JAMES Documentation

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Contents

Preface

Hi, welcome to JAMES!

This document contains documentation of the Joint Automatic Measurement and Evaluation System (JAMES). JAMES is fully programmed in `R` and makes it functionality available as an API running under `OpenCPU`.

This contents of the file is fully in the works. It is it neither complete nor garanteed to be accurate, consider it as a journey guide for your travel through JAMES. Nevertheless, I hope that it will help to understand basic ideas, technologies and applications.

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Chapter 1

Introduction

1.1 Overview

This chapter gives a brief overview the Joint Automatic Measurement and Evaluation System (JAMES).

JAMES is an experimental web service for creating and interpreting charts of child growth and development. The current version

1. provides access to high-quality over 300 growth charts used by the Dutch youth health care;
2. interchanges data coded according to the Basisdataset JGZ;
3. screens for abnormal height, weight and head circumference;
4. converts developmental data into the D-score;
5. plot D-scores on special D-score charts;
6. predicts future growth and development.

The service can be used by anyone interested in high-quality charts for monitoring and evaluating childhood growth and development. This chapter highlights the components of JAMES.

1.2 Architecture

JAMES provides its services through OpenCPU, an open system for scientific computing and reproducible research. The system allows for easy integration of growth charts into any `HTTPS` compliant client by means of OpenCPU's API. The JAMES webservice is a RESTful Application Programming Interface (API).

The contents of the system consist of two parts:

- **JAMES**: A collection of R packages that provides back-end functionality
- **JESSE**: A gateway front-end JAMES that translates incoming and outcoming requests (not yet realised)

1.3 R packages

1.3.1 JAMES Active packages

Active packages reside on the JAMES server and provide all functionality.

Package	Open	Description
`james`	Y	Joint Automatic Measurement and Evaluation System
`nlreferences`	Y	Growth References for Children living in The Netherlands
`centile`	Y	Translate Measurements, Z-Scores and Centiles with the RIF format
`chartbox`	Y	Collection of Growth Charts
`chartcatalog`	Y	Catalog of JAMES Growth Charts
`chartplotter`	N	Analysing and Plotting Growth Curves
`curvematching`	N	Personalised Prediction by Matching Invididuals
`donorloader`	N	Loads Donor Data from Package or Database
`brokenstick`	Y	Broken Stick Model for Irregular Longitudinal Data
`dscore`	Y	D-Score for Child Development
`bdsreader`	Y	Read Data from the Basisdataset Jeugdgezondheidszorg
`growthscreener`	Y	Finding Children with Unusual Growth Patterns
`jamesclient`	Y	Client-side R Functions for JAMES
`jamesdemodata`	Y	Demo Data for JAMES

1.3.2 JAMES Support packages

Support packages produce half-fabricated materials, provide testing or store documentation.

Package	Open	Description
`donordata`	N	Longitudinal Data for Curve Matching
`chartdesigner`	N	Design Growth Charts for JAMES
`gateway`	N	Entry to TNO online analytic growth modules
`jamesdocker`	N	JAMES Docker API
`bdsschema`	Y	Data Exchange Tools for the Basisdataset JGZ
`jamesdemo`	Y	App to interact with the JAMES chart site
`minihealth`	Y	Mini Dossier for Individual Health Data
`clopus`	N	Growth reference library

Package	Open	Description
`jamesdocs`	Y	JAMES Documentation

1.4 JESSE

1.5 JAMES servers

- Production: https://groeidiagrammen.nl/ocpu/test/, Docs (outdated): https://groeidiagrammen.nl
- Test: https://vps.stefvanbuuren.nl/ocpu/test/
- Future: `james.tno.nl`

1.6 Resources

- Demo JAMES at https://tnochildhealthstatistics.shinyapps.io/james_tryout/
- OpenCPU system
- OpenCPU API
- https://www.tno.nl/groei, https://www.tno.nl/growth

Chapter 2

JAMES data formats

2.1 Objective

This chapter describes

1. the format of the input child data accepted by JAMES;
2. the internal format used in the code in the `R` packages on https://github.com/growthcharts.

2.2 Input child data accepted by JAMES

The specification for the input data

- follows the definition of the Basisdataset JGZ 4.0.1;
- defines data objects;
- defines the actions taken by JAMES in case of incorrect, missing or out-of-range data;
- defines the error messages for informing the client.

Data accepted by JAMES should follow the JSON schema defined at https://raw.githubusercontent.com/growthcharts/bdsreader/srm/inst/schemas/bds_v3.0.json.

For backward compatibility, JAMES supports older versions of the schema (v1.0, v1.1 and v2.0). Do not use these deprecated formats for new applications.

2.3 Error checking policy

Error checking of the JSON data occurs in three phases:

1. PHASE 1: Check whether the JSON data are valid JSON. The process terminates with an error message if the input JSON is not valid.
2. PHASE 2: Validate the JSON data against the JSON schema specification. The process terminates with an error if any required fields are missing. The process generates messages for data points that do not conform to the JSON schema, but continues.
3. PHASE 3: Check the range of the numeric data. The process generates messages for out-of-range values, but continues using the specified values.

The default JSON schema in PHASE 2 is the built-in JSON schema `bds_v3.0.json`, a data format implementing a version that accepts strings as values for BDS-elements.

2.4 Checking structure of the input data against the JSON schema

The `inst/extdata/bds_v3.0` directory of the `jamesdemodata` package contains examples of input data in JSON format. Non-R user can access these from GitHub from link https://github.com/growthcharts/jamesdemodata/tree/master/inst/extdata/bds_v3.0.

Manual checking the structure of your child data can be done as follows. Surf to https://www.jsonschemavalidator.net, paste the JSON schema definition in the left panel and paste the child data in the right panel. You should see something like the Figure 2.1.

Experiment with your child file (e.g. remove the required Format field) to see what types errors the validator can catch.

2.5 BDS-elements supported by JAMES

BDS	Description	Value	Label	`R` name
19	Sex of child	“0” “1” “2”	Unknown Male Female	`sex`

BDS	Description	Value	Label	R name
		“3”	Not specified	
20	Date of birth	“yyyymmdd”	year-month-day	dob
62	Caretaker relation	“01”	biological father	
		“02”	biological mother	
		“03”	male partner, stepfather	
		“04”	female partner, stepmother	
		“05”	adoptive father	
		“06”	adoptive mother	
		“07”	foster father	
		“08”	foster mother	
		“98”	other	
63	Caretaker date of birth	“yyyymmdd”	year-month-day	dobf
				dobm
				agem
66	Caretaker education	“01”	no primary school	-
		“02”	primary school, special ed	
		“03”	VSO-MLK/IVBO/VMBO-LWOO	
		“04”	LBO/VBO/VMBO-BBL&KBL	
		“05”	MAVO/VMBO-GL&TL	
		“06”	MBO	
		“07”	HAVO/VWO	
		“08”	HBO/HTS/HEAO	
		“09”	WO	
		“98”	Other	
		“00”	Unknown	
71	Caretaker birth country	“dddd”	4-digit code, Table 34	etn (always NL)
82	Gestational age	“ddd”	in days	gad
91	Smoking during pregnancy	“1”	yes	smo
		“2”	no	
		“99”	unknown	
110	Birth weight	“dddd”	3-4 digits, grammes	bw (g)
235	Length/height	“dddd”	3-4 digits, millimeters	hgt (cm)
245	Body weight	“dddddd”	3-6 digits, grammes	wgt (kg)

BDS	Description	Value	Label	`R` name
252	Head circumference	"ddd"	2-3 digits, millimeters	`hdc` (cm)
238	Height biological mother	"dddd"	3-4 digits, millimeters	`hgtf` (cm)
240	Height biological father	"dddd"	3-4 digits, millimeters	`hgtm` (cm)
510	Passive smoking	"01"	No smoking in house	-
		"02"	Never with child	
		"03"	Not in last 7 days	
		"04"	Yes	

JAMES supports the following BDS numbers with Van Wiechen items: 879, 881, 883, 884, 885, 887, 888, 889, 890, 891, 894, 896, 897, 898, 902, 903, 906, 907, 910, 912, 914, 916, 917, 918, 920, 922, 923, 926, 945, 951, 955, 956, 958, 959, 961, 962, 964, 966, 968, 970, 971, 973, 975, 977, 978, 986, 989, 991, 993, 994, 996, 999, 1002, 886, 892, 893, 900, 905, 909, 913, 921, 927, 928, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 943, 947, 948, 949, 950, 953, 954, 972, 980, 982, 984, 998, 1001, 1278.

The results of the Van Wiechen items are converted into 0/1 codes (by bdsreader:::convert_ddi_gsed) and stored with GSED 9-position names as defined by the `dscore` package.

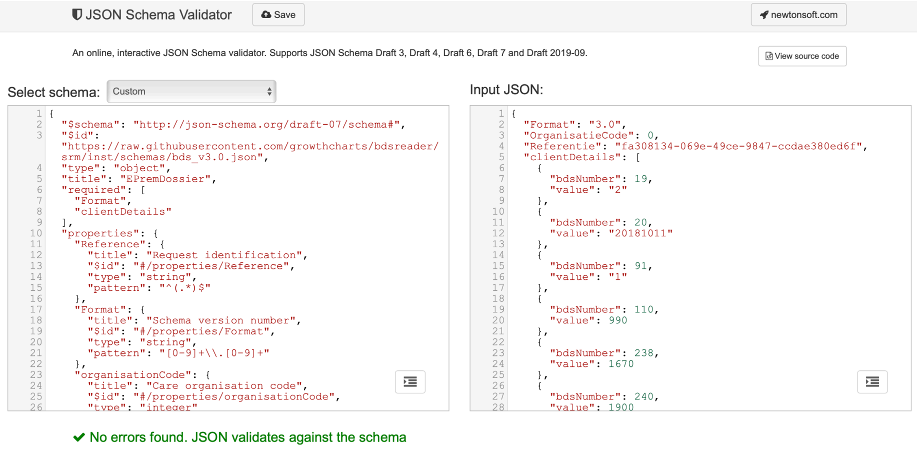
In addition, JAMES reads the following non-BDS fields:

Fields	Description	Type	`R` name
Reference	Description (opt)	String	`name`
Format	JSON schema number (req)	Number.Number	-
organisationCode	Organisation code (opt)	Integer	`src`

2.6 JAMES internal data

Suppose we coded the following data set.

```
{
  "Format": "3.0",
  "organisationCode": 1234,
  "Reference": "Maria",
  "clientDetails": [
    {
      "bdsNumber": 19,
```



An online, interactive JSON Schema validator. Supports JSON Schema Draft 3, Draft 4, Draft 6, Draft 7 and Draft 2019-09.

Select schema: Custom

```
{
  "$schema": "http://json-schema.org/draft-07/schema#",
  "$id":
  "https://raw.githubusercontent.com/growthcharts/bdsreader/
  srm/inst/schemas/bds_v3.0.json",
  "type": "object",
  "title": "EPremDossier",
  "required": [
    "Format",
    "clientDetails"
  ],
  "properties": {
    "Reference": {
      "title": "Request identification",
      "$id": "#/properties/Reference",
      "type": "string",
      "pattern": "^(.*)$"
    },
    "Format": {
      "title": "Schema version number",
      "$id": "#/properties/Format",
      "type": "string",
      "pattern": "[0-9]+\\.[0-9]+"
    },
    "organisationCode": {
      "title": "Care organisation code",
      "$id": "#/properties/organisationCode",
      "type": "integer"
```

Input JSON:

```
{
  "Format": "3.0",
  "OrganisatieCode": 0,
  "Referentie": "fa308134-069e-49ce-9847-ccdae380ed6f",
  "clientDetails": [
    {
      "bdsNumber": 19,
      "value": "2"
    },
    {
      "bdsNumber": 20,
      "value": "20181011"
    },
    {
      "bdsNumber": 91,
      "value": "1"
    },
    {
      "bdsNumber": 110,
      "value": 990
    },
    {
      "bdsNumber": 238,
      "value": 1670
    },
    {
      "bdsNumber": 240,
      "value": 1900
```

✓ No errors found. JSON validates against the schema

Figure 2.1: Manual validation of a child dataset (right side) according JSON schema `bds_v3.0.json`.

```
      "value": "2"
    },
    {
      "bdsNumber": 20,
      "value": "20181011"
    },
    {
      "bdsNumber": 82,
      "value": 189
    },
    {
      "bdsNumber": 91,
      "value": "1"
    },
    {
      "bdsNumber": 110,
      "value": 990
    },
    {
      "bdsNumber": 238,
      "value": 1670
    },
    {
      "bdsNumber": 240,
      "value": 1900
    }
  ],
  "clientMeasurements": [
    {
      "bdsNumber": 235,
      "values": [
        {
          "date": "20181111",
          "value": 380
        },
        {
          "date": "20181211",
          "value": 435
        }
      ]
    },
    {
      "bdsNumber": 245,
      "values": [
        {
          "date": "20181011",
          "value": 990
        },
        {
          "date": "20181111",
          "value": 1250
        },
        {
          "date": "20181211",
          "value": 2100
        }
      ]
    },
    {
      "bdsNumber": 252,
      "values": [
        {
          "date": "20181111",
          "value": 270
        },
        {
          "date": "20181211",
          "value": 305
        }
      ]
    }
  ],
  "nestedDetails": [
    {
      "nestingBdsNumber": 62,
      "nestingCode": "01",
      "clientDetails": [
        {
          "bdsNumber": 63,
          "value": "19950704"
        }
      ],
      "clientMeasurements": [

      ]
    },
    {
      "nestingBdsNumber": 62,
      "nestingCode": "02",
      "clientDetails": [
        {
          "bdsNumber": 63,
          "value": "19901202"
        }
      ],
      "clientMeasurements": [

      ]
    }
  ]
}
```

The following R script shows reading and conversion of the data.

```
library(bdsreader)
fn <- system.file("examples/maria.json", package = "bdsreader")
m <- read_bds(fn)
```

Object `m` object is a list with two components:

- `m$psn` a tibble with one row containing fixed covariates
- `m$xyz` a tibble with multiple rows with time-varying data

```
m$psn
```

```
## # A tibble: 1 x 16
##      id name  dob        dobf       dobm       src   dnr   sex      gad    ga
##   <int> <chr> <date>     <date>     <date>     <chr> <chr> <chr>  <dbl> <dbl>
## 1    -1 Maria 2018-10-11 1995-07-04 1990-12-02 1234  <NA>  female   189    27
## # i 6 more variables: smo <int>, bw <dbl>, hgtm <dbl>, hgtf <dbl>, agem <dbl>,
## #   etn <chr>
```

```
m$xyz
```

```
## # A tibble: 11 x 8
##       age xname yname zname zref                        x     y      z
##     <dbl> <chr> <chr> <chr> <chr>                   <dbl> <dbl>  <dbl>
##  1 0.0849 age   hgt   hgt_z nl_2012_hgt_female_27  0.0849 38    -0.158
##  2 0.0849 age   wgt   wgt_z nl_2012_wgt_female_27  0.0849  1.25 -0.203
##  3 0.0849 age   hdc   hdc_z nl_2012_hdc_female_27  0.0849 27    -0.709
##  4 0.0849 age   bmi   bmi_z nl_1997_bmi_female_nl  0.0849  8.66 -5.72
##  5 0.167  age   hgt   hgt_z nl_2012_hgt_female_27  0.167  43.5   0.047
##  6 0.167  age   wgt   wgt_z nl_2012_wgt_female_27  0.167   2.1   0.015
##  7 0.167  age   hdc   hdc_z nl_2012_hdc_female_27  0.167  30.5  -0.913
##  8 0.167  age   bmi   bmi_z nl_1997_bmi_female_nl  0.167  11.1  -3.77
##  9 0      age   wgt   wgt_z nl_2012_wgt_female_27  0       0.99  0.19
## 10 0.0849 hgt   wfh   wfh_z nl_2012_wfh_female_   38       1.25 -0.001
## 11 0.167  hgt   wfh   wfh_z nl_2012_wfh_female_   43.5     2.1   0.326
```

Chapter 3

Growth charts in JAMES

3.1 Chart naming conventions

The link https://groeidiagrammen.nl/ocpu/lib/james/www/ contains an interactive overview of the available growth charts. There are many different charts: for boys and girls, for preterms, for different age ranges, for specific ethnic groups, for height, weight, BMI, and so on. Each chart has a chart code, a character code identifying the design. This section explains the construction of the chart codes.

The GitHub repository https://github.com/growthcharts/chartbox contains the chart libraries that are available to JAMES. The `list_charts()` function produces a tabular overview.

```
charts <- chartbox::list_charts()
dim(charts)
```

```
## [1] 478   8
```

```
charts[c(1, 22, 23, 300, 301, 340), ]
```

```
##     chartgrp chartcode population    sex design  side language week
## 1     nl2010      DJAA         DS   male      A front    dutch     
## 22    nl2010      DMBA         DS female      B front    dutch     
## 23    nl2010      DMBB         DS female      B  back    dutch     
## 300  preterm   PMAAN32         PT female      A front    dutch   32
## 301  preterm   PMAAN33         PT female      A front    dutch   33
## 340  preterm   PMAHN36         PT female      A   hgt    dutch   36
```

The `chartbox` package currently contains three chart groups: `nl2010`, `preterm` and `who`. Each group collects charts of a similar type.

Chart Group	N	Chart code	Description	Source
`nl2010`	140	CCCC	Dutch children 0-21 years, including minorities	Talma et al. (2010)
`preterm`	240	CCCCCNN	Dutch preterms, ga <= 36 weeks, 0-4 years	Bocca-Tjeertes et al. (2012)
`who`	14	CCCC	WHO Child Growth Standards 0-4 years	WHO

The chart code is an alpha-numeric code of four (for `nl2010` and `who`) or seven (for `preterm`) that uniquely identifies each of the charts. The table below specifies the full coding schema used to construct the chart codes.

Position	Field	Value	Description
1	Population	N	Dutch
		T	Turkish
		M	Moroccan
		H	Hindostan
		P	Preterm
		W	WHO
2	Sex	J	Male
		M	Female
3	Design	A	0-15 months
		B	0-4 years, WFH
		C	1-21 years
		D	0-21 years
		E	0-4 years, WFA
4	Side	A	A4, front
		B	A4, back
		C	A4, back, no `hdc`
		D	square, `dsc`
		H	square, `hgt`
		O	square, `hdc`
		Q	square, `bmi`
		R	square, `wfh`
		W	square, `wgt`
		X	A4, double sided

Position	Field	Value	Description
5	Language	N	Dutch
		E	English
6-7	Week	25-36	Gestational age

For illustration, code `NJAA` references to Dutch (`N`), boys (`J`), 0-15 month (`A`), front side (`A`). Likewise, `PMEAN33` codes for the chart of preterm (`M`), girls (`M`), 0-4 years (`E`), front side (`A`), Dutch language (`N`) born at 33 weeks of gestation (`33`).

Some forms hold multiple growth charts. For example, the `NJAA` chart is designed for A4 paper size (297mm × 210mm) and contains three growth charts: head circumference by age, length by age, and weight by age. Some others have no diagram, like `NJAB`. All square formats hold just one growth chart. All of the square forms have equal sizes (160mm × 160mm).

The following table lists the measures per design-form combination.

Design	Side	Measure	Description
A	A	`hdc`	Head circumference by age, 0-15 mo
		`hgt`	Length by age, 0-15 mo
		`wgt`	Weight by age, 0-15 mo
	B		Backside explanations
	D	`dsc`	D-score by age, 0-15 mo
	H	`hgt`	Length by age, 0-15 mo
	O	`hdc`	Head circumference by age, 0-15 mo
	W	`wgt`	Weight by age, 0-15 mo
B	A	`wfh`	Weight for height, 0-4 yr
		`hgt`	Length by age, 0-4 yr
	B	`hdc`	Head circumference by age, 0-4 yr
	C		Backside explanations
	D	`dsc`	D-score by age, 0-4 yr
	H	`hgt`	Height by age, 0-4 yr
	O	`hdc`	Head circumference by age, 0-4 yr
	R	`wfh`	Weight for height, 0-4 yr
	W	`wgt`	Weight by age, 0-4 yr
C	A	`wfh`	Weight for height, 1-21 yr
		`hgt`	height by age, 1-21 yr
	B	`bmi`	BMI by age, 1-21 yr
		`hdc`	Head circumference by age, 1-21 yr
	C	`bmi`	BMI by age, 1-21 yr
	H	`hgt`	Height by age, 1-21 yr
	O	`hdc`	Head circumference by age, 1-21 yr
	Q	`bmi`	Body mass index by age, 1-21 yr

Design	Side	Measure	Description
E	R	`wfh`	Weight for height, 1-21 yr
	A	`wgt`	Weight by age, 0-4 yr
		`hgt`	height by age, 0-4 yr
	B	`hdc`	Head circumference by age, 0-4 yr
	H	`hgt`	Height by age, 0-4 yr
	O	`hdc`	Head circumference by age, 0-4 yr
	W	`wgt`	Weight by age, 0-4 yr

Chapter 4

Methods

We describe our methods in this chapter.

Chapter 5

D-score implementation

This document describes the actions taken to implement the D-score into JAMES. The functionality of JAMES is distributed over multiple packages. This set of actions may be of interest when implementing new features.

5.1 Actions

Package	PR	Description
minihealth	03a32f1	Create milestones descriptions
dscore	f0013ce	Link BDS number to Van Wiechen milestones
dscore	6886854	Fine tuning of milestone labels
minihealth		Create the `bds_lexicon` object
minihealth	4893982	Add milestones to BDS validation JSON schema
minihealth	0069671	Add `convert_ddi_gsed()` to convert BDS-milestones into GSED items
minihealth	8ab1392	Add a new class `individualDS` for storing milestones, D-score and DAZ
clopus	1182cb0	Add Dutch and GCDG D-score references

Package	PR	Description
clopus	7bdbcd9	Construct age-shifted D-score references for preterms
clopus	ceab7f9	Import the D-score references into `clopus`
chartdesigner	6883190	Add chart constructor functions for D-score, both terms and pre-terms
chartdesigner	511f456	Extend internal `set.axes.design()` to D-score charts
chartdesigner	6582af8	Extend to `axes.locations` object to D-score charts
chartdesigner	47e3cc3	Create `dchart()` function and extend its helper functions
chartdesigner	fbbc7c8	Function `chartcode()` factory, make one function for each chart code
chartcatalog	cc46788	Extend the chart naming system to D-score charts
chartcatalog	84aaded	Extend the lookup table `ynames_lookup` to handle new D-score charts
chartbox	aa31067	Extend chart box with all D-score charts
james	6412840	Add radio button for D-score charts
minihealth	06a04c9	Calculate D-score and DAZ
chartplotter	4b58638	Skip the `dsc` field for finding matches
minihealth	816be33	Add D-score and DAZ to class `individualAN`
donordata	77e01b4	Add milestones to SMOCC donor data
donordata	ecb3413	Calculate D-score and DAZ for SMOCC data
donordata	3fa9d4d	Fit and store brokenstick model for D-score on SMOCC data
donorloader	c22c446	Update internal data after changes in donordata
jamesdocs	TBD	Document steps (this file)

Package	PR	Description
donordata	7983c3	Saves the item scores to create JSON files
donordata	1537182	Save mapping between SMOCC and BDS coding scheme
donorloader	e9a8ed	Make `smocc_bds` available to JAMES
jamestest	648419	Regenerate smocc JSON files to include DDI scores
jamestest	ce1dbe	Update the `installed.cabinets` object with the new individual milestones data
minihealth	4dda8d	Add class `individualRW` to store and convert raw milestones data
minihealth	9e03e7	Complete the JSON validator schema

Chapter 6

OpenCPU deployment

6.1 Objective

This chapter describes how to install JAMES on the server that run OpenCPU. This is the classic way to install and run OpenCPU applications, and has the advantage that AppArmor prevents various types of malicious behaviour. In the future, we will replace this procedure by containerised deployment using Docker.

6.2 Pre-requisites

- The server runs `Ubuntu 18.04` (or later, not tested on Ubuntu 20.04).
- The user needs sudo access to the server that run `OpenCPU`.

6.3 Installation of JAMES in

Here is a set of commands that removes R and its libraries, installs the latest R fresh from source, install JAMES and puts the machine to work.

A lot can go wrong. Please be patient to check each step.

```
#!/bin/bash
# Re-install opencpu-server, R and the libs

# make system up to date
sudo apt-get update
sudo apt-get upgrade
```

```
# disable opencpu
sudo a2dissite opencpu
sudo apachectl restart

# disable pubertyplot & webtool (only on testserver)
sudo a2dissite puberty
sudo a2dissite webtool
sudo apachectl restart

# save configuration files
mkdir conf
cp -rv /etc/opencpu/ ~/conf/
cp -rv /etc/apache2/ ~/conf/

# uninstall opencpu server & full
sudo apt-get purge opencpu-server
sudo apt-get purge opencpu-full

# remove all R libs
R -e '.libPaths()'
sudo rm -rf /usr/local/lib/R/site-library
sudo rm -rf /usr/lib/R/site-library
sudo rm -rf /usr/lib/R/library

# remove R
sudo apt-get purge r-base-core
sudo apt-get purge r-base
sudo apt-get autoremove

# add backport repositories for Ubuntu packages required by some R packages
sudo add-apt-repository 'deb https://mirror.nl.datapacket.com/ubuntu/ bionic main'
sudo add-apt-repository 'deb-src https://mirror.nl.datapacket.com/ubuntu/ bionic main'

# install R. See https://cran.r-project.org/bin/linux/ubuntu/
# update indices
sudo apt update -qq
# install two helper packages we need
sudo apt install --no-install-recommends software-properties-common dirmngr
# import the signing key (by Michael Rutter) for these repo
sudo apt-key adv --keyserver keyserver.ubuntu.com --recv-keys E298A3A825C0D65DFD57CBB65
# we use R 4.0 (however note this actually installs R 4.1!! (May 2021))
sudo add-apt-repository 'deb https://cloud.r-project.org/bin/linux/ubuntu bionic-cran40
# in the future: use cran-41
sudo apt install r-base
# install r-base-dev because we want to compile from source
```

```
sudo apt-get install r-base-dev

# install opencpu-server
sudo add-apt-repository -y ppa:opencpu/opencpu-2.2
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install -y opencpu-server

# restart opencpu
sudo a2ensite opencpu
sudo apachectl restart

# manually check https://vps.stefvanbuuren.nl/ocpu
# or https://www.groeidiagrammen.nl/ocpu

# install application package: pubertyplot - only on dev server
sudo R -e 'install.packages("/home/stef/packages/pubertyplot_1.3.tar.gz", repos = NULL)'
sudo a2ensite puberty
sudo apachectl restart

# install application package: webtool - only on dev server
sudo R -e 'install.packages("RMySQL")'
sudo R -e 'install.packages("/home/stef/packages/webtool_1.1.tar.gz", repos = NULL)'
sudo a2ensite webtool
sudo apachectl restart

# install JAMES packages - this may take a while - you need the right priveledges
sudo R -e 'install.packages("remotes")'
sudo R -e 'remotes::install_github("growthcharts/james")'

# remove duplicate packages
# evade errors: "namespace 'vctrs' 0.3.6 is already loaded, but >= 0.3.8 is required"
sudo R -e 'remove.packages(c("ellipsis", "pillar", "vctrs"), "/usr/lib/opencpu/library")'

# copy back opencpu configuration for JAMES (if they were OK, otherwise tweak)
sudo rm -rf /etc/opencpu
sudo cp -rv ~/conf/opencpu /etc/opencpu/

# active JAMES
sudo apachectl restart

# check on https://tnochildhealthstatistics.shinyapps.io/james_tryout/

# clean up: delete ~/conf/ after everything works
rm -rf conf
```

Chapter 7

Dockerfile for JAMES

7.1 Objective

This chapter describes how to build and deploy JAMES as a Docker container.

7.2 Pre-requisites

JAMES is currently constructed from a collection of `R` packages. The top-level package at https://github.com/growthcharts/james also defines a Javascript interface in the `inst/www` directory. Deployment of JAMES relies on the `OpenCPU` server. In principle, it is enough to install the `james` package on the `OpenCPU` server, and will also install all dependencies.

The following is needed to build and run a JAMES image:

- Permission to read from the following private repo's:
  - `growthcharts/chartplotter`
  - `growthcharts/curvematching`
  - `growthcharts/donorloader`
  - `growthcharts/jamesdocker`
- If needed, a personal Github token with repo scope from here, Generate a token with only scope repo.
- Install `Docker Desktop` on your local machine, and run some tutorials

7.3 Dockerfile

The Dockerfile is at https://raw.githubusercontent.com/growthcharts/jamesdocker/master/Dockerfile, which is located in the private repo https://github.com/growthcharts/jamesdocker. You need authentication to use this resource.

- Clone the `growthcharts/jamesdocker` repo to your machine
- Set working directory to root of `jamesdocker`
- If needed: Add the file `docker/opencpu_config/Renviron` with contents `GITHUB_PAT=fa2...` with your own GITHUB_PAT.

7.4 Docker commands

Build the `james` image, type in a terminal

```
docker build -t james .
```

This may takes a long time (30 minutes), in which the entire application is downloaded from various web-locations. After (hopefully successful) completion, check the image

```
docker images -a
```

If all is well, the top line is called `james`. Now run the container on your local machine:

```
docker run -t -d -p 80:80 james
```

If the ports are already taken by other containers, stop and remove all containers:

```
docker stop $(docker ps -a -q)
docker rm $(docker ps -a -q)
```

Reissue the `docker run`, and the container should now run. Check by

```
docker ps
```

which should list a container created from the `james` image.

If you want to enter the container use

```
docker exec -i -t 6c /bin/bash
```

where `6c` are the first two characters of the container ID.

Inside the container, check font matching of Arial as

```
fc-match Arial
```

7.5 Checks with the browser

```
http://localhost
```

should show Apache2 Ubuntu default screen.

```
http://localhost/ocpu/test/
```

should show `OpenCPU` test page.

```
http://localhost/rstudio/
```

should start the Rstudio IDE - *if installed* . Use `opencpu:opencpu` to log in.

```
http://localhost/ocpu/library/james/www/
```

should start the JAMES javascript interface.

See also https://registry.hub.docker.com/r/opencpu/rstudio

7.6 Security

1. Don't use the intermediate container, since it will contain your token in `/.Renviron`. The latest (`james`) container does not hold your token, and can be shared.
2. The container is shielded from the machine on which it runs. However, the materials within the container are only protected by `R_LIMITS`. In general, for production it is wise to add restriction on the `OpenCPU` server.

Chapter 8

Certificates

8.1 Objective

The use of `htpps` requires that Apache runs with proper and validated certificates. Users can assess the status of the certificate by clicking on the slot in the browser bar. Certificates are issues by a Certificate Authority (CA) and are valid for one year. The period of one year is just enough to forget how to install and update certificates. This text shows how to renew the certificate.

8.2 vps.stefvanbuuren.nl

The server runs `Ubuntu 18.04 LTS`. The Apache configuration file `/etc/apache2/sites-enabled/default-ssl.con` contains the following lines

```
        SSLCertificateFile  /etc/ssl/crt/vps.stefvanbuuren.nl.chained.crt
        SSLCertificateKeyFile   /etc/ssl/crt/vps.stefvanbuuren.nl.key
```

The file `.key` is the private key, which should not leave the machine and only be read/write by sudoers. The file `..chained.crt` is the certificate file, which needs to be updated after expiry. There is some hand work involved in creating this file.

8.2.1 Step 1: Create the CSR file

```
ssh into vps.stefvanbuuren.nl
cd /etc/ssl/crt
openssl req -new -newkey rsa:2048 -nodes -keyout vps.stefvanbuuren.nl.key -out vps.stefvanbuuren.
```

You need to answer some questions (See http://edtechchris.com/2020/02/11/generate-csr-with-openssl-on-ubuntu/). Show the result:

```
cat vps.stefvanbuuren.nl.csr
```

Copy the contents of the CSR file onto the clipboard. Save also on desktop under `Package/james/certificates_vps.stefvanbuuren.nl/{expiryyear}` for archiving.

8.2.2 Step 2: Buy new certificate

The current CA is Network Solutions. Log into their website, and pay their renewal fee (about $86 per year). Select Apache/Ubuntu, paste CSR clipboard file into appropriate box, and submit.

Within 30 minutes you get a request to validate in the mailbox. After that is done, you get a new mail saying that certificates are available. Download everything.

8.2.3 Step 3: Create the crt file

Collect the following four files into `Package/james/certificates_vps.stefvanbuuren.nl/{expiryyea`

```
dv_chain.txt
DV_NetworkSolutionsDVServerCA2.crt
DV_USERTrustRSACertificationAuthority.crt
VPS.STEFVANBUUREN.NL.crt
```

Create a new file as follows:

- Open with text editor `dv_chain.txt` and `VPS.STEFVANBUUREN.NL.crt`
- Paste the contents of `VPS.STEFVANBUUREN.NL.crt` *before* the contents of `dv_chain.txt`. There will be three sections.
- Save the result under file name `vps.stefvanbuuren.nl.chained.crt`

8.2.4 Step 4: Transfer to server

Copy the file onto the server, home directory, by `ftp`. Move it in place by

```
sudo mv vps.stefvanbuuren.nl.chained.crt /etc/ssl/crt/vps.stefvanbuuren.nl.chained.crt
```

This overwrites the expired certificate.

8.2.5 Step 5: Restart Apache2

If you changed `/etc/apache2/sites-enabled/default-ssl.conf` check for syntactic validity.

```
apachectl configtest
```

If OK, then

```
sudo apachectl restart
```

If all is well, Apache restarts and uses the updated certificate.

8.2.6 Troubleshooting

If it doesn't work, check whether the results of the following statements are identical.

```
openssl x509 -noout -modulus -in vps.stefvanbuuren.nl.chained.crt | openssl md5
sudo openssl rsa -noout -modulus -in vps.stefvanbuuren.nl.key | openssl md5
```

If not, there is a mismatch between private key and certificate. See https://stackoverflow.com/questions/26191463/ssl-error0b080074x509-certificate-routinesx509-check-private-keykey-values?rq=1 for fixes.

For others errors, consult the standard log

```
sudo tail -f /var/log/apache2/error.log
```

Bibliography

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