

Package ‘valh’

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Type Package

Title Interface Between R and the OpenStreetMap-Based Routing Service
'Valhalla'

Version 0.2.0

Description An interface between R and the 'Valhalla' API. 'Valhalla' is a routing service based on 'OpenStreetMap' data.
See <<https://valhalla.github.io/valhalla/>> for more information.
This package enables the computation of routes, trips, isochrones and travel distances matrices (travel time and kilometer distance).

License GPL (>= 3)

Imports jsonlite, googlePolylines, curl, utils, sf

Depends R (>= 3.5.0)

Suggests knitr, rmarkdown, tinytest

URL <https://github.com/riatelab/valh>

BugReports <https://github.com/riatelab/valh/issues>

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valh	<i>Shortest Paths and Travel Time with the OpenStreetMap-Based Routing Service Valhalla</i>
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Description

An interface between R and the Valhalla API.

Valhalla is a routing service based on OpenStreetMap data. See <https://valhalla.github.io/valhalla/> for more information.

This package enables the computation of routes, trips, isochrones and travel distances matrices.

- **vl_matrix**: Build and send Valhalla API queries to get travel time matrices between points. This function interfaces the *matrix* Valhalla service.
- **vl_route**: Build and send a Valhalla API query to get the travel geometry between two points. This function interfaces with the *route* Valhalla service.
- **vl_optimized_route**: Build and send a Valhalla API query to get the shortest travel geometry between multiple unordered points. This function interfaces the *optimized_route* Valhalla service. Use this function to resolve the travelling salesman problem.
- **vl_locate**: Build and send an Valhalla API query to get the nearest point on the street network. This function interfaces the *locate* Valhalla service.
- **vl_isochrone**: This function computes areas that are reachable within a given time span (or road distance) from a point and returns the reachable regions as polygons. These areas of equal travel time are called isochrones. This function interfaces the *isochrone & isodistance* Valhalla service.
- **vl_elevation**: Build and send a Valhalla API query to get the elevation at a set of input locations. This function interfaces with the *height* Valhalla service.
- **vl_status**: Build and send a Valhalla API query to get information on the Valhalla server (version etc.). This function interfaces with the *status* Valhalla service.

Note

This package relies on the usage of a running Valhalla service (tested with versions 3.4.x & 3.5.x of Valhalla).

To use a custom Valhalla instance, you just need to change the `valh.server` option to the url of the instance :

```
options(valh.server = "http://address.of.the.server/")
```

You can also set this option in your `.Rprofile` file to make it permanent.

The package ships a sample dataset of 100 random pharmacies in Berlin (© OpenStreetMap contributors - <https://www.openstreetmap.org/copyright/en>).

The `sf` dataset uses the projection WGS 84 / UTM zone 34N (EPSG:32634).

The `csv` dataset uses WGS 84 (EPSG:4326).

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See Also

Useful links:

- <https://github.com/riatelab/valh>
- Report bugs at <https://github.com/riatelab/valh/issues>

vl_elevation

Get elevation along a route

Description

Build and send a Valhalla API query to get the elevation at a set of input locations.

This function interfaces with the *height* service.

If `sampling_dist` is provided, the elevation is sampled at regular intervals along the input locations.

Usage

```
vl_elevation(loc, sampling_dist, server = getOption("valh.server"))
```

Arguments

loc	one (or multiples) point(s) at which to get elevation. loc can be: <ul style="list-style-type: none"> • a vector of coordinates (longitude and latitude, WGS 84), • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT.
sampling_dist	distance between each point to sample the elevation (in meters). Default is no sampling.
server	URL of the Valhalla server.

Value

An sf POINT object is returned with the following fields: 'distance' (the distance from the first points), 'height' (the sampled height on the DEM) and 'geometry' (the geometry of the sampled point).

Examples

```
## Not run:
# Inputs are data frames
apotheke.df <- read.csv(system.file("csv/apotheke.csv", package = "valh"))
# The first 5 points
pts <- apotheke.df[1:5, c("lon", "lat")]
# Ask for the elevation at these points
elev1 <- vl_elevation(loc = pts)

# Inputs are sf points
library(sf)
apotheke.sf <- st_read(system.file("gpkg/apotheke.gpkg", package = "valh"),
  quiet = TRUE
)
# The first 5 points
pts2 <- apotheke.sf[1:5, ]
# Ask for the elevation at these points
elev2 <- vl_elevation(loc = pts2)
# Ask for elevation between the first and the second points,
# sampling every 100 meters
elev3 <- vl_elevation(loc = apotheke.sf[1:2, ], sampling_dist = 100)
# Plot the corresponding elevation profile
plot(as.matrix(st_drop_geometry(elev3)), type = "l")

# Input is a route (sf LINESTRING) from vl_route
# Compute the route between the first and the second points
library(sf)
apotheke.sf <- st_read(system.file("gpkg/apotheke.gpkg", package = "valh"),
  quiet = TRUE
)
src <- apotheke.sf[1, ]
```

```

dst <- apotheke.sf[2, ]
route <- vl_route(src = src, dst = dst)

# Split the LINESTRING into its composing points
pts_route <- sf::st_cast(route, "POINT")
# Ask for the elevation at these points
elev4 <- vl_elevation(loc = pts_route)

# Plot the elevation profile
plot(as.matrix(st_drop_geometry(elev4)), type = "l")

## End(Not run)

```

vl_isochrone

Get isochrones and isodistances from a point

Description

Build and send a Valhalla API query to get isochrones or isodistances from a point.

This function interfaces with the *Isochrone & Isodistance* service.

Note that you must provide either 'times' or 'distances' to compute the isochrones at given times or distances from the center point.

Usage

```

vl_isochrone(
  loc,
  times,
  distances,
  costing = "auto",
  costing_options = list(),
  server = getOption("valh.server")
)

```

Arguments

loc	one point from which to compute isochrones. loc can be: <ul style="list-style-type: none"> • a vector of coordinates (longitude and latitude, WGS 84), • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT.
times	vector of travel times (in minutes) to compute the isochrones. The maximum number of isochrones is 4. The minimal value must be greater than 0.
distances	vector of travel distances (in kilometers) to compute the isochrones. The maximum number of isochrones is 4. The minimal value must be greater than 0.

costing costing model to use.

costing_options list of options to use with the costing model (see <https://valhalla.github.io/valhalla/api/turn-by-turn/api-reference/#costing-options> for more details about the options available for each costing model).

server URL of the Valhalla server.

Value

An sf MULTIPOLYGON object is returned with the following fields: 'metric' (the metric used, either 'time' or 'distance') and 'contour' (the value of the metric).

Examples

```
## Not run:
# Inputs are data frames
apotheke.df <- read.csv(system.file("csv/apotheke.csv", package = "valh"))

# Extract the first point and compute isochrones at 3, 6, 9 and 12 kilometers,
# using the "auto" costing model
pt1 <- apotheke.df[1, c("lon", "lat")]
iso1 <- vl_isochrone(loc = pt1, distances = c(3, 6, 9, 12), costing = "auto")

# Inputs are sf points
library(sf)
apotheke.sf <- st_read(system.file("gpkg/apotheke.gpkg", package = "valh"),
  quiet = TRUE
)
# Extract the first point and compute isochrones at 15, 30, 45 and 60 minutes
# using the "bicycle" costing model
pt2 <- apotheke.sf[1, ]
iso2 <- vl_isochrone(loc = pt2, times = c(15, 30, 45, 60), costing = "bicycle")

## End(Not run)
```

vl_locate

Get the nearest point on the road network

Description

This function interfaces with the *locate* Valhalla service.

Usage

```
vl_locate(
  loc,
  verbose = FALSE,
  costing = "auto",
```

```

    costing_options = list(),
    server = getOption("valh.server")
  )

```

Arguments

loc	one (or multiples) point(s) to snap to the street network. loc can be: <ul style="list-style-type: none"> • a vector of coordinates (longitude and latitude, WGS 84), • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT.
verbose	logical indicating whether to return additional information.
costing	costing model to use.
costing_options	list of options to use with the costing model (see https://valhalla.github.io/valhalla/api/turn-by-turn/api-reference/#costing-options for more details about the options available for each costing model).
server	URL of the Valhalla server.

Value

If there is only one input point, return a single sf object containing the nearest point(s) on the road network. If there is more than one input point, return a list of sf objects, one for each input point.

Examples

```

## Not run:
# Inputs are data frames
apotheker.df <- read.csv(system.file("csv/apotheke.csv", package = "valh"))

loc <- apotheker.df[1, c("lon", "lat")]

# Ask for the nearest point on the road network at this point
# using "auto" costing model
on_road_1 <- vl_locate(loc = loc)

# Inputs are sf points
library(sf)
apotheker.sf <- st_read(system.file("gpkg/apotheke.gpkg", package = "valh"),
  quiet = TRUE
)

# Ask for one point
locsf1 <- apotheker.sf[1, ]
# The result is a single sf object
on_road_2 <- vl_locate(loc = locsf1)

# Ask for multiple points

```

```

locsf2 <- apotheker.sf[1:3, ]
# The result is a list of sf objects
on_road_3 <- vl_locate(loc = locsf2)

## End(Not run)

```

vl_matrix

Get Travel Time Matrices Between Points

Description

Build and send Valhalla API queries to get travel time matrices between points.

This function interfaces the *matrix* Valhalla service.

Use *src* and *dst* to set different origins and destinations. Use *loc* to compute travel times or travel distances between all points.

Usage

```

vl_matrix(
  src,
  dst,
  loc,
  costing = "auto",
  costing_options = list(),
  server = getOption("valh.server")
)

```

Arguments

<i>src</i>	<p>origin points. <i>src</i> can be:</p> <ul style="list-style-type: none"> • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT. <p>If relevant, row names are used as identifiers.</p>
<i>dst</i>	<p>destination. <i>dst</i> can be:</p> <ul style="list-style-type: none"> • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT. <p>If relevant, row names are used as identifiers.</p>
<i>loc</i>	<p>points. <i>loc</i> can be:</p> <ul style="list-style-type: none"> • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84),

- an sfc object of type POINT,
- an sf object of type POINT.

If relevant, row names are used as identifiers.

costing costing model to use.

costing_options list of options to use with the costing model (see <https://valhalla.github.io/valhalla/api/turn-by-turn/api-reference/#costing-options> for more details about the options available for each costing model).

server URL of the Valhalla server.

Value

The output of this function is a list composed of one or two matrices and 2 data.frames

- durations: a matrix of travel times (in minutes)
- distances: a matrix of distances (in specified units, default to kilometers)
- sources: a data.frame of the coordinates of the points actually used as starting points (EPSG:4326 - WGS84)
- destinations: a data.frame of the coordinates of the points actually used as destinations (EPSG:4326 - WGS84)

Examples

```
## Not run:
# Inputs are data frames
apotheke.df <- read.csv(system.file("csv/apotheke.csv", package = "valh"))
# Travel time matrix
distA <- vl_matrix(loc = apotheke.df[1:50, c("lon", "lat")])
# First 5 rows and columns
distA$durations[1:5, 1:5]

# Travel time matrix with different sets of origins and destinations
distA2 <- vl_matrix(
  src = apotheke.df[1:10, c("lon", "lat")],
  dst = apotheke.df[11:20, c("lon", "lat")]
)
# First 5 rows and columns
distA2$durations[1:5, 1:5]

# Inputs are sf points
library(sf)
apotheke.sf <- st_read(system.file("gpkg/apotheke.gpkg", package = "valh"),
  quiet = TRUE
)
distA3 <- vl_matrix(loc = apotheke.sf[1:10, ])
# First 5 rows and columns
distA3$durations[1:5, 1:5]

# Travel time matrix with different sets of origins and destinations
```

```

distA4 <- vl_matrix(src = apotheke.sf[1:10, ], dst = apotheke.sf[11:20, ])
# First 5 rows and columns
distA4$durations[1:5, 1:5]

## End(Not run)

```

vl_optimized_route *Get the Optimized Route Between Multiple Points*

Description

Build and send a Valhalla API query to get the optimized route (and so a solution to the Traveling Salesman Problem) between multiple points.

This function interfaces with the *optimized_route* Valhalla service.

Usage

```

vl_optimized_route(
  loc,
  end_at_start = FALSE,
  costing = "auto",
  costing_options = list(),
  server = getOption("valh.server")
)

```

Arguments

loc	starting point and waypoints to reach along the route. loc can be: <ul style="list-style-type: none"> • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT. <p>The first row or element is the starting point. Row names, if relevant, or element indexes are used as identifiers.</p>
end_at_start	logical indicating whether the route should end at the first point (making the trip a loop).
costing	costing model to use.
costing_options	list of options to use with the costing model (see https://valhalla.github.io/valhalla/api/turn-by-turn/api-reference/#costing-options for more details about the options available for each costing model).
server	URL of the Valhalla server.

Value

a list of two elements:

- summary: a list whose elements are a summary of the trip (duration, distance, presence of tolls, highways, time restrictions and ferries),
- shape: an sf LINESTRING of the optimized route.

Examples

```
## Not run:
# Inputs are data frames
apotheke.df <- read.csv(system.file("csv/apotheke.csv", package = "valh"))
pts1 <- apotheke.df[1:6, c("lon", "lat")]

# Compute the optimized route between the first 6 points
# (starting point, 4 waypoints and final destination), by bike
trip1a <- vl_optimized_route(loc = pts1, end_at_start = FALSE, costing = "bicycle")

# Compute the optimized route between the first 6 points returning to the
# starting point, by bike
trip1b <- vl_optimized_route(loc = pts1, end_at_start = TRUE, costing = "bicycle")

# Inputs are sf points
library(sf)
apotheke.sf <- st_read(system.file("gpkg/apotheke.gpkg", package = "valh"),
  quiet = TRUE
)
pts2 <- apotheke.sf[1:6, ]
# Compute the optimized route between the first 6 points
# (starting point, 4 waypoints and final destination)
trip2a <- vl_optimized_route(loc = pts2, end_at_start = FALSE, costing = "auto")

# Compute the optimized route between the first 6 points, returning to the
# starting point
trip2b <- vl_optimized_route(loc = pts2, end_at_start = TRUE, costing = "auto")

## End(Not run)
```

vl_route

Get the Shortest Path Between Two Points

Description

Build and send a Valhalla API query to get the travel geometry between two points.

This function interfaces with the *route* Valhalla service.

Use *src* and *dst* to get the shortest direct route between two points. Use *loc* to get the shortest route between two points using ordered waypoints.

Usage

```
vl_route(
  src,
  dst,
  loc,
  costing = "auto",
  costing_options = list(),
  server = getOption("valh.server")
)
```

Arguments

- | | |
|-----------------|---|
| src | <p>starting point of the route. src can be:</p> <ul style="list-style-type: none"> • a vector of coordinates (longitude and latitude, WGS 84), • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT. <p>If relevant, row names are used as identifiers.
If src is a data.frame, a matrix, an sfc object or an sf object then only the first row or element is considered.</p> |
| dst | <p>destination of the route. dst can be:</p> <ul style="list-style-type: none"> • a vector of coordinates (longitude and latitude, WGS 84), • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT. <p>If relevant, row names are used as identifiers.
If dst is a data.frame, a matrix, an sfc object or an sf object then only the first row or element is considered.</p> |
| loc | <p>starting point, waypoints (optional) and destination of the route. loc can be:</p> <ul style="list-style-type: none"> • a data.frame of longitudes and latitudes (WGS 84), • a matrix of longitudes and latitudes (WGS 84), • an sfc object of type POINT, • an sf object of type POINT. <p>The first row or element is the starting point then waypoints are used in the order they are stored in loc and the last row or element is the destination.
If relevant, row names are used as identifiers.</p> |
| costing | costing model to use. |
| costing_options | list of options to use with the costing model (see https://valhalla.github.io/valhalla/api/turn-by-turn/api-reference/#costing-options for more details about the options available for each costing model). |
| server | URL of the Valhalla server. |

Value

The output of this function is an sf `LINestring` of the shortest route.
It contains 4 fields:

- starting point identifier
- destination identifier
- travel time in minutes
- travel distance in kilometers.

Examples

```
## Not run:
# Inputs are data frames
apotheker.df <- read.csv(system.file("csv/apotheker.csv", package = "valh"))
src <- apotheker.df[1, c("lon", "lat")]
dst <- apotheker.df[2, c("lon", "lat")]
# Route between the two points, using bicycle costing model
route1 <- vl_route(src = src, dst = dst, costing = "bicycle")

# Inputs are sf points
library(sf)
apotheker.sf <- st_read(system.file("gpkg/apotheker.gpkg", package = "valh"),
  quiet = TRUE
)
srcsf <- apotheker.sf[1, ]
dstsf <- apotheker.sf[2, ]
# Route between the two points, using bicycle costing model and a custom
# costing option
route2 <- vl_route(
  src = srcsf,
  dst = dstsf,
  costing = "bicycle",
  costing_options = list(cycling_speed = 19)
)

## End(Not run)
```

vl_status

Get Valhalla Service Status

Description

Use this function to return information on the Valhalla server (version etc.).
This function interfaces with the *Status* Valhalla service.

Usage

```
vl_status(server = getOption("valh.server"), verbose = FALSE)
```

Arguments

server	URL of the Valhalla server.
verbose	if TRUE and if the service has it enabled, it will return additional information about the loaded tileset.

Value

A list with information on the Valhalla service is returned.

Examples

```
## Not run:  
vl_status("https://valhalla1.openstreetmap.de/", verbose = FALSE)  
  
## End(Not run)
```

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