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## **TSACE-TSAUG Meeting # 10**

# **RJDemetra tools for statistical production**

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# Presentation Overview

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## ○ Pt.1: Tool for specification conversion

- JD\_JSON format
- TRAMO-SEATS (Gomez & Maravall) to RJDemetra (v2) / JDemetra+

## ○ Pt.2: RJDemetra Processor: an RJDemetra processing pipeline ready for you

- Architecture
- Adaptable input interfaces to suit your context

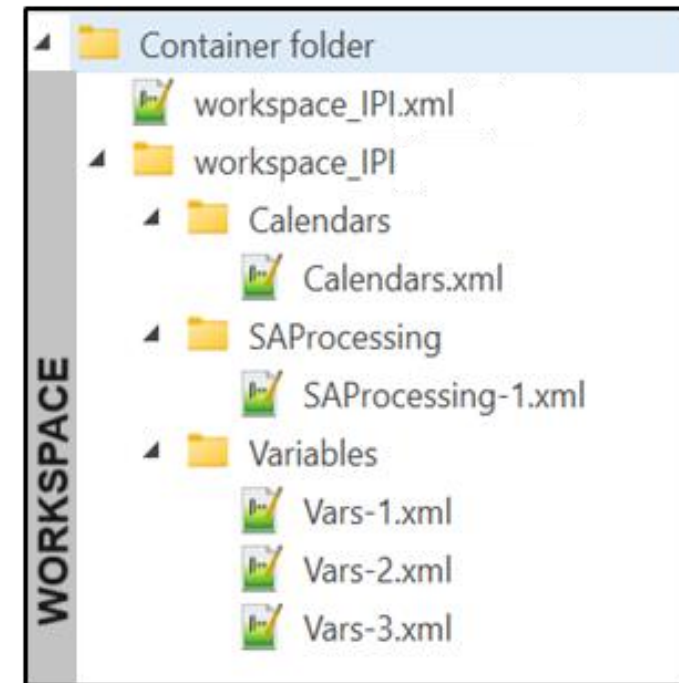
# **Pt.1: Tool for specification conversion**

(TRAMO-SEATS to JDemetra+ and RJDemetra)

# Specifications in JDemetra+ and RJDemetra

JDemetra+ specifications can be retrieved from:

- the **workspace** (XML files into nested folders)
- **.cfgx** files
- **.RData** files (only RJDemetra and rjd3)



# Why do we need this?

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We found **difficulties** in handling specifications/workspaces **in memorization stage**:

- limited transparency
  - workspace XML are verbous
  - .cfgx or .RData files are not human-readable
- our database stores individual time series information, workspaces are designed for multiple time series
- one workspace for time-series is not practical for seasonal adjustment in JD+
- need a directory storage system (on filesystem or BLOB type field on DB) for workspaces
- workspaces store data, specifications, and external regressors together
- difficulties for the users in refreshing data (input time series and external regressors).
  - JD+ providers keep searching for data in the exact same location where they were originally loaded

# JD\_JSON format

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## ○ JSON format:

- simple and widely recognized format → many libraries in any languages to handle it
- JavaScript types to represent the data → similar and easy to be mapped in R/Java types
- "key":value pairs, divided by comma, enclosed in { }; arrays enclosed in [ ]; nested JSONs allowed
- easy to read and write for users

## ○ Key-values specifications format:

- same as **c("SA\_spec", "TRAMO\_SEATS")** class attributes from **RJDemetra** (v2)
- **little additions**
  - series name → to link specification and data
  - external regressors info → information to retrieve ext.reg., preferred to values for readability
- comments with JavaScript/Java format (`// inline`, `/* ... */ multiline`)

# JD\_JSON: examples

```
{
  "series_name" : "FATEXP_10",
  "spec"        : "RSA0",
  "transform.function" : "Log", // inline Comment
  "usrdef.outliersEnabled" : true,
  "usrdef.outliersType"   : ["AO", "LS"],
  "usrdef.outliersDate"   : ["2010-06-01", "2009-01-01"],
  "arima.mu"             : false
}
```

```
{
  "series_name" : "C_DEFL",
  "spec"        : "RSA0",
  "transform.function" : "Log",
  "usrdef.outliersEnabled" : true,
  "usrdef.outliersType"   : ["AO", "LS", "AO", "AO", "AO", "AO"],
  "usrdef.outliersDate"   : ["2007-12-01", "2008-11-01", "2020-03-01", "2020-04-01", "2020-05-01", "2020-06-01"],
  "userdef.varFromFile"   : true,

  "userdef.varFromFile.infoList": [ { "file_name": "tdu02m.txt", "start":"2002-01-01", "frequency":12},
                                     { "file_name": "lym_02.txt", "start":"2002-01-01", "frequency":12}],
  "usrdef.varEnabled"      : true,
  "usrdef.varType"         : ["Calendar", "Calendar"],
  "tradingdays.option"   : "UserDefined",
  "arima.mu"              : false
}
```

# JD\_JSON: attributes borrowed from RJDemetra class `c("SA_spec", "TRAMO_SEATS")`

## SOURCE: RJDemetra documentation

tramoseats_spec	TRAMO-SEATS model specification	Arguments	
<b>Description</b>		spec	a TRAMO-SEATS model specification. It can be the 'JDemetra+' name (character) of a predefined TRAMO-SEATS model specification (see <i>Details</i> ), an object of class <code>c("SA_spec", "TRAMO_SEATS")</code> or an object of class <code>c("SA", "TRAMO_SEATS")</code> . The default is "RSAfull".
Function to create (and/or modify) a <code>c("SA_spec", "TRAMO_SEATS")</code> class object with the SA model specification for the TRAMO-SEATS method. It can be done from a pre-defined 'JDemetra+' model specification (a character), a previous specification ( <code>c("SA_spec", "TRAMO_SEATS")</code> object) or a seasonal adjustment model ( <code>c("SA", "TRAMO_SEATS")</code> object).		preliminary.check	a logical to check the quality of the input series and exclude highly problematic series e.g. the series with a number of identical observations and/or missing values above pre-specified threshold values.  The time span of the series, which is the (sub)period used to estimate the regarima model, is controlled by the following six variables: <code>estimate.from</code> , <code>estimate.to</code> , <code>estimate.first</code> , <code>estimate.last</code> , <code>estimate.exclFirst</code> and <code>estimate.exclLast</code> ; where <code>estimate.from</code> and <code>estimate.to</code> have priority over the remaining span control variables, <code>estimate.last</code> and <code>estimate.first</code> have priority over <code>estimate.exclFirst</code> and <code>estimate.exclLast</code> , and <code>estimate.last</code> has priority over <code>estimate.first</code> . Default= "All".
<b>Usage</b>		estimate.from	a character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). It can be combined with the parameter <code>estimate.to</code> .
<pre>tramoseats_spec(   spec = c("RSAfull", "RSA0", "RSA1", "RSA2", "RSA3", "RSA4", "RSA5"),   preliminary.check = NA,   estimate.from = NA_character_,   estimate.to = NA_character_,   estimate.first = NA_integer_,   estimate.last = NA_integer_,   estimate.exclFirst = NA_integer_,   estimate.exclLast = NA_integer_,   estimate.tol = NA_integer_,   estimate.eml = NA,   estimate.urfinal = NA_integer_,   transform.function = c(NA, "Auto", "None", "Log"),   transform.fct = NA_integer_,   usrdef.outliersEnabled = NA,   usrdef.outliersType = NA,   usrdef.outliersDate = NA,   usrdef.outliersCoef = NA,   ...</pre>		estimate.to	a character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with the parameter <code>estimate.from</code> .
		estimate.first	numeric, the number of periods considered at the beginning of the series.
		estimate.last	numeric, the number of periods considered at the end of the series.
		estimate.exclFirst	numeric, the number of periods excluded at the beginning of the series. It can be combined with the parameter <code>estimate.exclLast</code> .
		...	



# JD\_JSON: additional attributes

## with respect to RJDemetra c("SA\_spec", "TRAMO\_SEATS")

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- **series\_name**: a character string indicating the name of the time series. Mandatory, because it allows the matching between specification and rawdata.
- **userdef.varFromFile**: logical indicating whether user-defined variable data will be read from the files specified by *userdef.varFromFile.infoList*, instead of *userdef.var* (raw data). If TRUE, the *userdef.var* field is ignored; if FALSE, *userdef.varFromFile.infoList* is ignored. Default = FALSE.
- **userdef.varFromFile.infoList**: A vector of JSON elements, each with the attributes:
  - **file\_name**: character string representing the name of the file containing the external regressor data;
  - **start**: a character string in the format "YYYY-MM-DD" indicating the starting time of the external regressor data;
  - **frequency**: integer. 12 for monthly data, 4 for quarterly.

# JD\_JSON: additional attributes

## with respect to RJDemetra c("SA\_spec", "TRAMO\_SEATS")

```
{
  "series_name" : "FATEXP_10",
  "spec"        : "RSA0",
  "transform.function" : "Log", // inline Comment
  "usrdef.outliersEnabled" : true,
  "usrdef.outliersType"   : ["AO", "LS"],
  "usrdef.outliersDate"   : ["2010-06-01", "2009-01-01"],
  "arima.mu"             : false
}
```

Series name

External regressors information

```
{
  "series_name" : "C_DEFL",
  "spec"        : "RSA0",
  "transform.function" : "Log",
  "usrdef.outliersEnabled" : true,
  "usrdef.outliersType"   : ["AO", "LS", "AO", "AO", "AO", "AO"],
  "usrdef.outliersDate"   : ["2007-12-01", "2008-11-01", "2020-03-01", "2020-04-01", "2020-05-01", "2020-06-01"],
  "userdef.varFromFile"   : true,
  "userdef.varFromFile.infoList": [ { "file_name": "tdu02m.txt", "start": "2002-01-01", "frequency": 12 },
                                   { "file_name": "lym_02.txt", "start": "2002-01-01", "frequency": 12 } ],
  "usrdef.varEnabled"     : true,
  "usrdef.varType"        : ["Calendar", "Calendar"],
  "tradingdays.option"   : "UserDefined",
  "arima.mu"             : false
}
```

# JD\_JSON: features

- Already documented in large part → see `tramoseats_spec` function in RJDemetra doc.
- Easy to read and write for users → no nested objects, apart from `userdef.varFromFile.infoList`
- Easy to be stored into a DB → TEXT/VARCHAR or JSON\* field DB types
  - \* some DBMS allow querying fields directly from JSON!
- Easy to be handled in R and Java → many libraries available (R: `jsonlite/rjson`, Java: `jackson`)  
→ easy to be read by RJDemetra
- Facilitates synthesis → like specifying arguments to the `tramoseats_spec` function → default specification to assign values not provided by the user (e.g. "RSA0")  
→ tools to produce the full version (see slide 13)

# From full to synthetic version and vice versa

```
{
  "series_name": "FATEXP_15",
  "spec": "RSA0",
  "usrdef.outliersEnabled": true,
  "usrdef.outliersType": ["AO", "LS"],
  "usrdef.outliersDate": ["2009-09-01", "2009-03-01"],
  "arima.mu": false,
  "arima.p": 1,
  "arima.d": 0,
  "arima.q": 0,
  "arima.bq": 0
},
```



```
{
  "series_name": "FATEXP_15",
  "spec": "RSA0",
  "preliminary.check": true,
  "estimate.from": "NA",
  "estimate.to": "NA",
  "estimate.first": "NA",
  "estimate.last": "NA",
  "estimate.exclFirst": 0,
  "estimate.exclLast": 0,
  "estimate.tol": 1e-07,
  "estimate.eml": true,
  "estimate.urfinal": 0.96,
  "transform.function": "None",
  "transform.fct": 0.95,
  "usrdef.outliersEnabled": true,
  ...
  "arima.mu": false,
  "arima.p": 1,
  "arima.d": 0,
  "arima.q": 0,
  "arima.bp": 0,
  "arima.bd": 1,
  "arima.bq": 0,
  "arima.coefEnabled": false,
  "arima.coef": "NA",
  "arima.coefType": "NA",
  "fcst.horizon": -2,
  "seats.predictionLength": -1,
  "seats.approx": "Legacy",
  "seats.trendBoundary": 0.5,
  "seats.seasdBoudary": 0.8,
  "seats.seasdBoudary1": 0.8,
  "seats.seasTol": 2,
  "seats.maBoundary": 0.95,
  "seats.method": "Burman"
},
```

## JD\_JSON.R

- `from_reduced_to_full_JD_JSON_file(...)`
- `from_full_to_reduced_JD_JSON_file(...)`

# Workflow & Software

Now:



Work in progress:



## JD\_JSON.R

- JD\_JSON\_from\_virtual\_workspace(...)
- JD\_JSON\_to\_virtual\_workspace(...)
- JD\_JSON\_to\_TSplus (...)\*
- from\_reduced\_to\_full\_JD\_JSON\_obj (...)
- JD\_JSON\_from\_materialized\_workspace(...)
- JD\_JSON\_to\_materialized\_workspace(...)
- JD\_JSON\_from\_TSplus (...)\*
- from\_full\_to\_reduced\_JD\_JSON\_obj(...)

} interoperability with JD+

\* = work in progress

# **Pt.2: RJDemetra Processor: an RJDemetra processing pipeline ready for you**

# General overview

JD\_JSON format is a component of a larger processing system that is:

- **R/RJDemetra based**
- **Object Oriented** → S4 Object System for R
- **Modular architecture**

This system is the response of our needs of:

- **a semi-automated production pipeline, interoperable with the JD+ suite**  
→ workspaces as interoperability tool
- **use RJDemetra API with many time series without "hardcoding" specifications**  
→ JD\_JSON format
- **a tool expandable and adaptable to many situations**  
→ adapting to various input formats/producing custom output
- **a platform maintainable also by statisticians without expertise in Java**  
→ building R prototypes converted into Java by IT teams

# Building blocks

## Responsibility

### JD\_JSON\_file\_processor.R

- JD\_JSON\_file\_processor (input\_data\_reader, ext\_reg\_data\_reader, spec\_file\_name, output\_workspace\_dir, series\_to\_proc\_names)

Processing and output of the results

### JD\_JSON.R

Interaction with workspace and input-output of specifications

### c ("Extended tramoseats spec")

- Extends c("SA\_spec", "TRAMOSEATS") from RJDemetra
- Attributes
- Constructor(...)
- to\_JD\_JSON(...)
- from\_JD\_JSON(...)
- to\_named\_list(...)
- from\_named\_list(...)
- to\_sa\_spec(...)
- from\_sa\_spec(...)
- to\_tramoseats\_spec\_args(...)

Interaction with RJDemetra

### DATA READERS

Acquisition of the input data

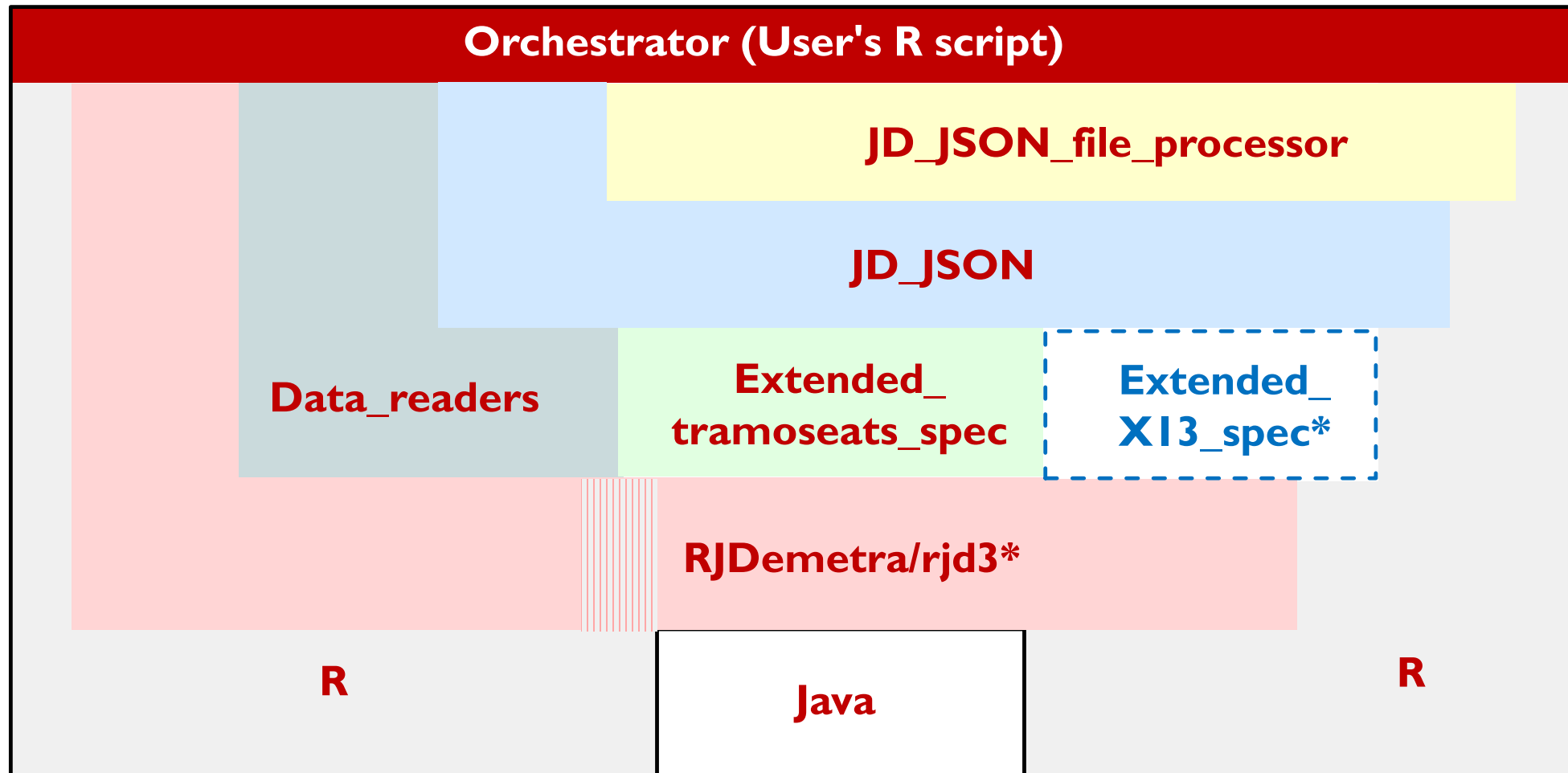
c ("Data\_reader")

c ("Data\_reader\_ext\_reg")



# Full JDProcessor Stack + possible extensions(\*)

**Notation:** when a block lies on top of another, it means that it uses (or could use) it. → dependencies description



# Adapt to your environment through PROVIDER interfaces

- To utilize JDProcessor in your environment, simply **implement the Provider and Provider\_ext\_reg interfaces** to read your data and external regressors.
  - flexible input, strict rules for the output
  - e.g. Provider\_csv, Provider\_txt, Provider\_jdbc
- Then, pass the Providers to the processor.

## Provider:

- Constructor's arguments:
  - input\_source: "ANY"
- read\_data(...) method:
  - output: mts (multivariate time series) obj., with time series names and dates
  - no specific input (...)

	FATEXP_10	FATEXP_11	FATEXP_13
2006-09-01	14,2	18,8	42,2
2006-10-01	14,9	21,3	43,6
2006-11-01	14	18,4	45,1
2006-12-01	13	15	45,8
2007-01-01	14,2	19,7	45,8
2007-02-01	14,9	20,2	44,4



# PROVIDER\_EXT\_REG interface

## Provider\_ext\_reg:

- Constructor: input\_source (type : "ANY")
- **read\_ext\_reg\_data** (var\_info=NULL, time\_series\_info=NULL, ... ):
  - var\_info = list with filename, start\_date and frequency
  - time\_series\_info = series\_name,
  - output: ts (time series) object
- **read\_ext\_reg\_info** (var\_info\_container, ...):
  - e.g. var\_info\_container = ext\_reg\_files\_folder
  - **output: list of ext\_var\_info** for each ts →

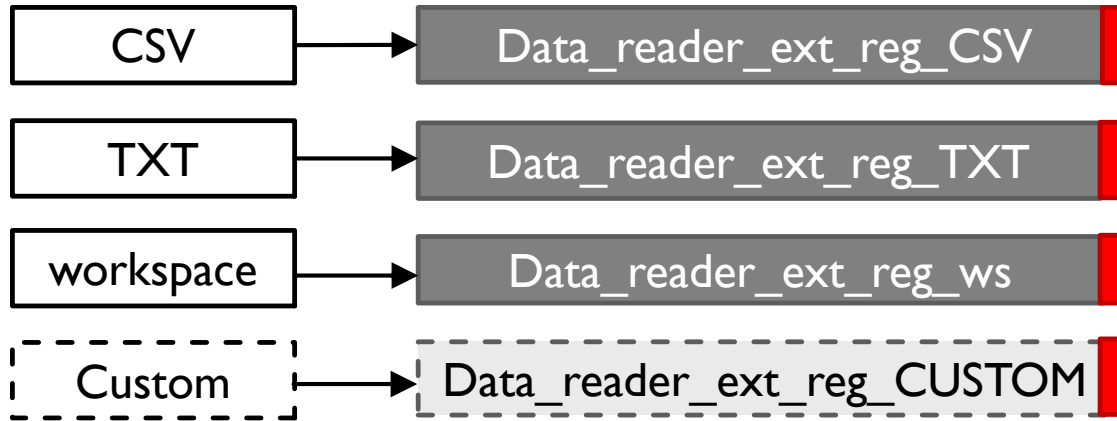
how to read data  
from var. info.

how to  
produce var.  
info.  
(metadata)

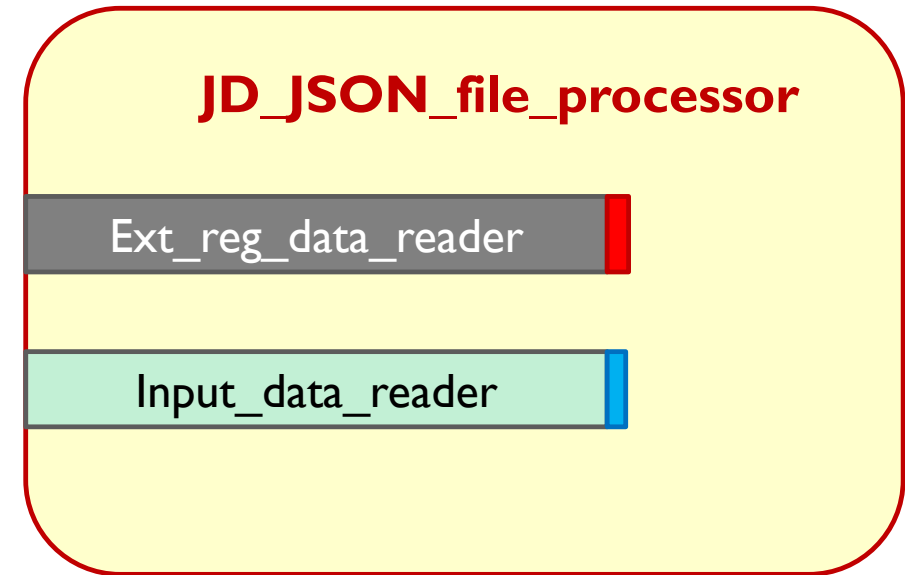
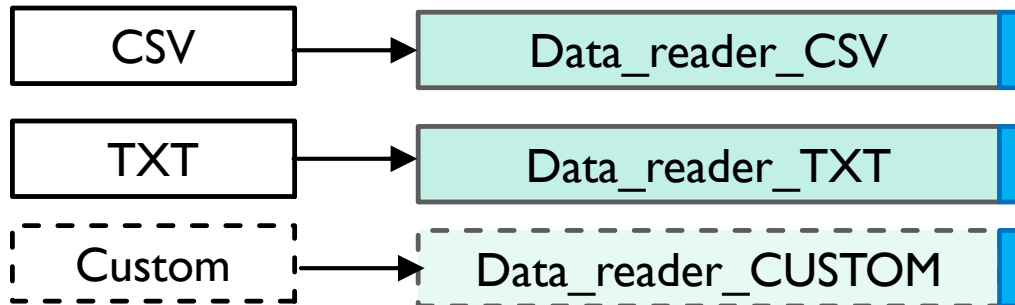
Name	Type	Value
all_jmodel_vars	list [105]	List of length 105
FATEXP_10	list [0]	List of length 0
C_DEFL	list [2]	List of length 2
[[1]]	list [3]	List of length 3
file_name	character [1]	'tdu02m.txt'
start	character [1]	'2002-01-01'
frequency	double [1]	12
[[2]]	list [3]	List of length 3
file_name	character [1]	'lym_02.txt'
start	character [1]	'2002-01-01'
frequency	double [1]	12

# Adapt the processor with your Data Readers

## Input\_ext\_reg



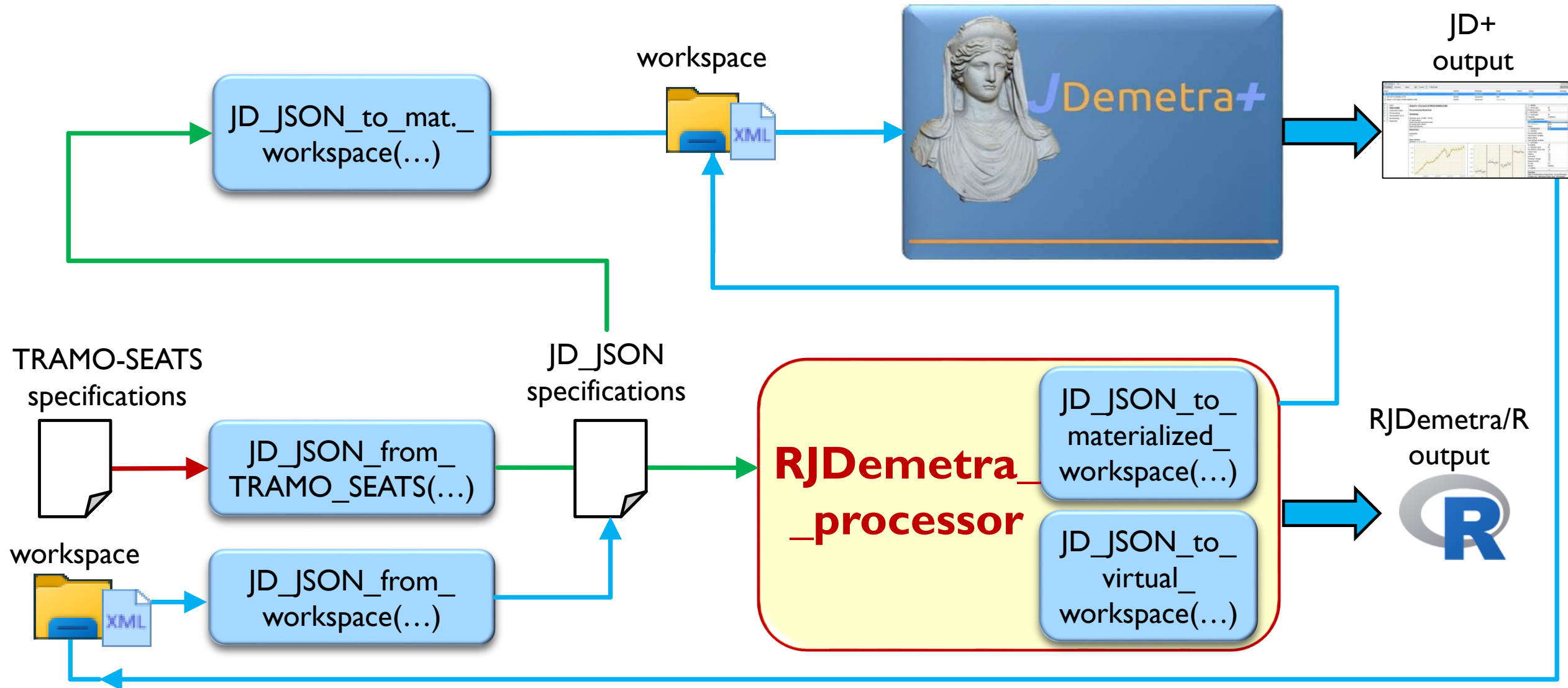
## Input\_data



■ Data\_reader\_ext\_reg interface

■ Data\_reader interface

# Interoperability with JDemetra+ (GUI, Cruncher, ...) through Workspace



# Example of use: orchestrator.R

```
input_workspace_directory <- "C:\\Workspace-dir\\WS-FAT.xml" #Built with sa_ext plugin
input_data_file_name      <- "C:\\SITIC-FAT\\raw_data.csv"
regr_directory            <- "C:\\SITIC-FAT\\TS_regr" #Folder with external regressors
spec_file_name            <- "C:\\JD_JSON_specifications.txt"

diff <- TRUE # Reduced JSON if diff=TRUE, Full JD_JSON format otherwise

##### Operational flow #####

input_data_provider      <- Provider_csv_istat_format(input_data_file_name)
ext_reg_input_provider   <- Provider_ext_reg_tsplus(regr_directory)

JD_JSON_from_materialized_workspace(input_workspace_directory, ext_reg_input_provider,
                                     JSON_file_name = spec_file_name, diff)

models <- JD_JSON_file_processor(input_data_provider, ext_reg_input_provider,
                                 spec_file_name, "output_workspace_container") #RJDemetra models

from_reduced_to_full_JD_JSON_file(spec_file_name, "JD_JSON_specifications_full.txt")
```

# Future developments

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- X13 integration
- Developing some default input providers
- Creating a rjd3-based version instead of RJDemetra
- Production of output formatting components
- Enhancing code performance by using RJDemetra functions that operate directly on Java objects rather than R ones
- Add other custom fields to JD\_JSON ("Keep\_ARIMA\_coefficients\_fixed", ...) and relative functionalities in the processor
- Addition of detailed error messages
- Additional testing

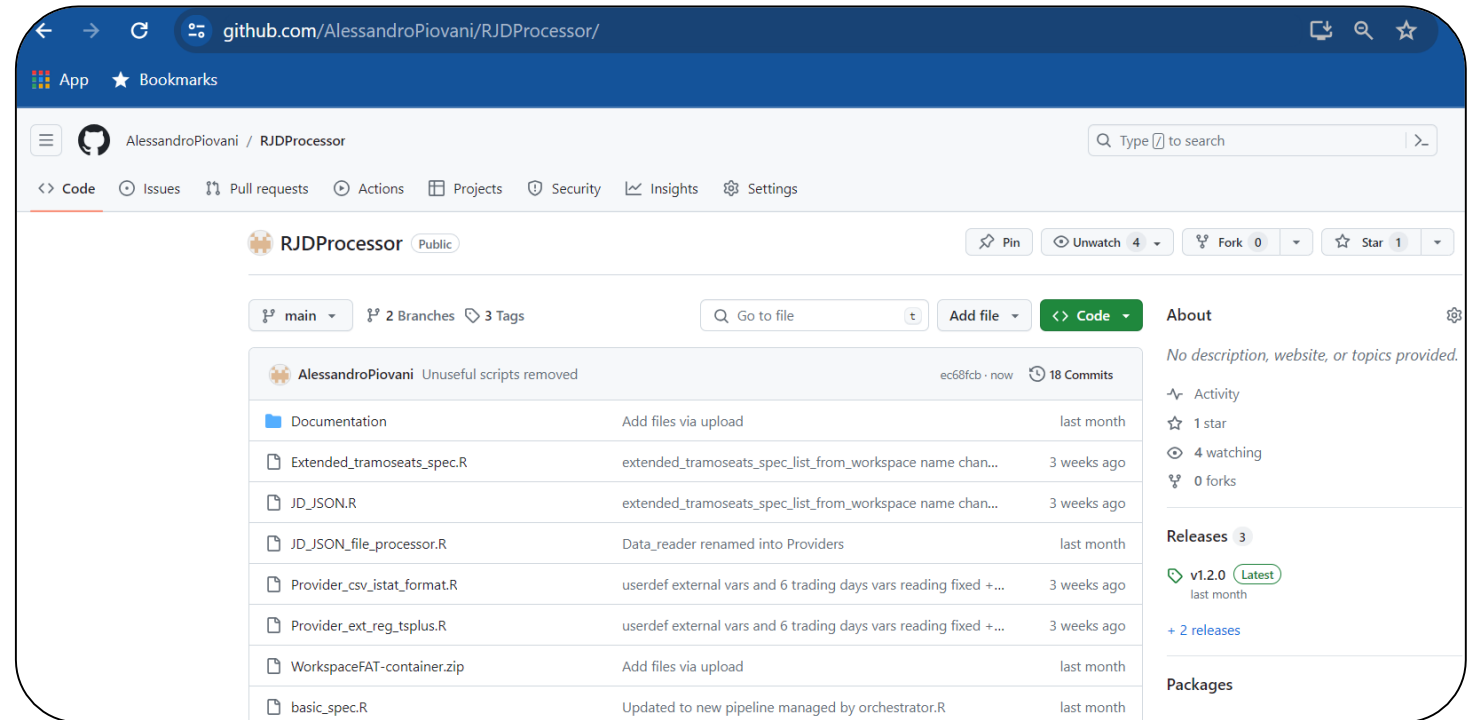
# Source code

Source code is available on GitHub:

<https://github.com/AlessandroPiovani/RJDProcessor>

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# Thanks for your attention!

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