Updating spatialLIBD
From SingleCellExperiment to VisiumExperiment classes

spatialLIBD version 1.1.7

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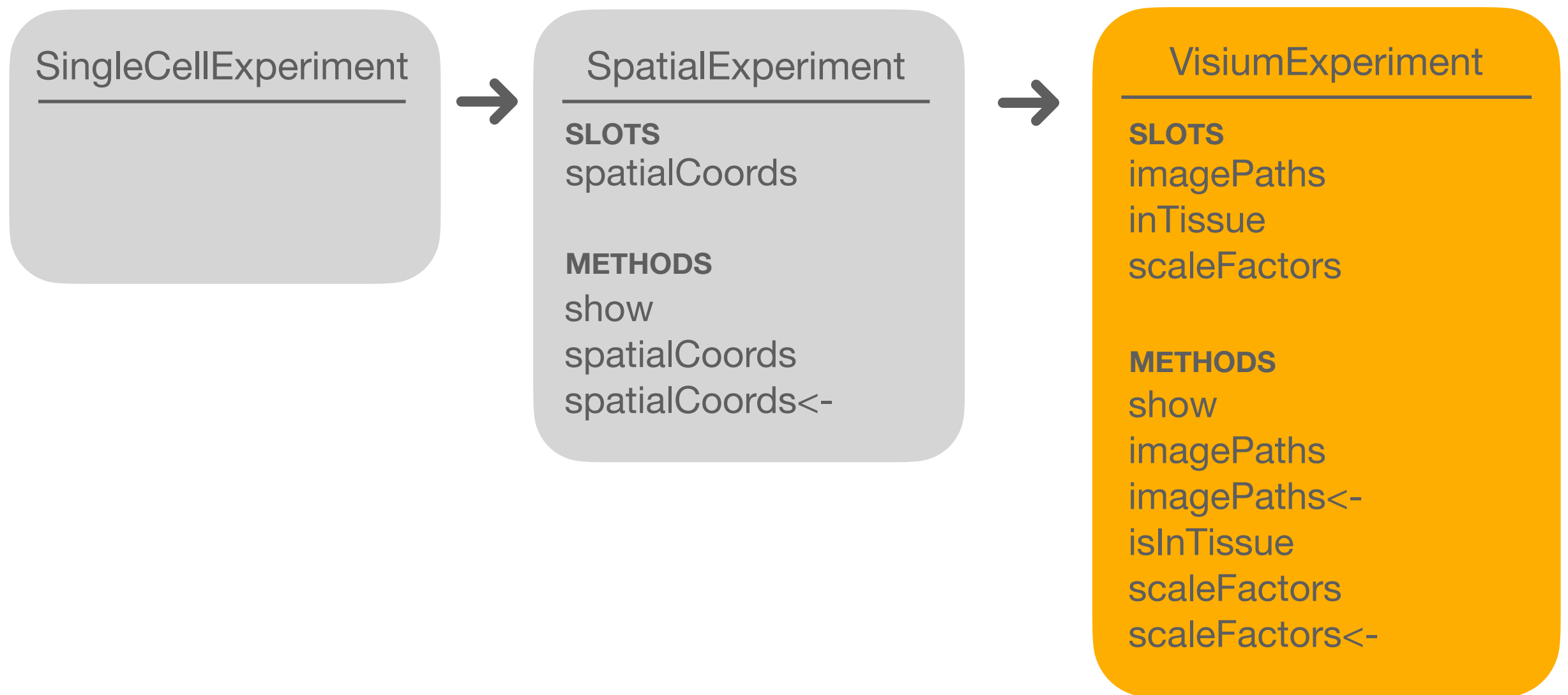bpardo99

LIBD

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VisiumExperiment class contains new attributes and methods

SingleCellExperiment → **SpatialExperiment**

SLOTS
spatialCoords

METHODS
show
spatialCoords
spatialCoords<-

→ **VisiumExperiment**

SLOTS
imagePaths
inTissue
scaleFactors

METHODS
show
imagePaths
imagePaths<-
isInTissue
scaleFactors
scaleFactors<-

Before starting

Install spatialLIBD

```r
if (!requireNamespace("BiocManager", quietly = TRUE)) {
    install.packages("BiocManager")
  }


BiocManager::install("spatialLIBD")
```

Load packages

```r
library("spatialLIBD")
```

Downloading DLPFC data contained in a VisiumExperiment object

- Retrieving data with fetch_data( )

```
## Connect to ExperimentHub
ehub <- ExperimentHub::ExperimentHub()
## Download ve object
ve <- fetch_data(type = "ve", eh = ehub)
```

Downloading DLPFC data contained in a VisiumExperiment object

- sce_to_ve( ) takes data from sce and rearranges it to the structure of VisiumExperiment class

```r
#Download data in a SingleCellExperiment object
if (!exists("sce")) sce <- fetch_data("sce")
#Subset data
sce_sub <- sce[, sce$sample_name == "151673"]
#Make the SingleCellExperiment object a VisiumExperiment one
ve_sub <- sce_to_ve(sce_sub)
```

Downloading DLPFC data contained in a VisiumExperiment object

- ve object structure

```
ve
```

```
## class: VisiumExperiment
## dim: 33538 47681
## metadata(0):
## assays(2): counts logcounts
## rownames(33538): ENSG00000243485 ENSG00000237613 ... ENSG00000277475
##    ENSG00000268674
## rowData names(9): source type ... gene_search is_top_hvg
## colnames(47681): AAACAACGAATAGTTC-1 AAACAAGTATCTCCCA-1 ...
##    TTGTTTCCATACAACT-1 TTGTTTGTGTAAATTC-1
## colData names(66): Cluster height ... pseudobulk_UMAP_spatial
##    markers_UMAP_spatial
## reducedDimNames(6): PCA TSNE_perplexity50 ... TSNE_perplexity80
##    UMAP_neighbors15
## altExpNames(0):
## spatialCoordinates(7): Cell_ID sample_name ... pxl_row_in_fullres
##    pxl_col_in_fullres
## inTissue(1): 47681
## imagePaths(12):
##    /Users/brendapardo/Library/Caches/BiocFileCache/6e17e40d5ec_151507
_tissue_lowres_image.png
##    /Users/brendapardo/Library/Caches/BiocFileCache/6e134363fac_151508
_tissue_lowres_image.png
##    ...
##    /Users/brendapardo/Library/Caches/BiocFileCache/6e17b9ee30f_151675
_tissue_lowres_image.png
##    /Users/brendapardo/Library/Caches/BiocFileCache/6e17c4d2d30_151676
_tissue_lowres_image.png
```

Storing and retrieving scale factors from a VisiumExperiment object

- scaleFactors contains
  - a list with the required four scale factors names.
  - a fifth list element with the full list of scale factors for all our samples.

```
#Get scale factors
scaleFactors(ve)
```

```
## $spot_diameter_fullres
## [1] 96.37511
##
## $tissue_hires_scalef
## [1] 0.150015
##
## $fiducial_diameter_fullres
## [1] 144.5627
##
## $tissue_lowres_scalef
## [1] 0.0450045
##
## $all_images
## $all_images$`151507`
## $all_images$`151507`$spot_diameter_fullres
## [1] 96.37511
##
## $all_images$`151507`$tissue_hires_scalef
## [1] 0.150015
##
## $all_images$`151507`$fiducial_diameter_fullres
## [1] 144.5627
##
## $all_images$`151507`$tissue_lowres_scalef
## [1] 0.0450045
##
```

Storing and retrieving scale factors from a VisiumExperiment object

- update_scaleFactors( ) generates a VisiumExperiment object with updated scale factors for a given input sample ID

```
## Check the default scale factors
scaleFactors(ve)[1:4]
```

```
## $spot_diameter_fullres
## [1] 96.37511
##
## $tissue_hires_scalef
## [1] 0.150015
##
## $fiducial_diameter_fullres
## [1] 144.5627
##
## $tissue_lowres_scalef
## [1] 0.0450045
```

Storing and retrieving scale factors from a VisiumExperiment object

- update_scaleFactors( ) generates a VisiumExperiment object with updated scale factors for a given input sample ID

```
## Replace them for those for the second image and check them
ve <- update_scaleFactors(ve, "151508")
scaleFactors(ve)[1:4]
```

```
## $spot_diameter_fullres
## [1] 96.36957
##
## $tissue_hires_scalef
## [1] 0.150015
##
## $fiducial_diameter_fullres
## [1] 144.5543
##
## $tissue_lowres_scalef
## [1] 0.0450045
```

Visualizing the histology image from a VisiumExperiment object

- Tissue images are downloaded at the moment ve is created in sce_to_ve
  - Paths in imagePaths have to be local

```
imagePaths(ve)[1:2]
```

```
##
                      151507
## "/Users/brendapardo/Library/Caches/BiocFileCache/6e17e40d5ec_15150
7_tissue_lowres_image.png"
##
                      151508
## "/Users/brendapardo/Library/Caches/BiocFileCache/6e134363fac_15150
8_tissue_lowres_image.png"
```

Visualizing the histology image from a VisiumExperiment object

- read_image() makes possible to give geom_spatial( ) a VisiumExperiment object
  - It takes the image path of the desired samples, creates the grobs and puts them on a tibble

```
## Extract data from a sample (with ID 151507)
sample_id <- "151507"
ve_sub <- ve[, SpatialExperiment::spatialCoords(ve)$sample_name == sa
mple_id]
sample_df <- as.data.frame(SpatialExperiment::spatialCoords(ve_sub))

## Plot with geom_spatial
ggplot2::ggplot(
  sample_df,
  ggplot2::aes(
    x = imagecol,
    y = imagerow,
  )
) +
geom_spatial(
  data = read_image(ve_sub, sample_id),
  ggplot2::aes(grob = grob),
  x = 0.5,
  y = 0.5
)
```
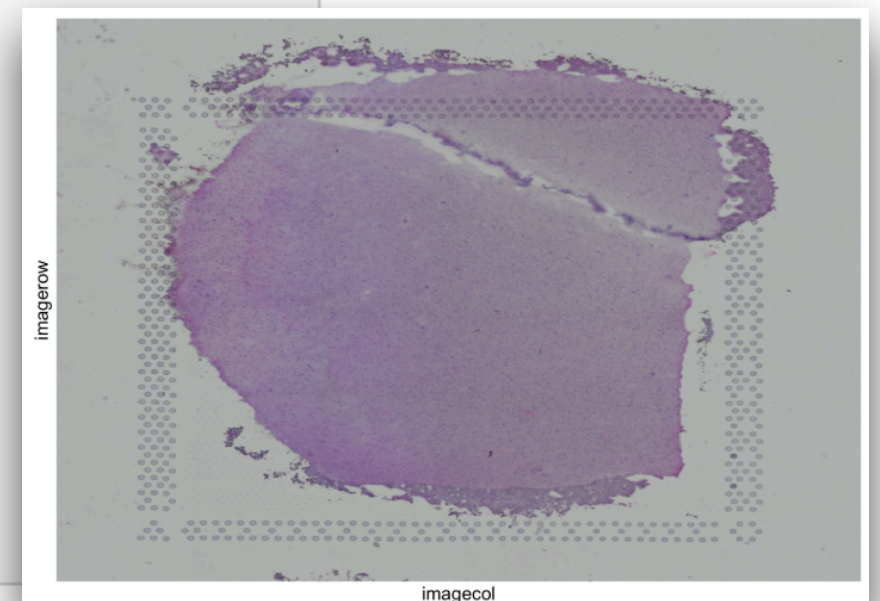
Making other functions compatible with VisiumExperiment class

- ve_image_colData( ) generates an input data frame for sce_image_clus_p( ) and sce_image_gene_p( ).

```r
## Use the data previously extracted for a sample
## Prepare the data for the plotting function
df <- colData(ve_sub)
df$COUNT <- df$expr_chrM_ratio

sce_image_gene_p(
  sce = ve_sub,
  d = df,
  sampleid = sample_id,
  title = "151507 chrM expr ratio",
  spatial = FALSE
)
```


151507 chrM expr ratio
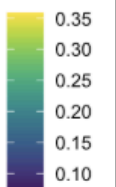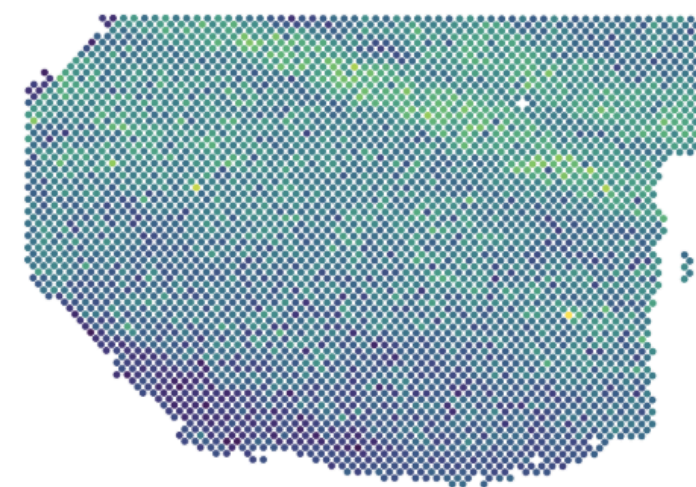
Making other functions compatible with VisiumExperiment class

- sce_image_gene( ), sce_image_clus( ), sce_image_grid( ) and sce_image_grid_gene( ) access sample IDs from the slot spatialCoords.

```
sce_image_gene(
    sce = ve_sub,
    sampleid = sample_id,
    spatial = TRUE
)
```
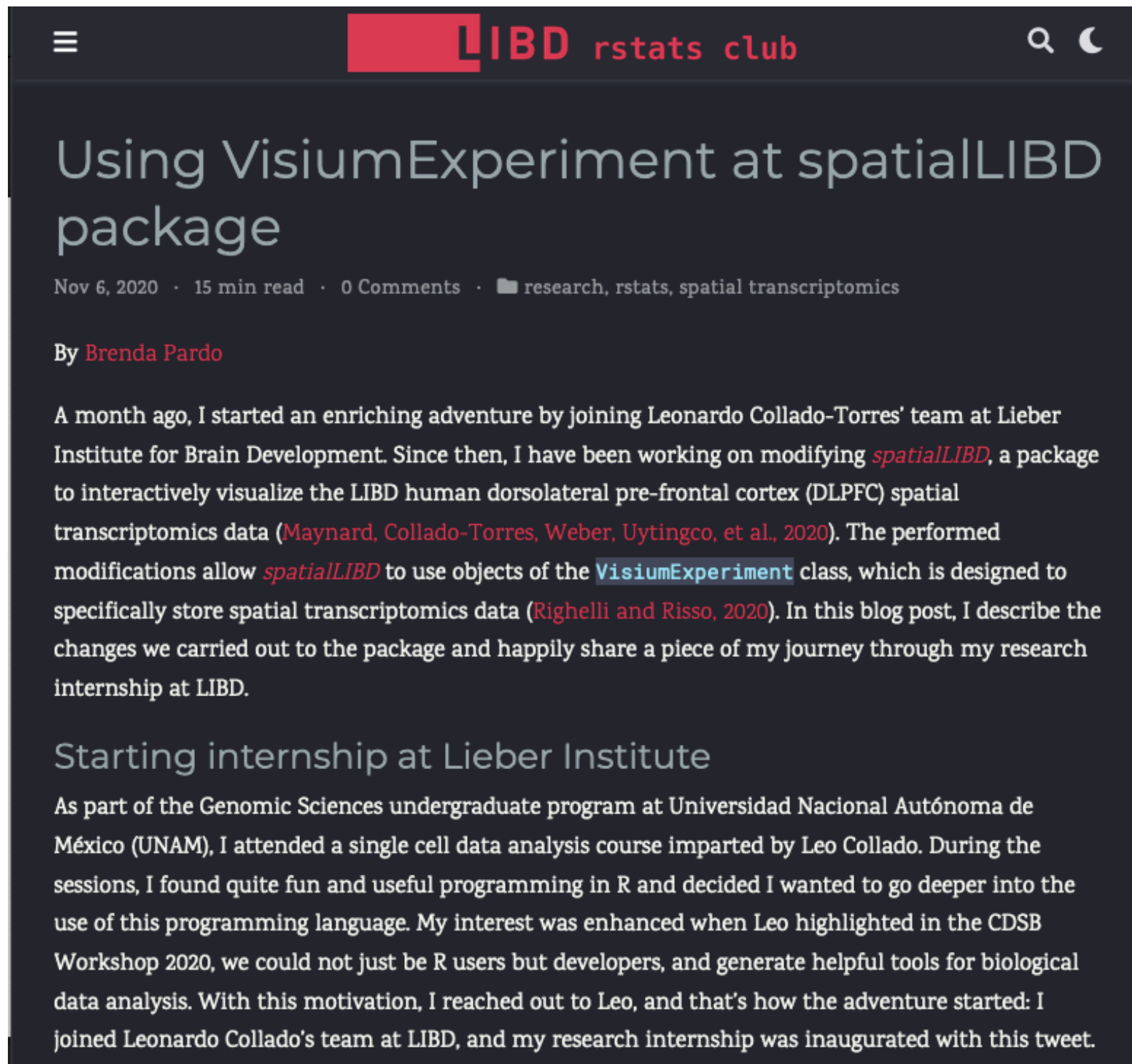

151507 SCGB2A2; ENSG00000110484
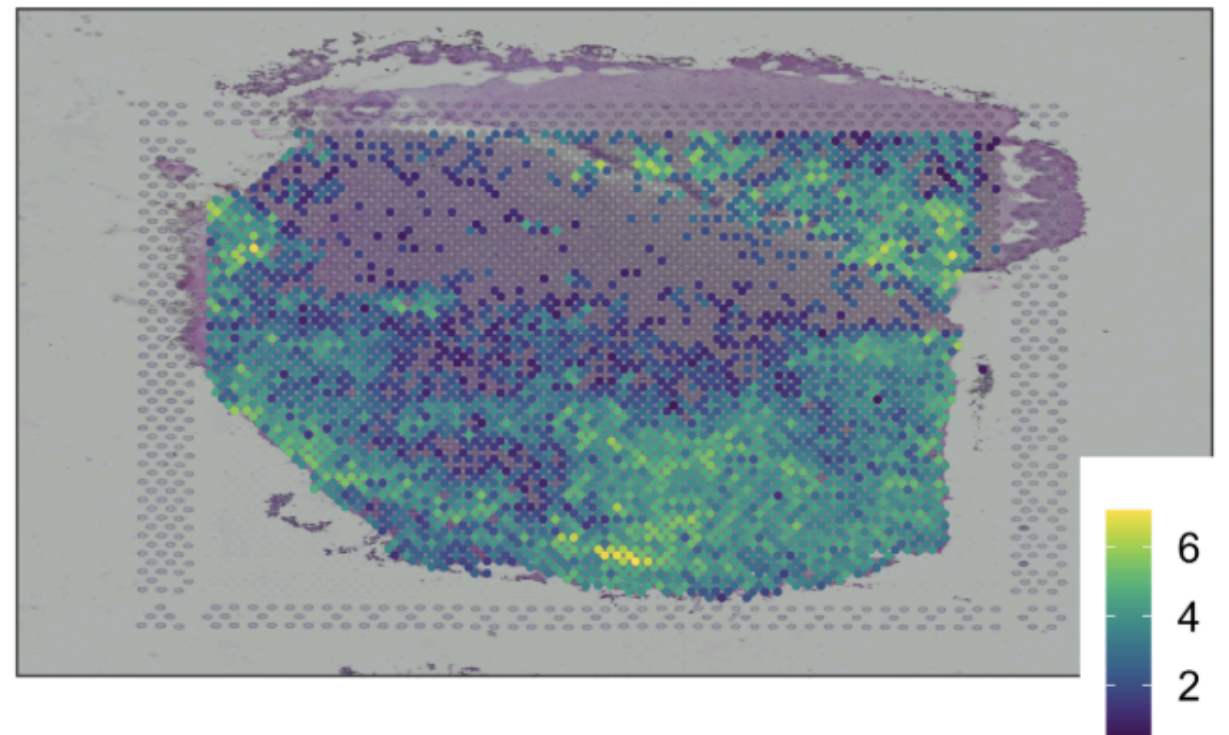
logcounts min > 0

Blog post at LIBD rstats club

Check it out here!

http://research.libd.org/rstatsclub/2020/11/06/using-visiumexperiment-at-spatiallibd-package/#starting-internship-at-lieber-institute