml4rclient/supporting/statmod_1.4.21.zip", repos=NULL)
   ```

Each successful package installation produces this message in the R console:

```
package 'package_name' successfully unpacked and MD5 sums checked
```

A.4 Verifying the Oracle Machine Learning for R Installation

To verify that the basic functionality of OML4R is working, establish a connection to an OML4R server and run several basic functions.

> **Note:**
>
> To start and use OML4R, your database user must have the privileges required for OML4R installation. See User Requirements for details.

Example A-2 Connecting to an OML4R Server

To connect the an OML4R client to an OML4R server:

1. Type this command to start OML4R:

```
$ ORE
R> library(ORE)
```

2. Type this command to connect to the OML4R server. The following example connects user `OML_USER` to the database `orcl` on the server host `serv1` using port 1521:

```
>  ore.connect(user="OML_USER", sid="orcl", host="serv1", password="OML_USERpsw",
               port=1521, all=TRUE)
Loading required package: ROracle
Loading required package: DBI
```

3. Run `ore.is.connected` to validate the connection. If the connection is successful, the function returns `TRUE`:

```
> ore.is.connected()
[1] TRUE
```

Example A-3 Listing the Database Tables Accessible in a Schema

The `ore.ls` function lists the `ore.frame` proxy objects that correspond to database tables in the environment for a schema. In the following example, `TABLE1` and `TABLE2` exist in the current schema:

```
> ore.ls()
[1] "TABLE1" "TABLE2"
```

Example A-4 Pushing an R Data Frame to the Database

The `ore.push` function pushes a local R object into an OML4R object of the appropriate data type in the database. The following example creates an R `data.frame` and pushes it an `ore.frame` object in the database.

```
df <- data.frame(a="abc",
                 b=1.456,
                 c=TRUE,
                 d=as.integer(1))
of <- ore.push(df)
```

Example A-5 Running an Embedded R Function

The `ore.doEval` function runs the specified function in an R engine on the database server and returns the results. This example declares a function in the `ore.doEval` invocation.

```
> ore.doEval(function() { 123 })
[1] 123
```

B

R Package Installation Tips

This appendix introduces some of the mechanics involved in working with R packages. If you are tasked with installing, uninstalling, or upgrading Oracle Machine Learning for R but you do not have extensive experience working with R packages, then you may find the information in this appendix helpful.

This appendix contains these topics:

- R Package Installation Basics
  You can install R packages from the R command line or from your system's command line.
- Set the R Repository
  Instructions for setting the R repository.
- About R Package Installation for Oracle Machine Learning for R
  Embedded R execution with OML4R allows the use of CRAN or other third-party R packages in user-defined R functions ran on the Oracle Database server.
- About CRAN Task Views
  CRAN maintains a set of Task Views that identify packages associated with a particular task or methodology.

B.1 R Package Installation Basics

You can install R packages from the R command line or from your system's command line.

R package installation basics are outlined in Chapter 6 of the *R Installation and Administration Guide*. The following example installs a package on Oracle Linux using Oracle R Distribution. It installs the `arules` package as root so that packages are installed in the default R system-wide location where all users can access it, `/usr/lib64/R/library`.

Within R, using the `install.packages` function always attempts to install the latest version of the requested package available on CRAN:

```
R> install.packages("arules")
```

If the `arules` package depends upon other packages that are not already installed locally, the R installer automatically downloads and installs those required packages. This is a huge benefit that frees users from the task of identifying and resolving those dependencies.

You can also install R from the shell command line. This is useful for some packages when an internet connection is not available or for installing packages not uploaded to CRAN. To install packages this way, first locate the package on CRAN and then download the package source to your local machine. For example:

```
$ wget https://cran.r-project.org/src/contrib/arules_1.1-9.tar.gz
```

Then, install the package using the command `R CMD INSTALL`:

```
$ R CMD INSTALL arules_1.1-9.tar.gz
```

A major difference between installing R packages using the R package installer at the R command line and shell command line is that package dependencies must be resolved

manually at the shell command line. Package dependencies are listed in the Depends section of the package's CRAN site. If dependencies are not identified and installed prior to the package's installation, you will see an error similar to:

```
ERROR: dependency 'xxx' is not available for package 'yyy'
```

As a best practice and to save time, always refer to the package's CRAN site to understand the package dependencies prior to attempting an installation.

If you don't run R as root, you won't have permission to write packages into the default system-wide location and you will be prompted to create a personal library accessible by your userid. You can accept the personal library path chosen by R, or specify the library location by passing parameters to the `install.packages` function. For example, to create an R package repository in your home directory:

```
R> install.packages("arules", lib="/home/username/Rpackages")
```

or

```
$ R CMD INSTALL arules_1.1-9.tar.gz --library=/home/username/Rpackages
```

Refer to the `install.packages` help file in R or run `R CMD INSTALL --help` at the shell command line for a full list of command line options.

To set the library location and avoid having to specify this at every package install, simply create the R startup environment file `.Renviron` in your home area if it does not already exist, and add the following piece of code to it:

```
R_LIBS_USER = "/home/username/Rpackages"
```

B.2 Set the R Repository

Instructions for setting the R repository.

Each time you install an R package from the R command line, you are asked which CRAN mirror, or server, R should use. To set the repository and avoid having to specify this during every package installation, create the R startup command file `.Rprofile` in your home directory and specify the CRAN mirror to use. The following code sets the R package repository to the Seattle CRAN mirror at the start of each R session.

```
cat("Setting Seattle repository")
r = getOption("repos")
r["CRAN"] = "http://cran.fhcrc.org/"
options(repos = r)
rm(r)
```

B.3 About R Package Installation for Oracle Machine Learning for R

Embedded R execution with OML4R allows the use of CRAN or other third-party R packages in user-defined R functions ran on the Oracle Database server.

The steps for installing and configuring packages for use with OML4R are the same as for open source R. The database-side R engine just needs to know where to find the R packages.

The OML4R installation is performed by the user oracle, which typically does not have write permission to the default site-wide library, `/usr/lib64/R/library`. On Linux and UNIX platforms, the OML4R Server installation provides the `ORE` script ran from the operating system shell to install R packages and to start R. The `ORE` script is a wrapper for the default R script, a shell wrapper for the R executable. It can be used to start R, run batch scripts, and build or install R packages. Unlike the default R script, the `ORE` script installs packages to a location writable by the oracle user and accessible by all OML4R users: `$ORACLE_HOME/R/library`.

To install a package on the database server so that any R user can use it and for use in embedded R execution, an Oracle DBA would typically download the package source from CRAN using `wget`. If the package depends on any packages that are not in the R distribution in use, download the sources for those packages, also.

For a single Oracle Database instance, replace the R script with `ORE` to install the packages in the same location as the OML4R packages.

```
$ wget https://cran.r-project.org/src/contrib/arules_1.1-9.tar.gz
$ ORE CMD INSTALL arules_1.1-9.tar.gz
```

Behind the scenes, the `ORE` script performs the equivalent of setting `R_LIBS_USER` to the value of `$ORACLE_HOME/R/library`, and all R packages installed with the `ORE` script are installed to this location. For installing a package on multiple database servers, such as those in an Oracle Real Application Clusters (Oracle RAC) or a multinode Oracle Exadata Database Machine environment, use the `ORE` script in conjunction with the Exadata Distributed Command Line Interface (DCLI) utility.

```
$ dcli -g nodes -l oracle ORE CMD INSTALL arules_1.1-9.tar.gz
```

The DCLI -g flag designates a file containing a list of nodes to install on, and the -l flag specifies the user id to use when executing the commands.

If you are using an OML4R client, install the package in the same way as any R package, bearing in mind that you must install the same version of the package on both the client and server machines to avoid incompatibilities.

B.4 About CRAN Task Views

CRAN maintains a set of Task Views that identify packages associated with a particular task or methodology.

Task Views are helpful in guiding users through the huge set of available R packages. They are actively maintained by volunteers who include detailed annotations for routines and packages. If you find one of the task views is a perfect match, then you can install every package in that view using the `ctv` package, which automates package installation.

Install the ctv Package and Task Views

To use the `ctv` package to install a task view, first, install and load the `ctv` package.

```
R> install.packages("ctv")
R> library(ctv)
```

Then query the names of the available task views and install the view you choose.

```
R> available.views()
R> install.views("TimeSeries")
```

Use and Manage Packages

To use a package, start R and load packages one at a time with the `library` command.

Load the `arules` package in your R session.

```
R> library(arules)
```

Verify the version of `arules` installed.

```
R> packageVersion("arules")
[1] '1.1.9'
```

Verify the version of `arules` installed on the database server using embedded R execution.

```
R> ore.doEval(function() packageVersion("arules"))
```

View the help file for the `apropos` function in the `arules` package.

```
R> ?apropos
```

Over time, your package repository will contain more and more packages, especially if you are using the system-wide repository in which others are also adding packages. It's good to know the entire set of R packages accessible in your environment. To list all available packages in your local R session, use the `installed.packages` command:

```
R> myLocalPackages <- row.names(installed.packages())
R> myLocalPackages
```

C

Installing RStudio

This appendix provides tips for installing RStudio Server for use with Oracle Machine Learning for R on Linux. This appendix includes these topics:

- About RStudio
  Describes RStudio.
- Install RStudio Server
  RStudio Server is a Linux application that provides a web-based interface to R on a server.
- Install RStudio Desktop
  RStudio Desktop is an IDE for standalone machines.

C.1 About RStudio

Describes RStudio.

RStudio is a free, open source Integrated Development Environment (IDE) for R. RStudio is available under GNU Affero General Public License (AGPL). You can use RStudio with Oracle Machine Learning for R, however RStudio is not included with OML4R. If you want to use RStudio, you must install and license it separately.

> **See Also:**
>
> - GNU Affero General Public License for details about AGPL
> - RStudio for details about RStudio

C.2 Install RStudio Server

RStudio Server is a Linux application that provides a web-based interface to R on a server.

To install RStudio Server for use with Oracle Machine Learning for R:

1. Go to the RStudio website and navigate to the RStudio Server Download page. Download the server to your Linux system and follow the installation instructions.
2. Create the file `/etc/rstudio/rserver.conf`. Add the values of `R_HOME` and `ORACLE_HOME`.

   ```
   sudo vi /etc/rstudio/rserver.conf
       rsession-ld-library-path=R_HOME/lib:ORACLE_HOME/lib
   ```

   Note: The default value of `R_HOME` on Linux is `/usr/lib64/R`.

3. Create the configuration file `/usr/lib64/R/etc/Renviron.site`. Supply the values of `ORACLE_HOME`, `ORACLE_HOSTNAME`, and `ORACLE_SID`. For example, using the BASH shell:

```
cd /usr/lib64/R/etc
sudo vi Renviron.site
    ORACLE_HOME=ORACLE_HOME
    ORACLE_HOSTNAME=ORACLE_HOSTNAME
    ORACLE_SID=ORACLE_SID
```

4. Restart the RStudio Server service as sudo or root:

```
sudo rstudio-server restart
```

Refer to the instructions for configuring the server. Return to the RStudio Server Download page, then navigate to the Configuring the Server article in the RStudio documentation.

C.3 Install RStudio Desktop

RStudio Desktop is an IDE for standalone machines.

To install RStudio Desktop:

1. Install R.
2. Go to the RStudio website, navigate to the RStudio Desktop Download page, and download RStudio Desktop.
3. Run the installer and follow the prompts.
4. Click the desktop icon to initialize RStudio.

D

Oracle R Distribution Packages

The table in this section lists the packages in Oracle R Distribution that are used by Oracle Machine Learning for R.

> **See Also:**
>
> - Table 6-1 for a list of the packages in Oracle Machine Learning for R
> - Table 6-2 for a list of the open source packages that ship with Oracle Machine Learning for R

Table D-1 Oracle R Distribution Packages Used by Oracle Machine Learning for R

Package Name	Package Description
`base`	The R Base Package
`boot`	Bootstrap Functions (originally by Angelo Canty for S)
`class`	Functions for Classification
`cluster`	Cluster Analysis Extended Rousseeuw et al
`codetools`	Code Analysis Tools for R
`compiler`	The R Compiler Package
`datasets`	The R Datasets Package
`foreign`	Read Data Stored by Minitab, S, SAS, SPSS, Stata, Systat, dBase
`graphics`	The R Graphics Package
`grDevices`	The R Graphics Devices and Support for Colours and Fonts
`grid`	The Grid Graphics Package
`KernSmooth`	Functions for kernel smoothing for Wand & Jones (1995)
`lattice`	Lattice Graphics
`MASS`	Support Functions and Datasets for Venables and Ripley's MASS
`Matrix`	Sparse and Dense Matrix Classes and Methods
`methods`	Formal Methods and Classes
`mgcv`	GAMs with GCV/AIC/REML smoothness estimation and GAMMs by PQL
`nlme`	Linear and Nonlinear Mixed Effects Models
`nnet`	Feed-forward Neural Networks and Multinomial Log-Linear Models
`parallel`	Support for parallel computation, including random-number generation
`rpart`	Recursive Partitioning
`spatial`	Functions for Kriging and Point Pattern Analysis
`splines`	Regression Spline Functions and Classes

Table D-1 (Cont.) Oracle R Distribution Packages Used by Oracle Machine Learning for R

Package Name	Package Description
stats	The R Stats Package
stats4	Statistical Functions using S4 Classes
survival	Survival analysis, including penalised likelihood.
tcltk	Tcl/Tk Interface
tools	Tools for Package Development
translation	Bindings for the Google Translate API v2
utils	The R Utils Package

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