# Operations With Raster Data II

HES 505 Fall 2022: Session 12

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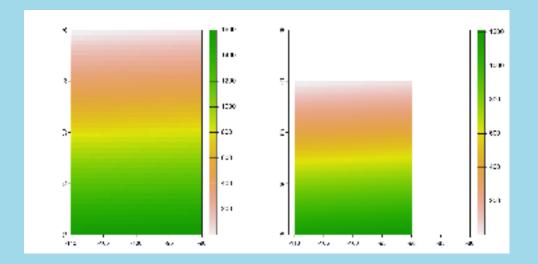
# Objectives

- By the end of today, you should be able to:
  - Access and manipulate cell values
  - Generate new rasters using mathematical functions
  - Summarize rasters using global functions
  - Generate new rasters describing the spatial context of individual cells

# **Revisiting Projections**

# Revisiting Projections

- resample transfers values between SpatRaster objects that do not align
- Must have same crs



```
1 origin(a)
[1] 0 0
1 origin(b)
[1] 0.1382979 0.0000000
1 origin(w)
[1] 0.1382979 0.0000000
1 res(a)
[1] 0.5 0.5
1 res(b)
[1] 0.3297872 0.1612903
1 res(w)
[1] 0.3297872 0.1612903
```

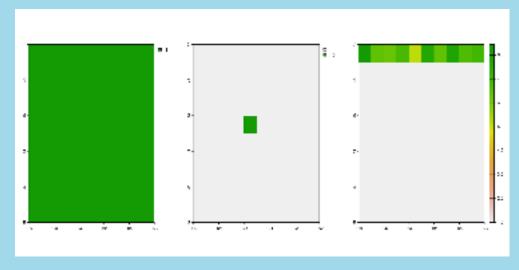
# Revisiting Projections

• if origin and extent are the same consider using aggregate, disagg, extend or crop

# Cell-wise operations

# Accessing Cell Values

We can extract or change cell values using []



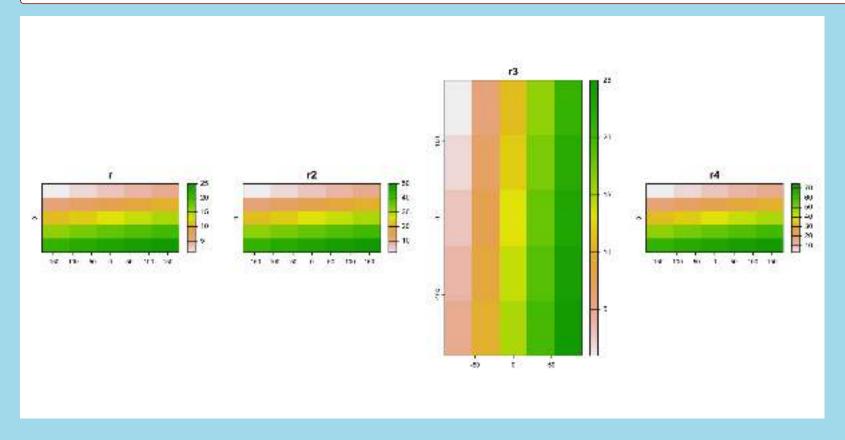
#### Raster Math

- Performs cell-wise calculations on 1 (or more)

  SpatRasters
- Generally works the same as matrix operations
- All layers must be aligned

#### Raster Math

```
1 r <- rast(ncol=5, nrow=5)
2 values(r) <- 1:ncell(r)
3 r2 <- r*2
4 r3 <- t(r)
5 r4 <- r + r2</pre>
```

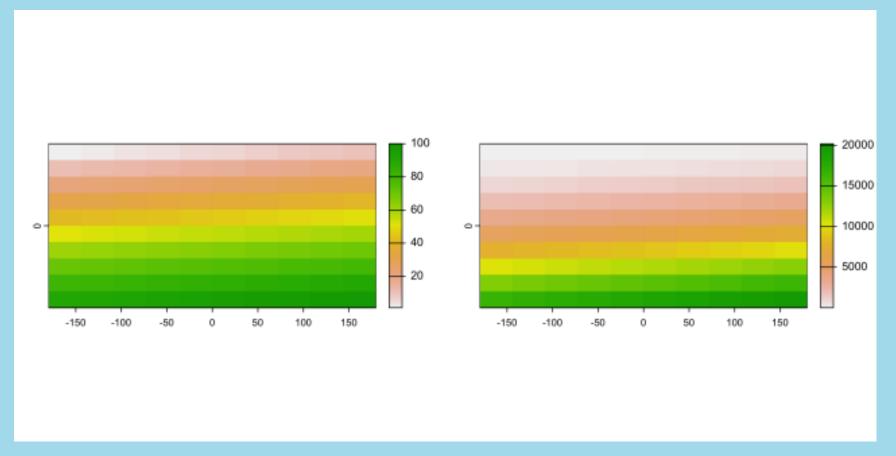


# Cell-wise operations

- terra has a special set of apply functions
- app, lapp, tapp
- app applies a function to the values of each cell
- lapp applies a function using the layer as the value
- tapp applies the function to a subset of layers

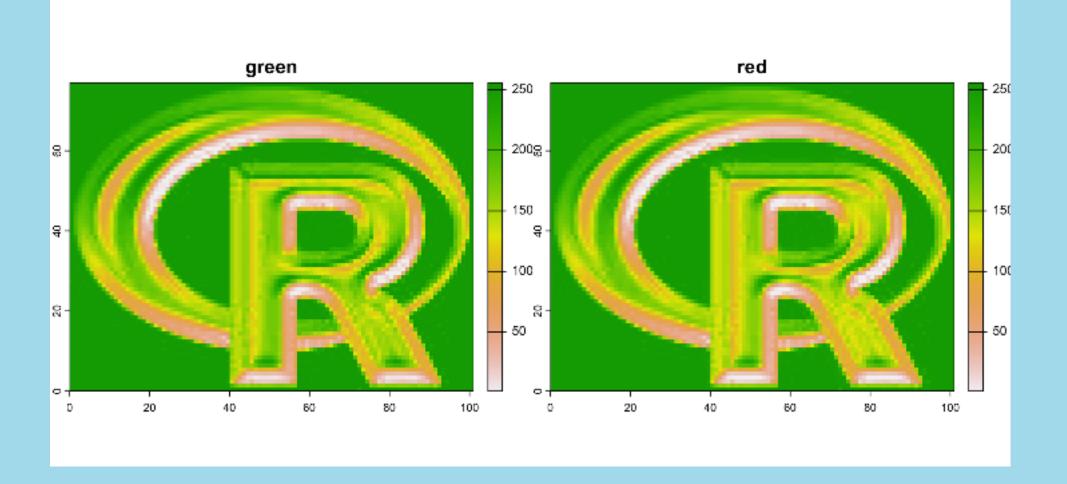
## Cell-wise operations

```
1 r <- rast(ncols=10, nrows=10)
2 values(r) <- 1:ncell(r)
3 f <- function(i) (i+1) * 2 * i + sqrt(i)
4 s <- app(r, f)</pre>
```



# Cell-wise Operations

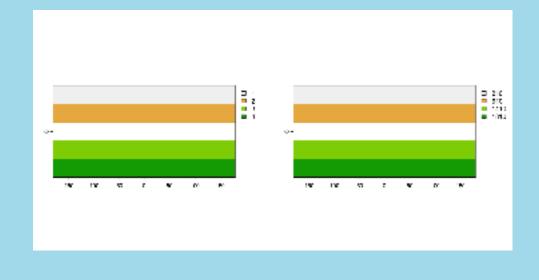
```
1 s <- rast(system.file("ex/logo.tif", package="terra")) + 1
2 ss <- s[[2:1]]
3
4 fvi <- function(x, y){ (x - y ) / (x + y) }
5 x <- lapp(ss, fun=fvi)</pre>
```



#### **Global Methods**

- Provide summaries of 1 or more layers
- Use zonal to extract values from one layer based on categorical layer

```
1 r <- rast(ncols=10, nrows=10)
2 values(r) <- 1:ncell(r)
3 z <- rast(r)
4 values(z) <- rep(c(1:2, NA, 3:4),
5 names(z) <- "zone"
6 a <- zonal(r, z, "sum", na.rm=TRU
7 b <- zonal(r, z, "sum", na.rm=TRU
8 plot(b)</pre>
```





### Context-specific Functions

- distance and relatives are based on relationships between cells
- focal provides moving windows for smoothing data
- terrain allows calculation of slope, ruggedness, aspect using elevation rasters
- shade calculates hillshade based on terrain

# Using focal

- focal requires a window (w) or weights matrix
- na.policy determines how to deal with NAs in the smoother
- fillvalue and expand tell terra what to do at the edges

```
1 r <- rast(ncols=10, nrows=10, ext(0, 10, 0, 10))
2 values(r) <- 1:ncell(r)
3
4 f <- focal(r, w=3, fun=function(x, ...) quantile(x, c(.25, .5, .75), ...),
5 plot(f)</pre>
```

# Using focal

