RHive : Integrating R and Hive

Introduction

JunHo Cho

Data Analysis Platform Team

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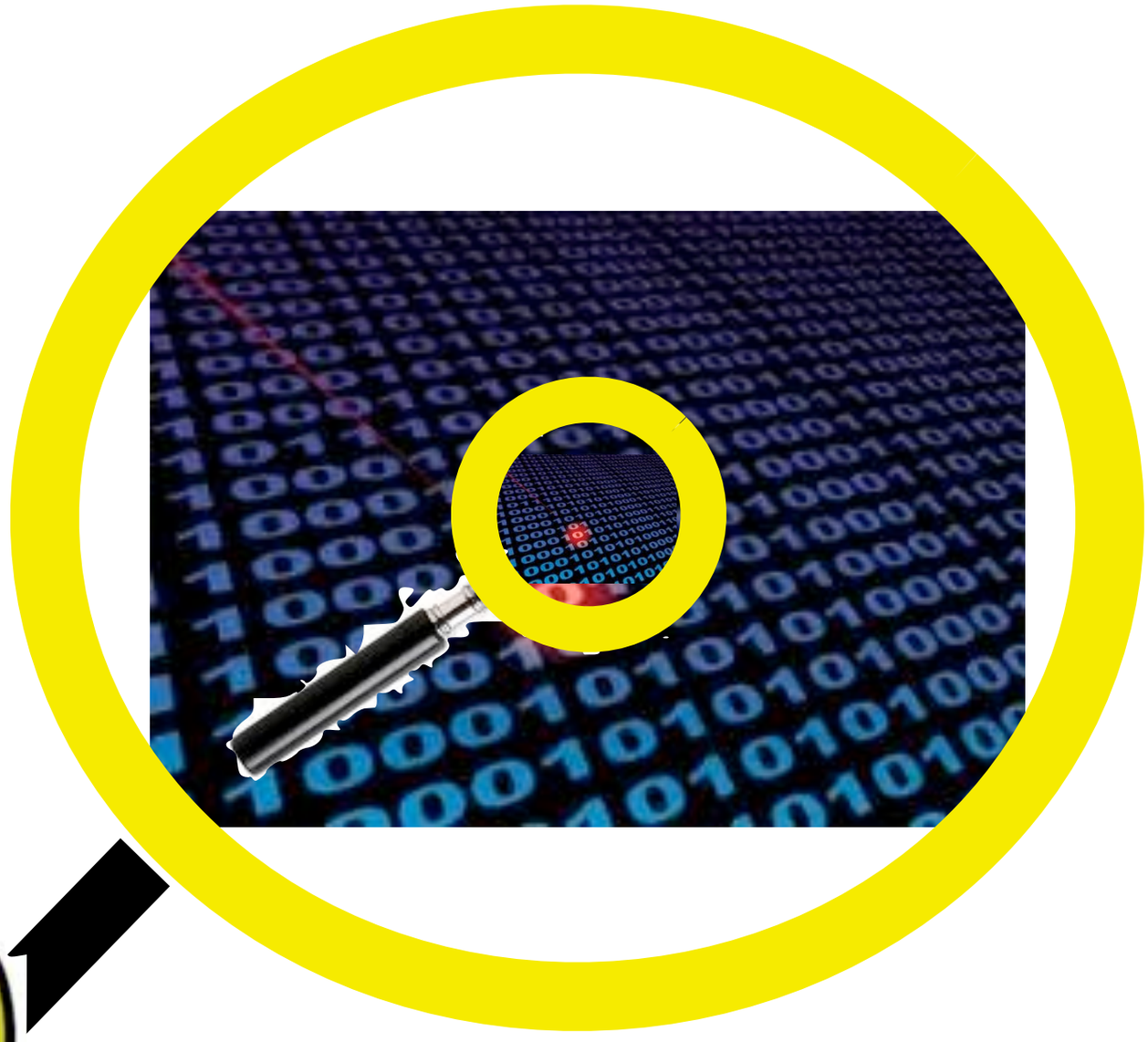
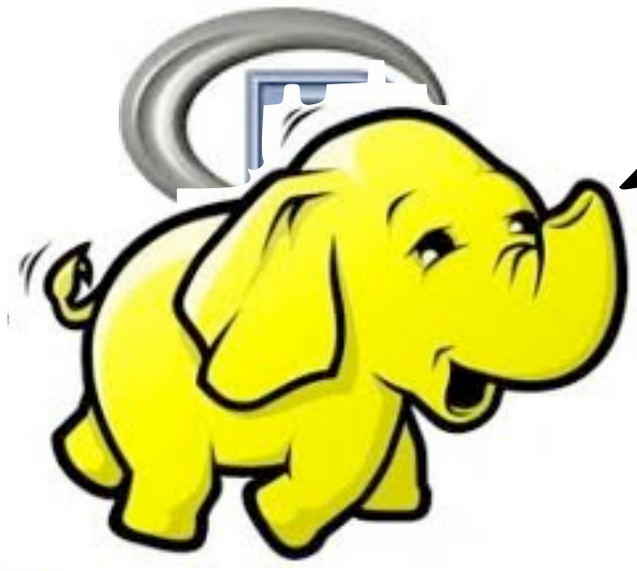
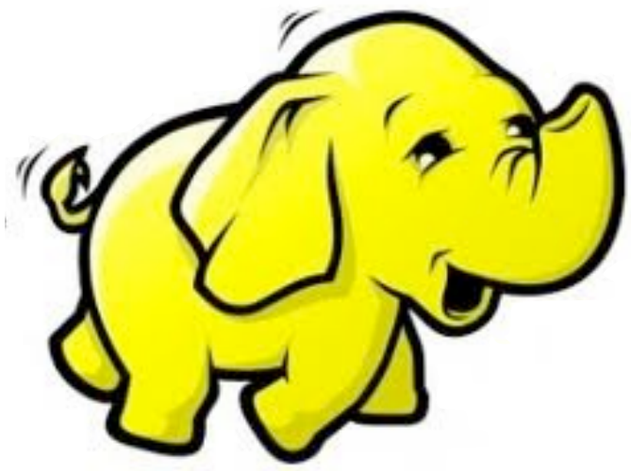
Analysis of Data





Analysis of Data



MapReduce

SPSS

sas

CF Classifier Decision Tree

Recommendation

Clustering Graph

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RHive

Related Works

- RHIPE
- RHadoop
- hive (Hadoop InteractiVE)
- seuge

Must understand MapReduce

RHive is inspired by ...

- Many analysts have been used R for a long time
- Many analysts can use SQL language
- There are already a lot of statistical functions in R
- R needs a capability to analyze big data
- Hive supports SQL-like query language (HQL)
- Hive supports MapReduce to execute HQL

R is the best solution for familiarity
Hive is the best solution for capability

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RHive Components

- Hadoop
  - store and analyze big data
- Hive
  - use HQL instead of MapReduce programming
- R
  - support friendly environment to analysts

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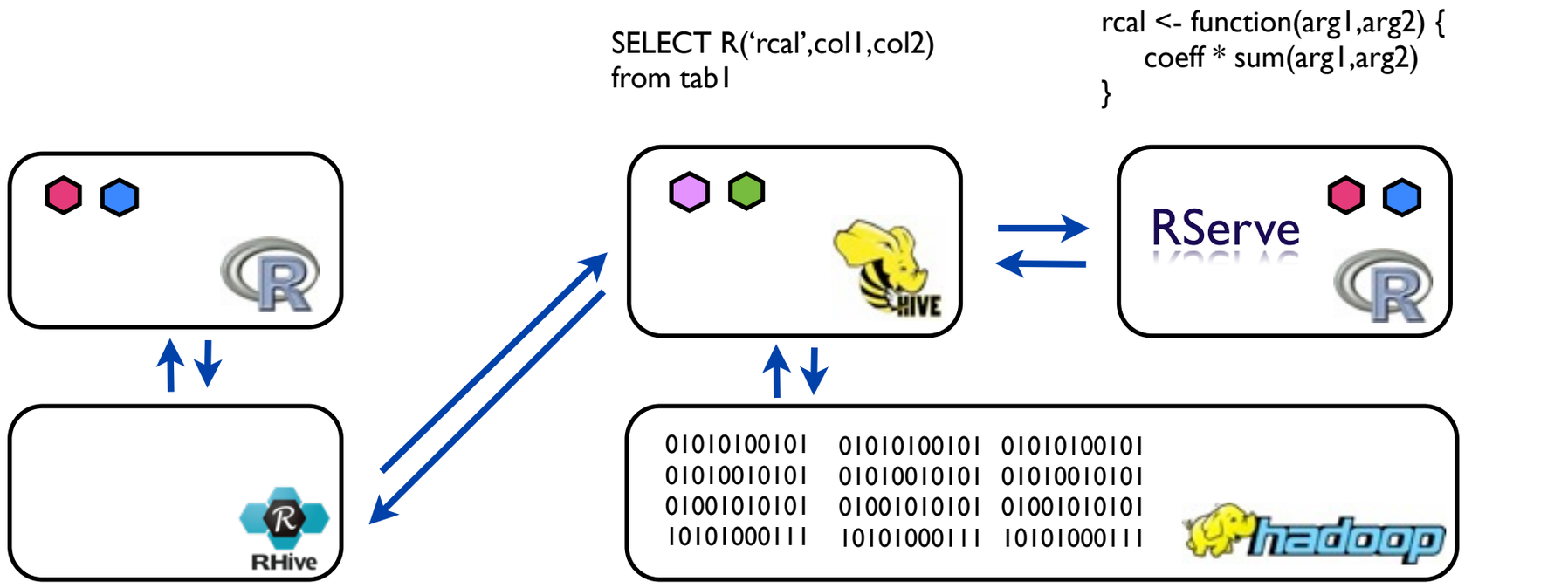
RHive - Architecture

Execute R Function Objects and R Objects through Hive Query

Execute Hive Query through R



RHive API

- Extension R Functions
  - rhive.connect
  - rhive.query
  - rhive.assign
  - rhive.export
  - rhive.napply
  - rhive.sapply
  - rhive.aggregate
  - rhive.list.tables
  - rhive.load.table
  - rhive.desc.table

- Extension Hive Functions
  - RUDF
  - RUDAF
  - GenericUDTFExpand
  - GenericUDTFUnFold

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RUDF - R User-defined Functions

SELECT R('*R function-name*',col1,col2,...,TYPE)

- UDF doesn't know return type until calling R function
  - TYPE : return type

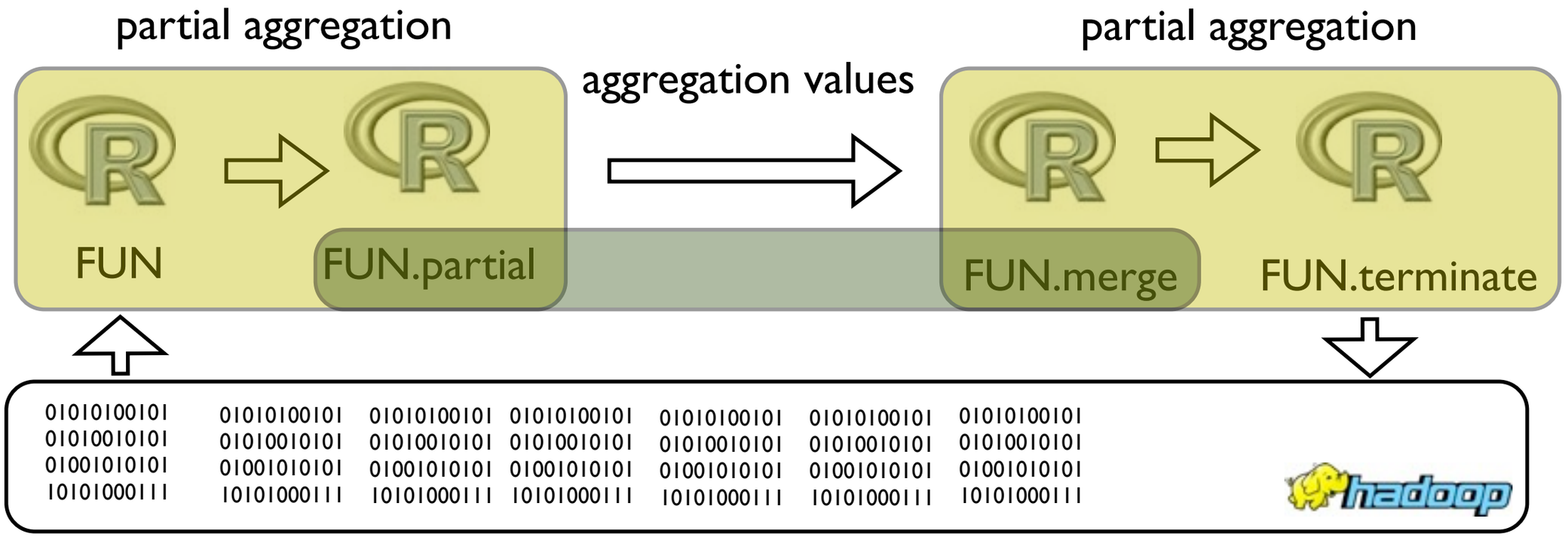
Example : R function which sums all passed columns

```
sumCols <- function(arg1,...) {
    sum(arg1,...)
}
rhive.assign('sumCols',sumCols)
rhive.exportAll('sumCols',hadoop-clusters)
result <- rhive.query("SELECT R('sumCols', col1, col2, col3, col4, 0.0) FROM tab")
plot(result)
```

RUDAF - R User-defined Aggregation Function

SELECT RA('*R function-name*',col1,col2,...)

- R can not manipulate large dataset
- Support UDAF's life cycle
  - iterate, partial-merge, merge, terminate
- Return type is only string delimited by ',' - "data1,data2,data3,..."



UDTF : unfold and expand

- RUDAF only returns string delimited by ‘,’
- Convert RUDAF’s result to R data.frame

unfold(string_value,type1,type2,...,delimiter)

expand(string_value,type,delimiter)

RA(‘newcenter’,...) return “num1,num2,num3” per cluster-key

select unfold(tb1.x,0.0,0.0,0.0,’,’) as (col1,col2,col3) from (select RA(‘newcenter’, attr1,attr2,attr3,attr4) as x from table group by cluster-key

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napply and sapply

rhive.napply(table-name,FUN,col1,...)

rhive.sapply(table-name,FUN,col1,...)

- napply : R apply function for Numeric type
- sapply : R apply function for String type

Example : R function which sums all passed columns

```
sumCols <- function(arg1,...) {
    sum(arg1,...)
}
result <- rhive.napply("tab", sumCols, col1, col2, col3, col4)
rhive.load.table(result)
```

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napply

- ‘napply’ is similar to R apply function
- Store big result to HDFS as Hive table

```
rhive.napply <- function(tablename, FUN, col = NULL, ...) {
    if(is.null(col))
        cols <- ""
    else
        cols <- paste(",",col)

    for(element in c(...)) {
         cols <- paste(cols,",",element)
    }

    exportname <- paste(tablename,"_sapply",as.integer(Sys.time()),sep="")

    rhive.assign(exportname,FUN)
    rhive.exportAll(exportname)

    tmptable <- paste(exportname,"_table")
    rhive.query(
          paste("CREATE TABLE ", tmptable," AS SELECT ","R('",exportname,"'",cols,",0.0) FROM ",tablename,sep=""))

    tmptable
}
```

aggregate

rhive.aggregate(table-name,hive-FUN,...,goups)

- RHive aggregation function to aggregate data stored in HDFS using HIVE Function

Example : Aggregate using SUM (Hive aggregation function)

*result <- **rhive.aggregate**("emp","SUM", sal,groups="deptno")*
rhive.load.table(result)

Examples - predict flight delay

```
library(RHive)

rhive.connect()
```

- Retrieve training set from large dataset stored in HDFS

```
train <- rhive.query("SELECT dayofweek,arrdelay,distance FROM airlines TABLESAMPLE(BUCKET 1 OUT OF 10000 ON rand())

train$arrdelay <- as.numeric(train$arrdelay)

train$distance <- as.numeric(train$distance)

train <- train[!(is.na(train$arrdelay) | is.na(train$distance)),]

model <- lm(arrdelay ~ distance + dayofweek,data=train)
```

Native R code

- Export R object data

```
rhive.assign("model", model)
```

- Analyze big data using model calculated by R

```
predict_table <- rhive.napply("airlines",function(arg1,arg2,arg3) {

        if(is.null(arg1) | is.null(arg2) | is.null(arg3))  return(0.0)

        res <- predict.lm(model, data.frame(dayofweek=arg1,arrdelay=arg2,distance=arg3))

        return(as.numeric(res)) }, 'dayofweek','arrdelay','distance')
```

HiveQuery + R code

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DEMO

Conclusion

- RHive supports HQL, not MapReduce model style
- RHive allows analytics to do everything in R console
- RHive interacts R data and HDFS data

- Future & Current Works
  - Integrate Hadoop HDFS
  - Support Transform/Map-Reduce Scripts
  - Distributed Rserve
  - Support more R style API
  - Support machine learning algorithms (k-means, classifier, ...)

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RHive

Cooperators

- JunHo Cho
- Seonghak Hong
- Choonghyun Ryu

YOU!

How to join RHive project

- Logo

- github (https://github.com/nexr/RHive)
- CRAN (http://cran.r-project.org/web/packages/RHive)
- Welcome to join RHive project

References

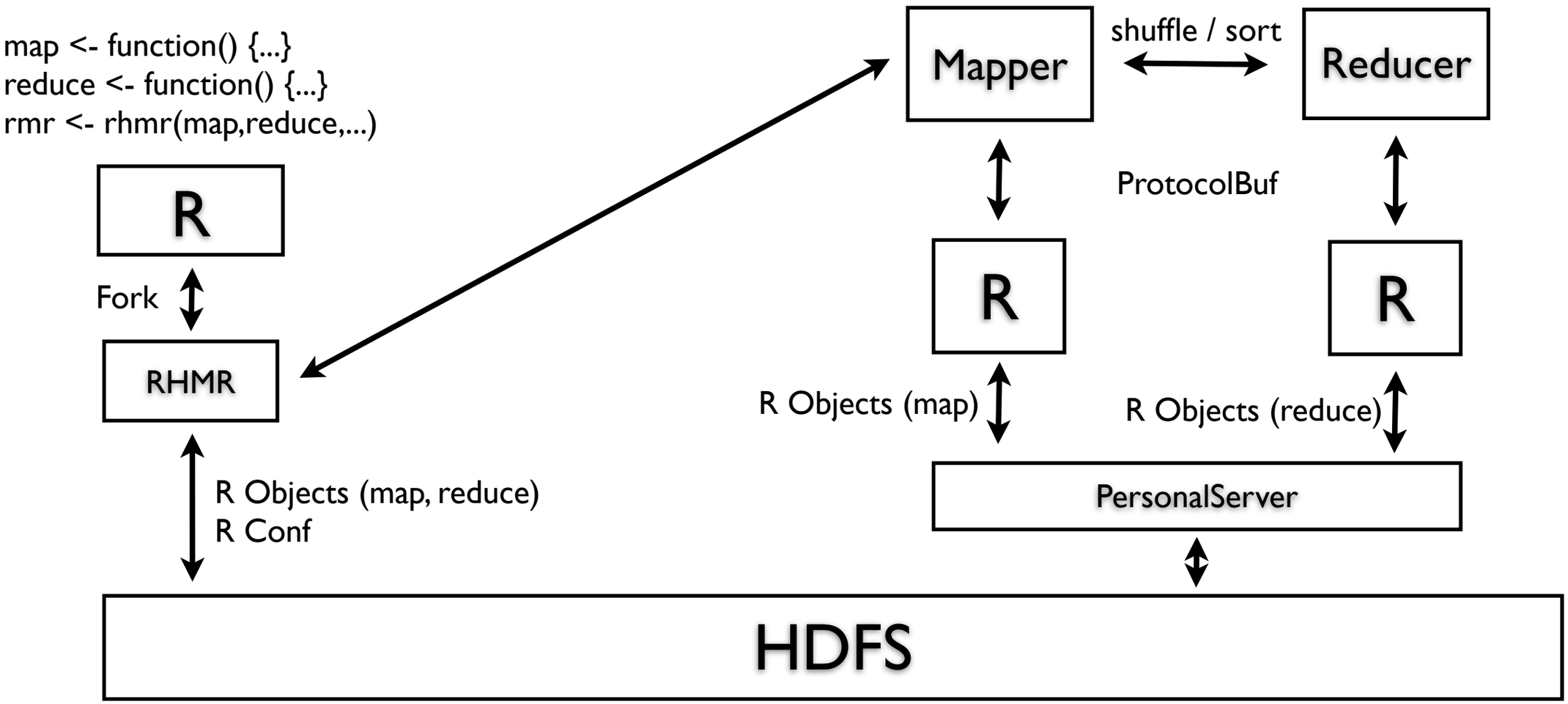
- Recardo (https://mpi-inf.mpg.de/~rgemulla/publications/das10ricardo.pdf)
- RHIPE (http://ml.stat.purdue.edu/rhipe)
- Hive (http://hive.apache.org)
- Parallels R by Q. Ethan McCallum and Stephen Weston

jun.cho@nexr.com

Appendix

RHIPE

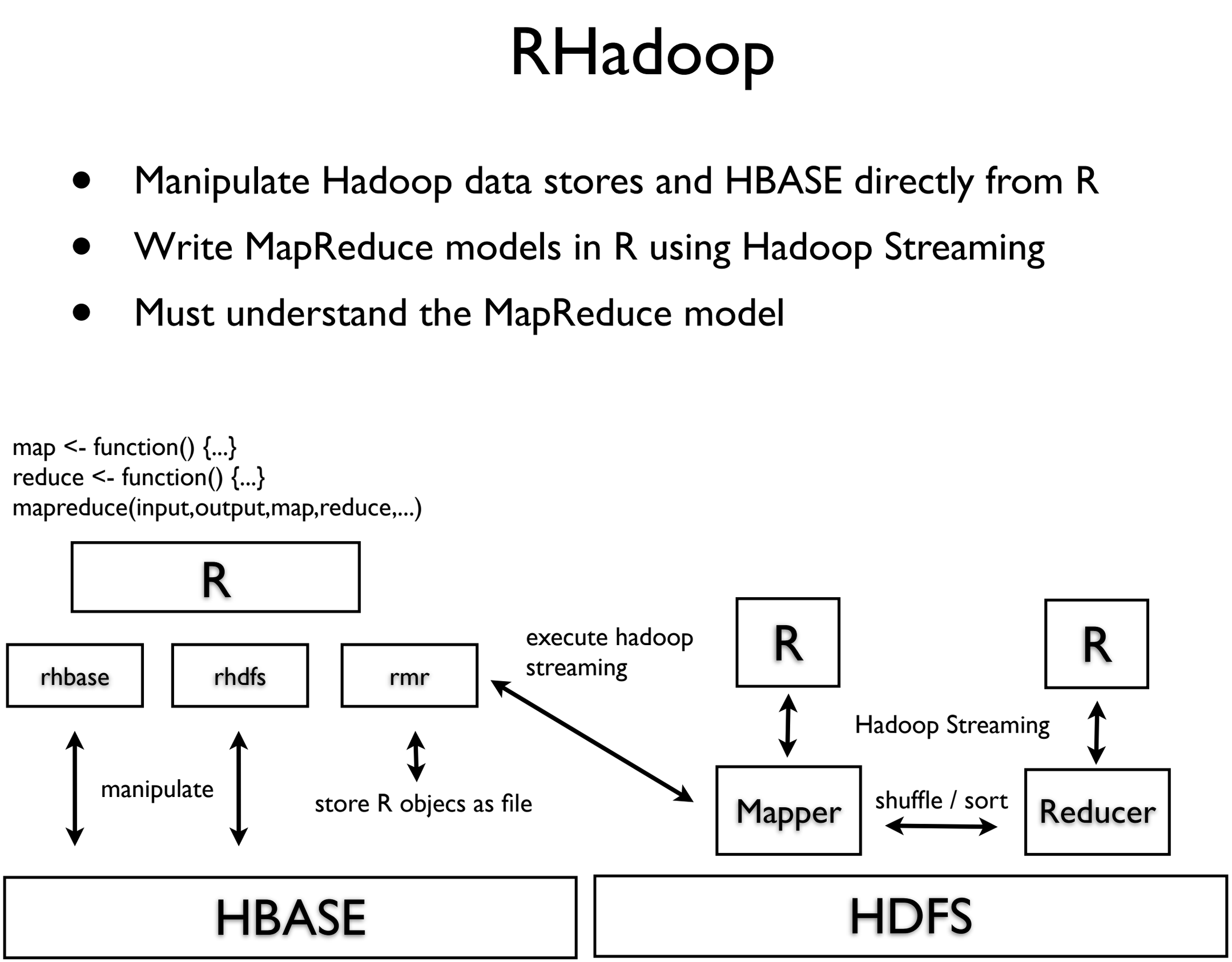
- the R and Hadoop Integrated Processing Environment
- Must understand the MapReduce model



RHadoop

- Manipulate Hadoop data stores and HBASE directly from R
- Write MapReduce models in R using Hadoop Streaming
- Must understand the MapReduce model

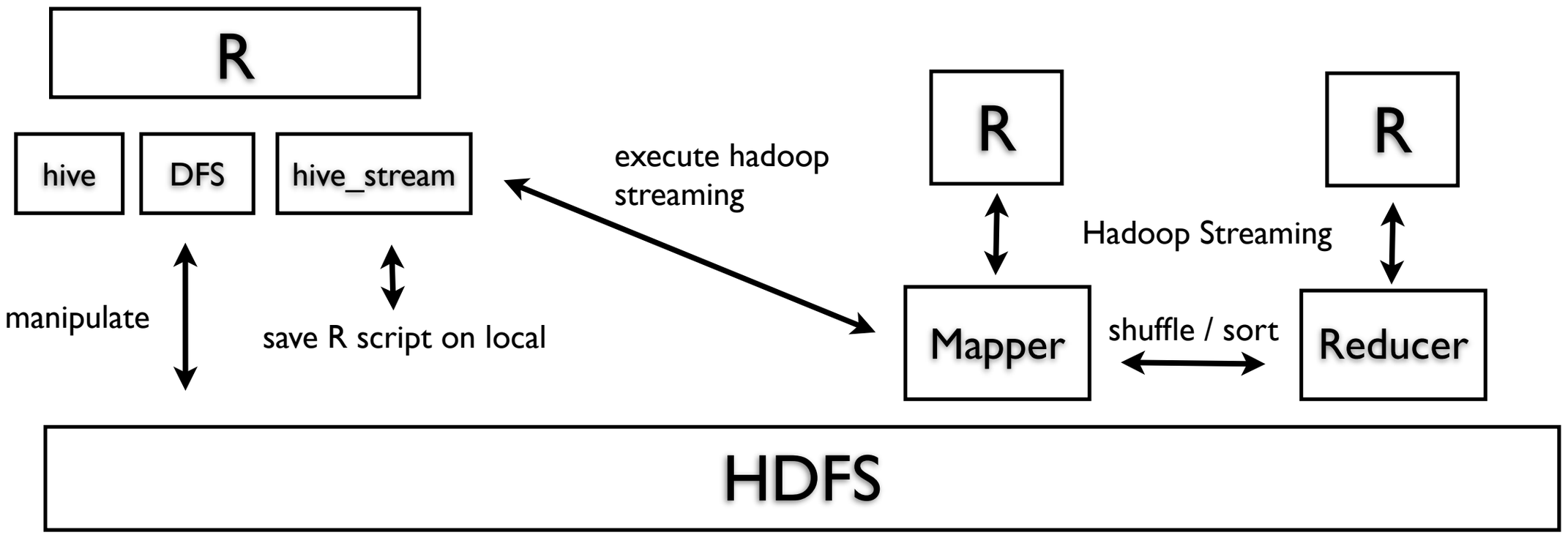
```
map <- function() {...}
reduce <- function() {...}
mapreduce(input,output,map,reduce,...)
```



hive(Hadoop InteractiVE)

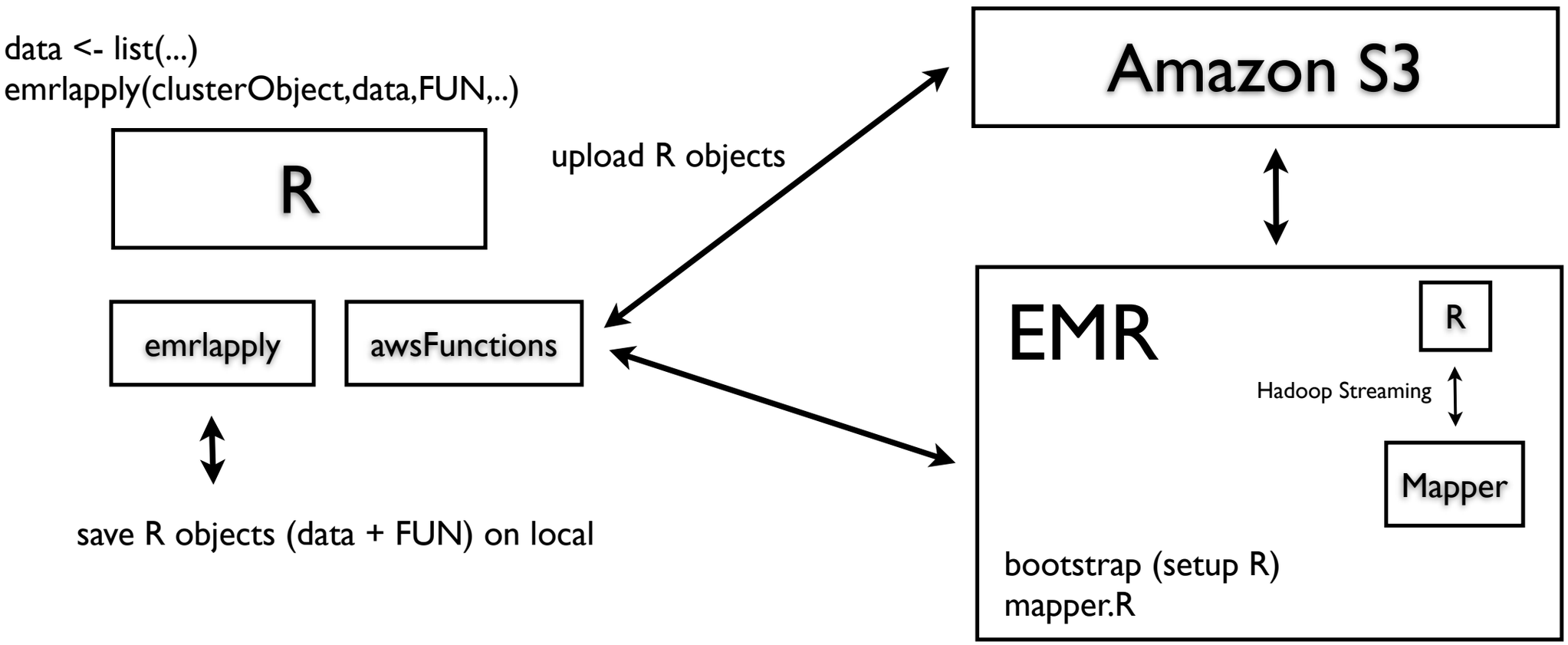
- R extension facilitating distributed computing via the MapReduce paradigm
- Provide an interface to Hadoop, HDFS and Hadoop Streaming
- Must understand the MapReduce model

```
map <- function() {...}
reduce <- function() {...}
hive_stream(map,reduce,...)
```



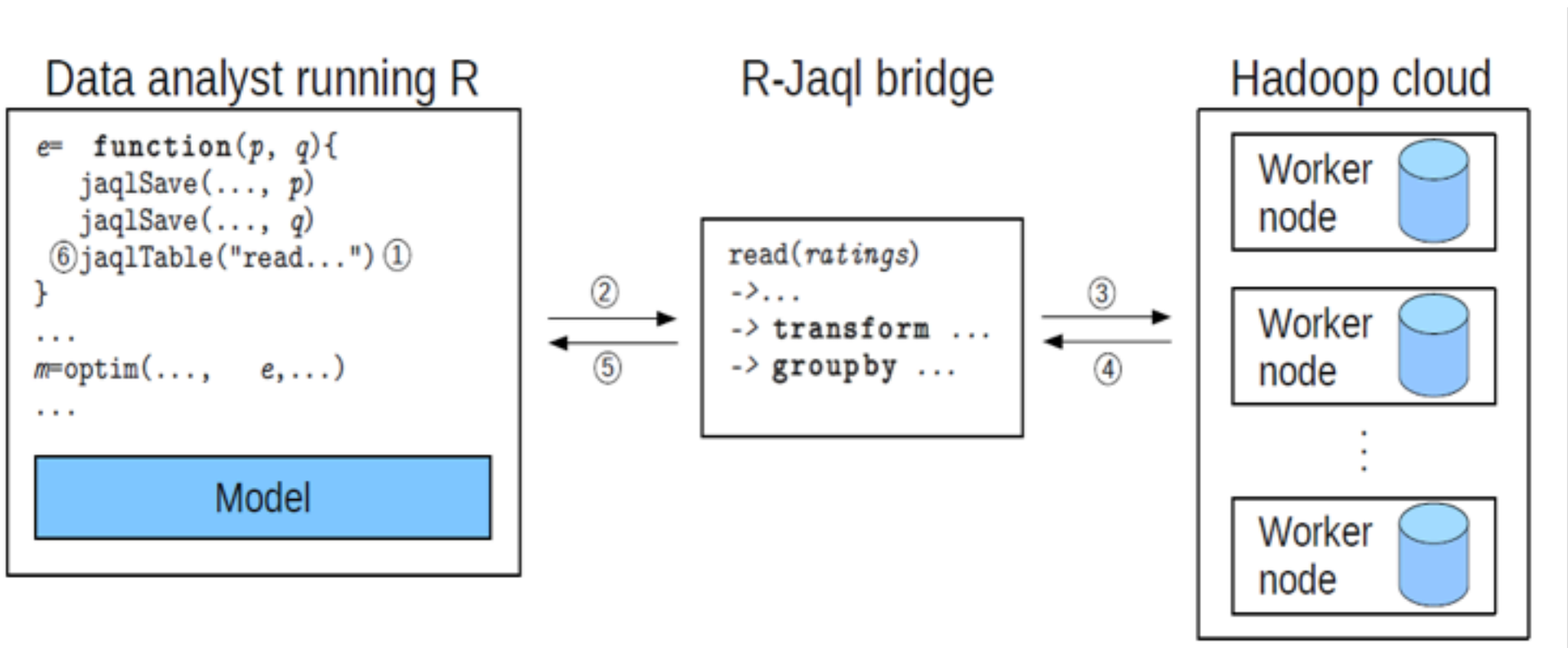
seuge

- Simple parallel processing with a fast and easy setup on Amazon's WS.
- Parallel lapply function for the EMR engine using Hadoop streaming.
- Does not support MapReduce model but only Map model.



Ricardo

- Integrate R and Jaql (JSON Query Language)
- Must know how to use uncommon query, Jaql
- Not open-source



Ref : Ricardo-SIGMOD10