Focused Run for SAP Solution Manager 2.0
## Typographic Conventions

<table>
<thead>
<tr>
<th>Type Style</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><em>Example</em></td>
<td>Words or characters quoted from the screen. These include field names, screen titles, pushbuttons labels, menu names, menu paths, and menu options. Textual cross-references to other documents.</td>
</tr>
<tr>
<td><em>Example</em></td>
<td>Emphasized words or expressions.</td>
</tr>
<tr>
<td><strong>EXAMPLE</strong></td>
<td>Technical names of system objects. These include report names, program names, transaction codes, table names, and key concepts of a programming language when they are surrounded by body text, for example, SELECT and INCLUDE.</td>
</tr>
<tr>
<td><em>Example</em></td>
<td>Output on the screen. This includes file and directory names and their paths, messages, names of variables and parameters, source text, and names of installation, upgrade and database tools.</td>
</tr>
<tr>
<td><em>Example</em></td>
<td>Exact user entry. These are words or characters that you enter in the system exactly as they appear in the documentation.</td>
</tr>
<tr>
<td><code>&lt;Example&gt;</code></td>
<td>Variable user entry. Angle brackets indicate that you replace these words and characters with appropriate entries to make entries in the system.</td>
</tr>
<tr>
<td><strong>EXAMPLE</strong></td>
<td>Keys on the keyboard, for example, <em>F2</em> or <em>ENTER</em>.</td>
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## Document History

**Caution**

Before you start the implementation, make sure that you have the latest version of this document that is available at [https://help.sap.com/viewer/p/FOCUSED RUN](https://help.sap.com/viewer/p/FOCUSED RUN).

<table>
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<th>Date</th>
<th>Change</th>
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<tr>
<td>1.0</td>
<td>2018-07-23</td>
<td>Initial version. This document is prepared with R 3.5.1 and SAP HANA 1.0 SP12</td>
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</table>
| 1.1     | 2018-12-12 | Changes:  
1. The installation of keras library is moved to “3. Configuration in R host” section after creating the ruser (from section 2.3 to section 3.2) |
| 1.2     | 2019-03-12 | Changes:  
1. Moved Install Rserve from section 1.2.4 to 2.2  
2. Improved sections 5.1 “Grant Privilege” and 5.3 “Maintain Rserve Credentials” |
| 1.3     | 2019-07-18 | Changes:  
1. Added information about support of custom models in Section 1: Introduction  
2. Tested Platforms is added in Section  
3. Improved section 4. Install keras |
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Introduction

The HANA R Integration guide for System Anomaly Prediction of Focused Run for SAP Solution Manager (also referenced in this guide as Focused Run and FOCUSED RUN) is designed to provide the steps that needs to be completed and considered. This guide focuses on the setup in SLES 12 SP03 only.

The R and Rserve environments should be installed on a separate host. You cannot install R on the SAP HANA host. This guide assumes an R installation on a Linux system, preferably SLES Linux. The R/Rserve host has to be reachable from the SAP HANA host. For high availability, it is possible to install R/Rserve on multiple distinct hosts. When one of them becomes unreachable, another host can take over.


**Note:** You need to select your SAP HANA release, in the top right corner of the help portal page.

The installation is described in chapter “Install R” the installation of R by a local compilation (“make”). It is required to have a Linux Developer PC or maintain a compilation environment for your platform. For your convenience, we describe the installation of R, keras, and Rserve below with pre-compiled packages. This is only tested with Focused Run System Anomaly Prediction. Please be cautious to apply the same for other applications and in case of doubt ask the application support (SV-FRN-APP-SYM).

The minimum required version for System Anomaly Prediction in Focused Run is R >= 3.5. Additionally, you need to install Rserve package and the Open Source Keras package. The setup is tested only on x86 64-bit architecture hardware machines only.

Kindly note that functionally it is not possible to create own custom models or have a learning infrastructure with Focused Run. It is however possible to add custom models to System Anomaly Prediction starting Focused Run 2.0 SP00. The guide to achieve this is available in the Focused Run Expert Portal.
1. Pre-requisites

1.1 Check the packages

Please know that package from openSUSE are not part of the standard SuSe SLES support. You need to have SUSE SLES software repositories registered. (home of SuSe https://www.suse.com)

Make sure that the host have secure connectivity to the internet (maintain proxy configuration)

Make sure the following Linux packages are installed. Use the newest packages available for your Linux version with `zypper install` or `zypper update` commands.

- xorg-x11-devel
- gcc-fortran
- readline-devel (install only if you want to use R as a standalone application)
- libgfortran46 (install only if you use SLES 11 SP2)
- gcc-c++

1.2 Install python, pip and virtualenv

You need python, pip and virtualenv to install the keras library.

1.2.1 Install python

Check if python is installed by checking for the python version before proceeding.
Use `python --version` to check python version.

Note: pip is already installed, if you are using Python 2 >=2.7.9 or Python 3 >=3.4. Use command “pip” to verify if pip is already installed.

1.2.2 Install pip

Type the below commands in the shell (in order).

`curl https://bootstrap.pypa.io/get-pip.py -o get-pip.py`
`python get-pip.py`
1.2.3 virtualenv

Install virtual environment using pip

> pip install virtualenv
2 Install R

You need to execute the below commands to install R and keras package in R. The minimum required version for System Anomaly Prediction in Focused Run is R > 3.5

2.1 Add R-base repository and install R

This step is to add R-base repository of SUSE Linux 12 for installation.
> zypper addrepo -f http://download.opensuse.org/repositories/devel\:/languages\:/R\:/patched/SLE_12/ R-base

This step is to install R-base after the repository is added.
> zypper install R-base

Note:
After installation, type R in the shell to start or get into the R console and check if R is installed and check the version of R.
> R

2.2 Install Rserve

In the R console, type the below to install Rserve.
> install.packages("Rserve")

Note: Wait for some time to select the mirror. enter the mirror number. Mirror number that is input should be closest to the server.

In the R console, type the below command to check the installation. if the command returns empty, then the library is installed.
> library("Rserve")

Note: To quit the R console, type >q()
3 Configuration in R host

3.1 Create a non-privileged user

You need to create a non-privileged user (eg: ruser) with a home directory.

Type the below commands to create the user.

> useradd ruser
> passwd ruser. Enter the password for ruser

Type the below commands to create the home directory.

> mkdir /home/ruser
> chown ruser:users /home/ruser

3.2 Maintain password file for Rserve

As root user, the file /home/ruser/passwordfile needs to be created and should contain the user and password to access the Rserve.

Eg: myRserveUserName myRservePW
You can choose any user name and password. This will be later used in HANA system for connecting to Rserve.

Change the owner and access permissions of password file to be readable only by ruser.

> chown ruser:users /home/ruser/passwordfile
> chmod 600 /home/ruser/passwordfile

3.3 Rserv.conf file

As root user, create the file /etc/Rserv.conf with the following content;

maxinbuf 4194304
maxsendbuf 0
remote enable
auth required
plaintext disable
pwdfile /home/ruser/passwordfile

Note: We recommend that you set the value of maxinbuf to (physical memory size, in bytes) / 2048. For example, if you installed R on a host with 8 GB of physical memory you should set maxinbuf to 4194304.

Change the access permissions of RServ.conf to be readable for the ruser.
>chmod o+r /etc/Rserv.conf

### 3.4 Create a crontab entry

The port for starting Rserve has to be chosen according to the cer_rserve_port value in the indexserver.ini file. `<PORT>` is the port number (e.g., 30120). The --no-save option makes sure that the invoked R runtimes do not store the R environment onto the file system after the R execution has been stopped. This is important to avoid the file system to be filled over time due to multiple R runs.

As root user, the file /home/ruser/crontab needs to be created to make sure that the Rserve process is running continuously.
Eg: `* * * * * ruser pgrep -u ruser -f "Rserve --RS-port 30120 --no-save --RS-encoding utf8" || R CMD Rserve --RS-port 30120 --no-save --RS-encoding utf8`

Change the owner and access permissions of password file to be readable only by ruser.
>chown ruser:users /home/ruser/crontab

As root user, you need to execute the following command to get the Rserve process automatically started, if it is not running. If the process is unexpectedly stopped, it will be restarted automatically after a maximum of one minute.
>crontab -u ruser /home/ruser/crontab

Verify whether the Rserve process is running through the following commands;
>ps -ef | grep -v grep | grep Rserve
>netstat -ap | grep Rserve

Note: It may take up to one minute to start the process after making the crontab entry.
3.5 Set Up SSL/TLS from SAP HANA to Rserve

You need to refer the SAP HANA R integration guide to setup SSL/TLS from SAP HANA to Rserve.
4 Install keras

Login as non-privileged user (ruser) and install keras. In the R console (type command R to enter the R console), type the below commands (in order) to install keras and the dependent libraries.

```r
> install.packages("reticulate")
> install.packages("tensorflow")
> install.packages("tfruns")
> install.packages("magrittr")
> install.packages("zeallot")
> install.packages("R6")
> packageurl<-"https://cran.r-project.org/src/contrib/Archive/keras/keras_2.1.6.tar.gz"
> install.packages(packageurl, repos=NULL, type="source")
> library(keras)
> install_keras(tensorflow = "1.5")
```

Troubleshooting:
If your host CPU does not support AVX instructions, then you might have to install tensorflow from source or download community supported wheel for your platform and install it using pip in the r-tensorflow environment created by install_keras()

Quit the R prompt and run the below commands:

1. You can switch to r-tensorflow environment by using this command
   ```bash
   source /home/ruser/.virtualenvs/r-tensorflow/bin/activate
   ```
2. You can install tensorflow from a community supported wheel using this command. If this is not possible, build tensor flow from the source (https://www.tensorflow.org/install/source)
   ```bash
   pip install <path/to/tensorflowwheel>
   ```

Note:
1. Refer documentation https://keras.rstudio.com/
2. If you are prompted to create a new folder for R library for ruser, say “Yes”
3. There is no tensorflow distribution available for PowerPC architecture. You might have to build tensorflow from source (not tested by SAP).
5 Configuration in SAP HANA

5.1 Grant Privilege

To grant the privilege, a user who already has this privilege (such as the SYSTEM user), along with ability to grant it to others, can execute the following SQL command:

```
GRANT CREATE R SCRIPT TO <user>
```

The <user> you want to grant permission should be owner of the ABAP Database schema which is by default SAP<SID> where SID is the System ID of the Focused Run system.

Note: The SAP HANA schema user by default is SAP<SID>. Log in to Focused Run ABAP system and check the name of the SAP HANA schema user in System -> Status.

5.2 Maintain configuration parameters for Rserve

Follow the below steps to add configuration parameters in SAP HANA server.

1. Open the indexserver.ini or xsengine.ini file either in the SAP HANA cockpit or SAP HANA studio.
2. If the calcEngine section is missing, add it.
3. Add the following parameters as required.

   Parameter: cer_rserve_addresses
   Value: <Rserve host name>:<Rserve port. eg: 30120>:crypted
   Description: List of locations where Rserve is running. Each location is specified in the following format: host1:port1,host2:port2, where the host is given by its IPv4 address. Use multiple hosts to implement high availability.
   Note: In the connection string (cer_rserve_addresses parameter), add the authentication mode, either “plain” or “encrypted”, If no authentication mode is specified, no authentication is required.

   Parameter: cer_timeout
   Value: 300
   Description: Connection timeout in seconds. This parameter defines the maximum runtime allowed for the execution of a single R procedure. If you expect your R processing to run longer than 5 minutes, modify this parameter; otherwise R processing may be stopped before completion.

   Parameter: cer_rserve_maxsendsize
   Value: 0 (that is, no limit)
Description: Maximum size of a result transferred from R to SAP HANA, in kilobytes. If the result exceeds the limit, the transfer is aborted with an error.

Note: Rserve host should be reachable from the Focused Run HANA host/s.

5.3 Maintain Rserve credentials

Store the user name and password for connecting to Rserve in the SAP HANA secure internal credential store, by executing the following SQL as a user with the system privilege CREDENTIAL ADMIN:

```
CREATE CREDENTIAL FOR COMPONENT 'RINTEGRATION' PURPOSE '<host:port>:crypted' TYPE 'PASSWORD' USING '<user>:<password>'
```

Note: Replace <user> and <password> with the user name and password of the user who is connecting to the Rserve. Refer section 3.2 Maintain password file for Rserve for the details.

5.4 Validation

Use the sample code below to validate the connection between SAP HANA and R. You can execute the below with the SAP<SID> user or SYSTEM or user in SAP HANA studio.

```
-- clean up
DROP PROCEDURE "PASSAMPLE_R_CLUSTER";
DROP TYPE "PASSAMPLE_RESULTS";
DROP TABLE "PASSAMPLE_OUTPUT";

-- create tables
CREATE TYPE "PASSAMPLE_RESULTS" AS TABLE ("PASSAMPLE_NO" INTEGER);
CREATE COLUMN TABLE "PASSAMPLE_OUTPUT" LIKE "PASSAMPLE_RESULTS";

-- create stored procedure with R script
CREATE PROCEDURE "PASSAMPLE_R_CLUSTER" (OUT results "PASSAMPLE_RESULTS") LANGUAGE RLANG AS BEGIN
  library(keras)
  PASSAMPLE_NO <- c(1,2,3)
  results <- data.frame(PASSAMPLE_NO)
END;

CALL "PASSAMPLE_R_CLUSTER" ("PASSAMPLE_OUTPUT") WITH OVERVIEW;
```
SELECT * FROM "PASSAMPLE_OUTPUT";

You should expect the results table with 3 rows here as output here.