Tutorial of Wheatmap

Contents

This is a tutorial on the usage of wheatmap for generating complex heatmaps in a procedure way.

A heatmap is easy to generate in R. There are many packages like heatmap2, heatmap3, heatmap.plus and ComplexHeatmaps. But many times, I found myself in a situation of plotting a set of heatmaps in a procedure way. And none-of the above packages are nimble enough to allow multiple heatmaps be positioned arbitrarily. So I wrote this package for that purpose.

Preparation

We start with some data

```r
library(devtools)
load_all('~/tools/wheatmap/wheatmap/')
```

```
## Loading wheatmap
```

```r
m <- cbind(matrix(rnorm(20),nrow=4), 5+matrix(rnorm(8),nrow=4))
m2 <- matrix(1:16,nrow=4)
dimnames(m) <- list(c('w','x','y','z'), c('a','b','c','d','e','f','g'))
row.data <- c(1,2,3,1)
col.data <- c(1:6,6)
m
```

```
##            a           b          c           d          e        f
## w 0.01448724 -0.97094289 -1.2643950  0.05775565 -0.4449571 6.570336
## x 1.13970893 -0.02276648 -0.1234149  0.30418903 -0.4610230 3.962738
## y 0.51602821  0.61757695  1.3678379 -0.49323250 -0.4636941 6.203882
## z 1.26813753  1.10795336 -1.4284009  0.39511403  1.6599175 5.253850
##          g
## w 4.315276
## x 6.096808
## y 4.417195
## z 5.068353
```

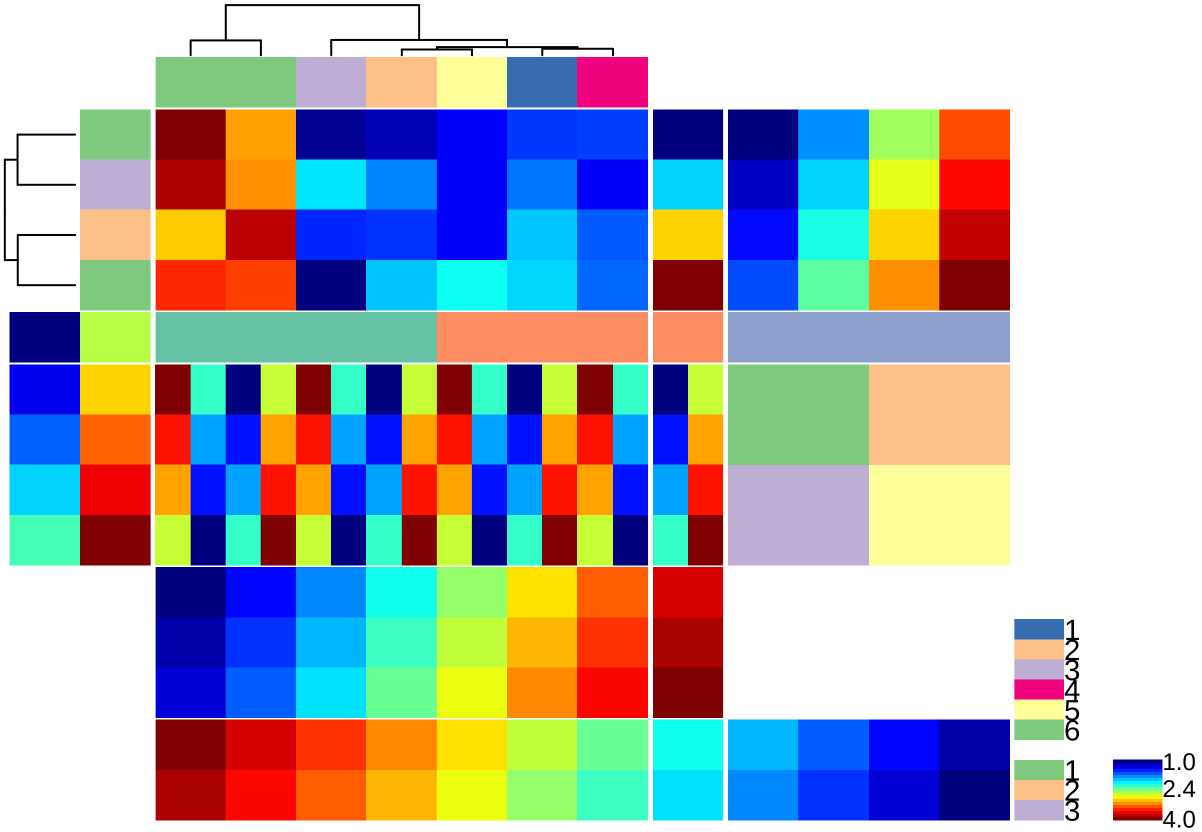
We perform some clustering

```
cc <- both.cluster(m)
row.data <- row.data[cc$row.clust$order]
col.data <- col.data[cc$column.clust$order]
```

Final results

The end result of our tutorial can be done by the “one”-liner

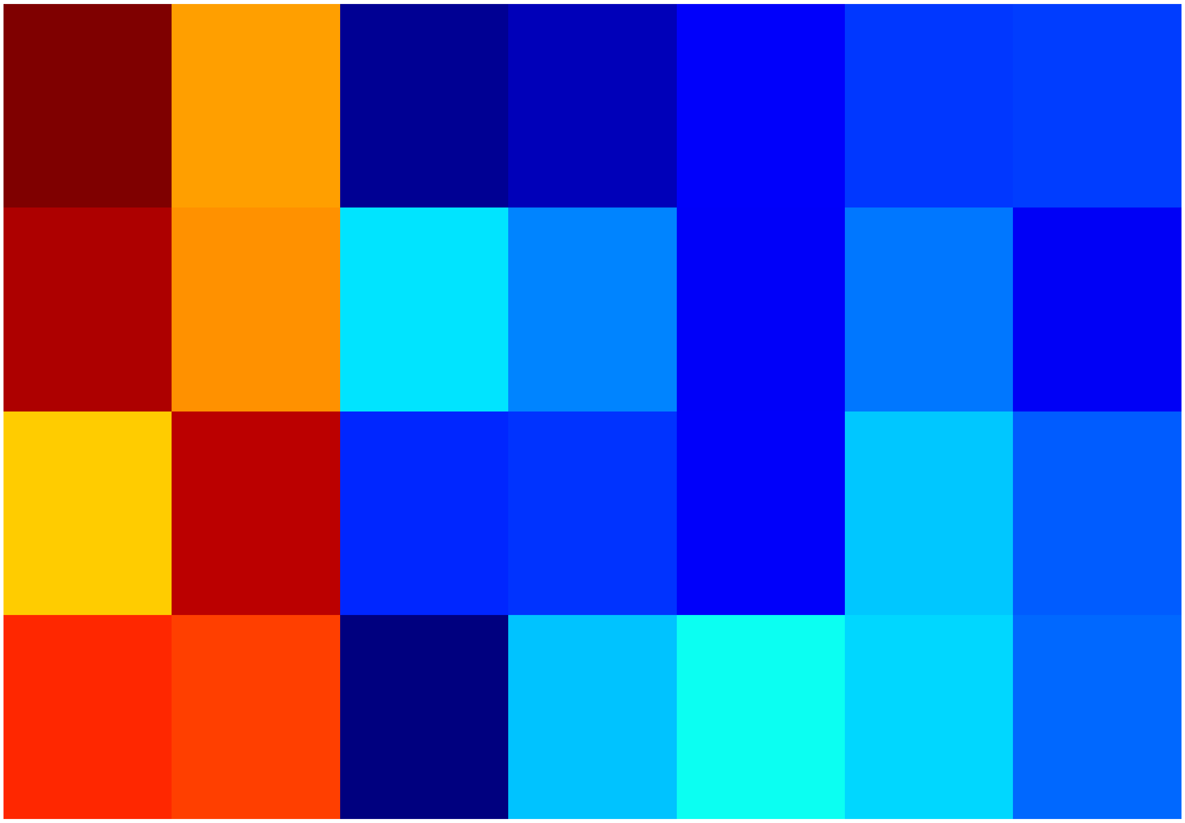
```
WHeatmap(cc$mat, name='h1') +
  WColorBarV(row.data, LeftOf('h1'), 'c1') +
  WColorBarH(col.data, TopOf('h1'), 'c2') +
  WDendrogram(cc$row.clust, LeftOf('c1'), facing='right') +
  WDendrogram(cc$column.clust, TopOf('c2'), facing='bottom') +
  WColorBarV(1:4, RightOf('h1'), 'c3', continuous=TRUE) +
  WHeatmap(m2, RightOf('c3'), 'h2') +
  WColorBarH(rep(c(1,2,3),each=4),
             Beneath(WColumnBind('h1', 'c3', 'h2')), 'c4',
             cmp=CMPar(brewer.name='Set2'), continuous=FALSE) +
  WHeatmap(matrix(rep(c(8:1,1:8),4),nrow=4),
           Beneath('c4', h.aln=WColumnBind('h1','c3')), 'h3') +
  WHeatmap(matrix(rep(1:10),ncol=2),LeftOf(WRowBind('c4.1.1','h3.1.1'))) +
  WHeatmap(matrix(1:4,nrow=2), RightOf('h3', h.scale='h2'), 'h4') +
  WHeatmap(matrix(1:24,nrow=3), Beneath('h3'), 'h5') +
  WHeatmap(matrix(24:1,nrow=2),
           Beneath('h5', h.aln=WColumnBind('h1','c3','h2')), 'h6') +
  WLegendV('c1', BottomRightOf('h6.1.3', h.pad=0.01), 'l1') +
  WLegendV('c2', TopOf('l1', pad = 0.1), 'l2') +
  WLegendV('c3', RightOf('l1', pad=0.1), n.text=3, label.fontsize = 10)
```



Step by step construction

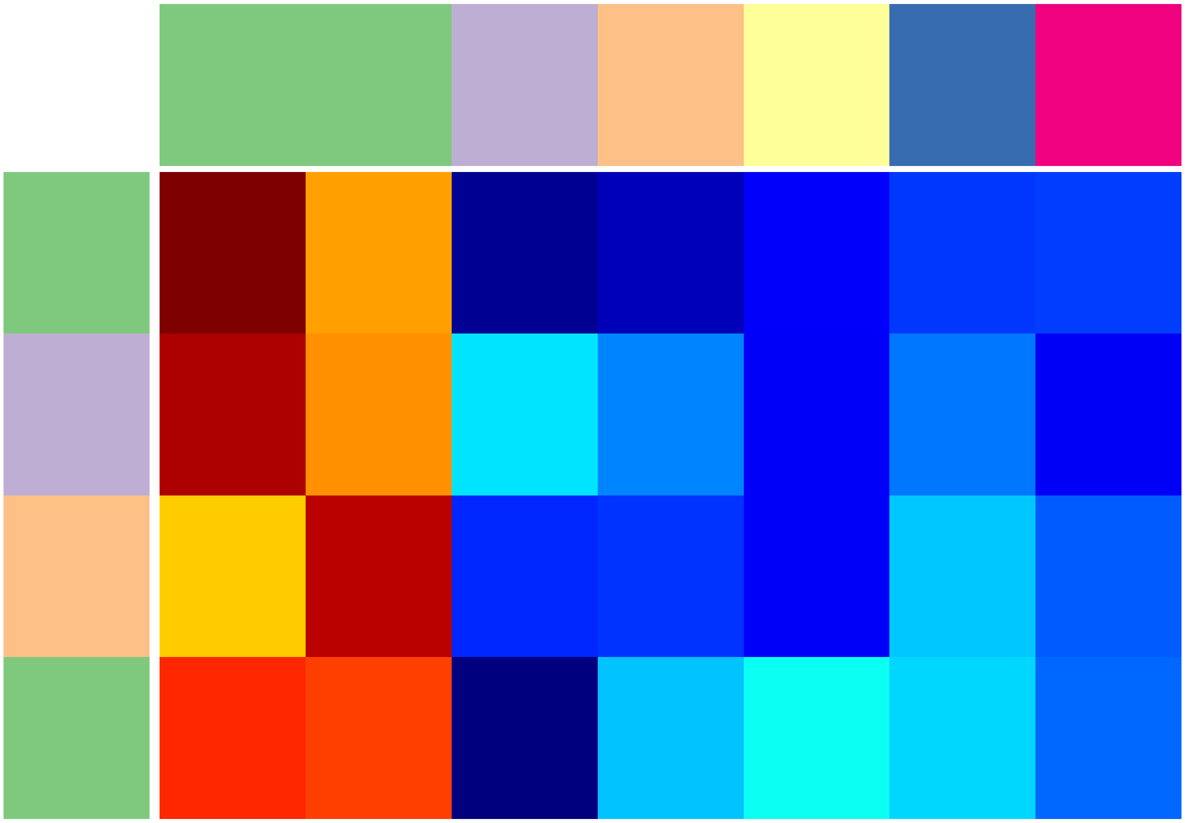
We plot one heatmap first

```
a <- WHeatmap(cc$mat, name='h1')
a
```



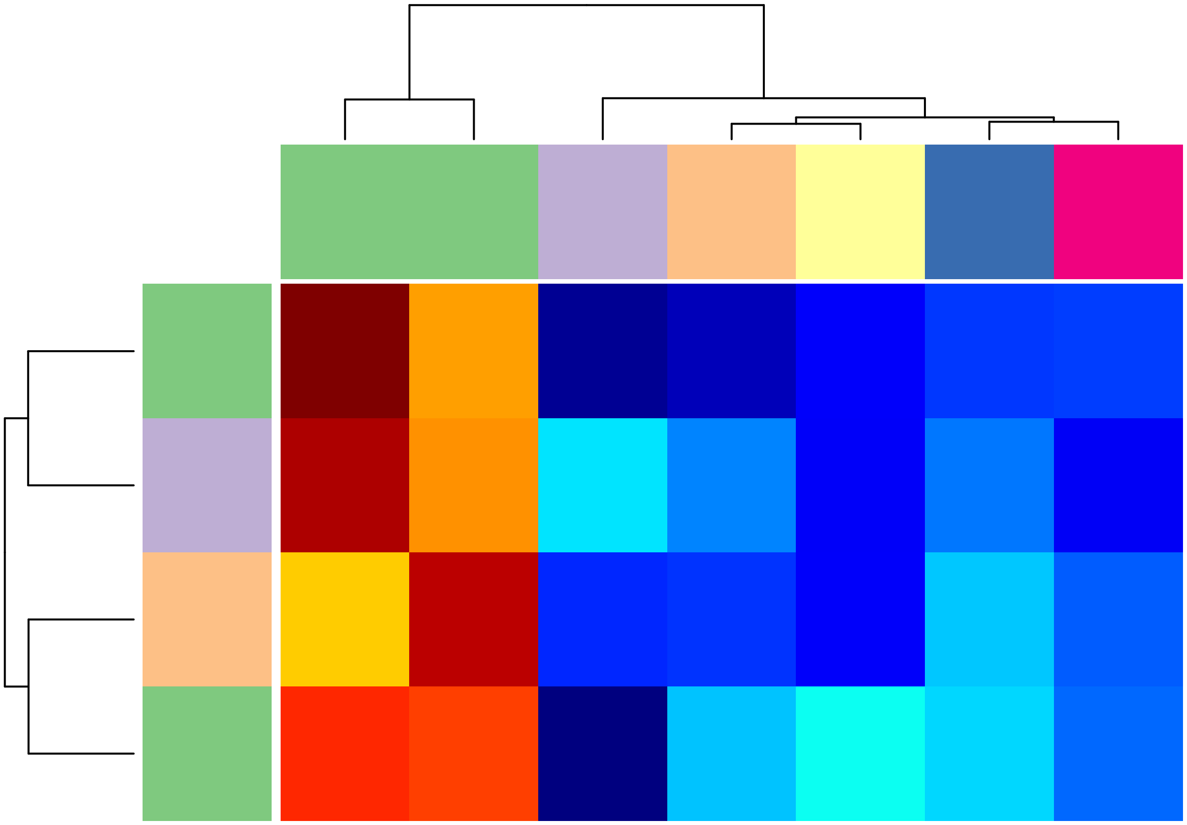
Then we add top and left color bars

```
a <- a + WColorBarV(row.data, LeftOf('h1'), 'c1')
a <- a + WColorBarH(col.data, TopOf('h1'), 'c2')
a
```



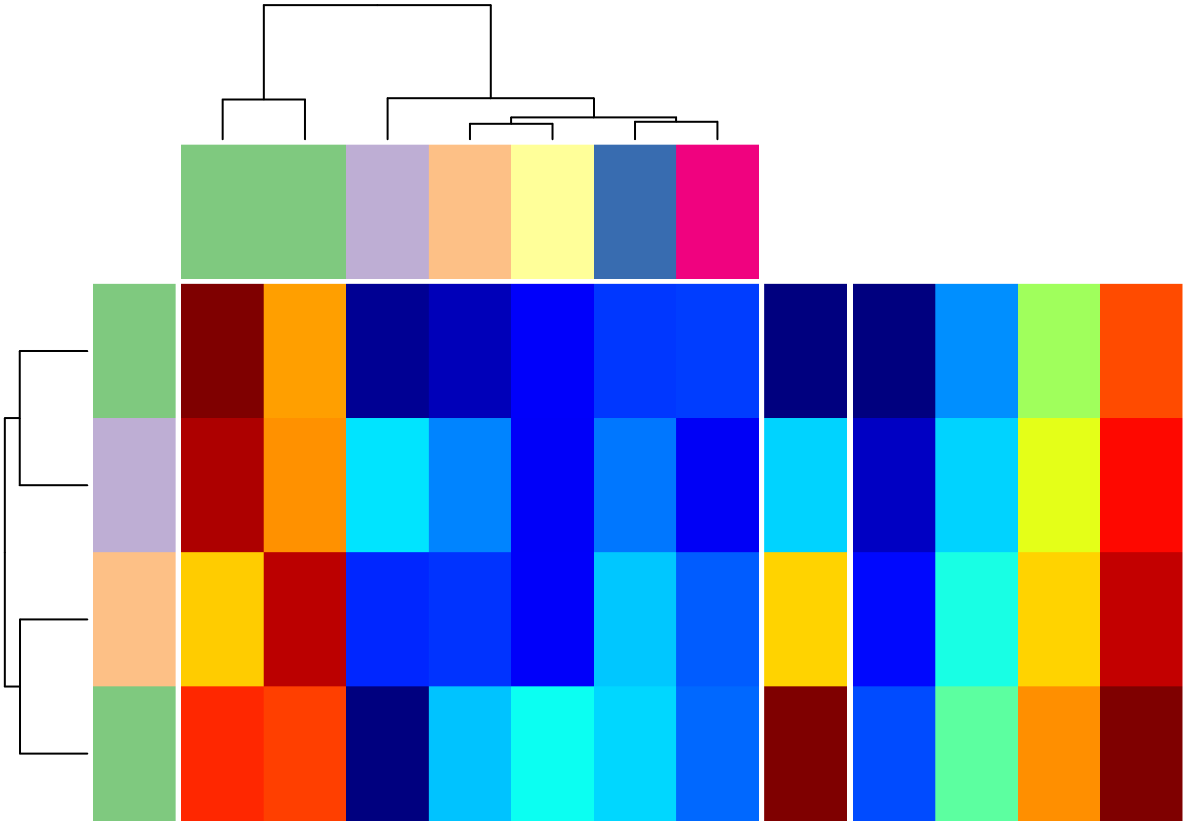
Then the dendrograms

```
a <- a + WDendrogram(cc$row.clust, LeftOf('c1'), facing='right')
a <- a + WDendrogram(cc$column.clust, TopOf('c2'), facing='bottom')
a
```



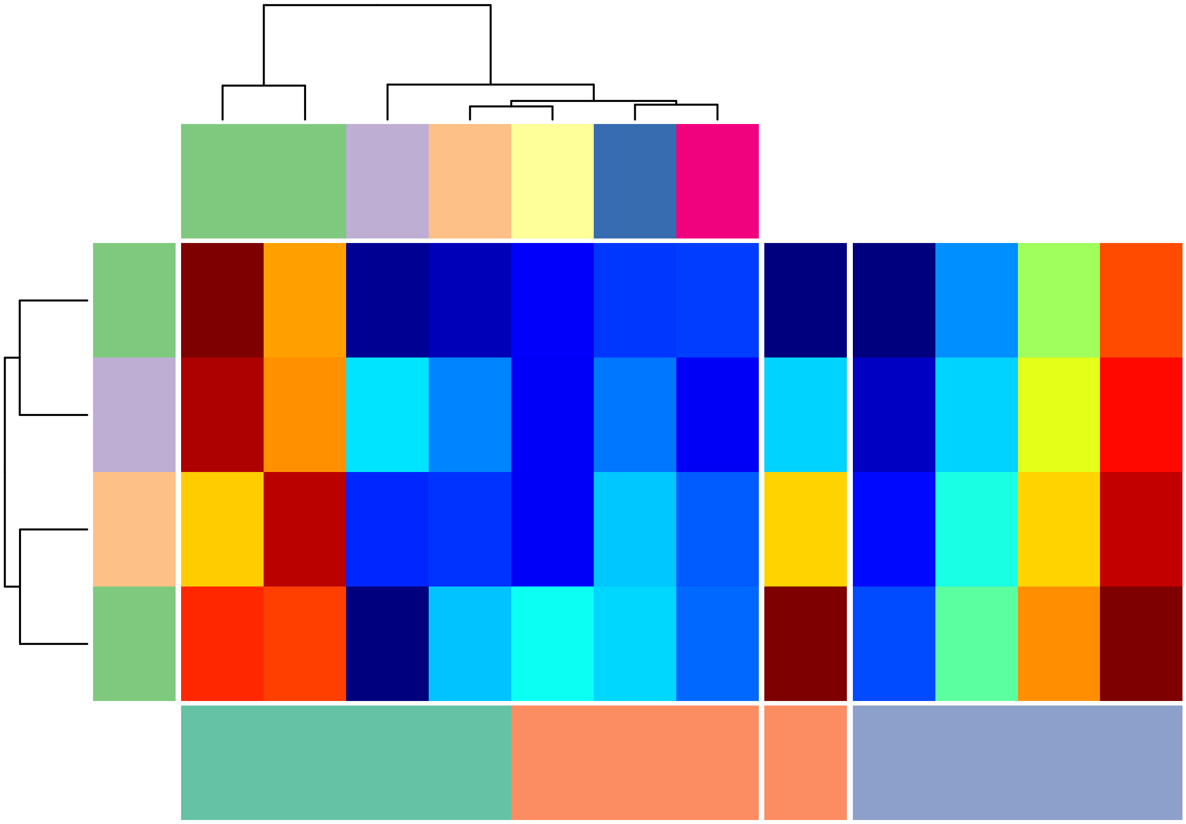
Then another vertical color bar on the right. This one we want to have a continuous scale. Then another heatmap on the further right.

```
a <- a + WColorBarV(1:4, RightOf('h1'), 'c3', continuous=TRUE)
a <- a + WHeatmap(m2, RightOf('c3'), 'h2')
a
```



Now we can merge 3 items we plot and add a horizontal bar below. Note wheatmap automatically computes the split for you. It's the users' responsibility however, to make sure data are alignable.

```
a <- a + WColorBarH(rep(c(1,2,3),each=4),
                    Beneath(WColumnBind('h1', 'c3', 'h2')), 'c4',
                    cmp=CMPar(brewer.name='Set2'), continuous=FALSE)
a
```

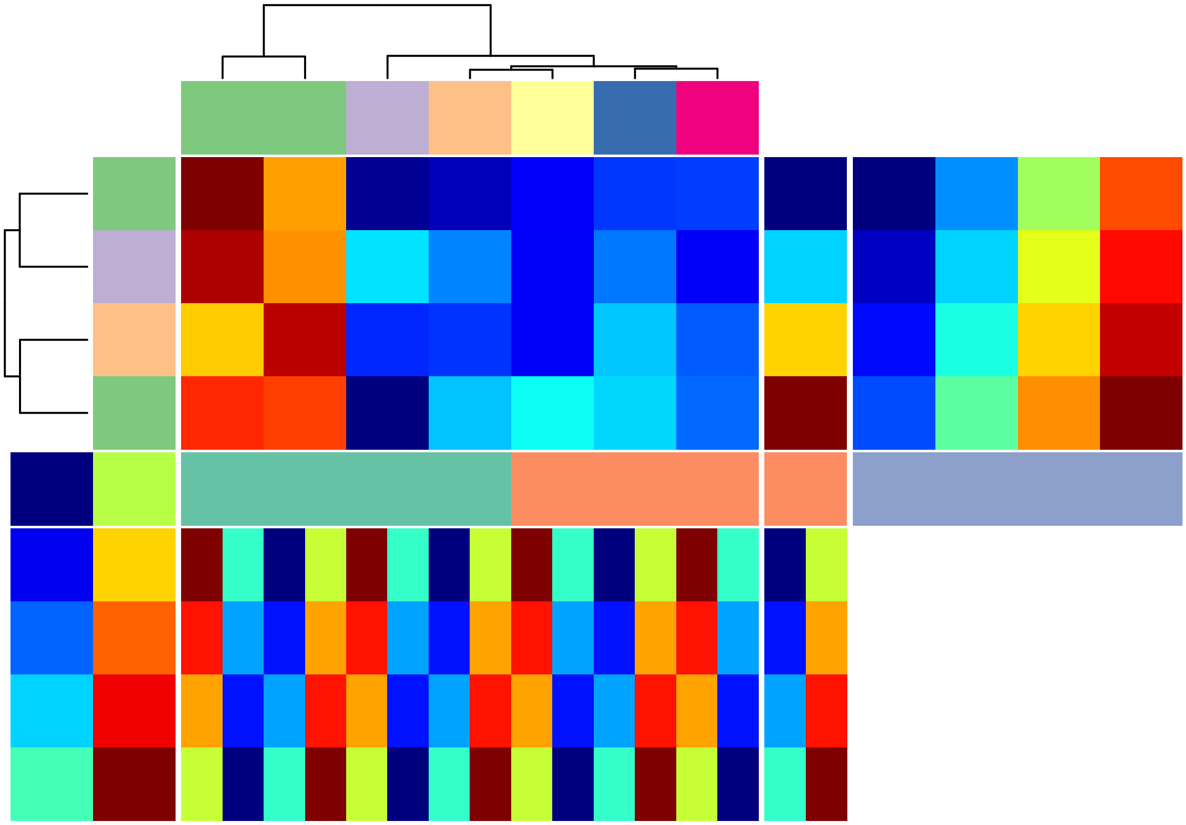


We then add another matrix that span two objects under c4. And a vertial 2-column heatmap on the left that span 2 elements.

```
load_all('~/tools/wheatmap/wheatmap/')
```

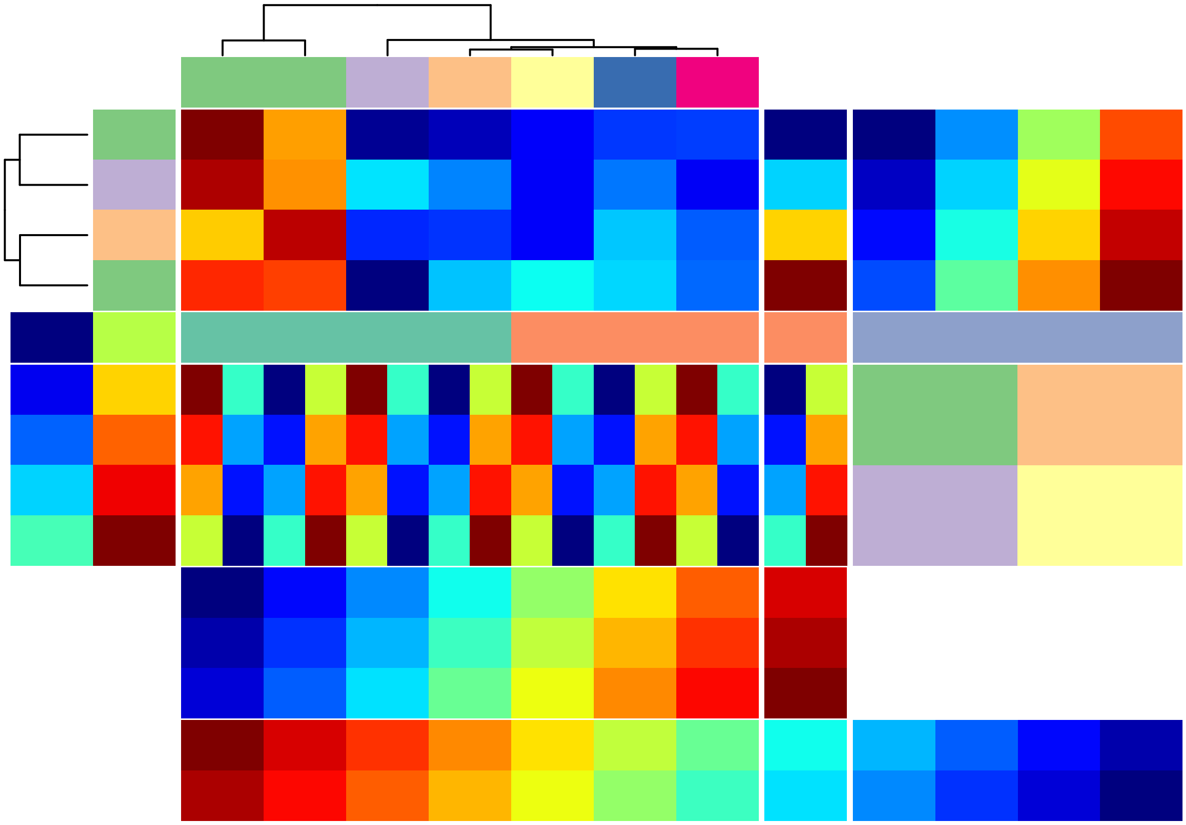
```
## Loading wheatmap
```

```
a <- a + WHeatmap(
  matrix(rep(c(8:1,1:8),4),nrow=4),
  Beneath('c4', h.aln=WColumnBind('h1','c3')), 'h3')
a <- a + WHeatmap(matrix(rep(1:10),ncol=2),
                  LeftOf(WRowBind('c4.1.1','h3.1.1')))
a
```



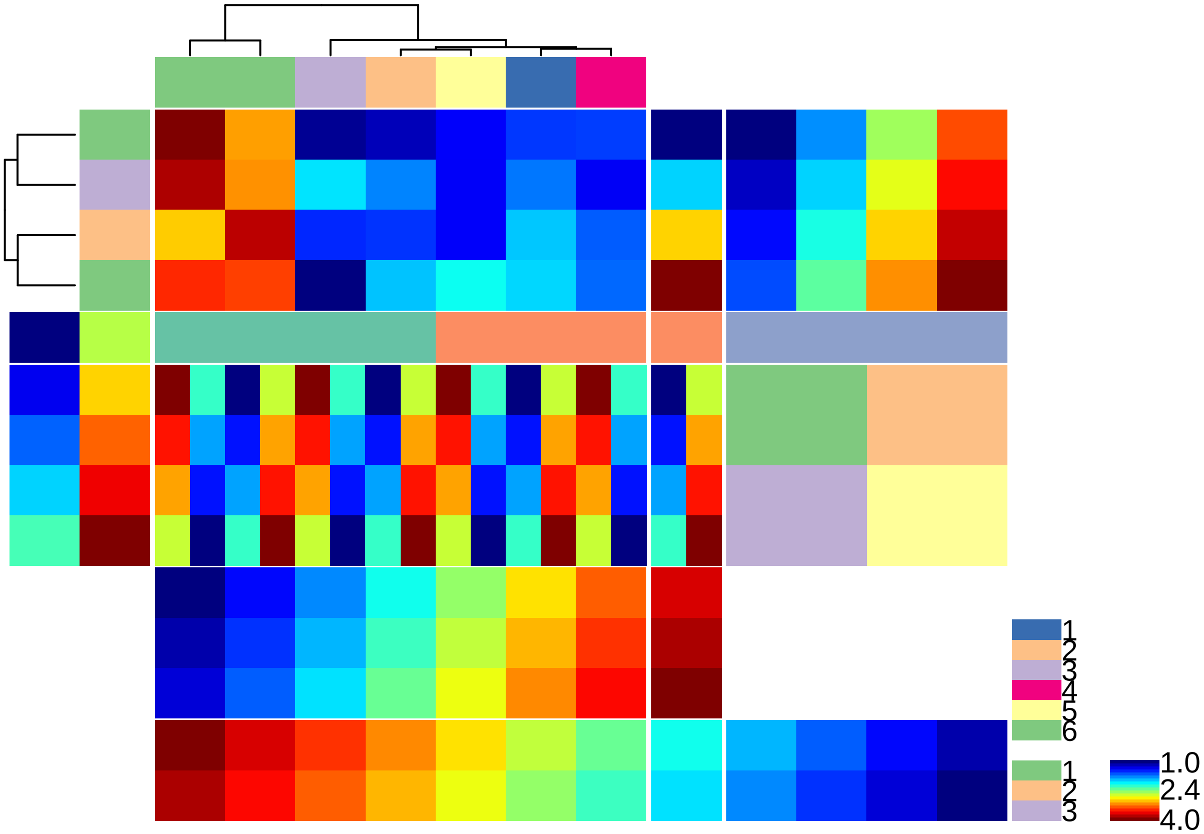
Another to the right of h3

```
a <- a + WHeatmap(
  matrix(1:4,nrow=2), RightOf('h3', h.scale='h2'), 'h4')
a <- a + WHeatmap(
  matrix(1:24,nrow=3), Beneath('h3'), 'h5')
a <- a + WHeatmap(
  matrix(24:1,nrow=2),
  Beneath('h5', h.aln=WColumnBind('h1','c3','h2')), 'h6')
a
```



Let's add legend

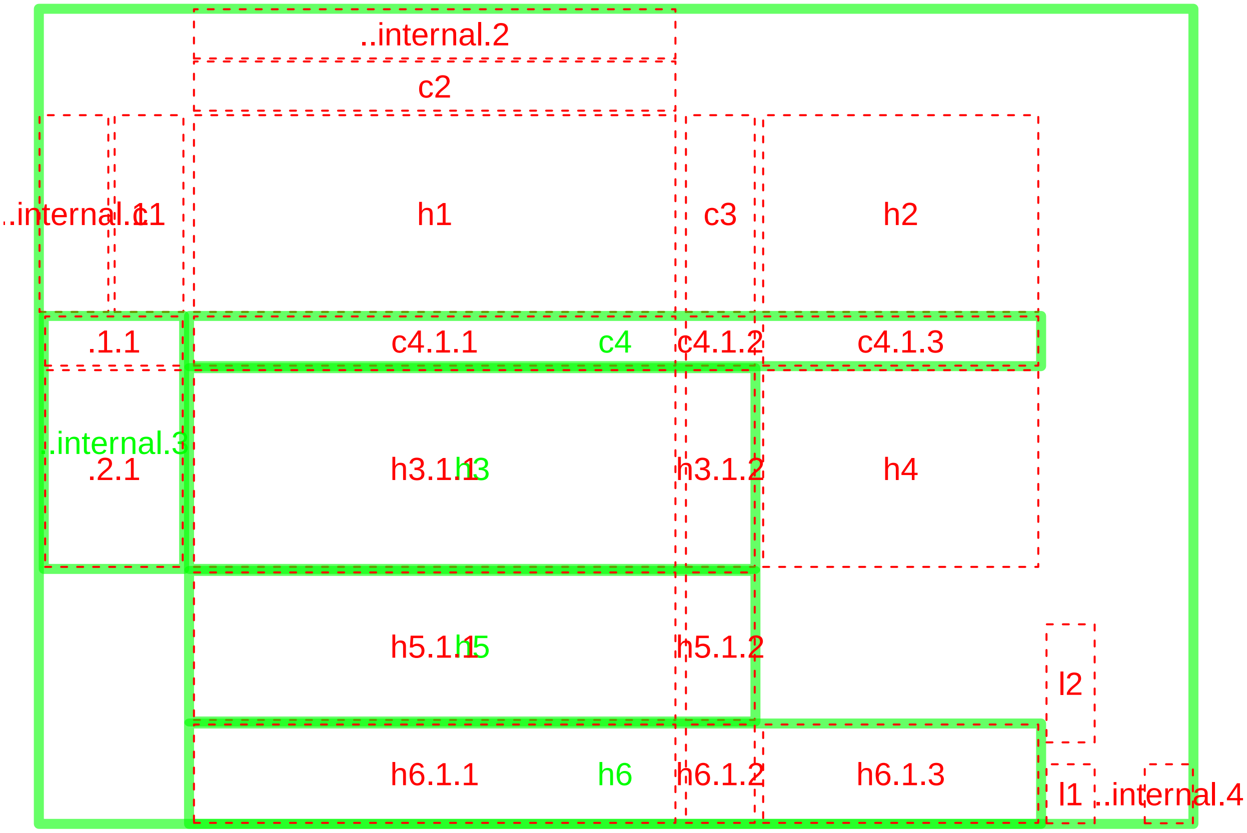
```
a <- a + WLegendV('c1', BottomRightOf('h6.1.3', h.pad=0.01), 'l1')
a <- a + WLegendV('c2', TopOf('l1', pad = 0.1), 'l2')
a <- a + WLegendV('c3', RightOf('l1', pad=0.1), n.text=3)
a
```



Show layout and refer to objects

We can view the internal layout by the providing the `layout.only=TRUE` option. This is useful to see the labeling visually.

```
print(a, layout.only=TRUE)
```



Each object has members with unique names. One can specify a name or have wheatmap generate a name. If an item is a group object by itself, it can also have members of its own. The names of members from different groups can be identical. When that's the case, one needs to use the full path to refer to the object.

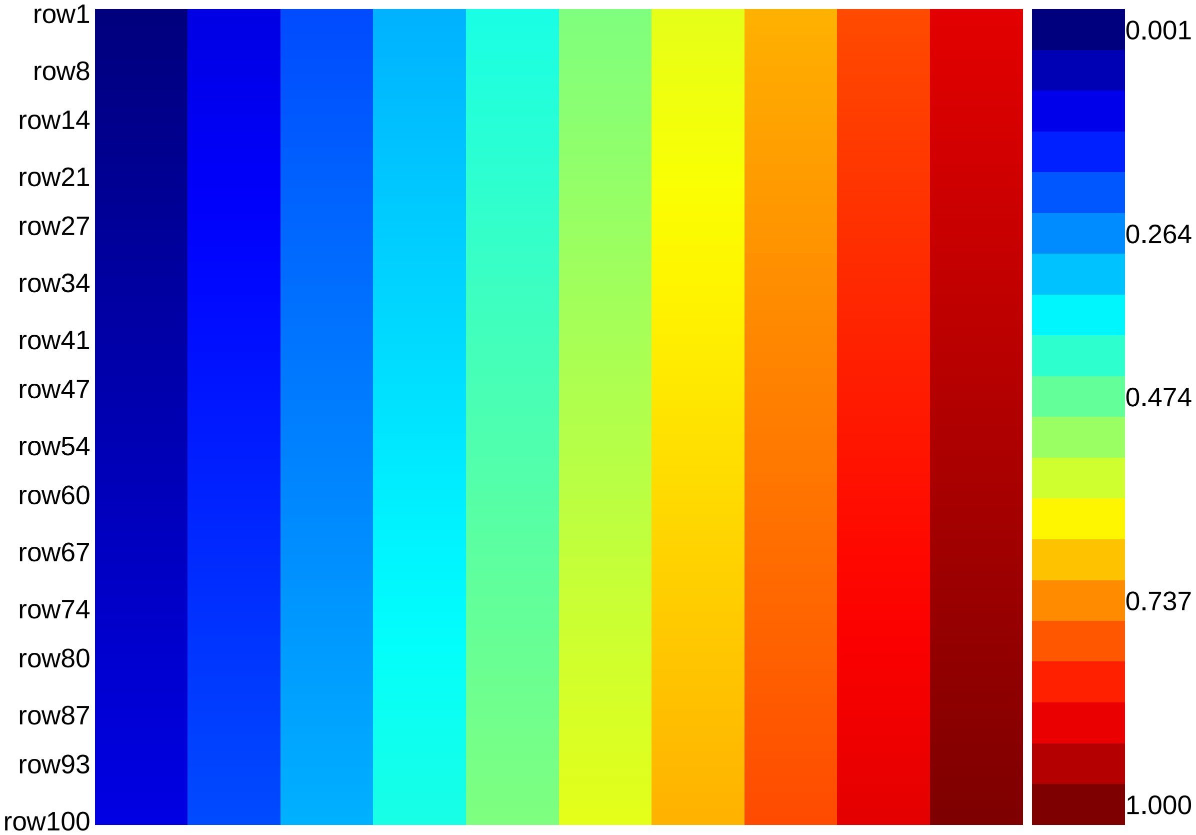
Declutter text labels

Wheatmap automatically de-cluttered the labels when there are too many. Below is an example of too many labels:

```
load_all('~/tools/wheatmap/wheatmap/')
```

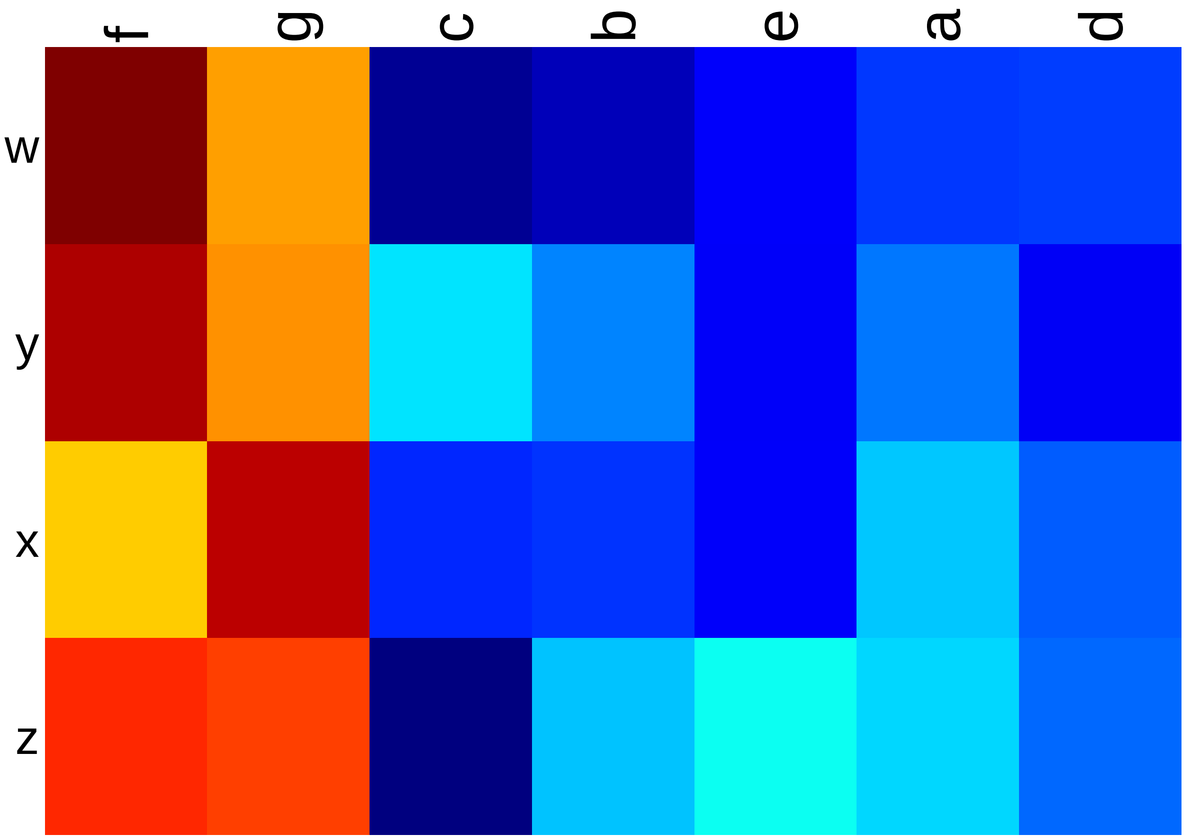
```
## Loading wheatmap
```

```
m <- matrix((1:1000)/1000, nrow=100)
rownames(m) <- paste0('row', 1:100)
WHeatmap(m, yticklabels = TRUE) + WLegendV(NULL, RightOf(), height=0.5)
```



Text and labels

```
WHeatmap(cc$mat, name='h1', yticklabels = TRUE, xticklabels = TRUE, xticklabel.side = 't', xticklabel.f
```



Anchor to corner

```
WHeatmap(matrix(1:9,nrow=3)) + WHeatmap(matrix(1:16,nrow=4), BottomRightOf(just='topleft')) + WHeatmap(
```