

Package ‘fhircrackr’

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Type Package

Title Handling HL7 FHIR® Resources in R

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Description Useful tools for conveniently downloading FHIR resources in xml format and converting them to R data.frames. The package uses FHIR-search to download bundles from a FHIR server, provides functions to save and read xml-files containing such bundles and allows flattening the bundles to data.frames using XPath expressions. FHIR® is the registered trademark of HL7 and is used with the permission of HL7. Use of the FHIR trademark does not constitute endorsement of this product by HL7.

BugReports <https://github.com/POLAR-fhiR/fhircrackr/issues>

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Suggests knitr, rmarkdown

VignetteBuilder knitr

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'fhir_bundle_list.R' 'build_resources.R' 'design.R'
'download_resources.R' 'fhir_xpath_expression.R'
'fhir_columns.R' 'fhir_resource_type.R'
'fhir_table_description.R' 'fhir_design.R' 'fhir_style.R'
'fhir_table_list.R' 'fhir_tree.R' 'flatten_resources.R'
'miscellaneous.R' 'multiple_entries.R' 'sample_resources.R'

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| | |
|---------|--|
| as_fhir | <i>Coerce character vector to fhir_bundle_list</i> |
|---------|--|

Description

Tries to convert a character vector containing xml strings representing FHIR bundles to an object of class [fhir_bundle_list](#).

Usage

```
as_fhir(x)
```

Arguments

| | |
|---|--|
| x | A character vector where each element is a string representing an xml FHIR bundle. |
|---|--|

Examples

```
#character vector containing fhir bundles
bundle_strings <- c(
"<Bundle>
<type value='searchset' />
<entry>
  <resource>
    <Patient>
      <id value='id1' />
      <name>
        <given value='Marie' />
      </name>
    </Patient>
  </resource>
</entry>
</Bundle>",
"<Bundle>
<type value='searchset' />
<entry>
  <resource>
    <Patient>
      <id value='id2' />
      <name>
        <given value='Max' />
      </name>
    </Patient>
  </resource>
</entry>
</Bundle>"
)

#convert to FHIR bundle list
bundles <- as_fhir(bundle_strings)
```

example_bundles1

Toy example bundles for multiple entries

Description

These data examples are bundles that contain very few, very simple resources that have multiple entries and can be used for demonstration purposes. See **Source** for how the xml versions look.

Usage

example_bundles1

example_bundles2

example_bundles3

example_bundles4

example_bundles5

example_bundles6

example_bundles7

example_bundles_empty

Format

An object of class `fhir_bundle_list` of length 1.

An object of class `fhir_bundle_list` of length 1.

An object of class `fhir_bundle_list` of length 1.

An object of class `fhir_bundle_list` of length 1.

An object of class `fhir_bundle_list` of length 1.

An object of class `fhir_bundle_list` of length 1.

An object of class `fhir_bundle_list` of length 1.

An object of class `fhir_bundle_list` of length 1.

Details

example_bundles1 contains 1 bundle with 2 Patient resources.

example_bundles2 contains 1 bundle with 3 Patient resources.

example_bundles3 contains 1 bundle with 3 Patient resources and 1 Observation resource.

example_bundles4 contains 1 bundle with 2 Medication resources, one of which has some `@id` xml attributes

example_bundles5 contains 1 bundle with 2 Observation resources.

example_bundles6 contains 1 bundle with 2 Patient resources.

example_bundles7 contains 1 bundle with 2 Patient resources.

example_bundles_empty contains one empty bundle.

Source

example_bundles1

```
<Bundle>
  <type value='searchset' />
  <entry>
    <resource>
      <Patient>
```

```

    <id value='id1' />
  <address>
    <use value='home' />
    <city value='Amsterdam' />
    <type value='physical' />
    <country value='Netherlands' />
  </address>
  <name>
    <given value='Marie' />
  </name>
</Patient>
</resource>
</entry>

```

```

<entry>
  <resource>
    <Patient>
      <id value='id3' />
      <address>
        <use value='home' />
        <city value='Berlin' />
      </address>
      <address>
        <type value='postal' />
        <country value='France' />
      </address>
      <address>
        <use value='work' />
        <city value='London' />
        <type value='postal' />
        <country value='England' />
      </address>
      <name>
        <given value='Frank' />
      </name>
      <name>
        <given value='Max' />
      </name>
    </Patient>
  </resource>
</entry>
</Bundle>

```

example_bundles2

```

<Bundle>
  <type value='searchset' />
  <entry>
    <resource>

```

```
<Patient>
  <id value='id1' />
  <address>
    <use value='home' />
    <city value='Amsterdam' />
    <type value='physical' />
    <country value='Netherlands' />
  </address>
  <name>
    <given value='Marie' />
  </name>
</Patient>
</resource>
</entry>

<entry>
  <resource>
    <Patient>
      <id value='id2' />
      <address>
        <use value='home' />
        <city value='Rome' />
        <type value='physical' />
        <country value='Italy' />
      </address>
      <address>
        <use value='work' />
        <city value='Stockholm' />
        <type value='postal' />
        <country value='Sweden' />
      </address>
      <name>
        <given value='Susie' />
      </name>
    </Patient>
  </resource>
</entry>

<entry>
  <resource>
    <Patient>
      <id value='id3' />
      <address>
        <use value='home' />
        <city value='Berlin' />
      </address>
      <address>
        <type value='postal' />
      </address>
    </Patient>
  </resource>
</entry>
```

```

        <country value='France' />
    </address>
    <address>
        <use value='work' />
        <city value='London' />
        <type value='postal' />
        <country value='England' />
    </address>
    <name>
        <given value='Frank' />
    </name>
    <name>
        <given value='Max' />
    </name>
</Patient>
</resource>
</entry>
</Bundle>

```

example_bundles3

```

<Bundle>
  <type value='searchset' />
  <entry>
    <resource>
      <Patient>
        <id value='id1' />
        <address>
          <use value='home' />
          <city value='Amsterdam' />
          <type value='physical' />
          <country value='Netherlands' />
        </address>
        <name>
          <given value='Marie' />
        </name>
      </Patient>
    </resource>
  </entry>

  <entry>
    <resource>
      <Patient>
        <id value='id2' />
        <address>
          <use value='home' />
          <city value='Rome' />
          <type value='physical' />
          <country value='Italy' />
        </address>
      </Patient>
    </resource>
  </entry>
</Bundle>

```

```
    </address>
    <address>
      <use value='work' />
      <city value='Stockholm' />
      <type value='postal' />
      <country value='Sweden' />
    </address>
    <name>
      <given value='Susie' />
    </name>
  </Patient>
</resource>
</entry>

<entry>
  <resource>
    <Patient>
      <id value='id3' />
      <address>
        <use value='home' />
        <city value='Berlin' />
      </address>
      <address>
        <type value='postal' />
        <country value='France' />
      </address>
      <address>
        <use value='work' />
        <city value='London' />
        <type value='postal' />
        <country value='England' />
      </address>
      <name>
        <given value='Frank' />
      </name>
      <name>
        <given value='Max' />
      </name>
    </Patient>
  </resource>
</entry>

<entry>
  <resource>
    <Observation>
      <id value = 'obs1' />
      <code>
        <coding>
```

```

        <system value='http://loinc.org' />
        <code value='29463-7' />
        <display value='Body Weight' />
    </coding>
    <coding>
        <system value='http://snomed.info/sct' />
        <code value='27113001' />
        <display value='Body weight' />
    </coding>
</code>
<subject>
    <reference value='Patient/id3' />
</subject>
</Observation>
</resource>
</entry>
</Bundle>"

```

example_bundles4

```

<Bundle>
  <type value='searchset' />
  <entry>
    <resource>
      <Medication>
        <id value='1285' />
        <code>
          <coding>
            <system value='http://www.nlm.nih.gov/research/umls/rxnorm' />
            <code value='1594660' />
            <display value='Alemtuzumab 10mg/ml (Lemtrada)' />
          </coding>
        </code>
        <ingredient id='1'>
          <itemReference>
            <reference value='Substance/5463' />
          </itemReference>
        </ingredient>
        <ingredient id='2'>
          <itemReference>
            <reference value='Substance/3401' />
          </itemReference>
        </ingredient>
      </Medication>
    </resource>
  </entry>

  <entry>

```

```

<resource>
  <Medication>
    <id value='45226' />
    <code>
      <coding>
        <system value='http://snomed.info/sct' />
        <code value='373994007' />
        <display value='Prednisone 5mg tablet (Product)' />
      </coding>
      <text value='Prednisone 5mg tablet (Product)' />
    </code>
    <ingredient id='1'>
      <itemReference>
        <reference value='Substance/6912' />
      </itemReference>
    </ingredient>
    <ingredient id='2'>
      <itemReference>
        <reference value='Substance/3710' />
      </itemReference>
    </ingredient>
  </Medication>
</resource>
</entry>

</Bundle>

```

example_bundles5

```

<Bundle>
  <type value='searchset' />
  <entry>
    <resource>
      <Observation>
        <id value = 'obs1' />
        <code>
          <coding>
            <system value='http://loinc.org' />
            <code value='29463-7' />
            <display value='Body Weight' />
          </coding>
          <coding>
            <system value='http://snomed.info/sct' />
            <code value='27113001' />
            <display value='Body weight' />
          </coding>
        </code>
        <subject>

```

```

        <reference value='Patient/id3'/>
      </subject>
    </Observation>
  </resource>
</entry>

<entry>
  <resource>
    <Observation>
      <id value = 'obs2'/>
      <code>
        <coding>
          <system value='http://loinc.org'/>
          <code value='8302-2'/>
          <display value='Body Height'/>
        </coding>
        <coding>
          <system value='http://snomed.info/sct'/>
          <code value='50373000'/>
          <display value='Body height measure'/>
        </coding>
      </code>
      <subject>
        <reference value='Patient/id3'/>
      </subject>
    </Observation>
  </resource>
</entry>
</Bundle>"

```

example_bundles6

```

"<Bundle>
  <type value='searchset'/>
  <entry>
    <resource>
      <Patient>
        <id value='id1'/>
        <address>
          <line value='Example Street 1'/>
          <line value='c/o Baker'/>
          <city value = 'London'/>
          <use value = 'home'/>
        </address>
        <address>
          <line value = 'Some firm'/>
          <line value = 'Some Department'/>
          <line value = 'Some Lane 1'/>

```

```

<city value = 'London' />
<use value = 'work' />
</address>
</Patient>
</resource>
</entry>
<entry>
<resource>
<Patient>
<id value='id2' />
<address>
<line value='Rue example 3' />
<city value = 'Paris' />
<use value = 'home' />
</address>
<address>
<line value = 'La fabrique' />
<line value = 'Avenue 33' />
<city value = 'Paris' />
<use value = 'work' />
</address>
</Patient>
</resource>
</entry>
</Bundle>"

```

example_bundles7

```

"<Bundle>
  <type value='searchset' />
  <entry>
    <resource>
      <Patient>
        <id value='id1' />
        <name>
          <given value='Marie' />
          <given value='Luise' />
          <family value = 'Smith' />
          <use value = 'official' />
        </name>
        <name>
          <given value = 'Lea' />
          <given value = 'Sophie' />
          <given value = 'Anna' />
          <family value = 'Baker' />
          <use value = 'nickname' />
        </name>
      </Patient>

```

```

</resource>
  </entry>
  <entry>
<resource>
<Patient>
<id value='id2' />
<name>
<given value='Max' />
<family value = 'Brown' />
<use value = 'official' />
</name>
<name>
<given value = 'Anton' />
<given value = 'John' />
<family value = 'Jones' />
<use value = 'nickname' />
</name>
</Patient>
</resource>
  </entry>
</Bundle>"

```

example_bundles_empty

```

<Bundle>
  <id value="c9edcd82-092c-4f63-8c8d-fdfd03e38d64" />
  <meta>
    <versionId value="23558aa5-aeba-4145-89a3-195bb6ec5401" />
    <lastUpdated value="2024-11-19T13:43:34.556+00:00" />
  </meta>
  <type value="searchset" />
  <timestamp value="2024-11-19T13:43:34.556+00:00" />
  <total value="0" />
  <link>
    <relation value="self" />
    <url value="https://server.fire.ly/Patient?gender=bla&_total=accurate&_count=0&_sk" />
  </link>
</Bundle>

```

Examples

```

#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles1)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles2)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles3)

```

```

#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles4)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles5)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles6)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles7)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = example_bundles_empty)

```

fhir_authenticate *Create token for Authentication*

Description

This function is a wrapper to create an [httr::Token](#) object for authentication with OAuth2/OpenID Connect. Internally, it calls [httr::oauth_app\(\)](#), [httr::oauth_endpoint\(\)](#) and [httr::oauth2.0_token\(\)](#) to create a token that can then be used in [fhir_search](#).

Usage

```

fhir_authenticate(
  secret,
  key,
  base_url,
  access,
  authorize,
  query_authorize_extra = list()
)

```

Arguments

| | |
|-----------------------|---|
| secret | The consumer/client secret, belonging to key. |
| key | Consumer key, also called client ID. For Keycloak this would for instance be the Keycloak client, e.g. "postman". |
| base_url | The URL the user will be redirected to after authorization is complete. This will usually be the base url of you FHIR server. |
| access | The url used to exchange unauthenticated for authenticated token. This can be identical to authorize. |
| authorize | The url to send the client for authorization. |
| query_authorize_extra | The url to send the client for authorization. A named list holding query parameters to append to initial auth page query. Could hold info about user identity and scope for keycloak like this: <pre>list(scope = "openid", grant_type = "password", username = "fhir-user", password = "fhirtest")</pre> |

| | |
|-----------|--------------------------------|
| fhir_body | Create <i>fhir_body</i> object |
|-----------|--------------------------------|

Description

Create [fhir_body](#) object

Usage

```
fhir_body(content, type)

## S4 method for signature 'list,missing'
fhir_body(content)

## S4 method for signature 'list,character'
fhir_body(content, type)

## S4 method for signature 'character,character'
fhir_body(content, type)
```

Arguments

| | |
|---------|--|
| content | A character vector of length one representing the body for the post in the format specified in type. If you provide a named list here, it will be taken as key value pairs of FHIR search parameters and will be concatenated appropriately. In this case the type will automatically be set to "application/x-www-form-urlencoded". See examples. |
| type | A string defining the type of the body e.g. "application/x-www-form-urlencoded" or "xml". |

Value

An object of type [fhir_body](#).

Examples

```
#body that could be used in a FHIR search request POSTed to an URL like baseUrl/Patient/_search
fhir_body(content = "gender=female&_summary=count", type="application/x-www-form-urlencoded")
fhir_body(content = list("gender" = "female", "_summary" = "count"))
```

| | |
|-----------------|--|
| fhir_body-class | <i>An s4 class to represent a body for a POST to a FHIR server</i> |
|-----------------|--|

Description

Objects of this class should always be created with a call to the function `fhir_body()`

Slots

`content` A vector of length one representing the body for the post.

`type` A vector of length one defining the type of the body e.g. "application/x-www-form-urlencoded" or "xml".

| | |
|-------------------|----------------------------|
| fhir_build_bundle | <i>Build a FHIR bundle</i> |
|-------------------|----------------------------|

Description

This function takes a table as produced by `fhir_crack()` with `format="wide"` and builds a `fhir_bundle_xml` object from it. It is primarily used to create transaction/batch bundles to POST back to a FHIR server. The column names of the table must represent the XPath expression of the respective element with indices for repeating items. A table like this is produced when FHIR resources have been cracked with `fhir_crack()` without assigning explicit column names in the `fhir_design/fhir_table_description` and the format has been set to "wide".

Usage

```
fhir_build_bundle(
  table,
  brackets,
  resource_type,
  bundle_type = "transaction",
  verbose = 1
)

## S4 method for signature 'data.frame'
fhir_build_bundle(
  table,
  brackets,
  resource_type,
  bundle_type = "transaction",
  verbose = 1
)

## S4 method for signature 'list'
fhir_build_bundle(table, brackets, bundle_type = "transaction", verbose = 1)
```

Arguments

| | |
|---------------|--|
| table | A wide table as produced by <code>fhir_crack()</code> , possibly modified (see details) or a named list of wide tables, if different resource types have to be included in the same bundle. In this case the names of the list elements must correspond to the resource type represented in the table! |
| brackets | A character vector of length one. The brackets used for cracking. |
| resource_type | A character vector of length one or <code>fhir_resource_type</code> object indicating which resource type is represented in the table, if a single table is provided. This argument is ignored when table is a named list of tables. |
| bundle_type | A character vector of length one defining the bundle type. Will usually be either "transaction" (the default) or "batch". |
| verbose | An integer vector of length one. If 0, nothing is printed, if > 0 progress message is printed. Defaults to 1. |

Details

The typical use case would look like this:

1. Download resources from a server with `fhir_search()`
2. Crack to wide format them with `fhir_crack()`
3. Do something to values (e.g. some kind of anonymization)
4. Translate the data back into FHIR resources with `fhir_build_bundle()`
5. Post the resources to a server

A FHIR bundle that can be POSTed to a server is usually of type transaction or batch. Each entry of these bundles consists of the resource itself as well as an instruction for the server of what to do with the resource. A very simple example looks like this:

```
<Bundle>
  <type value="transaction"/>
  <entry>
    <resource>
      <Patient>
        <id value="id1"/>
        <address>
          <city value="Amsterdam"/>
          <country value="Netherlands"/>
        </address>
        <name>
          <given value="Marie"/>
        </name>
      </Patient>
    </resource>
    <request>
      <method value="POST"/>
      <url value="Patient"/>
    </request>
  </entry>
</Bundle>
```

```

    </request>
  </entry>
  <entry>
    <resource>
      <Patient>
        <id value="id2"/>
        <address>
          <city value="Paris"/>
          <country value="France"/>
        </address>
        <name>
          <given value="Anne"/>
        </name>
      </Patient>
    </resource>
    <request>
    <method value="POST"/>
    <url value="Patient"/>
    </request>
  </entry>
</Bundle>

```

In this example the bundle contains two Patient resources that are sent to server with a POST. For more information the structure of transaction/batch bundles, please see the FHIR documentation at <https://www.hl7.org/fhir/http.html> and <https://www.hl7.org/fhir/bundle.html>.

In the table, each row corresponds to one resource that is created. To add the information for the request element of the bundle, this table has to be augmented with two columns named `request.method` and `request.url`, which contain the respective HTTP verb and URL for the resource. If these columns are not added to the table, `fhir_build_bundle()` still builds bundles from it, but those bundles will not be POSTable to a server. See examples.

Value

A `fhir_bundle_xml` object.

See Also

[fhir_crack\(\)](#), [fhir_cast\(\)](#), [fhir_build_resource\(\)](#), [fhir_post\(\)](#)

Examples

```

#unserialize example
bundles <- fhir_unserialize(bundles = example_bundles1)

#crack fhir resources
table_desc_pat <- fhir_table_description(
  resource = "Patient",
  brackets = c("[", "]"),
  sep      = " ",

```

```

    format = "wide"
  )

df <- fhir_crack(bundles = bundles, design = table_desc_pat)

#add request info to table
request <- data.frame(
  request.method = c("POST", "PUT"),
  request.url    = c("Patient", "Patient/id3")
)

request_df <- cbind(df, request)

#build bundle
bundle <- fhir_build_bundle(table      = request_df,
                           brackets   = table_desc_pat@brackets,
                           resource_type = "Patient",
                           bundle_type = "transaction")

#print to console
cat(toString(bundle))

```

fhir_build_resource *Build a single FHIR resource*

Description

This function takes a single row from a wide table as produced by [fhir_crack\(\)](#) and builds a [fhir_resource_xml](#) object from it. The column names of the table must represent the XPath expression of the respective element with indices for repeating items. A table like this is produced when FHIR resources have been cracked with [fhir_crack\(\)](#) without assigning explicit column names in the [fhir_design/fhir_table_description](#) and with `format` set to "wide".

Usage

```
fhir_build_resource(row, brackets, resource_type)
```

Arguments

| | |
|----------------------------|---|
| <code>row</code> | Single row from a wide table as produced by fhir_crack() with <code>format="wide"</code> |
| <code>brackets</code> | A character vector of length one. The brackets used for cracking. |
| <code>resource_type</code> | A character vector of length one or fhir_resource_type object indicating which resource type the table is build from. |

Value

A [fhir_resource_xml](#) object.

See Also

[fhir_cast\(\)](#), [fhir_crack\(\)](#), [fhir_build_bundle\(\)](#), [fhir_post\(\)](#), [fhir_put\(\)](#)

Examples

```
#unserialize example
bundles <- fhir_unserialize(bundles = example_bundles1)

#crack fhir resources
Pat <- fhir_table_description(
  resource = "Patient",
  brackets = c("[", "]"),
  sep      = " ",
  format   = "wide"
)

df <- fhir_crack(bundles = bundles, design = Pat)

#build resource
resource <- fhir_build_resource(
  row          = df[1,],
  brackets     = c('[', ']'),
  resource_type = "Patient"
)

#print to console
resource
```

fhir_bundle-class *An S4 class to represent FHIR bundles*

Description

An S4 class to represent FHIR bundles

fhir_bundle_list *Create [fhir_bundle_list](#) object*

Description

A `fhir_bundle_list` is a list of `fhir_bundle_xml` or `fhir_bundle_serialized` objects. It is usually returned by a call to [fhir_search\(\)](#).

Usage

```
fhir_bundle_list(bundles)
```

Arguments

`bundles` A list of `xml_nodes/fhir_bundle_xml` objects or of `raw/fhir_bundle_serialized` objects

Details

The only scenario where one would use this constructor function is when several `fhir_bundle` or `fhir_bundle_list` objects should be merged into one big `fhir_bundle_list` before cracking (see examples).

Examples

```
#unserialize example bundles
bundles1 <- fhir_unserialize(example_bundles1)
bundles2 <- fhir_unserialize(example_bundles2)

#bind them together in one fhir_bundle_list
bound_bundles <- fhir_bundle_list(c(bundles1, bundles2))
class(bound_bundles)

#bound list contains bundles from both original lists
length(bundles1)
length(bundles2)
length(bound_bundles)

#Create fhir_bundle list from xml objects
b1 <- xml2::read_xml("<Bundle><Resource><item value='1'/></Resource></Bundle>")
b2 <- xml2::read_xml("<Bundle><Resource><item value='2'/></Resource></Bundle>")

fhir_bundle_list(bundles = list(b1, b2))
fhir_bundle_list(bundles = list(fhir_bundle_xml(b1), fhir_bundle_xml(b2)))

r1 <- xml2::xml_serialize(object = b1, connection= NULL)
r2 <- xml2::xml_serialize(object = b2, connection= NULL)

fhir_bundle_list(bundles = list(r1, r2))
```

fhir_bundle_list-class

S4 class to represent a list of FHIR bundles

Description

A `fhir_bundle_list` is a list of `fhir_bundle_xml` or `fhir_bundle_serialized` objects. It should not be created by the user but returned by a call to `fhir_search()`.

 fhir_bundle_serialized-class

An S4 class to represent a FHIR bundle in serialized form

Description

A `fhir_bundle_serialized` is a `fhir_bundle_xml` that has been serialized using `fhir_serialize()`. In this form, the bundle cannot be used in any meaningful way, but it can be saved and loaded as an `.RData` or `.rds` object without breaking the external pointers in the xml. See `?fhir_serialize` and `?fhir_unserialize`.

 fhir_bundle_xml

Create `fhir_bundle_xml` object

Description

This should only be used if you want to create small examples. Usually, a `fhir_bundle_xml` will be returned by `fhir_search()`.

Usage

```
fhir_bundle_xml(bundle)
```

Arguments

`bundle` A xml-object representing a FHIR bundle

Examples

```
fhir_bundle_xml(bundle = xml2::xml_unserialize(patient_bundles[[1]]))
```

 fhir_bundle_xml-class *An S4 class to represent a FHIR bundle in xml form*

Description

A `fhir_bundle_xml` is an xml representation of a FHIR bundle (<https://www.hl7.org/fhir/bundle.html>). It is usually found inside a `fhir_bundle_list` which is returned by a call to `fhir_search()`.

Slots

`next_link` A `fhir_url` pointing to the next bundle on the server.

`self_link` A `fhir_url` pointing to this bundle on the server.

fhir_canonical_design *Retrieve design of last call to fhir_crack*

Description

Returns the [fhir_design](#) of the last call to [fhir_crack\(\)](#).

Usage

```
fhir_canonical_design()
```

See Also

[fhir_design\(\)](#), [fhir_table_description\(\)](#)

Examples

```
#load example bundles
bundles <- fhir_unserialize(bundles = patient_bundles)

#define design
patients <- fhir_table_description(resource = 'Patient')

design <- fhir_design(patients)

result <- fhir_crack(bundles = bundles, design = design)

fhir_canonical_design()
```

fhir_capability_statement

Get capability statement

Description

Get the capability statement of a FHIR server.

This function downloads a capability statement and creates three data.frames from it:

- Meta contains general information on the server
- Rest contains information on the Rest operations the server supports
- Resources contains information on the supported resource types

When there is more than one piece of information regarding a variable in these data.frames, they are divided by the string specified in `sep`. If `brackets` is not NULL, those entries will also be assigned indices so you can melt them using [fhir_melt\(\)](#).

Usage

```
fhir_capability_statement(
  url = "https://hapi.fhir.org/baseR4",
  username = NULL,
  password = NULL,
  token = NULL,
  add_headers = NULL,
  brackets = NULL,
  sep = " ::: ",
  log_errors = NULL,
  verbose = deprecated()
)
```

Arguments

| | |
|-------------|---|
| url | The base URL of the FHIR server. |
| username | A character vector of length one containing the username for basic authentication. Defaults to NULL, meaning no authentication. |
| password | A character vector of length one containing the password for basic authentication. Defaults to NULL, meaning no authentication. |
| token | A character vector of length one or object of class <code>httr::Token</code> , for bearer token authentication (e.g. OAuth2). See <code>fhir_authenticate()</code> for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. <code>c(myHeader = "somevalue")</code> or <code>c(firstHeader = "value1", secondHeader = "value2")</code> . |
| brackets | A character vector of length two defining the brackets surrounding indices for multiple entries, e.g. <code>c("[", "]")</code> . Defaults to NULL. If NULL, no indices will be added to multiple entries. |
| sep | A character vector of length one to separate pasted multiple entries |
| log_errors | Either NULL or a character vector of length one indicating the name of a file in which to save the http errors. NULL means no error logging. When a file name is provided, the errors are saved in the specified file. Defaults to NULL |
| verbose | [Deprecated] |

Value

A list of data frames containing the information from the statement

Examples

```
## Not run:
##without indices
cap <- fhir_capability_statement(url = "https://server.fire.ly")

##with indices
cap <- fhir_capability_statement(url = "https://server.fire.ly",
```

```

brackets = c("[", "]"),
sep = " || ")

#melt searchInclude variable
resources <- fhir_melt(cap$Resources,
  columns = "searchInclude",
  brackets = c("[", "]"),
  sep = " || ",
  all_columns = FALSE)

#remove indices
resources <- fhir_rm_indices(resources, brackets = c("[", "]"))

head(resources)

## End(Not run)

```

| | |
|-----------|--|
| fhir_cast | <i>Cast table with multiple entries This function divides multiple entries in a compact indexed table as produced by fhir_crack() into separate columns.</i> |
|-----------|--|

Description

This function turns a table from compact format into wide format. Every column containing multiple entries will be turned into multiple columns. The number of columns created from a single column in the original table is determined by the maximum number of multiple entries occurring in this column. Rows with less than the maximally occurring number of entries will be filled with NA values.

Usage

```
fhir_cast(indexed_df, brackets, sep, verbose = 1)
```

Arguments

| | |
|------------|--|
| indexed_df | A compact data.frame/data.table with indexed multiple entries. Column names should reflect the XPath expression of the respective element. |
| brackets | A character vector of length two, defining the brackets used for the indices. |
| sep | A character vector of length one defining the separator that was used when pasting together multiple entries in fhir_crack() . |
| verbose | An integer vector of length one. If 0, nothing is printed, if 1, only general progress is printed, if > 1, progress for each variable is printed. Defaults to 1. |

Details

For `fhir_cast()` to work properly, column names of the input data must reflect the Xpath to the corresponding resource element with `.` as a separator, e.g. `code.coding.system`. These names are produced automatically by `fhir_crack()` when the names are not explicitly set in the `cols` element of the `fhir_table_description()/fhir_design()`.

In the names of the newly created columns the indices will be added in front of the column names, similar to the result of `fhir_crack()` with `format="wide"`. See examples and the corresponding package vignette for a more detailed description.

See Also

`fhir_crack()`, `fhir_melt()`, `fhir_build_bundle()`

Examples

```
#unserialize example
bundles <- fhir_unserialize(bundles = example_bundles1)

#crack fhir resources
table_desc <- fhir_table_description(
  resource = "Patient",
  brackets = c('[', ']'),
  sep      = " ",
  keep_attr=TRUE
)
df <- fhir_crack(bundles = bundles, design = table_desc)

#original df
df

#cast
fhir_cast(df, brackets=c('[', ']'), sep = ' ', verbose = 0)
```

fhir_collapse

Collapse multiple entries

Description

This function collapses multiple entries that belong to the same higher level FHIR element (see examples).

Usage

```
fhir_collapse(indexed_data_frame, columns, sep, brackets, collapse = " ")
```

Arguments

| | |
|--------------------|---|
| indexed_data_frame | A data.frame/data.table with indexed multiple entries. |
| columns | A character vector of column names where values should be collapsed |
| sep | A character vector of length one defining the separator that was used when pasting together multiple entries in <code>fhir_crack()</code> . |
| brackets | A character vector of length two, defining the brackets used for the indices. |
| collapse | A character vector of length one used to separate the collapsed fields. Defaults to blank space. |

Details

Currently this function is only needed for very few FHIR elements where multiple values should be kept together in the melting process. To our knowledge, this is only true for `address.line` elements and `name.given` elements. Rather than building the cross product with all other elements in the resource as done by `fhir_melt()`, these elements should be collapsed into a single entry before melting. See examples to get a better idea of this.

Value

The modified data.table/data.frame with collapsed multiple entries

See Also

`fhir_melt()`

Examples

```
### First example: Keep name.given elements together
#unserialize example
bundles <- fhir_unserialize(bundles = example_bundles7)

#Have a look at the structure of example_bundles7
?example_bundles7

#Define sep and brackets
sep <- "|"
brackets <- c("[", "]")

#crack fhir resources
table_desc <- fhir_table_description(
  resource = "Patient",
  brackets = brackets,
  sep = sep
)

df <- fhir_crack(bundles = bundles, design = table_desc)
df
```

```

#name.given elements from the same name (i.e. the official vs. the nickname)
#should be collapsed

df2 <- fhir_collapse(df, columns = "name.given", sep = sep, brackets = brackets)
df2

#Next the name can be molten
fhir_melt(df2, brackets = brackets, sep = sep, columns = fhir_common_columns(df2,"name"))

### Second: Keep address line elements together
#unserialize example
bundles <- fhir_unserialize(bundles = example_bundles6)

#Have a look at the structure of example_bundles6
?example_bundles6

#Define sep and brackets
sep <- "|"
brackets <- c("[", "]")

#crack fhir resources
table_desc <- fhir_table_description(
  resource = "Patient",
  brackets = brackets,
  sep = sep
)

df <- fhir_crack(bundles = bundles, design = table_desc)
df

#Address.line elements from the same address (i.e. the work vs. the home address)
#should be collapsed

df2 <- fhir_collapse(df, columns = "address.line", sep = sep, brackets = brackets, collapse = ", ")
df2

#Next the address can be molten
fhir_melt(df2, brackets = brackets, sep = sep, columns = fhir_common_columns(df2,"address"))

```

fhir_columns

Create *fhir_columns* object

Description

An object of class `fhir_columns` is part of a `fhir_table_description` in a `fhir_design` and holds information on the elements that should be extracted from the FHIR resources, as well as the column names of the resulting data.frame. The elements to be extracted are indicated by XPath

xpaths. If no column names are provided, they are generated automatically and reflect the elements position in the resource.

Usage

```
fhir_columns(xpaths, colnames)

## S4 method for signature 'missing,missing'
fhir_columns()

## S4 method for signature 'NULL,missing'
fhir_columns(xpaths)

## S4 method for signature 'character,character'
fhir_columns(xpaths, colnames)

## S4 method for signature 'character,missing'
fhir_columns(xpaths)

## S4 method for signature 'list,missing'
fhir_columns(xpaths)
```

Arguments

| | |
|----------|---|
| xpaths | A (named) character vector or (named) list containing xpath xpaths, or a fhir_xpath_expression object. |
| colnames | The names of the columns to create. If no colnames are provided and the list or vector in xpaths has names, those names are taken as the colnames. If no colnames are provided and xpaths is unnamed too, the colnames are generated automatically from the xpath xpaths. See examples. |

Examples

```
#provide colnames explicitly
fhir_columns(xpaths = c("name/given", "code/coding/code"),
             colnames = c("name", "code"))

#colnames are taken from xpaths argument
fhir_columns(xpaths = c(name = "name/given", code = "code/coding/code"))

#colnames are taken from xpaths argument
fhir_columns(xpaths = list(name = "name/given", code = "code/coding/code"))

#colnames are generated automatically
fhir_columns(xpaths = c("name/given", "code/coding/code"))
```

fhir_columns-class *A S4 class to represent columns in a [fhir_table_description](#)*

Description

An object of class `fhir_columns` is part of a [fhir_table_description](#) in a [fhir_design](#) and holds information on the elements that should be extracted from the FHIR resources, as well as the column names of the resulting data.frame. The elements to be extracted are indicated by XPath xpaths.

Slots

names The column names

fhir_common_columns *Find common columns*

Description

This is a convenience function to find all column names in a data frame starting with the same string that can then be used for [fhir_melt\(\)](#).

Usage

```
fhir_common_columns(data_frame, column_names_prefix)
```

Arguments

`data_frame` A data.frame/data.table with automatically named columns as produced by [fhir_crack\(\)](#).
`column_names_prefix` A string containing the common prefix of the desired columns.

Details

It is intended for use on data frames with column names that have been automatically produced by [fhir_design\(\)/fhir_crack\(\)](#) and follow the form `level1.level2.level3` such as `name.given` or `code.coding.system`. Note that this function will only work on column names following exactly this scheme.

The resulting character vector can be used for melting all columns belonging to the same attribute in an indexed data frame, see [?fhir_melt](#).

Value

A character vector with the names of all columns matching `column_names_prefix`.

See Also

`fhir_melt()`, `fhir_rm_indices()`

Examples

```
#unserialize example bundles
bundles <- fhir_unserialize(bundles = medication_bundles)

#crack Patient Resources
pats <- fhir_table_description(resource = "Patient")

df <- fhir_crack(bundles = bundles, design = pats)

#look at automatically generated names
names(df)

#extract all column names beginning with the string "name"
fhir_common_columns(data_frame = df, column_names_prefix = "name")
```

fhir_count_resource *Get Resources' Counts*

Description

Downloads a count of resources matching the resource type and search parameters specified in resource and parameters. This function makes use of the `_summary=count` parameter of FHIR search and is therefore able to count resources on the server without actually downloading them.

Usage

```
fhir_count_resource(
  base_url,
  resource,
  parameters = NULL,
  username = NULL,
  password = NULL,
  token = NULL,
  add_headers = NULL
)
```

Arguments

| | |
|----------|---|
| base_url | A character vector of length one specifying the base URL of the FHIR server, e.g. "http://hapi.fhir.org/baseR4". |
| resource | A character vector of length one or <code>fhir_resource_type</code> object with the resource type to be searched, e.g. "Patient". |

| | |
|-------------|--|
| parameters | Optional. Either a length 1 character vector containing properly formatted FHIR search parameters, e.g. "gender=male&_summary=count" or a named list or named character vector e.g. list(gender="male", "_summary"="count") or c(gender="male", "_summary"="count"). Note that parameter names beginning with _ have to be put in quotation marks! |
| username | A character vector of length one containing the username for basic authentication. |
| password | A character vector of length one containing the password for basic authentication. |
| token | A character vector of length one or object of class <code>httr::Token</code> , for bearer token authentication (e.g. OAuth2). See <code>fhir_authenticate()</code> for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. c(myHeader = "somevalue") or c(firstHeader = "value1", secondHeader = "value2"). |

Details

For more information on authentication options, please see the help page of `fhir_search()`

Value

An integer of length 1 containing the number of resources matching the type and search parameters specified in `resource` and `parameters`.

Examples

```
#the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#you can skip it when the server is reachable
```

```
try({

#number of female Patient resources on the server
fhir_count_resource(
  base_url = 'https://vonk.fire.ly/R4',
  resource = "Patient",
  parameters = c(gender = "female"))
}, silent = TRUE)
```

Description

Converts a `fhir_bundle_list` (the result of `fhir_search()`) to a `data.frame/data.table` or list of `df/dt`, if more than one resource type is extracted at once.

There are two main output formats for the table: compact and wide. They differ regarding their handling of multiple occurrences of the same FHIR element (e.g. `Patient.address`). In the compact format multiple occurrences are pasted together into one cell/column, in the wide format multiple occurrences are distributed over several (indexed) columns. If none of the resources contains any multiple values on the extracted elements, the two formats will result in the same structure.

To increase speed with larger amounts of data the cracking process can be parallelised over a number of cores defined in the `ncores` argument.

Usage

```
fhir_crack(
  bundles,
  design,
  sep = NULL,
  brackets = NULL,
  rm_empty_cols = NULL,
  verbose = 2,
  data.table = FALSE,
  format = NULL,
  keep_attr = NULL,
  ncores = 1
)

## S4 method for signature 'ANY,fhir_table_description'
fhir_crack(
  bundles,
  design,
  sep = NULL,
  brackets = NULL,
  rm_empty_cols = NULL,
  verbose = 2,
  data.table = FALSE,
  format = NULL,
  keep_attr = NULL,
  ncores = 1
)

## S4 method for signature 'ANY,fhir_design'
fhir_crack(
  bundles,
  design,
  sep = NULL,
  brackets = NULL,
  rm_empty_cols = NULL,
  verbose = 2,
```

```

    data.table = FALSE,
    format = NULL,
    keep_attr = NULL,
    ncores = 1
  )

```

Arguments

| | |
|---------------|--|
| bundles | A FHIR search result as returned by <code>fhir_search()</code> . |
| design | A <code>fhir_design</code> or <code>fhir_table_description</code> object. See <code>fhir_design()/fhir_table_description()</code> and the corresponding vignette (<code>vignette("flattenResources", package = "fhircrackr")</code>) for a more detailed explanation and comprehensive examples of both. |
| sep | Optional. A character of length one containing the separator string used for separating multiple entries in cells when <code>format = "compact"</code> . Will overwrite the <code>sep</code> defined in <code>design</code> . If <code>sep = NULL</code> , it is looked up in <code>design</code> , where the default is <code>":::"</code> . |
| brackets | Optional. A character of length one or two used for the indices of multiple entries, which will overwrite the brackets defined in <code>design</code> . If <code>brackets = NULL</code> , it is looked up in <code>design</code> , where the default is <code>character(0)</code> , i.e. no indices are added to multiple entries. Empty strings (<code>"</code>) are not allowed. |
| rm_empty_cols | Optional. Remove empty columns? Logical scalar which will overwrite the <code>rm_empty_cols</code> defined in <code>design</code> . If <code>rm_empty_cols = NULL</code> , it is looked up in <code>design</code> , where the default is <code>FALSE</code> . |
| verbose | An integer vector of length one. If 0, nothing is printed, if 1, only finishing message is printed, if > 1, extraction progress will be printed. Defaults to 2. |
| data.table | A logical vector of length one. If it is set to <code>TRUE</code> the <code>fhir_crack</code> -function returns a <code>data.table</code> , otherwise a <code>data.frame</code> . Defaults to <code>FALSE</code> . |
| format | Optional. A character of length one indicating whether the resulting table should be cracked to a wide or compact format. Will overwrite the <code>format</code> defined in <code>design</code> which defaults to <code>compact</code> . <code>wide</code> means multiple entries will be distributed over several columns with indexed names. <code>compact</code> means multiple entries will be pasted into one cell/column separated by <code>sep</code> . |
| keep_attr | Optional. A logical of length one indicating whether the attribute name of the respective element (<code>@value</code> in most cases) should be attached to the name of the variable in the resulting table. Will overwrite <code>keep_attr</code> in <code>design</code> which defaults to <code>FALSE</code> . |
| ncores | Either <code>NULL</code> (no parallelisation) or an integer of length 1 containing the number of cpu cores that should be used for parallelised cracking. Parallelisation currently only works on linux systems. Defaults to <code>NULL</code> . |

Value

If a `fhir_design` was used, the result is a list of `data.frames`, i.e. a `fhir_df_list` object, or a list of `data.tables`, i.e. a `fhir_dt_list` object. If a `fhir_table_description` was used, the result is a single `data.frame/data.table`.

See Also

- Downloading bundles from a FHIR server: [fhir_search\(\)](#)
- Creating designs/table_descriptions: [fhir_table_description\(\)](#) and [fhir_design\(\)](#)
- Dealing with multiple entries: [fhir_melt\(\)](#), [fhir_cast\(\)](#), [fhir_rm_indices\(\)](#)

Examples

```
#unserialize example bundle
bundles <- fhir_unserialize(medication_bundles)

###Example 1###
#Extract just one resource type

#define attributes to extract
med_desc <- fhir_table_description(
  resource = "MedicationStatement",
  cols     = c(
    id       = "id",
    status   = "status",
    system   = "medicationCodeableConcept/coding/system",
    code     = "medicationCodeableConcept/coding/code",
    display  = "medicationCodeableConcept/coding/display"
  )
)

med_df <- fhir_crack(bundles = bundles, design = med_desc)

head(med_df) #data.frame

###Example 2###
#extract two resource types at once

pat_desc <- fhir_table_description(
  resource = "Patient"
)

design <- fhir_design(med_desc, pat_desc)

df_list <- fhir_crack(bundles = bundles, design = design)

#list of data.frames/fhir_df_list
head(df_list$med_desc)
head(df_list$pat_desc)

#The design that was used can be extracted from a fhir_df_list
fhir_design(df_list)

###Example 3###
```

```

#Filter values before extracting

#unserialize example bundle
b <- fhir_unserialize(bundles = example_bundles5)

#only extract codings with loinc system
table_desc <- fhir_table_description(
  resource = "Observation",
  cols = c(
    id = "id",
    loinc = "code/coding[system[@value='http://loinc.org']]/code",
    display = "code/coding[system[@value='http://loinc.org']]/display"
  )
)

table <- fhir_crack(bundles = b,
  design = table_desc)

table

```

fhir_current_request *Return FHIR search request used in last call to [fhir_search\(\)](#) or [fhir_url\(\)](#)*

Description

Return FHIR search request used in last call to [fhir_search\(\)](#) or [fhir_url\(\)](#)

Usage

```
fhir_current_request()
```

Value

An object of class [fhir_url\(\)](#)

Examples

```

#the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#you can skip it when the server is reachable

```

```

try({

request <- fhir_url(url = "https://server.fire.ly", resource = "Patient")
fhir_current_request()

fhir_search("https://server.fire.ly/Medication", max_bundles = 1)
fhir_current_request()

```

```
},silent = TRUE)
```

fhir_design *Create a [fhir_design](#) object*

Description

A `fhir_design` is a named list of `fhir_table_description` objects (See [fhir_table_description\(\)](#)) and should be created using the function described here. The design is used in [fhir_crack\(\)](#) to tell the function how to flatten each resource type.

Usage

```
fhir_design(...)

## S4 method for signature 'fhir_table_description'
fhir_design(...)

## S4 method for signature 'list'
fhir_design(...)

## S4 method for signature 'fhir_table_list'
fhir_design(...)
```

Arguments

... One or more `fhir_table_description` objects or a named list containing `fhir_table_description` objects, or an object of class `fhir_df_list/fhir_dt_list`. See [fhir_table_description\(\)](#).

Details

A `fhir_design` looks for example like this:

A `fhir_design` with 2 `table_descriptions`:
A `fhir_table_description` with the following elements:

```
fhir_resource_type: Patient

fhir_columns:
-----
column name | xpath expression
-----
id           | id
```

```

name      | name/family
gender    | gender
-----
sep:      '||'
brackets: '[' , ']'
rm_empty_cols: FALSE
format:   'compact'
keep_attr: TRUE

```

A `fhir_table_description` with the following elements:

```
fhir_resource_type: MedicationAdministration
```

```
fhir_columns:
An empty fhir_columns object
```

```

sep:      ':::'
brackets: no brackets
rm_empty_cols: FALSE
format:   'wide'
keep_attr: TRUE

```

The names of the `table_descriptions` are taken from the names of the arguments. If the `table_descriptions` are created within the call to `fhir_design` and therefore have no names, the names will be created from the respective resource type. See examples.

For backwards compatibility it is for the moment also possible to build it from an old-style design as used in `fhircrackr` (< 1.0.0). See examples.

If this function is given an object of class `fhir_df_list` or `fhir_dt_list`, it will extract the design that was used to create the respective list.

See Also

[fhir_table_description\(\)](#), [fhir_crack\(\)](#)

Examples

```

####Example 1####

###create fhir_table_descriptions first
#see ?fhir_table_description for explanation

pat <- fhir_table_description(
  resource = "Patient",
  cols     = c(
    id      = "id",
    name    = "name/family",
    gender  = "gender"
  ),

```

```

    sep          = "||",
    brackets     = c("[", "]"),
    rm_empty_cols = FALSE

)

meds <- fhir_table_description(resource = "MedicationAdministration")

###create design
#First option: Explicitly define names

design1 <- fhir_design(Pats = pat, Medics = meds)
print(design1)

#Second option: Names are taken from the object names

design2 <- fhir_design(pat, meds)
print(design2)

#Third option: Create table_description within fhir_design

design3 <- fhir_design(fhir_table_description(resource = "MedicationAdministration"))
print(design3)

#Fourth option: Names are taken from named list

design3 <- fhir_design(list(Patients = pat, Medications = meds))
print(design3)

###Example 2###
###Extract design from fhir_df_list/fhir_dt_list

#unserialize and crack example bundles
med_bundles <- fhir_unserialize(bundles = medication_bundles)
dfs <- fhir_crack(bundles = med_bundles, design = design1)

#extract design

fhir_design(dfs)

```

Description

A fhir_design is a named list of [fhir_table_description](#) objects. Each table_description contains information on how to flatten one resource type which will result in one data.frame. The fhir_design is passed to the function [fhir_crack\(\)](#) along with a list of bundles containing FHIR resources.

Slots

.Data The list of fhir_table_description objects.

names The names of the table_descriptions. Those will also be the names of the resulting data.frames.

See Also

[fhir_table_description\(\)](#), [fhir_crack\(\)](#)

fhir_df_list-class *List of data.frames as returned by [fhir_crack\(\)](#)*

Description

Objects of this class are returned by [fhir_crack\(\)](#) when data.table=FALSE (the default). They behave like an ordinary named list of data.frames but have some additional information in the slot design.

Slots

names Character vector containing the names of the data.frames.

design An object of class [fhir_design](#) that was used to create the df_list.

fhir_dt_list-class *List of data.tables as returned by [fhir_crack\(\)](#)*

Description

Objects of this class are returned by [fhir_crack\(\)](#) when data.table=TRUE. They behave like an ordinary named list of data.tables but have some additional information in the slot design.

Slots

names A character vector containing the names of the data.tables.

design An object of class [fhir_design](#) that was used to create the dt_list.

 fhir_get_resources_by_ids

Get Resources by their IDs

Description

Downloads FHIR resources represented by a vector of resource IDs.

Usage

```
fhir_get_resources_by_ids(
  base_url,
  resource,
  ids,
  id_param = "_id",
  parameters = NULL,
  username = NULL,
  password = NULL,
  token = NULL,
  add_headers = NULL,
  verbose = 0
)
```

Arguments

| | |
|------------|---|
| base_url | A character vector of length one specifying the base URL of the FHIR server, e.g. "http://hapi.fhir.org/baseR4". |
| resource | A character vector of length one or fhir_resource_type object with the resource type to be searched, e.g. "Patient". |
| ids | A character vector containing the IDs of the resources that should be downloaded. In the default setting these should be resource (aka logical) IDs. |
| id_param | A character vector of length one containing the FHIR Search parameter belonging to the ids in ids. Defaults to "_id" meaning ids is interpreted as containing resource (aka logical) ids. Could be changed to "identifier" if ids contains a vector of identifier values instead. |
| parameters | FHIR Search parameters to further restrict the set of resources that is returned, e.g. gender=male to only download the resources from the ids list that correspond to males. Can be either a length 1 character containing properly formatted FHIR search parameters, e.g. "gender=male" or a named list or named character vector e.g. list(gender="male") or c(gender="male"). Defaults to NULL meaning no restriction on the IDs provided in ids. |
| username | A character vector of length one containing the username for basic authentication. |
| password | A character vector of length one containing the password for basic authentication. |

| | |
|-------------|--|
| token | A character vector of length one or object of class httr::Token , for bearer token authentication (e.g. OAuth2). See fhir_authenticate() for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. <code>c(myHeader = "somevalue")</code> or <code>c(firstHeader = "value1", secondHeader = "value2")</code> . |
| verbose | An integer vector of length 1 containing the level of verbosity. Defaults to 0. |

Details

This function takes a character vector `ids` containing logical Ids of resources of a given type (specified in `resource`) on a FHIR server (specified in `base_url`) and downloads the corresponding resources from the server. The function will attempt to download the resources using a FHIR search request via POST where the IDs are part of the body. See [fhir_search\(\)](#) for details. If this fails (e.g. because the server doesn't allow POST operations), the function falls back on a GET request. If the set of `ids` is too long to fit into one GET request (i.e. if the request gets longer than 2083 characters), it will be spread across several requests.

For more information on authentication options, please see the help page of [fhir_search\(\)](#)

Value

A [fhir_bundle_list](#) containing the downloaded resources.

See Also

[fhir_search\(\)](#), [fhir_get_resource_ids\(\)](#)

Examples

```
#the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#you can skip it when the server is reachable

try({

#find IDs of Patient resources representing Homer Simpson
ids <- fhir_get_resource_ids(
  base_url = 'https://hapi.fhir.org/baseR4',
  resource = "Patient",
  parameters = "name=Homer&name=Simpson")

#Download all corresponding resources
bundles <- fhir_get_resources_by_ids(
  base_url = 'https://hapi.fhir.org/baseR4',
  resource = "Patient",
  ids = ids)

#have a look at the resources
fhir_crack(
  bundles,
```

```

fhir_table_description(
  resource = "Patient",
  cols     = list(
    ID      = "id",
    given   = "name/given",
    family  = "name/family"))
), silent = TRUE)

```

fhir_get_resource_ids *Get Resources' IDs*

Description

Download the resource (aka logical) IDs of all resources matching the FHIR search request build from the resource type and search parameters specified in `resource` and `parameters`. This function does not download the entire resources, but only extracts their IDs using the `_elements` parameter of FHIR Search.

Usage

```

fhir_get_resource_ids(
  base_url,
  resource,
  parameters = NULL,
  username = NULL,
  password = NULL,
  token = NULL,
  add_headers = NULL,
  verbose = 0
)

```

Arguments

| | |
|-------------------------|--|
| <code>base_url</code> | A character vector of length one specifying the base URL of the FHIR server, e.g. "http://hapi.fhir.org/baseR4". |
| <code>resource</code> | A character vector of length one or fhir_resource_type object with the resource type to be searched, e.g. "Patient". |
| <code>parameters</code> | Optional. Either a length 1 character vector containing properly formatted FHIR search parameters, e.g. "gender=male&_summary=count" or a named list or named character vector e.g. <code>list(gender="male", "_summary"="count")</code> or <code>c(gender="male", "_summary"="count")</code> . Note that parameter names beginning with <code>_</code> have to be put in quotation marks! |
| <code>username</code> | A character vector of length one containing the username for basic authentication. |

| | |
|-------------|--|
| password | A character vector of length one containing the password for basic authentication. |
| token | A character vector of length one or object of class <code>httr::Token</code> , for bearer token authentication (e.g. OAuth2). See <code>fhir_authenticate()</code> for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. <code>c(myHeader = "somevalue")</code> or <code>c(firstHeader = "value1", secondHeader = "value2")</code> . |
| verbose | An integer of length 1 containing the level of verbosity. Defaults to 0. |

Details

For more information on authentication options, please see the help page of `fhir_search()`

Value

A character vector containing the resource (aka logical) IDs of all requested resources.

See Also

`fhir_search()`, `fhir_get_resources_by_ids()`

Examples

```
#the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#you can skip it when the server is reachable
```

```
try({
  fhir_get_resource_ids(
    base_url = 'https://vonk.fire.ly/R4',
    resource = "Patient",
    parameters = "gender=female", verbose=1)
}, silent = TRUE)
```

fhir_is_empty

Check if Bundle/Bundlelist is empty

Description

Checks if a `fhir_bundle_xml` or `fhir_bundle_list` is empty, i.e. does not contain any resources.

Usage

```
fhir_is_empty(bundles)

## S4 method for signature 'fhir_bundle_list'
fhir_is_empty(bundles)

## S4 method for signature 'fhir_bundle_xml'
fhir_is_empty(bundles)
```

Arguments

`bundles` A FHIR search result as returned by `fhir_search()`

Details

Empty bundles are returned when a search on a FHIR server does not yield any resources, such as when no resources on the server match the specified search criteria. In this case, the server responds with an empty searchset bundle. This function checks whether:

- For objects of type `fhir_bundle_xml`, the bundle contains at least one "entry" element (if not, the bundle is empty and the functions returns TRUE)
- For objects of type `fhir_bundle_list`, the first bundle in the list contains at least one "entry" element (if not, the bundle is empty and the functions returns TRUE)

Value

TRUE if the bundle/bundle list is empty, FALSE if it is not empty.

Examples

```
#Load empty example bundles
bundles <- fhir_unserialize(example_bundles_empty)
bundles
fhir_is_empty(bundles)

#Load non-empty example bundles
bundles <- fhir_unserialize(patient_bundles)
bundles
fhir_is_empty(bundles)
```

fhir_load

Load bundles from xml-files

Description

Reads all bundles stored as xml files from a directory.

Usage

```
fhir_load(directory, indices = NULL, pattern = "[0-9]+\\.xml$")
```

Arguments

| | |
|-----------|---|
| directory | A character vector of length one containing the path to the folder where the files are stored. |
| indices | A numeric vector of integers indicating which bundles from the specified directory should be loaded. Defaults to NULL meaning all bundles from the directory are loaded. |
| pattern | A character vector of length one with a regex expression defining the naming pattern of the xml files to be read. Defaults to the regex expression matching file names as produced by fhir_save() . |

Value

A [fhir_bundle_list](#).

Examples

```
#unserialize example bundle
bundles <- fhir_unserialize(medication_bundles)
length(bundles)

#save to temporary directory
dir <- tempdir()
fhir_save(bundles, directory = dir)

#load from temporary directory
loaded_bundles <- fhir_load(dir)
length(loaded_bundles)

#load only two, the second and the third bundle
loaded_bundles <- fhir_load(dir, indices = c(2,3))
length(loaded_bundles)
```

fhir_load_design *Load design from xml*

Description

Loads a [fhir_design](#) for use with [fhir_crack\(\)](#) from an xml file into R.

Usage

```
fhir_load_design(file)
```

Arguments

file A string specifying the file from which to read.

Value

A [fhir_design](#) object. See `?fhir_design`.

See Also

[fhir_design\(\)](#), [fhir_table_description\(\)](#), [fhir_save_design\(\)](#)

Examples

```
table_desc1 <- fhir_table_description(  
  resource = 'Patient',  
  cols     = c(  
    id      = 'id',  
    name    = 'name/family',  
    gender  = 'gender'  
  ),  
  sep      = ':::',  
  brackets = c('[', ']'),  
  rm_empty_cols = FALSE,  
  format    = 'compact',  
  keep_attr = FALSE  
)  
  
table_desc2 <- fhir_table_description(  
  resource = 'Observation',  
  cols     = c(  
    'code/coding/system',  
    'code/coding/code'  
  )  
)  
  
design <- fhir_design(  
  Patients     = table_desc1,  
  Observations = table_desc2  
)  
temp <- tempfile()  
  
fhir_save_design(design = design, file = temp)  
  
design <- fhir_load_design(file = temp)
```

`fhir_melt`*Melt multiple entries*

Description

This function divides multiple entries in an indexed data frame as produced by `fhir_crack()` into separate rows.

Usage

```
fhir_melt(  
  indexed_data_frame,  
  columns,  
  brackets = c("<", ">"),  
  sep = " ",  
  id_name = "resource_identifier",  
  all_columns = FALSE  
)
```

Arguments

| | |
|---------------------------------|---|
| <code>indexed_data_frame</code> | A <code>data.frame</code> / <code>data.table</code> with indexed multiple entries. |
| <code>columns</code> | A character vector specifying the names of all columns that should be molten simultaneously. It is advisable to only melt columns simultaneously that belong to the same (repeating) attribute! |
| <code>brackets</code> | A character vector of length two, defining the brackets used for the indices. |
| <code>sep</code> | A character vector of length one defining the separator that was used when pasting together multiple entries in <code>fhir_crack()</code> . |
| <code>id_name</code> | A character vector of length one, the name of the column that will hold the identification of the origin of the new rows. |
| <code>all_columns</code> | Return all columns? Defaults to <code>FALSE</code> , meaning only those specified in <code>columns</code> are returned. |

Details

Every row containing values that consist of multiple entries on the variables specified by the argument `columns` will be turned into multiple rows, one for each entry. Values on other variables will be repeated in all the new rows.

The new `data.frame` will contain only the molten variables (if `all_columns = FALSE`) or all variables (if `all_columns = TRUE`) as well as an additional variable `resource_identifier` that maps which rows came from the same origin. The name of this column can be changed in the argument `id_name`.

For a more detailed description on how to use this function please see the corresponding package vignette.

Value

A data.frame/data.table where each entry from the variables in columns appears in a separate row.

See Also

[fhir_common_columns\(\)](#), [fhir_rm_indices\(\)](#)

Examples

```
#unserialize example
bundles <- fhir_unserialize(bundles = example_bundles1)

#crack fhir resources
table_desc <- fhir_table_description(
  resource = "Patient",
  brackets = c("[", "]"),
  sep = " "
)

df <- fhir_crack(bundles = bundles, design = table_desc)

#find all column names associated with attribute address
col_names <- fhir_common_columns(df, "address")

#original data frame
df

#only keep address columns
fhir_melt(
  indexed_data_frame = df,
  columns             = col_names,
  brackets            = c("[", "]"),
  sep = " "
)

#keep all columns
fhir_melt(indexed_data_frame = df, columns = col_names,
          brackets = c("[", "]"), sep = " ", all_columns = TRUE)
```

fhir_melt_all

Melt all columns with multiple entries

Description

This function divides all multiple entries in an indexed data frame as produced by [fhir_crack\(\)](#) into separate rows.

Usage

```
fhir_melt_all(indexed_data_frame, brackets, sep, column_name_separator = ".")
```

Arguments

| | |
|-----------------------|---|
| indexed_data_frame | A data.frame/data.table with indexed multiple entries. |
| brackets | A character vector of length two, defining the brackets used for the indices. |
| sep | A character vector of length one defining the separator that was used when pasting together multiple entries in <code>fhir_crack()</code> . |
| column_name_separator | A character string that separates element levels column names. Defaults to ".", which is used when column names were generated automatically with <code>fhir_crack()</code> . |

Details

The function repeatedly calls `fhir_melt()` on groups of columns that belong to the same FHIR element (e.g. `address.city`, `address.country` and `address.type`) until every cell contains a single value. If there is more than one FHIR element with multiple values (e.g. multiple address elements and multiple name elements), every possible combination of the two elements will appear in the resulting table. Caution! This creates something like a cross product of all values and can multiply the number of rows from the original table considerably.

Value

A completely molten data.table.

Examples

```
#unserialize example
bundles <- fhir_unserialize(bundles = example_bundles1)

#crack fhir resources
table_desc <- fhir_table_description(
  resource = "Patient",
  brackets = c("[", "]"),
  sep = " "
)

df <- fhir_crack(bundles = bundles, design = table_desc)

#original data frame
df

#melt all multiple entries
fhir_melt_all(
  indexed_data_frame = df,
  brackets           = c("[", "]"),
  sep = " "
)
```

fhir_melt_internal *Internal function to melt multiple entries in a data.table*

Description

This function handles the core melting operation for multiple entries in an indexed data.table. It is used internally by `fhir_melt()` to separate multiple entries in a given set of columns into individual rows.

Usage

```
fhir_melt_internal(indexed_dt, columns, brackets, sep, id_name, all_columns)
```

Arguments

| | |
|-------------|--|
| indexed_dt | A data.table with indexed multiple entries. |
| columns | A character vector specifying the names of all columns that should be melted simultaneously. It is advisable to only melt columns that belong to the same repeating attribute. |
| brackets | A character vector of length two, defining the brackets used for the indices. |
| sep | A character vector of length one, the separator that was used when pasting together multiple entries. |
| id_name | A character vector of length one, the name of the column that will hold the identification of the origin of the new rows. |
| all_columns | A boolean indicating whether all columns should be returned (default is FALSE). |

Value

A data.table where each entry from the variables in columns appears in a separate row.

See Also

`fhir_melt()`, `fhir_rm_indices()`

fhir_next_bundle_url *Next Bundle's URL*

Description

`fhir_next_bundle_url()` gives the link to the next available bundle, either of the bundle you provided in the argument `bundle` or of the last call to `fhir_search()`, if `bundle=NULL` (the default).

This function is useful when you don't have a lot of memory available or when a download of bundles was interrupted for some reason. In case of small memory, you can use `fhir_next_bundle_url` together with the `max_bundle` argument from `fhir_search()` to download bundles in smaller batches in a loop. See details in the example.

Usage

```
fhir_next_bundle_url(bundle = NULL)
```

Arguments

bundle The bundle from which you wish to extract the next link. If this is NULL (the default), the function will extract the next link from the last bundle that was downloaded in the most recent call to [fhir_search\(\)](#).

Value

A [fhir_url](#) object referencing next bundle available on the FHIR server. Empty [fhir_url](#) / character vector, if no further bundle is available.

Examples

```
#' #the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#' you can skip it when the server is reachable
```

```
try({

# workflow for small memory environments, downloading small batches of bundles
# for really small memory environments consider also using the `_count` option in
# your FHIR search request.
# You can iteratively download, crack and save the bundles until all bundles are processed or the
# desired number of bundles is reached.
url <- fhir_url("https://server.fire.ly/Patient")
count <- 0
obs <- fhir_table_description(resource = "Patient")
design <- fhir_design(obs)
while(length(url)>0 && count < 5){
  bundles <- fhir_search(url, max_bundles = 2)
  tables <- fhir_crack(bundles, design)
  save(tables, file = paste0(tempdir(),"/table_", count, ".RData"))
  count <- count + 1
  url <- fhir_next_bundle_url()
}
#you can see the saved tables here:
dir(tempdir())

}, silent = TRUE)
```

`fhir_post`*POST to a FHIR server*

Description

This function is a convenience wrapper around `httr::POST()`.

Usage

```
fhir_post(  
  url,  
  body,  
  username = NULL,  
  password = NULL,  
  token = NULL,  
  add_headers = NULL,  
  verbose = 1,  
  log_errors = NULL  
)  
  
## S4 method for signature 'ANY,fhir_resource'  
fhir_post(  
  url,  
  body,  
  username = NULL,  
  password = NULL,  
  token = NULL,  
  add_headers = NULL,  
  verbose = 1,  
  log_errors = NULL  
)  
  
## S4 method for signature 'ANY,fhir_bundle_xml'  
fhir_post(  
  url,  
  body,  
  username = NULL,  
  password = NULL,  
  token = NULL,  
  add_headers = NULL,  
  verbose = 1,  
  log_errors = NULL  
)  
  
## S4 method for signature 'ANY,fhir_body'  
fhir_post(  
  url,
```

```

    body,
    username = NULL,
    password = NULL,
    token = NULL,
    add_headers = NULL,
    verbose = 1,
    log_errors = NULL
  )

```

Arguments

| | |
|-------------|---|
| url | An object of class fhir_url or a character vector of length one containing the url to POST to. |
| body | An object of class fhir_resource , fhir_bundle_xml or fhir_body . See details for how to generate them. |
| username | A character vector of length one containing the username for basic authentication. |
| password | A character vector of length one containing the password for basic authentication. |
| token | A character vector of length one or object of class httr::Token , for bearer token authentication (e.g. OAuth2). See fhir_authenticate() for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. <code>c(myHeader = "somevalue")</code> or <code>c(firstHeader = "value1", secondHeader = "value2")</code> . |
| verbose | An integer vector of length one. If 0, nothing is printed, if > 0 success message is printed. Defaults to 1. |
| log_errors | Either NULL or a character vector of length one indicating the name of a file in which to save http errors. NULL means no error logging. When a file name is provided, the errors are saved in the specified file. Defaults to NULL. Regardless of the value of <code>log_errors</code> the most recent http error message within the current R session is saved internally and can be accessed with fhir_recent_http_error() . |

Details

[fhir_post\(\)](#) accepts four classes for the body:

1. A [fhir_resource](#) as created by [fhir_build_resource\(\)](#). This is used when just a single resource should be POSTed to the server. In this case `url` must contain the base url plus the resource type, e.g. `http://hapi.fhir.org/baseR4/Patient`.
2. A [fhir_bundle_xml](#) representing a transaction or batch bundle as created by [fhir_build_bundle\(\)](#).
3. A [fhir_body](#) as created by [fhir_body\(\)](#). This is the most flexible approach, because within the [fhir_body](#) object you can represent any kind of content as a string and set the type accordingly. See examples.

For examples of how to create the different body types see the respective help pages. For an example of the entire workflow around creating and POSTing resources, see the package vignette on recreating resources.

Examples

```
## Not run:
### 1. POST transaction bundle
#unserialize example bundles
bundle <- fhir_unserialize(transaction_bundle_example)

#have a look at the bundle
cat(toString(bundle))

#post
fhir_post(url = "http://hapi.fhir.org/baseR4", body = bundle)

### 2. POST single resource
#unserialize example resource
resource <- fhir_unserialize(example_resource1)

#have a look at the resource
resource

#post
url <- fhir_url(url = "http://hapi.fhir.org/baseR4", resource = "Patient")
fhir_post(url = url, body = resource)

### 3. POST arbitrary body
#define body
body <- fhir_body(content = "<Patient> <gender value='female' /> </Patient>", type = "xml")

#post
url <- fhir_url(url = "http://hapi.fhir.org/baseR4", resource = "Patient")
fhir_post(url = url, body = body)

## End(Not run)
```

fhir_put

PUT to a FHIR server

Description

This function is a convenience wrapper around `httr::PUT()`.

Usage

```
fhir_put(
  url,
  body,
  username = NULL,
  password = NULL,
```

```

    token = NULL,
    add_headers = NULL,
    verbose = 1,
    log_errors = NULL
  )

```

Arguments

| | |
|-------------|---|
| url | An object of class fhir_url or a character vector of length one containing the url to PUT to. |
| body | An object of class fhir_resource or fhir_body . See details for how to generate them. |
| username | A character vector of length one containing the username for basic authentication. |
| password | A character vector of length one containing the password for basic authentication. |
| token | A character vector of length one or object of class http::Token , for bearer token authentication (e.g. OAuth2). See fhir_authenticate() for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. <code>c(myHeader = "somevalue")</code> or <code>c(firstHeader = "value1", secondHeader = "value2")</code> . |
| verbose | An integer vector of length one. If 0, nothing is printed, if > 0 success message is printed. Defaults to 1. |
| log_errors | Either NULL or a character vector of length one indicating the name of a file in which to save http errors. NULL means no error logging. When a file name is provided, the errors are saved in the specified file. Defaults to NULL. Regardless of the value of <code>log_errors</code> the most recent http error message within the current R session is saved internally and can be accessed with fhir_recent_http_error() . |

Details

[fhir_put\(\)](#) accepts two classes for the body:

1. A [fhir_resource](#) as created by [fhir_build_resource\(\)](#). This is used when just a single resource should be PUT to the server. In this case `url` must contain the base url plus the resource type and the resource id, e.g. `http://hapi.fhir.org/baseR4/Patient/1a2b3c`.
2. A [fhir_body](#) as created by [fhir_body\(\)](#). This is the most flexible approach, because within the [fhir_body](#) object you can represent any kind of content as a string and set the type accordingly. See examples.

For examples of how to create the different body types see the respective help pages. For an example of the entire workflow around creating and PUTting resources, see the package vignette on recreating resources.

Examples

```
## Not run:
### 1. PUT fhir__resource object
#unserialize example resource
resource <- fhir_unserialize(example_resource2)

#have a look at the resource
resource

#put
fhir_put(url = "http://hapi.fhir.org/baseR4/Patient/1a2b3c", body = resource)

### 2. PUT fhir_body object
#define body
body <- fhir_body(content = "<Patient> <id value='x1y2' /> <gender value='female' /> </Patient>",
                  type = "xml")

#put
fhir_put(url = "http://hapi.fhir.org/baseR4/Patient/x1y2", body = body)

## End(Not run)
```

fhir_recent_http_error

Return most recent http error from [fhir_search\(\)](#)

Description

Whenever a call to [fhir_search\(\)](#) produces any http error, the error information is saved internally until the next http error occurs (or the R session ends). The error information can be accessed with `fhir_recent_http_error`. If you want to log that information outside of your R session, set the argument `log_errors` of [fhir_search\(\)](#).

Usage

```
fhir_recent_http_error()
```

Value

A string containing the error message

See Also

[fhir_search\(\)](#)

Examples

```
## Not run:
fhir_search("https://server.fire.ly/Medicatio", max_bundles = 1)
cat(fhir_recent_http_error())

## End(Not run)
```

| | |
|--------------|---------------------|
| fhir_request | <i>fhir_request</i> |
|--------------|---------------------|

Description

A Wrapper for fhir_url

Usage

```
fhir_request(url, resource = NULL, parameters = NULL, url_enc = TRUE)
```

Arguments

| | |
|------------|---|
| url | The same as for fhir_url(). |
| resource | The same as for fhir_url(). Defaults to NULL. |
| parameters | The same as for fhir_url(). Defaults to NULL. |
| url_enc | The same as for fhir_url(). Defaults to TRUE. |

Value

The same as for fhir_url().

Examples

```
#provide full FHIR search request
fhir_request(url = "http://hapi.fhir.org/baseR4/Patient?gender=male&_summary=count")

#provide base url and resource type
fhir_request(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient"
)

#parameters in one string
fhir_request(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient",
  parameters = "gender=male&_summary=count"
)
```

```
#parameters as a named character
fhir_request(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient",
  parameters = c("gender" = "male", "_summary" = "count")
)

#parameters as a named list
fhir_request(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient",
  parameters = list("gender" = "male", "_summary" = "count")
)
```

fhir_resource-class *An S4 class to represent FHIR resources*

Description

An S4 class to represent FHIR resources

fhir_resource_serialized-class
An S4 class to represent a FHIR resource in serialized form

Description

A `fhir_resource_serialized` is a `fhir_resource_xml` that has been serialized using `fhir_serialize()`. In this form, the resource cannot be used in any meaningful way, but it can be saved and loaded as an `.RData` or `.rds` object without breaking the external pointers in the xml. See `?fhir_serialize` and `?fhir_unserialize`.

fhir_resource_type *Create [fhir_resource_type](#) object*

Description

This function creates an object of class `fhir_resource_type`. It checks the resource type against the list of resource types provided at <https://hl7.org/FHIR/resourcelist.html>, corrects wrong cases (which can be disabled with `fix_capitalization = FALSE`) and throws a warning if the resource cannot be found at hl7.org.

Usage

```
fhir_resource_type(string, fix_capitalization = TRUE)
```

Arguments

`string` A length one character vector containing the resource type. Will usually be one of the official FHIR resource types listed at <https://hl7.org/FHIR/resourcelist.html>

`fix_capitalization` Correct wrong capitalization for known resource types? E.g. patients -> Patients or medicationstatement -> MedicationStatement. Defaults to TRUE.

Value

An `fhir_resource_type` object

Examples

```
fhir_resource_type(string = "Patient")
fhir_resource_type(string = "medicationadministration")
```

`fhir_resource_type-class`

A representation of a FHIR resource type

Description

An object of class `fhir_resource_type` is a string containing a FHIR resource type. It is part of a `fhir_table_description` which in turn is part of a `fhir_design` and used in `fhir_crack()`.

`fhir_resource_xml` *Create `fhir_resource_xml` object*

Description

Create `fhir_resource_xml` object

Usage

```
fhir_resource_xml(resource)

## S4 method for signature 'xml_document'
fhir_resource_xml(resource)

## S4 method for signature 'xml_node'
fhir_resource_xml(resource)

## S4 method for signature 'character'
fhir_resource_xml(resource)
```

Arguments

resource A xml-object representing a FHIR resource

Examples

```
fhir_resource_xml(resource = xml2::read_xml("<Patient><id value = '1' /></Patient>"))
```

fhir_resource_xml-class

An S4 class to represent a FHIR resource in xml form

Description

A fhir_resource_xml is an xml representation of a FHIR resource (<https://www.hl7.org/fhir/resourcelist.html>).

fhir_rm_div

Remove html elements

Description

This function is a convenience wrapper for `fhir_rm_tag()` that removes all `<div>` `</div>` elements from an xml. `div` tags in FHIR resources contain html code, which is often server generated and in most cases neither relevant nor usable for data analysis.

Usage

```
fhir_rm_div(x)
```

Arguments

x A `fhir_bundle_xml` or `fhir_bundle_list` object or a character vector containing xml objects.

Value

An object of the same class as x where all tags matching the tag argument are removed.

See Also

`fhir_rm_tag()`

Examples

```
#Example 1: Remove div tags from xmls in a character vector
string <- c("Hallo<div>Please<p>Remove Me</p></div> World!",
           "A<div><div><p>B</p></div>C</div>D")

fhir_rm_div(x = string)

#Example 2: Remove div tags in a single fhir bundle
bundle <- fhir_unserialize(patient_bundles)[[1]]

#example bundle contains html parts in div tags:
cat(toString(bundle))

#remove html parts
bundle_cleaned <- fhir_rm_div(x = bundle)

#have a look at the result
cat(toString(bundle_cleaned))

#Example 3: Remove div tags in a list of fhir bundles
bundle_list <- fhir_unserialize(patient_bundles)

#remove html parts
bundle_list_cleaned <- fhir_rm_div(x = bundle_list)

#check out how much the size of the bundle list is reduced by removing html
size_with_html <- sum(sapply(bundle_list, function(x)object.size(toString(x))))
size_without_html <- sum(sapply(bundle_list_cleaned, function(x)object.size(toString(x))))

size_without_html/size_with_html
```

fhir_rm_indices

Remove indices from data.frame/data.table

Description

Removes the indices in front of multiple entries as produced by `fhir_crack()` when brackets are provided in the design.

Usage

```
fhir_rm_indices(  
  indexed_data_frame,  
  brackets = c("<", ">"),  
  columns = names(indexed_data_frame)  
)
```

Arguments

| | |
|--------------------|---|
| indexed_data_frame | A data frame with indices for multiple entries as produced by fhir_crack() |
| brackets | A character vector of length two defining the brackets that were used in fhir_crack() |
| columns | A character vector of column names, indicating from which columns indices should be removed. Defaults to all columns. |

Value

A data frame without indices.

See Also

[fhir_melt\(\)](#)

Examples

```
#unserialize example  
bundles <- fhir_unserialize(bundles = example_bundles1)  
  
patients <- fhir_table_description(resource = "Patient")  
  
df <- fhir_crack(bundles = bundles,  
               design = patients,  
               brackets = c("[", "]"))  
  
df_indices_removed <- fhir_rm_indices(indexed_data_frame = df, brackets=c("[", "]"))
```

fhir_rm_tag

Remove a certain xml tag

Description

Removes a given xml tag from xml objects represented in a [fhir_bundle_xml](#), [fhir_bundle_list](#) or character vector.

Usage

```
fhir_rm_tag(x, tag)

## S4 method for signature 'character'
fhir_rm_tag(x, tag)

## S4 method for signature 'fhir_bundle_xml'
fhir_rm_tag(x, tag)

## S4 method for signature 'fhir_bundle_list'
fhir_rm_tag(x, tag)
```

Arguments

| | |
|-----|--|
| x | A fhir_bundle_xml or fhir_bundle_list object or a character vector containing xml objects. |
| tag | A character vector of length 1 containing the tag that should be removed, e.g. "div". |

Details

In the example Hello<div>Please<p>Remove Me</p></div>World! one could for example remove the tag p, resulting in Hello<div>Please</div>World! or remove the div tag resulting in Hello World!.

Value

An object of the same class as x where all tags matching the tag argument are removed.

See Also

[fhir_rm_div\(\)](#)

Examples

```
#Example 1: Remove tag from xmls in a character vector
string <- c("Hello<div>Please<p>Remove Me</p></div> World!",
           "A<div><div><p>B</p></div>C</div>D")
```

```
fhir_rm_tag(x = string, tag = "p")
```

```
#Example 2: Remove div tags in a single fhir bundle
bundle <- fhir_unserialize(patient_bundles)[[1]]
```

```
#example bundle contains html parts in div tags:
cat(toString(bundle))
```

```
#remove html parts
bundle_cleaned <- fhir_rm_tag(x = bundle, tag = "div")

#have a look at the result
cat(toString(bundle_cleaned))

#Example 3: Remove div tags in a list of fhir bundles
bundle_list <- fhir_unserialize(patient_bundles)

#remove html parts
bundle_list_cleaned <- fhir_rm_tag(x = bundle_list, tag = "div")

#check out how much the size of the bundle list is reduced by removing html
size_with_html <- sum(sapply(bundle_list, function(x)object.size(toString(x))))
size_without_html <- sum(sapply(bundle_list_cleaned, function(x)object.size(toString(x))))

size_without_html/size_with_html
```

fhir_sample_resources *Randomly sample resources from a FHIR server*

Description

Downloads a random sample of resources of a given resource type from a FHIR server. The resources can be further constrained using FHIR search parameters.

Usage

```
fhir_sample_resources(
  base_url,
  resource,
  parameters = NULL,
  username = NULL,
  password = NULL,
  token = NULL,
  add_headers = NULL,
  sample_size = 20,
  seed = 1,
  verbose = 1
)
```

Arguments

| | |
|-------------|--|
| base_url | A character vector of length one specifying the base URL of the FHIR server, e.g. "http://hapi.fhir.org/baseR4". |
| resource | A character vector of length one or fhir_resource_type object with the resource type to be downloaded, e.g. "Patient". |
| parameters | Optional. Either a length 1 character vector containing properly formatted FHIR search parameters, e.g. "gender=male&_summary=count" or a named list or named character vector e.g. <code>list(gender="male", "_summary"="count")</code> or <code>c(gender="male", "_summary"="count")</code> . Note that parameter names beginning with <code>_</code> have to be put in quotation marks! |
| username | A character vector of length one containing the username for basic authentication. |
| password | A character vector of length one containing the password for basic authentication. |
| token | A character vector of length one or object of class httr::Token , for bearer token authentication (e.g. OAuth2). See fhir_authenticate() for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. <code>c(myHeader = "somevalue")</code> or <code>c(firstHeader = "value1", secondHeader = "value2")</code> . |
| sample_size | A integer of length 1 containing the number of resources to sample. |
| seed | A integer of length 1 containing the seed for the random generator. |
| verbose | An integer of length 1 containing the level of verbosity. Defaults to 1. |

Details

This function performs three steps to draw a random sample of resources from a FHIR server:

1. Count how many resources matching the type `resource` and the search parameters in `parameters` are found on the server. This is done to assert that the desired `sample_size` is bigger than the number of resources it is drawn from. This step can also be performed individually using [fhir_count_resource\(\)](#).
2. Extract the resource (aka logical) IDs of all requested resources (without downloading the resources completely). This step can also be performed individually using [fhir_get_resource_ids\(\)](#).
3. Draw a random sample of size `sample_size` from the vector of resource IDs and download the corresponding set of resources from the server. This can also be done individually using [fhir_sample_resources_by_ids\(\)](#).

The actual download of the resources is done by [fhir_get_resources_by_ids\(\)](#). This function will attempt to download the resources using a FHIR search request via POST where the IDs are part of the body. See [fhir_search\(\)](#) for details. If this fails (e.g. because the server doesn't allow POST operations), the function falls back on a GET request. If the set of IDs is too long to fit into one GET request (i.e. if the request gets longer than 2083 characters), it will be spread across several requests.

For more information on authentication options, please see the help page of [fhir_search\(\)](#)

Value

A [fhir_bundle_list](#) containing randomly sampled resources.

See Also

[fhir_search\(\)](#), [fhir_sample_resources_by_ids\(\)](#), [fhir_get_resources_by_ids\(\)](#), [fhir_count_resource\(\)](#)

Examples

```
#the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#you can skip it when the server is reachable
```

```
try({

#how many resources are on the server?
count <- fhir_count_resource(
  base_url   = 'https://hapi.fhir.org/baseR4',
  resource   = "Patient",
  parameters = "gender=female")

#randomly sample 30 of them
bundles <- fhir_sample_resources(
  base_url   = 'https://hapi.fhir.org/baseR4',
  resource   = "Patient",
  parameters = "gender=female",
  sample_size = 30,
  seed       = 1)

bundles

}, silent = TRUE)
```

fhir_sample_resources_by_ids

Download a random sample of resources from a vector of resource IDs.

Description

Download a random sample of resources from a vector of resource IDs.

Usage

```
fhir_sample_resources_by_ids(
  base_url,
  resource,
  ids,
```

```

    id_param = "_id",
    username = NULL,
    password = NULL,
    token = NULL,
    add_headers = NULL,
    sample_size = 20,
    seed = 1,
    verbose = 1
)

```

Arguments

| | |
|-------------|---|
| base_url | A character vector of length one specifying the base URL of the FHIR server, e.g. "http://hapi.fhir.org/baseR4". |
| resource | A character vector of length one or fhir_resource_type object with the resource type to be downloaded e.g. "Patient". |
| ids | A character vector containing the IDs from which to sample. |
| id_param | A character vector of length one containing the FHIR Search parameter belonging to the ids in ids. Defaults to "_id" meaning ids is interpreted as containing resource (aka logical) ids. Could be changed to "identifier" if ids contains a vector of identifier values instead. |
| username | A character vector of length one containing the username for basic authentication. |
| password | A character vector of length one containing the password for basic authentication. |
| token | A character vector of length one or object of class httr::Token , for bearer token authentication (e.g. OAuth2). See fhir_authenticate() for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. c(myHeader = "somevalue") or c(firstHeader = "value1", secondHeader = "value2"). |
| sample_size | A integer of length 1 containing the number of resources to sample. |
| seed | A integer of length 1 containing the seed for the random generator. |
| verbose | An integer of length 1 containing the level of verbosity. Defaults to 1. |

Details

This function takes a character vector `ids` containing logical Ids of resources of a given type (specified in `resource`) on a FHIR server (specified in `base_url`) and downloads a random sample of size `sample_size` of the corresponding resources from the server.

Internally, the download of the resources is done by [fhir_get_resources_by_ids\(\)](#). This function will attempt to download the resources using a FHIR search request via POST where the IDs are part of the body. See [fhir_search\(\)](#) for details. If this fails (e.g. because the server doesn't allow POST operations), the function falls back on a GET request. If the set of IDs is too long to fit into one GET request (i.e. if the request gets longer than 2083 characters), it will be spread across several requests.

For more information on authentication options, please see the help page of ['fhir_search\(\)](#)

Value

A list of bundles containing sampled resources.

See Also

[fhir_search\(\)](#), [fhir_sample_resources\(\)](#), [fhir_get_resources_by_ids\(\)](#), [fhir_count_resource\(\)](#)

Examples

```
#the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#you can skip it when the server is reachable
```

```
try({

#find IDs of all resources representing Homer Simpson
ids <- fhir_get_resource_ids(
  base_url = 'https://hapi.fhir.org/baseR4',
  resource = "Patient",
  parameters = "name=Homer&name=Simpson")
```

```
#Sample 10 of them
bundles <- fhir_sample_resources_by_ids(
  base_url = 'https://hapi.fhir.org/baseR4',
  resource = "Patient",
  ids = ids,
  sample_size = 10,
  seed = 1)
```

```
#Have a look at the samples
fhir_crack(
  bundles,
  fhir_table_description(
    resource = "Patient",
    cols = list(
      ID = "id",
      given = "name/given",
      family = "name/family"))))
```

```
}, silent = TRUE)
```

fhir_save

Save FHIR bundles as xml-files

Description

Writes a list of FHIR bundles as numbered xml files into a directory.

Usage

```
fhir_save(bundles, directory)
```

Arguments

| | |
|-----------|--|
| bundles | A list of xml objects representing the FHIR bundles. |
| directory | A character vector of length one containing the path to the folder to store the data in. |

Examples

```
#unserialize example bundle
bundles <- fhir_unserialize(medication_bundles)

#save all bundles to temporary directory
fhir_save(bundles, directory = tempdir())

#save only two bundles (the second and the third) to temporary directory
fhir_save(bundles[c(2,3)], directory = tempdir())
```

| | |
|------------------|----------------------------|
| fhir_save_design | <i>Write design to xml</i> |
|------------------|----------------------------|

Description

Writes a [fhir_design](#) for use with [fhir_crack\(\)](#) to an xml file.

Usage

```
fhir_save_design(design, file = "design.xml")
```

Arguments

| | |
|--------|--|
| design | A fhir_design object. See fhir_design() . |
| file | A string specifying the file to write to, defaults to writing 'design.xml' into the current working directory. |

See Also

[fhir_design\(\)](#), [fhir_table_description\(\)](#), [fhir_load_design\(\)](#)

Examples

```

#create and save design
table_desc1 <- fhir_table_description(
  resource = 'Patient',
  cols     = c(
    id      = 'id',          # column names with xpaths
    name    = 'name/family',
    gender  = 'gender'
  ),
  sep      = ':::',
  brackets = c('[', ']'),
  rm_empty_cols = FALSE,
  format   = 'compact',
  keep_attr = FALSE
)

table_desc2 <- fhir_table_description(
  resource = 'Observation',
  cols     = c(
    'code/coding/system', # only xpaths
    'code/coding/code'
  )
)

design <- fhir_design(
  Patients      = table_desc1,
  Observations = table_desc2
)

fhir_save_design(design = design, file = tempfile())

```

fhir_search

Download FHIR search result

Description

Downloads all FHIR bundles of a FHIR search request from a FHIR server by iterating through the bundles. Search via GET and POST is possible, see Details.

Usage

```

fhir_search(
  request = fhir_current_request(),
  body    = NULL,
  username = NULL,
  password = NULL,
  token    = NULL,
  add_headers = NULL,
  max_bundles = Inf,

```

```

    verbose = 1,
    delay_between_attempts = c(1, 3, 9, 27, 81),
    log_errors = NULL,
    save_to_disc = NULL,
    delay_between_bundles = 0,
    rm_tag = "div",
    stop_on_error = 0
  )

```

Arguments

| | |
|------------------------|---|
| request | An object of class <code>fhir_url</code> or a character vector of length one containing the full FHIR search request. It is recommended to explicitly create the request via <code>fhir_url()</code> as this will do some validity checks and format the url properly. Defaults to <code>fhir_current_request()</code> |
| body | A character vector of length one or object of class <code>fhir_body</code> with type <code>"application/x-www-form-urlencoded"</code> . A body should be provided when the FHIR search request is too long and might exceed the maximal allowed length of the URL when sent to the server. In this case a search via POST (see https://www.hl7.org/fhir/search.html#Introduction) can be used. The body should contain all the parameters that follow after the <code>?</code> in the FHIR search request. When a body is provided, the required <code>_search</code> is automatically added to the url in request. See examples and <code>?fhir_body</code> . |
| username | A character vector of length one containing the username for basic authentication. |
| password | A character vector of length one containing the password for basic authentication. |
| token | A character vector of length one or object of class <code>httr::Token</code> , for bearer token authentication (e.g. OAuth2). See <code>fhir_authenticate()</code> for how to create this. |
| add_headers | A named character vector of custom headers to add to the HTTP request, e.g. <code>c(myHeader = "somevalue")</code> or <code>c(firstHeader = "value1", secondHeader = "value2")</code> . |
| max_bundles | Maximal number of bundles to get. Defaults to <code>Inf</code> meaning all available bundles are downloaded. |
| verbose | An integer vector of length one. If 0, nothing is printed, if 1, only finishing message is printed, if > 1 , downloading progress will be printed. Defaults to 1. |
| delay_between_attempts | A numeric vector specifying the delay in seconds between attempts of reaching the server that <code>fhir_search()</code> will make. The length of this vector determines the number of attempts that will be made when the server can't be reached before stopping with an error. Defaults to <code>c(1, 3, 9, 27, 81)</code> . If you want the function to stop immediately after the first error when trying to reach the server, set this argument to 1. |
| log_errors | Either <code>NULL</code> or a character vector of length one indicating the name of a file in which to save the http errors. <code>NULL</code> means no error logging. When a file name is provided, the errors are saved in the specified file. Defaults to <code>NULL</code> . Regardless |

| | |
|------------------------------------|--|
| | of the value of <code>log_errors</code> the most recent http error message within the current R session is saved internally and can be accessed with <code>fhir_recent_http_error()</code> . |
| <code>save_to_disc</code> | Either NULL or a character vector of length one indicating the name of a directory in which to save the bundles. If a directory name is provided, the bundles are saved as numerated xml-files into the directory specified and not returned as a bundle list in the R session. This is useful when a lot of bundles are to be downloaded and keeping them all in one R session might overburden working memory. When the download is complete, the bundles can be loaded into R using <code>fhir_load()</code> . Defaults to NULL, i.e. bundles are returned as a list within the R session. |
| <code>delay_between_bundles</code> | A numeric scalar specifying a time in seconds to wait between pages of the search result, i.e. between downloading the current bundle and the next bundle. This can be used to avoid choking a weak server with too many requests to quickly. Defaults to zero. |
| <code>rm_tag</code> | Character vector of length 1 defining an xml tag of elements that will be removed from the bundle automatically. Defaults to "div", leading to the removal of all html parts (see Details). Set to NULL to keep the bundles untouched. See <code>fhir_rm_div()</code> and <code>fhir_rm_tag()</code> for more info. |
| <code>stop_on_error</code> | Controls error handling for server requests <ul style="list-style-type: none"> • <code>stop_on_error = 0</code>: Issues warning and retries requests as defined by <code>delay_between_attempts</code>. Returns empty <code>bundle_list</code> if all attempts fail • <code>stop_on_error = 1</code>: Stops immediately on any error. Overrides <code>delay_between_attempts</code>, as no retries will be attempted. • <code>stop_on_error = <vector of HTTP codes></code>: Stops on specified codes (e.g. <code>c(401, 404)</code>), warns for others |

Details

Request type:

`fhir_search` allows for two types of search request:

1. FHIR search via GET: This is the more common approach. All information on which resources to download is contained in the URL that is sent to the server (request argument). This encompasses the base url of the server, the resource type and possible search parameters to further qualify the search (see `fhir_url()`). The search via GET is the default and performed whenever the argument body is NULL.
2. FHIR search via POST: This option should only be used when the parameters make the search URL so long the server might deny it because it exceeds the allowed length. In this case the search parameters (everything that would usually follow the resource type after the `?`) can be transferred to a body of type "application/x-www-form-urlencoded" and sent via POST. If you provide a body in `fhir_search()`, the url in request should only contain the base URL and the resource type. The function will automatically amend it with `_search` and perform a POST.

Authentication:

There are several ways of authentication implemented in `fhir_search()`. If you don't need any authentication, just leave the arguments described in the following at their default values of NULL.

1. Basic Authentication: Provide the username and the password for basic authentication in the respective arguments.
2. Token Authentication: Provide a token in the argument `token`, either as a character vector of length one or as an object of class `httr::Token`. You can use the function `fhir_authenticate()` to create this object.

Additional headers:

Per default, the underlying HTTP requests are equipped with *Accept* and *Authorization* headers. If you need to pass additional headers, e.g. cookies for authentication or other custom headers, you can add these to the request as a named character vector using the `add_headers` argument.

HTML removal:

FHIR resources can contain a considerable amount of html code (e.g. in a `narrative` object), which is often created by the server for example to provide a human-readable summary of the resource. This data is usually not the aim of structured statistical analysis, so in the default setting `fhir_search()` will remove the html parts immediately after download to reduce memory usage (on a hapi server typically by around 30%, see `fhir_rm_div()`). The memory gain is payed with a runtime increase of 10%-20%. The html removal can be disabled by setting `rm_tag = NULL` to increase speed at the cost of increased memory usage.

Value

A `fhir_bundle_list` when `save_to_disc = NULL` (the default), else `NULL`.

See Also

- Creating a FHIR search request: `fhir_url()` and `fhir_body()` (for POST based search)
- OAuth2 Authentication: `fhir_authenticate()`
- Saving/reading bundles from disc: `fhir_save()` and `fhir_load()`
- Flattening the bundles: `fhir_crack()`

Examples

```
#the try({}, silent = TRUE) statement is only there to catch errors when the server is down
#you can skip it when the server is reachable

try({

### Search with GET

#create fhir search url

request <- fhir_url(url = "https://server.fire.ly",
                   resource = "Patient",
                   parameters = c(gender="female"))

#download bundles
bundles <- fhir_search(request, max_bundles = 5)
```

```

### Search with POST (should actually be used for longer requests)

request <- fhir_url(url = "https://server.fire.ly",
                  resource = "Patient")

body <- fhir_body(content = list(gender = "female"))

bundles <- fhir_search(request = request,
                      body = body,
                      max_bundles = 5)

}, silent = TRUE)

```

| | |
|----------------|---|
| fhir_serialize | <i>Serialize a fhir_bundle, fhir_bundle_list or fhir_resource</i> |
|----------------|---|

Description

Serializes FHIR bundles or resources to allow for saving in .rda or .RData format without losing integrity of pointers i.e. it turns a [fhir_bundle_xml/fhir_resource_xml](#) object into an [fhir_bundle_serialized/fhir_resource_serialized](#) object.

Usage

```

fhir_serialize(bundles)

## S4 method for signature 'fhir_bundle_xml'
fhir_serialize(bundles)

## S4 method for signature 'fhir_bundle_serialized'
fhir_serialize(bundles)

## S4 method for signature 'fhir_bundle_list'
fhir_serialize(bundles)

## S4 method for signature 'fhir_resource_xml'
fhir_serialize(bundles)

## S4 method for signature 'fhir_resource_serialized'
fhir_serialize(bundles)

```

Arguments

bundles A [fhir_bundle](#), [fhir_bundle_list](#) or [fhir_resource](#) object.

Value

A [fhir_bundle_xml](#), [fhir_bundle_list](#) or [fhir_resource_xml](#) object.

Examples

```
#example bundles are serialized, unserialize like this:
bundles <- fhir_unserialize(medication_bundles)

#Serialize like this:
bundles_for_saving <- fhir_serialize(bundles)

#works also on single bundles
fhir_serialize(bundles[[1]])
```

fhir_table_description

Create [fhir_table_description](#) object

Description

A `fhir_table_description` holds the information [fhir_crack\(\)](#) needs to flatten (aka crack) FHIR resources from a FHIR bundle. There should be one `fhir_table_description` per resource type as [fhir_crack\(\)](#) will create one `data.frame/data.table` per resource type in a bundle. See [Details](#).

Usage

```
fhir_table_description(
  resource,
  cols = fhir_columns(),
  sep = " ::: ",
  brackets = character(),
  rm_empty_cols = FALSE,
  format = "compact",
  keep_attr = FALSE,
  style = deprecated()
)
```

Arguments

| | |
|----------|--|
| resource | A character vector of length one or fhir_resource_type object indicating which resource type should be extracted. |
| cols | Optional. A fhir_columns object or something that can be coerced to one, like a (named) character vector, a (named) list containing xpath expressions, or a fhir_xpath_expression object. See fhir_columns() and the examples. If this |

| | |
|----------------------------|--|
| | argument is omitted, an empty <code>fhir_columns</code> object will be supplied. This means that in the call to <code>fhir_crack()</code> , all available elements are extracted in put in automatically named columns. |
| <code>sep</code> | A character of length one containing the separator string used for separating multiple entries in cells when <code>format = "compact"</code> . ignored when <code>format = "wide"</code> . Defaults to <code>":::"</code> . |
| <code>brackets</code> | A character of length one or two used for the indices of multiple entries. The first one is the opening bracket and the second one the closing bracket. Vectors of length one will be recycled. Defaults to <code>character(0)</code> , i.e. no brackets, meaning that multiple entries won't be indexed. |
| <code>rm_empty_cols</code> | A logical of length one indicating whether empty columns should be removed from the resulting table or not. Defaults to <code>FALSE</code> . |
| <code>format</code> | A character of length one indicating whether the resulting table should be cracked to a "wide" or "compact" format. "wide" means multiple entries will be distributed over several columns with indexed names. "compact" means multiple entries will be pasted into one cell/column separated by <code>sep</code> . Defaults to "compact". |
| <code>keep_attr</code> | A logical of length one indicating whether the attribute name of the respective element (<code>@value</code> in most cases) should be attached to the name of the variable in the resulting table. Defaults to <code>FALSE</code> . |
| <code>style</code> | [Deprecated] |

Details

A `fhir_table_description` consists of the following elements:

- The resource element: Defines the resource type (e.g. Patient or Observation). See `fhir_resource_type()`.
- The cols element: Contains the column names and XPath expressions defining the columns to extract. If this element is empty, `fhir_crack()` will extract all available elements of the resource and name the columns automatically. See `fhir_columns()`.
- The sep element: A character of length one containing the separator string used for separating multiple entries in cells.
- The brackets element: A character of length one or two used for the indices of multiple entries. The first one is the opening bracket and the second one the closing bracket. Vectors of length one will be recycled. Defaults to `character(0)`, i.e. no brackets, meaning that multiple entries won't be indexed.
- The rm_empty_cols element: A logical of length one indicating whether empty columns should be removed in the resulting table or not. Defaults to `FALSE`.
- The format element: A character of length one indicating whether the resulting table should be cracked to a wide or compact format. wide means multiple entries will be distributed over several columns with indexed names. compact means multiple entries will be pasted into one cell/column separated by `sep`. Defaults to `compact`.
- The keep_attr element: A logical of length one indicating whether the attribute name of the respective element (`@value` in most cases) should be attached to the name of the variable in the resulting table. Defaults to `FALSE`.

A full fhir_table_description looks for example like this:

```
fhir_resource_type: Patient

fhir_columns:
column name | xpath expression
-----
name        | name/family
gender      | gender
id          | id

sep:         ':::'
brackets:    '[' , ']
rm_empty_cols: FALSE
format:      'compact'
keep_attr:   FALSE
```

Value

An object of class [fhir_table_description](#).

Examples

```
# a minimal table description
fhir_table_description(
  resource = "Patient"
)

# named list for cols
fhir_table_description(
  resource = "Patient",
  cols     = list(
    id     = "id",
    name   = "name/family",
    gender = "gender"
  )
)

#unnamed character for cols, colnames are generated automatically
fhir_table_description(
  resource = "Patient",
  cols     = c(
    "id",
    "name/family",
    "gender"
  )
)

# named character for cols, and overwritten default for other arguments
fhir_table_description(
  resource = "Patient",
```

```

    cols = c(
      id          = "id",
      name        = "name/family",
      gender      = "gender"
    ),
    brackets     = c("[", "]"),
    rm_empty_cols = TRUE,
    format       = "wide"
  )

# no column arguments is given -> creates a column for all available elements
fhir_table_description(
  resource = "Patient",
  sep      = " <~> ",
  brackets = c("<<<", ">>>"),
  rm_empty_cols = FALSE,
  format       = "wide"
)

```

fhir_table_description-class

A S4 class describing the form of a table produced by [fhir_crack\(\)](#)

Description

A `fhir_table_description` holds the information `fhir_crack()` needs to flatten (aka crack) FHIR resources from a FHIR bundle and is created with its constructor function `fhir_table_description()`. Each `fhir_table_description` describes a table for a specific resource type as `fhir_crack()` will create one `data.frame`/`data.table` per resource type. See Details.

Details

A `fhir_table_description` consists of the following elements:

- The `resource` element: Defines the resource type (e.g. Patient or Observation). See `fhir_resource_type()`.
- The `cols` element: Contains the column names and XPath expressions defining the columns to extract. If this element is empty, `fhir_crack()` will extract all available elements of the resource and name the columns automatically. See `fhir_columns()`.
- The `sep` element: A character of length one containing the separator string used for separating multiple entries in cells.
- The `brackets` element: A character of length one or two used for the indices of multiple entries. The first one is the opening bracket and the second one the closing bracket. Vectors of length one will be recycled. Defaults to `character(0)`, i.e. no brackets, meaning that multiple entries won't be indexed.
- The `rm_empty_cols` element: A logical of length one indicating whether empty columns should be removed in the resulting table or not. Defaults to `FALSE`.

- The `format` element: A character of length one indicating whether the resulting table should be cracked to a wide or compact format. `wide` means multiple entries will be distributed over several columns with indexed names. `compact` means multiple entries will be pasted into one cell/column separated by `sep`. Defaults to `compact`.
- The `keep_attr` element: A logical of length one indicating whether the attribute name of the respective element (`@value` in most cases) should be attached to the name of the variable in the resulting table. Defaults to `FALSE`.

A full `fhir_table_description` looks for example like this:

```
fhir_resource_type: Patient

fhir_columns:
column name | xpath expression
-----
name        | name/family
gender      | gender
id          | id

sep:         ':::'
brackets:    '[' , ']
rm_empty_cols: FALSE
format:      'compact'
keep_attr:   FALSE
```

Slots

- `resource` An object of class `fhir_resource_type` defining the resource type that should be extracted.
- `cols` An object of class `fhir_columns` describing which columns should be created and how. If this is an empty `fhir_columns` object, the call to `fhir_crack()` will extract all available elements and put them in automatically named columns.
- `sep` A character of length one containing the separator string used for separating multiple entries in cells when `format = "compact"`. ignored when `format = "wide"`.
- `brackets` A character of length one or two used for the indices of multiple entries. The first one is the opening bracket and the second one the closing bracket. Vectors of length one will be recycled. Defaults to `character(0)`, i.e. no brackets, meaning that multiple entries won't be indexed.
- `rm_empty_cols` A logical of length one indicating whether empty columns should be removed from the resulting table or not. Defaults to `FALSE`.
- `format` A character of length one indicating whether the resulting table should be cracked to a wide or compact format. `wide` means multiple entries will be distributed over several columns with indexed names. `compact` means multiple entries will be pasted into one cell/column separated by `sep`. Defaults to `compact`.
- `keep_attr` A logical of length one indicating whether the attribute name of the respective element (`@value` in most cases) should be attached to the name of the variable in the resulting table. Defaults to `FALSE`.

See Also

[fhir_resource_type\(\)](#), [fhir_columns\(\)](#), [fhir_design\(\)](#), [fhir_crack\(\)](#)

fhir_tree

Represent a wide cast table as a tree

Description

This function takes a wide table as created by [fhir_crack\(\)](#) with `format="wide"` and creates the tree structure implicit in the column names of the tables. It is useful to get an overview over the implied structure when planning to create FHIR bundles from this table using [fhir_build_bundle\(\)](#).

Usage

```
fhir_tree(
  table,
  brackets,
  resource = "Resource",
  keep_attr = FALSE,
  keep_ids = FALSE,
  skip_one = FALSE,
  format = "plain",
  prompt = ": "
)
```

Arguments

| | |
|-----------|--|
| table | A data.frame or data.table as produced by fhir_crack() with <code>format="wide"</code> or fhir_cast() |
| brackets | A character vector of length two. The brackets used in the table. |
| resource | A character vector of length one or fhir_resource_type object indicating which resource type the table is build from. |
| keep_attr | A logical vector of length one indicating whether attributes should be displayed or not. Only used for formats "plain" and "fancy". |
| keep_ids | A logical vector of length one indicating whether indices should be displayed or not. Only used for formats "plain" and "fancy". |
| skip_one | A logical vector of length one indicating whether first index 1 should be displayed or not. Only used for formats "plain" and "fancy". |
| format | The format of the tree. One of "plain", "fancy" or "xml". |
| prompt | A character vector of length one use as prompt Only used for formats "plain" and "fancy". |

Value

A string that can be used with `cat()` or can be written to a text file.

See Also

[fhir_cast\(\)](#), [fhir_build_bundle\(\)](#)

Examples

```
#' #unserialize example
bundles <- fhir_unserialize(bundles = example_bundles1)

#crack fhir resources
table_desc <- fhir_table_description(
  resource = "Patient",
  brackets = c("[", "]"),
  sep      = " ",
  format   = "wide"
)

df <- fhir_crack(bundles = bundles, design = table_desc)

###show tree

#plain format
cat(fhir_tree(
  table = df,
  brackets = c("[", "]"),
  resource = "Patient"
)
)

#fancy format with indices
cat(fhir_tree(
  table = df,
  brackets = c("[", "]"),
  resource = "Patient",
  format = "fancy",
  keep_ids = TRUE
)
)

#xml format
cat(fhir_tree(
  table = df,
  brackets = c("[", "]"),
  resource = "Patient",
  format = "xml"
)
)
```

Description

Unserializes FHIR resources or bundles that have been serialized to allow for saving in .rda or .RData format, i.e. it turns a `fhir_bundle_serialized/fhir_resource_serialized` object into an `fhir_bundle_xml/fhir_resource_xml` object.

Usage

```
fhir_unserialize(bundles)

## S4 method for signature 'fhir_bundle_xml'
fhir_unserialize(bundles)

## S4 method for signature 'fhir_bundle_serialized'
fhir_unserialize(bundles)

## S4 method for signature 'fhir_resource_xml'
fhir_unserialize(bundles)

## S4 method for signature 'fhir_resource_serialized'
fhir_unserialize(bundles)

## S4 method for signature 'fhir_bundle_list'
fhir_unserialize(bundles)
```

Arguments

`bundles` A `fhir_bundle`, `fhir_bundle_list` or `fhir_resource` object.

Value

A `fhir_bundle_serialized`, `fhir_bundle_list` or `fhir_resource_serialized` object.

Examples

```
#unserialize bundle list
fhir_unserialize(patient_bundles)

#unserialize single bundle
fhir_unserialize(patient_bundles[[1]])
```

fhir_url

Create FHIR URL

Description

This function creates an object of class `fhir_url` which mostly represents a URL-encoded URL for a FHIR search request. A valid Search URL contains a base URL and a resource type and may contain additional search parameters. For more info on FHIR search see <https://www.hl7.org/fhir/search.html>.

Usage

```
fhir_url(url, resource, parameters, url_enc = TRUE)

## S4 method for signature 'character,missing,missing'
fhir_url(url, url_enc = TRUE)

## S4 method for signature 'character,character,missing'
fhir_url(url, resource, url_enc = TRUE)

## S4 method for signature 'character,character,character'
fhir_url(url, resource, parameters, url_enc = TRUE)

## S4 method for signature 'character,character,list'
fhir_url(url, resource, parameters, url_enc = TRUE)
```

Arguments

| | |
|------------|---|
| url | A character of length one specifying either the full search request, e.g. "http://hapi.fhir.org/baseR4" or the base URL to the FHIR server, e.g. "http://hapi.fhir.org/baseR4". |
| resource | A character of length one or fhir_resource_type object with the resource type to be searched, e.g. "Patient". |
| parameters | Optional. Either a length 1 character containing properly formatted FHIR search parameters, e.g. "gender=male&_summary=count" or a named list or named character vector e.g. list(gender="male", "_summary"="count") or c(gender="male", "_summary"="count"). Note that parameter names beginning with _ have to be put in quotation marks! |
| url_enc | Should the url be URL-encoded? Defaults to TRUE. |

Details

You can use this function in two ways. If you provide just one string in the argument url with the full FHIR search request, this string will be taken as a full FHIR search request. If you also provide the arguments resource and/or parameters, the string in url will be taken as the base url of your FHIR server and the arguments will be concatenated appropriately to form the full request. See examples.

Note that only the latter approach does a validity check on the resource type!

You can disable URL-encoding by setting url_enc=FALSE.

Value

An object of class [fhir_url](#)

Examples

```
#provide full FHIR search request
fhir_url(url = "http://hapi.fhir.org/baseR4/Patient?gender=male&_summary=count")

#provide base url and resource type
```

```

fhir_url(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient"
)

#parameters in one string
fhir_url(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient",
  parameters = "gender=male&_summary=count"
)

#parameters as a named character
fhir_url(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient",
  parameters = c("gender" = "male", "_summary" = "count")
)

#parameters as a named list
fhir_url(
  url      = "http://hapi.fhir.org/baseR4",
  resource = "Patient",
  parameters = list("gender" = "male", "_summary" = "count")
)

```

fhir_url-class *An S4 object to represent a URL for a FHIR server*

Description

Objects of this class are basically strings (character vectors of length one) representing a URL. They are usually url encoded. See [fhir_url\(\)](#) for how to build them.

fhir_xpath_expression *Create fhir_xpath_expression*

Description

This function takes a character vector, checks whether it contains valid XPath (1.0) expressions and returns it as an `fhir_xpath_expression` object. These objects are used in `fhir_parameters` objects.

Usage

```
fhir_xpath_expression(expression)
```

Arguments

expression A character vector of the XPath expressions

Value

A XPath expression object

Examples

```
fhir_xpath_expression(c("//Patient", "name/given"))
```

fhir_xpath_expression-class

An S4 class for xpath_expressions Objects of this class are essentially character vectors, but can only be valid XPath (1.0) expressions. They are mostly used in the fhir_columns class.

Description

An S4 class for xpath_expressions Objects of this class are essentially character vectors, but can only be valid XPath (1.0) expressions. They are mostly used in the fhir_columns class.

medication_bundles *Exemplary FHIR bundles*

Description

These data examples can be used to explore some of the functions from the fhircrackr package when direct access to a FHIR server is not possible.

All example data sets are [fhir_bundle_lists](#) containing [fhir_bundle_serialized](#) objects representing FHIR bundles as returned by [fhir_search\(\)](#). They have to be unserialized (once per R session), before you can work with them!

Usage

medication_bundles

patient_bundles

Format

An object of class fhir_bundle_list of length 3.

An object of class fhir_bundle_list of length 2.

Details

medication_bundles contains 3 bundles with MedicationStatement resources representing Medications with Snomed CT code 429374003 and the respective Patient resources that are linked to these MedicationStatements.

patient_bundles contains 2 bundles with Patient resources.

Source

The data sets are generated by the following code:

medication_bundles (*Downloaded 10-05-21*)

```
search_request <- fhir_url(url = "https://hapi.fhir.org/baseR4",
  resource = "MedicationStatement",
  parameters = c("code" = "http://snomed.info/ct|429374003",
    "_include" = "MedicationStatement:subject"))
```

```
bundles <- fhir_search(request = search_request, max_bundles = 3)
```

```
medication_bundles <- fhir_serialize(bundles = bundles)
```

patient_bundles (*Downloaded 10-05-21*)

```
bundles <- fhir_search(request="https://hapi.fhir.org/baseR4/Patient",
  max_bundles=2,
  verbose = 0)
```

```
patient_bundles <- fhir_serialize(bundles = bundles)
```

Examples

```
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = medication_bundles)
```

```
#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = patient_bundles)
```

pastep

Concatenate paths

Description

Concatenates two or more strings to a path string correctly.

Usage

```
pastep(..., list_of_paths = NULL, ext = NULL)
```

Arguments

... A Set of Path Strings. Only works if list_of_paths is NULL
 list_of_paths Either a vector or a list of paths strings
 ext An Extension to add at the end of the path

Value

A Character of length one, the combined path.

Examples

```
paste0('a', 'b', 'c', 'd')
paste0(list_of_paths = list(paste0('/', letters, '/'), as.character(1:13)))
paste0(list_of_paths = c(letters, as.character(1:13)))
paste0(list_of_paths = c(letters, as.character(1:13)), ext = '.txt')
paste0(list_of_paths = c(letters, as.character(1:13)), ext = '_dat.txt')
```

| | |
|-------------|------------------------------|
| paste_paths | <i>Concatenate two paths</i> |
|-------------|------------------------------|

Description

Concatenates two strings to a path string correctly.

Usage

```
paste_paths(path1 = "w", path2 = "d", os = "Linux")
```

Arguments

path1 A a character vector of length one specifying the left hand part of the resulting path.
 path2 A a character vector of length one specifying the right hand part of the resulting path.
 os A a character vector of length one specifying the operating system you're operating on: windows or linux.

Value

A a character vector of length one containing the concatenated path.

Examples

```
paste_paths(path1 = "data", path2 = "patients")
paste_paths(path1 = "/data", path2 = "patients")
paste_paths(path1 = "/data/", path2 = "patients")
paste_paths(path1 = "/data", path2 = "/patients")
paste_paths(path1 = "/data/", path2 = "/patients/")
paste_paths(path1 = "data", path2 = "patients", os = "windows")
```

transaction_bundle_example

Toy examples to POST/PUT on a server

Description

These data examples are simple examples to try out POSTing/PUTing resources to a server. See **Source** for how the xml versions look.

Usage

transaction_bundle_example

example_resource1

example_resource2

example_resource3

Format

An object of class fhir_bundle_serialized of length 1277.

An object of class fhir_resource_serialized of length 267.

An object of class fhir_resource_serialized of length 290.

An object of class fhir_resource_serialized of length 608.

Details

transaction_bundle_example contains 1 transaction bundle with 2 Patient resources.

example_resource1 contains 1 patient resource without id for POSTing

example_resource2 contains 1 patient resource with id for PUTing

example_resource3 contains 1 Medication resource with an id xml attribute

Source

transaction_bundle_example

```
<Bundle>
  <type value='transaction' />
  <entry>
    <resource>
      <Patient>
        <id value='id1' />
        <address>
          <use value='home' />
```

```
        <city value='Amsterdam' />
        <type value='physical' />
        <country value='Netherlands' />
    </address>
    <name>
        <given value='Marie' />
    </name>
</Patient>
</resource>
<request>
    <method value='POST' />
    <url value='Patient' />
</request>
</entry>
<entry>
    <resource>
        <Patient>
            <id value='id3' />
            <address>
                <use value='home' />
                <city value='Berlin' />
            </address>
            <address>
                <use value='work' />
                <city value='London' />
                <type value='postal' />
                <country value='England' />
            </address>
            <address>
                <type value='postal' />
                <country value='France' />
            </address>
            <name>
                <given value='Frank' />
            </name>
            <name>
                <given value='Max' />
            </name>
        </Patient>
    </resource>
    <request>
        <method value='POST' />
        <url value='Patient' />
    </request>
</entry>
</Bundle>
```

example_resource1

```

<Patient>
  <name>
    <given value = 'Marie' />
  </name>
  <gender value = 'female' />
  <birthDate value = '1970-01-01' />
</Patient>

```

example_resource2

```

<Patient>
  <id value = '1a2b3c' />
  <name>
    <given value = 'Marie' />
  </name>
  <gender value = 'female' />
  <birthDate value = '1970-01-01' />
</Patient>

```

example_resource3

```

<Medication>
  <code>
    <coding>
      <system value="http://www.nlm.nih.gov/research/umls/rxnorm"/>
      <code value="1594660"/>
      <display value="Alemtuzumab 10mg/ml (Lemtrada)"/>
    </coding>
  </code>
  <ingredient id="1">
    <itemReference>
      <reference value="Substance/5463"/>
    </itemReference>
  </ingredient>
  <ingredient id="2">
    <itemReference>
      <reference value="Substance/3401"/>
    </itemReference>
  </ingredient>
</Medication>

```

Examples

```

#unserialize xml objects before doing anything else with them!
fhir_unserialize(bundles = transaction_bundle_example)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(example_resource1)
#unserialize xml objects before doing anything else with them!
fhir_unserialize(example_resource2)

```

```
#unserialize xml objects before doing anything else with them!  
fhir_unserialize(example_resource3)
```

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