

The *rmoparser* : Parser combinator in R

Juan Gea Rosat, Ramon Martínez Coscollà

December 12, 2013

Contents

1	Introduction	2
1.1	Package functionality	2
1.2	Package descriptive files in R	3
1.2.1	Field parametrization	3
	Package name	3
	Name of file containing this document	3
	Package title	3
	Description	3
	Author	3
	Version	3
	Date	4
	License	4
1.2.2	DESCRIPTION	4
1.2.3	qmrparser-package	4
1.2.4	NAMESPACE	6
2	Parser combinator	7
2.1	StreamParser	7
2.1.1	Motivation	7
2.1.2	Generic interface	7
2.1.3	StreamParser from file name	11
2.1.4	Stream parser from character string	17
2.2	Character sets	21
2.2.1	isWhitespace	21
2.2.2	isNewline	22
2.2.3	isDigit	23
2.2.4	isUppercase	24
2.2.5	isLowercase	25
2.2.6	isLetter	26
2.2.7	isSymbol	27
2.2.8	isHex	28
2.3	Tokens/Words	29
2.3.1	eofMark	30

2.3.2	whitespace	32
2.3.3	separator	34
2.3.4	numberNatural	38
2.3.5	numberInteger	40
2.3.6	numberFloat	42
2.3.7	numberScientific	45
2.3.8	symbolic	52
2.3.9	string	54
2.3.10	commentParser	57
2.3.11	keyword	62
2.3.12	dots	64
2.3.13	empty	66
2.3.14	charParser	68
2.3.15	charInSetParser	70
2.3.16	Tests	72
	Combined tests	72
	RUnit	74
	Utility functions	75
	printCStream	75
	checkTokenParserOk	75
	checkTokenParserFail	75
	checkSentParserOk	76
	checkSentParserFail	76
	RUnit in R CMD check	76
2.4	Parsers combining parsers	79
2.4.1	alternation	80
2.4.2	option	83
2.4.3	concatenation	86
2.4.4	repetition1N	90
2.4.5	repetition0N	94
2.4.6	Tests	98
	Combined tests	98
	RUnit	99
	Utility functions	99
	action	100
	actionString	100
3	PC-AXIS	101
3.1	Introduction	101
3.2	PC-AXIS file format syntactical analysis	101
3.2.1	Notes	101
3.2.2	man	104
3.2.3	code	108
3.2.4	test	116

3.3	PC-AXIS cube : Semantics (PC-AXIS file content	120
3.3.1	Notes	120
3.3.2	man	121
3.3.3	code	125
3.4	CSV file creation from PC-AXIS cube	133
3.4.1	man	133
3.4.2	code	135
3.5	Combined tests for functions handling PC-AXIS files	135
4	Package creation	138
4.1	Instructions	138
4.2	Makefile	140
5	Data files used	149
5.1	Manual test files	149
5.1.1	datInTest01.txt	149
5.2	PC-AXIS test functions	149
5.2.1	datInSFexample6_1.px	150
5.2.2	datInSFexample6_2.px	150
5.2.3	datInSFexample6_3.px	152
5.2.4	datInSFexample6_4.px	155
5.2.5	datInSFexampleA_5.px	156
5.2.6	datInSFexample6_5.px	160
6	Appendix	163
6.1	Literate programming	163
6.1.1	totex	163

Chapter 1

Introduction

1.1 Package functionality

The aim of this package is to provide a collection of functions which allow easily programming of parsers, for not so common data files formats. To achieve this objective it is enough to have a very basic collection of functions. As the first practical applications, recognition of PC-AXIS format is implemented.

Theoretical references about grammars, parsers, parser combinator can be found in:

- Context-free grammar.
http://en.wikipedia.org/wiki/Context-free_grammar
- Backus–Naur Form.
http://en.wikipedia.org/wiki/Backus%E2%80%93Naur_Form
- Extended Backus–Naur Form
http://en.wikipedia.org/wiki/Extended_Backus%E2%80%93Naur_Form
- Parser combinator
http://en.wikipedia.org/wiki/Parser_combinator
- Parsing
http://en.wikipedia.org/wiki/List_of_algorithms#Parsing

and references about PC-AXIS:

- PC-Axis file format
http://www.scb.se/Pages/List____314011.aspx

- PC-Axis file format manual. Statistics of Finland.
http://tilastokeskus.fi/tup/pcaxis/tiedostomuoto2006_laaja_en.pdf

1.2 Package descriptive files in R

1.2.1 Field parametrization

Package name

It is convenient to use a system and language portable name.

$\langle PACKAGE \rangle \equiv$

qmrparser

Name of file containing this document

Extension cannot be tex since a latex file is generated with this name

$\langle NAMEPKGLP \rangle \equiv$

< < PACKAGE > >.nw

Package title

$\langle TITLE \rangle \equiv$

Parser combinator in R

Description

$\langle DESCRIPTIONFIELD \rangle \equiv$

Basic functions for building parsers, with an application to PC–AXIS format files.

Author

$\langle AUTHOR \rangle \equiv$

Juan Gea Rosat, Ramon Martínez Coscollà

Version

$\langle VERSION \rangle \equiv$

0.1.4

Date

$\langle DATE \rangle \equiv$

2012-08-29

License

$\langle LICENSE \rangle \equiv$

GPL (≥ 3)

1.2.2 DESCRIPTION

$\langle DESCRIPTION \rangle \equiv$

Package: $\langle \langle PACKAGE \rangle \rangle$

Type: Package

Title: $\langle \langle TITLE \rangle \rangle$

Version: $\langle \langle VERSION \rangle \rangle$

Date: $\langle \langle DATE \rangle \rangle$

Author: $\langle \langle AUTHOR \rangle \rangle$.

Maintainer: Juan Gea $\langle \text{juangea@geax.net} \rangle$

Description: $\langle \langle DESCRIPTIONFIELD \rangle \rangle$

License: $\langle \langle LICENSE \rangle \rangle$

Depends: R ($\geq 2.11.1$)

Suggests: RUnit

LazyLoad: yes

Encoding: UTF-8

1.2.3 qmrparser-package

$\langle \text{qmrparser-package.Rd} \rangle \equiv$

```

\name{< < PACKAGE > >-package}
\alias{< < PACKAGE > >-package}
\alias{< < PACKAGE > >}
\docType{package}
\title{
< < TITLE > >
}
\description{
< < DESCRIPTIONFIELD > >
}
\details{
\table{ll}{
Package: \tab < < PACKAGE > >\cr
Type: \tab Package\cr
Version: \tab < < VERSION > >\cr
Date: \tab < < DATE > >\cr
License: \tab < < LICENSE > >\cr
LazyLoad: \tab yes\cr
}
Collection of functions to build programs to read complex data files
  formats, with an application to the case of PC-Axis format.
}
\author{
< < AUTHOR > >

Maintainer: Juan Gea Rosat <juangea@geax.net>
}
\references{

Parser combinator.
\url{http://en.wikipedia.org/wiki/Parser_combinator}

Context-free grammar.
\url{http://en.wikipedia.org/wiki/Context-free_grammar}

PC-Axis file format.
\url{http://www.scb.se/Pages/List_____314011.aspx}

Type \code{RShowDoc("index",package="< < PACKAGE > >")} at
  the R command line to open the package vignette.

Type \code{RShowDoc("< < PACKAGE > >",package="< <
  PACKAGE > >")} to open pdf developer guide.

```


Source code used in literate programming can be found in folder 'noweb'.

```
}  
\keyword{ package }  
\keyword{ parser combinator }  
\keyword{ token }  
\keyword{ PC-Axis }
```

1.2.4 NAMESPACE

```
 $\langle NAMESPACE \rangle =$   
exportPattern("^[:alpha:]+")
```

Chapter 2

Parser combinator

2.1 StreamParser

2.1.1 Motivation

While syntactically analysing, text characters are processed sequentially. In each point of the process, there may be several applicable rules and, for this reason, the chosen and applied rule may turn out to be incorrect after one or some steps. In this case, analysis cannot go forward and parser needs to go backwards in text. Therefore, an interface which allows this translation throughout the text is required.

2.1.2 Generic interface

Generic interface defining four functions which allows character processing.

They are implemented as list elements, although S3 or S4 could have been used.

From now on, this interface is called streamParser.

$\langle streamParser.Rd \rangle \equiv$

```

\name{streamParser}
\alias{streamParserNextChar}
\alias{streamParserNextChar}
\alias{streamParserNextCharSeq}
\alias{streamParserPosition}
\alias{streamParserClose}
\title{
  Generic interface for character processing, allowing forward and
  backwards translation.
}
\description{
  Generic interface for character processing. It allows going forward
  sequentially or backwards to a previous arbitrary position.

  Each one of these functions performs an operation on or obtains
  information from a character sequence (stream).
}
\usage{
streamParserNextChar(stream)
streamParserNextCharSeq(stream)
streamParserPosition(stream)
streamParserClose(stream)
}
\arguments{
\item{stream}{object containing information about the text to be
  processed and, specifically, about the next character to be read}
}

\details{
\itemize{
\item{streamParserNextChar}{

  Reads next character, checking if position to be read is correct.
}

\item{streamParserNextCharSeq}{

  Reads next character, without checking if position to be read is
  correct. Implemented since it is faster than streamParserNextChar}

\item{streamParserPosition}{

  Returns information about text position being read.}
}
}

```

```

\item{streamParserClose}{
    Closes the stream}
}

\value{
\item{streamParserNextChar and streamParserNextCharSeq}{
    Three field list:
    \itemize{
        \item{status}{
            "ok" or "eof"}
        \item{char}{
            Character read (ok) or "" (eof)}
        \item{stream}{
            With information about next character to be read or same
            position if end of file has been reached ("eof")}
    }
}

\item{streamParserPosition}{
    Three field list:
    \itemize{
        \item{fileName}{
            File name or "" if the stream is not associated with a file name
        }
        \item{line}{
            line number}
        \item{linePos}{
            character to be read position within its line}
        \item{streamPos}{
            character to be read position from the text beginning}
    }
}

\item{streamParserClose}{NULL}
}

```

```

\seealso{
  \code{\link{streamParserFromFile}}
  \code{\link{streamParserFromString}}
}

\examples{

stream <- streamParserFromString("Hello world")

cstream <- streamParserNextChar(stream)

while( cstream$status == "ok" ) {
  print(streamParserPosition(cstream$stream))
  print(cstream$char)
  cstream <- streamParserNextCharSeq(cstream$stream)
}

streamParserClose(stream)

}

\keyword{streamParser}

 $\langle streamParserNextChar.R \rangle \equiv$ 

streamParserNextChar <- function(stream) stream$
  streamParserNextChar(stream)

 $\langle streamParserNextCharSeq.R \rangle \equiv$ 

streamParserNextCharSeq <- function(stream) stream$
  streamParserNextCharSeq(stream)

 $\langle streamParserPosition.R \rangle \equiv$ 

streamParserPosition <- function(stream) stream$
  streamParserPosition(stream)

 $\langle streamParserClose.R \rangle \equiv$ 

streamParserClose <- function(stream) stream$streamParserClose(
  stream)

```

2.1.3 StreamParser from file name

Implements a streamParser from a file name

$\langle streamParserFromFileName.Rd \rangle \equiv$

```

\name{streamParserFromFileName}
\alias{streamParserFromFileName}
\title{
  Creates a streamParser from a file name
}
\description{
  Creates a list of functions which allow streamParser manipulation (
  when defined from a file name)
}
\usage{
streamParserFromFileName(fileName,encoding = getOption("encoding
"))
}
\arguments{
\item{fileName}{file name}
\item{encoding}{file encoding}
}
\details{

```

See `\link[< < PACKAGE > >]{streamParser}`

This function implementation uses function `\link{seek}`.

Documentation about this function states:

```

”
Use of 'seek' on Windows is discouraged. We have found so many
errors in the Windows implementation of file positioning that
users are advised to use it only at their own risk, and asked not
to waste the R developers' time with bug reports on Windows'
deficiencies.
”

```

If "fileName" is a url, `\link{seek}` is not possible.

In order to cover these situations, streamPaserFromFileName functions are converted in:

```

\code{
  \link{streamParserFromString}(\link{readLines}( fileName,
encoding=encoding))
}

```

Alternatively, it can be used:

`\link{streamParserFromString}}` with:

```
\code{
  \link{streamParserFromString}(\link{readLines}(fileName))
}
```

or

```
\code{
  \link{streamParserFromString}(
    \link{iconv}(\link{readLines}(fileName),
encodingOrigen,encodingDestino)
  )
}
```

Since `streamParserFromFile` also uses `\link{readChar}`}, this last option is the one advised in Linux if encoding is different from Latin-1 or UTF-8. As documentation states, `\link{readChar}` may generate problems if file is in a multi-byte non UTF-8 encoding:

”

’nchars’ will be interpreted in bytes not characters in a non-UTF-8 multi-byte locale, with a warning.

”

}

\value{

A list of four functions which allow stream manipulation:

\item{streamParserNextChar}{Function which takes a `streamParser` as argument and returns a `\code{list(status,char,stream)}`}

\item{streamParserNextCharSeq}{Function which takes a `streamParser` as argument and returns `\code{list(status,char,stream)}`}

\item{streamParserPosition}{Function which takes a `streamParser` as argument and returns position of next character to be read}

\item{streamParserClose}{Closes the stream}

\examples{


```

name <- system.file("extdata","datInTest01.txt", package = "< <
PACKAGE > >")

stream <- streamParserFromFileName(name)

cstream <- streamParserNextChar(stream)

while( cstream$status == "ok" ) {
  print(streamParserPosition(cstream$stream))
  print(cstream$char)
  cstream <- streamParserNextCharSeq(cstream$stream)
}

streamParserClose(stream)

}

\keyword{streamParser}

<streamParserFromFileName.R>≡

```

```

streamParserFromFileName <- function(fileName,encoding =
  getOption("encoding")) {

  ## streamParseFromFileName can be used?
  if( Sys.info()["sysname"] == "Windows" ) {

    fromString <- TRUE

  } else {
    conn <- file(fileName,"r",encoding =encoding)
    if ( ! isOpen(conn) ) stop(paste("Error: file cannot be opened",
    fileName))
    fromString <- tryCatch({ seek(conn) ; FALSE}, error =function
    (e) TRUE, finally= close(conn) )

  }

  if ( fromString ) return( streamParserFromString( readLines(
  fileName, encoding=encoding)) )
  else
    return( list(
      streamParserNextChar = function(stream) {

        if ( stream$pos != seek(stream$conn) ) seek(
stream$conn,stream$pos)

        char <- readChar(stream$conn,nchars=1,
useBytes = FALSE)

        if (length(char) == 0)
          list(status="eof",char="",stream=stream)
        else {

          stream$pos <- seek(stream$conn)

          if ( char == "\n" ) {
            stream$line <- stream$line + 1
            stream$linePos <- 0
          } else {
            stream$linePos <- stream$linePos + 1
          }

          list(status="ok" ,char=char,stream=stream)
        }
      }
    )
  )

```

```

    },

    streamParserNextCharSeq = function(stream) {
        char <- readChar(stream$conn,nchars=1,
useBytes = FALSE)
        if (length(char) == 0)
            list(status="eof",char="",stream=stream)

        else {

            stream$pos <- seek(stream$conn)

            if ( char == "\n" ) {
                stream$line <- stream$line + 1
                stream$linePos <- 0
            } else {
                stream$linePos <- stream$linePos + 1
            }

            list(status="ok" ,char=char,stream=stream)
        }
    },

    streamParserClose = function(stream) { close(
stream$conn) ; stream$conn <- -1 ; invisible(NULL)
        },

    streamParserPosition = function(stream) { list(
fileName=stream$fileName, line=stream$line, linePos=stream$
linePos+1, streamPos=stream$pos+1)
        },

    conn = local({
        conn <- file(fileName,"r",encoding =encoding)
        if ( ! isOpen(conn) ) stop(paste("Error: file cannot
be opened.",fileName))
        tryCatch( seek(conn) , error =function(e) stop(
paste("Error: 'seek' not enabled for this connection", fileName)))
        conn
    }),
    pos = 0,
    line = 1,
    linePos = 0,
    fileName = fileName
)

```

)
}

2.1.4 Stream parser from character string

Implements a streamParser from a character string.

$\langle streamParserFromString.Rd \rangle \equiv$

```

\name{streamParserFromString}
\alias{streamParserFromString}
\title{
  Creates a streamParser from a string
}
\description{
  Creates a list of functions which allow streamParser manipulation (
  when defined from a character string)
}
\usage{
streamParserFromString(string)
}
\arguments{
\item{string}{string to be recognised}
}
\details{

  See \link[< < PACKAGE > >]{streamParser}
}

\value{

  A list of four functions which allow stream manipulation:

\item{streamParserNextChar}{Functions which takes a streamParser
  as argument ant returns a \code{list(status,char,stream)}}

\item{streamParserNextCharSeq}{Function which takes a
  streamParser as argument and returns a \code{list(status,char,
  stream)}}

\item{streamParserPosition}{Function which takes a streamParser as
  argument and returns position of next character to be read}

\item{streamParserClose}{Function which closes the stream}
}

\examples{
# reads one character
streamParserNextChar(streamParserFromString("\U00B6"))

# reads a string
stream <- streamParserFromString("Hello world")

```

```

cstream <- streamParserNextChar(stream)

while( cstream$status == "ok" ) {
  print(streamParserPosition(cstream$stream))
  print(cstream$char)
  cstream <- streamParserNextCharSeq(cstream$stream)

streamParserClose(stream)
}

}

\keyword{streamParser}

<streamParserFromString.R>≡

```

```

streamParserFromString <- function(string) {

  stringIn <- paste(string,collapse="\n")
  nchars <- nchar(stringIn)

  ## One at a time character processing multiplies space by 8 (in 64
bits OS) but reduces time /40
  stringIn <- strsplit(stringIn,split=character(0))[[1]]
  string <- stringIn
  if( nchars > 0 && length(string) < 1 ) stop("Error: encoding error
")

  return(
    list(
      streamParserNextChar = function(stream) {
        if ( stream$pos + 1 > stream$lenchar ) list(status="
eof",char="" ,stream=stream)
        else {

          stream$pos <- stream$pos+1

          ## version for substr char <- substr(string, stream$pos, stream$pos)
          char <- string[stream$pos]

          if ( char == "\n" ) {
            stream$line <- stream$line + 1
            stream$linePos <- 0
          } else {
            stream$linePos <- stream$linePos + 1
          }

          list(status="ok" ,char=char,stream=stream)
        }
      },

      streamParserNextCharSeq = function(stream) {
        if ( stream$pos + 1 > stream$lenchar ) list(status="
eof",char="" ,stream=stream)
        else {

          stream$pos <- stream$pos+1

          ## version for substr char <- substr(string,stream$pos, stream$pos)
          char <- string[stream$pos]

```

```

        if ( char == "\n" ) {
            stream$line <- stream$line + 1
            stream$linePos <- 0
        } else {
            stream$linePos <- stream$linePos + 1
        }

        list(status="ok" ,char=char,stream=stream)
    }
},

    streamParserClose = function(stream) { lenchar <- 0 ;
invisible(NULL)
    },
    streamParserPosition = function(stream) { list(
fileName="", line=stream$line, linePos=stream$linePos+1,
streamPos=stream$pos+1 )
    },

## lenchar = nchar(stringIn) , ## version for substr
    lenchar = length(stringIn),
    pos = 0,
    line = 1,
    linePos = 0
)
)
}

```

2.2 Character sets

The first step in syntactical analysis is breaking the text into words. Word separation is determined by the definition of characters separating words and the collection of characters that can make up a valid word. This schema requires, therefore, a character classification, according to the role played in word separation or word formation.

This section includes predicates (functions returning TRUE or FALSE) to determine if a character belongs to a set of characters playing a specific role.

2.2.1 isWhitespace

⟨isWhitespace.Rd⟩≡


```

\name{isWhitespace}
\alias{isWhitespace}
\title{
Is it a white space?
}
\description{
Checks whether a character belongs to the set \{\blank, tabulator, new
line, carriage return, page break \}.
}
\usage{
isWhitespace(ch)
}
\arguments{
\item{ch}{character to be checked}
}
\value{
TRUE/FALSE, depending on character belonging to the specified set.
}
\examples{
isWhitespace(' ')
isWhitespace('\n')
isWhitespace('a')
}

\keyword{set of character}

this version is slower

isWhitespace <- function(ch) ch %in% c(' ', '\t', '\f', '\r', '\n' )
than
 $\langle isWhitespace.R \rangle \equiv$ 

isWhitespace <- function(ch) switch(ch, ' '= , '\t'= , '\f'= , '\r'= , '\n'=TRUE,FALSE)

```

2.2.2 isNewline

$\langle isNewline.Rd \rangle \equiv$

```

\name{isNewline}
\alias{isNewline}
\title{
Is it a new line character?
}
\description{
Checks whether a character is a new line character.
}
\usage{
isNewline(ch)
}
\arguments{
\item{ch}{character to be checked}
}
\value{
TRUE/FALSE, depending on character being a newline character
}
\examples{
isNewline(' ')
isNewline('\n')
}

\keyword{set of character}

 $\langle isNewline.R \rangle \equiv$ 

isNewline <- function(ch) ch == '\n'

```

2.2.3 isDigit

$\langle isDigit.Rd \rangle \equiv$

```

\name{isDigit}
\alias{isDigit}
\title{
Is it a digit?
}
\description{
Checks whether a character is a digit:  $\{ 0 \dots 9 \}$ .
}
\usage{
isDigit(ch)
}
\arguments{
\item{ch}{character to be checked}
}
\value{
TRUE/FALSE, depending on the character being a digit.
}
\examples{
isDigit('9')
isDigit('a')
}

```

```

\keyword{set of character}

```

This version

```

isDigit <- function(ch) ch %in% c('0' , '1' , '2' , '3' , '4' , '5' , '6' , '7'
, '8' , '9')

```

is slower than

$\langle isDigit.R \rangle \equiv$

```

isDigit <- function(ch) switch(ch,'0'= , '1'= , '2'= , '3'= , '4'= , '5'
= , '6'= , '7'= , '8'= , '9'=TRUE,FALSE)

```

2.2.4 isUppercase

$\langle isUppercase.Rd \rangle \equiv$

`\name{isUppercase}`

`\alias{isUppercase}`

`\title{`

Is it an upper case?

`}`

`\description{`

Checks whether a character is an upper case.

Restricted to ASCII character (does not process ñ, ç, accented vowels
...)

`}`

`\usage{`

`isUppercase(ch)`

`}`

`\arguments{`

`\item{ch}{character to be checked}`

`}`

`\value{`

TRUE/FALSE, depending on character being an upper case character.

`}`

`\examples{`

`isUppercase('A')`

`isUppercase('a')`

`isUppercase('9')`

`}`

`\keyword{set of character}`

$\langle isUppercase.R \rangle \equiv$

`isUppercase <- function(ch) 'A' <= ch && ch <= 'Z'`

2.2.5 isLowercase

$\langle isLowercase.Rd \rangle \equiv$

`\name{isLowercase}`

`\alias{isLowercase}`

`\title{`

Is it a lower case?

`}`

`\description{`

Checks whether a character is a lower case.

Restricted to ASCII character (does not process ñ, ç, accented vowels
...)

`}`

`\usage{`

`isLowercase(ch)`

`}`

`\arguments{`

`\item{ch}{character to be checked}`

`}`

`\value{`

TRUE/FALSE, depending on character being a lower case character.

`}`

`\examples{`

`isLowercase('A')`

`isLowercase('a')`

`isLowercase('9')`

`}`

`\keyword{set of character}`

$\langle isLowercase.R \rangle \equiv$

`isLowercase <- function(ch) 'a' <= ch && ch <= 'z'`

2.2.6 isLetter

$\langle isLetter.Rd \rangle \equiv$

```

\name{isLetter}
\alias{isLetter}
\title{
Is it a letter?
}
\description{
Checks whether a character is a letter

Restricted to ASCII character (does not process ñ, ç, accented vowels
...)
}
\usage{
isLetter(ch)
}
\arguments{
\item{ch}{character to be checked}
}
\value{
TRUE/FALSE, depending on the character being a letter.
}
\examples{
isLetter('A')
isLetter('a')
isLetter('9')
}

\keyword{set of character}

 $\langle isLetter.R \rangle \equiv$ 

isLetter <- function(ch) isUppercase(ch) || isLowercase(ch)

```

2.2.7 isSymbol

$\langle isSymbol.Rd \rangle \equiv$

```

\name{isSymbol}
\alias{isSymbol}
\title{
Is it a symbol?
}
\description{
Checks whether a character is a symbol, a special character.
}
\usage{
isSymbol(ch)
}
\arguments{
\item{ch}{character to be checked}
}
\details{
These characters are considered as symbols:

'!' , '%' , '&' , '$' , '#' , '+' , '-' , '/' , ':' , '<' , '=' , '>' , '?' , '@'
, '\|' , '~' , '^' , '/' , '*'

}
\value{
TRUE/FALSE, depending on character being a symbol.
}
\examples{
isSymbol('+')
isSymbol('A')
isSymbol('a')
isSymbol('9')
}

\keyword{set of character}

 $\langle isSymbol.R \rangle \equiv$ 

isSymbol <- function(ch) ch %in% c('!' , '%' , '&' , '$' , '#' , '+' , '
- ' , '/' , ':' , '<' , '=' , '>' , '?' , '@' , '\\ ' , '~' , '^' , '|' , '*')

```

2.2.8 isHex

$\langle isHex.Rd \rangle \equiv$

```

\name{isHex}
\alias{isHex}
\title{
Is it an hexadecimal digit?
}
\description{
Checks whether a character is an hexadecimal digit.
}
\usage{
isHex(ch)
}
\arguments{
\item{ch}{character to be checked}
}
\value{
TRUE/FALSE, depending on character being an hexadecimal digit.
}
\examples{
isHex('+')
isHex('A')
isHex('a')
isHex('9')
}

\keyword{set of character}

```

$\langle isHex.R \rangle \equiv$

```

isHex <- function(ch) ( '0' <= ch && ch <= '9' ) || ( 'a' <= ch &&
  ch <= 'f' ) || ( 'A' <= ch && ch <= 'F' )

```

2.3 Tokens/Words

Word (token) recognition is a basic action in syntactic analysis.

Functions to break text into words. The list of valid words depend on analysed language. A typical set of functions for word/token recognition is included.

These functions share some homogeneity, since they must return the same data type in order to be able to combine them to create more complex parsers.

- Functions share, at least, these input parameters:

$\langle TokenArguments \rangle \equiv$

`\item{action}`{Function to be executed if recognition succeeds.
Character stream making up the token is passed as parameter
to this function}

`\item{error}`{Function to be executed if recognition does not
succeed. Position of `\link[< < PACKAGE > >]{streamParser}` obtained with `\link{streamParserPosition}` is passed as parameter to this function}

- These functions always have the next value:

$\langle Token Value \rangle \equiv$

Anonymous function, returning a list.

```
\code{function(stream)} --> \code{ list(status,node,
stream) }
```

From input parameters, an anonymous function is defined. This
function admits just one parameter, stream, with type `\link[< < PACKAGE > >]{streamParser}`, and returns a three
-field list:

```
\itemize{
  \item{status}{
    "ok" or "fail"}
```

```
  \item{node}{
```

With `\code{action}` or `\code{error}` function output,
depending on the case}

```
  \item{stream}{
```

With information about the input, after success or failure
in recognition}

```
}
```

2.3.1 eofMark

$\langle eofMark.Rd \rangle \equiv$

```

\name{eofMark}
\alias{eofMark}
\title{
    End of file token
}
\description{
    Recognises the end of input flux as a token.

```

When applied, it does not make use of character and, therefore, end of input can be recognised several times.

```

}
\usage{
    eofMark(action = function(s) list(type="eofMark",value=s),
          error = function(p) list(type="eofMark",pos =p ) )
}
\arguments{
< < TokenArguments > >
}
\details{
    When succeeds, parameter \code{s} takes the value "".
}
\value{
    < < TokenValue > >
}
\examples{

```

```

# fail
stream <- streamParserFromString("Hello world")
( eofMark()(stream) )[c("status","node")]

```

```

# ok
stream <- streamParserFromString("")
( eofMark()(stream) )[c("status","node")]

```

```

}

```

```

\keyword{token}

```

$\langle eofMark.R \rangle \equiv$

```

eofMark <- function(action = function(s) list(type="
eofMark",value=s),
                                error = function(p) list(type="eofMark",
pos=p ))

function (stream) {

  cstream <- streamParserNextChar(stream)

  if ( cstream$status != "eof" ) return(list(status="fail",
node=error(streamParserPosition(stream)), stream=stream))

  return(list(status="ok",node=action(""),stream=cstream$
stream))
}

```

Test for RUnit

```

<testTokens01>≡
checkTokenParserOk ("",eofMark(),"eofMark")

```

2.3.2 whitespace

```

<whitespace.Rd>≡

```

```

\name{whitespace}
\alias{whitespace}
\title{
  White sequence token.
}
\description{
  Recognises a white character sequence (this sequence may be
  empty).
}
\usage{
  whitespace(action = function(s) list(type="white",value=s),
            error = function(p) list(type="white",pos =p) )
}
\arguments{
< < TokenArguments > >
}
\details{
  A character is considered a white character when function \
  code{\link{isWhitespace}} returns TRUE
}
\value{
< < TokenValue > >
}
\examples{

# ok
stream <- streamParserFromString("Hello world")
( whitespace()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString(" Hello world")
( whitespace()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("")
( whitespace()(stream) )[c("status","node")]

}

\keyword{token}

 $\langle whitespace.R \rangle \equiv$ 

```

```

whitespace <- function(action = function(s) list(type="
  white",value=s),
                                error = function(p) list(type="white",
  pos =p) )

function (stream) {

  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" || ! isWhitespace(cstream$
  char) ) return(list(status="ok",node=action(""),stream=
  stream))

  s <- cstream$char
  repeat {
    stream <- cstream$stream
    cstream <- streamParserNextCharSeq(stream)

    if ( cstream$status == "eof" || ! isWhitespace(cstream$
    char) ) return(list(status="ok",node=action(paste(s,
    collapse="")),stream=stream))

    s <- c(s,cstream$char)
  }
}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk ("",whitespace(),"white")
checkTokenParserOk (" ",whitespace(),"white")
checkTokenParserOk ("\n",whitespace(),"white")
checkTokenParserOk ("A",whitespace(),"white","")
checkTokenParserOk ("1",whitespace(),"white","")

```

2.3.3 separator

$\langle separator.Rd \rangle \equiv$

```

\name{separator}
\alias{separator}
\title{
    Generic word separator token.
}
\description{
    Recognises a white character sequence, with comma or
    semicolon optionally inserted in the sequence.
    Empty sequences are not allowed.
}
\usage{
separator(action = function(s) list(type="separator",value=s) ,
          error = function(p) list(type="separator",pos =p) )
}
\arguments{
    < < TokenArguments > >
}
\details{
    A character is considered a white character when function \
    code{\link{isWhitespace}} returns TRUE
}
\value{
    < < TokenValue > >
}

\note{ PC-Axis has accepted the delimiters comma, space,
    semicolon, tabulator. }

\examples{

# ok
stream <- streamParserFromString("; Hello world")
( separator()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString(" ")
( separator()(stream) )[c("status","node")]

# fail
stream <- streamParserFromString("Hello world")
( separator()(stream) )[c("status","node")]

# fail

```

```

stream <- streamParserFromString("")
( separator()(stream) )[c("status","node")]

}

\keyword{token}

 $\langle separator.R \rangle \equiv$ 

```

```

separator <- function(action= function(s) list(type="
separator",value=s),
                                error = function(p) list(type="separator"
,pos=p ))
function (stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(stream)),stream=stream))

  ## possible whites
  s <- ""
  repeat {
    if ( cstream$status == "eof" || ! isWhitespace(cstream$
char) ) break()
    s <- c(s,cstream$char)
    stream <- cstream$stream
    cstream <- streamParserNextCharSeq(stream)
  }

  ##possible , ;
  if ( cstream$status == "eof" || ( cstream$char != ',' &&
cstream$char != ';' ) ) {
    if ( length(s) > 1 ) return(list(status="ok",node=
action(paste(s,collapse="")),stream=stream))
    else
      return(list(status="fail",node=error(
streamParserPosition(stream)),stream=stream))
  }
  ##
  s <- c(s,cstream$char)

  ## possible white
  repeat {
    stream <- cstream$stream
    cstream <- streamParserNextCharSeq(stream)

    if ( cstream$status == "eof" || ! isWhitespace(cstream$
char) ) return(list(status="ok",node=action(paste(s,
collapse="")),stream=stream))

    s <- c(s,cstream$char)
  }
}

```


Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```
checkTokenParserFail ("",separator(),"separator")
checkTokenParserFail ("A",separator(),"separator")
checkTokenParserFail ("1",separator(),"separator")
checkTokenParserOk  (" ",separator(),"separator")
checkTokenParserOk  ("\\n",separator(),"separator")
checkTokenParserOk  (";",separator(),"separator")
checkTokenParserOk  (";",separator(),"separator")
checkTokenParserOk  (";",separator(),"separator")
checkTokenParserOk  (";",separator(),"separator")
checkTokenParserOk  (";",separator(),"separator")
checkTokenParserOk  (" ",separator(),"separator")
```

2.3.4 numberNatural

$\langle numberNatural.Rd \rangle \equiv$

```

\name{numberNatural}
\alias{numberNatural}
\title{
  Natural number token.
}
\description{
  A natural number is a sequence of digits.
}
\usage{
  numberNatural(action = function(s) list(type="numberNatural",value=s),
               error = function(p) list(type="numberNatural",
               pos =p))
}
\arguments{
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("Hello world")
( numberNatural()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("123")
( numberNatural()(stream) )[c("status","node")]

}

\keyword{token}

<numberNatural.R>≡

```

```

numberNatural <- function(action = function(s) list(type="
  numberNatural",value=s),
                        error = function(p) list(type="
  numberNatural",pos =p) )

function (stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" || ! isDigit(cstream$char) )
  return(list(status="fail",node=error(streamParserPosition(
stream)),stream=stream))

  s <- cstream$char

  repeat {

    stream <- cstream$stream
    cstream <- streamParserNextCharSeq(stream)

    if ( cstream$status == "eof" || ! isDigit(cstream$char) )
    return(list(status="ok",node=action(paste(s,collapse="")),
stream=stream))

    s <- c(s,cstream$char)

  }
}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk ("123" ,numberNatural() ,"numberNatural"
)

```

2.3.5 numberInteger

$\langle numberInteger.Rd \rangle \equiv$

```

\name{numberInteger}
\alias{numberInteger}
\title{
  Integer number token.
}
\description{
  Recognises an integer, i.e., a natural number optionally
  preceded by a + or - sign.
}
\usage{
  numberInteger(action = function(s) list(type="numberInteger",
    value=s),
               error = function(p) list(type="numberInteger",
    pos =p))
}
\arguments{
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("Hello world")
( numberInteger()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("-1234")
( numberInteger()(stream) )[c("status","node")]

}

\keyword{token}

 $\langle numberInteger.R \rangle \equiv$ 

```

```

numberInteger <- function(action = function(s) list(type="
  numberInteger",value=s),
                        error = function(p) list(type="
  numberInteger",pos =p))

function (stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(stream)),stream=stream))

  if ( cstream$char %in% c("+","-") ) {
    s <- cstream$char
    cstream <- numberNatural()(cstream$stream)
  }
  else {
    s <- ""
    cstream <- numberNatural()(stream)
  }
  if ( cstream$status == "fail" ) return(list(status="fail",
node=error(streamParserPosition(stream)),stream=stream))
  return(list(status="ok",node=action(paste(s,cstream$
node$value,sep="")),stream=cstream$stream))
}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk ("123" ,numberInteger() ,"numberInteger" )
checkTokenParserOk (" +123" ,numberInteger() ,"numberInteger"
)
checkTokenParserOk (" -123" ,numberInteger() ,"numberInteger"
)

```

2.3.6 numberFloat

$\langle numberFloat.Rd \rangle \equiv$

```

\name{numberFloat}
\alias{numberFloat}
\title{
  Floating-point number token.
}
\description{
  Recognises a floating-point number, i.e., an integer with a
  decimal part. One of them (either integer or decimal part) must
  be present.
}
\usage{
  numberFloat(action = function(s) list(type="numberFloat",
    value=s),
              error = function(p) list(type="numberFloat",pos =
    p))
}
\arguments{
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("Hello world")
( numberFloat()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("-456.74")
( numberFloat()(stream) )[c("status","node")]

}

\keyword{token}

 $\langle numberFloat.R \rangle \equiv$ 

```

```

numberFloat <- function(action = function(s) list(type="
  numberFloat",value=s),
                        error = function(p) list(type="
  numberFloat",pos=p) )

function (stream) {
  streamFail <- stream
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))

  ## sign
  if ( cstream$char %in% c("+","-") ) {
    signo <- cstream$char
    stream <- cstream$stream
    cstream <- streamParserNextChar(stream)

    if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))

  } else {
    signo <- ""
  }
  if ( cstream$char == '.' ) {
    entero <- ""
    punto <- cstream$char
    cstream <- numberNatural()(cstream$stream)
    if ( cstream$status == "ok" ) {
      decimal <- cstream$node$value
      stream <- cstream$stream
    } else {
      return(list(status="fail",node=error(
streamParserPosition(streamFail)),stream=streamFail))
    }
  }
  else {
    cstream <- numberNatural()(stream)

    if (cstream$status=="fail") return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=

```

```

streamFail))

entero <- cstream$node$value
stream <- cstream$stream
cstream <- streamParserNextChar(stream)
if ( cstream$char == '.' ) {
  punto <- cstream$char
  stream <- cstream$stream
  cstream <- numberNatural()(stream)
  if ( cstream$status == "ok" ) {
    decimal <- cstream$node$value
    stream <- cstream$stream
  } else {
    decimal <- ""
  }
} else {
  punto <- ""
  decimal <- ""
}
}
return(list(status="ok",node=action(paste(signo,entero,
punto,decimal,sep="")),stream=stream))

}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk ("123",numberFloat(), "numberFloat" )
checkTokenParserOk (" +123",numberFloat(), "numberFloat" )
checkTokenParserOk (" -123",numberFloat(), "numberFloat" )
checkTokenParserOk ("123.",numberFloat(), "numberFloat" )
checkTokenParserOk (" +123.",numberFloat(), "numberFloat" )
checkTokenParserOk (" -123.",numberFloat(), "numberFloat" )
checkTokenParserOk (".123",numberFloat(), "numberFloat" )
checkTokenParserOk (" +.123",numberFloat(), "numberFloat" )
checkTokenParserOk (" -.123",numberFloat(), "numberFloat" )

```

2.3.7 numberScientific

This function is made up of the previous function code. They are not directly called because of performance optimization.

$\langle numberScientific.Rd \rangle \equiv$


```

\name{numberScientific}
\alias{numberScientific}
\title{
  Number in scientific notation token.
}
\description{
  Recognises a number in scientific notation, i.e., a floating-point
  number with an (optional) exponential part.
}
\usage{
  numberScientific(action = function(s) list(type="
  numberScientific",value=s),
                  error = function(p) list(type="
  numberScientific",pos=p) )
}
\arguments{
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("Hello world")
( numberScientific()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("-1234e12")
( numberScientific()(stream) )[c("status","node")]

}

\keyword{token}

<numberScientific.R>≡

```

```

numberScientific <- function(action = function(s) list(type=
  "numberScientific",value=s),
                                error = function(p) list(type="
numberScientific",pos=p )
                                )
function (stream) {
  streamFail <- stream

#### numberFloat
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))

  if( cstream$char == "-" || cstream$char == "+" ){
    signo <- cstream$char
    stream <- cstream$stream
    cstream <- streamParserNextChar(stream)

    if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))
  } else {
    signo <- ""
  }
  if ( cstream$char == '.' ) {
    entero <- ""
    punto <- cstream$char

#### numberNatural
    cstream <- streamParserNextChar(cstream$stream)

    if ( cstream$status == "eof" || ! isDigit(cstream$char) )
return(list(status="fail",node=error(streamParserPosition(
streamFail)),stream=streamFail))

    s <- cstream$char
    repeat {
      stream <- cstream$stream
      cstream <- streamParserNextCharSeq(stream)
      if ( cstream$status == "eof" || ! isDigit(cstream$char)
) break()
      s <- c(s,cstream$char)

```

```

    }
#####
    decimal <- paste(s,collapse="")
  }
  else {
##### numberNatural
    if ( ! isDigit(cstream$char) ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))
    s <- cstream$char
    repeat {
      stream <- cstream$stream
      cstream <- streamParserNextCharSeq(stream)
      if ( cstream$status == "eof" || ! isDigit(cstream$char)
) break()
      s <- c(s,cstream$char)
    }
#####
    entero <- paste(s,collapse="")
##
    cstream <- streamParserNextChar(stream)
    if ( cstream$char == '.' ) {
      punto <- cstream$char
      stream <- cstream$stream
##### numberNatural
      cstream <- streamParserNextChar(stream)
      if ( cstream$status == "eof" || ! isDigit(cstream$char)
) {
        decimal <- ""
      } else {
        s <- cstream$char
        repeat {
          stream <- cstream$stream
          cstream <- streamParserNextCharSeq(stream)
          if ( cstream$status == "eof" || ! isDigit(cstream$
char) ) break()
          s <- c(s,cstream$char)
        }
        decimal <- paste(s,collapse="")
      }
#####
    } else {
      punto <- ""
      decimal <- ""

```

```

    }
  }
  mantisa <- paste(signo,entero,punto,decimal,sep="")
#
  cstream <- streamParserNextChar(stream)
  if ( cstream$char == "E" || cstream$char == "e" ) {
    E <- cstream$char
    stream <- cstream$stream
    cstream <- streamParserNextChar(stream)

    if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))
#####
    if ( cstream$char == "-" || cstream$char == "+" ) {
      signoE <- cstream$char
      stream <- cstream$stream
      cstream <- streamParserNextChar(stream)

      if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))
    } else {
      signoE <- ""
    }
  }
##### numberNatural
  if ( ! isDigit(cstream$char) ) return(list(status="fail",
node=error(streamParserPosition(streamFail)),stream=
streamFail))
  s <- cstream$char
  repeat {
    stream <- cstream$stream
    cstream <- streamParserNextCharSeq(stream)
    if ( cstream$status == "eof" || ! isDigit(cstream$char)
) break()
    s <- c(s,cstream$char)
  }
#####
  exponente <- paste(signoE,paste(s,collapse=""),sep="")
} else {
  E <- ""
  exponente <- ""
}
}

```

```

    return(list(status="ok",node=action(paste(mantisa,E,
exponente,sep="")),stream=stream))
}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk ("127" ,numberScientific(),"numberScientific
" )
checkTokenParserOk (" +127" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" -127" ,numberScientific(),"
numberScientific" )

checkTokenParserOk ("127." ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" +127." ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" -127." ,numberScientific(),"
numberScientific" )

checkTokenParserOk (" .127" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" +.127" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" -.127" ,numberScientific(),"
numberScientific" )

checkTokenParserOk ("0123.123" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" +0123.123" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" -0123.123" ,numberScientific(),"
numberScientific" )

checkTokenParserOk ("127E33" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" +127E33" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" -127E33" ,numberScientific(),"
numberScientific" )

checkTokenParserOk ("127.E33" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" +127.E33" ,numberScientific(),"
numberScientific" )
checkTokenParserOk (" -127.E33" ,numberScientific(),"
numberScientific" )

checkTokenParserOk (" .127E33" ,numberScientific(),"
numberScientific" )

```

```

checkTokenParserOk ("+.127E33" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk ("-.127E33" ,numberScientific(), "
    numberScientific" )

checkTokenParserOk ("0123.123E33" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk (" +0123.123E33" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk (" -0123.123E33" ,numberScientific(), "
    numberScientific" )

checkTokenParserOk (" -121.01e-222" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk ("1211e+33" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk (" -123e-222" ,numberScientific(), "
    numberScientific" )

checkTokenParserOk (" +0123.123e+11" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk (" -1233.e-66" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk (" -1233.e+66" ,numberScientific(), "
    numberScientific" )
checkTokenParserOk (" +.123E600" ,numberScientific(), "
    numberScientific" )

checkTokenParserFail("+.E600" ,numberScientific(), "
    numberScientific" )
checkTokenParserFail(" .E600" ,numberScientific(), "
    numberScientific" )

```

2.3.8 symbolic

$\langle symbolic.Rd \rangle \equiv$

```

\name{symbolic}
\alias{symbolic}
\title{
  Alphanumeric token.
}
\description{
  Recognises an alphanumeric symbol. By default, a sequence of
  alphanumeric, numeric and dash symbols, beginning with an
  alphabetical character.
}
\usage{
symbolic (charFirst=isLetter,
          charRest=function(ch) isLetter(ch) || isDigit(ch) ||
          ch == "-",
          action = function(s) list(type="symbolic",value=s)
          ,
          error = function(p) list(type="symbolic",pos =p))

}
\arguments{
\item{charFirst}{Predicate of valid characters as first symbol
  character}
\item{charRest}{Predicate of valid characters as the rest of
  symbol characters}
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("123")
( symbolic()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("abc123__2")
( symbolic()(stream) )[c("status","node")]

}

\keyword{token}

<symbolic.R>≡

```



```

symbolic <- function(charFirst=isLetter,
                     charRest=function(ch) isLetter(ch) ||
                     isDigit(ch) || ch == "-",
                     action = function(s) list(type="symbolic"
, value=s),
                     error = function(p) list(type="symbolic",
pos =p))

function (stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" || ! charFirst(cstream$char) )
return(list(status="fail",node=error(streamParserPosition(
stream)),stream=stream))

  s <- cstream$char
  repeat {
    stream <- cstream$stream
    cstream <- streamParserNextCharSeq(stream)

    if ( cstream$status == "eof" || ! charRest(cstream$char)
) return(list(status="ok",node=action(paste(s,collapse="")
),stream=stream))

    s <- c(s,cstream$char)
  }
}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk ("abd" ,symbolic(), "symbolic")
checkTokenParserOk ("ac12" ,symbolic(), "symbolic")
checkTokenParserOk ("asd:" ,symbolic(), "symbolic", "asd")

```

2.3.9 string

$\langle string.Rd \rangle \equiv$

```

\name{string}
\alias{string}
\title{
Token string
}
\description{
Any character sequence, by default using simple or double
quotation marks.
}
\usage{
string(isQuote= function(c) switch(c, ""=, ""=TRUE,FALSE),
      action = function(s) list(type="string",value=s),
      error = function(p) list(type="string",pos =p))

}
\arguments{
\item{isQuote}{Predicate indicating whether a character begins
and ends a string}
< < TokenArguments > >
}
\details{
Characters preceded by \ are not considered as part of string
end.
}
\value{
< < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("Hello world")
( string()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("'Hello world'")
( string()(stream) )[c("status","node")]

}

\keyword{token}

 $\langle string.R \rangle \equiv$ 

```

```

string <- function(isQuote= function(c) switch(c,"'",'"'=
  TRUE,FALSE),
  action = function(s) list(type="string",
  value=s),
  error = function(p) list(type="string",pos
  =p))

function (stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" || ! isQuote(cstream$char) )
  return(list(status="fail",node=error(streamParserPosition(
  stream)),stream=stream))

  delimiter <- cstream$char

  charPrev <- ""
  s <- ""
  repeat {
    cstream <- streamParserNextCharSeq(cstream$stream)

    if ( cstream$status == "eof" ) return(list(status="fail",
    node=error(streamParserPosition(stream)),stream=stream))

    if ( cstream$char == delimiter && charPrev != "\\")
    return(list(status="ok",node=action(paste(s,collapse="")),
    stream=cstream$stream))

    charPrev <- cstream$char
    s <- c(s,cstream$char)
  }
}

```

Test for RUnit

<testTokens01>+≡

```

checkTokenParserOk ("aaaa",string(),"string","aaaa")
checkTokenParserOk ("aaaa",string(),"string","aaaa")
checkTokenParserOk ("aaa4567",string(),"string","aaa4567")
checkTokenParserOk ("aa aa",string(),"string","aa aa")
checkTokenParserOk ("aa\\' aa",string(),"string","aa\\' aa")
checkTokenParserOk ("?aaaa?",string(isQuote=function(c) c
=="?"),"string","aaaa")

```

2.3.10 commentParser

$\langle \textit{commentParser.Rd} \rangle \equiv$

```

\name{commentParser}
\alias{commentParser}
\title{
  Comment token.
}
\description{
  Recognises a comment, a piece of text delimited by two
  predefined tokens.
}
\usage{

  commentParser(beginComment,endComment,
                 action = function(s) list(type="commentParser",value
=s),
                 error = function(p) list(type="commentParser",pos =p
))

}
\arguments{
  \item{beginComment}{String indicating comment beginning}
  \item{endComment}{String indicating comment end}
  < < TokenArguments > >
}
\details{
  Characters preceded by \ are not considered as part of
  beginning of comment end.
}
\value{
  < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("123")
( commentParser("(*","*")(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("(*123*)")
( commentParser("(*","*")(stream) )[c("status","node")]

}

\keyword{token}

```

$$\langle commentParser.R \rangle \equiv$$

```

commentParser <- function(beginComment,endComment,
                           action = function(s)list(type="
commentParser",value=s),
                           error = function(p)list(type="
commentParser",pos=p ))

function (stream) {

  ## begin comment
  s <- as.character()
  cstream <- streamParserNextChar(stream)

  for( i in 1:nchar(beginComment) ) {

    if ( cstream$status == "eof" || cstream$char != substr(
beginComment,i,i) ) return(list(status="fail",node=error(
streamParserPosition(stream)),stream=stream))

    s <- c(s,cstream$char)

    cstream <- streamParserNextCharSeq(cstream$stream)
  }

  previo <- ""
  lenEndComment <- nchar(endComment)
  repeat {
    ## end comment
    for( i in 1:lenEndComment ) {

      if ( cstream$status == "eof" ) return(list(status="fail
",node=error(streamParserPosition(stream)),stream=stream))

      s <- c(s,cstream$char)

      if ( cstream$char != substr(endComment,i,i) ) break()
      if ( previo == "\\\" ) break()

      if ( i == lenEndComment) return(list(status="ok",
node=action(paste(s,collapse="")), stream=cstream$stream))

      cstream <- streamParserNextCharSeq(cstream$stream)
    }
    previo <- cstream$char
    cstream <- streamParserNextCharSeq(cstream$stream)
  }

```

}

}

Test for RUnit

$\langle testTokens01 \rangle + \equiv$


```

checkTokenParserOk ("(*)" ,commentParser("(*", "*")", "
    commentParser")
checkTokenParserOk ("(* *)" ,commentParser("(*", "*")", "
    commentParser")
checkTokenParserOk ("(* 123 *)" ,commentParser("(*", "*")", "
    commentParser")
checkTokenParserOk ("(* ( * *)" ,commentParser("(*", "*")", "
    commentParser")
checkTokenParserOk ("(* ( * * ) *)" ,commentParser("(*", "*")", "
    commentParser")
checkTokenParserOk ("/* ( * * ) */" ,commentParser("/*", "*/")", "
    commentParser")
checkTokenParserOk ("-- aadad\n" ,commentParser("--", "\n"
    ), "commentParser")

checkTokenParserOk ("/* \\ */" ,commentParser("/*", "*/")", "
    commentParser")
checkTokenParserOk ("\\*\\*" ,commentParser("\\*", "\\*")", "
    commentParser")
checkTokenParserOk ("\\* sdas \\*" ,commentParser("\\*", "\\*
    "), "commentParser")
checkTokenParserOk ("\\* \\*\\*\\* \\*" ,commentParser("\\*", "\\
    *"), "commentParser")

checkTokenParserFail("(*" ,commentParser("(*", "*")", "
    commentParser")
checkTokenParserFail("( * " ,commentParser("(*", "*")", "
    commentParser")
checkTokenParserFail("( * *)" ,commentParser("(*", "*")", "
    commentParser")

checkTokenParserFail("/* \\ */" ,commentParser("/*", "*/")", "
    commentParser")
checkTokenParserFail("\\* \\*\\*\\* " ,commentParser("\\*", "\\*")
    , "commentParser")

```

2.3.11 keyword

$\langle keyword.Rd \rangle \equiv$

```

\name{keyword}
\alias{keyword}
\title{
    Arbitrary given token.
}
\description{
    Recognises a given character sequence.
}
\usage{

    keyword(word,
            action = function(s) list(type="keyword",value=s),
            error = function(p) list(type="keyword",pos =p))

}
\arguments{
\item{word}{Symbol to be recognised.}
    < < TokenArguments > >
}
\value{
    < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("Hello world")
( keyword("world")(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("world")
( keyword("world")(stream) )[c("status","node")]

}

\keyword{token}

 $\langle keyword.R \rangle \equiv$ 

```

```

keyword <- function(word,
                    action = function(s) list(type="keyword",
value=s),
                    error = function(p) list(type="keyword",
pos =p))

function (stream) {

  ## begin word
  s <- as.character()
  cstream <- streamParserNextChar(stream)

  for( i in 1:nchar(word) ) {

    if ( cstream$status == "eof" || cstream$char != substr(
word,i,i) ) return(list(status="fail",node=error(
streamParserPosition(stream)),stream=stream))

    s <- c(s,cstream$char)

    if( i == nchar(word) )
      return(list(status="ok", node=action(paste(s,collapse=
"")), stream=cstream$stream))

    cstream <- streamParserNextChar(cstream$stream)

  }

}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

checkTokenParserOk ("else" ,keyword("else"),"keyword")

2.3.12 dots

$\langle dots.Rd \rangle \equiv$

```

\name{dots}
\alias{dots}
\title{
    Dots sequence token.
}
\description{
    Recognises a sequence of an arbitrary number of dots.
}
\usage{

    dots(action = function(s) list(type="dots",value=s),
         error = function(p) list(type="dots",pos =p))

}
\arguments{
    < < TokenArguments > >
}
\value{
    < < TokenValue > >
}
\examples{

# fail
stream <- streamParserFromString("Hello world")
( dots()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("..")
( dots()(stream) )[c("status","node")]

}

\keyword{token}

 $\langle dots.R \rangle \equiv$ 

```

```

dots <- function(action = function(s) list(type="dots",value
=s),
                error = function(p) list(type="dots",pos =p))

function (stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" || cstream$char != "." )
  return(list(status="fail",node=error(streamParserPosition(
stream)),stream=stream))
  s <- cstream$char
  repeat {
    stream <- cstream$stream
    cstream <- streamParserNextCharSeq(stream)

    if ( cstream$status == "eof" || ! ( cstream$char == "." )
    ) return(list(status="ok",node=action(paste(s,collapse="")
),stream=stream))

    s <- c(s,cstream$char)
  }
}

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk (".." ,dots(),"dots")
checkTokenParserOk ("..." ,dots(),"dots")
checkTokenParserFail("a..." ,dots(),"dots")

```

2.3.13 empty

$\langle empty.Rd \rangle \equiv$

```

\name{empty}
\alias{empty}
\title{
Empty token
}
\description{
  Recognises a null token. This parser always succeeds.
}
\usage{

  empty(action = function(s) list(type="empty",value=s),
        error = function(p) list(type="empty",pos =p))

}
\arguments{
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\details{
  \code{action} \code{s} parameter is always "".
  Error parameters exists for the sake of homogeneity with the
  rest of functions. It is not used.
}
\examples{

# ok
stream <- streamParserFromString("Hello world")
( empty()(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("")
( empty()(stream) )[c("status","node")]

}

\keyword{token}

 $\langle empty.R \rangle \equiv$ 

```

```
empty <- function(action = function(s) list(type="empty",
  value=s),
  error = function(p) list(type="empty",pos
    =p))

function (stream) return(list(status="ok" ,node=action(""))
  , stream=stream))
```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```
checkTokenParserOk ("",empty(),"empty","")
checkTokenParserOk ("12",empty(),"empty","")
```

2.3.14 charParser

$\langle charParser.Rd \rangle \equiv$

```

\name{charParser}
\alias{charParser}
\title{
  Specific single character token.
}
\description{
  Recognises a specific single character.
}
\usage{

  charParser(char,
             action = function(s) list(type="char",value=s),
             error = function(p) list(type="char",pos =p))

}
\arguments{
\item{char}{character to be recognised}
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\seealso{
  \code{\link{keyword}}
}
\examples{

# fail
stream <- streamParserFromString("H")
( charParser("a")(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("a")
( charParser("a")(stream) )[c("status","node")]

# ok
( charParser("\U00B6")(streamParserFromString("\U00B6")) )[c(
  "status","node")]

}

\keyword{token}

 $\langle charParser.R \rangle \equiv$ 

```



```

charParser <- function(char,
                        action = function(s) list(type="char",
value=s),
                        error = function(p) list(type="char",pos
= p))

function(stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(stream)),stream=stream))

  if ( cstream$char != char ) return(list(status="fail",node
=error(streamParserPosition(stream)),stream=stream))
  return(list(status="ok" ,node=action(char),stream=
cstream$stream))
}
##

```

Test for RUnit

$\langle testTokens01 \rangle + \equiv$

```

checkTokenParserOk (":",charParser(":"),"char")
checkTokenParserFail(";",charParser(":"),"char")

```

2.3.15 charInSetParser

$\langle charInSetParser.Rd \rangle \equiv$

```

\name{charInSetParser}
\alias{charInSetParser}
\title{
  Single character, belonging to a given set, token
}
\description{
  Recognises a single character satisfying a predicate function.
}
\usage{
  charInSetParser(fun,
                  action = function(s) list(type="charInSet",value
=s),
                  error = function(p) list(type="charInSet",pos =
p))
}
\arguments{
\item{fun}{Function to determine if character belongs to a set.
  Argument "fun" is a signature function: character ->
  logical (boolean)}
  < < TokenArguments > >
}
\value{
  < < TokenValue > >
}
\examples{
# fail
stream <- streamParserFromString("H")
( charInSetParser(isDigit)(stream) )[c("status","node")]

# ok
stream <- streamParserFromString("a")
( charInSetParser(isLetter)(stream) )[c("status","node")]

}

\keyword{token}

<charInSetParser.R>≡

```

```

charInSetParser <- function(fun,
                           action = function(s) list(type="
charInSet",value=s),
                           error = function(p) list(type="
charInSet",pos =p))

function(stream) {
  cstream <- streamParserNextChar(stream)

  if ( cstream$status == "eof" ) return(list(status="fail",
node=error(streamParserPosition(stream)),stream=stream))

  if ( fun(cstream$char) )
    return(list(status="ok", node=action(cstream$char),
stream=cstream$stream))
    return(list(status="fail",node=error(streamParserPosition(
stream)),stream=stream))
}

```

Test for RUnit

```

<testTokens01>+≡
checkTokenParserOk ("a" ,charInSetParser(isLetter),"charInSet")
checkTokenParserOk ("a" ,charInSetParser(function (char)
TRUE),"charInSet")

checkTokenParserFail("a" ,charInSetParser(isDigit ),"charInSet")
checkTokenParserFail("a" ,charInSetParser(function (char)
FALSE),"charInSet")

```

2.3.16 Tests

Combined tests

Tests using several functions for token recognition are included.
Next function executes, sequentially, recognition of several tokens.

```

<testTokens01>+≡
parser12 <- function(p1,p2) { function(stream) { r <- p1(
stream); if (r$status=="ok") p2(r$stream) else return(r) }}

```

And tests combining several tokens recognition:

```

<testTokens01>+≡

```

```

checkTokenParserOk (" -1233.e+66" ,parser12(whitespace(),
    numberScientific()),"numberScientific" ,"-1233.e+66")
checkTokenParserFail("asd-1233.e+66" ,parser12(symbolic() ,
    numberScientific()),"numberScientific" ,"-1233.e+66")
checkTokenParserOk ("asd+1233.e+66" ,parser12(symbolic() ,
    numberScientific()),"numberScientific" ," +1233.e+66")
checkTokenParserOk (" -1233.e+66asd" ,parser12(
    numberScientific(),symbolic()),"symbolic" ,"asd")
checkTokenParserOk("elseasd" ,parser12(keyword("else"),
    symbolic()),"symbolic" ,"asd")
checkTokenParserOk ("elseasd" ,symbolic(),"symbolic" ,"elseasd")

```

and the same exercises, from a file:

$\langle testTokens02 \rangle \equiv$

```

parseList <- list(
  whitespace(),
  string(), whitespace(),
  numberScientific(), whitespace(),
  numberNatural(), whitespace(),
  numberScientific(), whitespace(),
  numberScientific(), whitespace(),
  numberInteger(), whitespace(),
  numberFloat(), whitespace(),
  numberFloat(), whitespace(),
  numberScientific(), whitespace(),
  numberScientific(), whitespace(),
  numberScientific(), whitespace(),
  numberScientific(), whitespace(),
  symbolic(), whitespace(),
  string(), whitespace(),
  eofMark()
)

for( i in 1:length(parseList) ) {

  stream <- streamParserFromFileName( system.file(
    "extdata", "datInTest01.txt", package = "< < PACKAGE >
    >"))

    for( j in 1:i ) {
      cstream <- parseList[[j]](stream)
      stream <- cstream$stream
    }
    streamParserClose(stream)
    checkEquals("ok", cstream$status, msg=paste(" hasta
    ", as.character(i)))
  }
}

```

RUnit

Here, test for previous functions are assembled.

This function for test from streamParseFromString.

$\langle \text{runit.01tokens.RUnit} \rangle \equiv$

```

    < < testFuncionesUtiles > >
test.tokens01 <- function() {
    < < testTokens01 > >
}

```

This function for test from streamParseFromFileName.

⟨runit.01tokens.RUnit⟩+≡

```

test.tokens02 <- function() {
    < < testTokens02 > >
}

```

Utility functions

Functions used to carry out tests with RUnit.

printCStream Shows relevant information about a StreamParse.

⟨testFuncionesUtiles⟩≡

```

printCStream <- function(cstream) print(paste("[" ,cstream$
node$value,"] [" ,cstream$status,"]",sep=""))

```

checkTokenParserOk Returns TRUE if token recognition is correct, when it is expected to be correct. Status ("ok"), token type and recognised character stream are checked.

⟨testFuncionesUtiles⟩+≡

```

checkTokenParserOk <- function(text,parse,type,token=text,
    msg=paste(type,"[" ,token,"]",sep=""))
    checkIdentical(list(status="ok",node=list(type
    =type ,value=token)),parse(streamParserFromString(text)) [c
    ("status","node")],msg=msg)

```

checkTokenParserFail Returns TRUE if token recognition does not succeed, when it is expected not to succeed.

⟨testFuncionesUtiles⟩+≡

```
checkTokenParserFail <- function(text,parse,type,token=text
,msg=paste(type,": [",token,"]",sep=""))
  checkIdentical("fail",parse(
streamParserFromString(text))$status,msg=msg)
```

checkSentParserOk Returns TRUE if parser recognition is correct, when it is expected to be correct. It is used to test parsers not being just tokens.

<testFuncionesUtiles>+=

```
checkSentParserOk <- function(text,parse,type,sent=text,
msg=paste(type,": [",sent,"]",sep="")) {
  r <- parse(
streamParserFromString(text)) [c("status","node")]
  r$node$value <- paste(r$node
$value,collapse="",sep="")
#print(r)
  checkIdentical(list(status="ok",
node=list(type=type ,value=sent)),r,msg=msg)
}
```

checkSentParserFail Returns TRUE if parser recognition does not succeed, when it is expected not to succeed. It is used to test parser not being just tokens.

<testFuncionesUtiles>+=

```
checkSentParserFail <- function(text,parse,type,sent=text,
msg=paste(type,": [",sent,"]",sep="")) {
  checkIdentical("fail",parse(
streamParserFromString(text))$status,msg=msg)
}
```

RUnit in R CMD check This function aim is to cause unitary tests to be executed with R CMD check.

The function is a slightly modified version of the one in: unit testing in R. <http://rwiki.sciviews.org/doku.php?id=developers:runit>

<test.RUnit.tstR>=

```

## unit tests will not be done if RUnit is not available

if(require("RUnit", quietly=TRUE)) {
  ##
  ## ---- Setup ----
  ##
  pkg <- "< < PACKAGE > >" # <-- Change to package
  name!

  ##
  ## When in developing
  path <- file.path(getwd(), "runit")
  if ( file.exists(path) ) {
    ## When in developing, developing environment is
    prioritised
    .libPaths(c(file.path(getwd(), ".."),.libPaths()))
  } else {
    ## Otherwise, check if package already installed
    path <- system.file(package=pkg, "tests", "runit")
  }
  ##
  ##
  ##
  cat("\nRunning unit tests\n")
  print(list(pkg=pkg, getwd=getwd(), pathToUnitTests=path
  ))
  ##
  require(package=pkg, character.only=TRUE)
  ##
  wd <- setwd(path) ; path <- "."

  ## If desired, load the name space to allow testing of private
  functions
  ## if (is.element(pkg, loadedNamespaces()))
  ## attach(loadNamespace(pkg), name=paste("namespace", pkg
  , sep=":"), pos=3)
  ##
  ## or simply call PKG:::myPrivateFunction() in tests

  ## ---- Testing ----

  ## Define tests
  testSuite <- defineTestSuite(
    name=paste(pkg, "unit testing"),
    dirs=path,

```



```

        testFileRegexp = "^runit.+\\.\\.[rR]$",
        testFuncRegexp = "^test.+")

## Run
tests <- runTestSuite(testSuite)

## Default report name
pathReport <- file.path(path, "report")
dir.create(path=pathReport, recursive = TRUE)

## Report to stdout and text files
cat("----- UNIT TEST
SUMMARY -----\\n\\n")
printTextProtocol(tests, showDetails=TRUE,
                   fileName=file.path(pathReport, "report.txt"
))
printTextProtocol(tests, showDetails=FALSE,
                   fileName=file.path(pathReport, "Summary.
txt"))

## Report to HTML file
testFileToSFLinkMap <- function(testFileName, testDir = "
..") {
  return(file.path("..", basename(testFileName)))
}

printHTMLProtocol(tests, fileName=file.path(pathReport, "
report.html"),
                  testFileToLinkMap = testFileToSFLinkMap)

setwd(wd)
## Return stop() to cause R CMD check stop in case of
## - failures i.e. FALSE to unit tests or
## - errors i.e. R errors
tmp <- getErrors(tests)
if(tmp$nFail > 0 | tmp$nErr > 0) {
  stop(paste("\\n\\nunit testing failed (#test failures: ", tmp$
nFail,
              ", #R errors: ", tmp$nErr, ")\\n\\n", sep=""))
}
} else {
  warning("cannot run unit tests -- package RUnit is not
available")
}

```

2.4 Parsers combining parsers

In this section, functions which combine basic, primitives or combined-created parser are described. These functions are used to create new parsers.

Since these functions may be combined to construct a new parser, they must return the same data type and, therefore, they share certain homogeneity.

- As these functions are used to combine parsers, they will have as input parameters at least one parser and, moreover:

$\langle ParserCombinatorArguments \rangle \equiv$

`\item{action}`{Function to be executed if recognition succeeds. It takes as input parameters information derived from parsers involved as parameters}

`\item{error}`{Function to be executed if recognition does not succeed. It takes two parameters:

`\itemize{`
`\item \code{p}`

with position where parser, `\code{\link[< < PACKAGE > >]{streamParser}}`, starts its recognition, obtained with `\code{\link{streamParserPosition}}`

`\item \code{h}`

with information obtained from parsers involved as parameters, normally related with failure(s) position in component parsers.

Its information depends on how parser involved as parameters are combined and on the `\code{error}` definition in these parsers.

`}`
`}`

- These functions, just as parsers which process tokens, return always the following value:

$\langle ParserCombinatorValue \rangle \equiv$

Anonymous functions, returning a list.

```
\code{function(stream)} --> \code{ list(status,node,
stream) }
```

From these input parameters, an anonymous function is constructed. This function admits just one parameter, stream, with `\link[< < PACKAGE > >]{streamParser}` class, and returns a three-field list:

```
\itemize{
  \item{status}{
    "ok" or "fail"}

  \item{node}{
```

With `\code{action}` or `\code{error}` function output, depending on the case}

```
  \item{stream}{
```

With information about the input, after success or failure in recognition}

```
}
```

2.4.1 alternation

$\langle alternation.Rd \rangle \equiv$

```

\name{alternation}
\alias{alternation}
\title{
Alternative phrases
}
\description{
Applies parsers until one succeeds or all of them fail.
}
\usage{

alternation(...,
              action = function(s) list(type="alternation",
              value=s),
              error = function(p,h) list(type="alternation",
              pos =p,h=h) )

}
\arguments{
  \item{...}{list of alternative parsers to be executed}
< < ParserCombinatorArguments > >
}
\details{

In case of success, \code{action} gets the \code{node}
from the first parse to succeed.

In case of failure, parameter \code{h} from \code{error}
gets a list, with information about failure from all the
parsers processed.

}

\value{
< < ParserCombinatorValue > >
}
\examples{

# ok
stream <- streamParserFromString("123 Hello world")
( alternation(numberNatural(),symbolic())(stream) )[c("
status","node")]

```

```
# fail
stream <- streamParserFromString("123 Hello world")
( alternation(string(),symbolic()(stream) )[c("status","node
")]
```

```
}
\keyword{parser combinator}
```

$\langle alternation.R \rangle \equiv$

```
alternation <- function(...,
                        action = function(s) list(type="
alternation",value=s),
                        error = function(p,h) list(type="
alternation",pos =p,h=h) )
```

```
function(stream) {
  dots <- list(...)
  h <- rep(list(list()),length(dots))
```

```
for( i in 1:length(dots) ) {
  cstream <- (dots[[i]])(stream)
```

```
  if (cstream$status=="ok") return(list(status="ok"
,node=action(cstream$node),stream=cstream$stream))
```

```
  h[[i]] <- cstream$node
}
return(list(status="fail",node=error(
streamParserPosition(stream),h),stream=stream))
```

```
}
```

Tests for RUnit

$\langle testRules01 \rangle \equiv$

```

# alternation
checkSentParserOk (
  "aaa 123",
  alternation(string(action=actionString),numberNatural(
    action=action)),
  "alternation")

checkSentParserOk (
  "1234",
  alternation(string(action=actionString),numberNatural(
    action=action)),
  "alternation")

```

2.4.2 option

$\langle option.Rd \rangle \equiv$

```

\name{option}
\alias{option}
\title{
    Optional parser
}
\description{
    Applies a parser to the text. If it does not succeed, an
    empty token is returned.

    Optional parser never fails.
}
\usage{
    option(ap,
           action = function(s ) list(type="option",value=s ),
           error = function(p,h) list(type="option",pos =p,h
           =h))
}
\arguments{
\item{ap}{Optional parser}
< < ParserCombinatorArguments > >
}
\details{

    In case of success, \code{action} gets the \code{node}
    returned by parser passed as optional. Otherwise, it gets
    the \code{node} corresponding to token \code{\link{
    empty}}}: \code{list(type="empty" ,value="")}

    Function \code{error} is never called. It is defined as
    parameter for the sake of homogeneity with the rest of
    functions.

}
\value{
< < ParserCombinatorValue > >
}
\examples{

# ok
stream <- streamParserFromString("123 Hello world")
( option(numberNatural())(stream) )[c("status","node")]

```

```

# ok
stream <- streamParserFromString("123 Hello world")
( option(string())(stream) )[c("status","node")]

}
\keyword{parser combinator}

 $\langle option.R \rangle \equiv$ 

option <- function(ap,
                    action = function(s) list(type="
option",value=s ),
                    error = function(p,h) list(type="
option",pos=p, h=h))

function(stream) {
  cstream <- ap(stream)

  if (cstream$status=="ok")
    return(list(status="ok",node=action(cstream$node
),stream=cstream$stream))

  else return(list(status="ok",node=action(list(type=
"empty" ,value="")),stream=stream))

}

Tests for RUnit
 $\langle testRules01 \rangle + \equiv$ 

```



```

# option
checkSentParserOk (
  ""aaa1234"",
  option(string(action=actionString)),
  "option")

checkSentParserOk (
  "1234",
  option(string(action=actionString)),
  "option","empty")

checkSentParserOk (
  "1234",
  option(string(action=actionString),action=function(s) if(
    is.list(s) ) list(type="option",value=s$value) else list(
      type="option",value=s)),
  "option","")

checkSentParserOk (
  ""1234"",
  option(string(action=actionString),action=function(s) if(
    is.list(s) ) list(type="option",value=s$value) else list(
      type="option",value=s)),
  "option")

```

2.4.3 concatenation

$\langle \text{concatenation.Rd} \rangle \equiv$

```

\name{concatenation}
\alias{concatenation}
\title{
One phrase then another
}
\description{
  Applies to the recognition a parsers sequence. Recognition
  will succeed as long as all of them succeed.
}
\usage{

  concatenation(...,
                action = function(s) list(type="
concatenation",value=s),
                error = function(p,h) list(type="
concatenation",pos=p ,h=h))

}
\arguments{
\item{...}{list of parsers to be executed}
< < ParserCombinatorArguments > >
}
\details{

  In case of success, parameter \code{s} from \code{action}
  gets a list with information about \code{node} from all
  parsers processed.

  In case of failure, parameter \code{h} from \code{error}
  gets the value returned by the failing parser.

}
\value{
< < ParserCombinatorValue > >
}
\examples{

# ok
stream <- streamParserFromString("123Hello world")
( concatenation(numberNatural(),symbolic())(stream) )[c("
status","node")]

# fail

```

```

stream <- streamParserFromString("123 Hello world")
( concatenation(string(),symbolic()(stream) ) [c("status","
node")]

}
\keyword{parser combinator}

 $\langle concatenation.R \rangle \equiv$ 

concatenation <- function(...,
                           action = function(s) list(type=
"concatenation", value=s),
                           error = function(p,h) list(type=
"concatenation", pos=p ,h=h))

function(stream) {

  streamFail <- stream
  dots <- list(...)
  value <- rep(list(list()),length(dots))

  for( i in 1:length(dots) ) {
    cstream <- (dots[[i]])(stream)

    if (cstream$status == "fail") return(list(status="
fail",node=error(streamParserPosition(streamFail),cstream
$node),stream=streamFail))

    value[[i]] <- cstream$node
    stream <- cstream$stream
  }
  return(list(status="ok",node=action(value),stream=
stream))
##
}

Test for RUnit
 $\langle testRules01 \rangle + \equiv$ 

```

```

# concatenation
checkSentParserOk (
  " 123",
  concatenation(whitespace(action=action),numberNatural(
    action=action)),
  "concatenation")

checkSentParserOk (
  " 'abs 21'",
  concatenation(whitespace(action=action),string(action=
    actionString)),
  "concatenation")

checkSentParserOk (
  " a123",
  concatenation(whitespace(action=action),symbolic(action
    =action)),
  "concatenation")

checkSentParserOk (
  " 123 abcd",
  concatenation(whitespace(action=action),numberNatural(
    action=action),whitespace(action=action),symbolic(
    action=action)),
  "concatenation")

checkSentParserOk (
  " 123abcd",
  concatenation(whitespace(action=action),numberNatural(
    action=action),whitespace(action=action),symbolic(
    action=action)),
  "concatenation")

checkSentParserOk (
  " 'aa' 123",
  concatenation(whitespace(action=action),string(action=
    actionString),whitespace(action=action),numberNatural(
    action=action)),
  "concatenation")

checkSentParserFail(
  "1 'aa' 123",
  concatenation(whitespace(action=action),string(action=
    actionString),whitespace(action=action),numberNatural(

```

action=action)),
 "concatenation")

2.4.4 repetition1N

$\langle \textit{repetition1N.Rd} \rangle \equiv$

```

\name{repetition1N}
\alias{repetition1N}
\title{
  Repeats a parser, at least once.
}
\description{
  Repeats a parser application indefinitely while it is
  successful. It must succeed at least once.
}
\usage{
  repetition1N(rpa,
               action = function(s) list(type="repetition1N
",value=s ),
               error = function(p,h) list(type="repetition1N
",pos=p,h=h))
}
\arguments{
\item{rpa}{ parse to be applied iteratively }
< < ParserCombinatorArguments > >
}
\details{
  In case of success, \code{action} gets a list with
  information about the \code{node} returned by the
  applied parser. List length equals the number of successful
  repetitions.

  In case of failure, parameter \code{h} from \code{error}
  gets error information returned by the first attempt of
  parser application.
}
\value{
< < ParserCombinatorValue > >
}
\examples{
# ok
stream <- streamParserFromString("Hello world")
( repetition1N(symbolic())(stream) )[c("status","node")]

# fail

```

```

stream <- streamParserFromString("123 Hello world")
( repetition1N(symbolic())(stream) )[c("status","node")]

}

\keyword{parser combinator}

```

This function preallocates the list which will contain values returned by the iterative parser application. It may be the case that this list exceeds the actual required length. However, this implementation is preferred due to the extreme slowness in R when appending elements to a long list.

$\langle \textit{repetition1N.R} \rangle \equiv$

```

repetition1N <- function(rpa,
                        action = function(s) list(type="
repetition1N",value=s ),
                        error = function(p,h) list(type="
repetition1N",pos=p,h=h))

```

```

function(stream) {
  cstream <- rpa(stream)

  if ( cstream$status == "fail" ) return(list(status="
fail",node=error(streamParserPosition(stream),cstream$
node),stream=stream))

```

```

  iinc <- 1000
  value <- rep(list(list()),iinc)
  imax <- iinc
  i <- 1
  value[[i]] <- cstream$node
  stream <- cstream$stream

```

```

while( TRUE ) {
  cstream <- rpa(stream)
  if ( cstream$status == "fail" ) break()
  i <- i + 1
  if ( i >= imax ) {
    value <- c(value, rep(list(list()),iinc))
    imax <- imax + iinc
  }
  value[[i]] <- cstream$node
  stream <- cstream$stream
}
return(list(status="ok",node=action(value[1:i]),
stream=stream))
}

```

Tests for Runit.

$\langle testRules01 \rangle + \equiv$


```

# repetition1N
checkSentParserOk (
  ""1234"",
  repetition1N(string(action=actionString)),
  "repetition1N")

checkSentParserOk (
  ""1234''1234"",
  repetition1N(string(action=actionString)),
  "repetition1N")

checkSentParserOk (
  ""1234''1234''1234"",
  repetition1N(string(action=actionString)),
  "repetition1N")

```

2.4.5 repetition0N

$\langle \text{repetition0N.Rd} \rangle \equiv$

```

\name{repetition0N}
\alias{repetition0N}
\title{
    Repeats one parser
}
\description{

    Repeats a parser indefinitely, while it succeeds. It will
    return an empty token if the parser never succeeds,

    Number of repetitions may be zero.
}
\usage{

    repetition0N(rpa0,
                action = function(s) list(type="repetition0N
",value=s ),
                error = function(p,h) list(type="repetition0N
",pos=p,h=h))

}
\arguments{
\item{rpa0}{parse to be applied iteratively}
< < ParserCombinatorArguments > >
}
\details{

    In case of at least one success, \code{action} gets the \
code{node} returned by the parser \code{\link{repetition
1N}} after applying the parser to be repeated. Otherwise,
it gets the \code{node} corresponding to token \code{\
link{empty}}: \code{list(type="empty",value="")}.

    Function\code{error} is never called. It is defined as
    parameter for the sake of homogeneity with the rest of
    functions.

}
\value{
< < ParserCombinatorValue > >
}
\examples{

# ok

```

```
stream <- streamParserFromString("Hello world")
( repetition0N(symbolic())(stream) )[c("status","node")]
```

```
# ok
stream <- streamParserFromString("123 Hello world")
( repetition0N(symbolic())(stream) )[c("status","node")]
```

```
}
```

```
\keyword{parser combinator}
```

$\langle \text{repetition0N.R} \rangle \equiv$

```
repetition0N <- function(rpa0,
                        action = function(s) list(type
= "repetition0N", value=s ),
                        error = function(p,h) list(type
= "repetition0N", pos=p, h=h))
```

```
option(repetition1N(rpa0),action=action,error=error)
```

Tests for RUnit

$\langle \text{testRules01} \rangle + \equiv$

```

# repetition0N

checkSentParserOk (
  "1234",
  repetition0N(string(action=actionString)),
  "repetition0N", "empty")

checkSentParserOk (
  ""1234"",
  repetition0N(string(action=actionString)),
  "repetition0N",
  "repetition1Nlist(\ ""1234'\")"
)
checkSentParserOk (
  ""1234''1234"",
  repetition0N(string(action=actionString)),
  "repetition0N",
  "repetition1Nlist(\ ""1234'\", \ ""1234'\")"
)
checkSentParserOk (
  ""1234''1234''1234"",
  repetition0N(string(action=actionString)),
  "repetition0N",
  "repetition1Nlist(\ ""1234'\", \ ""1234'\", \ ""1234'\")"
)

checkSentParserOk (
  ""1234''1234''1234"",
  repetition0N(string(action=actionString),action=
    function(s) if( is.list(s) ) list(type="repetition0N",value
      =s$value) else list(type="repetition0N",value=s)),
  "repetition0N",
)

checkSentParserOk (
  "1234'1234'1234'",
  repetition0N(string(action=actionString),action=
    function(s) if( is.list(s) ) list(type="repetition0N",value
      =s$value) else list(type="repetition0N",value=s)),
  "repetition0N", ""
)

```

2.4.6 Tests

Combined tests

Tests using several combining parsers functions are included.

Tests for RUnit

$\langle testRules02 \rangle \equiv$

combinations

```
checkSentParserOk (  
  " 'aa'",  
  concatenation(whitespace(action=action),alternation(string  
    (action=actionString),numberNatural(action=action),  
    action=action)),  
  "concatenation")
```

```
checkSentParserOk (  
  " 123",  
  concatenation(whitespace(action=action),alternation(string  
    (action=actionString),numberNatural(action=action),  
    action=action)),  
  "concatenation")
```

```
checkSentParserOk (  
  " 123 ",  
  concatenation(whitespace(action=action),alternation(string  
    (action=actionString),numberNatural(action=action),  
    action=action),whitespace(action=action)),  
  "concatenation")
```

The same exercise from a file

$\langle testRules02 \rangle_+ \equiv$

```

parser <- concatenation(
  whitespace(),
  string(), whitespace(),
  repetition1N(concatenation(
numberScientific(), whitespace()),
  symbolic(), whitespace(),
  string(), whitespace(),
  eofMark()
)

stream <- streamParserFromFileName(system.file
("extdata", "datInTest01.txt", package = "< <
PACKAGE > >"))

cstream <- parser(stream)
streamParserClose(cstream$stream)
checkEquals("ok", cstream$status)

```

RUnit

Here, tests associated with previous functions are assembled for RUnit.

This function in the case of streamParseFromString.

<runit.02rules.RUnit>≡

```

< < testFuncionesUtiles > >
test.rules01 <- function() {
  < < testRules01 > >
}

```

And this one in the case of streamParseFromString.

<runit.02rules.RUnit>+≡

```

test.rules02 <- function() {
  < < testRules02 > >
}

```

Utility functions

Functions used to perform test with RUnit.

action In order to be used as action function and convert syntactical tree in one string.

$\langle testFuncionesUtiles \rangle + \equiv$

```
action <- function(s) paste(s,collapse="",sep="")
```

actionString In order to be used as action function and convert syntactical tree in one quoted string (simple-quotation).

$\langle testFuncionesUtiles \rangle + \equiv$

```
actionString <- function(s) paste("",s,"",collapse="",sep=""  
= "")
```

Chapter 3

PC-AXIS

3.1 Introduction

3.2 PC-AXIS file format syntactical analysis

3.2.1 Notes

Notes extracted from 'PC-Axis file format manual. Statistics of Finland.'

http://tilastokeskus.fi/tup/pcaxis/tiedostomuoto2006_laaja_en.pdf

The kind of sentences that may contain a file are:

- a table-specific keyword has the form `KEYWORD=`
- a variable-specific keyword has the form `KEYWORD("Variable")=`
- a value-specific keyword has the form `KEYWORD("Variable","Value")=`
- the form of cell and special keywords is given in the specifications of each keyword (e.g. `CELLNOTE`).

The definition of variables in the file:

Variables are described in PC-Axis with keywords `STUB` (row variables) `HEADING` (column variables).

It is also possible to create a variable consisting of various content variables; the keyword `CONTVARIABLE` is used for this.

Domains in these variables can be informed through codes, values or both.

The variable is divided into values, which are expressed as texts and possible codes. The values of variables (classes, headings) are indicated by variable with the VALUES and codes with the CODES keywords.

Numerical values format:

The numerical values of a statistical table are given in the numerical table following the DATA decimal separator of the figures is a full stop, the minus sign is in front of a negative figure and separators are not used. The figures are separated from one another with space or tabulator. The data row must have a space before the line feed. In addition to numerical values, missing, masked hidden information can be expressed in PC–Axis data part by means of so–called dot codes.

Statistics Finland's application guideline: The following notations in accordance with the Official Statistics of Finland standard accepted in 2005 are in use:

0.0 Magnitude less than half of unit employed (not working properly in PC–Axis)

”” Category not applicable

”..” Data not available or too uncertain for presentation

”...” Data subject to secrecy

”....” Magnitude nil (do not use a dash!)

”.....”

”.....”

”–” Magnitude nil (do not use in PC–Axis because it is interpreted as zero).

It must be pointed out that some files follow PC-AXIS definition in a quite lax manner. Grammar has been adapted in order to be able to read the widest number of versions possible.

On the other hand, there may be some problems with some 'encoding'. This piece of comment is parametrized here, so it can be repeated throughout the documentation.

$\langle encodingProblem \rangle \equiv$

```

#
# Error messages like
# " ... invalid multibyte string ... "
# or warnings
# " input string ... is invalid in this locale"
#
# For example, in Linux the error generated by this code:
name <- "http://www.ine.es/pcaxisdl/t20/e245/p04/
a2009/10/00000008.px"
stream <- streamParserFromString( readLines( name ) )
cstream <- pcAxisParser(stream)
if ( cstream$status == 'ok' ) cube <- pcAxisCubeMake
(cstream)
#
# is caused by files with a non-readable 'encoding'.
# In the case where it could be read, there may also be
problems
# with string-handling functions, due to multibyte
characters.
# In Windows, according to \code{link{Sys.getlocale}()},
# file may be read but accents, ñ, ... may not be correctly
recognised.
#
#
# There are, at least, the following options:
# - File conversion to utf-8, from the OS, with
# "iconv - Convert encoding of given files from one
encoding to another"
#
# - File conversion in R:
name <- "http://www.ine.es/pcaxisdl/t20/e245/p04/
a2009/10/00000008.px"
stream <- streamParserFromString( iconv( readLines(
name ), "IBM850", "UTF-8" ) )
cstream <- pcAxisParser(stream)
if ( cstream$status == 'ok' ) cube <- pcAxisCubeMake
(cstream)
#
# In the latter case, latin1 would also work, but accents, ñ
, ... would not be correctly read.
#
# - Making the assumption that the file does not contain
multibyte characters:
#

```

```

localeOld <- Sys.getlocale("LC_CTYPE")
Sys.setlocale(category = "LC_CTYPE", locale = "C")
#
name <-
  "http://www.ine.es/pcaxisdl/t20/e245/p04/a2009/10/
00000008.px"
stream <- streamParserFromString( readLines( name ) )
cstream <- pcAxisParser(stream)
if ( cstream$status == 'ok' ) cube <- pcAxisCubeMake
(cstream)
#
Sys.setlocale(category = "LC_CTYPE", locale =
localeOld)
#
# However, some characters will not be correctly read (
accents, ñ, ...)

```

3.2.2 man

$\langle pcAxisParser.Rd \rangle \equiv$

```

\name{pcAxisParser}
\alias{pcAxisParser}
\title{
Parser for PC–AXIS format files
}
\description{
  Reads and creates the syntactical tree from a PC–AXIS
  format file or text.
}
\usage{
  pcAxisParser(streamParser)
}
\arguments{
\item{streamParser}{stream parse associated to the file/
  text to be recognised}
}
\details{

Grammar definition, wider than the strict PC–AXIS
definition
\preformatted{

pcaxis = { rule } , eof ;

rule = keyword ,
      [ '[' , language , ']' ] ,
      [ '(' , parameterList , ')' ] ,
      = ,
      ruleRight ;

parameterList = parameter , { ',' , parameterList } ;

ruleRight = string , string , { string } , ';'
          | string , { ',' , string } , ';'
          | number , sepearator , { , number } , ( ';' |
eof )
          | symbolic
          | 'TLIST' , '(' , symbolic ,
                                ( ( ')' , { ',' , string } )
                                |
                                ( ',' , string , '-' , string ,
                                ')' )
                                ) , ';'
          ;

```

```

keyword = symbolic ;

language = symbolic ;

parameter = string ;

separator = ' ' | ',' | ';' ;

eof = ? eof ? ;

string = ? string ? ;

symbolic = ? symbolic ? ;

number = ? number ? ;
}

```

Normally, this function is a previous step in order to eventually call `\code{pcAxisCubeMake}`:

```

\code{
  cstream <- pcAxisParser(stream)
  if ( cstream$status == 'ok' ) cube <- pcAxisCubeMake
    (cstream)
}
}
\value{
Returns a list with "status" "node" "stream":
\item{status}{ "ok" or "fail"}

\item{stream}{Stream situation after recognition}

\item{node}{List, one node element for each "keyword" in
  PC-AXIS file.
  Each node element is a list with: "keyword" "language" "
  parameters" "ruleRight":
\itemize{
\item{keyword}{

  PC-AXIS keyword}
\item{language}{

  language code or ""}

```

```

\item{parameters}{

  null or string list with parenthesised values associated to
  keyword }
\item{ruleRight}{

  is a list of two elements, "type" "value" :

  If type = "symbol", value = symbol

  If type = "liststring", value = string vector, originally
  delimited by ","

  If type = "stringstring", value = string vector, originally
  delimited by blanks, new line, ...

  If type = "list" , value = numerical vector, originally
  delimited by ","

  If type = "tlist" , value = (frequency, "limit" keyword ,
  lower-limit , upper-limit) or (frequency, "list" keyword ,
  periods list ) }

}}
}
\examples{

\dontrun{
  ## significant time reductions may be achieve by doing:
  library("compiler")
  enableJIT(level=3)
}

name <- system.file("extdata","datInSFexample6__1.px",
  package = "< < PACKAGE > >")
stream <- streamParserFromFileName(name,encoding="
UTF-8")
cstream <- pcAxisParser(stream)
if ( cstream$status == 'ok' ) {

  ## HEADING
  print(Filter(function(e) e$keyword=="HEADING",
cstream$node)[[1]] $ruleRight$value)

```

```

## STUB
print(Filter(function(e) e$keyword=="STUB",cstream$
node)[[1]] $ruleRight$value)

## DATA
print(Filter(function(e) e$keyword=="DATA",cstream$
node)[[1]] $ruleRight$value)

}

\dontrun{
  < < encodingProblem > >
}

}

\references{

PC–Axis file format.

\url{http://www.scb.se/Pages/List_____314011.aspx}

PC–Axis file format manual. Statistics of Finland.

\url{http://tilastokeskus.fi/tup/pcaxis/tiedostomuoto2006
__laaja__en.pdf}

}

\keyword{PC–AXIS}

```

3.2.3 code

```

 $\langle pcAxisParser.R \rangle \equiv$ 

pcAxisParser <- function(streamParser) {

Function to print where the error happens

 $\langle pcAxisParser.R \rangle + \equiv$ 

```

```

errorFun <- function(strmPosition,h=NULL,type="") {
  if ( is.null(h) || type != "concatenation" )
    print(paste("Error from line:",strmPosition$line,"
position:",strmPosition$linePos))
  else errorFun(h$pos,h$h,h$type)

  return(list(type=type,pos=strmPosition,h=h))
}

```

Auxiliary function to recognise frequency and date intervals in time series

$\langle pcAxisParser.R \rangle + \equiv$


```

tlistParse <-
  concatenation(keyword("TLIST"),
    whitespace(),
    charParser("("),
    whitespace(),
    symbolic(),
    whitespace(),
    alternation(
      concatenation(charParser(")"),
        repetition1N(
          concatenation
            (
              whitespace(),

              charParser(","),
              whitespace(),
              string(action = function(s) s),
              action = function(s) s[[4]]),

action = function(s) list(type="list",value=unlist(s))),
              action =
                function(s) s[[2]] ),
              concatenation(charParser(","),
                whitespace(),
                string(action
                  = function(s) s),
                whitespace(),
                charParser("-"
                  = function(s) s),
                whitespace(),
                string(action
                  = function(s) s),
                whitespace(),
                charParser(")"))
            ,
            action =
function(s) list(type="limit",value=s[c(3,7)]) ),
            action = function(s) s),
            whitespace(),
            charParser(";"),
            action = function(s) list(type="tlist",
value=s[c(5,7)]) )

```

Here it is implemented the left hand side, before '=' sign in 'rule'.
 $\langle pcAxisParser.R \rangle + \equiv$

```

##
rule <- concatenation(
# left rule
# keyword
symbolic(action = function(s)
s),
# optional multi-language
option(concatenation(
whitespace
(),
charParser(
"["),
whitespace
(),
symbolic(
action = function(s) s),
whitespace
(),
charParser(
"]"),
action =
function(s) s[4]),
action = function(s) if
(!is.null(s$type) && s$type=="empty") NULL else s),
# optional variables / values
option(concatenation(
whitespace
(),
charParser(
"("),
whitespace
(),
string(
action = function(s) s),
repetition0N
(
concatenation
(
whitespace(),
charParser("),"),
whitespace(),
string(action = function(s) s),
action = function(s) s[4]), # end concatenation
action = function(s) if (!is.null(s$type) && s$type=="

```

```

empty") NULL else s$value),# end repetition0N
                                whitespace
()),
                                charParser(
"),"),
                                action =
function(s) if( is.null(s[[5]]) ) s[c(4)] else c(s[c(4)],unlist
(s[c(5)]))), # end concatenation
                                action = function(s) if
(!is.null(s$type) && s$type=="empty") NULL else s),
                                # end option
                                whitespace(),
                                charParser("="),

```

Rule right hand side, after '=' sign

$\langle pcAxisParser.R \rangle + \equiv$

```

whitespace(),
alternation(

```

Alternatively, it may be:

A string, followed by other strings delimited by blanks.

$\langle pcAxisParser.R \rangle + \equiv$

```

concatenation(
  string(action = function(s)s), repetition1N(
concatenation(
  whitespace(),
  string(action = function(s)
s),
  action = function(s) s[[2]]),
  action = function(s) s ),
  whitespace(),
  charParser(";"),
  action = function(s) list(type="stringstring
",value=c(s[c(1)],unlist(s[c(2)]))) ),

```

Strings lists, delimited by commas.

$\langle pcAxisParser.R \rangle + \equiv$

```

concatenation( string(action = function(s) s) ,
                repetition0N(
                    concatenation(
                        whitespace(),
                        charParser(";","),
                        whitespace(),
                        string(action =

function(s) s),

                        action =

function(s) s[[4]]),
                        action = function(s) if (!is.
null(s$type) && s$type=="empty") NULL else s$value)
                    ,
                    whitespace(),
                    charParser(";","),
                    action = function(s) list(type="liststring",
value=if( is.null( s[[2]] ) ) s[c(1)] else c(s[c(1)],unlist(s[c
(2)],use.names = FALSE))) ),

```

Numbers list or the DATA= format, which may include variables codes and may end without ";" and with end-of-file marks.

$\langle pcAxisParser.R \rangle + \equiv$

```

concatenation(
    alternation(
        numberScientific(action =
function(s) s),
        string(action = function(s) s),
        dots (action = function(s) s),
        action = function(s) s) ,
    repetition0N(
        concatenation(
            separator(),
            alternation(
                numberScientific
( action = function(s) s),
                string(
action = function(s) s),
                dots (
action
= function(s) s) ,
                action =
function(s) s[[2]]),
            action = function(s) if (!is.null(s$type) &
& s$type=="empty") NULL else s$value), # en
repetition0N
        whitespace(),
        alternation(
            concatenation(charParser(";"),
                whitespace(),
                option(
concatenation( charParser(";"), whitespace()))),
                option(
concatenation( charParser("\032"), whitespace()))
            ),
            concatenation(charParser("\032"),
                whitespace()
            ),
            eofMark()),
        action = function(s) list(type="list",value=
if( is.null( s[[2]] ) ) s[c(1)] else c(s[c(1)],unlist(s[c(2)]),
use.names = FALSE))) ),

```

Frequency and date intervals in time series.

$\langle pcAxisParser.R \rangle + \equiv$

tlistParse,

Right hand side, make up by only one symbol.

$\langle pcAxisParser.R \rangle + \equiv$

```
concatenation(symbolic(action = function(s) s),
               whitespace(),
               charParser(";"),
               action = function(s) list(type="symbol",
value=s[[1]])),
```

When finishing the rule, after “;”, blanks are allowed and, within each rule, relevant information is contained in position 1, 2, 3, 7, which may be null and correspond to "keyword", "language", "parameters", "ruleRight".

$\langle pcAxisParser.R \rangle + \equiv$

```
               action = function(s) s), ## end alternation
               whitespace(), ## blanks behind ;
               action = function(s) { rule <-
s[c(1,2,3,7)] ; names(rule) <- c("keyword","language","
parameters","ruleRight") ; rule }
               )
```

Finally, a PC-AXIS file consists in the repetition of 'rule', n times, followed by the end-of-file mark.

$\langle pcAxisParser.R \rangle + \equiv$

```
cstream <- concatenation(repetition1N(rule,action =
function(s) s) ,eofMark(error=errorFun),action =
function(s) s[[1]]) (streamParser)
return(cstream)
}
```

3.2.4 test

$\langle runit.PCAXIS \rangle \equiv$

```

# Check kinds of tokens in PC–AXIS files

name <- system.file("extdata", "datInSFexample6__1.px",
  package = "< < PACKAGE > >")
rule <- alternation(symbolic(),string(),numberScientific(),
  charParser("("),charParser(")"),
  charParser("["),charParser("]"),
  charParser(","),charParser(";"),
  charParser("-"),charParser("="),
  eofMark(),
  charParser(' '),
  charParser('\n'),charParser("\r"),
  charParser("\t"))

stream <- streamParserFromFileName(name,encoding="
  UTF-8")

cstream <- rule(stream)
printCStream(cstream) ;
checkEquals("ok",cstream$status,'tokens read')

while( cstream$status == "ok" && cstream$node$value$
  type != "eofMark" ) {
  cstream <- rule(cstream$stream)
  printCStream(cstream) ;
  checkEquals("ok",cstream$status,'tokens read')
}

if( cstream$status == "fail" ) {
  print(streamParserNextChar(cstream$stream)) ;
  print(streamParserPosition(cstream$stream)) ;
}
streamParserClose(cstream$stream)

# step by step PC–AXIS format checking
checkEquals("ok",pcAxisParser(streamParserFromString('
  CHARSET="ANSI";'))$status,'CHARSET')

checkEquals("ok",pcAxisParser(streamParserFromString('
  AXIS-VERSION="2000"; '))$status,'AXIS-VERSION')

checkEquals("ok",pcAxisParser(streamParserFromString('
  DECIMALS=0;'))$status,'DECIMALS')

```



```

checkEquals("ok",pcAxisParser(streamParserFromString('
    SUBJECT-AREA="Väestö";'))$status,'SUBJECT-
    AREA')

checkEquals("ok",pcAxisParser(streamParserFromString('
    SUBJECT-AREA="Väestö";
'))$status,'SUBJET-AREA/TITLE/CONTENTS')

checkEquals("ok",pcAxisParser(streamParserFromString('
    TITLE="Väestö 31.12. muuttujina Sukupuoli, Kunta,
    Vuosi ja Siviilisääty";'))$status,'TITLE')

checkEquals("ok",pcAxisParser(streamParserFromString('
    SUBJECT-AREA="Väestö";
    TITLE="Väestö 31.12. muuttujina Sukupuoli, Kunta, Vuosi
    ja Siviilisääty";
    CONTENTS="Väestö 31.12.";'))$status,'SUBJET-AREA/
    TITLE/CONTENTS')

checkEquals("ok",pcAxisParser(streamParserFromString('
    HEADING="Vuosi","Siviilisääty";'))$status,'HEADING'
)

checkEquals("ok",pcAxisParser(streamParserFromString('
    VALUES("Kunta")="Espoo","Helsinki","Vantaa";'))$
    status,'VALUES')

checkEquals("ok",pcAxisParser(streamParserFromString('
    DATA=57516 43030 100546 57516 43030 100546 91202
    67623 158825 91202 67623 158825 ; ' ))$status,'DATA 01'
)

checkEquals("ok",pcAxisParser(streamParserFromString('
    DATA=57516 43030 100546 57516 43030 100546 91202
    67623 158825 91202 67623 158825 ' ))$status,'DATA 02')

checkEquals("ok",pcAxisParser(streamParserFromString('
    DATA=
    57516 43030 100546 57516 43030 100546
    144564 85339 229903 144564 85339 229903
    47131 33688 80819 47131 33688 80819
    53821 43375 97196 53821 43375 97196
    151536 86184 237720 151536 86184 237720

```

```

44071 33935 78006 44071 33935 78006
111337 86405 197742 111337 86405 197742
296100 171523 467623 296100 171523 467623
91202 67623 158825 91202 67623 158825;'))$status,'DATA')

checkEquals("ok",pcAxisParser(streamParserFromString('
DATA=
39669394 19399549 20269845
13782827 6554619 7228208
    52709 28052 24657
    739409 382664 356745
    800097 406813 393284
1444239 727941 716298
3129220 1563613 1565607
3599227 1789972 1809255
4525296 2241138 2284158
4996377 2467192 2529185
3157049 1549638 1607411
3442944 1687907 1755037
    0 0 0
\032'))$status,'DATA')

```

3.3 PC-AXIS cube : Semantics (PC-AXIS file content

3.3.1 Notes

Notes extracted from 'PC-Axis file format manual. Statistics of Finland.'

http://tilastokeskus.fi/tup/pcaxis/tiedostomuoto2006_laaja_en.pdf

Here, the meaning of the most relevant metadata keywords in a PC-AXIS cube is outlined. In order to extract numerical data, keywords STUB, HEADING, VALUES, CODES are relevant.

"Managing the character set", CHARSET . CODEPAGE

"Basic language", "PC-Axis compatibility" AXIS-
VERSION

"Creation and updating", "Information about the creation"
CREATION-DATE

"The information on statistical topics" SUBJECT-AREA,
SUBJECT-CODE,DATABASE, MATRIX

"Table titling" TITLE, DESCRIPTION,
DESCRIPTIONDEFAULT , CONTENTS

"Measurement units" UNITS

"Variables", "Row variables" STUB

"Variables", "Column variables" HEADING

"The classifications (variable values)" VALUES, CODES.

"Decimal numbers", "The number of saved decimal"
DECIMALS

"Decimal numbers" , "Presentation precision"
SHOWDECIMALS

"Creation and updating", "Information about updating"
LAST-UPDATED

"Source and contact information" SOURCE, CONTACT.

"COPYRIGHT" COPYRIGHT

"saving and display mode of variable texts and codes",
PRETEXT,

0, "Do not use!"

1, "texts and codes are saved to their own keywords"

2, "save texts as codes and vice versa"

3 "indicates that both texts and codes are shown in
the table."

"the file name of the table specification attached to the
table without the extension.", INFOFILE

"the name of the map template file corresponding to the table.", MAP
 "the time series data are working-day adjusted. YES/NO", DAYADJ
 "the time series data are working-day adjusted. YES/NO", SEASADJ

TIMEVAL is a variable-specific specification that can appear only once in a table.

The keyword value is the TLIST specification expressing the time scale and period, which can be given either in time limit or list format.

TIMEVAL("Time")=TLIST(M1,"199605"-"199704");

TIMEVAL("Time")=TLIST(M1)

,"199605","199606","199607","199608","199609","199610","199611","199612","199701",

The following TLIST specifications are used:

A1 in annual statistics in form CCYY (CC century, YY year)

H1 quarterly in form CCYYH, where H is 1 or 2

Q1 quarterly in form CCYYQ, where Q is 1-4.

M1 in monthly statistics in form CCYYMM, where MM is 01-12

W1 in weekly information in form CCYYWW, where WW is 01-52.

3.3.2 man

$\langle pcAxisCubeMake.Rd \rangle \equiv$

```

\name{pcAxisCubeMake}
\alias{pcAxisCubeMake}
\title{
    Creates PC–AXIS cube
}

\description{
    From the constructed syntactical tree, structures in R are
    generated. These structures contain the PC–AXIS cube
    information.
}

\usage{
pcAxisCubeMake(cstream)
}
\arguments{
\item{cstream}{tree returned by the PC–AXIS file
    syntactical analysis }
}

%\details{}

\value{
    It returns a list with the following elements:
    \item{pxCube (data.frame)}{
        \tabular{ll}{
            headingLength \tab Number of variables in "
            HEADING".\cr
            StubLength \tab Number of variables in "STUB".\cr
            frequency \tab Data frequency if "TIMEVAL" is
            present. \cr
        }}
    \item{pxCubeVariable (data.frame)}{
        \tabular{ll}{
            variableName \tab Variable name.\cr
            headingOrStud \tab Indicator, whether the variable
            appears in "HEADING" or "STUB". \cr
            codesYesNo \tab Indicator, whether there is "
            CODES" associated to the variable.\cr
            valuesYesNo \tab Indicator, whether there is "
            VALUES" associated to the variable.\cr
            variableOrder \tab Variable order number in "
            HEADING" or "STUB".\cr
            valueLength \tab Number of different "CODES"
        }}
    }
}

```

```

and/or "VALUES" associated with the variable.\cr
}}
\item{pxCubeVariableDomain (data.frame)}{
  \tabular{ll}{
    variableName \tab Variable name.\cr
    code \tab Value code when "CODES" is present.\cr
    value \tab Value literal when "VALUES" is present.\cr
  }
  \cr
  valueOrder \tab Variable order number in "CODES"
and/or "VALUES".\cr
  eliminationYesNo \tab Indicator, whether the value
for the variables is present in "ELIMINATION".\cr
}
}
\item{pxCubeAttrN}{data.frame list, one for each
different parameters cardinalities appearing in "keyword"
\itemize{
\item{pxCubeAttrN$A0 (data.frame)}{
  \tabular{ll}{
    keyword \tab Keyword.\cr
    language \tab Language code o "".\cr
    length \tab Number of elements of value list.\cr
    value \tab Associated data, keyword[language] =
value.\cr
  }
}
\item{pxCubeAttrN$A1 (data.frame)}{
  \tabular{ll}{
    keyword \tab Keyword.\cr
    language \tab Language code o "".\cr
    arg1 \tab Argument value.\cr
    length \tab Number of elements of value list.\cr
    value \tab Associated data , keyword[language](arg)
= value.\cr
  }
}
\item{pxCubeAttrN$A2 (data.frame)}{
  \tabular{ll}{
    keyword \tab Keyword.\cr
    language \tab Language code o "".\cr
    arg1 \tab Argument one value.\cr
    arg2 \tab Argument to value.\cr
    length \tab Value list number of elements.\cr
    value \tab Associated data , keyword[language](arg
1,arg2) = value.\cr
  }
}
}
}

```

```

\item{pxCubeData (data.frame)}{
  \tabular{ll}{
    StubLength + headingLength columns \tab, with
    variables values, ordered according to "STUB" and
    followed by those appearing in "HEADING".

    Variables names correspond to variable names.\cr
    data \tab associated value.\cr
  }}

Returned value short version is:
\preformatted{
Value:
pxCube (headingLength, StubLength)
pxCubeVariable (variableName , headingOrStud,
  codesYesNo, valuesYesNo, variableOrder, valueLength)
pxCubeVariableDomain(variableName , code, value,
  valueOrder, eliminationYesNo)
pxCubeAttr -> list pxCubeAttrN(key, {variableName} ,
  value)
pxCubeData ({variableName}+, data) varia signatura

}

}
\examples{

\dontrun{
  ## significant time reductions may be achieve by doing:
  library("compiler")
  enableJIT(level=3)
}

name <- system.file("extdata","datInSFexample6__1.px",
  package = "< < PACKAGE > >")

stream <- streamParserFromFileName(name,encoding="
UTF-8")

cstream <- pcAxisParser(stream)
if ( cstream$status == 'ok' ) {
  cube <- pcAxisCubeMake(cstream)
}

```

```

## Variables
print(cube$pxCubeVariable)

## Data
print(cube$pxCubeData)

}

\dontrun{
  < < encodingProblem > >
}

}
\references{

PC–Axis file format.

\url{http://www.scb.se/Pages/List_____314011.aspx}

PC–Axis file format manual. Statistics of Finland.

\url{http://tilastokeskus.fi/tup/pcaxis/tiedostomuoto
2006__laaja__en.pdf}

}

\keyword{PC–AXIS}

```

3.3.3 code

$\langle pcAxisCubeMake.R \rangle \equiv$


```

pcAxisCubeMake <- function(cstream) {
##
  stringsAsFactorsOld <- options("stringsAsFactors")
  on.exit(options(stringsAsFactors=stringsAsFactorsOld
$stringsAsFactors
))
  options(stringsAsFactors=FALSE)
##
## Creates a vector with values associated with a keyword,
taking into account data type
  avecMapValue <- function(e) {
    mapValue <- e[[4]]
    if (length(mapValue) == 0 ) return(c())
    switch(mapValue$type,
      stringstring=as.character(mapValue$value),
      liststring =as.character(mapValue$value),
      symbol =as.character(mapValue$value),
      list =as.character(mapValue$value),
      tlist =c(as.character(unlist(mapValue$value
[[1]]$value)),as.character(mapValue$value[[2]]$type),as.
character(unlist(mapValue$value[[2]]$value))),
      as.character(mapValue$value))
    }
##
## Flattens data associated with a keyword
## "rownum" "keyword" "variable" "variableValue" "
mapValueType" "mapValueLength" "mapValue"

  keywordsAplana <- function(e)
    list( keyword = e[[1]][[1]],
      language= if(! is.null(e[[2]]) && length(e[[2]])
> 0 ) e[[2]][[1]] else list(as.character("")),
      arity =length(e[[3]]),
      args = e[[3]],
      type = e[[4]]$type,
      length = length(e[[4]]$value),
      value = avecMapValue(e) )
##
##
  productoCartersiano <- function(a,b) unlist(lapply(
a,function(e1) lapply(b,function(e2) c(list(),e1,e2))),
recursive=FALSE,use.names = FALSE)
##
  combinaValores <- function(listVar) {

```

```

listVar <- Filter(function(x) length(x) > 0, listVar
)
if( length(listVar) <= 1 ) as.list(listVar[[1]])
else {
  expa <- listVar[[1]]
  for( i in 2:length(listVar) ) expa <-
productoCartersiano(expa,listVar[[i]])
  return(expa)
}
}
proyect <- function(listlist,n) lapply(listlist,function
(e) e[[n]])
##
##
keywords <- lapply(cstream[[2]],function(x)
keywordsAplana(x))

selectClauses <- function(data,filter,fields)
  if( missing(filter) ) { if ( missing(fields) ) data else
lapply( data ,function(e) e[fields]) } else
  { if ( missing(fields) ) Filter(filter,data) else lapply(
Filter(filter,data),function(e) e[fields]) }

getColumn <- function(data,field) as.vector(unlist(
lapply(data,function(e) e[[field]])))
##
STUB <- selectClauses(keywords, function(e) e$
language==" " && e$arity == 0 && e$keyword == "
STUB" )[[1]]
HEADING <- selectClauses(keywords, function(e) e$
language==" " && e$arity == 0 && e$keyword == "
HEADING" )[[1]]
DATA <- selectClauses(keywords, function(e) e$
language==" " && e$arity == 0 && e$keyword == "
DATA" )[[1]]
TIMEVAL <- selectClauses(keywords, function(e) e$
language==" " && e$arity == 1 && e$keyword == "
TIMEVAL" )
KEYS <- selectClauses(keywords, function(e) e$
language==" " && e$arity == 1 && e$keyword == "
KEYS" )
##
frequency <- if ( length(TIMEVAL) > 0 )
TIMEVAL[[1]]$value[[1]] else as.character(NA)

```

```

keysFlag <- length(KEYS) > 0
##
## pxCube:
## (headingLength, StubLength, frequency)
pxCube <- data.frame(headingLength=HEADING$
length,StubLength=STUB$length,frequency=
frequency)
##
## pxCubeAttrN
aritys <- unique(as.vector(lapply(keywords,
function(e) e$arity)))
pxCubeAttrN <- list()
for ( a in aritys ) {
  ##print(a)
  ks <- Filter(function(e) e$arity == a && e$
keyword != "DATA" , keywords )
  ksap <- lapply(ks, function(e) c(e$keyword,e$
language,e$args,e$length,value=paste("'",e$value,"'",sep
="'",collapse=" ")[[1]]))
  ksdf <- data.frame(lapply(do.call(function(...)
rbind.data.frame(..., deparse.level=0),ksap),unlist))
  names(ksdf) <- c("keyword","language",if(a>0)
paste("arg",1:a,sep="")) else NULL,"length","value")
  pxCubeAttrN[[paste("A",as.character(a),sep="")]
<- ksdf
}
##
##
##
## CODES or VALUES registries
codesvalues <- selectClauses(keywords,
function(e) e$language
==" " && e$arity == 1 && e$keyword %in% c("CODES
","VALUES"),
c("keyword","args","
length","value"))
## Value number, by variables
codesValuesLength <- aggregate(getColumn(
codesvalues,"length"),list(getColumn(codesvalues,"args")),
max)
rownames(codesValuesLength) <- codesValuesLength
$Group.1
colnames(codesValuesLength) <- c("variable","
valueLength")

```

```

## Whether use "codes" or "values" in the numerical
value key/pk
codesOValues <- aggregate(getColumn(codesvalues,"
keyword"),list(getColumn(codesvalues,"args")),function(
x) min(as.character(x)))
rownames(codesOValues ) <- codesOValues$Group.1
colnames(codesOValues ) <- c("variable","keyword")

## Information union: Number of values, by variables
and whether use "codes" or "values" in the numerical
value key/pk
variableMeta <- merge(codesOValues,
codesValuesLength)
rownames(variableMeta) <- codesOValues$variable
##

valueselimination <- selectClauses(keywords,function(
e) e$language==" && e$arity == 1 && e$keyword ==
"ELIMINATION")

## pxCubeVariable:
## (variableName, headingOrStud, codesYesNo,
valuesYesNo, variableOrder, valueLength)
variableName <- unlist(c(HEADING$value,STUB$
value))

headingOrStud <- c(rep("HEADING",HEADING$
length),rep("STUB" ,STUB$length))

codesYesNo <- sapply(variableName,function(v)
length(selectClauses(codesvalues,function(e) e$keyword
== "CODES" && e$args[[1]] == v)) >= 1 )

valuesYesNo <- sapply(variableName,function(v)
length(selectClauses(codesvalues,function(e) e$keyword
== "VALUES" && e$args[[1]] == v)) >= 1 )

variableOrder <- c(1:HEADING$length,1:STUB$
length)

valueLength <- unlist(variableMeta[variableName,"
valueLength"])

```

```

pxCubeVariable<- cbind.data.frame(variableName,
headingOrStud, codesYesNo, valuesYesNo, variableOrder,
valueLength)

colnames(pxCubeVariable) <- c("variableName", "
headingOrStud", "codesYesNo", "valuesYesNo", "
variableOrder", "valueLength")
##
## pxCubeVariableDomain:
## (variableName, code, value, valueOrder,
eliminationYesNo)
variableName <- unlist(sapply(1:length(
pxCubeVariable$variableName),function(i) rep(
pxCubeVariable$variableName[i],pxCubeVariable$
valueLength[i])))

code <- unlist(sapply(1:length(pxCubeVariable$
variableName),function(i) if(pxCubeVariable$codesYesNo
[i]) selectClauses(codesvalues,function(e) e$keyword ==
"CODES" && e$args[[1]] == pxCubeVariable$
variableName[i],"value") else rep(as.character(NA),
pxCubeVariable$valueLength[i])))

value <- unlist(sapply(1:length(pxCubeVariable$
variableName),function(i) if(pxCubeVariable$
valuesYesNo[i]) selectClauses(codesvalues,function(e) e$
keyword == "VALUES" && e$args[[1]] ==
pxCubeVariable$variableName[i],"value") else rep(as.
character(NA),pxCubeVariable$valueLength[i])))

valueOrder <- unlist(sapply(1:length(
pxCubeVariable$variableName),function(i) 1:
pxCubeVariable$valueLength[i]))

eliminationYesNo <- unlist(sapply(1:length(value),
function(i) length(selectClauses(valueselimination,
function(e) e$keyword == "ELIMINATION" && e$
args[[1]] == variableName[i] && e$value == value[i])) >
0))

if ( length(code) != length(value) ) stop("Error:
CODE and VALUE non-consistent")

pxCubeVariableDomain <- cbind.data.frame(

```

```

variableName,code,value,valueOrder,eliminationYesNo)
  names(pxCubeVariableDomain) <- c("
variableName","code","value","valueOrder","
eliminationYesNo")
  ##
  ## pxCubeData:
  ## ({variableName}+, data)
  if ( ! keysFlag ) {
    STUDValues <- combinaValores(lapply(STUB$
value ,function(v) unlist(selectClauses(codesvalues,
function(e) e$keyword == variableMeta[v,"keyword"] &
& e$args[[1]] == v,"value"))))

    HEADINGValues <- combinaValores(lapply(
HEADING$value,function(v) unlist(selectClauses(
codesvalues,function(e) e$keyword == variableMeta[v,"
keyword"] && e$args[[1]] == v,"value"))))

    pxCubeData <- combinaValores(list(STUDValues,
HEADINGValues))
    ##
    ## data.frame construction, from the values
combinations list
    e1 <- pxCubeData[[1]]
    pxCubeData <- do.call("cbind.data.frame",
                        lapply(1:length(e1),function(i
) as.character(proyect(pxCubeData,i))))
    colnames(pxCubeData) <- pxCubeVariable$
variableName
    ##
    ##
    if( length(DATA$value) < nrow(pxCubeData) )
stop("Error: variables and data inconsistency", " ",length
(DATA$value) ," ", nrow(pxCubeData) )

    if( length(DATA$value) > nrow(pxCubeData) )
warning("Warnings: variables and data inconsistency", " "
,length(DATA$value) ," ", nrow(pxCubeData) )

    pxCubeData$data <- DATA$value[1:nrow(
pxCubeData)]
    names(pxCubeData) <- c(STUB$value,HEADING$
value,"data")
    rownames(pxCubeData) <- 1:nrow(pxCubeData)

```

```

} else {
  HEADINGValues <- combinaValores(lapply(
    HEADING$value,function(v) unlist(selectClauses(
      codesvalues,function(e) e$keyword == variableMeta[v,"
      keyword"] && e$args[[1]] == v,"value"))))

  numFields <- pxCube$StubLength + length(
    HEADINGValues)
  keysdata <- DATA$value
  ## print(paste(pxCube$StubLength," - ",length(
  HEADINGValues)))
  ## print(paste( length(keysdata)," - ",numFields))
  numreg <- length(keysdata)/numFields

  keys <- sapply(1:numreg,function(i) as.list(
    keysdata[((i-1)*numFields+1):((i-1)*numFields+pxCube
    $StubLength)]),simplify = FALSE)

  pxCubeData <- combinaValores(list(keys,
    HEADINGValues))
  ##
  ## data.frame construction, from the values
  combinations list
  e1 <- pxCubeData[[1]]
  pxCubeData <- do.call("cbind.data.frame",
    lapply(1:length(e1),function(i
  ) as.character(project(pxCubeData,i))))
  colnames(pxCubeData) <- pxCubeVariable$
  variableName
  ##
  ##
  data <- as.vector(sapply(1:numreg,function(i)
    keysdata[((i-1)*numFields+1+pxCube$StubLength):((i
    -1)*numFields+pxCube$StubLength+length(
    HEADINGValues)]),simplify = TRUE))

  if( length(data) != nrow(pxCubeData) ) stop("
  Error: variables and data inconsistency"," ",length(data),
  " ",nrow(pxCubeData))

  pxCubeData$data <- as.numeric(data)
  names(pxCubeData) <- c(STUB$value,HEADING$
  value,"data")

```

```

    rownames(pxCubeData) <- 1:nrow(pxCubeData)

  }
  ##
  return(list(pxCube=pxCube,pxCubeAttrN=
pxCubeAttrN,pxCubeVariable=pxCubeVariable,
pxCubeVariableDomain=pxCubeVariableDomain,
pxCubeData=pxCubeData))

}

```

3.4 CSV file creation from PC-AXIS cube

3.4.1 man

$\langle pcAxisCubeToCSV.Rd \rangle \equiv$


```

\name{pcAxisCubeToCSV}
\alias{pcAxisCubeToCSV}
\title{
  Exports a PC–AXIS cube into CSV in several files.
}
\description{
  It generates four csv files, plus four more depending on "
  keyword" parameters in PC–AXIS file.
}
\usage{
pcAxisCubeToCSV(prefix,pcAxisCube)
}
\arguments{
\item{prefix}{prefix for files to be created}
\item{pcAxisCube}{PC–AXIS cube}
}
\details{
  Created files names are:
\itemize{
\item{prefix+"pxCube.csv"}{}
\item{prefix+"pxCubeVariable.csv"}{}
\item{prefix+"pxCubeVariableDomain.csv"}{}
\item{prefix+"pxCubeData.csv"}{}
\item{prefix+"pxCube"+name+".csv"}{ With name = A0,
  A1,A2 ...}
}
}
\value{
NULL
}
\examples{

  name <- system.file("extdata","datInSFexample6__1.px",
    package = "< < PACKAGE > >")
  stream <- streamParserFromFileName(name,encoding="
  UTF-8")
  cstream <- pcAxisParser(stream)
  if ( cstream$status == 'ok' ) {
    cube <- pcAxisCubeMake(cstream)

    pcAxisCubeToCSV(prefix="datInSFexample6__1",
pcAxisCube=cube)

  }

```

```
}
\keyword{PC-AXIS}
```

3.4.2 code

$\langle pcAxisCubeToCSV.R \rangle \equiv$

```
pcAxisCubeToCSV <- function(prefix,pcAxisCube) {

  write.csv(pcAxisCube$pxCube , file = paste(prefix,"
pxCube.csv" ,sep=""),row.names = FALSE)

  write.csv(pcAxisCube$pxCubeVariable , file = paste(
prefix,"pxCubeVariable.csv" ,sep=""),row.names =
FALSE)

  write.csv(pcAxisCube$pxCubeVariableDomain, file =
paste(prefix,"pxCubeVariableDomain.csv",sep=""),row.
names = FALSE)

  write.csv(pcAxisCube$pxCubeData , file = paste(prefix,
"pxCubeData.csv " ,sep=""),row.names = FALSE)

  for( name in names(pcAxisCube$pxCubeAttrN) )
    write.csv(pcAxisCube$pxCubeAttrN[[name]], file =
paste(prefix,"pxCube",name,".csv " ,sep=""),row.names
= FALSE)
}
```

3.5 Combined tests for functions handling PC-AXIS files

$\langle runit.03PCAXIS.RUnit \rangle \equiv$

```

< < testFuncionesUtiles > >
< < runit.PCAXIS > >

test.filesPcAxis01 <- function() {

  auxfun00 <- function(stream) {
    cstream <- pcAxisParser(stream)
    streamParserClose(cstream$stream)
    print(names(cstream))
    checkEquals("ok",cstream$status,name)

    if( cstream$status != "ok" ) {
      printCStream(cstream)
    } else {
      cube <- pcAxisCubeMake(cstream)
      print(names(cube))
    }
  }

  auxfun01 <- function(pcaxisFiles,encoding= getOption
("encoding")) {
    for ( name in pcaxisFiles) {

      print("");print("");
      print(paste("File:",name))

      name <- system.file("extdata", name, package = "
< < PACKAGE > >")

      stream <- streamParserFromFileName(name,
encoding=encoding)

      # print(stream)
      auxfun00(stream)
    }
  }

  auxfun02 <- function(pcaxisFiles,encoding) {
    for ( name in pcaxisFiles) {

      print("");print("");
      print(paste("File:",name))

      name <- system.file("extdata", name, package = "

```

```

< < PACKAGE > >")

    stream <- streamParserFromString(iconv(readLines(
name,encoding),"UTF-8"))
# print(stream)
    auxfun00(stream)
  }
}

## from sample files:
pcaxisFilesExamples <- list(
    "datInSFexample6_1.px", "
datInSFexample6_2.px" ,
    "datInSFexample6_3.px", "
datInSFexample6_4.px" ,
    "datInSFexampleA_5.px", "
datInSFexample6_5.px" )
auxfun01(pcaxisFilesExamples,"UTF-8")

} # end function

```

Chapter 4

Package creation

4.1 Instructions

Instructions for generating the literate documentation and the R package.

$\langle README \rangle \equiv$

In order to generate package and the pdf file associated to this document:

0. Required software

noweb <http://www.cs.tufts.edu/~nr/noweb/> <http://en.wikipedia.org/wiki/Noweb>

"notangle" is used and in makefile variable ("MARKUP"), it is identified the "markup" program associated to noweb.

bash. <http://www.gnu.org/s/bash/> http://en.wikipedia.org/wiki/Bash_%28Unix_shell%29

xelatex <http://www.tug.org/xetex/> <http://en.wikipedia.org/wiki/XeTeX>

ps2pdf <http://pages.cs.wisc.edu/~ghost/> <http://en.wikipedia.org/wiki/Ghostscript>

make <http://www.gnu.org/software/make/> http://en.wikipedia.org/wiki/Make_%28software%29

sed <http://www.gnu.org/s/sed/> <http://en.wikipedia.org/wiki/Sed>

awk <http://www.gnu.org/s/gawk/> <http://en.wikipedia.org/wiki/Awk>

qpdf <http://qpdf.sourceforge.net/> <http://en.wikipedia.org/wiki/QPDF>

1. Create a working directory and copy these files:

```
< < NAMEPKGLP > >  
< < PACKAGE > > -vignette.Rnw
```

2. Execute:

```
notangle -t8 < < NAMEPKGLP > > > Makefile ; make
```

The following directories are created:

```
< < PACKAGE > > : package source
```

< < PACKAGE > >.Rcheck : directory created by "R
CMD check"

Moreover, these files are also created:

< < PACKAGE > >__< < VERSION > >.tar.gz :
package file
< < PACKAGE > >.pdf : pdf version of this document

4.2 Makefile

The following objectives are available, within Makefile:

- * all: generates literate documentation, recreates package directory structure (along with its content), checks the package and creates tar file for its installation. Default option.
- * doc: generates only literate documentation pdf file.
- * vignette: generates vignette and R associate, during development phase.
- * pkgbuild: recreates packages directory structure (along with its content), checks the package and creates tar file for its installation.
Package is checked twice: the first time, it is checked the package directory. It generates a warning and the vignette file. The second time, tar.gz is checked, it should generate no warning in order to upload the package to CRAN.
- * pkgcheck: recreates package directory structure (along with its content) and checks the package.
- * pkg: recreates package directory structure (along with its content).

Package configuration variables:

< * > ≡

```

#
SHELL:=/bin/bash
#
PKGDIR=./< < PACKAGE > >
#
RDIR=$(PKGDIR)/R
#
MANDIR=$(PKGDIR)/man
#
VIGNETTESDIR=$(PKGDIR)/vignettes
#
TESTDIR=$(PKGDIR)/tests
RUNITDIR=$(PKGDIR)/tests/runit
#
EXAMPLESDIR=$(PKGDIR)/tests/examples
#
INSTDOCDIR=$(PKGDIR)/inst/doc
INSTDATDIR=$(PKGDIR)/inst/extdata
#
NOWEB=noweb
INSTNWDIR=$(PKGDIR)/inst/$(NOWEB)
#
#
LIBR=-l /opt/R-devel/library
#
NAMEPKG=< < PACKAGE > >
#
NAMEPKGGLP=< < NAMEPKGGLP > >
#
NAMEVIGNETTE=< < PACKAGE > >-vignette
#

```

Variables for noweb, so we can achieve the desired presentation in latex:

```

< * > +≡

```

```

# Program markup de noweb
MARKUP=/usr/lib/noweb/markup
#
# Modified back-end totex
TOTEX=./totex

```


The following instruction generates automatically the names for functions to be processed as R files and their Rd associated documentation, etc. Depending on the chunk suffix, its destination directory varies.

Source code for functions in R package	.R	\$(RDIR)
Package functions documentation	.Rd	\$(MANDIR)
R functions for testing the package	.tstR	\$(TESTDIR)
Main function in R, for tests control	.RUnit	\$(RUNITDIR)
Data file for tests	.DUnit	\$(INSTDATDIR)

⟨ * ⟩ + ≡

```
#
RFUN=$(shell sed -rn -e 's/^[<][<](.*)[.]R[>][>]=/\1/p'
$(NAMEPKGLP))
RMAN=$(shell sed -rn -e 's/^[<][<](.*)[.]Rd[>][>]=/\1/
p' $(NAMEPKGLP))
TEST=$(shell sed -rn -e 's/^[<][<](.*)[.]tstR[>][>]=/\1/
p' $(NAMEPKGLP))
RUNI=$(shell sed -rn -e 's/^[<][<](.*)[.]RUnit[>][>]=/\1
/p' $(NAMEPKGLP))
DUNI=$(shell sed -rn -e 's/^[<][<](.*)[.]DUnit[>][>]=/\1
/p' $(NAMEPKGLP))
#
```

Objectives available when executing make.

⟨ * ⟩ + ≡

all: pkgcheck

doc: \$(NAMEPKG).pdf

pkgcheck: pkgbuild check

pkgbuild: pkgprecheck build

pkgprecheck: pkg precheck

```
pkg: $(RFUN:%=$(RDIR)/%.R) \
      $(RMAN:%=$(MANDIR)/%.Rd) \
      $(MANDIR)/$(NAMEPKG)-package.Rd \
      $(TEST:%=$(TESTDIR)/%.R) \
      $(RUNI:%=$(UNITDIR)/%.R) \
      $(DUNI:%=$(INSTDATDIR)/%) \
      $(PKGDIR)/DESCRIPTION \
      $(PKGDIR)/NAMESPACE \
      pkgdoc \
      pkgvignette
```

```
pkgdoc: $(INSTDOCDIR)/$(NAMEPKG).pdf \
        $(INSTNWDIR)/README \
        $(INSTNWDIR)/$(NAMEPKGGLP)
```

```
pkgvignette: $(VIGNETTESDIR)/$(NAMEVIGNETTE).
Rnw
```

INSTALL:

```
R CMD INSTALL $(LIBR) --html < <
PACKAGE > >_< < VERSION > >.tar.gz
```

REMOVE:

```
R CMD REMOVE $(LIBR) < < PACKAGE > >
```

literate documentation

installation pdf in package

```
$(INSTDOCDIR)/$(NAMEPKG).pdf: $(NAMEPKG).pdf |
$(INSTDOCDIR)
cp $(NAMEPKG).pdf $(INSTDOCDIR)/$(
NAMEPKG).pdf
```

literate documentation

```

# pdf generation
$(NAMEPKG).pdf: $(NAMEPKG).tex
    xelatex $(NAMEPKG).tex
    xelatex $(NAMEPKG).tex
    ps2pdf -dAutoRotatePages=/None $(NAMEPKG).
pdf
    mv qmrparser.pdf.pdf qmrparser.pdf

# literate documentation
# tex generation
$(NAMEPKG).tex: $(NAMEPKGGLP) $(TOTEX)
    $(MARKUP) $(NAMEPKGGLP) | $(TOTEX) -
    delay | cpif $(NAMEPKG).tex
# noweave -delay $(NAMEPKGGLP) > $(NAMEPKG).tex

# Required, so latex/pdf documentation can be generated
$(TOTEX): $(NAMEPKGGLP)
    notangle -R'basename $@' $(NAMEPKGGLP) | cpif
    $@
    chmod +x $(TOTEX)

# For developing phase, vignette generation
vignette: $(NAMEVIGNETTE).pdf \
    $(NAMEVIGNETTE).R

# literate documentation
# nw installation in package
# NOWEB PKG
$(INSTNWDIR)/$(NAMEPKGGLP): $(NAMEPKGGLP) | $(
INSTNWDIR)
    cp $(NAMEPKGGLP) $@

# VIGNETTE PKG doc
$(VIGNETTESDIR)/$(NAMEVIGNETTE).Rnw: $(
NAMEVIGNETTE).Rnw | $(VIGNETTESDIR)
    cat $(NAMEVIGNETTE).Rnw | cpif $@

# Package creation
# README
$(INSTNWDIR)/README: $(NAMEPKGGLP) | $(
INSTNWDIR)
    notangle -R'basename $@' $(NAMEPKGGLP) | cpif
    $@

```

```

# DESCRIPTION PKG
$(PKGDIR)/DESCRIPTION: $(NAMEPKG) | $(
    PKGDIR)
    notangle -R'basename $@' $(NAMEPKG) | cpif
    $@

# NAMESPACE PKG
$(PKGDIR)/NAMESPACE: $(NAMEPKG) | $(
    PKGDIR)
    notangle -R'basename $@' $(NAMEPKG) | cpif
    $@

# R PKG
$(RDIR)/%.R: $(NAMEPKG) | $(RDIR)
    cat <( echo "#do not edit, edit $(NOWEB)/$(
    NAMEPKG)" ) \
    <( notangle -R'basename $@' $(
    NAMEPKG) ) | cpif $@
#
# man PKG
$(MANDIR)/%.Rd: $(NAMEPKG) | $(MANDIR)
    cat <( echo "%do not edit, edit $(NOWEB)/$(
    NAMEPKG)" ) \
    <( notangle -R'basename $@' $(
    NAMEPKG) ) | cpif $@

# VIGNETTE for development phase, in local directory
$(NAMEVIGNETTE).pdf: $(NAMEVIGNETTE).tex
    pdflatex $(NAMEVIGNETTE).tex
    pdflatex $(NAMEVIGNETTE).tex

$(NAMEVIGNETTE).tex: $(NAMEVIGNETTE).Rnw
    R CMD Sweave $(NAMEVIGNETTE).Rnw

$(NAMEVIGNETTE).R: $(NAMEVIGNETTE).Rnw
    R CMD Stangle $(NAMEVIGNETTE).Rnw

Data files, for examples and tests
< * >+≡

```

```
$(INSTDATDIR)/%: $(NAMEPKGGLP) | $(INSTDATDIR)
    notangle -R'basename $@ 'DUnit $(NAMEPKGGLP)
    ) | cpif $@
```

Rules to create R test code, in test and tests/runit directories.
As directories are nested, rule order is relevant.

```
< * > +≡
```

```
$(RUNITDIR)/%.R: $(NAMEPKGGLP) | $(RUNITDIR)
    notangle -R'basename $@ R'RUnit $(
    NAMEPKGGLP) | cpif $@
```

```
$(TESTDIR)/%.R: $(NAMEPKGGLP) | $(TESTDIR)
    notangle -R'basename $@ R'tstR $(NAMEPKGGLP)
    ) | cpif $@
```

Rules to check and construct package

```
< * > +≡
```

```
# checking package source directory
# "Non-standard file/directory found at top level: qmrparser
-Ex.'R"
# and move qmrparser-Ex.R EXAMPLESDIR
precheck: $(PKGDIR) | $(EXAMPLESDIR)
    R CMD check --as-cran $(PKGDIR)
    mv $(PKGDIR)/< < PACKAGE > >-Ex.R $(
    EXAMPLESDIR)
```

```
# tar.gz creation
build: < < PACKAGE > >__< < VERSION > >.tar.gz
```

```
< < PACKAGE > >__< < VERSION > >.tar.gz: $(
    PKGDIR) precheck
    R CMD build --compact-vignettes=qpdf $(
    PKGDIR)
```

```
# checking tar.gz
check: < < PACKAGE > >__< < VERSION > >.tar.gz
    R CMD check --as-cran < < PACKAGE > >__<
    < VERSION > >.tar.gz
```

Rules to create source package directories

```
< * > +≡
```

```

# package directory
$(PKGDIR):
    mkdir -p $(PKGDIR)

# R directory
$(RDIR):
    mkdir -p $(RDIR)

# man directory
$(MANDIR):
    mkdir -p $(MANDIR)

# vignettes directory
$(VIGNETTESDIR):
    mkdir -p $(VIGNETTESDIR)

# inst/doc directory. In installed package, doc directory (
# with no inst)
$(INSTDOCDIR):
    mkdir -p $(INSTDOCDIR)

# inst/extdata directory. In installed package, extdata
# directory (with no inst)
$(INSTDATDIR):
    mkdir -p $(INSTDATDIR)

# inst/noweb directory. In installed package, noweb
# directory (with no inst)
$(INSTNWDIR):
    mkdir -p $(INSTNWDIR)

# test directory, not present in installed package
$(TESTDIR):
    mkdir -p $(TESTDIR)

# tests/runit directory, not present in installed package
$(RUNITDIR):
    mkdir -p $(RUNITDIR)

# tests/examples directory, not present in installed package
$(EXAMPLESDIR):
    mkdir -p $(EXAMPLESDIR)

```

If no tabulators are inserted or -t8 is used, make errors are generated:

```
Makefile:: *** missing separator (did you mean TAB instead
             of 8 spaces?). Stop.
```

```
Makefile:: *** missing separator. Stop.
```

Chapter 5

Data files used

5.1 Manual test files

5.1.1 datInTest01.txt

Files for testing recognising tokens and combination rules functions.

$\langle \textit{datInTest01.txt.DUnit} \rangle \equiv$

"aaa4567"

-121.01e-222

121

1211e33

-123e-222

+127

0123.123

1233.

.123E22

+0123.123e+11

-1233.e-66

+.123E600

abd

"aaas45"

5.2 PC-AXIS test functions

Test files obtained:

PC-Axis file format manual. Statistics of Finland.

http://tilastokeskus.fi/tup/pcaxis/tiedostomuoto2006_laaja_en.pdf

5.2.1 datInSFexample6_1.px

$\langle \text{datInSFexample6_1.px.DUnit} \rangle \equiv$

```
CHARSET="ANSI";
AXIS-VERSION="2000";
DECIMALS=0;
MATRIX="vaerak";
SUBJECT-CODE="VRM";
SUBJECT-AREA="Väestö";
TITLE="Väestö 31.12. muuttujina Sukupuoli, Kunta, Vuosi
      ja Siviilisääty";
CONTENTS="Väestö 31.12.";
UNITS="Henkilöä";
STUB="Sukupuoli","Kunta";
HEADING="Vuosi","Siviilisääty";
VALUES("Sukupuoli")="Sukupuoli yhteensä","Miehet","
      Naiset";
VALUES("Kunta")="Espoo","Helsinki","Vantaa";
VALUES("Vuosi")="2001","2002";
VALUES("Siviilisääty")="Siviilisääty yhteensä","Naimaton
      ","Naimisissa";
DATA=
57516 43030 100546 57516 43030 100546
144564 85339 229903 144564 85339 229903
47131 33688 80819 47131 33688 80819
53821 43375 97196 53821 43375 97196
151536 86184 237720 151536 86184 237720
44071 33935 78006 44071 33935 78006
111337 86405 197742 111337 86405 197742
296100 171523 467623 296100 171523 467623
91202 67623 158825 91202 67623 158825;
```

5.2.2 datInSFexample6_2.px

$\langle \text{datInSFexample6_2.px.DUnit} \rangle \equiv$

```

CHARSET="ANSI";
AXIS-VERSION="2000";
LANGUAGE="fi";
CREATION-DATE="20001212 11:00";
DECIMALS=0;
SHOWDECIMALS=0;
MATRIX="vaerak";
COPYRIGHT=YES;
SUBJECT-CODE="VRM";
SUBJECT-AREA="Väestö";
DESCRIPTION="Väestö 31.12.2003";
TITLE="Väestö 31.12.2003 muuttujina Sukupuoli, Kunta ja
      Siviilisääty";
CONTENTS="Väestö 31.12.2003";
UNITS="Henkilöä";
STUB="Sukupuoli","Kunta";
HEADING="Siviilisääty";
VALUES("Sukupuoli")="Sukupuoli yhteensä","Miehet","
      Naiset";
VALUES("Kunta")="Espoo","Helsinki","Vantaa";
VALUES("Siviilisääty")="Siviilisääty yhteensä","Naimaton
      ","Naimisissa";
CODES("Sukupuoli")="S","1","2";
CODES("Kunta")="049","091","092";
CODES("Siviilisääty")="S","1","2";
LAST-UPDATED="20040319 09:00";
CONTACT="Tilastokeskus, Väestötilastopalvelu#
      Postiosoite:"
      "Väestötilastopalvelu, #PL 4A, 00022 Tilastokeskus#
      Puhelin: (09) 1734 3590"
      "#Faksi: (09) 1734 #3251#Yhteyshenkilö: Nicola Brun#
      Sähköposti:"
      "#vaestotilasto.palvelu@tilastokeskus.fi#<A HREF=http:/
      /tilastokeskus.fi/ "
      "TARGET=__blank>Linkki tilastokeskuksen kotisivulle</A
      >";
SOURCE="Tilastokeskus";
INFOFILE="vaerak";
NOTE="Vuodesta 2002 lähtien on siviilisäätytietoihin
      lisätty rekisteröidyt
      "parisuhteet...";
DATA=
197742 111337 86405
467623 296100 171523

```

158825 91202 67623
100546 57516 43030
229903 144564 85339
80819 47131 33688
97196 53821 43375
237720 151536 86184
78006 44071 33935;

5.2.3 datInSFexample6_3.px

$\langle \text{datInSFexample6_3.px.DUnit} \rangle \equiv$

```

CHARSET="ANSI";
AXIS-VERSION="2000";
LANGUAGE="fi";
CREATION-DATE="19930401 12:10";
DECIMALS=0;
MATRIX="vaerak";
COPYRIGHT=YES;
SUBJECT-CODE="VRM";
SUBJECT-AREA="Väestö";
DESCRIPTION="Väestö 1990-1992";
TITLE="Väestö muuttujina siviilisääty, sukupuoli, alue ja
      aika";
CONTENTS="Väestö";
UNITS="henkilöiden lukumäärä";
STUB="siviilisääty", "sukupuoli";
HEADING="alue", "aika";
VALUES("siviilisääty")="naimisissa", "naimaton", "eronnut
      ", "leski";
VALUES("sukupuoli")="mies", "nainen";
VALUES("alue")="Koko maa", "Helsinki", "Espoo";
VALUES("aika")="1990", "1991", "1992";
TIMEVAL("aika")=TLIST(A1, "1990", "1991", "1992";
CODES("siviilisääty")="1", "2", "3", "4";
CODES("sukupuoli")="1", "2";
CODES("alue")="SSS", "091", "049";
ELIMINATION("alue")="Koko maa";
ELIMINATION("sukupuoli")=YES;
LAST-UPDATED="19950209 13:00";
SEASADJ=NO;
CONTACT="Tilastokeskus#PC-Axis-koulutus#fax 09
      1734 1234#s-posti pcaxis@stat.fi";
DATABASE="TKDB";
SOURCE="Tilastokeskus";
REFPERIOD="Viiteajankohta on 31. joulukuuta joka vuosi
      ";
INFOFILE="vaerak";
NOTE("siviilisääty")="Siviilisääty on riippuvainen
      väestölaskennan "
      "rekistereistä. Naimisissa olevat yhdessä asuvat merkitään
      naimisissa "
      "oleviksi. Muut yhdessä asuvat kuuluvat naimattomiin";
VALUENOTE("alue", "Espoo")="Tähän selitystä Espoon
      datasta#ja selitys "
      "jaetaan näytössä usealle riville.#Tästä alkaakin jo kolmas

```

```
selitysrivi";  
DATA=  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42
```

43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72

;

5.2.4 datInSFexample6__4.px

$\langle \text{datInSFexample6_4.px.DUnit} \rangle \equiv$

```

CHARSET="ANSI";
AXIS-VERSION="2000";
LANGUAGE="fi";
DECIMALS=0;
SHOWDECIMALS=0;
MATRIX="tyti";
COPYRIGHT=YES;
SUBJECT-CODE="TYM";
SUBJECT-AREA="Työmarkkinat";
DESCRIPTION="T01E Väestö 31.12.2000";
TITLE="T01E Väestö 31.12.2000 muuttujina Osa-alue,"
"Ikä ja Pääasiallinen toiminta/ammattiasema.";
CONTENTS="T01E Väestö 31.12.2000";
UNITS="Henkilö";
STUB="Osa-alue","Ikä";
HEADING="Pääasiallinen toiminta/ammattiasema";
VALUES("Osa-alue")="049 Espoo","078 Hanko-Hangö
","091 Helsinki",
"092 Vantaa","106 Hyvinkää";
VALUES("Ikä")="0-6","7-14","30-34";
VALUES("Pääasiallinen toiminta/ammattiasema")="
Työvoima",
"Työlliset","Palkansaajat";
CODES("Osa-alue")="049","078","091","092","106";
DOMAIN("Osa-alue")="OSAL_01 2002";
INFOFILE="tyti";
KEYS("Osa-alue")=CODES;
KEYS("Ikä")=VALUES;
DATA=
"049","30-34",16064 15324 14660
"078","30-34",560 490 470
"091","30-34",42100 39027 37423
"092","30-34",13215 12358 11806
"106","30-34",2646 2423 2270;

```

5.2.5 datInSFexampleA_5.px

$\langle \text{datInSFexampleA_5.px.DUnit} \rangle \equiv$

```

CHARSET="ANSI";
AXIS-VERSION="2005";
LANGUAGE="en";
LANGUAGES="en","sv","fi";
CREATION-DATE="20050217 18:34";
DECIMALS=0;
SHOWDECIMALS=0;
MATRIX="BE0101F1";
SUBJECT-CODE="BE";
SUBJECT-AREA="Population";
SUBJECT-AREA[sv]="Befolkning";
SUBJECT-AREA[fi]="Väestö";
DESCRIPTION="Migration 2003";
DESCRIPTION[sv]="Flyttningar 2003";
DESCRIPTION[fi]="Väestönmuutokset 2003";
TITLE="Migration by region, age, period, type and sex";
TITLE[sv]="Flyttningar efter region, ålder, tid, typ och kön";
TITLE[fi]="Väestönmuutokset muuttujina kunta, ikä, aika,
    tyyppi ja sukupuoli";
CONTENTS="Migration";
CONTENTS[sv]="Flyttningar";
CONTENTS[fi]="Väestönmuutokset";
UNITS="number";
UNITS[sv]="antal";
UNITS[fi]="henkilöä";
STUB="region","age";
STUB[sv]="region","ålder";
STUB[fi]="kunta","ikä";
HEADING="period","type","sex";
HEADING[sv]="tid","typ","kön";
HEADING[fi]="aika","tyyppi","sukupuoli";
CONTVARIABLE="type";
CONTVARIABLE[sv]="typ";
CONTVARIABLE[fi]="tyyppi";
VALUES("region")="Sweden","Stockholm county","
    Upplands Väsby","Vallentuna";
VALUES[sv]("region")="Riket","Stockholms län","Upplands
    Väsby","Vallentuna";
VALUES[fi]("kunta")="Ruotsi","Tukholman lääni","
    Upplands Väsby","Vallentuna";
VALUES("age")="20","21","22";
VALUES[sv]("ålder")="20","21","22";
VALUES[fi]("ikä")="20","21","22";

```



```

VALUES("period")="2003";
VALUES[sv]("tid")="2003";
VALUES[fi]("aika")="2003";
VALUES("type")="Inmigrated","Outmigrated";
VALUES[sv]("typ")="Inflyttade","Utflyttade";
VALUES[fi]("tyyppi")="Tulomuutto","Lähtömuutto";
VALUES("sex")="men","women";
VALUES[sv]("kön")="män","kvinnor";
VALUES[fi]("sukupuoli")="miehet","naiset";
CODES("region")="00","01","0114","0115";
CODES[sv]("region")="00","01","0114","0115";
CODES[fi]("kunta")="00","01","0114","0115";
CODES("age")="20","21","22";
CODES[sv]("ålder")="20","21","22";
CODES[fi]("ikä")="20","21","22";
CODES("type")="BE0101F1","BE0101F2";
CODES[sv]("typ")="BE0101F1","BE0101F2";
CODES[fi]("tyyppi")="BE0101F1","BE0101F2";
CODES("sex")="1","2";
CODES[sv]("kön")="1","2";
CODES[fi]("sukupuoli")="1","2";
DOMAIN("age")="Age";
DOMAIN[sv]("ålder")="Ålder";
DOMAIN[fi]("ikä")="ikä";
ELIMINATION("region")="Sweden";
ELIMINATION[sv]("region")="Riket";
ELIMINATION[fi]("kunta")="Ruotsi";
LAST-UPDATED("Inmigrated")="20040212 16:28";
LAST-UPDATED[sv]("Inflyttade")="20040212 16:28";
LAST-UPDATED[fi]("Tulomuutto")="20040212 16:28";
UNITS("Inmigrated")="number";
UNITS[sv]("Inflyttade")="antal";
UNITS[fi]("Tulomuutto")="henkilö";
UNITS("Outmigrated")="number";
UNITS[sv]("Utflyttade")="antal";
UNITS[fi]("Lähtömuutto")="henkilö";
SOURCE="Statistics Sweden";
SOURCE[sv]="Statistiska centralbyrån (SCB)";
SOURCE[fi]="SCB";
CONTACT("Inmigrated")="Ewa Eriksson, SCB#Tel: +46
19-17 67 43";
CONTACT[sv]("Inflyttade")="Ewa Eriksson, SCB#Tel:
019-17 67 43";

```

CONTACT[fi]("Tulomuutto")="Ewa Eriksson, SCB#Tel:
 019-17 67 43";
 DATABASE="SDB";
 DATABASE[sv]="SDB";
 DATABASE[fi]="SDB";
 INFOFILE="BE0101en";
 INFOFILE[sv]="BE0101sv";
 INFOFILE[fi]="BE0101fi";
 NOTEX="Mandatory English note";
 NOTEX[sv]="Obligatorisk svensk not";
 NOTEX[fi]="Pakollinen suomalainen alaviite";
 NOTEX("region")="Mandatory footnote for region";
 NOTEX[sv]("region")="Obligatorisk fotnot för region";
 NOTEX[fi]("kunta")="Pakollinen suomalainen alaviite
 muuttujalle kunta";
 NOTE("age")="Age refers to age attained by the end of the
 year, "
 "i.e. in principal, an account for the year of birth.";
 NOTE[sv]("ålder")="Med ålder avses uppnådd ålder vid
 årets slut, "
 "d.v.s. i princip en redovisning efter födelseår.";
 NOTE[fi]("ikä")="Sama suomeksi";
 VALUENOTEX("type","Immigrated")="Migration cannot
 be added with regard to "
 "regions. When, for instance, municipalities are added to
 metropolitan areas, "
 "migration to the region is added to migrations within the
 region.#With "
 "calculating of age-specific rates per 1 000 of the mean
 population you shall "
 "use the mean population per year of birth. And some more
 ";
 VALUENOTEX[sv]("typ","Inflyttade")="Flyttningar kan
 inte summeras vad avser "
 "region. Vid t ex summering av kommuner till
 storstadsområde, summeras "
 "flyttningar till regionen med flyttningar inom regionen.#
 Vid beräkning av "
 "åldersdifferentierade tal per 1 000 av medelfolkmängden
 skall medelfolkmängden "
 "per födelseår användas.";
 VALUENOTEX[fi]("tyyppi","Tulomuutto")=" "
 "Väestönmuutoksia ei saa laskea yhteen";
 VALUENOTE("type","Immigrated")="Request value note

```

    for inmigrated";
    VALUENOTE[sv]("typ","Inflyttade")="Frivillig fotnot för
    inflyttade.";
    VALUENOTE[fi]("tyyppi","Tulomuutto")="Suomalainen
    alaviite, tulomuutto.";
    CELLNOTE("*","20","*","Inmigrated","*")="Cellnote
    inmigrated 20 years";
    CELLNOTE[sv]("","20","*","Inflyttade","*")="Cellnot
    inflyttade 20 år.";
    CELLNOTE[fi]("","20","*","Tulomuutto","*")="Soluviite,
    tulomuutto, 20.";
    DATA=
    456 938 223 327
    613 948 305 464
    835 968 325 511
    590 1017 480 741
    771 1145 668 993
    924 1273 672 906
    14 38 22 43
    21 36 34 57
    26 36 34 34
    17 20 22 30
    13 21 29 42
    20 23 33 35;

```

5.2.6 datInSFexample6_5.px

$\langle \text{datInSFexample6_5.px.DUnit} \rangle \equiv$

```

CHARSET="ANSI";
AXIS-VERSION="2000";
LANGUAGE="sv";
CREATION-DATE="20030425 18:21";
DECIMALS=0;
SHOWDECIMALS=0;
MATRIX="BE0101F1";
SUBJECT-CODE="BE";
SUBJECT-AREA="Befolkning";
DESCRIPTION="Flyttningar 2000";
TITLE="Flyttningar med region, ålder, kön, tid och typ";
CONTENTS="Flyttningar";
UNITS="antal";
STUB="region","ålder","kön";
HEADING="tid","typ";
CONTVARIABLE="typ";
VALUES("region")="00 Riket";
VALUES("ålder")="2";
VALUES("kön")="män","kvinnor";
VALUES("tid")="2000";
VALUES("typ")="Inflyttade","Flyttningsöverskott","in3";
TIMEVAL("tid")=TLIST(A1,"2000";
CODES("region")="00";
CODES("ålder")="2";
CODES("kön")="1","2";
CODES("typ")="typ1","typ2","in3";
DOMAIN("ålder")="Ålder";
LAST-UPDATED("Inflyttade")="20030212 16:49";
LAST-UPDATED("Flyttningsöverskott")="20030212
16:49";
LAST-UPDATED("in3")="20030212 16:49";
UNITS("Inflyttade")="antal";
UNITS("Flyttningsöverskott")="antal";
UNITS("in3")="ton";
CONTACT("Inflyttade")="Ewa Eriksson, SCB#Tel:
019-17 67 43";
REFPERIOD("in3")="2000";
DATABASE="Sveriges Statistiska Databaser";
SOURCE="Statistiska centralbyrån (SCB)";
INFOFILE="BE0101";
NOTE="Det här är också bra att veta";
DATA=
0 0 0

```

0 0 0;

Chapter 6

Appendix

6.1 Literate programming

Package has been developed using literate programming (http://en.wikipedia.org/wiki/Literate_programming) and noweb programm (<http://www.cs.tufts.edu/~nr/noweb/> and <http://en.wikipedia.org/wiki/Noweb>).

In order to format in a nice way code coming from different languages (R, Rd, make, etc.), listing latex package has been used (<http://www.ctan.org/tex-archive/macros/latex/contrib/listings/> and <http://en.wikibooks.org/wiki/LaTeX/Packages/Listings>). Therefore, totex noweb program must be slightly modified (modification is included next).

Listing package solves 'Overfull hbox' massive problem, allowing carriage return control control.

6.1.1 totex

$\langle totex \rangle \equiv$

```

#!/bin/sh
# Copyright 1991 by Norman Ramsey. All rights reserved.
# See file COPYRIGHT for more information.
# Don't try to understand this file! Look at lib/totex.nw in
  the noweb source!
delay=0 noindex=0
for i do
  case $i in
    -delay) delay=1 ;;
    -noindex) noindex=1 ;;
    *) echo "This can't happen -- $i passed to totex" 1>
      &2 ; exit 1 ;;
  esac
done
nawk 'BEGIN { code=0 ; quoting=0 ; text=1; defs[0] = 0
                                ulist
                                [0] = 0 }
  /^@begin code/ { code=1 ; printf "\\nwbegincode{%s}", substr($0, 13) }
  /^@end code/ { code=0 ; printf "\\nwendcode{ }";
  lastdefnlabel = "" }
  /^@begin code/ { code=1 ; printf "\\nwbegincode{%s}", substr($0, 13) }
  /^@end code/ { code=0 ; printf "\\end{lstlisting}";
  lastdefnlabel = "" }
  /^@begin docs 0$/ { if (delay) next }
  /^@end docs 0$/ { if (delay) {
                                printf "\\nwfilename{%s}",
filename; delay=0; next
                                } }
  /^@begin docs/ { text=0 ; printf "\\nwbegindocs{%s}", substr($0, 13) }
  /^@end docs/ { printf "\\nwenddocs{ }" }
  /^@text / { line = substr($0, 7) ; text += length -
6
                                if (code) printf "%s", line ##
escape__brace__bslash(line)
                                else if (quoting) printf "%s",
TeXliteral(line)
                                else printf "%s", line
                                }
  /^@nl$/ { if (!code) {if (text==0) printf "\\nwdocspar"
                                text=1}

```

```

                                if (quoting) printf "\\nwnewline
”
                                printf "\\n”
                                }
                                /^@defn / { name = substr($0, 7); if (lastxreflabel !
= ””) {
                                printf ”
\\sublabel{”%s}”, lastxreflabel
                                printf ”
\\nwmargin tag{”%s}”, label2tag(lastxreflabel)
                                }
                                printf ”\\
moddef{”%s”%s}\\%sendmoddef\\nwendcode{”}\\begin{
lstlisting}”, escape__brace__bslash( convquotes(name)) , (
lastxrefref != ”” ? (”~” label2tag(lastxrefref)) : ””),defns[
name]
                                lastdefnlabel
                                = lastxreflabel
                                lastxreflabel
                                = lastxrefref = ””
                                defns[
name] = ”plus” }
                                /^@use / { printf ”< < %s%s > >”, ##printf ”\\
LA{ }%s%s\\RA{ }”,
                                convquotes(substr($0, 6)), (
lastxrefref != ”” ? (”~” label2tag(lastxrefref)) : ””)
                                }
                                /^@quote$/ { quoting = 1 ; printf ”{\\tt{ }” }
                                /^@endquote$/ { quoting = 0 ; printf ”}” }
                                /^@file / { filename = substr($0, 7); lastxreflabel =
lastxrefref = ””
                                if (!delay) printf ”\\nwfilename
{”%s}”, filename
                                }
                                /^@literal / { printf ”%s”, substr($0, 10) }
                                /^@header latex / { printf ”\\documentclass{article
}\\usepackage{noweb}\\pagestyle{noweb}\\noweboptions
{”%s}”%s”,
                                substr($0, 15), ”\\begin
{document}” }
                                /^@header tex / { printf ”\\input nwmac ” }
                                /^@trailer latex$/ { print ”\\end{document}” }
                                /^@trailer tex$/ { print ”\\bye” }
                                /^@xref label / { lastxreflabel = substr($0, 13) }

```



```

lastxrefref != "")
                                                                    printf
"\nwindexdefn{%s}{%s}{%s}", TeXliteral(arg),
indexlabel(arg), lastxrefref
                                                                    lastxreflabel
= lastxrefref = "" } }
/^@index use / {
    if (!noindex) { arg = substr($0, 12); if (!
code) {
                                                                    if (
lastxreflabel != "") printf "\protect\nosublabel{%s}",
lastxreflabel
                                                                    if (
lastxrefref != "")
                                                                    printf
"\protect\nwindexuse{%s}{%s}{%s}",
                                                                    TeXliteral
(arg), indexlabel(arg), lastxrefref
                                                                    }
                                                                    lastxreflabel
= lastxrefref = "" } }
/^@index begindefs$/ { if (!noindex) { printf "\n
nwidentdefs{" } }
/^@index isused / { if (!noindex) { } } # handled by
latex
/^@index defitem / { if (!noindex) { i = substr($
0,16); printf "\\\{\{%s\}{%s}\}", TeXliteral(i), indexlabel(
i) } }
/^@index enddefs$/ { if (!noindex) { printf "" } }
/^@index beginsuses$/ { if (!noindex) { printf "\n
nwidentuses{"; ucount = 0 } }
/^@index isdefined / { if (!noindex) { } } # latex
finds the definitions
/^@index useitem / { if (!noindex) { i = substr($0,
16); printf "\\\{\{%s\}{%s}\}", TeXliteral(i), indexlabel(i)
ulist[ucount++] =
i
                                                                    } }
/^@index enduses$/ { if (!noindex) { printf ""}; if (
lastdefnlabel != "") {
                                                                    for
(j = 0; j < ucount; j++)
                                                                    printf
"\nwindexuse{%s}{%s}{%s}",

```

```

(ulist[j]), indexlabel(ulist[j]), lastdefnlabel
    }
} }
/^@index beginindex$/ { if (!noindex) { } }
/^@index entrybegin / { if (!noindex) { label = $3;
name = substr($0, 20 + length(label))
    printf "\\
nwixlogsorted{i}{%s}{%s}}%%%\n",
    TeXliteral(
name), indexlabel(name)
    } }
/^@index entryuse / { if (!noindex) { } } # handled
by latex
/^@index entrydefn / { if (!noindex) { } } # handled
by latex
/^@index entryend$/ { if (!noindex) { } }
/^@index endindex$/ { if (!noindex) { } }

END { printf "\n" }
function label2tag(label) {
    return "{\\nwtagstyle{\\subpageref{ label }}"
}
function escape__brace__bslash(line) {
    gsub(/[\{\}]/, "\n&", line)
    gsub(/\\n/, "\\ ", line)
    gsub(/__/, "\\_", line)
    return line
}
function convquotes(s, r, i) {
    r = ""
    while (i = index(s, "[") {
        r = r substr(s, 1, i-1) "\\code{"
        s = substr(s, i+2)
        if (i = match(s, "\\]\\]+")) {
            r = r TeXliteral(substr(s, 1, i-1+RLENGTH
-2)) "\\edoc{"
            s = substr(s, i+RLENGTH)
        } else {
            r = r s "\\edoc{"
            s = ""
        }
    }
}
return r s

```

```

}
function indexlabel(ident, l) {
  l = ident
  gsub(/:/, ":", l) # must be first (colon)
  gsub(/ /, "sp", l) # space
  gsub(/#/ , "has", l) # hash
  gsub(/\$/, "do", l) # dollar
  gsub(/%/ , "pe", l) # percent
  gsub(/&/ , "am", l) # ampersand
  gsub(/,/ , "com", l) # commad
  gsub(/\\/, "bs", l) # backslash
  gsub(/\\^/, "hat", l) # hat
  gsub(/_/, "un", l) # underscore
  gsub(/{/ , "lb", l) # left brace
  gsub(/}/ , "rb", l) # right brace
  gsub(/~/ , "ti", l) # tilde
  return l
}
function TeXliteral(arg) {
  gsub(/\\/, "<\\char92>", arg)
  gsub(/}/, "<\\char125}", arg)
  gsub(/{/ , "{\\char123}", arg)
  gsub(/<\\char/, "{\\char", arg)
  gsub(/{\\char92>/, "{\\char92}", arg)
  gsub(/\\$/, "{\\char36}", arg)
  gsub(/&/, "{\\char38}", arg)
  gsub(/#/ , "{\\char35}", arg)
  gsub(/\\^/, "{\\char94}", arg)
  gsub(/_/, "{\\char95}", arg)
  gsub(/%/ , "{\\char37}", arg)
  gsub(/~/ , "{\\char126}", arg)
  gsub(/ / , "\\ ", arg)
  return arg
}' delay=$delay noindex=$noindex

```

And a copy of COPYRIGHT noweb file, included to meet license requirements.

Noweb is copyright 1989–2000 by Norman Ramsey. All rights reserved.

Noweb is protected by copyright. It is not public–domain software or shareware, and it is not protected by a “copyleft”

agreement like the one used by the Free Software Foundation.

Noweb is available free for any use in any field of endeavor.

You may redistribute noweb in whole or in part provided you acknowledge its source and include this COPYRIGHT file. You may modify noweb and create derived works, provided you retain this copyright notice, but the result may not be called noweb without my written consent.

You may sell noweb if you wish. For example, you may sell a CD–ROM including noweb.

You may sell a derived work, provided that all source code for your derived work is available, at no additional charge, to anyone who buys your derived work in any form. You must give permission for said source code to be used and modified under the terms of this license.

You must state clearly that your work uses or is based on noweb and that noweb is available free of charge. You must also request that bug reports on your work be reported to you.