Geospatial Data Carpentry Workshop for Urbanism: : **CHEATSHEET**

Basics

USING LIBRARIES

```
install.packages("here")
library(here)
```

ASSIGNMENT

```
x <- "apple"
```

DATA TYPES

as.character(x)	"1" , "2", "one"	Character strings
as.numeric(x)	1, 2, 1	Numbers
as.logical(x)	TRUE, FALSE, T	Boolean
as.factor(x)	"1", "2", "1" Levels: "1", "2"	Strings with preset levels

VECTORS

Function **c()** joins elements of the same data type:

```
c(1, 2, 4, 5)
c(y, x)
```

Combine vectors to create a new one

Missing values

is.na(x)	Is missing
!is.na(x)	Not missing

EXPLORE DATASETS

head(df,n)	First **n** rows of dataset **df**
summary(df)	Summary stats of **df**
nrow(df)	Number of rows in **df**
ncol(df)	Number of columns in **df**

Rbanism
Reproducibility. Automation. Scalability.

Data manipulation

DPLYR

Pipes

x %>% f(y) or **x |> f(y)**
becomes **f(x,y)**

SUBSET

df %>% **select**(variables)	Select columns by name.
df %>% **filter**(condition)	Extract rows meeting logical condition

CREATE NEW VARIABLE

```
df %>%
mutate(x=mean(y))
```

Compute new columns

SUMMARISE

```
df %>%
summarize(x=mean(y))
```

Summarize data into summary table

GROUP CASES

to create summaries by category

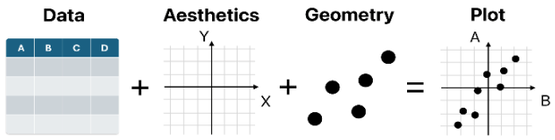
```
df %>%
group_by(variable) %>%
summarize(x=mean(y)) %>%
ungroup()
```

Remove grouping

Data visualization

GGPLOT2

ggplot2 is based on the grammar of graphics - idea that plots are build based on three components: data set, coordinate system, and geoms—visual marks that represent data points.



data

aesthetics

```
ggplot(dataset,
       aes(x=variable) +
       geom_histogram()
```

geometry

The **geom_** functions define shape of a plot.

SCATTER PLOT
ggplot(df, aes(x = var1, y = var2) +
geom_point()

HISTOGRAM
ggplot(df, aes(x = var1) +
geom_histogram()

BAR CHART
ggplot(df, aes(x = var1, y = var2) +
geom_col()

TITLES AND LABELS

labs() function allows naming axes, adding titles and useful legend names

```
plot1 +
labs( title = "Plot title",
      subtitle = "Plot subtitle"
       x  = "Axis X",
       y = " Axis Y",
      color = "Legend title ")
```

Vector data

SF BASICS

st_read(dsn, layer, ...) Read file or database vector dataset as a sf object

st_geometry_type(x, by_geometry = TRUE) Return the geometry type of an object

st_crs(x, …) Set or retrieve coordinate reference system (CRS) from an sf object

Long output with all CRS info

Short output with specific parts of CRS

st_crs(x, …)$Name – Get CRS name
st_crs(x, …)$epsg – Get EPSG code

st_bbox(obj, ...) Return bounding box of an sf object as an object of class bbox with xmin, ymin, xmax and ymax values

st_transform(x, crs, ...) Convert coordinates of an sf, sfc, sfg or bbox object

st_length(x, ...) Compute the length of a LINESTRING or MULTILINESTRING geometry in a projected CRS like Amersfoort / RD New (EPSG:28992)

st_write(obj, dsn, layer = NULL, ...) Write sf object to file

VISUALISING SF OBJECTS

geom_sf() visualise sf objects with ggplot2

coord_sf() ensures that all layers use the same CRS, either specified with the crs parameter or taken automatically from the first layer that defines a CRS

sf object

No need to specify x and y

```
ggplot(data) +
 geom_sf() +
 coord_sf(datum = st_crs(28992))
```

rainbow(n) Create a vector of n colors, optionally customized with the palette parameter (e.g., palette = "viridis")

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Raster Data

TERRA BASICS

describe(x, ...) Describe the properties
of spatial data in a file.

rast(x, nrows, ncols,…) Create a SpatRaster, from scratch, from a filename, or from another object.

summary(x, …) Compute summary statistics (min, max, mean, and quartiles). A sample of cells is used for very large files.

values(x,…) Get the cell values of a SpatRaster or the attributes of a SpatVector.

DATA WRANGLING

If TRUE, coordinates are included

as.data.frame(x, xy=FALSE, geom, na.rm=NA, …) Coerce a SpatRaster or SpatVector to a data.frame.

minmax(x, …) and **setminmax**(x, …) Get or compute the min and max cell values.

nlyr(x, …) Get the number of rows (**nrow**), columns (**ncol**), cells (**ncell**), layers (**nlyr**), resolution (**res**), and other dimensions of a SpatRaster.

ext(x,…) Get a SpatExtent of a SpatRaster, SpatVector, or other spatial objects.

PROJECTIONS

crs(x, …) Get or set the coordinate reference system of a SpatRaster or SpatVector.

project(x, y, …) Change the coordinate reference system ("project") of a SpatVector, SpatRaster or a matrix with coordinates.

PLOT

plotRGB(x,filename,…) Make a Red-Green-Blue plot based on three layers in a SpatRaster.

EXPORT

writeRaster(x,filename,…) Write a SpatRaster to a file.

Visualisation

ggplot2::geom_raster(x, aes(fill=z), …) Draw a raster plot.

ggplot2::coord_equal(ratio = 1, xlim = NULL, ylim = NULL, …) Cartesian coordinates with fixed "aspect ratio"

Terrain.colors(n, alpha, rev=FALSE) Create a vector of n contiguous colors

Open Street Map

BOUNDING BOX

With the OSMdata package, it is possible to geocode a spatial text using the Nominatim API. The function `getbb` returns the coordinates of its bounding box: xmin, xmax, ymin and ymax.

```
osmdata::getbb("place name")
```

OVERPASS QUERY

To extract and download Open Street Map (OSM) data into R, we access the Overpass API using a query, to which we add OSM features defined by hierarchical tags called keys and values. To download data about greenhouses for example, the key is "building" and the value "greenhouse".

```
osmdata::opq(bbox) |>
  add_osm_feature(key, value)|>
  osmdata_sf()
```

Format of resulting object (sf object)

The result of this query can contain **points**, **lines** and/or **polygons**, each described by a data frame.

Interactive mapping

The **leaflet** package provides a way to create map with interactive features such as zoom, popups, image overlay, etc.


```
leaflet(x) |>
  addTiles() |>
  addPolygons()
```

Background map

Added geometries from x

Geoprocessing

BUFFER

A buffer corresponds to a circular polygon around an 'x' feature with a specified distance 'dist'

```
sf::st_buffer(x,dist)
```

UNION

A union corresponds to the combination of polygons by removing internal boundaries

```
sf::st_union(x,y,...) |>
  sf::st_cast(to = "POLYGON") |>
  sf::st_as_sf()
```

Format of resulting object

Type of resulting object

CENTROID

A centroid corresponds to the centre of mass of a geometric object.

Disables geographic projection

```
sf::sf_use_s2(FALSE)
sf::st_centroid(x) |>
  sf::st_transform(.,crs)
```

Reproject the resulting object

INTERSECT / INTERSECTION

'Intersect' tests whether geometric objects x and y intersect each other. 'Intersection' performs the intersection and returns an object of the same type as x.

```
sf::st_intersection(x,y)
```

AREA

Computation of the area of a set of features x

Specifies area unit

```
sf::st_area(x) |>
  units::set_units(., km^2)
```

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