

pbmc_analysis

Purpose

This project processes and analyzes single-cell RNA-seq (scRNA-seq) data from human peripheral blood mononuclear cells (PBMCs). The workflow includes data loading, quality control, normalization, and dimensionality reduction using the Seurat package.

Libraries

```
library(Seurat)

## Loading required package: SeuratObject

## Loading required package: sp

## 'SeuratObject' was built under R 4.4.0 but the current version is
## 4.4.2; it is recommended that you reinstall 'SeuratObject' as the ABI
## for R may have changed

## 'SeuratObject' was built with package 'Matrix' 1.7.0 but the current
## version is 1.7.1; it is recommended that you reinstall 'SeuratObject' as
## the ABI for 'Matrix' may have changed

##
## Attaching package: 'SeuratObject'

## The following objects are masked from 'package:base':
##       intersect, t

library(SeuratObject)
library(tidyverse)

## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr     1.1.4      v readr     2.1.5
## vforcats   1.0.0      v stringr   1.5.1
## v ggplot2   3.5.1      v tibble    3.2.1
## v lubridate 1.9.4      v tidyrr    1.3.1
## v purrr    1.0.2

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()   masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

Data Loading

The raw scRNA-seq data is loaded from an h5 file.

```
pbmc_sparse <- Read10X_h5(filename = '~/Desktop/Projects/scRNASeq_analysis/20k_Human_Donor1-4_PBMC_3p_g
str(pbmc_sparse)
```

```
## Formal class 'dgCMatrix' [package "Matrix"] with 6 slots
## ..@ i       : int [1:83004326] 8667 5913 23580 38298 6568 36897 12410 14919 17383 21186 ...
## ..@ p       : int [1:2458524] 0 1 2 4 6 16 17 68 70 71 ...
## ..@ Dim     : int [1:2] 38606 2458523
## ..@ Dimnames:List of 2
## ... .$. : chr [1:38606] "DDX11L2" "MIR1302-2HG" "FAM138A" "ENSG00000290826" ...
## ... .$. : chr [1:2458523] "AAACCAAAGAACCGAGG-1" "AAACCAAAGAACCTATT-1" "AAACCAAAGAACCTAT-1" "AAACCAAAG...
## ..@ x       : num [1:83004326] 1 1 1 1 1 1 1 1 1 1 ...
## ..@ factors : list()
```

Create Seurat Object

Transform the raw counts into a Seurat object for downstream analysis.

```
pbmc_sparse <- CreateSeuratObject(counts = pbmc_sparse, project = 'pbmc', min.cells = 3, min.features =
pbmc_sparse
```

```
## An object of class Seurat
## 29606 features across 20276 samples within 1 assay
## Active assay: RNA (29606 features, 0 variable features)
## 1 layer present: counts
```

```
glimpse(pbmc_sparse)
```

```
## Formal class 'Seurat' [package "SeuratObject"] with 13 slots
## ..@ assays      :List of 1
## ... .$. RNA:Formal class 'Assay5' [package "SeuratObject"] with 8 slots
## ..@ meta.data   :'data.frame': 20276 obs. of 3 variables:
## ... .$. orig.ident : Factor w/ 1 level "pbmc": 1 1 1 1 1 1 1 1 1 ...
## ... .$. nCount_RNA : num [1:20276] 2047 9189 7064 7242 21018 ...
## ... .$. nFeature_RNA: int [1:20276] 1205 2758 2418 2420 4080 3406 232 217 3160 3301 ...
## ..@ active.assay: chr "RNA"
## ..@ active.ident: Factor w/ 1 level "pbmc": 1 1 1 1 1 1 1 1 1 ...
## ... .-. attr(*, "names")= chr [1:20276] "AAACCAAAGGCTATAT-1" "AAACCAAAGTAACCCA-1" "AAACCAAAGTCGAATT...
## ..@ graphs      : list()
## ..@ neighbors   : list()
## ..@ reductions  : list()
## ..@ images      : list()
## ..@ project.name: chr "pbmc"
## ..@ misc        : list()
## ..@ version     :Classes 'package_version', 'numeric_version' hidden list of 1
## ... .$. : int [1:3] 5 0 2
## ..@ commands   : list()
## ..@ tools       : list()
```

```

head(pbmc_sparse@meta.data)

##          orig.ident nCount_RNA nFeature_RNA
## AAACCAAAGGCTATAT-1      pmbc     2047     1205
## AAACCAAAGTAACCCA-1      pmbc     9189     2758
## AAACCAAAGTCGAATT-1      pmbc     7064     2418
## AAACCAAAGTGATGCC-1      pmbc     7242     2420
## AAACCATTTCACATTGG-1      pmbc    21018     4080
## AAACCATTTCAGCACTA-1      pmbc     10830     3406

```

Quality Control

Add mitochondrial content percentage and visualize quality metrics.

```

pbmc_sparse[["percent.mt"]] <- PercentageFeatureSet(pbmc_sparse, pattern = "MT-")
head(pbmc_sparse@meta.data)

```

```

##          orig.ident nCount_RNA nFeature_RNA percent.mt
## AAACCAAAGGCTATAT-1      pmbc     2047     1205  3.810454
## AAACCAAAGTAACCCA-1      pmbc     9189     2758  3.939493
## AAACCAAAGTCGAATT-1      pmbc     7064     2418  6.058890
## AAACCAAAGTGATGCC-1      pmbc     7242     2420  4.128694
## AAACCATTTCACATTGG-1      pmbc    21018     4080  3.335236
## AAACCATTTCAGCACTA-1      pmbc     10830     3406  2.834718

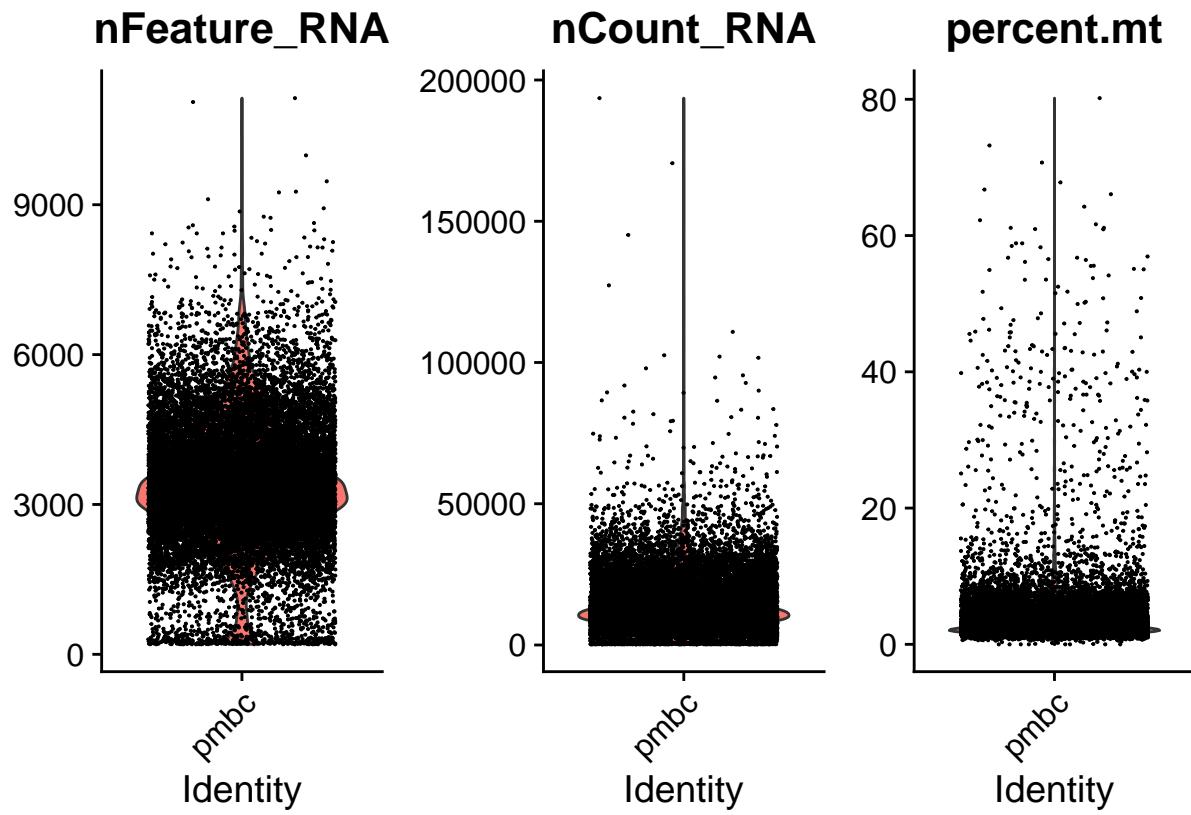
```

```
VlnPlot(pbmc_sparse, features = c("nFeature_RNA", "nCount_RNA", "percent.mt"), ncol = 3)
```

```

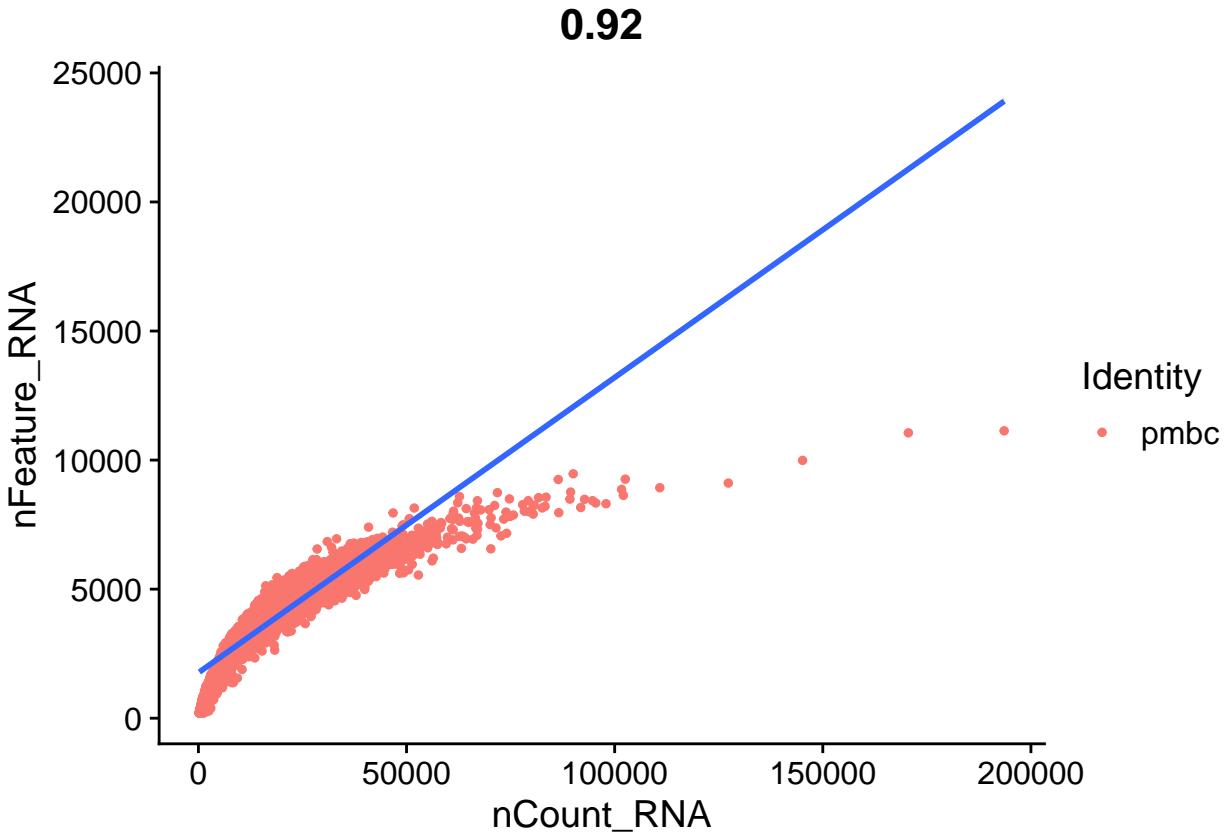
## Warning: Default search for "data" layer in "RNA" assay yielded no results;
## utilizing "counts" layer instead.

```



```
FeatureScatter(pbmc_sparse, feature1 = "nCount_RNA", feature2 = "nFeature_RNA") +  
  geom_smooth(method = 'lm')
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



Filter cells based on quality metrics:

```
pbmc_sparse <- subset(pbmc_sparse, subset = nFeature_RNA > 200 & nFeature_RNA < 2500 &
                         percent.mt < 5)
```

Data Normalization

Normalize the gene expression data.

```
pbmc_sparse <- NormalizeData(pbmc_sparse)
```

```
## Normalizing layer: counts
```

```
str(pbmc_sparse)
```

```
## Formal class 'Seurat' [package "SeuratObject"] with 13 slots
##   ..@ assays      :List of 1
##   ...$ RNA:Formal class 'Assay5' [package "SeuratObject"] with 8 slots
##   ....@ layers    :List of 2
##   ....$ counts:Formal class 'dgCMatrix' [package "Matrix"] with 6 slots
##   ....@ i         : int [1:3491719] 11 34 51 86 185 245 253 274 277 318 ...
##   ....@ p         : int [1:1878] 0 1205 3625 3842 6295 8717 10975 13032 15257 17545 ...
##   ....@ Dim       : int [1:2] 29606 1877
##   ....@ Dimnames:List of 2
```

```

## ... . . . . . $ : NULL
## ... . . . . . $ : NULL
## ... . . . . . @ x : num [1:3491719] 1 1 1 1 1 1 1 2 2 1 ...
## ... . . . . . @ factors : list()
## ... . . . . . $ data :Formal class 'dgCMatrix' [package "Matrix"] with 6 slots
## ... . . . . . @ i : int [1:3491719] 11 34 51 86 185 245 253 274 277 318 ...
## ... . . . . . @ p : int [1:1878] 0 1205 3625 3842 6295 8717 10975 13032 15257 17545 ...
## ... . . . . . @ Dim : int [1:2] 29606 1877
## ... . . . . . @ Dimnames:List of 2
## ... . . . . . $ : NULL
## ... . . . . . $ : NULL
## ... . . . . . @ x : num [1:3491719] 1.77 1.77 1.77 1.77 1.77 ...
## ... . . . . . @ factors : list()
## ... . . . . . @ cells :Formal class 'LogMap' [package "SeuratObject"] with 1 slot
## ... . . . . . @ .Data: logi [1:1877, 1:2] TRUE TRUE TRUE TRUE TRUE ...
## ... . . . . . - attr(*, "dimnames")=List of 2
## ... . . . . . $ : chr [1:1877] "AAACCAAAGGCTATAT-1" "AAACCAAAGTGTGCC-1" "AAACCATTCCCCGTGTA-1"
## ... . . . . . $ : chr [1:2] "counts" "data"
## ... . . . . . $ dim : int [1:2] 1877 2
## ... . . . . . $ dimnames:List of 2
## ... . . . . . $ : chr [1:1877] "AAACCAAAGGCTATAT-1" "AAACCAAAGTGTGCC-1" "AAACCATTCCCCGTGTA-1"
## ... . . . . . $ : chr [1:2] "counts" "data"
## ... . . . . . @ features :Formal class 'LogMap' [package "SeuratObject"] with 1 slot
## ... . . . . . @ .Data: logi [1:29606, 1:2] TRUE TRUE TRUE TRUE TRUE ...
## ... . . . . . - attr(*, "dimnames")=List of 2
## ... . . . . . $ : chr [1:29606] "ENSG00000238009" "ENSG00000239945" "ENSG00000241860" "ENSG00000241860"
## ... . . . . . $ : chr [1:2] "counts" "data"
## ... . . . . . $ dim : int [1:2] 29606 2
## ... . . . . . $ dimnames:List of 2
## ... . . . . . $ : chr [1:29606] "ENSG00000238009" "ENSG00000239945" "ENSG00000241860" "ENSG00000241860"
## ... . . . . . $ : chr [1:2] "counts" "data"
## ... . . . . . @ default : int 1
## ... . . . . . @ assay.orig: chr(0)
## ... . . . . . @ meta.data :'data.frame': 29606 obs. of 0 variables
## ... . . . . . @ misc : Named list()
## ... . . . . . @ key : chr "rna_"
## ... . @ meta.data :'data.frame': 1877 obs. of 4 variables:
## ... . $ orig.ident : Factor w/ 1 level "pmbc": 1 1 1 1 1 1 1 1 1 ...
## ... . $ nCount_RNA : num [1:1877] 2047 7242 246 7309 8071 ...
## ... . $ nFeature_RNA: int [1:1877] 1205 2420 217 2453 2422 2258 2057 2225 2288 2282 ...
## ... . $ percent.mt : num [1:1877] 3.81 4.13 2.44 3.23 3.06 ...
## ... . @ active.assay: chr "RNA"
## ... . @ active.ident: Factor w/ 1 level "pmbc": 1 1 1 1 1 1 1 1 1 ...
## ... . - attr(*, "names")= chr [1:1877] "AAACCAAAGGCTATAT-1" "AAACCAAAGTGTGCC-1" "AAACCATTCCCCGTGTA-1"
## ... . @ graphs : list()
## ... . @ neighbors : list()
## ... . @ reductions : list()
## ... . @ images : list()
## ... . @ project.name: chr "pmbc"
## ... . @ misc : list()
## ... . @ version :Classes 'package_version', 'numeric_version' hidden list of 1
## ... . $ : int [1:3] 5 0 2
## ... . @ commands :List of 1
## ... . $ NormalizeData.RNA:Formal class 'SeuratCommand' [package "SeuratObject"] with 5 slots

```

```

## ... . . . . @ name      : chr "NormalizeData.RNA"
## ... . . . . @ time.stamp : POSIXct[1:1], format: "2025-01-27 16:11:12"
## ... . . . . @ assay.used : chr "RNA"
## ... . . . . @ call.string: chr "NormalizeData(pbmc_sparse)"
## ... . . . . @ params     :List of 5
## ... . . . . .$ assay       : chr "RNA"
## ... . . . . .$ normalization.method: chr "LogNormalize"
## ... . . . . .$ scale.factor   : num 10000
## ... . . . . .$ margin        : num 1
## ... . . . . .$ verbose       : logi TRUE
## ..@ tools      : list()

```

Identification of Variable Features

Identify and visualize the top variable features.

```

pbmc_sparse <- FindVariableFeatures(pbmc_sparse, selection.method = "vst", nfeatures = 2000)

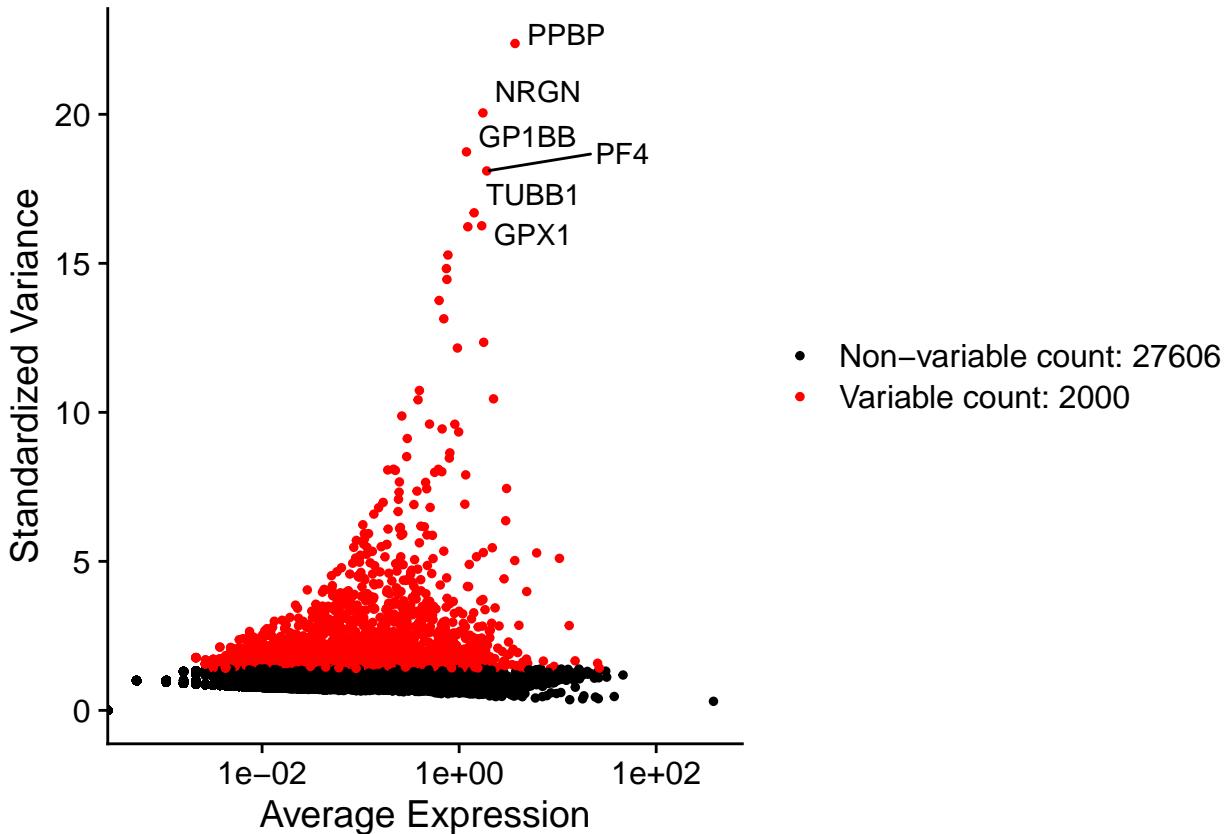
## Finding variable features for layer counts

top10 <- head(VariableFeatures(pbmc_sparse))
plot1 <- VariableFeaturePlot(pbmc_sparse)
LabelPoints(plot = plot1, points = top10, repel = TRUE)

## When using repel, set xnudge and ynudge to 0 for optimal results

## Warning in scale_x_log10(): log-10 transformation introduced infinite values.

```



Scaling Data

Scale the data to standardize values.

```
all_genes <- rownames(pbmc_sparse)
pbmc_sparse <- ScaleData(pbmc_sparse, features = all_genes)

## Centering and scaling data matrix

str(pbmc_sparse)

## Formal class 'Seurat' [package "SeuratObject"] with 13 slots
## ..@ assays      :List of 1
## ...$ RNA:Formal class 'Assay5' [package "SeuratObject"] with 8 slots
## ...@ layers      :List of 3
## ...@ counts     :Formal class 'dgCMatrix' [package "Matrix"] with 6 slots
## ...@ i          : int [1:3491719] 11 34 51 86 185 245 253 274 277 318 ...
## ...@ p          : int [1:1878] 0 1205 3625 3842 6295 8717 10975 13032 15257 17545 ...
## ...@ Dim        : int [1:2] 29606 1877
## ...@ Dimnames   :List of 2
## ...@ . : NULL
## ...@ . : NULL
## ...@ x          : num [1:3491719] 1 1 1 1 1 1 1 2 2 1 ...
## ...@ factors    : list()
```

```

## .. . . . . . $ data      :Formal class 'dgCMatrix' [package "Matrix"] with 6 slots
## .. . . . . . . @ i        : int [1:3491719] 11 34 51 86 185 245 253 274 277 318 ...
## .. . . . . . . @ p        : int [1:1878] 0 1205 3625 3842 6295 8717 10975 13032 15257 17545 ...
## .. . . . . . . @ Dim      : int [1:2] 29606 1877
## .. . . . . . . @ Dimnames:List of 2
## .. . . . . . . . $ : NULL
## .. . . . . . . . $ : NULL
## .. . . . . . . @ x        : num [1:3491719] 1.77 1.77 1.77 1.77 1.77 ...
## .. . . . . . . @ factors   : list()
## .. . . . . . . . $ scale.data: num [1:29606, 1:1877] -0.0598 0 -0.0861 0 -0.0929 ...
## .. . . . . . . @ cells     :Formal class 'LogMap' [package "SeuratObject"] with 1 slot
## .. . . . . . . . @ .Data: logi [1:1877, 1:3] TRUE TRUE TRUE TRUE TRUE TRUE ...
## .. . . . . . . . - attr(*, "dimnames")=List of 2
## .. . . . . . . . . $ : chr [1:1877] "AAACCAAAGGCTATAT-1" "AAACCAAAGTGTGCC-1" "AAACCATTCCCCCTGT...
## .. . . . . . . . . $ : chr [1:3] "counts" "data" "scale.data"
## .. . . . . . . . $ dim      : int [1:2] 1877 3
## .. . . . . . . . $ dimnames:List of 2
## .. . . . . . . . . $ : chr [1:1877] "AAACCAAAGGCTATAT-1" "AAACCAAAGTGTGCC-1" "AAACCATTCCCCCTGT...
## .. . . . . . . . . $ : chr [1:3] "counts" "data" "scale.data"
## .. . . . . . . @ features  :Formal class 'LogMap' [package "SeuratObject"] with 1 slot
## .. . . . . . . . @ .Data: logi [1:29606, 1:3] TRUE TRUE TRUE TRUE TRUE TRUE ...
## .. . . . . . . . - attr(*, "dimnames")=List of 2
## .. . . . . . . . . $ : chr [1:29606] "ENSG00000238009" "ENSG00000239945" "ENSG00000241860" "EN...
## .. . . . . . . . . $ : chr [1:3] "counts" "data" "scale.data"
## .. . . . . . . . $ dim      : int [1:2] 29606 3
## .. . . . . . . . $ dimnames:List of 2
## .. . . . . . . . . $ : chr [1:29606] "ENSG00000238009" "ENSG00000239945" "ENSG00000241860" "ENSG0...
## .. . . . . . . . . $ : chr [1:3] "counts" "data" "scale.data"
## .. . . . . . . @ default   : int 1
## .. . . . . . . @ assay.orig: chr(0)
## .. . . . . . . @ meta.data :'data.frame': 29606 obs. of  8 variables:
## .. . . . . . . . $ vf_vst_counts_mean           : num [1:29606] 0.00373 0 0.00799 0 0.01012 ...
## .. . . . . . . . $ vf_vst_counts_variance       : num [1:29606] 0.00372 0 0.009 0 0.01003 ...
## .. . . . . . . . $ vf_vst_counts_variance.expected: num [1:29606] 0.00442 0 0.01009 0 0.01298 ...
## .. . . . . . . . $ vf_vst_counts_variance.standardized: num [1:29606] 0.84 0 0.892 0 0.773 ...
## .. . . . . . . . $ vf_vst_counts_variable        : logi [1:29606] FALSE FALSE FALSE FALSE FALSE ...
## .. . . . . . . . $ vf_vst_counts_rank            : int [1:29606] NA NA NA NA NA NA NA NA NA ...
## .. . . . . . . . $ var.features                 : chr [1:29606] NA NA NA NA ...
## .. . . . . . . . $ var.features.rank            : int [1:29606] NA NA NA NA NA NA NA NA NA ...
## .. . . . . . . @ misc      : Named list()
## .. . . . . . . @ key       : chr "rna_"
## .. @ meta.data  :'data.frame': 1877 obs. of  4 variables:
## .. . . $ orig.ident : Factor w/ 1 level "pmbc": 1 1 1 1 1 1 1 1 1 ...
## .. . . $ nCount_RNA : num [1:1877] 2047 7242 246 7309 8071 ...
## .. . . $ nFeature_RNA: int [1:1877] 1205 2420 217 2453 2422 2258 2057 2225 2288 2282 ...
## .. . . $ percent.mt : num [1:1877] 3.81 4.13 2.44 3.23 3.06 ...
## .. @ active.assay: chr "RNA"
## .. @ active.ident: Factor w/ 1 level "pmbc": 1 1 1 1 1 1 1 1 1 ...
## .. . - attr(*, "names")= chr [1:1877] "AAACCAAAGGCTATAT-1" "AAACCAAAGTGTGCC-1" "AAACCATTCCCCCTGT...
## .. @ graphs     : list()
## .. @ neighbors  : list()
## .. @ reductions : list()
## .. @ images    : list()
## .. @ project.name: chr "pmbc"

```

```

## ..@ misc      : list()
## ..@ version   :Classes 'package_version', 'numeric_version' hidden list of 1
## ...$ : int [1:3] 5 0 2
## ..@ commands  :List of 3
## ...$ NormalizeData.RNA      :Formal class 'SeuratCommand' [package "SeuratObject"] with 5 slots
## ... .@ name     : chr "NormalizeData.RNA"
## ... .@ time.stamp : POSIXct[1:1], format: "2025-01-27 16:11:12"
## ... .@ assay.used : chr "RNA"
## ... .@ call.string: chr "NormalizeData(pbmcsparse)"
## ... .@ params    :List of 5
## ... . . . $ assay       : chr "RNA"
## ... . . . $ normalization.method: chr "LogNormalize"
## ... . . . $ scale.factor : num 10000
## ... . . . $ margin      : num 1
## ... . . . $ verbose     : logi TRUE
## ...$ FindVariableFeatures.RNA:Formal class 'SeuratCommand' [package "SeuratObject"] with 5 slots
## ... .@ name     : chr "FindVariableFeatures.RNA"
## ... .@ time.stamp : POSIXct[1:1], format: "2025-01-27 16:11:14"
## ... .@ assay.used : chr "RNA"
## ... .@ call.string: chr [1:2] "FindVariableFeatures(pbmcsparse, selection.method = \"vst\","
## ... .@ params    :List of 12
## ... . . . $ assay       : chr "RNA"
## ... . . . $ selection.method : chr "vst"
## ... . . . $ loess.span   : num 0.3
## ... . . . $ clip.max    : chr "auto"
## ... . . . $ mean.function: function (mat, display_progress)
## ... . . . $ dispersion.function: function (mat, display_progress)
## ... . . . $ num.bin     : num 20
## ... . . . $ binning.method: chr "equal_width"
## ... . . . $ nfeatures   : num 2000
## ... . . . $ mean.cutoff  : num [1:2] 0.1 8
## ... . . . $ dispersion.cutoff: num [1:2] 1 Inf
## ... . . . $ verbose     : logi TRUE
## ...$ ScaleData.RNA      :Formal class 'SeuratCommand' [package "SeuratObject"] with 5 slots
## ... .@ name     : chr "ScaleData.RNA"
## ... .@ time.stamp : POSIXct[1:1], format: "2025-01-27 16:11:16"
## ... .@ assay.used : chr "RNA"
## ... .@ call.string: chr "ScaleData(pbmcsparse, features = all_genes)"
## ... .@ params    :List of 10
## ... . . . $ features   : chr [1:29606] "ENSG00000238009" "ENSG00000239945" "ENSG0000024
## ... . . . $ assay       : chr "RNA"
## ... . . . $ model.use   : chr "linear"
## ... . . . $ use.umi     : logi FALSE
## ... . . . $ do.scale    : logi TRUE
## ... . . . $ do.center   : logi TRUE
## ... . . . $ scale.max   : num 10
## ... . . . $ block.size  : num 1000
## ... . . . $ min.cells.to.block: num 3000
## ... . . . $ verbose     : logi TRUE
## ..@ tools     : list()

```

Principal Component Analysis

Perform PCA to identify major sources of variation.

```
pbmc_sparse <- RunPCA(pbmc_sparse, features = VariableFeatures(object = pbmc_sparse))

## PC_ 1
## Positive: TUBB1, GP1BB, GNG11, GP9, CLU, PPBP, RGS18, PRKAR2B, CMTM5, MPIG6B
##           ENSG00000288882, SH3BGRL2, C2orf88, TREML1, GP1BA, ITGA2B, PTCRA, MYL9, ACRBP, SMANTIS
##           FAXDC2, PTGS1, MYLK, SEPTIN5, CTTN, TMEM40, ENSG00000236304, SLC18A2-AS1, TRIM58, GUCY1B1
## Negative: GNG2, NFKB1, ZEB1, PRKCH, PDE3B, CDC14A, CD247, RORA, RPS12, ATP2B1
##            PITPN1, RPL10, ATP8A1, RPS10, TBL1X, TNFAIP3, SERINC5, IL7R, MAML2, INPP5D
##            SAMSN1, NIBAN1, CHST11, MED13L, TGFBR3, PPP3CA, RPS26, RAPGEF1, VAV3, FKBP5
## PC_ 2
## Positive: RPL10, RPS12, IL7R, LTB, TSC22D3, RPS26, RPS10, ZEB1, IFITM1, ABLIM1
##            IL32, LEF1, SESN3, TNIK, PDE3B, ANK3, TSHZ2, TRBC1, CD247, CDC14A
##            KIF2A, OST4, RORA, PRKCH, CD69, FHIT, CD37, TNFAIP3, GRAP2, FAAH2
## Negative: RBM47, PPARG, CHST15, FGD4, ABCA1, DOCK4, ITGAX, CSF2RA, SULF2, GAB2
##            NCF2, DMXL2, KYNU, TBXAS1, RAB31, PLAUR, EEPD1, PID1, JARID2, SDC2
##            CLEC7A, AQP9, LRMDA, MAP3K20, NLRP12, EMILIN2, IL6R, CD86, MYO9B, FAM20C
## PC_ 3
## Positive: IGHM, BANK1, IGHD, MS4A1, LINC00926, HLA-DRA, AFF3, ADAM28, CD74, COL19A1
##            IGKC, RUBCNL, GNG7, CD22, HLA-DMB, HLA-DRB1, HLA-DQA1, COBLL1, TNFRSF13C, HLA-DPA1
##            ADAM7-AS1, EBF1, NIBAN3, HLA-DQB1, HLA-DPB1, SWAP70, RALGPS2, CD37, PLEKHG1, TCF4
## Negative: PRKCH, CD247, RORA, PITPN1, TGFBR3, CDC14A, TNIK, NIBAN1, PDE3B, YES1
##            PYHIN1, SYNE1, NCALD, PRKCA, TNFAIP3, GNG2, STK39, CMIP, SAMD3, C1orf21
##            TBL1X, ZFYVE28, ITGB1, EPHA4, PPP2R2B, ARHGAP26, OTULIN, SLA2, CD226, CCL5
## PC_ 4
## Positive: IL7R, LEF1, FTH1, SERINC5, TSHZ2, NELL2, ANK3, FHIT, VIM, FAAH2
##            SESN3, LTB, LYZ, MAML2, PRKCA, PCBP3, RPS12, ICOS, PLAUR, S100A9
##            RPL10, FKBP5, SLC16A10, CSGALNACT1, CMTM8, SAMSN1, LDLRAD4, IL6R, S100A8, PGAP1
## Negative: MCTP2, C1orf21, AUTS2, KLRD1, IL18RAP, ZBTB16, NCALD, GZMB, CARD11, MTSS1
##            SLC15A4, VAV3, YES1, SYNE1, LYN, CEP78, GPR141, BNC2, FAM53B, NKG7
##            ABCB1, ZEB2, GNG2, ATP8A1, PDGFD, SLA2, PTPN12, DTHD1, EPG5, SETBP1
## PC_ 5
## Positive: ZEB1, SERINC5, SESN3, GRK5, CDC14A, PDE3B, ANK3, PRKCA, CSGALNACT1, MGAT5
##            TNIK, FKBP5, LDLRAD4, ELAPOR2, MAML2, NR3C2, ENSG00000289474, TSHZ2, MAN1C1, TBL1X
##            SSBP2, PRKCE, PGAP1, LEF1, FAAH2, PCBP3, ANKH, ABLIM1, HS2ST1, SAMD4A
## Negative: FTH1, S100A4, RPL10, NKG7, S100A6, IFITM1, RPS12, CST7, SH3BGRL3, CTSW
##            GZMA, RPS10, ACTB, S100A10, MYL6, CCL5, DUSP2, EFHD2, GZMB, TYROBP
##            FGFBP2, METRNL, GZMH, CCL4, LGALS1, RPS26, CRIP1, IL32, VIM, FCGR3A

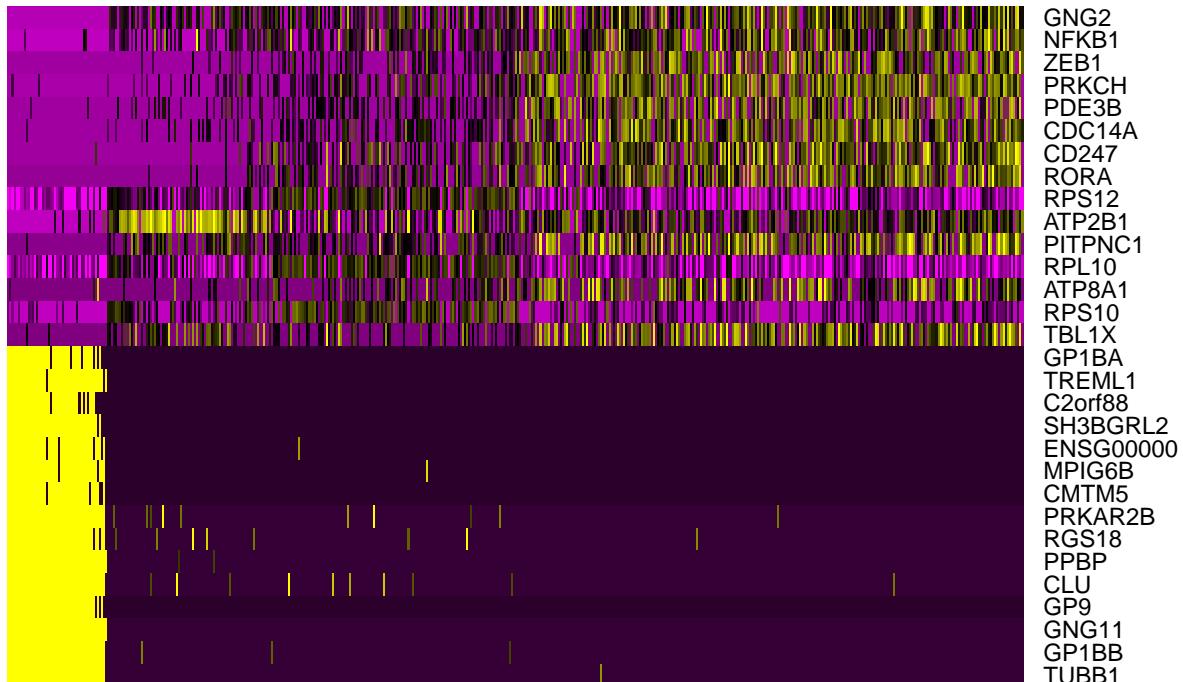
print(pbmc_sparse[["pca"]], dims = 1:5, nfeatures = 5)
```

```
## PC_ 1
## Positive: TUBB1, GP1BB, GNG11, GP9, CLU
## Negative: GNG2, NFKB1, ZEB1, PRKCH, PDE3B
## PC_ 2
## Positive: RPL10, RPS12, IL7R, LTB, TSC22D3
## Negative: RBM47, PPARG, CHST15, FGD4, ABCA1
## PC_ 3
## Positive: IGHM, BANK1, IGHD, MS4A1, LINC00926
## Negative: PRKCH, CD247, RORA, PITPN1, TGFBR3
```

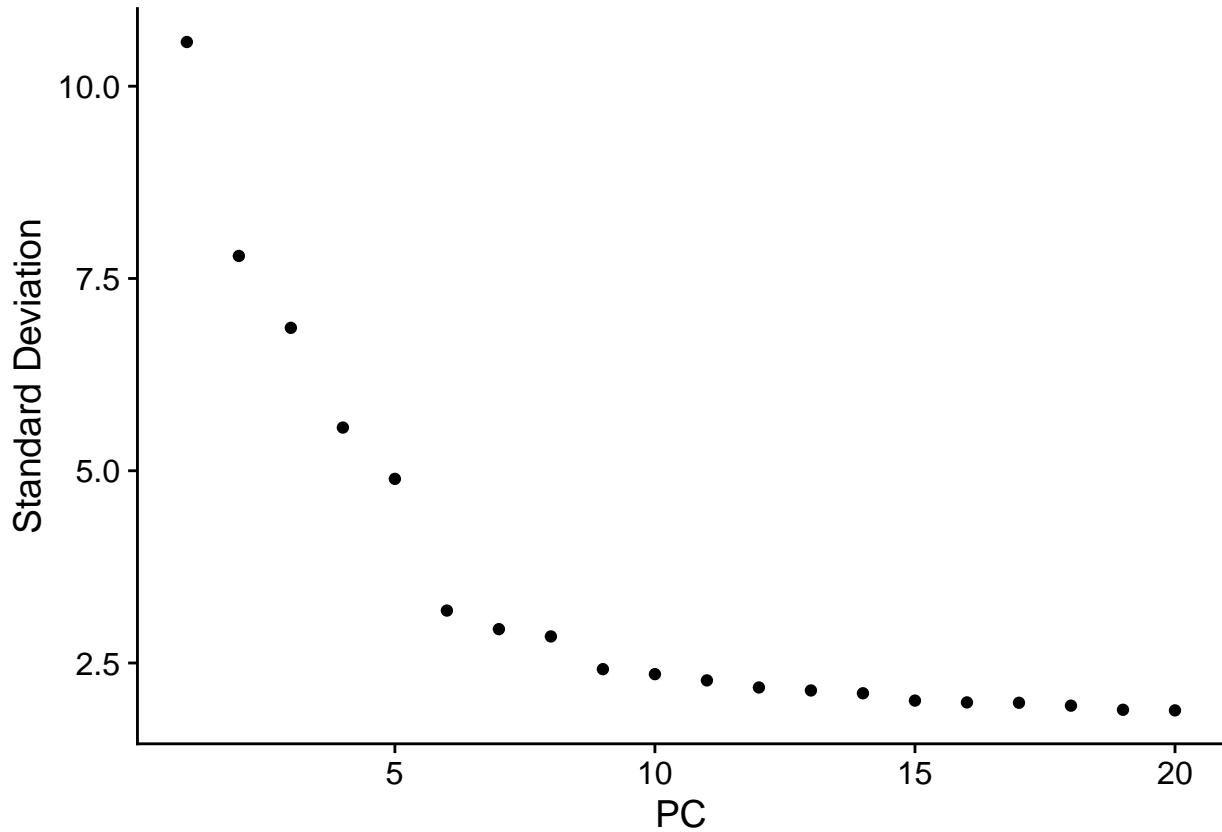
```
## PC_ 4  
## Positive: IL7R, LEF1, FTH1, SERINC5, TSHZ2  
## Negative: MCTP2, C1orf21, AUTS2, KLRD1, IL18RAP  
## PC_ 5  
## Positive: ZEB1, SERINC5, SESN3, GRK5, CDC14A  
## Negative: FTH1, S100A4, RPL10, NKG7, S100A6
```

```
DimHeatmap(pbmc_sparse, dims = 1, cells = 500, balanced = TRUE)
```

PC_1



```
ElbowPlot(pbmc_sparse)
```



Clustering

Cluster cells based on principal components.

```

pbmc_sparse <- FindNeighbors(pbmc_sparse, dims = 1:15)

## Computing nearest neighbor graph

## Computing SNN

pbmc_sparse <- FindClusters(pbmc_sparse, resolution = c(0.1,0.3,0.5,0.7,1))

## Modularity Optimizer version 1.3.0 by Ludo Waltman and Nees Jan van Eck
##
## Number of nodes: 1877
## Number of edges: 62383
##
## Running Louvain algorithm...
## Maximum modularity in 10 random starts: 0.9649
## Number of communities: 5
## Elapsed time: 0 seconds
## Modularity Optimizer version 1.3.0 by Ludo Waltman and Nees Jan van Eck
##

```

```

## Number of nodes: 1877
## Number of edges: 62383
##
## Running Louvain algorithm...
## Maximum modularity in 10 random starts: 0.9232
## Number of communities: 8
## Elapsed time: 0 seconds
## Modularity Optimizer version 1.3.0 by Ludo Waltman and Nees Jan van Eck
##
## Number of nodes: 1877
## Number of edges: 62383
##
## Running Louvain algorithm...
## Maximum modularity in 10 random starts: 0.8974
## Number of communities: 10
## Elapsed time: 0 seconds
## Modularity Optimizer version 1.3.0 by Ludo Waltman and Nees Jan van Eck
##
## Number of nodes: 1877
## Number of edges: 62383
##
## Running Louvain algorithm...
## Maximum modularity in 10 random starts: 0.8737
## Number of communities: 12
## Elapsed time: 0 seconds
## Modularity Optimizer version 1.3.0 by Ludo Waltman and Nees Jan van Eck
##
## Number of nodes: 1877
## Number of edges: 62383
##
## Running Louvain algorithm...
## Maximum modularity in 10 random starts: 0.8423
## Number of communities: 14
## Elapsed time: 0 seconds

```

```
print(head((pbmc_sparse@meta.data)))
```

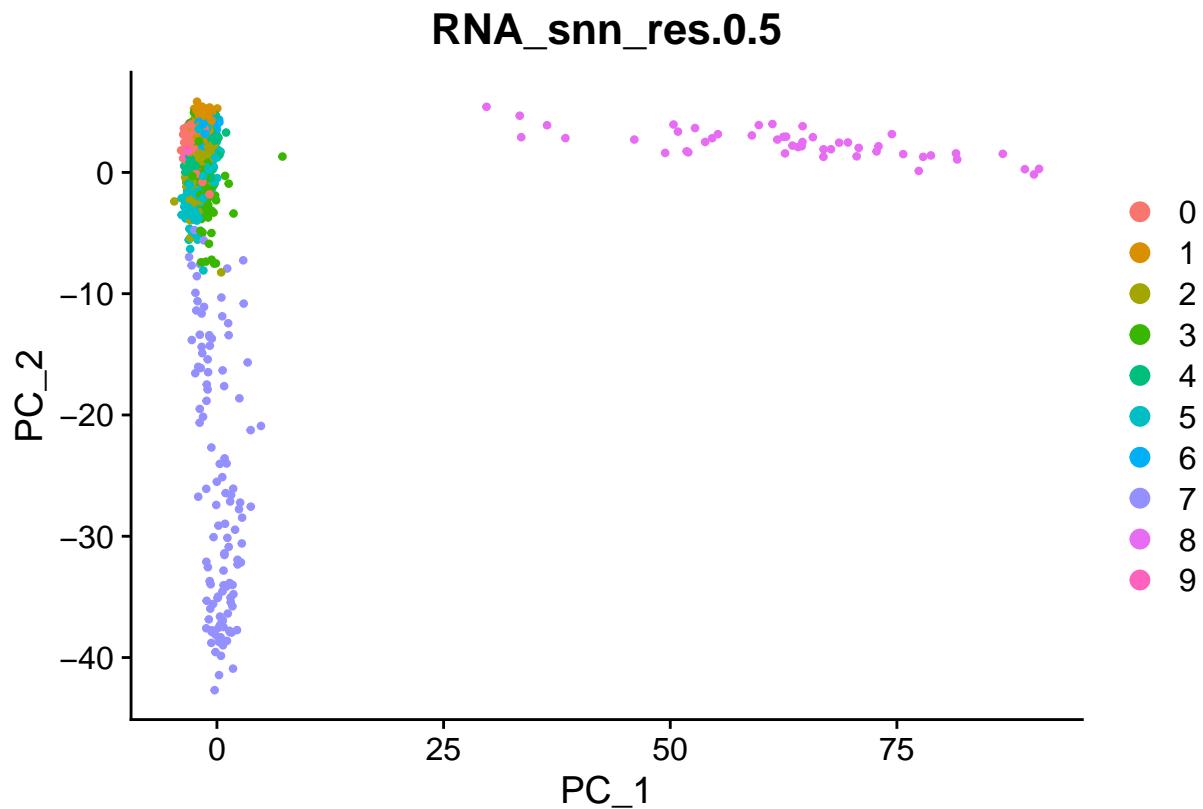
	orig.ident	nCount_RNA	nFeature_RNA	percent.mt
## AAACCAAAGGCTATAT-1	pmbc	2047	1205	3.810454
## AAACCAAAGTGTGCC-1	pmbc	7242	2420	4.128694
## AAACCATTCCCCCTGTA-1	pmbc	246	217	2.439024
## AACGAATCAGCACGT-1	pmbc	7309	2453	3.228896
## AACGACAGGGCTCTG-1	pmbc	8071	2422	3.060339
## AACGACAGGTCATTG-1	pmbc	7579	2258	1.820821
	RNA_snn_res.0.1	RNA_snn_res.0.3	RNA_snn_res.0.5	
## AAACCAAAGGCTATAT-1	0	1	0	
## AAACCAAAGTGTGCC-1	0	1	0	
## AAACCATTCCCCCTGTA-1	2	2	3	
## AACGAATCAGCACGT-1	0	0	1	
## AACGACAGGGCTCTG-1	0	0	6	
## AACGACAGGTCATTG-1	0	0	1	
	RNA_snn_res.0.7	RNA_snn_res.1	seurat_clusters	
## AAACCAAAGGCTATAT-1	0	1	1	
## AAACCAAAGTGTGCC-1	0	1	1	

```

## AAACCATTCCCCTGTA-1      3      3      3
## AAACGAATCAGCACGT-1     1      0      0
## AAACGACAGGGCTCTG-1     5      4      4
## AAACGACAGGTCAATTG-1    1      0      0

```

```
DimPlot(pbmc_sparse, group.by = "RNA_snn_res.0.5")
```



```
Idents(pbmc_sparse)
```

```

## AAACCAAAGGCTATAT-1 AAACCAAAGTGTGCC-1 AAACCATTCCCCTGTA-1 AAACGAATCAGCACGT-1
##           1           1           3           0
## AAACGACAGGGCTCTG-1 AAACGACAGGTCAATTG-1 AAACGCCTCGAACGCT-1 AAACGTAAGCTATGCA-1
##           4           0           5           9
## AAAGCAATCATGCTTC-1 AAAGCTAAGATAGATG-1 AAAGCTAAGTGTCTG-1 AAAGGTCAGTATGAGA-1
##           9           5           7           5
## AAAGTCAAGCAAGGGC-1 AAAGTCAAGCATTAAAC-1 AAAGTTGAGCCTTCCA-1 AAATGAGTCCCATGAA-1
##           2           2           9           3
## AAATGGATCCGTCCGT-1 AAATGGGCAGGTTCGA-1 AAATGTGAGCCGATGA-1 AAATTCCGAAGTGGCC-1
##          11          13          9           5
## AAATTCCGAAGTGGCC-1 AACACCGCATGAAGGA-1 AACACTTAGATACTCG-1 AACAGGTAGGCGTAGA-1
##           0           1           1           4
## AACATAGAGATTGAGA-1 AACATAGAGTGGGTCT-1 AACATCACAGGTAGCC-1 AACATTCACTATGATC-1
##           7           7           0           2
## AACATTCACTATGATC-1 AACATTGCAGGGCTAC-1 AACCAACCAACCTCAC-1 AACCAAGGTGAACCGG-1
##          10          8           1           9

```

```

## AACCAATTGCTGACG-1 AACAGCTCACCTCG-1 AACAGCTCCATGTCT-1 AACAGGAGTCAAGGG-1
##          1             1             3             11
## AACCATTAGTGCGCCA-1 AACCCACAGCAATTG-1 AACCCAGCAAATGGAG-1 AACCCAGCACCAGCTT-1
##          4             0             6             6
## AACCCAGCAGGGCACT-1 AACCTAACGAACTGC-1 AACCTAACGCTACGAC-1 AACCGATCATTAGGAC-1
##          3             1             5             2
## AACCTAACAAACCATA-1 AACCTAACAGCTCTCG-1 AACCTAGTCGTGCGAT-1 AACCTCAAGTCGAGTC-1
##          6             2             9             9
## AACGAACAGCTGGGTT-1 AACGAATGTTAGCGAA-1 AACGCTATCTGTCTGT-1 AACGGATAGGGATTG-1
##          4             13            1            10
## AACGGATAGGTAGTGG-1 AACGGCAAGAAGGGTT-1 AACGGGGCAACTAGCG-1 AACGGGGCATGAAGGA-1
##          0             0             2             7
## AACGGTGAGATTCGAT-1 AACGGTGAGTATGACT-1 AACGTAAGGGTCTCG-1 AACTAGAACGCCGACCA-1
##          0             7             6             5
## AACTAGAACGCACTTA-1 AACTAGAAGTAGTCCA-1 AACTAGAACGTACAGT-1 AACTAGCCACATTACT-1
##          4             0             2             5
## AACTGAAAGCATGACC-1 AAGCCAAGTTCGGCGT-1 AAGCCATCAGGCAATT-1 AAGCCATCATCGGTGA-1
##          4             5             6             5
## AAGCCCCGTGAAGTAT-1 AAGCCGCAAAACTGA-1 AACGCTATCCACCTGC-1 AACGCTGCAAGCGTAT-1
##          7             6             5             2
## AACGCATAGGAACCAG-1 AACGGGATCCTGATCT-1 AACGGGGCAACCTCGT-1 AACGGGGCAACTATGA-1
##          1             8             8             9
## AAGGACTAGGGACGT-1 AAGGCCAAGATTGCCA-1 AACGCCAAGGTCCCAG-1 AACGCCAACCTTGCG-1
##          4             0             0            10
## AACGGCCCAGGCAATT-1 AACGCTAGTGTAGTG-1 AACGGCATCAGCCCGA-1 AACGGCCAGCGGGTAA-1
##          1             10            1            0
## AACGGTTAGTAGCAGG-1 AAGTACCCAAATCATG-1 AACGCTAAAGGGTTGGA-1 AACGCTAAAGTTAGAGA-1
##          5             13            1            2
## AACGCTATTCCGTCCAC-1 AACGCTCCCTGGCT-1 AACGCTCGCTTGAA-1 AACGCTCAAGCCGTA-1
##          1             3             3             5
## AACGCTCCATAATCTC-1 AACGCTAAAGTAGAGGT-1 AACGCTCAGCTGGTT-1 AACGCTCAAGTCGAAGG-1
##          9             7             0             8
## AACACGAAAGTTGCAGC-1 AACACGTTCCCATGCC-1 AACACGTTCTATCACC-1 AACACGCTCCCATGCC-1
##          1             3             6             3
## AACATGGAGAATCCAT-1 AACACTAGGGCTCCA-1 AACACTCAGTTAGGCC-1 AACACGCTCCCATGCC-1
##          10            2             2             5
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          0             8             10            12
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          9             6             4             6
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          7             13            0             3
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          10            0             1             1
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          3             3             11            5
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          6             0             2            10
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          6             1             2             3
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          2             0             3             6
## AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1 AACACGCTCCCATCTC-1
##          9             6             1             7

```

```

## ACAGAATGTTATCATG-1 ACAGATGGTAATTGGG-1 ACAGCGAAGCTATCGA-1 ACAGGAACAAACCAAGT-1
##          5           1           2           7
## ACAGGGGCAGTAATCA-1 ACAGGTGAGGGTTAGG-1 ACAGGTGAGTGCTCGG-1 ACAGTTGTCCAGCTAA-1
##          5           5           2           10
## ACAGTTAGGCGTACT-1 ACATAGAAGGGGCAGT-1 ACATAGAAGTTAGCAT-1 ACATAGCCATCCTGTA-1
##          4           2           1           7
## ACATCATAGGGTCATC-1 ACATCATAGGTCCATA-1 ACATCCCCATGGCTTC-1 ACATCCTCAGGGCAA-1
##          4           2           3           0
## ACATGAAAGCGAACCT-1 ACATGAAAGCTGGTCG-1 ACATGAAAGGGCAGAC-1 ACATGCCAGGGCAAC-1
##          0           4           1           0
## ACATGGCTCTCACTAC-1 ACATGGTCAAGTTACA-1 ACATGGTCAGGCTCAA-1 ACATTCCTCCCATGAA-1
##          5           5           5           3
## ACCAAACCACCTGCAT-1 ACCAAGTCATCGGTGA-1 ACCAATTAGGTTACTG-1 ACCACGTAGCATGTAT-1
##          6           6           11          7
## ACCACTAAGCTATCAG-1 ACCATAACAGGACAGG-1 ACCATAGTCGTGCTAA-1 ACCATATAGCATATAC-1
##          10          6           9           5
## ACCATTCAAATGGAG-1 ACCCATAAGCGAGACA-1 ACCCATAAGCGCAACT-1 ACCCATAAGGGCAGGT-1
##          8           11          11          7
## ACCCATAAGGTTGCAC-1 ACCCCATCAAAGGTAG-1 ACCCGAACATAGGCTG-1 ACCCGAACATCGCTTA-1
##          2           4           4           7
## ACCCGATAGATTAGAG-1 ACCCGATAGTGCCAG-1 ACCCGCAAGGCAATGG-1 ACCCGTGAGGTAGCAG-1
##          0           0           0           12
## ACCCTAGGTTCTTCA-1 ACCCTCGACAAGGCC-1 ACCCTTAGAAGCCAG-1 ACCCTTAGATTACCG-1
##          4           3           2           1
## ACCCTTAGTCGAGTC-1 ACCGACTAGCATCCGG-1 ACCGCAACATCAAGCG-1 ACCGCCAAGCATAAGGG-1
##          2           2           6           0
## ACCGCCAAGTTACGAT-1 ACCGGTTAGCAACCAC-1 ACCTATGAGGTGGCAA-1 ACCTCTTAGCATGGGA-1
##          2           0           2           0
## ACCTGAATCAGCGAAG-1 ACCTTCACAGCCAGTA-1 ACGAACCTCTATGTGG-1 ACGAACAGCTGATTTC-1
##          4           6           1           0
## ACGACATCATAAAGTGC-1 ACGAGCAAGATTGTG-1 ACGAGTAGTTGATGC-1 ACGATTTAGCCAACTA-1
##          8           7           1           5
## ACGCCAACAAAGGGTA-1 ACGCCATAGAACGATA-1 ACGCCATAGCAGGGAC-1 ACGCCATAGCTGGTAC-1
##          10          0           13          13
## ACGCCATAGTGTCCA-1 ACGCCAAGTCAATGT-1 ACGCTTGGTTGGCTG-1 ACGGACAAGGGTCTCG-1
##          1           2           1           7
## ACGGCAAAGCGCTGTG-1 ACGGCAAAGTACCAGC-1 ACGGCTTAGCAACCTA-1 ACGGCTTAGTAGGCAG-1
##          1           5           11          7
## ACGGCTTAGTGCCTGG-1 ACGGGTAAGAACGGTG-1 ACGGGTAAGTAACCCA-1 ACGGGTTCCATGTCT-1
##          1           4           2           3
## ACGGTCACAGTTAGGT-1 ACGGTGAAGGATGAAC-1 ACGGTGAAGGGTACTC-1 ACGTAACCATAAGCTA-1
##          1           0           1           0
## ACGTATTAGCATAGTT-1 ACGTCACAGGATCACC-1 ACGTGGTTCTAGTTCC-1 ACGTGGTTCTGGCGT-1
##          2           4           10          1
## ACGTTCAAGTCGCACG-1 ACGTCCCAGGACTTG-1 ACGTTTAGTGAAGGAG-1 ACGTTGAGAACGGAT-1
##          1           3           0           2
## ACGTTTGAGTACGGAG-1 ACTAAGGGTGAAGCTA-1 ACTACCCCAGGTACG-1 ACTACCTCCCGCAAG-1
##          4           0           3           8
## ACTATCCTCCGTTACT-1 ACTATTCCATGGTGCA-1 ACTCAATAGCGCATTAA-1 ACTCACAAAGCCAGGAA-1
##          9           0           1           5
## ACTCACAAGGGTACA-1 ACTCACAAGGTGGACA-1 ACTCCAAAGAATCCTG-1 ACTCCAAAGCCCTGGA-1
##          0           4           4           2
## ACTCCCATCCCGCTGT-1 ACTCCCGAACCAAGT-1 ACTCCTTAGGCGAATG-1 ACTCGAACATCGTCTCTG-1
##          1           6           2           4

```

```

## ACTCGCCTCCCATTAC-1 ACTCTCACACAGCAAT-1 ACTGAGGAGCGAACTC-1 ACTGAGGAGGTATCCA-1
##          3           6           7           0
## ACTGCCCTCCTGATTC-1 ACTGCCTCATTGTC-1 ACTGCTAACGCGAGAGC-1 ACTTAGGTCCAGCACG-1
##          4           5           8           5
## ACTTCATCACATTAAG-1 ACTTCGTTCCCATTAC-1 ACTTGCTTCAATGCC-1 ACTTGCTCCCGCTAG-1
##          5           3           3           0
## ACTTGTGAGCCATGAC-1 ACTTCGCAGTTAGCG-1 AGAAGTCAGCCATGAC-1 AGAAGTCAGCCGAGTT-1
##          9           2           7           9
## AGACAACAGCGAGCTT-1 AGACAGACAGCTATGG-1 AGACATAAGCGCAATC-1 AGACATAAGGGTGAGC-1
##          0           5           0           1
## AGACATAAGTCGAATT-1 AGACGATAGGTTAGTT-1 AGACGCAAGGTTACGC-1 AGACGGATCCTCTACG-1
##          8           0           9           4
## AGACGGGCAAACGTGA-1 AGACGGGCAGGTTAGT-1 AGACGGGCATCCTGCG-1 AGACTGCTCCCATGAA-1
##          5           0           2           3
## AGACTGCTCCTCGTG-1 AGAGAATCAATCAGCG-1 AGAGACCGTAGTGCAG-1 AGAGACTAGTGGCTTA-1
##          2           6          13           0
## AGAGAGAAGATTGAGA-1 AGAGGGTCACATTCCA-1 AGAGTATGTGCGGTCT-1 AGAGTCCTCGTGATAT-1
##          0           2           7           5
## AGCAACCTCACGTAGC-1 AGCAATTCCCCATGC-1 AGCACCACAAACTGCG-1 AGCACCACAATACGCG-1
##          1           3           3          10
## AGCACCACACCTCCC-1 AGCACTTGTTCACCAG-1 AGCAGCAAGGAATGCG-1 AGCATCATCCGTAATG-1
##          5           8           7           0
## AGCATCGCAACCTTGC-1 AGCATCGCAATCGGCA-1 AGCATCGCATAGATCA-1 AGCATGGAGCTGGAAG-1
##          0           8           2           2
## AGCATGGAGCTTCCCA-1 AGCATTGTCCATGTCT-1 AGCATTAGCAACCAC-1 AGCCAAAGTTGAGTAG-1
##          0           3           4           5
## AGCCCCAAGGCATAG-1 AGCCGATCGAATTAC-1 AGCCCTAGTTGACGCC-1 AGCCGATTCGAGTTGC-1
##          12          6           3           9
## AGCCGTTAGCTGGTCG-1 AGCCTGACAGTAATTG-1 AGCCTGGTCCTGTGAA-1 AGCGAATAGGCTCAGT-1
##          8           8           0           2
## AGCGAATAGGTATAT-1 AGCGAATAGTTACCGA-1 AGCGACAAGCAATGAA-1 AGCGACCCAAGGTCGC-1
##          2          12           0           1
## AGCGAGGCAAGTAAGG-1 AGCGATGAGCTGGTGT-1 AGCGCCATCCCTCGTA-1 AGCGCCATCGTGCCAG-1
##          2          12           0           0
## AGCGGTAAGGTTACGC-1 AGCGGTTCCCGTAGG-1 AGCGGTTCCCTCGCA-1 AGCGTCCGTTCGTCAG-1
##          2          6           0           1
## AGCTGGITCCATGTCT-1 AGCTGTTGTTGCGTAT-1 AGCTTATAGGGGTAGC-1 AGGAACTAGGATCCGT-1
##          3           7           0           5
## AGGAACTAGGTAAAGGT-1 AGGAACTAGGTAGCAG-1 AGGAATGCAACCTGAG-1 AGGACCAAGCCAGGTT-1
##          0           0          10           5
## AGGACCAAGGGTTAC-1 AGGACCAAGTTGCGCG-1 AGGACCCCAGGTTCAG-1 AGGACTAGTGAGTCGG-1
##          7           4           1           1
## AGGACTAGTGGCAGTG-1 AGGAGTTAGGCACAGA-1 AGGAGTTAGGTGGCTT-1 AGGATTAAGGCACGAA-1
##          1           8           1           1
## AGGCAAGTCGCGTGTG-1 AGGCAATAGGATGAAC-1 AGGCATGAGGTTAGTT-1 AGGCCAAAGGTACCCG-1
##          0           11          9          12
## AGGCCAAAGGTCGAGA-1 AGGCCATTCCCTCGTGC-1 AGGCCATTCTGTCAAG-1 AGGCGAATCTCATCAC-1
##          4           10           0           1
## AGGCGTTCCCTCATG-1 AGGCGTTCTGTCAAG-1 AGGCTCACATGACTAA-1 AGGGAACCAAAGGCC-1
##          3           0           1          13
## AGGGATTAGGATTCCG-1 AGGGCAATCAAGTCG-1 AGGGCTAACGGCTTC-1 AGGGTATAGGAGGTTG-1
##          10          0           2           4
## AGGGTCAAGATTAACC-1 AGGGTCAAGCAGGTAG-1 AGGGTCAAGCATTGAT-1 AGGGTTAGTCAATCAC-1
##          4           0           7          12

```

```

## AGGGTTGAGAATCAAG-1 AGGGTTGAGCCAGTGT-1 AGGGTTGAGGGACTA-1 AGGTAAATCCACCGGA-1
##          0           11           4           9
## AGGTAACAGAACGGGC-1 AGGTAGTAGCAGGTCT-1 AGGTAGTAGGATGGCA-1 AGGTGATAGTGGCGAA-1
##          7           1           1           6
## AGGTGCTCGAGGTCT-1 AGGTGTGAGGCTTCGG-1 AGGTGTGAGGGATGC-1 AGGTTCCAGGTTGGC-1
##          5           4           2           8
## AGGTTGGAGCATCAA-1 AGGTTGGAGTATGAAG-1 AGTAACCCAGCTACGA-1 AGTACACCATAAGTCG-1
##          7           5          13           2
## AGTATAGAGATTGGTT-1 AGTATGAAGAAGCTCC-1 AGTATGAAGGTACGAG-1 AGTATGTTCTCGATT-1
##          7           0           4           4
## AGTATTCAAGCATATA-1 AGTATTCAAGCCAGGTT-1 AGTCAGGAGGTTGAGG-1 AGTCATTAGGGCATA-1
##          8           4           0           8
## AGTCCTAACGCGATGT-1 AGTCGATCATAGAGAG-1 AGTCTCAAGCCTAGCG-1 AGTCTCAAGGAGGACC-1
##          7           2           0           5
## AGTCTTGAGCGGATGA-1 AGTGAACAGGGTTAGG-1 AGTGAACAGTGCCGA-1 AGTGACAGTAAGCACA-1
##          9           5           2           6
## AGTGAGGTCGAACGCT-1 AGTGATCCAAGTGGC-1 AGTGATCCAAGCCAAT-1 AGTGCGCCAGCAGGCT-1
##          0           6           8           2
## AGTGCGCCATGTTGC-1 AGTGCTCAGAATCGGG-1 AGTGCTCAGATAGTCT-1 AGTGCTCAGGAGTAAC-1
##          8           2           1           2
## AGTGGAACAAACGGTC-1 AGTGGATAGGGTAGCA-1 AGTGGCTTCCACCTTG-1 AGTGTAAAGAATCAAG-1
##          6           0          11           1
## AGTGTGCAACTGGCA-1 AGTGTGAGTCTGGTTG-1 AGTGTGTCGCACTC-1 AGTGTGTCGTACAGC-1
##          2          12           1           9
## AGTTAGAACGGAATCC-1 AGTTAGCCAGTTAGGT-1 AGTTAGCCATCACACC-1 AGTTAGCCATGGTACG-1
##          2           0           7           5
## AGTTGAGGTGAGCACG-1 AGTTGCATCACTTCAC-1 AGTTGGAGGCTACGT-1 ATAACGAAGCTAGAGG-1
##          1           4           0           4
## ATAAGCTCCCCATGC-1 ATAAGGATCCATCGAA-1 ATAAGTGAGCGGTGAA-1 ATAATGCTCTAGGCC-1
##          3           9           2           3
## ATACCATAGGTGCGTT-1 ATACGAAAGGGCTAGA-1 ATACGCGCAGGACTTG-1 ATACGTTAGGGCAGTA-1
##          9           0           6           5
## ATACGTTAGGTGCGTAC-1 ATACGTTAGGTGATCC-1 ATACTGGTCGCTGGCA-1 ATAGCGCTCACTTCGT-1
##          10          0           0           1
## ATAGCGCTCCGTGCGA-1 ATAGGATGTTGCTTAA-1 ATAGGCCTCCGGACAT-1 ATAGGCAGTGACCTA-1
##          4           4           5           4
## ATAGGGTAGGTACGGA-1 ATAGGGTAGTTGGATT-1 ATAGTGAAGTACGGTC-1 ATATCACAGCGAAGTG-1
##          4           1           2          12
## ATATCACAGTCAGGAG-1 ATATCAGCAAGGTATC-1 ATATCAGCATTACCTG-1 ATATGCCAGCTCTCG-1
##          0           5           6           6
## ATATGTCAGGAATGCG-1 ATATGTCAGGATCCCG-1 ATATTCCCATTAGAGC-1 ATATTCCCATTCGTGC-1
##          1           1           5           0
## ATCAACTAGTTGGCTA-1 ATCAGGGAGCCTATCT-1 ATCAGGGAGTAAGGTA-1 ATCAGGTATGACTAA-1
##          1           5           4           3
## ATCAGTTAGCCTGAGT-1 ATCAGTTAGTGACCGA-1 ATCATCCTCAATCCCT-1 ATCATGGTCGCTCCGT-1
##          1           1           1           0
## ATCATTCCAAACCGTG-1 ATCCAATAGGATGAAC-1 ATCCACAAGAACATA-1 ATCCACAAGTAGGAGT-1
##          8           7           1          12
## ATCCACTTCCCATGCC-1 ATCCACTTCTATCCAC-1 ATCCATAGTGAAGGTC-1 ATCCATGAGTAATGTC-1
##          3           3          13           9
## ATCCCAAAGGGTGACA-1 ATCCCTTAGGAGGCAC-1 ATCCGACAGCATCAAT-1 ATCCGACAGCTACGGT-1
##          11          4           7           0
## ATCCGCTCCCATGCC-1 ATCCGTAAGCCTAGCG-1 ATCCGTAAGCGCAATC-1 ATCCGTAAGGTATCTG-1
##          3           8           0           2

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## ATCCGTAAGTCAGGGA-1 ATCCGTAAGTTAGGTT-1 ATCCTAGAGATTGCGC-1 ATCCTAGAGCCTGTAA-1
##          12            7            5            2
## ATCCTAGAGCGGTAGA-1 ATCCTCCGTCAAGCGG-1 ATCCTGAAGAAGGACT-1 ATCCTGAAGGCAACGA-1
##          0            1            0            4
## ATCGAAGGTTCACTCC-1 ATCGAGGAGTTGGTCA-1 ATCGATTAGCGATTGC-1 ATCGATTAGCTGGAA-1
##          6            5            3            2
## ATCGCCCTCATGGACC-1 ATCGCCCTCCCATTAC-1 ATCGCGCGTAACCAA-1 ATCTAACAGGAGGTTG-1
##          3            3            0            0
## ATCTAACAGGTTCAGC-1 ATCTCATCAACCTTC-1 ATCTGCCAGGATGCC-1 ATCTGCAAGCTGGATC-1
##          1            8            6            0
## ATCTGGATCCTGGTAA-1 ATCTGTGAGCGAGAGC-1 ATCTGTGAGGTACTTG-1 ATCTGTTCACAGGGTC-1
##          9            2            1            3
## ATCTTAGGTGGTCCT-1 ATCTTGCTCCCATTAC-1 ATGAAAGTCGTTAGAT-1 ATGACCCAGCCTATCT-1
##          6            3            9            4
## ATGAGGCGTTATCAGC-1 ATGAGGTAGTGCAACC-1 ATGAGTAAGGAACCCT-1 ATGAGTAAGGCGCATT-1
##          1            2            4            8
## ATGAGTAAGTTACGCA-1 ATGATGAAGGTACCCG-1 ATGCACGCAAATTCC-1 ATGCACGCATAACCAA-1
##          2            10           5            7
## ATGCAGGAGTCGCGTG-1 ATGCATTAGATTAGGA-1 ATGCCAATCCCCATGC-1 ATGCCACAGTAGGCGA-1
##          2            0            3            7
## ATGCCTAACGGTGAGC-1 ATGCGGTTCGAGTGTC-1 ATGCTAACAAATAGACC-1 ATGCTAACACAGGCGT-1
##          5            5            6            2
## ATGCTAACATGGATCG-1 ATGCTCAAGGAGGACC-1 ATGCTCCATGGTCAG-1 ATGCTCCATGGTCTC-1
##          0            12           3            3
## ATGCTTGAGAAGCTAA-1 ATGGACCTCACACCTT-1 ATGGACCTCCCATGCC-1 ATGGAGACATTAGTGA-1
##          0            1            3            8
## ATGGAGTAGGTAGTCC-1 ATGGAGTAGTTAGCTG-1 ATGGCAAGTCTGGCT-1 ATGGCCCGTGACTCGC-1
##          0            4            11           3
## ATGGCGAAGGTATAGA-1 ATGGGATAGTACCAACA-1 ATGGGCAAGTATCTCC-1 ATGGGTGAGGAGCTAG-1
##          2            12           2            1
## ATGGGTGAGTGACCAC-1 ATGGTAAAGCTATGTG-1 ATGGTGAGTGATAGTG-1 ATGGTTTAGCTGAGAG-1
##          5            1            0            0
## ATGGTTAGGTACCAAC-1 ATGTCCCCAGGTATCG-1 ATGTCCCCATGACCC-1 ATGTCCCCATTACTCG-1
##          1            3            3            3
## ATGTCTTCAATGGCC-1 ATGTGTTAGCGATGA-1 ATTACAGCAGTTGCGA-1 ATTACACCTCCATGTCT-1
##          1            0            5            3
## ATTCACTAGTTACGGC-1 ATTCCGCCATGACGAT-1 ATTCACTAGCTTAACG-1 ATTCACTCAATATCTC-1
##          0            3            4            6
## ATTGAGGGTTAGGGTA-1 ATTGCCCATGAAGTC-1 ATTGCCCATGGTAAC-1 ATTGCCCATGGTACG-1
##          1            3            3            3
## ATTGGCCAGTGAGCCT-1 ATTGGCTGTAAGCTCT-1 ATTGTCAAGTACG-1 CAAACCATCCCATGCC-1
##          2            5            8            3
## CAAACCCAGATAGCGG-1 CAAACTAGAATCAAG-1 CAAAGCCTCCCATGAA-1 CAAAGCGAGTTGGACC-1
##          5            10           3            1
## CAAAGCTCACTAGGCA-1 CAAAGGGTCGTAGTCA-1 CAAAGGTAGCAACCTA-1 CAAAGTAAGCATGGAG-1
##          10           4            2            2
## CAAATGTTCCGGTAGT-1 CAAATTCAAGTAACTT-1 CAAATTCAAGTGGGTCT-1 CAACACGCATTGGCCT-1
##          5            1            1            8
## CAAGCGAAGGATCCCG-1 CAAGCTCAGCCACTAA-1 CAAGCTCAGTTGGCGT-1 CAAGGATAGCCCGCGTA-1
##          2            2            12           0
## CAAGTAAAGTGGCAAG-1 CAAGTAAAGTGGTAG-1 CAAGTCGCATGAGCCA-1 CAAGTCTGTATGGTGA-1
##          2            10           13           1
## CAATAGAAGCCGATTA-1 CAATAGAAGGTCCAAC-1 CAATAGCCACTAGCAG-1 CAATCATAGCCATCCC-1
##          1            4            10           4

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## CAATCTTCAAGCTGGC-1 CAATGCATCCTGCTGC-1 CAATGGTCATGACCGA-1 CAATTAGCAATATGTG-1
##          0           3           7           6
## CAATTGGTCCCTCATG-1 CACAACATCTAACTGG-1 CACAAGTCAGCAGTCA-1 CACACAATCCCCATGC-1
##          3           1           6           3
## CACACAATCTAACTGG-1 CACACCTCATGCTGTC-1 CACACTAACGATTAGT-1 CACACTAACGCCGTCT-1
##          8           1           6           4
## CACATCAAGCCTGCCT-1 CACATTGAGGGCTTAC-1 CACATTGAGGGTGGGA-1 CACCAGACAATCGGGC-1
##          0           2           4           0
## CACCATCCACAATCCC-1 CACCATTCATCGTT-1 CACCGCAAGGAATGTA-1 CACCGCAAGTCTAGCA-1
##          9           5          12           4
## CACCGCAAGTGAGTCC-1 CACCTAAAGTGGCCTG-1 CACCTCATCAGTATGT-1 CACCTGCTCTAGGCCG-1
##          4           1           6           3
## CACCTGCTCTCACCTG-1 CACCTTAGGGTATGG-1 CACCTTAGTGACGGA-1 CACGACTAGTGAACGG-1
##          3           0           7           1
## CACGACTAGTGCAATT-1 CACGCAACATCGCTCG-1 CACGCCAAGCTAGGCT-1 CACGCCAAGCTAGGGA-1
##          0           9           1           0
## CACGCCAAGCTGGAGA-1 CACGCCAAGGAGGTTG-1 CACGTATGTGGGTTGG-1 CACGTTGGTGGGTCGA-1
##          4           7           2           5
## CACTACCCAAGTGTAC-1 CACTACCCATGACTCC-1 CACTACTTCACGGATC-1 CACTCCGCAATCTGGG-1
##          10          3           7           5
## CACTGCCTCCTCATGT-1 CACTGGACAAGTCGCA-1 CACTGTCCATGTCGGA-1 CACTTAGAGGCATGTC-1
##          3           2           3           4
## CAGCACTAGTAATCGT-1 CAGCCATAGGCGTCAT-1 CAGCGATTCCATGTCT-1 CAGCGCATCATCACTC-1
##          0           4           3          10
## CAGCGCATCCCCATGC-1 CAGCTAATCATGGTAT-1 CAGCTAATCGCTGAGT-1 CAGCTCTCATAACTCT-1
##          3           1           9           3
## CAGCTCTCATTACCTG-1 CAGGAACGTCTAGGTT-1 CAGGATAGTGAAGCGT-1 CAGGCACCACAGGCAC-1
##          3           4           5           3
## CAGGCCATCCATCGAA-1 CAGGGCTCAAGTAGTC-1 CAGGGCTCATGCAGTG-1 CAGGGTAGGTTGCAC-1
##          8           0           6           7
## CAGGTACACATAAGGTC-1 CAGGTCCGTGACTCTG-1 CAGGTGAAGTCAAGGG-1 CAGGTGAAGTTAGAGA-1
##          5           3           7           0
## CAGTATTAGCCAGCAT-1 CAGTATTAGGCAGATT-1 CAGTCAATCATGTGAT-1 CAGTCCCTCCATGTCT-1
##          2           9           8           3
## CAGTGTGTGAAGTCA-1 CAGTTATAGTCATTCC-1 CAGTTGAGCGATTCA-1 CATACAACATCATCAT-1
##          1           4           8           5
## CATAACCCATGACACG-1 CATAACCCATGGAATC-1 CATAGGGAGAACGACG-1 CATATTGGTAAGGGCT-1
##          3           3           0           1
## CATCCAAAGTAAGTCT-1 CATCCAAAGTAGGAAC-1 CATCCAAAGTGGGTCT-1 CATCCCATCACGTGCG-1
##          2           1           1           3
## CATCCGCTCTCATCCG-1 CATCCGCTCTGGTAGC-1 CATCCGGAGTCGCTAA-1 CATCTCACATAGGTTA-1
##          3           0           0           0
## CATGATTAGTGCTGGT-1 CATGCAATCCCCATGC-1 CATGCCTCAATCCGTC-1 CATGCCTCAATCTAAG-1
##          8           3           7           8
## CATGGGTTCGATTAAC-1 CATGTCAAGGTCCACG-1 CATGTCAAGGTCCAGT-1 CATGTTGAGCGACTAC-1
##          9           8           2           1
## CATTACCTCATGTGTG-1 CATTACCTCCGGTATA-1 CATTAGTAGCAATGAA-1 CATTAGTAGGTGCGTT-1
##          1           0           5           1
## CATTAGTAGTCAGGGA-1 CATTGCTTCATGCCGG-1 CATTGTGAGAAGCTAA-1 CATTTCGCTATAATCCT-1
##          6           3           7           6
## CCAAAGTCAGGATACT-1 CCAAAGTCATTCTCG-1 CCAACCTCAGGCAGGA-1 CCAACTAAGTGTCAAT-1
##          8           5           2           0
## CCAAGGTTCACCTGGG-1 CCAATAGTCTAGGCCGT-1 CCAATCAAGGCAACTC-1 CCAATCAAGTTGCATG-1
##          4           1           2           4

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## CCACATAAGAATCGTT-1 CCACCGTTCATCACAG-1 CCACGAACAACCGCAA-1 CCACGCAAGGTAAGCG-1
##          9           8           0           2
## CCAGAATCAGCTATGG-1 CCAGAGAAGAACATC-1 CCAGATGCAAAGGATG-1 CCAGCAACACAGCATG-1
##          13          0           6          12
## CCAGCCAAGGAACCTC-1 CCAGCCAAGGATTGGG-1 CCATAATAGTCGTTAG-1 CCATAACTTCGTGATAT-1
##          0           5           5           9
## CCATCCGCAACATTAG-1 CCATGGGTCGATCAGC-1 CCATTAGAGGGTATCC-1 CCATTAGAGTGGCTAC-1
##          9           1           0           2
## CCATTAGAGTTGGGTC-1 CCATTCAGCAGGTAG-1 CCCAATCCAGGTAGGG-1 CCCACGTTCCCCATGC-1
##          4           2           0           3
## CCCACGTTCTGCGCT-1 CCCACGTTCTAGCGCG-1 CCCAGCAAGAACGCTAA-1 CCCAGCAAGGCCATTGA-1
##          3           6           1           0
## CCCAGTGAGATACTCG-1 CCCAGTGAGGGCATT-1 CCCATCATCACGGAGA-1 CCCATGAGTCATGCGC-1
##          1           0           2           3
## CCCATGAGTTGCGGTC-1 CCCATGCTCATGCACA-1 CCCATGCTCCCATGCC-1 CCCATGCTCCGCGTGA-1
##          3           1           3           3
## CCCATGCTCGCGTCCT-1 CCCATGCTCTAATGCG-1 CCCATGCTCTCACCGC-1 CCCATGCTCTGTAAGT-1
##          3           3           1           3
## CCCATGGAGGGTAGAT-1 CCCATGGAGTGATCTG-1 CCCATTTAGCTACCGG-1 CCCATTTAGGAGCTAG-1
##          1           0           4           0
## CCCATTTAGGCGCATT-1 CCCGACAAGCAAGTCC-1 CCCGACAAGGTCAAGG-1 CCCGATGAGATTCCAG-1
##          1           5          13          11
## CCCGCATTCATAGCA-1 CCCGCTTAGAAGGTGCG-1 CCCGCTTAGGTTAGTT-1 CCCGTAAGTTCGTATA-1
##          6           0           0           6
## CCCTACGCATGGTAGT-1 CCCTATGTCTATGCAG-1 CCCTCACAGGCACAGA-1 CCCTCACAGGGGACGT-1
##          5           3          12           1
## CCCTGAGAGGCATGA-1 CCCTAACACCATTAGG-1 CCCTAACAGGTAATC-1 CCGAACTAGTAGAGCG-1
##          0           7          10           2
## CCGACATAGCAAGCTC-1 CCGACATAGGCTTACA-1 CCGACATAGTGAACCC-1 CCGACCAAGTACGCAC-1
##          11          1           0           6
## CCGACTTCACTATGAA-1 CCGATTAAGAACCGCA-1 CCGATTGGTTGGTCAT-1 CCGCAATAGCAACCCG-1
##          6           11          3           2
## CCGCAATAGGTCAACC-1 CCGCAATAGTAGCTGC-1 CCGCAATAGTTAGAGA-1 CCGCATGAGCGCTACG-1
##          2           1           2           7
## CCGCAAAGGTTCGCG-1 CCGCCATTCCCATGCC-1 CCGCCTAGGATAGAC-1 CCGCCTTAGGTCCCAG-1
##          0           3           0           8
## CCGCGAATCGCGCATG-1 CCGCTAGAGCCTGTGG-1 CCGCTAGAGTAGGCTC-1 CCGCTTATCACCGCAT-1
##          2           0           7           2
## CCGGATTAGGTCGTAC-1 CCGGATTAGTACCAAT-1 CCGGCTAAGTCAGGCT-1 CCGGTATAGGCTATAT-1
##          11          8           5           2
## CCGGTATAGGTGGATG-1 CCGGTATAGTGGCGAA-1 CCGGTCAAGCTGGTTA-1 CCGGTCAAGGCTTCCC-1
##          1           2           7           9
## CCGGTTGAGAACGGGC-1 CCGTAACAGTAGGAGT-1 CCGTCAAGTAGTGTCT-1 CCGTCAAGTGAGGTCG-1
##          4           2           3           1
## CCGTCCACATTACTCG-1 CCGTCGAAGGTGAGTG-1 CCGTCGTTCACTGCTA-1 CCGTGATAGCGGTGAA-1
##          3           4           9           0
## CCGTGATAGGGGACTA-1 CCGTGATAGGGGAGT-1 CCGTGCAAGTTAGGAA-1 CCGTGCTTCATGCCG-1
##          12          8           4           3
## CCGTGGATCCCTCTAG-1 CCGTGTGAGCCGAGTT-1 CCGTGTGAGGGCTTCG-1 CCGTGTGAGTCATCCT-1
##          1           2           2           1
## CCGTTCATCGCTGAGT-1 CCGTTCGGCATAGACCG-1 CCGTTGGAGCATCGAC-1 CCGTTGGAGTCGACCCG-1
##          4           5           2           6
## CCTAATGAGGTTGATT-1 CCTAATGAGTAATCAC-1 CCTAATTACAAGCAT-1 CCTACGGAGCATCCTT-1
##          9           4           6           4

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## CCTACGGAGGCTCTGG-1 CCTAGTTCATGCGAC-1 CCTATAGAGGCATCCG-1 CCTATGTTCCCTCTAG-1
##          4           3           8           1
## CCTCAGCTCCCTCATG-1 CCTCAGTCAATTACCT-1 CCTCATTAGGTAGAGT-1 CCTCGAAGTAGCGCGA-1
##          3           6           5           13
## CCTCTGATCAATCTGG-1 CCTCTGATCGACTGCC-1 CCTGAGACACAATGGT-1 CCTGCGAAGCTAGATT-1
##          5           0           6           0
## CCTGCGAAGTAGCGAG-1 CCTGCTCAGGATATGA-1 CCTGGTTCAACGGCTA-1 CCTGTAAAGCGATAGG-1
##          11          4           6           7
## CCTGTCGCAAGCGGTC-1 CCTGTGGAGCTCCTG-1 CCTGTGGAGTAGGAAC-1 CCTGTTGCCAGGA-1
##          2           2           2           0
## CTTTATATCATGCTGA-1 CTTTATATCGCTGGCA-1 CTTGCATCCATCCAT-1 CCTTAGCAGGACAGG-1
##          0           0           5           0
## CCTTCAGTCTAGGTT-1 CGAACATCATTAGTGA-1 CGAACGAAGAATCGAA-1 CGAACGAAGTTGCCGG-1
##          11          4           4           6
## CGAAAGTGAGCTATCCT-1 CGAAAGTGAGGAGCTAG-1 CGAAAGTGAGTGCTTAG-1 CGAATTAGGAATCAA-1
##          9           5           2           0
## CGAATTAGGTTACGC-1 CGAATTAGTAGTAGA-1 CGACAGCCACCAACGA-1 CGACCAACAAATCAGC-1
##          0           1           0           2
## CGACCATAGCATTCGA-1 CGACCATAGGTACTTG-1 CGACCGATCGTTAGTG-1 CGACGTTAGGTCGTAC-1
##          7           0           4           4
## CGACGTTAGTAGTCTG-1 CGACTAATCGACTAGC-1 CGACTAGCACTTAGGG-1 CGACTCCTCTTGACTC-1
##          1           5          10           3
## CGACTGACAGGCAGGA-1 CGACTGGTCGACATGC-1 CGAGCAAAGTGAGTGG-1 CGAGCACCAAGCTGTG-1
##          8           6           0           0
## CGAGCCATCCTCGTCA-1 CGAGGATGTAGGCGAT-1 CGAGGATGTTCGCAG-1 CGAGGGACATCCAGAG-1
##          0           3           6           9
## CGAGGGTAGGATGCCT-1 CGAGTCCTCTAAGTC-1 CGAGTGAAGATAGATG-1 CGAGTGAAGTAGAGTA-1
##          1           11          6           7
## CGATCAATCCCCATGC-1 CGATCAATCCTTGATC-1 CGATCCTCATGACTCC-1 CGATCTAAGTTAGTGT-1
##          3           5           3           1
## CGATGGTTGACTAAT-1 CGATGTCAGGAGTCGA-1 CGATTAACAATTAGTG-1 CGATTATAGCTACGAC-1
##          6           10          2           7
## CGATTCAAGATTCAAC-1 CGATTCCCATGGTCGA-1 CGATTTGAGGCCAGCAT-1 CGCAACTAGCAAGGTG-1
##          7           3           0           2
## CGCAACTAGCATGCCG-1 CGCAACTAGGATAGTA-1 CGCAACTAGGGGATTC-1 CGCACCTCCAGAGAG-1
##          4           1           9           4
## CGCACITCATTAGGGT-1 CGCACGGTCAGCAGGAG-1 CGCATCTCATCACCGA-1 CGCATTCCAGCCTATC-1
##          6           6           4           0
## CGCCAAGTCGTGCCTC-1 CGCCAATAGTTAGGAA-1 CGCCACAAGTACGCAC-1 CGCCATGAGGCAGTCG-1
##          4           13          1           6
## CGCCTAGAGCATTAAAC-1 CGCCTAGAGTGAAGGT-1 CGCCTCACATTACTCG-1 CGCCTGAAGGTTGCTA-1
##          2           2           3           1
## CGCCTGAAGTCAGTAT-1 CGCGAACCATGATTAG-1 CGCGATTAGCCAGTCG-1 CGCGATTAGGCAGTCG-1
##          12          1           0           0
## CGCGCATGTAGCTAGA-1 CGCGTAGTCAGGACAG-1 CGCGTAGTCCAGCACG-1 CGCGTAGTCTGGATGC-1
##          1           3           3           6
## CGCGTCAAGGTGGAGC-1 CGCTAACAGCATATAAC-1 CGCTAACAGCGCCTCT-1 CGCTAACAGGTAATCT-1
##          4           2           1          11
## CGCTAACATGTAACGTCT-1 CGCTACCTCTAGTTCC-1 CGCTGATAGGGTAGTG-1 CGCTGATAGTAGGACG-1
##          6           8           2           2
## CGCTGCAAGTAATGGA-1 CGCTGTGAGGATAGAC-1 CGCTTAGGTTCATCGG-1 CGGAACGGTTGACTAC-1
##          13          2           8           1
## CGGACTTAGGTGCATC-1 CGGATTCAAGGAGA-1 CGGCATTAGCAATTAC-1 CGGCCAATCCCATACT-1
##          5           1           8           3

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## CGGCCAATCTGGATTG-1 CGGCCCTAACGTGCCCA-1 CGGCTAACAAATTAGCA-1 CGGCTTGAGGATTGCC-1
##          10           4           12           0
## CGGGATGGTAGCGAGT-1 CGGGATGGTGCAACTT-1 CGGGCTTGTCTAGTGT-1 CGGGGAACACTATCTG-1
##          4           1           7           6
## CGGGGAACACTTAGCC-1 CGGGTAAAGCCTGGCA-1 CGGGTAAAGTAATGGA-1 CGGGTAGTCATCAGC-1
##          7           1           4           7
## CGGGTCATCTGTGCAA-1 CGGTGAAAGCGATCCG-1 CGGTGAAAGCTAATCG-1 CGGTGAAAGTTACCGA-1
##          4           5           9          12
## CGGTGTTAGCGGTCAT-1 CGGTTAGCAGCTCGAA-1 CGGTTCCAACATCCC-1 CGGTTCCAACCCTAC-1
##          6           2           1           6
## CGGTTCCATGATATG-1 CGTAATTAGAAGGAAG-1 CGTAATTAGCAGGCAA-1 CGTAATTAGTAATCAC-1
##          3           0           1          10
## CGTACGTAGTTAACGT-1 CGTAGTCAGGTGATCC-1 CGTATATAGCTATGGC-1 CGTATATAGGAGCCAA-1
##          4           7           1           0
## CGTATATAGTACGGGA-1 CGTATATAGTCGACCG-1 CGTATCCCAAGCGATT-1 CGTATGATCCCCATGC-1
##          7           4           2           3
## CGTATGATCGATCGTA-1 CGTCAAATCCCCATGC-1 CGTCAAATCTAATCCC-1 CGTCAGGTCATCGTCT-1
##          8           3           5           4
## CGTCAGTAGGAGTACCG-1 CGTCATAAGGGCTAAG-1 CGTCATAAGGTAGATA-1 CGTCATAAGTGAGATA-1
##          4           5           0           2
## CGTCCATCAGGGCTTA-1 CGTCCCACAATGTAGC-1 CGTCCTCAGCGGCATT-1 CGTCCTCAGGATTGCC-1
##          0           2           0           2
## CGTCCTTGTCTGGGTC-1 CGTCGTAGTAACCGAA-1 CGTCTATTCCCATGT-1 CGTGAAAGTCTAATTG-1
##          4           6           3           1
## CGTGAGAAGGCGAACG-1 CGTGATGCAGCTCATC-1 CGTGCTGAGTTAGTGT-1 CGTGCTGAGTTGCTTC-1
##          2           10          1           5
## CGTGGGTACCATCAC-1 CGTGGTTAGGCTCAGT-1 CGTGTATGTAATGACG-1 CGTGTATGTCATCCAG-1
##          8           7           4           4
## CGTGTATGTCTAGCCA-1 CGTGTATGTCTTACGG-1 CGTGTATGTGCGGATG-1 CGTGTCAAGTCCAGTG-1
##          1           0           0          11
## CGTGTAAAGAACGGAT-1 CGTGTAAAGGATAGGT-1 CGTGTAAAGGGTCTCG-1 CGTGTAAAGTGAACGG-1
##          2           2           1           2
## CGTGTGGTAGTAACCG-1 CGTGTGGTGCACGTC-1 CGTGTGGTGCAGCTC-1 CGTGTGGTTCACTGG-1
##          5           0           7          12
## CGTTACAAGGTGCTCG-1 CGTTACTTCACATGGC-1 CGTTATGAGGTACGAG-1 CGTTCACCACTAGGGC-1
##          9           0           4           8
## CGTTCAITCGTAGTC-1 CGTTCCATCCTGTATC-1 CGTTCCGCAGTTAGGT-1 CGTTCCGCATGGTAAC-1
##          9           6           2           5
## CGTTCCCTGTGACTCTG-1 CGTTCGCTCCGTGTC-1 CGTTGGGTCATGGAG-1 CGTTGTAAGGTTCATG-1
##          3           0           9           2
## CGTTGAAGGTATAGA-1 CGTTGAAGTTGGGTC-1 CTAAAACTAGGATGCCT-1 CTAAAACTAGGTGCAAG-1
##          0           0           2           8
## CTAAGCCAAGTTACA-1 CTAATGCAACTCCA-1 CTAACATAGCCTGATA-1 CTAAGGGAGCCAGCAT-1
##          2           8           5           0
## CTAAGGTATGCGGAC-1 CTAATCTCATTGTC-1 CTAATGGTCCCATGAA-1 CTACAATAGTTGGCCG-1
##          5           3           3           2
## CTACCAAAGCTGGTGT-1 CTACCAATTCCCGCAGA-1 CTACCCCTGTTCTTCA-1 CTACCGCTCTAGGCCG-1
##          8           5           7           3
## CTACGGACATGCTTGC-1 CTACGTAAGCTGAGTC-1 CTAGATTAGTAGCTGC-1 CTAGCCAGTAGGCGTG-1
##          6           0           5           0
## CTAGCCCGTGCAGTCC-1 CTAGGTCAGTACCCAC-1 CTAGTTGAGTGTAGAGA-1 CTAGTTGAGTTAGAGA-1
##          0           0           2           2
## CTATGCCAGTTAGCG-1 CTATGCAAGATTGTC-1 CTATGCTTCTGGCCGA-1 CTATGGGCATGGCTTC-1
##          7           4           3           8

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## CTATGTGAGGCATGTC-1 CTATGTGAGGTAGGTG-1 CTCAACTTCGACCCAG-1 CTCAAATTCAATACCGG-1
##          6           4           8           6
## CTCAGTAAGTCATGGC-1 CTCATAGAGGGGATGC-1 CTCATGAAGCAGGTAG-1 CTCATGTTCTATGCGA-1
##          1           4           2           3
## CTCATTCAAGTCAGTCA-1 CTCCAATTCAATCAGT-1 CTCCAGCTCCCTCTCAG-1 CTCCTAGTCTAAGTCG-1
##          2           6           6           9
## CTCCTCAAGGCACTTA-1 CTCGAACAGCATGCAC-1 CTCGAACAGTCAAGCC-1 CTCGAACAGTCGAACC-1
##          7           1           1           5
## CTCGATCCATGGCTCT-1 CTCGATTTCCCCATGC-1 CTCGCGAAGTACGCCG-1 CTCGCTATCTAGGCCG-1
##          3           3           8           3
## CTCGCTTGTTGCTTAA-1 CTCGGATAGGCAAGTG-1 CTCGGCAAGGTCCACG-1 CTCGTAAGAACAGGTAC-1
##          3           0           5           2
## CTCGTAAGATACTAC-1 CTCGTAAAGCGGGATA-1 CTCGTAAAGCGGTAAAG-1 CTCGTGAGTCTAGAGA-1
##          12          0           0           1
## CTCGTTACATTACGGG-1 CTCTAGAAGGCGAGTA-1 CTCTCGATCAGCAGAG-1 CTCTGGTCACAGGGTC-1
##          6           9           0           8
## CTCTGGTCATAAGTCA-1 CTCTGGTCATAGACGT-1 CTCTGTTAGGCATGGA-1 CTCTGTTAGTGAGTCC-1
##          6           8           2           5
## CTCTTCTCAAACGTGCG-1 CTCTTCTCACTTCATG-1 CTCTTCTCATTCAAGTT-1 CTGACAATCATAACAGT-1
##          10          5           5           9
## CTGACACAGTCATTCC-1 CTGACGTAGCTTACGA-1 CTGACGTAGTGGCTCG-1 CTGATAGTCACACCTT-1
##          2           2           2           8
## CTGATATAGCGATTGC-1 CTGATATAGGTGAAGT-1 CTGATCAAGATTAGTC-1 CTGCAACAGCCTAACG-1
##          2           5           6           7
## CTGCAACAGGTTGGAG-1 CTGCAATGTAACCTCA-1 CTGCATTCAGGCAGA-1 CTGCATTCCATGTCT-1
##          6           12          5           3
## CTGCCTGCAATATCGA-1 CTGCGATAGGTAGTGG-1 CTGCGATAGGTGCAGA-1 CTGCGATAGGTTACTG-1
##          7           9           0           2
## CTGCTAAAGCCACTAA-1 CTGCTGCTCTCATGTC-1 CTGGCAACAATGGAAG-1 CTGGCAACACAATCCC-1
##          7           3           2           5
## CTGGCCAAGCCTGTGG-1 CTGGCCAAGGAGGTGC-1 CTGGCCAAGGGAGAC-1 CTGGCCAAGGCTTGGT-1
##          5           2           2           2
## CTGGGCATCCCGTTGC-1 CTGGGTTAGCAAGTCC-1 CTGGGTTAGTGAGTCC-1 CTGGTTAAGCGAAGGC-1
##          6           1           7           11
## CTGGTTAAGCTGAGTC-1 CTGGTTAAGGCGAGTA-1 CTGGTTAAGGTTGCGT-1 CTGTAACGTTGACGAA-1
##          4           7           2           8
## CTGTAATAGTGACCAC-1 CTGTCAAAGGAGTATA-1 CTGTGCCTCCCTGTGC-1 CTGTTAGAGTAATGGA-1
##          8           1           3           8
## CTGTTCCGTTGGCCGT-1 CTGTTGAAGTACCGAC-1 CTTAATCCATGACGAT-1 CTTAGCTTCCGTAGCG-1
##          6           1           3           11
## CTTAGGATCCTCATGT-1 CTTATCGCAACTAGCG-1 CTTATGGAGTGCTTAG-1 CTTCATGAGGAGAGGA-1
##          4           0           2           1
## CTTGAATAGTTAACCG-1 CTTGAGGCATAATTGG-1 CTTGATGAGAAGCTAA-1 CTTGCAAAGCGAGCTT-1
##          2           6           2           10
## CTTGCTTAGTTAGGCC-1 CTTGGCGAGAACCTG-1 CTTGGCGAGGAACCTGG-1 CTTGGCGAGTTACACG-1
##          4           1           5           8
## CTTGGGACACTTCGAC-1 CTTGGCGTCTGGCTA-1 CTTGGGGTCCCATGCC-1 CTTGGGGTCGCTTGGG-1
##          6           8           3           3
## CTTGTGAAGTGAGGCA-1 GCAAAGGTCGAACCGT-1 GCAACATCAATGTCAA-1 GCAACTATCCCATGCC-1
##          1           4           7           3
## GCAAGCAAGGTGGAGC-1 GCAAGTGAGGCCAGTA-1 GCAAGTGAGGGGTAAT-1 GCAAGTGAGGGTCACT-1
##          5           1           5           2
## GCAAGTGAGTAAGCCC-1 GCAAGTGAGTGCTGTA-1 GCAATCGCAGCTCTAC-1 GCACACTAGCGGACTT-1
##          1           4           2           0

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## GCACAGCCAAGTCGTG-1 GCACCGATCGATGCGT-1 GCACGAAAGGATGGTG-1 GCACGAAAGTTGGTAT-1
##          9           4           7           1
## GCACTATGTAAGGTAT-1 GCACTCCTCCGCACTC-1 GCACTGACAGGGACAG-1 GCACTTGGTTATGGAG-1
##          3           3           8           1
## GCAGTGAAGATACTCG-1 GCAGTGAAGTTGCCCT-1 GCATAACCACAGCAAT-1 GCATAGCTCGATCCGG-1
##          0           9           3           9
## GCATAGTCATTCATGT-1 GCATCACAGGATCCCG-1 GCATCAGCATGACGGC-1 GCATCCTCATTGGGCA-1
##          8           0           9           0
## GCATCTAAGCCAGTTA-1 GCATCTAACGCCTAGCG-1 GCATCTAAGGAGTAGT-1 GCATGAGAGAACCTG-1
##          0           1           0           0
## GCATGAGAGCAAGGAT-1 GCATGGGGTTTCGTA-1 GCATGGTTCGTGCAG-1 GCATTATAGGTCGAAG-1
##          1           1           0           4
## GCATTCAAGCAATTG-1 GCATTCCCAGTACGGC-1 GCATTGAGCCGACAT-1 GCCACATAGGTAGCCT-1
##          8           3           0           8
## GCCACATAGTTGCACA-1 GCCATAATCAGGACAG-1 GCCATAGCAATCGCTC-1 GCCATCCTCAGGCTCG-1
##          5           6           11          6
## GCCATCCTCCGTCCTA-1 GCCCAATAGGTGGAGC-1 GCCCCAAAGGATCTAT-1 GCCCCATTGCTCTGC-1
##          7           4           9           3
## GCCCCATTCTATGCGA-1 GCCCCTTAGTCAGGGA-1 GCCCTAGAGAACGAAC-1 GCCCTAGAGGGTCTGT-1
##          3           10          2           1
## GCCCTGAAGGCGCATT-1 GCCCTGAAGGTGGAAT-1 GCCCTGAAGTAGCCCG-1 GCCCTGTTCCCCATGC-1
##          5           2           0           3
## GCCCTTGAGCTCGTT-1 GCCGCTAACGCGATAC-1 GCCGTTGAGCTACGAC-1 GCCTAAATCGACTGCG-1
##          2           7           9          10
## GCCTAACAGCTACCGG-1 GCCTGCAAGGGTGAAT-1 GCCTGCTTCCCATGAA-1 GCCTGGATCACAGAGG-1
##          0           4           3           5
## GCGAAAGTCCTCATGT-1 GCGACTTAGCGATGCT-1 GCGACTTAGCTGGAGA-1 GCGAGTAAGAACGAA-1
##          3           0           1           2
## GCGAGTTCTGTCGC-1 GCGATGAAGCGGTTAC-1 GCGCATTAGGCTAGAG-1 GCGCCTAACGCAAGTCC-1
##          9           0           1           1
## GCGCTAACAGTCGG-1 GCGCTAACGCTAGACC-1 GCGCTAACGCTAGTAT-1 GCGCTAACGCTATCAG-1
##          1           0           0          12
## GCGCTTGAGCGGTCTG-1 GCGGAGACATGCAGAT-1 GCGGAGTAGGTTCCAA-1 GCGGAGTAGTTAGACT-1
##          0           6           4           9
## GCGGGAACAGGAGCGA-1 GCGGGATAGGCTACTA-1 GCGGGATAGTGCCGTG-1 GCGGGTAGTAATTGCC-1
##          2           0           9           7
## GCGTACCGTCTCACCT-1 GCGTACCGTGAGGACT-1 GCGTCAACAAATCGGT-1 GCGTCCTTCCCCGTGA-1
##          7           4           4           1
## GCGTGTAGCATTAGT-1 GCGTTAGCAGGATAGA-1 GCGTTCTCATGTCTC-1 GCGTTTCCAATTAGTG-1
##          7           2           3           5
## GCTAACATCGCTCCTA-1 GCTAACATCGCTCCTA-1 GCTACAGCAACTACGG-1 GCTACAGCATCGGTAG-1
##          1           0           8           3
## GCTACCCCTCGACC-1 GCTAGGCCATGACTCC-1 GCTAGGTTCAGGCTAC-1 GCTAGGTTCCCATGAA-1
##          4           3           5           3
## GCTATTGAGCCACAGT-1 GCTCACCTCCATAGAT-1 GCTCAGTAGGGATAT-1 GCTCATAAGCCTGTCC-1
##          1           5           8           2
## GCTCATAAGTGCCAG-1 GCTCCATCACTCATGC-1 GCTCCTGCACCTGGAG-1 GCTCGTTCAAATTTCAG-1
##          9           3           6           8
## GCTCTATTCCCCATGC-1 GCTCTTGCCCCATGC-1 GCTGAGAAAGTGTCCA-1 GCTGGTTAGATTGCCA-1
##          3           3           0           2
## GCTGTATGTTCCAAG-1 GCTTAATAGGAGGATT-1 GCTTACAAGATTACGT-1 GCTTACAAGCCACGAT-1
##          0           11          5           9
## GCTTACTTCGTTACTC-1 GCTTATAGTAAGTGAT-1 GCTTATGAGCGCTCCT-1 GCTTATGAGCGCTTGG-1
##          3           1           11          4

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## GCTTCGCTCCATATC-1 GCTTGAATCACCAAGCG-1 GCTTGCCTCCATGAAT-1 GCTTGGGTACACCAA-1
##          3           0           3           0
## GCTTGTAAGGATAGCG-1 GGAAAGCCACAAGCCA-1 GGAAAGCCATCGGTT-1 GGAACATAGCATATCG-1
##          2           13          2           2
## GGAACATAGGTACTAT-1 GGAACCAAGATTAGAG-1 GGAACCAAGCTACCGC-1 GGAACCAAGGTTCCGT-1
##          11          4           8           4
## GGAACCAAGTTAATGC-1 GGAACCTGAGTTGCTTC-1 GGAAGCCAGGTATAGA-1 GGAAGCCAGTAGCCGT-1
##          1           12          1           5
## GGAATATGTTAATTG-1 GGAATTAAGTTAATGC-1 GGACACCCAGGGCATC-1 GGACACCCATCAAGTA-1
##          3           1           2           6
## GGACACGGTGAACGCG-1 GGACATGAGGTTCGCG-1 GGACGAATCAGGTTCA-1 GGACGAATCCAATGTG-1
##          10          1           8           8
## GGACGGACAAGCACCA-1 GGACGTAAGATAGCGG-1 GGACGTAAGATTAGCT-1 GGACGTAAGGGACGT-1
##          0           13          1           0
## GGAGCAATCCCTCACA-1 GGAGCTAACGCCATCGG-1 GGAGTATAGCCGAGTT-1 GGAGTATAGTAGACTT-1
##          6           8           1           4
## GGAGTCAAGCGGACTT-1 GGAGTCAAGTATGGTT-1 GGATAACAGCGCATA-1 GGATAGTAGTCATGTG-1
##          1           0           2           8
## GGATGCCAACATCGACG-1 GGATGCAAGCATGCCG-1 GGATGGCAGGACTTG-1 GGATGTTCAACCGCAA-1
##          0           1           5           8
## GGATGTTCAGGTAGTT-1 GGATTAAGAACGAGT-1 GGATTAGGTGCGGAAT-1 GGATTGCTCCCTCATG-1
##          9           8           1           3
## GGCAACCCAGTTGCCT-1 GGCAACTCGACTAGC-1 GGCAATGAGGATGCCT-1 GGCACACCAATCAGAC-1
##          5           6           0           0
## GGCACATTCCCCTGTA-1 GGCACCTGTGCGCGAA-1 GGCACGAGTATTGGTC-1 GGCATGAAGCGGTCTG-1
##          3           0           6           0
## GGCATGTTCACAGCGT-1 GGCATTCAAGTACCCG-1 GGCATTCAAGTCAGCCG-1 GGCACATTCAACCTACT-1
##          8           7          12           0
## GGCCCTAACGCTGGTTA-1 GGCCGATCATTGCCCG-1 GGCCCTAACACTCGGTT-1 GGCCTCAAGCTACGGT-1
##          0           13          5           1
## GGCCTTGAGCGAGACA-1 GGCCTTGAGGTAGATA-1 GGCATGGTTAGCGAA-1 GCGGTAGTGAACCAA-1
##          2           11          1           1
## GGCCTAACGCAACTAT-1 GGCCTAACGCGAGTA-1 GGCCTTGTCAGTGCC-1 GGCCTTGTCAGCATA-1
##          0           8           5           2
## GGCTAGAAGGAATTAG-1 GGCTAACATCCGCAT-1 GGCTGAAAGAAGCTAA-1 GGCTGGTCAAGTGCCA-1
##          4           2           2           7
## GGCTTAATCATGGCCG-1 GGCTTCCATGGACC-1 GGGACGTAGATAGGAC-1 GGGACGTAGGATGCAG-1
##          3           8           7           2
## GGGACGTAGGTGCGAA-1 GGGATTGAGAACGGGC-1 GGGATTGAGGTAGCGA-1 GGGATTGAGTAGTAAG-1
##          0           6           9           2
## GGGATTGAGTCAGCTA-1 GGGCAAATCACGTAGC-1 GGGCAAATCCCTGTA-1 GGGCAACAGCTTCCAT-1
##          1           0           3           1
## GGGCTAACGCTGGGT-1 GGGCTTGCTGGAAGG-1 GGGGACTAGGAGCTAG-1 GGGGATGCACTATGGG-1
##          11          4           7           6
## GGGTAATAGGATTAGA-1 GGGTACTTCCCCATGC-1 GGGTCAAAGAAGGGTT-1 GGGTCAGGTTCCGTGCT-1
##          6           3           0           5
## GGGTTAGAGCCTAGAC-1 GGGTTAGAGCTTCCGT-1 GGGTTGAAGATTACCG-1 GGGTTGGGTGAGGAAG-1
##          0           2           0           5
## GGGTTGGGTTAGGTC-1 GGGTTTCAGCGCATGT-1 GTAAAGGTCTGGTGTA-1 GTAAATGGTGATGATG-1
##          3           9           5           5
## GGTACGAAGGAACCGA-1 GGTACGCCAATGAGTC-1 GGTAGCAAGAACATCAGA-1 GGTAGCAAGCTTCCGC-1
##          7           6           4           5
## GGTAGCAAGGTAGTAA-1 GGTAGCGGTTCGAGT-1 GGTAGTGAGGAGGTTG-1 GGTAGTGAGGTTCCGT-1
##          0           8           0           1

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## GGTATTGTCAGCAGAG-1 GGTCAATCAGCACTAG-1 GGTCACTAGCGCAACT-1 GGTCACTAGCTAGTCA-1
##          4           6           3           7
## GGTCAATCAGGATAGAC-1 GGTCACTAGCTAGTCA-1 GGTCACTAGCTAGTCA-1 GGTCACTAGCTAGTCA-1
##          4           3           7           5
## GGTCTTAAGAACATCACT-1 GGTGATGAGCTACGAC-1 GGTGATGAGCTAATTC-1 GGTGCAGGTAATCGTC-1
##          5          10          7           6
## GGTGCCTGTAAGTGTG-1 GGTGCCTGTAAGTGTG-1 GGTGCTTAGCTATGTG-1 GGTGGCTCAAGCATAC-1
##          4           3           1           6
## GGTGGTAAGCCAGCAT-1 GGTTACGCAATACGGT-1 GGTTACGCAACTAACGG-1 GGTTAGCTCGCTGATA-1
##          2           6           8           1
## GTTTCAAGATAGGTA-1 GGTTCAAGATAGGTA-1 GGTTCAAGCATGGCT-1 GGTTCAAGCATGTCA-1
##          3           0           0           2
## GTAAACTTCCCCTGAG-1 GTAACCTGTTGACCG-1 GTAACGGAGCCCTTCA-1 GTAACGGAGTCGCGCA-1
##          5           4           6           1
## GTAAGCGAGATTGAGA-1 GTAAGCGAGCGCTGTG-1 GTAAGGGTCCCCTGAA-1 GTAAGGGTCCCCTCGA-1
##          12          0           3           2
## GTAAGGGTCGTGATTG-1 GTAATAGAGGATCTCA-1 GTAATAGAGTTAGGAA-1 GTAATCCGTTATGAGG-1
##          0           1           5           1
## GTACACGCACCATGAG-1 GTACCAATCGACTGCG-1 GTACCAATCGACTGCG-1 GTACCAATCGACTGCG-1
##          2           1           3          10
## GTACCCAGTGACTCTG-1 GTACCCCTCATGACTCC-1 GTACGATCAATCCGTC-1 GTACTAACATAACCTT-1
##          3           3           4           7
## GTACTAACATTACGCC-1 GTACTCCCATGAAGTC-1 GTACTCCCATGGTCC-1 GTAGCGCCAAACCATA-1
##          13          3           3           5
## TAGCGCCAGTACTCC-1 TAGGAACAACTAATG-1 TAGGATAGTGCCTG-1 TAGGCAAGCCTAGAC-1
##          0           5           2           2
## TAGGCAAGGAGGTTG-1 TAGTAAAGAAGGTCG-1 TAGTAAAGGGCTTCG-1 TAGTAAAGGTGAGCA-1
##          9          12          1           1
## TAGTAGGTATTGCCG-1 TAGTAGGTGAGACCG-1 TAGTCGCAGTTAACG-1 TAGTCTGTAGTGCTT-1
##          6           8           2           3
## TAGTTACATGCAGTG-1 TAGTTGTCATTAGC-1 TAGTTGTCAGGTCTA-1 TAGTTGTCATTAGC-1
##          5           9           4           3
## TAGTTAGAACGAGT-1 TAGTTAGGCAACGA-1 TAGTTAGGGTCACT-1 TAGTTAGTAGGTAA-1
##          2          13          5          10
## GTATATCAGTAAGTGA-1 GTATCCCCAGGACTTG-1 GTATCCCCATGCTACC-1 GTATCCCCATGGCTAG-1
##          9           3           3           3
## GTATCCCCATGGCTTC-1 GTATCCCCATGGCTTC-1 GTATCTCAACGGTGC-1 GTATCTCAGTTGCTC-1
##          3           3           8           1
## GTATGAAAGCGTTGG-1 GTATCCTCCCATGAA-1 GTCAACATCACCAGAC-1 GTCAATGTCTCATGTC-1
##          4           3           3           3
## GTCAATTAGCGGATAG-1 GTCAATTAGGCATCAC-1 GTCAATTAGTCTCTGT-1 GTCAATTAGTGATACT-1
##          2           2           1           9
## GTCACGTAGGTCCCGA-1 GTCATATAGCTATCGA-1 GTCATATAGGGGCATA-1 GTCATATAGTAATGTC-1
##          2           0           2           7
## GTCATCAAGAACATCCGC-1 GTCCAATCGACCGCA-1 GTCCAACAGTAAGCGG-1 GTCCCATCAACTTCAT-1
##          0           4           0           7
## GTCCCGAAGGGCATT-1 GTCCCGAAGTCGCATA-1 GTCCCTCAGCCAGATC-1 GTCCCTCAGGTGCAAG-1
##          9           0           0           8
## GTCCGCTTCATGTCCT-1 GTCCTAAAGATAGACA-1 GTCCTTAGGTTCCCTT-1 GTCGACTAGCTACGCG-1
##          4           0           7           0
## GTCGCAACACAGCCAA-1 GTCGCAACATCCTGCG-1 GTCGCAACAGGCAATTCA-1 GTCGCAACAGGCTTCGG-1
##          8           5           0           2
## GTCGGGTCACTACCT-1 GTCGGTTAGGATCATT-1 GTCGGTTAGGATGACG-1 GTCGTAATCATGAAC-1
##          8           0           1           8

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## GTCGTAATCCCCATGC-1 GTCGTAATCGTGAACC-1 GTCTAACGTGAGAGTC-1 GTCTACCCATTACCTG-1
##          3           9           5           3
## GTCTCCATCATCGAGC-1 GTGAACCTCCCCATGC-1 GTGACGAAGGGCTTCG-1 GTGACGAAGGTATGAA-1
##          0           3           5           1
## GTGACGAAGGTCGTAC-1 GTGACGAAGTTGCCAC-1 GTGACGTTCAAGTCGC-1 GTGACGTTCCCCATAT-1
##          9           4           9           4
## GTGAGTGAGCTTACGA-1 GTGAGTGAGTAAGGCG-1 GTGATGCTCCATGTCT-1 GTGATGGAGCTTAGGC-1
##          0           7           3           4
## GTGCCATAGTGGCCTG-1 GTGCCAAGCGACTGT-1 GTGCCAAGCTATCTC-1 GTGCCAAGCTGGGTT-1
##          7           1           2           6
## GTGCGCATCGTTAGGC-1 GTGCGGTCAAGCTATA-1 GTGCTCAGTGAAGGCT-1 GTGGACAAGGTTGCGT-1
##          1           10          8           0
## GTGGACAAGTCAGTTG-1 GTGGACCCATGGCTCT-1 GTGGAGGCAGCACTCT-1 GTGGATTCAAACCAAC-1
##          2           3           2           0
## GTGGATTCAAGCGGT-1 GTGGCAAAGGCAATGG-1 GTGGCAGGTTCCAGGC-1 GTGGCAGTCAGCTCA-1
##          2           1           1           3
## GTGTAACCAAATCGGT-1 GTGTAAGGTTGGGCT-1 GTGTAAGGTTGGGCT-1 GTGTAAGGTTGGGCT-1
##          0           1           2           2
## GTGTCCTCCATCAGA-1 GTGTCCTCACAGCACA-1 GTGTGAGAGGTTACAT-1 GTGTTAGTCCCATTAC-1
##          2           6           1           3
## GTGTTAGTCCTCATGT-1 GTGTTATAGATAGGAC-1 GTGTTCAAGCTGAGTC-1 GTGTTCAAGTGAAGTA-1
##          3           8           1           5
## GTGTTCCAATCAGAC-1 GTGTTCCATTGCGCT-1 GTTACCCCCTCGGAA-1 GTTACCCCATTGACACG-1
##          0           3           5           3
## GTTACTTCAACTCGCT-1 GTTAGCCAGCTAGTAT-1 GTTAGCCAGGATAGCG-1 GTTAGCCAGTAATCGT-1
##          6           7           4           7
## GTTAGCGCAATAGCGT-1 GTTAGGGAGAACGATA-1 GTTAGGGAGGAGGATT-1 GTTAGGTCAACATAGC-1
##          2           4           4           5
## GTTAGGTCAATTGCCG-1 GTTATCTCATGGCTCT-1 GTTATGGTCCAACCTCT-1 GTTCAATAGGTCCACG-1
##          3           3           5           7
## GTTCACTTCGTGAGTC-1 GTTCATGAGAACGGC-1 GTTCATGAGTCAGGCT-1 GTTCATGAGTGATTG-1
##          10          0           0           2
## GTTCATTCATGACAGT-1 GTTCATTCAATTAGCTT-1 GTTCAAAGCGGTCTG-1 GTTCAAAGTGCTCGG-1
##          6           7          13           1
## GTTCCACCAATTGGG-1 GTTCCAGGTTCGTAGT-1 GTTCCGGAGCGCTCCT-1 GTTCCATTAGTGAGCGA-1
##          1           7           7           2
## GTTCGAATCCCCATGC-1 GTTCGCTCAGGAGTG-1 GTTGAAGGTGCATCGC-1 GTTGATTAGTTGGCCG-1
##          3           0           4           0
## GTTGCAATCCCCATGAA-1 GTTGCTCATGACTCC-1 GTTGGGTTAGGAAGT-1 GTTGGTCAGTGACCGT-1
##          3           5           0           2
## GTTGTACGTTGAAGGC-1 TAAACGAAGATAGTCT-1 TAAACGAAGCGCATGT-1 TAAATGCTCGATGATT-1
##          13          10          0           8
## TAACACTAGTGAACCC-1 TAACCATAGGTAGAGT-1 TAACCGATCGCTCTGC-1 TAACCTAGTTCACGAT-1
##          9           2          12           5
## TAACTGACAACCAACG-1 TAAGCAAAGATAGGAC-1 TAAGCGGAGCATGGGA-1 TAAGCGGAGCGCAATC-1
##          1           1           2           0
## TAAGGCAGGATTCACT-1 TAAGGCAGGACATC-1 TAAGGCTCATTGGGA-1 TAATGAGAGAACCTGC-1
##          0           2           2           7
## TAATGTCAGCAGGGAC-1 TAATGTCAGCATGCCG-1 TAATGTCAGGATTAAG-1 TAATTCCAGGACTCA-1
##          1           2           1           3
## TAATTCCATAACTCT-1 TACAGGGAGTGAACGG-1 TACAGTTAGCAAGGTG-1 TACAGTTAGCAATCCA-1
##          3           0           2          11
## TACAGTTAGGCACGAA-1 TACCACAAGATTCTGT-1 TACCCATTCACTCATC-1 TACCCATTCTAGCGCG-1
##          1           1           5           9

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## TACCCGCTCAAGTGCC-1 TACCTAGAGTAGCATT-1 TACCTGAAGGCTACTA-1 TACCTGAAGTTGCGGT-1
##          4           5           7           2
## TACGAGGAGCATGCAC-1 TACGAGGAGCGGATCT-1 TACGCCCTCCATGTCT-1 TACGCTAAGGTGCTCG-1
##          2           4           3           2
## TACGCTAAGTGCAGGT-1 TACGGGCCAATCAGGT-1 TACGGGCCAGGCAGTC-1 TACGGGCCATGCGTCT-1
##          4           6           2           2
## TACGGTCAGGATTAGA-1 TACGGTCAGGTTCCCT-1 TACGTAGTCGATTAGT-1 TACGTTGAGGTAGTAA-1
##          7           5           1           5
## TACGTTGAGTAGTCAT-1 TACTACTCAACTAGAC-1 TACTGCCAGCAGTAT-1 TAGCATTAGAACATCGTT-1
##          2           6           6           1
## TAGCCACAGAACGGAGA-1 TAGCCACAGTGCTGCG-1 TAGCCCAGTCATGGTT-1 TAGCCCAGTTGGAGCG-1
##          13          0           1           5
## TAGCCCTCATGGCGAC-1 TAGCTAGTCCTGACTT-1 TAGCTCCAGGATCTG-1 TAGCTGATCCCCATGC-1
##          6           1           3           3
## TAGCTGATCCGTAGGT-1 TAGCTTGAGTAGAGGT-1 TAGCTTGAGTCGAGTC-1 TAGGAGTAGCAACCCG-1
##          0           0           2           4
## TAGGAGTAGCGAACATGG-1 TAGGAGTAGGATGACG-1 TAGGCGAAGTCAGTTG-1 TAGGCTGCAATCCAGG-1
##          8           0           11          7
## TAGGCTTGTAAATCCAC-1 TAGGGGATCCCCATGC-1 TAGGGTGAGTATGTAC-1 TAGGTCATCACGCGAT-1
##          1           3           9           6
## TAGGTGGAGTTGGACC-1 TAGTCAACACTATCCA-1 TAGTGGGAGGCTCAGT-1 TAGTGGGAGGGTGACA-1
##          8           0           1           0
## TAGTTAGCAAAGGCC-1 TATAACCCTCGAGTCTA-1 TATACGTAGGTTACAT-1 TATAGGGTCATGCCA-1
##          6           1           1           7
## TATAGGTTCCCCATGC-1 TATAGGTTCTTGAGGC-1 TATAGTCAGATTGCTG-1 TATAGTCAGGCACTCG-1
##          3           5           0           12
## TATATCCAATGTCGG-1 TATCAGGTCCGGGTAT-1 TATCCTGTTGCCTAG-1 TATCGAACATCCTATG-1
##          13          9           6           6
## TATCGGGCATTTCATCG-1 TATCGTTCAAGCTCCT-1 TATGACTAGATTAGAG-1 TATGACTAGTAGACCC-1
##          0           6           0           9
## TATGAGAAGAACGAT-1 TATGAGAAGGATTCGC-1 TATGCCCATGACCTC-1 TATGCTAGTTGTAAG-1
##          4           1           3           6
## TATGCCAGCCCTGGA-1 TATGGGTCAAGTCGGC-1 TATGGGTCAAGTCGGCATTG-1 TCAACATAGAACGGTAC-1
##          7           6           6           2
## TCAACATAGTCGAACC-1 TCAACATAGTTGCCTT-1 TCAACCAAGTCGAAGG-1 TCAACTGAGGCATTCA-1
##          7           5           5           4
## TCAATGGTCCCCAATT-1 TCACCGCTCCCCATGC-1 TCACGCCCTCCCATGAA-1 TCACGGGTCGAATTAC-1
##          1           3           3           1
## TCACGTAAGCCTAGAC-1 TCACGTAAGTCGAGGA-1 TCACTGTTCCGCACGA-1 TCACTGTTCTATCGGA-1
##          2           4           6           7
## TCAGAGGAGAACGGAT-1 TCAGAGGAGCGGATCT-1 TCAGATTAGTCGCGTG-1 TCAGCATGTGAGGAAG-1
##          9           4           7           4
## TCAGCATGTTCCAGCA-1 TCAGCTGGTGCAGCGA-1 TCAGTATAGGATGCCT-1 TCAGTATAGTAGAGCG-1
##          3           13          0           1
## TCAGTATAGTAGTTCG-1 TCATAACAGGAACCTGG-1 TCATAACAGGATCCAC-1 TCATAACAGTCGACAC-1
##          2           0           9           0
## TCATAACAGTCGATGC-1 TCATAGTAGCCAATCA-1 TCATCGAAGGTTCGTA-1 TCATCTATCCCTGACC-1
##          4           8           0           4
## TCATGTGAGCGAGGTA-1 TCATGTGAGCTTCCCA-1 TCATGTGAGGGGTACA-1 TCATGTTCATCACGCT-1
##          9           5           1           13
## TCATTCCGATCGACCT-1 TCATTGCTCCTCATGT-1 TCCAACCCAGGGACCT-1 TCCAACCTCATCTAGG-1
##          6           3           13          11
## TCCAATAGTTGGGCT-1 TCCAATGAGCATGTAT-1 TCCAATGAGCTAGCCG-1 TCCAATGAGGTACACC-1
##          10          1           0           7

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## TCCAGGGCTATGAGA-1 TCCAGGTAGGATATGA-1 TCCAGTAAGGTAGCCT-1 TCCAGTAAGTGATCTG-1
##          9           5           4           0
## TCCATAGAGGTCTGT-1 TCCATGAAGGTCGAAG-1 TCCATTAGAAGGTAC-1 TCCATTAGCTGGTGT-1
##          0           12          4           4
## TCCATTAGCGTAAG-1 TCCCACGCAACTCGGA-1 TCCCATTAGGTACGTC-1 TCCCCTGGTGGGAGG-1
##          4           2           2           8
## TCCCTCAAGCCGTAG-1 TCCCTCAAGTTAGATC-1 TCCTAGAAGCGAATCC-1 TCCTAGAAGTAAGGTA-1
##          1           2           5           1
## TCCTATATCCAGCATA-1 TCCTGTTAGAATCGGG-1 TCCTGTTAGATTGAC-1 TCGAATTAGATTCTC-1
##          6           13          2          12
## TCGAATTAGCGACTAC-1 TCGACACAGGTTACA-1 TCGACGTAGTGACCTA-1 TCGACTAAGTCGAGAG-1
##          10          1           4           5
## TCGACTGGTGAGTTGA-1 TCGATATAGTAATTGC-1 TCGATCAAGTCATCCT-1 TCGATTAGTGAGCGAT-1
##          10          2           8           0
## TCGCAGACATCGTTCA-1 TCGCATAAGTAGGATA-1 TCGCATTTCATGCGCG-1 TCGCCTGCAGGACTTG-1
##          5           9           0           6
## TCGCGCAAGGTAAGCG-1 TCGCGCAAGTGATCTG-1 TCGCTAAAGCTACTCT-1 TCGCTAAAGGCTTAAT-1
##          4           5           1           4
## TCGCTAAAGGTGAGC-1 TCGCTCGCACCTGCTG-1 TCGCTCTGTTAGCTGT-1 TCGCTCTGTTGCGATT-1
##          2           7          10          13
## TCGGGCATCAATCCTC-1 TCGGGTTAGCGATGCT-1 TCGGTAATCCCGCATG-1 TCGGTTAACGCCAGCAT-1
##          5           2           9           0
## TCGGTTAACGGGACTA-1 TCGTAATAGCATCGAC-1 TCGTAATAGGGTATGG-1 TCGTACCCAATCGGCA-1
##          0           1           8           8
## TCGTACCCATGACACG-1 TCGTATAGTCAGCCTA-1 TCGTATAGTGGCGAAT-1 TCGTATAGTTGGAGAC-1
##          3           0           0           5
## TCGTATAGTTCGCTC-1 TCGTCAAAGGATTAAG-1 TCGTCAAAGTCATACG-1 TCGTGAATCCTTAACC-1
##          1           7           2           0
## TCGTGGACAACCGTCT-1 TCGTGTCCACTTAATC-1 TCGTGTCCACTTCAAT-1 TCGTGTCCAGGCATAT-1
##          8           9           1           1
## TCGTGTCCAGGTTACG-1 TCGTGTCCAGTACCG-1 TCGTGTCCATAATCAG-1 TCGTGTCCATCACCGA-1
##          9           9           8           0
## TCGTGTCCATGCTTCA-1 TCGTTAGAGAATCGTT-1 TCGTTAGAGGTTCATG-1 TCGTTGGGTATTGCCG-1
##          6           5           4           1
## TCTACGGTTGGCGC-1 TCTATGGAGCCATGAC-1 TCTATGGAGGTTAGCC-1 TCTCACTAGAAGGCC-1
##          9           4           7           5
## TCTCACTAGGGTGAGC-1 TCTCCAACAAGTGGAA-1 TCTCGCATCCGGTAAC-1 TCTCTAACCCCCATGC-1
##          7           2           0           3
## TCTCTCCTCTCTCTC-1 TCTCTGGTCGTCTCTG-1 TCTGACCCATCAAGCG-1 TCTGACTTCCGTAGTA-1
##          6           6           7           9
## TCTGATGAGAACCCAGG-1 TCTGCGAGTGATTACC-1 TCTGCGGAGGTTACAGG-1 TCTGCGGAGTATGAAG-1
##          2           11          2           1
## TCTGGCGAGCGCATGT-1 TCTGGGGTCGTTGCC-1 TCTGTAAGTAGTCAAG-1 TCTGTTCCGGTGTG-1
##          2           0           10          0
## TCTGTTGCATTACGCC-1 TGAAAGGCACCACAC-1 TGAACATTCCAGGTGCG-1 TGAACATTCTAGCGCG-1
##          8           6           1           4
## TGAACCCAGGTAATGA-1 TGAACCCAGTGTCAAT-1 TGAACCTGTTACTCT-1 TGAACCTGTTGCCCT-1
##          1           1           4           5
## TGAATAGAGTAGCACC-1 TGACACGCAAGTGAGA-1 TGACCAATCGAATTAC-1 TGACCTAAGCGAACGA-1
##          11          8           1           4
## TGACCTAAGTCATCTC-1 TGACTCCCAGGCTGA-1 TGAGAACAGAACGCTAA-1 TGAGATGGTATGGACA-1
##          4           3           8           3
## TGAGCAAGTAATCGAG-1 TGAGGCCACATGATCCC-1 TGAGCGAAGGTGACAG-1 TGAGCGAAGTAACCCA-1
##          4           5           1           9

```

```

## TGAGCGGGTGAGACCG-1 TGAGGAACATCGCTAC-1 TGAGGCAAGCATCGGT-1 TGAGGTGAGGAGCTAG-1
##          7             6            11            4
## TGAGTAAAGTGATTCG-1 TGATAGCCAGCCATCT-1 TGATAGCCATTGCCG-1 TGATCCCCATGACTAA-1
##          0             1            2            3
## TGATCCTCGCTTGAA-1 TGATGAAAGCGATCCG-1 TGATGAAAGGCAATCC-1 TGATGCCAGCCATCGG-1
##          3             2            4            7
## TGATGGTCATTAGCCC-1 TGATTCCCTCCATGCC-1 TGATTGGTCCCATGAA-1 TGATTTCCATGGCTCT-1
##          8             3            3            3
## TGCAAACCATCCACTA-1 TGCAAATTCCCTGAGAC-1 TGCAATGTCCCCATGC-1 TGCACAGCACCATCAC-1
##          7             8            1            9
## TGCACCTCAAATCCAA-1 TGCACCTCATTACCGC-1 TGCACGTAGCCTGAAC-1 TGCACGTAGGATTCGC-1
##          6             5            0            1
## TGCAGTCAGCGATAACC-1 TGCATATAGATAGTCT-1 TGCATCAAGCCGACAT-1 TGCATCCCACCTATCA-1
##          2             5            0            1
## TGCATCCCATGACGGC-1 TGCCAGACAATATCGA-1 TGCCATAAGCCCTTCA-1 TGCCCGAAGTCGACGT-1
##          3             6            7            9
## TGCCCTTGTAAATTGCG-1 TGCCGTAGTTCGGGTC-1 TGCCTGCTCAGCAATT-1 TGCCTGCTCAGGGAAT-1
##          8             5            9            10
## TGCCTGCTCCCCGTAA-1 TGCAGACTAGGCATTTC-1 TGCAGATGCAAGTCGGC-1 TGCAGGTACACATACTT-1
##          3             11           0            8
## TGCTAAGTCGCGATAC-1 TGCTAAGTCGTGCTAA-1 TGCTAAGTCTATGAGT-1 TGCTATGAGCAGGTAG-1
##          8             8            6            4
## TGCTATGAGGCGAACG-1 TGCTCCGCAACTATCT-1 TGCTGCCTCGAGGTCT-1 TGCTGGGTCCGTGAGT-1
##          11            8            1            2
## TGCTGGGTCTGTCTGT-1 TGGAACCTCCCATTAC-1 TGGACGAAGTAGCCCG-1 TGGACTCAGGGGCTAA-1
##          0             3            0            4
## TGGACTCAGTCAGGTC-1 TGGACTCAGTGTCCGG-1 TGGATGGAGATTCCAG-1 TGGATTTAGCCAGCAT-1
##          2             1            1            4
## TGGATTTAGCTTACCT-1 TGGCACTAGCCAACTA-1 TGGCCATAGCGATGCT-1 TGGCCTGAGCCACGCA-1
##          10            8            0            2
## TGGCTAATCCTGCCAC-1 TGGCTGACAAACCAAC-1 TGGCTGACAAACTGCG-1 TGGGAACGTCAACCTG-1
##          5             6            8            1
## TGGGATAGTGAACCAA-1 TGGGCTTAGGCATGAA-1 TGGGGCTCAATGACAC-1 TGGGGCTCATTGCGCT-1
##          11            2            8            3
## TGGGGTAAGGCGTAAG-1 TGGGTGAAGTTAACGT-1 TGGTACGCAAGCCTCT-1 TGGTAGGAGGTCAATTG-1
##          2             0            6            7
## TGGTATTAGTATCTCC-1 TGGTCACAGGTTCTT-1 TGGTCCTCATTACTCG-1 TGGTGGTTCGTAACTG-1
##          1             1            3            0
## TGGTGGTTCTTGATGG-1 TGGTTATAGGAGTACG-1 TGGTTCAAGTCGCTAA-1 TGGTTCCCATGGCTCT-1
##          3             0            11           3
## TGGTTCCCATGGTCTC-1 TGGTTTAGTAGTCCTG-1 TGGTTTAGTGCAACTT-1 TGGTTTGAGAATCCAT-1
##          3             4            5            2
## TGGTTTGAGATAGCCC-1 TGGTTTGAGGTGGAGC-1 TGGTTTGAGGTCCGG-1 TGGTTTGAGTAATCAC-1
##          12            2            2            8
## TGTAACTAGCAATCTG-1 TGTAACTAGGTAAACGG-1 TGTAAGCCATCGTTCA-1 TGTACCTTCATCGGG-1
##          1             5            2            4
## TGTACCTCGAGTGTC-1 TGTACGATCATGACGC-1 TGTACGATCGACTAAT-1 TGTACTTCAATCCTAT-1
##          5             7            0            2
## TGTACTTCATCCGTCG-1 TGTACTTCATTCCGAC-1 TGTAGAGGTGGACACG-1 TGTAGCCAGTTAGGCC-1
##          2             0            7            0
## TGTAGTTAGAAGGGCC-1 TGTATGGTCCGGCCAA-1 TGTATTCCATGACTCC-1 TGTCACTTCCATGCC-1
##          2             1            3            5
## TGTCACTTCCGCTGTC-1 TGTCAAGGCAAATGGCT-1 TGTCAATGAGCGACTGT-1 TGTCAAAGCGGATTC-1
##          0             2            0            0

```

```

## TGTCCAAAGGTACGCT-1 TGTCCAAAGGTGGATG-1 TGTCCCATCCCGTTCA-1 TGTCCCTAGCAGGTTC-1
##          12           4           6           8
## TGTCGTCCATTACGAA-1 TGTCTGTTCGCTCAC-1 TGTGAGGAGTCAGGAG-1 TGTGCCCTCACTAGAT-1
##          5           1           4           6
## TGTGCCCTCATGTCTC-1
##          3
## Levels: 0 1 2 3 4 5 6 7 8 9 10 11 12 13

```

```

Idents(pbmc_sparse) <- "RNA_snn_res.0.1"
Idents(pbmc_sparse)

```

```

## AAACCAAAGGCTATAT-1 AAACCAAAGTGTGCC-1 AAACCATTCCCTGTA-1 AAACGAATCAGCACGT-1
##          0           0           2           0
## AAACGACAGGGCTCTG-1 AAACGACAGGTCAATTG-1 AAACGCCTCGAACGCT-1 AAACGTAAGCTATGCA-1
##          0           0           1           1
## AAAGCAATCATGCTTC-1 AAAGCTAAGATAGATG-1 AAAGCTAAGTGTATG-1 AAAGGTCAGTATGAGA-1
##          1           1           0           1
## AAAGTCAAGCAAGGGC-1 AAAGTCAAGCATTAAAC-1 AAAGTTGAGCCTTCCA-1 AAATGAGTCCCATGAA-1
##          3           3           1           2
## AAATGGATCCGTCGT-1 AAATGGGCAGGTTCGA-1 AAATGTGAGCGGATGA-1 AAATTGCAAGTGC-1
##          0           3           1           1
## AAATTGCGAGGAATGA-1 AACACCGCATGAAGGA-1 AACACTTAGATACTCG-1 AACAGGTAGGCGTAGA-1
##          0           0           0           0
## AACATAGAGATTGAGA-1 AACATAGAGTGGTCT-1 AACATCACAGGTAGCC-1 AACATTCACTATGATC-1
##          0           0           0           3
## AACATTCACTGAATGA-1 AACATTGCAGGGCTAC-1 AACCAACCAACCTCAC-1 AACCAAGGTGAACCGG-1
##          4           1           0           1
## AACCAATTGCTGACG-1 AACCAATTGCTGACG-1 AACCAATTGCTGACG-1 AACCAATTGCTGACG-1
##          0           0           2           0
## AACCCATTAGTGCGCCA-1 AACCCACAGCAATTG-1 AACCCAGCAAATGGAG-1 AACCCAGCACCAGCTT-1
##          0           0           2           2
## AACCCAGCAGGGCACT-1 AACCCCTAACGCAACTGC-1 AACCCCTAACGCAACTGC-1 AACCGATCATTAGGAC-1
##          2           0           1           3
## AACCTAACAAACCATA-1 AACCTAACAGCTCTCG-1 AACCTAGTCGTGCGAT-1 AACCTAACGCTGAGTC-1
##          2           3           1           1
## AACGAACAGCTGGTT-1 AACGAATGTTAGCGAA-1 AACGCTATCTGTCTGT-1 AACGGATAGGGATTG-1
##          0           3           0           4
## AACGGATAGGTAGTGG-1 AACGGCAAGAAGGGTT-1 AACGGGGCAACTAGCG-1 AACGGGGCATGAAGGA-1
##          0           0           3           0
## AACGGTGAGATTGAT-1 AACGGTGAGTATGACT-1 AACGTAAGGGTCTCG-1 AACTAGAAGCCGACCA-1
##          0           0           2           1
## AACTAGAACGCACTTA-1 AACTAGAACGCACTTA-1 AACTAGAACGCACTTA-1 AACTAGAACGCACTTA-1
##          0           0           3           1
## AACTGAAAGCATGACC-1 AAGCCAAGTTCGGCGT-1 AAGCCATCAGGCAATT-1 AAGCCATCATCGGTGA-1
##          0           1           2           1
## AAGCCCCGTGAAGTAT-1 AAGCCGCAATACTGA-1 AAGCCTATCCACCTGC-1 AAGCCTGCAAGCGTAT-1
##          0           2           1           3
## AAGCGATAGGAACCAG-1 AAGCGGATCCTGATCT-1 AAGCGGGCAACCTCGT-1 AAGCGGGCAACTATGA-1
##          0           1           1           1
## AAGGACTAGGGACGT-1 AAGGCCAAGATTGCCA-1 AAGGCCAAGGTCCCAG-1 AAGGCCAACCTTGCG-1
##          0           0           0           4
## AAGGCCAACCTTGCG-1 AAGGCCAACCTTGCG-1 AAGGCCAACCTTGCG-1 AAGGCCAACCTTGCG-1
##          0           4           0           0
## AAGGGTTAGTAGCAGG-1 AAGTACCCAAATCATG-1 AAGTCAAAGGTTGGA-1 AAGTCAAAGTTAGAGA-1

```

##	1	3	0	3
##	AAGTCATTCCGTCCAC-1	AAGTCGCTCCCTGGCT-1	AAGTCGCTCGCTTGAA-1	AAGTGTCCAAGCCGTA-1
##	0	2	2	1
##	AAGTGTCCATAATCTC-1	AAGTTGAAGTAGAGGT-1	AAGTTTCAGCTGGGTT-1	AATACGAAGTCGAAGG-1
##	1	0	0	1
##	AATACGAAGTTGCAGC-1	AATACGTTCCCATGCC-1	AATACGTTCTATCAC-1	AATATGCTCCCATGCC-1
##	0	2	2	2
##	AATATGGAGAATCCAT-1	AATCACTAGGGCTCCA-1	AATCATCAGTTAGGCC-1	AATCCAAGCAAGGGC-1
##	4	3	3	1
##	AATCCAAGCATCTCT-1	AATCCAAGGTATGGG-1	AATCCAAGTGATACT-1	AATCGCGCAGCATGGC-1
##	0	1	4	1
##	AATCGTTAGCAGGTCT-1	AATCTGGTCCGCTACC-1	AATGCAAAGCATGTGC-1	AATGCACCACTCAGGA-1
##	1	2	0	2
##	AATGCGGAGGTACATT-1	AATGGGACACCATCCG-1	AATGGGCGTCAACTCG-1	AATGGGCGTTAAGGGC-1
##	0	3	0	2
##	AATGGGTAGTCATCAG-1	AATGGTAAGCGCATT-1	AATGGTAAGTGAACCC-1	AATGTGAAGCATTGAT-1
##	4	0	0	0
##	AATTCCCTCATGACTCC-1	ACAACAGGTAAATGGAT-1	ACAACAGGTATGGACA-1	ACAACCGCATAAGGCT-1
##	2	2	0	1
##	ACAAGCTCAAAC TGCG-1	ACAAGGGTCGTAGTGC-1	ACAAGGTAGCTACGCG-1	ACAAGGTAGGAAC TGG-1
##	2	0	3	4
##	ACAAGGTAGTTGGCTA-1	ACAAGTAAGGATTGCC-1	ACAATTCA GTCAGCAC-1	ACACAAGGTTAGGGAC-1
##	2	0	3	2
##	ACACATTAGGTCACTA-1	ACACATTAGGTGCGTT-1	ACACCAGCATTGGAAC-1	ACACGATCACTTACTG-1
##	3	0	2	2
##	ACACTAGTCCATCCGC-1	ACACTAGTCCGGTACG-1	ACAGAACAGTAATCCG-1	ACAGAACAGTTGCTTC-1
##	1	2	0	0
##	ACAGAATGTTATCATG-1	ACAGATGGTAATTGGG-1	ACAGCGAAGCTATCGA-1	ACAGGAACAACCAAGT-1
##	1	0	3	0
##	ACAGGGCAGTAATCA-1	ACAGGTGAGGGTAGG-1	ACAGGTGAGTGCTCGG-1	ACAGTTGTCCAGCTAA-1
##	1	1	3	4
##	ACAGTTAGGCGTACT-1	ACATAGAAGGGCAGT-1	ACATAGAAGTTAGCAT-1	ACATAGCCATCCTGTA-1
##	0	3	0	0
##	ACATCATAGGTCA TC-1	ACATCATAGGTCCATA-1	ACATCCCCATGGCTTC-1	ACATCCTTCAGGGCAA-1
##	0	3	2	0
##	ACATGAAAGCGAACCT-1	ACATGAAAGCTGGTCG-1	ACATGAAAGGGCAGAC-1	ACATGCCAGGGCAAC-1
##	0	0	0	0
##	ACATGGCTCTCACTAC-1	ACATGGTCAAGTTACA-1	ACATGGTCAGGCTCAA-1	ACATTCCCTCCATGAA-1
##	1	1	1	2
##	ACCAAAACCA CCTGCAT-1	ACCAAGTCATCGGTGA-1	ACCAATTAGGTTACTG-1	ACCACGTAGCATGTAT-1
##	2	2	0	0
##	ACCACTAAGCTATCAG-1	ACCATAACAGGACAGG-1	ACCATAGTCGTGCTAA-1	ACCATATAGCATATAC-1
##	4	2	1	1
##	ACCATTTCAAATGGAG-1	ACCCATAAGCGAGACA-1	ACCCATAAGCGCAACT-1	ACCCATAAGGGCAGGT-1
##	1	0	0	0
##	ACCCATAAGGTTGCAC-1	ACCCCATCAAAGGTAG-1	ACCCGAACATAGGCTG-1	ACCCGAACATCGCTTA-1
##	3	0	0	0
##	ACCCGATAGATTAGAG-1	ACCCGATAGTGC CCAG-1	ACCCGCAAGGCAATGG-1	ACCCGTGAGGTAGCAG-1
##	0	0	0	1
##	ACCCTAGGTTCTTCA-1	ACCCTCGCACAAGGCC-1	ACCCTTTAGAAGCCAG-1	ACCCTTTAGATTACCG-1
##	0	2	3	0
##	ACCCTTTAGTCGAGTC-1	ACCGACTAGCATCCGG-1	ACCGCAACATCAAGCG-1	ACCGCCAAGCATAGGG-1
##	3	3	2	0
##	ACCGCCAAGTTACGAT-1	ACCGGTTAGCAACCAC-1	ACCTATGAGGTGGCAA-1	ACCTCTTAGCATGGGA-1

##	3	0	3	0
##	ACCTGAATCAGCGAAG-1	ACCTTCACAGCCAGTA-1	ACGAACCTCTATGTGG-1	ACGAAGGTCCTGATT-1
##	0	2	0	0
##	ACGACATCATAAGTGC-1	ACGAGCAAGATTCTGT-1	ACGAGTAGTTGATGC-1	ACGATTTAGCCAACTA-1
##	1	0	0	1
##	ACGCCAACAAAGGGTA-1	ACGCCATAGAACGATA-1	ACGCCATAGCAGGGAC-1	ACGCCATAGCTGGTAC-1
##	4	0	3	3
##	ACGCCATAGTGTATCCA-1	ACGCCAAGTCAATGT-1	ACGCTTGGTTGGCTG-1	ACGGACAAGGGTCTCG-1
##	0	3	0	0
##	ACGGCAAAGCGCTGTG-1	ACGGCAAAGTACCCAGC-1	ACGGCTTAGCAACCTA-1	ACGGCTTAGTAGGCAG-1
##	0	1	0	0
##	ACGGCTTAGTGCCTGG-1	ACGGGTAAGAACGGTG-1	ACGGGTAAGTAACCCA-1	ACGGGTTTCATGTCT-1
##	0	0	3	2
##	ACGGTCACAGTTAGGT-1	ACGGTGAAGGATGAAC-1	ACGGTGAAGGGTACTC-1	ACGTAACCATAAGCTA-1
##	0	0	0	0
##	ACGTATTAGCATAGTT-1	ACGTACAGGATCAC-1	ACGTGGTTCTAGTTCC-1	ACGTGTTGTTCGGCCT-1
##	3	0	4	0
##	ACGTTCAAGTCGCACG-1	ACGTTCCCAGGACTTG-1	ACGTTTAGTGAAGGAG-1	ACGTTGAGAACGGAT-1
##	0	2	0	3
##	ACGTTGAGTACGGAG-1	ACTAAGGGTAAGCTA-1	ACTACCCCAGGTACG-1	ACTACCTCCCGCAAG-1
##	0	0	2	1
##	ACTATCCTCCGTTACT-1	ACTATTCCATGGTGC-1	ACTCAATAGCGCATT-1	ACTCACAAGCCAGGAA-1
##	1	0	0	1
##	ACTCACAAGGGTACA-1	ACTCACAAGGTGGACA-1	ACTCCAAAGAACCTG-1	ACTCCAAAGCCCTGGA-1
##	0	0	0	3
##	ACTCCCACCCGCTGT-1	ACTCCCACCCAGT-1	ACTCCTTAGGCGAATG-1	ACTCGAATCGTCTCTG-1
##	0	2	3	0
##	ACTCGCCTCCCATTAC-1	ACTCTCACACAGCAAT-1	ACTGAGGAGCGAATC-1	ACTGAGGAGGTATCCA-1
##	2	2	0	0
##	ACTGCCCTCGATT-1	ACTGCCCTCGTCA-1	ACTGCTAACCGAGAGC-1	ACTTAGGTCCAGCAGC-1
##	0	1	1	1
##	ACTTCATCACATTAAG-1	ACTTCGTTCCCATTAC-1	ACTTGCTTCAATGGCC-1	ACTTGCTTCCCGCTAG-1
##	1	2	2	0
##	ACTTGTGAGCCATGAC-1	ACTTCGCAAGTTAGCG-1	AGAAGTCAGCCATGAC-1	AGAAGTCAGCCGAGTT-1
##	1	3	0	1
##	AGACAAACAGCGAGCTT-1	AGACAGACAGCTATGG-1	AGACATAAGCGCAATC-1	AGACATAAGGGTGAGC-1
##	0	1	0	0
##	AGACATAAGTCGAATT-1	AGACGATAGTTAGTT-1	AGACGCAAGGTTACGC-1	AGACGGATCCTCTACG-1
##	1	0	1	0
##	AGACGGCAAACGTAA-1	AGACGGGCAGGTTAGT-1	AGACGGGCATCCTGCG-1	AGACTGCTCCCATGAA-1
##	1	0	3	2
##	AGACTGCTCTCGTG-1	AGAGAAATCAATCAGCG-1	AGAGACCGTAGTGCAGG-1	AGAGACTAGTGGCTTA-1
##	3	2	3	0
##	AGAGAGAAGATTGAGA-1	AGAGGGTCACATTCCA-1	AGAGTATGTGCCGTCT-1	AGAGTCCTCGTGATAT-1
##	0	3	0	1
##	AGCAACCTCACGTAGC-1	AGCAATTCCCCATGC-1	AGCACCACAAACTGCG-1	AGCACCACAATACGCG-1
##	0	2	2	4
##	AGCACCACACCTTCCC-1	AGCACTTGTTCACCAG-1	AGCAGCAAGGAATGCG-1	AGCATCATCCGTAATG-1
##	1	1	0	0
##	AGCATCGCAACCTTGC-1	AGCATCGCAATCGGCA-1	AGCATCGCATAGATCA-1	AGCATGGAGCTGGAAG-1
##	0	1	3	3
##	AGCATGGAGCTTCCA-1	AGCATTGTCCATGTCT-1	AGCATTAGCAACCAC-1	AGCCAAAGTTGAGTAG-1
##	0	2	0	1
##	AGCCCCAACGGCAGATAG-1	AGCCCGATCGAATTAC-1	AGCCCTAGTTGACGCC-1	AGCCGATTCGAGTTGC-1

##	1	2	2	1
##	AGCCGTTAGCTGGTCG-1	AGCCTGACAGTAATTG-1	AGCCTGGTCTGTGAA-1	AGCGAATAGGCTCAGT-1
##	1	1	0	3
##	AGCGAATAGGTCAAT-1	AGCGAATAGTTACCGA-1	AGCGACAAGCAATGAA-1	AGCGACCCAAGGTCGC-1
##	3	1	0	0
##	AGCGAGGCAAGTAAGG-1	AGCGATGAGCTGGTGT-1	AGCGCCATCCCTCGTA-1	AGCGCCATCGTGCCAG-1
##	3	1	0	0
##	AGCGGTAAGGTTACGC-1	AGCGGTTCCCGTAGG-1	AGCGGTTCCCTCGCA-1	AGCGTCCGTTCGTCAG-1
##	3	2	0	0
##	AGCTGGTTCCATGTCT-1	AGCTGTTGTTGCGTAT-1	AGCTTATAGGGGTAGC-1	AGGAACCTAGGATCCGT-1
##	2	0	0	1
##	AGGAACCTAGGTAAGGT-1	AGGAACCTAGGTAGCAG-1	AGGAATGCAACCTGAG-1	AGGACCAAGCCAGGTT-1
##	0	0	4	1
##	AGGACCAAGGGCTTAC-1	AGGACCAAGTTGCGCG-1	AGGACCCCAGGTTCAG-1	AGGACTAGTGAGTCGG-1
##	0	0	0	0
##	AGGACTAGTGGCAGTG-1	AGGAGTTAGGCACAGA-1	AGGAGTTAGGTGGCTT-1	AGGATTAAGGCACGAA-1
##	0	1	0	0
##	AGGCAAGTCGCGTGTG-1	AGGCAATAGGATGAAC-1	AGGCATGAGGTTAGTT-1	AGGCCAAAGGTACCCG-1
##	0	0	1	1
##	AGGCCAAAGGTCGAGA-1	AGGCCATTCCCTCGTGC-1	AGGCCATTCTGTCAAG-1	AGCGAATCTCATCAC-1
##	0	4	0	0
##	AGGCCTTCCCTCATG-1	AGGCCTTCTGTCAAG-1	AGGCTCACATGACTAA-1	AGGGAACCAAAGGCC-1
##	2	0	0	3
##	AGGGATTAGGATTTCGC-1	AGGGCAATCAAGTTCG-1	AGGGCTAAGTTGCTTC-1	AGGGTATAGGAGGTTG-1
##	4	0	3	0
##	AGGGTCAAGATTAACC-1	AGGGTCAAGCAGGTAG-1	AGGGTCAAGCATTGAT-1	AGGGTTAGTCAATCAC-1
##	0	0	0	1
##	AGGGTTGAGAATCAAG-1	AGGGTTGAGCCAGTGT-1	AGGGTTGAGGGGACTA-1	AGTAAATCCACCGGA-1
##	0	0	0	1
##	AGGTAAACAGAACGGGC-1	AGGTAGTAGCAGGTCT-1	AGGTAGTAGGATGGCA-1	AGGTGATAGTGGCGAA-1
##	0	0	0	2
##	AGGTGCTTCGAGGTCT-1	AGGTGTGAGGCTTCGG-1	AGGTGTGAGGGGATGC-1	AGGTCGCAGGTTGGC-1
##	1	0	3	1
##	AGGTTGGAGCATCCAA-1	AGGTTGGAGTATGAAG-1	AGTAACCCAGCTACGA-1	AGTACACCATAAGGTGCG-1
##	0	1	3	3
##	AGTATAGAGATTGGTT-1	AGTATGAAGAAGCTCC-1	AGTATGAAGGTACGAG-1	AGTATGTTCTCGATT-1
##	0	0	0	0
##	AGTATTCAAGCATATAC-1	AGTATTCAAGCCAGGTT-1	AGTCAGGAGGTTGAGG-1	AGTCATTAGGGCATA-1
##	1	0	0	1
##	AGTCCTAACCGCATGT-1	AGTCGATCATAGAGAG-1	AGTCTCAAGCCTAGCG-1	AGTCTCAAGGAGGACC-1
##	0	3	0	1
##	AGTCTTGAGCGGATGA-1	AGTGAACAGGGTTAGG-1	AGTGAACAGTGGCGA-1	AGTGACAGTAAGCACA-1
##	1	1	3	2
##	AGTGAGGTCGAACGCT-1	AGTGATCCAACGGGC-1	AGTGATCCAAGCCAAT-1	AGTGCGCCAGCAGGCT-1
##	0	2	1	3
##	AGTGCGCCATGCTTGC-1	AGTGCTCAGAATCGGG-1	AGTGCTCAGATAGTCT-1	AGTGCTCAGGAGTAAC-1
##	1	3	0	3
##	AGTGGAACAAACGGGTC-1	AGTGGATAGGGTAGCA-1	AGTGGCTTCCACCTTG-1	AGTGTAAAGAATCAAG-1
##	2	0	0	0
##	AGTGTGCGCAACTGGCA-1	AGTGTGAGTCTGGTTG-1	AGTGTGTCGGCACTC-1	AGTGTGTCGTACAGC-1
##	3	1	0	1
##	AGTTAGAAGCGAATCC-1	AGTTAGCCAGTTAGGT-1	AGTTAGCCATCACACC-1	AGTTAGCCATGGTACG-1
##	3	0	0	1
##	AGTTGAGGTGAGCAGC-1	AGTTGCATCACTTCAC-1	AGTTGGAGGCTACGT-1	ATAACGAAGCTAGAGG-1

##	0	0	0	0
## ATAAGCTCCCCATGC-1	ATAAGGATCCATCGAA-1	ATAAGTGAGCGGTGAA-1	ATAATGCTCTAGGCCG-1	
##	2	1	3	2
## ATACCATAAGGTGCGTT-1	ATACGAAAGGGCTAGA-1	ATACGCGCAGGACTTG-1	ATACGTTAGGGCAGTA-1	
##	1	0	2	1
## ATACGTTAGGTCGTAC-1	ATACGTTAGGTGATCC-1	ATACTGGTCGCTGGCA-1	ATAGCGCTCACCGT-1	
##	4	0	0	0
## ATAGCGCTCCGTGCGA-1	ATAGGATGTTGCTTAA-1	ATAGGCCTCCGGACAT-1	ATAGGCGAGTGACCTA-1	
##	0	0	1	0
## ATAGGGTAGGTACCGA-1	ATAGGGTAGTTGGATT-1	ATAGTGAAGTACGGTC-1	ATATCACAGCGAAGTG-1	
##	0	0	3	1
## ATATCACAGTCAGGAG-1	ATATCAGCAAGGTATC-1	ATATCAGCATTACCTG-1	ATATGCCAGCTCTG-1	
##	0	1	2	2
## ATATGTCAGGAATGCG-1	ATATGTCAGGATCCCG-1	ATATTCCCATTAGAGC-1	ATATTCCCATTGTGC-1	
##	0	0	1	0
## ATCAACTAGTTGGCTA-1	ATCAGGGAGCCTATCT-1	ATCAGGGAGTAAGGTA-1	ATCAGGTCATGACTAA-1	
##	0	1	0	2
## ATCAGTTAGCCTGAGT-1	ATCAGTTAGTGACCGA-1	ATCATCCTCAATCCCT-1	ATCATGGTCGCTCCGT-1	
##	0	0	0	0
## ATCATTCAAACCGTG-1	ATCCAATAGGATGAAC-1	ATCCACAAGAACATA-1	ATCCACAAGTAGGAGT-1	
##	1	0	0	1
## ATCCACTTCCATGCC-1	ATCCACTTCTATCCAC-1	ATCCATAGTGAAGGTC-1	ATCCATGAGTAATGTC-1	
##	2	2	3	1
## ATCCCAAAGGGTGACA-1	ATCCCTTAGGAGGCAC-1	ATCCGACAGCATCAAT-1	ATCCGACAGCTACGGT-1	
##	0	0	0	0
## ATCCGCCTCCCATGCC-1	ATCCGTAAGCCTAGCG-1	ATCCGTAAGCGCAATC-1	ATCCGTAAGGTATCTG-1	
##	2	1	0	3
## ATCCGTAAGTCAGGGA-1	ATCCGTAAGTTAGGTT-1	ATCCTAGAGATTGCGC-1	ATCCTAGAGCCTGTAA-1	
##	1	0	1	3
## ATCCTAGAGCGGTAGA-1	ATCCTCCGTCAAGCGG-1	ATCCTGAAGAAGGACT-1	ATCCTGAAGGCAACGA-1	
##	0	0	0	0
## ATCGAAGGTTCACTCC-1	ATCGAGGAGTTGGTCA-1	ATCGATTAGCGATTGC-1	ATCGATTAGCTGGAA-1	
##	2	1	2	3
## ATCGCCCTCATGGACC-1	ATCGCCCTCCCATTAC-1	ATCGCGCGTAACCAA-1	ATCTAACAGGAGGTTG-1	
##	2	2	0	0
## ATCTAACAGGTTTCAGC-1	ATCTCATCAACCTTCA-1	ATCTCGCCAGGATGCC-1	ATCTGCAAGCTGGATC-1	
##	0	1	2	0
## ATCTGGATCCTGGTAA-1	ATCTGTGAGCGAGAGC-1	ATCTGTGAGGTACTTG-1	ATCTGTTCACAGGGTC-1	
##	1	3	0	2
## ATCTTAGGTGGGTCT-1	ATCTTGCTCCCATTAC-1	ATGAAAGTCGTTAGAT-1	ATGACCCAGCCTATCT-1	
##	2	2	1	0
## ATGAGGCCTTATCAGC-1	ATGAGGTAGTGCACCC-1	ATGAGTAAGGAACCT-1	ATGAGTAAGGCGCATT-1	
##	0	3	0	1
## ATGAGTAAGTTACGCA-1	ATGATGAAGGTACCCG-1	ATGCACGCAAATTCCCT-1	ATGCACGCATAACCAA-1	
##	3	4	1	0
## ATGCAGGAGTCGCGTG-1	ATGCATTAGATTAGGA-1	ATGCCAATCCCCATGC-1	ATGCCACAGTAGGCAGA-1	
##	3	0	2	0
## ATGCCTAACGGTGAGC-1	ATGCCGTTCGAGTGTC-1	ATGCTAACAAATAGACC-1	ATGCTAACACAGGCGT-1	
##	1	1	2	3
## ATGCTAACATGGATCG-1	ATGCTCAAGGAGGACC-1	ATGCTCCCATGGTCAG-1	ATGCTCCCATGGTCTC-1	
##	0	1	2	2
## ATGCTTGAGAAGCTAA-1	ATGGACCTCACACCTT-1	ATGGACCTCCCATGCC-1	ATGGAGACATTAGTGA-1	
##	0	0	2	1
## ATGGAGTAGGTAGTCC-1	ATGGAGTAGTTAGCTG-1	ATGGCAAGTCTGGGCT-1	ATGGCCCGTGACTCGC-1	

##	0	0	0	2
## ATGGCGAAGGTATAGA-1	ATGGGATAGTACCA-1	ATGGGCAAGTATCTCC-1	ATGGGTGAGGAGCTAG-1	
##	3	1	3	0
## ATGGGTGAGTGACCAC-1	ATGGTAAAGCTATGTG-1	ATGGTGAGTGATAGTG-1	ATGGTTTAGCTGAGAG-1	
##	1	0	0	0
## ATGGTTTAGGTACCAC-1	ATGTCCCCAGGTATCG-1	ATGTCCCCATGACCCT-1	ATGTCCCCATTACTCG-1	
##	0	2	2	2
## ATGTCCTTAATGCC-1	ATGTGTTAGGCATGA-1	ATTACAGCAGTGCAG-1	ATTACACCTCCATGTCT-1	
##	0	0	1	2
## ATTCACTAGTTACGGC-1	ATTCCGCCATGACGAT-1	ATTCGATAGCTAACG-1	ATTCGTTCAATATCTC-1	
##	0	2	0	2
## ATTGAGGGTTAGGGTA-1	ATTGCCCATGAAGTC-1	ATTGCCCATGGTAAC-1	ATTGCCCATGGTACG-1	
##	0	2	2	2
## ATTGCCAGTGAGCCT-1	ATTGGCTGTAAGCTCT-1	ATTGTCAGTAAGTACG-1	CAAACCATCCCATGCC-1	
##	3	1	1	2
## CAAACCCAGATAGCGG-1	CAAACCTAGAATCAAG-1	CAAAGCCTCCATGAA-1	CAAAGCGAGTTGGACC-1	
##	1	4	2	0
## CAAAGCTCACTAGGCA-1	CAAAGGGTCGTAGTCA-1	CAAAGGTAGCAACCTA-1	CAAAGTAAGCATGGAG-1	
##	4	0	3	3
## CAAATGTTCCGGTAGT-1	CAAATTCAAGGTAACCT-1	CAAATTCAAGTGGTCT-1	CAACACGCATTGGCCT-1	
##	1	0	0	1
## CAAGCGAAGGATCCCG-1	CAAGCTCAGCCACTAA-1	CAAGCTCAGTTGGCGT-1	CAAGGATAGCCGCGTA-1	
##	3	3	1	0
## CAAGTAAAGTGGCAAG-1	CAAGTAAAGTGGTAG-1	CAAGTCGCATGAGCCA-1	CAAGTCTGTATGGTGA-1	
##	3	4	3	0
## CAATAGAAGCCGATTA-1	CAATAGAAGGTCCAAC-1	CAATAGCCACTAGCAG-1	CAATCATAGCCATCCC-1	
##	0	0	4	0
## CAATCTTCAAGCTGGC-1	CAATGCATCCTGCTGC-1	CAATGGTCATGACCGA-1	CAATTAGCAATATGTG-1	
##	0	2	0	2
## CAATTGGTCCCTCATG-1	CACAACATCTAACTGG-1	CACAAGTCAGCAGTCA-1	CACACAATCCCCATGC-1	
##	2	0	2	2
## CACACAATCTAACTGG-1	CACACCTCATGCTGTC-1	CACACTAAGCATTAGT-1	CACACTAAGCCCGTCT-1	
##	1	0	2	0
## CACATCAAGCCTGCCT-1	CACATTGAGGGCTTAC-1	CACATTGAGGGTTGG-1	CACCAGACAATCGGGC-1	
##	0	3	0	0
## CACCATCCACAATCCC-1	CACCATTTCATCGTTC-1	CACCGCAAGGAATGTA-1	CACCGCAAGTCTAGCA-1	
##	1	1	1	0
## CACCGCAAGTGAAGTCC-1	CACCTAAAGTGGCTG-1	CACCTCATCAGTATGT-1	CACCTGCTCTAGGCCG-1	
##	0	0	2	2
## CACCTGCTCTCACCTG-1	CACCTTAGGGTATGG-1	CACCTTAGTGACGGA-1	CACGACTAGTGAACGG-1	
##	2	0	0	0
## CACGACTAGTGAATT-1	CACGCAACATCGCTCG-1	CACGCCAAGCTAGGCT-1	CACGCCAAGCTAGGGA-1	
##	0	1	0	0
## CACGCCAAGCTGGAGA-1	CACGCCAAGGAGGTTG-1	CACGTATGTGGGTTGG-1	CACGTTGGTGGGTCGA-1	
##	0	0	3	1
## CACTACCCAAGTGTAC-1	CACTACCCATGACTCC-1	CACTACTTCACGGATC-1	CACTCCGCAATCTGGG-1	
##	4	2	0	1
## CACTGCCTCCTCATGT-1	CACTGGACAAGTCGCA-1	CACTGTCCATGTCGGA-1	CACTTAGAGGCATGTC-1	
##	2	3	2	0
## CAGCACTAGTAATCGT-1	CAGCCATAGGCGTCAT-1	CAGCGATTCCATGTCT-1	CAGCGCATCATCACTC-1	
##	0	0	2	4
## CAGCGCATCCCCATGC-1	CAGCTAATCATGGTAT-1	CAGCTAATCGCTGAGT-1	CAGCTCTCATAACTCT-1	
##	2	0	1	2
## CAGCTCTCATTACCTG-1	CAGGAACGTCTAGGTT-1	CAGGATAGTGAAGCGT-1	CAGGCACCACAGGCAC-1	

##	2	0	1	2
## CAGGCCATCCATCGAA-1	CAGGGCTCAAGTAGTC-1	CAGGGCTCATGCAGTG-1	CAGGGGTAGGTTGCAC-1	
##	1	0	2	0
## CAGGTACATAAGGTC-1	CAGGTCCGTGACTCTG-1	CAGGTGAAGTCAAGGG-1	CAGGTGAAGTTAGAGA-1	
##	1	2	0	0
## CAGTATTAGCCAGCAT-1	CAGTATTAGGCAGATT-1	CAGTCAATCATGTGAT-1	CAGTCCCTCCATGTCT-1	
##	3	1	1	2
## CAGTGTGTGAAGTCA-1	CAGTTATAGTCATTCC-1	CAGTTTGAGCGATTCA-1	CATACAACATCATCAT-1	
##	0	0	1	1
## CATACCCCATGACACG-1	CATACCCCATGGAATC-1	CATAGGGAGAACGACCG-1	CATATTGTAAGGGCT-1	
##	2	2	0	0
## CATCCAAAGTAAGTCT-1	CATCCAAAGTAGGAAC-1	CATCCAAAGTGGGTCT-1	CATCCCATCACGTGCG-1	
##	3	0	0	2
## CATCCGCTCTCATCCG-1	CATCCGCTCTGGTAGC-1	CATCCGGAGTCGCTAA-1	CATCTCACATAGGTTA-1	
##	2	0	0	0
## CATGATTAGTGCTGGT-1	CATGCAATCCCCATGC-1	CATGCCTCAATCCGTC-1	CATGCCTCAATCTAAG-1	
##	1	2	0	1
## CATGGGTTCGATTAAC-1	CATGTCAAGGTCCACG-1	CATGTCAAGGTCCAGT-1	CATGTTGAGCGACTAC-1	
##	1	1	3	0
## CATTACCTCATGTGTG-1	CATTACCTCCGGTATA-1	CATTAGTAGCAATGAA-1	CATTAGTAGGTGCGTT-1	
##	0	0	1	0
## CATTAGTAGTCAGGGA-1	CATTGCTTCATGCCGG-1	CATTGTGAGAAGCTAA-1	CATTTCGCATAATCCT-1	
##	2	2	0	2
## CCAAAGTCAGGATACT-1	CCAAAGTCATTATCG-1	CCAACCTCAGGCAGGA-1	CCAACTAAGTGTCAAT-1	
##	1	1	3	0
## CCAAGGTTCACCTGGG-1	CCAATAGTCTAGGCCT-1	CCAATCAAGGCAACTC-1	CCAATCAAGTTGCATG-1	
##	0	0	3	0
## CCACATAAGAATCGTT-1	CCACCGTTCATCACAG-1	CCACGAACAAACCGCAA-1	CCACGCAAGGTAAGCG-1	
##	1	1	0	3
## CCAGAATCAGCTATGG-1	CCAGAGAAGAATCATC-1	CCAGATGCAAAGGATG-1	CCAGCAACACAGCATG-1	
##	3	0	2	1
## CCAGCCAAGGAACCTC-1	CCAGCCAAGGATTGGG-1	CCATAATAGTGCTTAG-1	CCATAACTTCGTGATAT-1	
##	0	1	1	1
## CCATCCGCAACATTAG-1	CCATGGGTCGATCAGC-1	CCATTAGAGGGTATCC-1	CCATTAGAGTGGCTAC-1	
##	1	0	0	3
## CCATTAGAGTTGGGTC-1	CCATTTCAGCAGGTAG-1	CCCACATCCAGGTAGGG-1	CCCACGTTCCCCATGC-1	
##	0	3	0	2
## CCCACGTTCTGCGCT-1	CCCACGTTCTAGCGCG-1	CCCAGCAAGAAGCTAA-1	CCCAGCAAGCCATTGA-1	
##	2	2	0	0
## CCCAGTGAGATACTCG-1	CCCAGTGAGGGCATT-1	CCCACATCATCACGGAGA-1	CCCACATGAGTCATGCGC-1	
##	0	0	3	2
## CCCATGAGTTGCGGTC-1	CCCATGCTCATGCACA-1	CCCACATGCTCCCATGCC-1	CCCACATGCTCCCGCGTGA-1	
##	2	0	2	2
## CCCATGCTCGCGTCCT-1	CCCATGCTCTAATGCG-1	CCCACATGCTCTCACCGC-1	CCCACATGCTCTGTAAGT-1	
##	2	2	0	2
## CCCATGGAGGGTAGAT-1	CCCATGGAGTGATCTG-1	CCCACATTAGCTACCGG-1	CCCACATTAGGAGCTAG-1	
##	0	0	0	0
## CCCACATTAGGCGCATT-1	CCCGACAAGCAAGTCC-1	CCCGACAAGGTCAAGG-1	CCCGATGAGATTCCAG-1	
##	0	1	3	0
## CCCGCATTCCATAGCA-1	CCCGCTTAGAAGGTGCG-1	CCCGCTTAGGTTAGTT-1	CCCGTAAGTTCGTATA-1	
##	2	0	0	2
## CCCTACGCATGGTAGT-1	CCCTATGTCTATGCAG-1	CCCTCACAGGCACAGA-1	CCCTCACAGGGGACGT-1	
##	1	2	1	0
## CCCTGAGAGGGCAGTGA-1	CCCTTAACACCATAGG-1	CCCTTAACAGGTAAATC-1	CCGAACTAGTAGAGCG-1	

##	0	0	4	3
## CCGACATAGCAAGCTC-1	CCGACATAGGCTTACA-1	CCGACATAGTGAACCC-1	CCGACCAAGTACGCAC-1	
##	0	0	0	2
## CCGACTTCACTATGAA-1	CCGATTAAGAAGCGCA-1	CCGATTGGTTGGTCAT-1	CCGCAATAGCAACCCG-1	
##	2	0	2	3
## CCGCAATAGGTCAACC-1	CCGCAATAGTAGCTGC-1	CCGCAATAGTTAGAGA-1	CCGCATGAGCGCTACG-1	
##	3	0	3	0
## CCGCCAAAGGTTCGCG-1	CCGCCATTCCCATGCC-1	CCGCCTTAGGATAGAC-1	CCGCCTTAGGTCCCAG-1	
##	0	2	0	1
## CCGCGAACCGCGCATG-1	CCGCTAGAGCCTGTGG-1	CCGCTAGAGTAGGCTC-1	CCGCTTATCACGCGAT-1	
##	3	0	0	3
## CCGGATTAGGTGTCGAC-1	CCGGATTAGTACCAAT-1	CCGGCTAAGTCAGGCT-1	CCGGTATAGGCTATAT-1	
##	0	1	1	3
## CCGGTATAGGTGGATG-1	CCGGTATAGTGGCGAA-1	CCGGTCAAGCTGGTTA-1	CCGGTCAAGGCTTCCC-1	
##	0	3	0	1
## CCGGTTGAGAACGGGC-1	CCGTAACAGTAGGAGT-1	CCGTCAGTAGTGTCT-1	CCGTCAAGTGAGGTCG-1	
##	0	3	2	0
## CCGTCCACATTACTCG-1	CCGTCGAAGGTGAGTG-1	CCGTCGTTCACTGCTA-1	CCGTGATAGCGGTGAA-1	
##	2	0	1	0
## CCGTGATAGGGACTA-1	CCGTGATAGGGCAGT-1	CCGTGCAAGTTAGGAA-1	CCGTGCTTCATGCCG-1	
##	1	1	0	2
## CCGTGGATCCCTCTAG-1	CCGTGTGAGCCGAGTT-1	CCGTGTGAGGGCTTCG-1	CCGTGTGAGTCATCCT-1	
##	0	3	3	0
## CCGTCATCGCTGAGT-1	CCGTCGCATAGACCG-1	CCGTTGGAGCATCGAC-1	CCGTTGGAGTCGACCG-1	
##	0	1	3	2
## CCTAATGAGGTTGATT-1	CCTAATGAGTAATCAC-1	CCTAATTACAAAGCAT-1	CCTACGGAGCATCCTT-1	
##	1	0	2	0
## CCTACGGAGGCTCTGG-1	CCTAGTTCATGCGAC-1	CCTATAGAGGCATCCG-1	CCTATGTTCCCTCTAG-1	
##	0	2	1	0
## CCTCAGCTCCCTCATG-1	CCTCAGTCATTACCT-1	CCTCATTAGGTAGAGT-1	CCTCGAAGTAGCGCGA-1	
##	2	2	1	3
## CCTCTGATCAATCTGG-1	CCTCTGATCGACTGCG-1	CCTGAGACACAATGGT-1	CCTGCGAAGCTAGATT-1	
##	1	0	2	0
## CCTGCGAAGTAGCGAG-1	CCTGCTCAGGATATGA-1	CCTGGTTCAACGGCTA-1	CCTGTAAGCGATAGG-1	
##	0	0	2	0
## CCTGTCGCAAGCGGTC-1	CCTGTGGAGCTTCCTG-1	CCTGTGGAGTAGGAAC-1	CCTGTTGTCCCCAGGA-1	
##	3	3	3	0
## CCTTATATCATGCTGA-1	CCTTATATCGCTGGCA-1	CCTTGCATCCATCCAT-1	CCTTTAGCAGGACAGG-1	
##	0	0	1	0
## CCTTTCAGTCTAGGTT-1	CGAACATCATTAGTGA-1	CGAACGAAGAACATCGAA-1	CGAACGAAGTTGCCGG-1	
##	0	0	0	2
## CGAAAGTGAGCTATCCT-1	CGAAAGTGAGGAGCTAG-1	CGAAAGTGAGTGCTTAG-1	CGAATTAGGAATCAA-1	
##	1	1	3	0
## CGAATTAGGTTACGC-1	CGAATTAGTAGTAGA-1	CGACAGCCACCAACGA-1	CGACCAACAAATCAGC-1	
##	0	0	0	3
## CGACCATAGCATTCGA-1	CGACCATAGGTACTTG-1	CGACCGATCGTTAGTG-1	CGACGTTAGGTGTCGAC-1	
##	0	0	0	0
## CGACGTTAGTAGTCTG-1	CGACTAACATCGACTAGC-1	CGACTAGCACTTAGGG-1	CGACTCCTCTTGACTC-1	
##	0	1	4	2
## CGACTGACAGGCAGGA-1	CGACTGGTCGACATGC-1	CGAGCAAAGTGAGTGG-1	CGAGCACCAAGCTGTG-1	
##	1	2	0	0
## CGAGCCATCCTCGTCA-1	CGAGGATGTAGGCGAT-1	CGAGGATGTTCGCAG-1	CGAGGGACATCCAGAG-1	
##	0	2	2	1
## CGAGGGTAGGATGCCT-1	CGAGTCCGTCTAACGTC-1	CGAGTGAAGATAGATG-1	CGAGTGAAGTAGAGTA-1	

##	0	0	2	0
## CGATCAATCCCCATGC-1	CGATCAATCCTTGATC-1	CGATCCTCATGACTCC-1	CGATCTAAGTTAGTGT-1	
##	2	1	2	0
## CGATGGTCGACTAAT-1	CGATGTCAGGAGTCGA-1	CGATTAACAATTAGTG-1	CGATTATAGCTACGAC-1	
##	2	4	3	0
## CGATTCAAGATTCAAC-1	CGATTCCCATGGTCGA-1	CGATTTGAGGCCAGCAT-1	CGCAACTAGCAAGGTG-1	
##	0	2	0	3
## CGCAACTAGCATGCCG-1	CGCAACTAGGATAGTA-1	CGCAACTAGGCGATTC-1	CGCACCTTCCAGAGAG-1	
##	0	0	1	0
## CGCACTTCATTAGGGT-1	CGCAGGTAGCAGCAGGAG-1	CGCATCTCATCACGGA-1	CGCATTCCAGCCTATC-1	
##	2	2	0	0
## CGCCAAGTCGTGCCTC-1	CGCCAATAGTTAGGAA-1	CGCCACAAAGTACGCAC-1	CGCCATGAGGCAGTCG-1	
##	0	3	0	2
## CGCCTAGAGCATTAAC-1	CGCCTAGAGTGAAGGT-1	CGCCTCACATTACTCG-1	CGCCTGAAGGTTGCTA-1	
##	3	3	2	0
## CGCCTGAAGTCAGTAT-1	CGCGAACCATGATTAG-1	CGCGATTAGCCAGTCG-1	CGCGATTAGGCAGTCG-1	
##	1	0	0	0
## CGCGCATGTAGCTAGA-1	CGCGTAGTCAGGACAG-1	CGCGTAGTCCAGCACG-1	CGCGTAGTCTGGATGC-1	
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## CGCGTCAAGGTGGAGC-1	CGCTAACAGCATATAAC-1	CGCTAACAGCGCCTCT-1	CGCTAACAGGTAATCT-1	
##	0	3	0	0
## CGCTAATGTAACTGCT-1	CGCTACCTCTAGTTCC-1	CGCTGATAGGGTAGTG-1	CGCTGATAGTAGGACG-1	
##	2	1	3	3
## CGCTGCAAGTAATGGA-1	CGCTGTGAGGATAGAC-1	CGCTTAGGTTCATCGG-1	CGGAACGGTTGACTAC-1	
##	3	3	1	0
## CGGACTTAGGTGCATC-1	CGGATTCAAGGAGA-1	CGGCATTAGCAATTAC-1	CGGCCAATCCCATACT-1	
##	1	0	1	2
## CGGCCAATCTGGATTG-1	CGGCCTAAGTGCGCA-1	CGGCTAACAAATTAGCA-1	CGGCTTGAGGATTCGC-1	
##	4	0	1	0
## CGGGATGGTAGCGAGT-1	CGGGATGGCAACTT-1	CGGGCTTGTCTAGTGT-1	CGGGGAACACTATCTG-1	
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## CGGGGAACACTTAGCC-1	CGGGTAAAGCCTGCGA-1	CGGGTAAAGTAATGGA-1	CGGGTAGGTCTACCG-1	
##	0	0	0	0
## CGGGTCATCTGTGCAA-1	CGGTGAAAGCGATCCG-1	CGGTGAAAGCTAATCG-1	CGGTGAAAGTTACCGA-1	
##	0	1	1	1
## CGGTGTTAGCGGTAT-1	CGGTTAGCAGCTCGAA-1	CGGTTCCAACATCCC-1	CGGTTCCAACCCTAC-1	
##	2	3	0	2
## CGGTTCCATGATATG-1	CGTAATTAGAAGGAAG-1	CGTAATTAGCAGGCAA-1	CGTAATTAGTAATCAC-1	
##	2	0	0	4
## CGTACGTAGTTAACGT-1	CGTAGTCAGGTGATCC-1	CGTATATAGCTATGGC-1	CGTATATAGGAGCCAA-1	
##	0	0	0	0
## CGTATATAGTACGGGA-1	CGTATATAGTCGACCG-1	CGTATCCAAGCGATT-1	CGTATGATCCCCATGC-1	
##	0	0	3	2
## CGTATGATCGATCGTA-1	CGTCAAATCCCCATGC-1	CGTCAAATCTAACCCC-1	CGTCAGGTCTACGTCT-1	
##	1	2	1	0
## CGTCAGTAGGAGTACG-1	CGTCATAAGGCTAAG-1	CGTCATAAGGTAGATA-1	CGTCATAAGTGAGATA-1	
##	0	1	0	3
## CGTCCATCAGGGCTTA-1	CGTCCCACAATGTAGC-1	CGTCCTCAGCGGCATT-1	CGTCCTCAGGATTCGC-1	
##	0	3	0	3
## CGTCCTTGTCTGGGT-1	CGTCGTAGTAACCGAA-1	CGTCTATTCCATGT-1	CGTGAAAGTCTAATTG-1	
##	0	2	2	0
## CGTGAGAAGGCGAACG-1	CGTGATGCAGCTCATC-1	CGTGCTGAGTTAGTGT-1	CGTGCTGAGTTGCTTC-1	
##	3	4	0	1
## CGTGGGTACCATCAC-1	CGTGGTTAGGCTAGT-1	CGTGTATGTAATGACG-1	CGTGTATGTCATCCAG-1	

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##          0          0          0          0
## CGTGTAAAGAACGGAT-1 CGTGTAAAGGATAGGT-1 CGTGTAAAGGGTCTCG-1 CGTGTAAAGTGAACGG-1
##          3          3          0          3
## CGTGTGGTAGTAACG-1 CGTGTGGTGCACGTC-1 CGTGTGGTGCAGCTC-1 CGTGTGGTCACTGG-1
##          1          0          0          1
## CGTTACAAGGTGCTCG-1 CGTTACTTCACATGGC-1 CGTTATGAGGTACGAG-1 CGTTCACCACTAGGGC-1
##          1          0          0          1
## CGTTCCATCGTGAGTC-1 CGTTCCATCCTGTATC-1 CGTTCCGCAGTTAGGT-1 CGTTCCGCATGGTAAC-1
##          1          2          3          1
## CGTTCCGTGACTCTG-1 CGTTCGCTCCCGTGT-1 CGTTGGTGCATGGAG-1 CGTTGTAAGGTTCATG-1
##          2          0          1          3
## CGTTTGAAGGTATAGA-1 CGTTTGAAGTTGGGTC-1 CTAAACTAGGATGCCT-1 CTAAACTAGGTGCAAG-1
##          0          0          3          1
## CTAAAGCCAAGTTACA-1 CTAAATGCAACTCCA-1 CTAACATAGCCTGATA-1 CTAAGGGAGCCAGCAT-1
##          3          1          1          0
## CTAAGGTCATGCGGAC-1 CTAATCTCATTGTC-1 CTAATGGTCCCAGTCAA-1 CTACAATAGTTGGCCG-1
##          1          2          2          3
## CTACCAAAGCTGGTGT-1 CTACCATTCCCGAGA-1 CTACCCCTGTTCTTCA-1 CTACCGCTCTAGGCCG-1
##          1          1          0          2
## CTACGGACATGCTTGC-1 CTACGTAAGCTGAGTC-1 CTAGATTAGTAGCTGC-1 CTAGCCAGTAGGCCTG-1
##          2          0          1          0
## CTAGCGCGTGCAGTCC-1 CTAGGTCAGTACGCAC-1 CTAGTTGAGTGTAGA-1 CTAGTTGAGTTAGAGA-1
##          0          0          3          3
## CTATGCCAGTTAGCG-1 CTATGCAAGATTGTC-1 CTATGCTTCTGGCCGA-1 CTATGGCATGGCTTC-1
##          0          0          2          1
## CTATGTGAGGCATGTC-1 CTATGTGAGGTAGGTG-1 CTCAACTTCGACCCAG-1 CTCAATTCAATACCGG-1
##          2          0          1          2
## CTCAGTAAGTCATGGC-1 CTCATAGAGGGATGC-1 CTCATGAAGCAGGTAG-1 CTCATGTTCTATGCGA-1
##          0          0          3          2
## CTCATTCAAGTCAGTCA-1 CTCCAATTCAATCAAGT-1 CTCCAGCTCCTCTCAG-1 CTCCTAGTCTAAGTCG-1
##          3          2          2          1
## CTCCTCAAGGCACCTTA-1 CTCGAACAGCATGCAC-1 CTCGAACAGTCAGGCC-1 CTCGAACAGTCGAACC-1
##          0          0          0          1
## CTCGATCCATGGCTCT-1 CTCGATTCCCCATGC-1 CTCGCGAAGTACGCCG-1 CTCGCTATCTAGGCCG-1
##          2          2          1          2
## CTCGCTTGTGCTTAA-1 CTCGGATAGGCAAGTG-1 CTCGGCAAGGTCCACG-1 CTCGTAAGAAGGTAC-1
##          2          0          1          3
## CTCGTAAGATACTAC-1 CTCGTAAGCGGGATA-1 CTCGTAAGCGGTAAAG-1 CTCGTAAGTCTAGAGA-1
##          1          0          0          0
## CTCGTTACATTACGGG-1 CTCTAGAAGGCAGTA-1 CTCTCGATCAGCAGAG-1 CTCTGGTCACAGGGTC-1
##          2          1          0          1
## CTCTGGTCATAAGTC-1 CTCTGGTCATAGACGT-1 CTCTGTTAGGCATGGA-1 CTCTGTTAGTGAAGTCC-1
##          2          1          3          1
## CTCTTCTCAAAGTCG-1 CTCTTCTCAATTGTC-1 CTCTTCTCATTCAAGT-1 CTGACAATCATACAGT-1
##          4          1          1          1
## CTGACACAGTCATTCC-1 CTGACGTAGCTTACGA-1 CTGACGTAGTGGCTCG-1 CTGATAGTCACACCTT-1
##          3          3          3          1
## CTGATATAGCGATTGC-1 CTGATATAGGTGAAGT-1 CTGATCAAGATTAGTC-1 CTGCAACAGCCTAAGC-1
##          3          1          2          0
## CTGCAACAGGTTGGAG-1 CTGCAATGTAACCTCA-1 CTGCATTTCAAGGCAGA-1 CTGCATTCCATGTCT-1
##          2          1          1          2
## CTGCCTGCAATATCGA-1 CTGCGATAGGTAGTGG-1 CTGCGATAGGTGCAGA-1 CTGCGATAGGTTACTG-1

```

##	0	1	0	3
##	CTGCTAAAGCCACTAA-1	CTGCTGCTCATGTC-1	CTGGCAACAATGGAAG-1	CTGGCAACACAATCCC-1
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##	CTGGCCAAGCCTGTGG-1	CTGGCCAAGGAGGTGC-1	CTGGCCAAGGCAGAC-1	CTGGCCAAGGCTTGGT-1
##	1	3	3	3
##	CTGGGCATCCCGTTGC-1	CTGGGTTAGCAAGTCC-1	CTGGGTTAGTGAGTCC-1	CTGGTTAACGCAAGGC-1
##	2	0	0	0
##	CTGGTTAACGCTGAGTC-1	CTGGTTAAGGCAGTA-1	CTGGTTAACGTTGCCT-1	CTGTAACGTTGACGAA-1
##	0	0	3	1
##	CTGTAATAGTGACCAC-1	CTGTCAAAGGAGTATA-1	CTGTGCCTCCCTGTGC-1	CTGTTAGAGTAATGGA-1
##	1	0	2	1
##	CTGTTCCGTTGCCGT-1	CTGTTGAAGTACCAAGC-1	CTTAATCCATGACGAT-1	CTTAGCTCCGTAGCG-1
##	2	0	2	0
##	CTTAGGATCCTCATGT-1	CTTATCGCAACTAGCG-1	CTTATGGAGTGCTTAG-1	CTTCATTGTGAGAGGA-1
##	0	0	3	0
##	CTTGAATAGTTAACCG-1	CTTGAGGCATAATTGG-1	CTTGATGAGAACGCTAA-1	CTTGCAAAGCGAGCTT-1
##	3	2	3	4
##	CTTGCTTAGTTAGGCC-1	CTTGGCGAGAACCTG-1	CTTGGCGAGGAACCTGG-1	CTTGGCGAGTTACACG-1
##	0	0	1	1
##	CTTGGGACACTTCGAC-1	CTTGGCGTCTGGCTA-1	CTTGGGGTCCCATGCC-1	CTTGGGGTCGCTTGGG-1
##	2	1	2	2
##	CTTGTGAAGTGAGGCA-1	GCAAAGGTCGAACCGT-1	GCAACATCAATGTCAA-1	GCAACTATCCCATGCC-1
##	0	0	0	2
##	GCAAGCAAGGTGGAGC-1	GCAAGTGAGGCAGTA-1	GCAAGTGAGGGGTAAT-1	GCAAGTGAGGGTCACT-1
##	1	0	1	3
##	GCAAGTGAGTAAGCCC-1	GCAAGTGAGTGCTGTA-1	GCAATCGCAGCTCTAC-1	GCACACTAGCGGACTT-1
##	0	0	3	0
##	GCACAGCCAAGTCGTG-1	GCACCGATCGATGCGT-1	GCACGAAAGGATGGTG-1	GCACGAAAGTTGGTAT-1
##	1	0	0	0
##	GCACTATGTAAGGTAT-1	GCACTCCTCCGCACTC-1	GCACTGACAGGGACAG-1	GCACTTGGTTATGGAG-1
##	2	2	1	0
##	GCAGTGAAAGATACTCG-1	GCAGTGAAAGTTGCCTT-1	GCATAACCACAGCAAT-1	GCATAGCTCGATCCGG-1
##	0	1	2	1
##	GCATAGTCATTGATGT-1	GCATCACAGGATCCCG-1	GCATCAGCATGACGGC-1	GCATCCTCATTGGCA-1
##	1	0	1	0
##	GCATCTAACGCCAGTTA-1	GCATCTAACGCTAGCG-1	GCATCTAACGGAGTAGT-1	GCATGAGAGAACCTTG-1
##	0	0	0	0
##	GCATGAGAGCAAGGAT-1	GCATGGGGTTTCGTA-1	GCATGGTCGTTGCGG-1	GCATTATAGGTCGAAG-1
##	0	0	0	0
##	GCATTCAAGCAATTG-1	GCATTCCCATGACGGC-1	GCATTGAGCCGACAT-1	GCCACATAGGTAGCCT-1
##	1	2	0	1
##	GCCACATAGTTGCACA-1	GCCATAATCAGGACAG-1	GCCATAGCAATCGCTC-1	GCCATCCTCAGGCTCG-1
##	1	2	0	2
##	GCCATCCTCCGTCTA-1	GCCCAATAGGTGGAGC-1	GCCCCAAAGGATCTAT-1	GCCCCATTGCTCTGC-1
##	0	0	1	2
##	GCCCCATTCTATGCGA-1	GCCCCTTAGTCAGGG-1	GCCCTAGAGAACGAAC-1	GCCCTAGAGGGTCTGT-1
##	2	4	3	0
##	GCCCTGAAGGCGCATT-1	GCCCTGAAGGTGGAAT-1	GCCCTGAAGTAGCCCG-1	GCCCTGTTCCCCATGC-1
##	1	3	0	2
##	GCCCTTGCAGCTCGTT-1	GCCGCTAACGCGCATA-1	GCCGTTGAGCTACGAC-1	GCCTAAATCGACTGCG-1
##	3	0	1	4
##	GCCTAACAGCTACCGG-1	GCCTGCAAGGGTGAAT-1	GCCTGCTTCCCATGAA-1	GCCTGGATCACAGAGG-1
##	0	0	2	1
##	GCGAAAGTCCTCATGT-1	GCGACTTAGCGATGCT-1	GCGACTTAGCTGGAGA-1	GCGAGTAAGAACGAA-1

##	2	0	0	3
##	GCGAGTTCTGTCGC-1	GCGATGAAGCGTTAC-1	GCGCATTAGGCTAGAG-1	GCGCCTAACAGCAAGTCC-1
##	1	0	0	0
##	GCGCTAACAGTCGG-1	GCGCTCAAGCTAGACC-1	GCGCTCAAGCTAGTAT-1	GCGCTCAAGCTATCAG-1
##	0	0	0	1
##	GCGCTTGAGCGGTCTG-1	GCGGAGACATGCAGAT-1	GCGGAGTAGGTTCAA-1	GCGGAGTAGTTAGACT-1
##	0	2	0	1
##	GCGGAAACAGGAGCGA-1	GCGGGATAGGCTACTA-1	GCGGGATAGTGCCGTG-1	GCGGGTAGTAATTGCC-1
##	3	0	1	0
##	GCGTACCGTCTCACCT-1	GCGTACCGTGAGGACT-1	GCGTCAACAAATCGGT-1	GCGTCCTCCCCGTGA-1
##	0	0	0	0
##	GCGTGTAGCATTAGT-1	GCGTTAGCAGGATAGA-1	GCGTTCCATGTCTC-1	GCGTTCCAATTAGTG-1
##	0	3	2	1
##	GCTAACATCGCTCCTA-1	GCTAATGTCCATGCC-1	GCTACAGCAACTACGG-1	GCTACAGCATCGGTAG-1
##	0	0	1	2
##	GCTACCCCTCGACC-1	GCTAGGCCATGACTCC-1	GCTAGGTTAGGCTAC-1	GCTAGGTTCCATGAA-1
##	0	2	1	2
##	GCTATTGAGCCACAGT-1	GCTCACCTCCATAGAT-1	GCTCAGTAGGGATAT-1	GCTCATAAGCCTGTCC-1
##	0	1	1	3
##	GCTCATAAGTGCCAG-1	GCTCCATCACTCATGC-1	GCTCCTGCACGGAG-1	GCTCGTTCAAATTCAAG-1
##	1	2	2	1
##	GCTCTATTCCCCATGC-1	GCTCTGTCCCCATGC-1	GCTGAGAAGTGTCCA-1	GCTGGTTAGATTGCCA-1
##	2	2	0	3
##	GCTGTATGTTCCAAG-1	GCTTAATAGGAGGATT-1	GCTTACAAGATTACGT-1	GCTTACAAGCCACGAT-1
##	0	0	1	1
##	GCTTACTTCGTTACTC-1	GCTTATAGTAAGTGAT-1	GCTTATGAGCGCTCCT-1	GCTTATGAGCGCTTGG-1
##	2	0	0	0
##	GCTTCGCTCCATATC-1	GCTTGAATCACCAGCG-1	GCTTGCCTCCATGAAT-1	GCTTGGGTACACCAA-1
##	2	0	2	0
##	GCTTGTAAGGATAGCG-1	GGAAAGCCACAAGCCA-1	GGAAAGCCATCGGTT-1	GGAACATAGCATATCG-1
##	3	3	3	3
##	GGAACATAGGTACTAT-1	GGAAACCAAGATTAGAG-1	GGAAACCAAGCTACGCG-1	GGAAACCAAGGTTGCCT-1
##	0	0	1	0
##	GGAAACCAAGTTAATGC-1	GGAACTGAGTTGCTTC-1	GGAAAGCCAGGTATAGA-1	GGAAAGCCAGTAGCCGT-1
##	0	1	0	1
##	GGAAATATGTTAATTG-1	GGAAATTAAAGTTAATGC-1	GGACACCCAGGGCATC-1	GGACACCCATCAAGTA-1
##	2	0	3	2
##	GGACACGGTGAACGCG-1	GGACATGAGGTTCGCG-1	GGACGAATCAGGTTCA-1	GGACGAATCCAATGTG-1
##	4	0	1	1
##	GGACGGACAAGCACCA-1	GGACGTAAGATAGCGG-1	GGACGTAAGATTAGCT-1	GGACGTAAGGGACGT-1
##	0	3	0	0
##	GGAGCAATCCCTCACA-1	GGAGCTAACGCCATCGG-1	GGAGTATAGCCGAGTT-1	GGAGTATAGTAGACTT-1
##	2	1	0	0
##	GGAGTCAGCGGACTT-1	GGAGTCAGTATGGTT-1	GGATAACAGCCGATAC-1	GGATAGTAGTCATGTG-1
##	0	0	3	1
##	GGATGCCAATCGACG-1	GGATGCAAGCATGCCG-1	GGATGGGCAGGACTTG-1	GGATGTTCAACCGCAA-1
##	0	0	1	1
##	GGATGTTAGGTAGTT-1	GGATTAAAGAACGGAGT-1	GGATTAGGTGCGGAAT-1	GGATTGCTCCCTCATG-1
##	1	1	0	2
##	GGCAACCCAGTTGCCT-1	GGCAACTTCGACTAGC-1	GGCAATGAGGATGCCT-1	GGCACACCAATCAGAC-1
##	1	2	0	0
##	GGCACATTCCCCGTGA-1	GGCACCTGTGCGCGAA-1	GGCACGAGTATTGGTC-1	GGCATGAAGCGGTCTG-1
##	2	0	2	0
##	GGCATGTTCACAGCGT-1	GGCATTCAAGTACCCG-1	GGCATTCAAGTCAGCCG-1	GGCCAATTCACCTACT-1

##	1	0	1	0
##	GGCCCTAACGCTGGTTA-1	GGCGATCATTGCCG-1	GGCCTAACACTCGGTT-1	GGCCTAACGCTACGGT-1
##	0	3	1	0
##	GGCCTTGAGCGAGACA-1	GGCCTTGAGGTAGATA-1	GGCGATGGTTAGCGAA-1	GGCGTAGTGAACCAA-1
##	3	0	0	0
##	GGCGTAAAGCAACTAT-1	GGCGTAAAGGCAGTA-1	GGCGTTGTCAAGTGCC-1	GGCGTTGTCCAGCATA-1
##	0	1	1	3
##	GGCTAGAAGGAATTAG-1	GGCTAACACATCCGCAT-1	GGCTGAAAGAAGCTAA-1	GGCTGGTCAAGTGCCA-1
##	0	3	3	0
##	GGCTTAATCATGGCCG-1	GGCTTCCTCATGGACC-1	GGGACGTAGATAGGAC-1	GGGACGTAGGATGCAG-1
##	2	1	0	3
##	GGGACGTAGGTGCGAA-1	GGGATTGAGAACGGGC-1	GGGATTGAGGTAGCGA-1	GGGATTGAGTAGTAAG-1
##	0	2	1	3
##	GGGATTGAGTCAGCTA-1	GGGCAAATCACGTAGC-1	GGGCAAATCCCCTGTA-1	GGGCAACAGCTTCCAT-1
##	0	0	2	0
##	GGGCTAAAGCTGGTGT-1	GGGCTGTCTGGAAGG-1	GGGGACTAGGAGCTAG-1	GGGGATGCACTATGGG-1
##	0	0	0	2
##	GGGTAATAGGATTAGA-1	GGGTACTTCCCCATGC-1	GGGTCAAAGAAGGGTT-1	GGGTCAGGTTCTGCT-1
##	2	2	0	1
##	GGGTTAGAGCCTAGAC-1	GGGTTAGAGCTTCTG-1	GGGTTGAAGATTACCG-1	GGGTTGGGTGAGGAAG-1
##	0	3	0	1
##	GGGTTGGGTTTAGGTC-1	GGGTTTCAGCGCATGT-1	GGTAAGGTCTGGTGTA-1	GGTAATGGTGATGATG-1
##	2	1	1	1
##	GGTACGAAGGAACCGA-1	GGTACGCCAATGAGTC-1	GGTAGCAAGAACATCAGA-1	GGTAGCAAGCTTCCGC-1
##	0	2	0	1
##	GGTAGCAAGGTAGTAA-1	GGTAGCGGTTTCGAGT-1	GGTAGTGAGGAGGTTG-1	GGTAGTGAGGTTGCGT-1
##	0	1	0	0
##	GGTATTGTCAGCAGAG-1	GGTCAATCAGCACTAG-1	GGTCACTAGCGCAACT-1	GGTCACTAGCTAGTCA-1
##	0	2	2	0
##	GGTCATCAGGATAGAC-1	GGTCGAGGTTAGGCT-1	GGTCGTTAGAACAGAAG-1	GGTCTAGCATGATCGG-1
##	0	2	0	1
##	GGTCTTAAGAACACT-1	GGTGATGAGCTACGAC-1	GGTGATGAGGTAATTC-1	GGTGCAGGTAATCGTC-1
##	1	4	0	2
##	GGTGCCTGTAAGTGTG-1	GGTGCCTGTGACTCTG-1	GGTGCTTAGCTATGTG-1	GGTGGCTCAAGCATAC-1
##	0	2	0	2
##	GGTGGTAAGCCAGCAT-1	GGTTACGCAATACGGT-1	GGTTACGCAACTAACGG-1	GGTTAGCTCGCTGATA-1
##	3	2	1	0
##	GGTTTAGTCCCATTAC-1	GGTTCAAGATAGGTA-1	GGTTCAAGCATGGCT-1	GGTTCAAGCATGTCA-1
##	2	0	0	3
##	GTAACACTCCCGTGAG-1	GTAACCTGTTGACCG-1	GTAACGGAGCCCTTCA-1	GTAACGGAGTCGCGCA-1
##	1	0	2	0
##	GTAAGCGAGATTGAGA-1	GTAAGCGAGCGCTGTG-1	GTAAGGGTCCCATGAA-1	GTAAGGGTCCCTCTCGA-1
##	1	0	2	3
##	GTAAGGGTCGTGATTG-1	GTAATAGAGGATCTCA-1	GTAATAGAGTTAGGAA-1	GTAATCCGTTATGAGG-1
##	0	0	1	0
##	GTACACGCACCATGAG-1	GTACCAATCGACTGCG-1	GTACCAGCAAGTAGGA-1	GTACCAGCAGGCTTAG-1
##	3	0	2	4
##	GTACCCAGTGAECTCTG-1	GTACCCCTCATGACTCC-1	GTACGATCAATCCGTC-1	GTACTAACATAACCTT-1
##	2	2	0	0
##	GTACTAACATTACGCC-1	GTACTCCCATGAAGTC-1	GTACTCCCATGGTTCC-1	GTAGCGCCAACCATA-1
##	3	2	2	1
##	GTAGCGCCAGTACTCC-1	GTAGGAACAACTAATG-1	GTAGGATAGTGCCTG-1	GTAGGCAAGCCTAGAC-1
##	0	1	3	3
##	GTAGGCAAGGAGGTTG-1	GTAGTAAAGAAGGTG-1	GTAGTAAAGGGCTTCG-1	GTAGTAAAGGTGAGCA-1

##	1	1	0	0
##	GTAGTAGGTATTGCCG-1	GTAGTAGGTGAGACCG-1	GTAGTCGCAGTTAACGC-1	GTAGTCTGTAGTGCTT-1
##	2	1	3	2
##	GTAGTTACATGCAGTG-1	GTAGTTGTCAATTAGC-1	GTAGTTGTCAGGTCTA-1	GTAGTTGTCCATGTCT-1
##	1	1	0	2
##	GTAGTTAGAACGAGT-1	GTAGTTAGGCAACGA-1	GTAGTTAGGGTCACT-1	GTAGTTAGTAGGTAA-1
##	3	3	1	4
##	GTATATCAGTAAGTGA-1	GTATCCCCAGGACTTG-1	GTATCCCCATGCTACC-1	GTATCCCCATGGCTAG-1
##	1	2	2	2
##	GTATCCCCATGGCTTC-1	GTATCCCCATGGTCTC-1	GTATCTCAACGGTGC-1	GTATCTCAGTTGCTC-1
##	2	2	1	0
##	GTATGAAAGCGCTTGG-1	GTATTCCCTCCATGAA-1	GTCAACATCACCAAGAC-1	GTCAATGTCTCATGTC-1
##	0	2	2	2
##	GTCAATTAGCGGATAG-1	GTCAATTAGGCATCAC-1	GTCAATTAGTCTCTGT-1	GTCAATTAGTGATACT-1
##	3	3	0	1
##	GTCACGTAGGTCCCAG-1	GTCATATAGCTATCGA-1	GTCATATAGGGGCATA-1	GTCATATAGTAATGTC-1
##	3	0	3	0
##	GTCATCAAAGAATCCGC-1	GTCCAATCGACCGCA-1	GTCCAACAGTAAGCGG-1	GTCCCATCAACTTCAT-1
##	0	0	0	0
##	GTCGGAAAGGCCATT-1	GTCCGAAGTCGCATA-1	GTCCTCAGCCAGATC-1	GTCCTCAGGTGCAAG-1
##	1	0	0	1
##	GTCCGCTTCATGTCCT-1	GTCCCTAAAGATAGACA-1	GTCCTTTAGGTTCCCTT-1	GTCGACTAGCTACGCG-1
##	0	0	0	0
##	GTCGCAACACAGCCAA-1	GTCGCAACATCCTGCG-1	GTCGCCAAGGCATTCA-1	GTCGCCAAGGCTTCGG-1
##	1	1	0	3
##	GTCGGGTCAGTACCCCT-1	GTCGGTTAGGATCATT-1	GTCGGTTAGGATGACG-1	GTCGTAATCATGAACT-1
##	1	0	0	1
##	GTCGTAATCCCCATGC-1	GTCGTAATCGTGAACC-1	GTCTAACGTGAGAGTC-1	GTCTACCCATTACCTG-1
##	2	1	1	2
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##	0	2	1	0
##	GTGACGAAGGTCGTAC-1	GTGACGAAGTTGCGAC-1	GTGACGTTCAAGTCGC-1	GTGACGTTCCCCATAT-1
##	1	0	1	0
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##	0	0	2	0
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##	0	0	3	2
##	GTGCGCATCGTTAGGC-1	GTGCGTCAGCTATA-1	GTGCTCAGTGAAGGCT-1	GTGGACAAGGTTGCGT-1
##	0	4	1	0
##	GTGGACAAGTCAGTTG-1	GTGGACCCATGGCTCT-1	GTGGAGGCAGCACTCT-1	GTGGATTCAAACCAAC-1
##	3	2	3	0
##	GTGGATTCAAGCGGTC-1	GTGGCAAAGGCAATGG-1	GTGGCAGGTTCCAGGC-1	GTGGGCAGTCAGCTCA-1
##	3	0	0	2
##	GTGTAACCAAATCGGT-1	GTGTAAGGTTGGGCT-1	GTGTAAGTCAACCTGCT-1	GTGTAAGTCATCGGGTA-1
##	0	0	3	3
##	GTGTCCTCCATCAGA-1	GTGTCCTCACAGCACA-1	GTGTGAGAGGTTACAT-1	GTGTTAGTCCCATTAC-1
##	3	2	0	2
##	GTGTTAGTCCTCATGT-1	GTGTTATAGATAGGAC-1	GTGTTCAAGCTGAGTC-1	GTGTTCAAGTGAAGTA-1
##	2	1	0	1
##	GTGTTCCCAATCAGAC-1	GTGTTCCCATTGCGCT-1	GTTACCCACTCGGAA-1	GTTACCCCATGACACG-1
##	0	2	1	2
##	GTTACTTCAACTCGCT-1	GTTAGCCAGCTAGTAT-1	GTTAGCCAGGATAGCG-1	GTTAGCCAGTAATCGT-1
##	2	0	0	0
##	GTTAGCGCAATAGCGT-1	GTTAGGGAGAAGCATA-1	GTTAGGGAGGAGGATT-1	GTTAGGTCAACATAGC-1

##	3	0	0	1
##	GTTAGGTCACTGCCG-1	GTTATCTCATGGCTC-1	GTTATGGTCCAACCTCT-1	GTTCAATAGGTCCACG-1
##	2	2	1	0
##	GTTCACTTCGTGAGTC-1	GTTCATGAGAACCGGC-1	GTTCATGAGTCAGGCT-1	GTTCATGAGTGATTG-1
##	4	0	0	3
##	GTTCATTGACAGT-1	GTTCATTGACTAGCTT-1	GTTCCAAAGCGGTCTG-1	GTTCCAAAGTGCTCG-1
##	2	0	3	0
##	GTTCCACCAATTGGG-1	GTTCCAGGTTCGTAGT-1	GTTCCGGAGCGCTCCT-1	GTTCCCTAGTGAGCGA-1
##	0	0	0	3
##	GTTCGAATCCCCATGC-1	GTTCCGCTCAGGAGTG-1	GTTGAAGGTGCATCGC-1	GTTGATTAGTTGGCCG-1
##	2	0	0	0
##	GTTGCAATCCCATGAA-1	GTTGCCTCATGACTCC-1	GTTGGGTTCAGGAAGT-1	GTTGGTCAGTGACCGT-1
##	2	1	0	3
##	GTTGTACGTTGAAGGC-1	TAAACGAAGATACT-1	TAAACGAAGCGCATGT-1	TAAATGCTCGATGATT-1
##	3	4	0	1
##	TAACACTAGTGAACCC-1	TAACCATAAGTAGAGT-1	TAACCGATCGCTCTGC-1	TAACCTAGTTCACGAT-1
##	1	3	1	1
##	TAACTGACAACCAACG-1	TAAGCAAAGATAGGAC-1	TAAGCGGAGCATGGGA-1	TAAGCGGAGCGCAATC-1
##	0	0	3	0
##	TAAGGCAGATTCACT-1	TAAGGCAGGGCACATC-1	TAAGGCTCATTGGGA-1	TAATGAGAGAACCTGC-1
##	0	3	3	0
##	TAATGTCAGCAGGGAC-1	TAATGTCAGCATGCCG-1	TAATGTCAGGATTAAG-1	TAATTCCCAGGACTCA-1
##	0	3	0	2
##	TAATTCCCATAACTCT-1	TACAGGGAGTGAACGG-1	TACAGTTAGCAAGGTG-1	TACAGTTAGCAATCCA-1
##	2	0	3	0
##	TACAGTTAGGCACGAA-1	TACCACAAGATTGTG-1	TACCCATTCACTCATC-1	TACCCATTCTAGCGCG-1
##	0	0	1	1
##	TACCCGCTCAAGTGCC-1	TACCTAGAGTAGCATT-1	TACCTGAAGGCTACTA-1	TACCTGAAGTTGGCGGT-1
##	0	1	0	3
##	TACGAGGAGCATGCAC-1	TACGAGGAGCGGATCT-1	TACGCCCTCCATGTCT-1	TACGCTAAGGTGCTG-1
##	3	0	2	3
##	TACGCTAAGTGGCGGT-1	TACGGCCAATCAGGT-1	TACGGGCCAGGCAGTC-1	TACGGGCCATGCGTCT-1
##	0	2	3	3
##	TACGGTCAGGATTAGA-1	TACGGTCAGGTTCCCTT-1	TACGTAGTCGATTAGT-1	TACGTTGAGGTAGTAA-1
##	0	1	0	1
##	TACGTTGAGTAGTCAT-1	TAATACTCAACTAGAC-1	TAATCGCCAGCAGTAT-1	TAATCATTAGAATCGTT-1
##	3	2	2	0
##	TAGCCACAGAACGGAGA-1	TAGCCACAGTGCTGCG-1	TAGCCCAGTCATGGTT-1	TAGCCCAGTTGGAGCG-1
##	3	0	0	1
##	TAGCCCTCATGGCGAC-1	TAGCTAGTCCTGACTT-1	TAGCTCCCAGGATCTG-1	TAGCTGATCCCCATGC-1
##	2	0	2	2
##	TAGCTGATCCGTAGGT-1	TAGCTTGAGTAGAGGT-1	TAGCTTGAGTCGAGTC-1	TAGGAGTAGCAACCCG-1
##	0	0	3	0
##	TAGGAGTAGCGAATGG-1	TAGGAGTAGGATGACG-1	TAGGCGAAGTCAGTTG-1	TAGGCTGCAATCCAGG-1
##	1	0	0	0
##	TAGGCTTGTAAATCCAC-1	TAGGGATCCCCATGC-1	TAGGGTGAGTATGTAC-1	TAGGTCATCACGCGAT-1
##	0	2	1	2
##	TAGGTGGAGTTGGACC-1	TAGTCAACACTATCCA-1	TAGTGGGAGGCTCAGT-1	TAGTGGGAGGGTGACA-1
##	1	0	0	0
##	TAGTTAGCAAAGGCC-1	TATACCCCTCGAGTCTA-1	TATACGTAGGTTACAT-1	TATAGGGGTCAATGCCA-1
##	2	0	0	0
##	TATAGGTTCCCCATGC-1	TATAGGTTCTTGAGGC-1	TATAGTCAGATTGCTG-1	TATAGTCAGGCACTCG-1
##	2	1	0	1
##	TATATCCCAATGTGG-1	TATCAGGTCCGGGTAT-1	TATCCTTGTGCTTAG-1	TATCGAACATCCTATG-1

```

##          3          1          2          2
## TATCGGGCATTCAATCG-1 TATCGTTCAAGCTCCT-1 TATGACTAGATTAGAG-1 TATGACTAGTAGACCC-1
##          0          2          0          1
## TATGAGAAGAAGCGAT-1 TATGAGAAGGATTCGC-1 TATGCCCATGACCTC-1 TATGCTAGTTGTAAG-1
##          0          0          2          2
## TATGCCAGCCCTGGA-1 TATGGTCAAGTCGGC-1 TATGGTCAGGCATTG-1 TCAACATAGAAAGGTAC-1
##          0          2          2          3
## TCAACATAGTCGAACC-1 TCAACATAGTTGCCTT-1 TCAACCAAGTCGAAGG-1 TCAACTGAGGCATTCA-1
##          0          1          1          0
## TCAATGGTCCCCAATT-1 TCACCGCTCCCCATGC-1 TCACGCCTCCCATGAA-1 TCACGGGTCGAATTAC-1
##          0          2          2          0
## TCACGTAAGCCTAGAC-1 TCACGTAAGTCGAGGA-1 TCACTGTTCCGCACGA-1 TCACTGTTCTATCGGA-1
##          3          0          2          0
## TCAGAGGAGAACGGAT-1 TCAGAGGAGCGGATCT-1 TCAGATTAGTCGCGTG-1 TCAGCATGTGAGGAAG-1
##          1          0          0          0
## TCAGCATGTTCCAGCA-1 TCAGCTGGTGCAGCGA-1 TCAGTATAGGATGCCT-1 TCAGTATAGTAGAGCG-1
##          2          3          0          0
## TCAGTATAGTAGTTCG-1 TCATAACAGGAACCTGG-1 TCATAACAGGATCCAC-1 TCATAACAGTCGACAC-1
##          3          0          1          0
## TCATAACAGTCGATGC-1 TCATAGTAGCCAATCA-1 TCATCGAAGGTTCGTA-1 TCATCTATCCCTGACC-1
##          0          1          0          0
## TCATGTGAGCGAGGTA-1 TCATGTGAGCTTCCA-1 TCATGTGAGGGGTACA-1 TCATGTTCATCACGCT-1
##          1          1          0          3
## TCATTCGCATCGACCT-1 TCATTGCTCCTCATGT-1 TCCAACCCAGGGACCT-1 TCCAACTTCATCTAGG-1
##          2          2          3          0
## TCCAATAGTCGGGCT-1 TCCAATGAGCATGTAT-1 TCCAATGAGCTAGCCG-1 TCCAATGAGGTACACC-1
##          4          0          0          0
## TCCAGGCGTCATGAGA-1 TCCAGGTAGGATATGA-1 TCCAGTAAGGTAGCCT-1 TCCAGTAAGTGATCTG-1
##          1          1          0          0
## TCCATAGAGGGCTGT-1 TCCATGAAGGTCGAAG-1 TCCATTCAAGGTAAGTAC-1 TCCATTCAAGCTGGTGT-1
##          0          1          0          0
## TCCATTCAAGGCGTAAG-1 TCCCACGCAACTCGGA-1 TCCCATTAGGTACGTC-1 TCCCCTGGTTGCGAGG-1
##          0          3          3          1
## TCCCTCAAGCCCGTAG-1 TCCCTCAAGTTAGATC-1 TCCTAGAAGCGAATCC-1 TCCTAGAAGTAAGGTA-1
##          0          3          1          0
## TCCTATATCCAGCATA-1 TCCTGTTAGAATCGGG-1 TCCTGTTAGATTCTGT-1 TCGAATTAGATTCCCTC-1
##          2          3          3          1
## TCGAATTAGCGACTAC-1 TCGACACAGGTTACA-1 TCGACGTAGTGACCTA-1 TCGACTAAGTCGAGAG-1
##          4          0          0          1
## TCGACTGGTGAGTTGA-1 TCGATATAGTAATTGC-1 TCGATCAAGTCATCCT-1 TCGATTAGTGAGCGAT-1
##          4          3          1          0
## TCGCAGACATCGTTCA-1 TCGCATAAGTAGGATA-1 TCGCATTTCATGCGCG-1 TCGCCTGCAGGACTTG-1
##          1          1          0          2
## TCGCGCAAGGTAAAGCG-1 TCGGCCAAGTGATCTG-1 TCGCTAAAGCTACTCT-1 TCGCTAAAGGCTTAAT-1
##          0          1          0          0
## TCGCTAAAGGGTGAGC-1 TCGCTCGCACCTGCTG-1 TCGCTCTGTTAGCTGT-1 TCGCTCTGTTGCGATT-1
##          3          0          4          3
## TCGGGCATCAATCCTC-1 TCGGGTTAGCGATGCT-1 TCGGTAATCCGCGATG-1 TCGGTTAAGCCAGCAT-1
##          1          3          1          0
## TCGGTTAAGGGACTA-1 TCGTAATAGCATCGAC-1 TCGTAATAGGGTATGG-1 TCGTACCCAATCGGCA-1
##          0          0          1          1
## TCGTACCCATGACACCG-1 TCGTATAGTCAGCCTA-1 TCGTATAGTGGCGAAT-1 TCGTATAGTTGGAGAC-1
##          2          0          0          1
## TCGTATAGTTCGCTC-1 TCGTCAAAGGATTAAG-1 TCGTCAAAGTCATACG-1 TCGTGAATCCTTAACC-1

```

##	0	0	3	0
## TCGTGGACAACCGTCT-1	TCGTGTCACCTAAC-1	TCGTGTCACCTCAAT-1	TCGTGTCAGGCATAT-1	
##	1	1	0	0
## TCGTGTCCAGGTTACG-1	TCGTGTCAGTACCAAG-1	TCGTGTCATAATCAG-1	TCGTGTCATCACGG-1	
##	1	1	1	0
## TCGTGTCCATGCTCA-1	TCGTTAGAGAATCGTT-1	TCGTTAGAGGTTCATG-1	TCGTTGGTATTGCCG-1	
##	2	1	0	0
## TCTACGGGTTGGCGC-1	TCTATGGAGCCATGAC-1	TCTATGGAGGTTAGCC-1	TCTCACTAGAAGGGCC-1	
##	1	0	0	1
## TCTCACTAGGGTGAGC-1	TCTCCAACAAGTGGAA-1	TCTCGCATCCGGTAAC-1	TCTCTAATCCCCATGC-1	
##	0	3	0	2
## TCTCTCCTCCTCTC-1	TCTCTGGTCGTCTCG-1	TCTGACCCATCAAGCG-1	TCTGACTTCCGTAGTA-1	
##	2	2	0	1
## TCTGATGAGAACCAAGG-1	TCTGCGAGTGATTACC-1	TCTGCGGAGGTACAGG-1	TCTGCGGAGTATGAAG-1	
##	3	0	3	0
## TCTGGCGAGCGCATGT-1	TCTGGGTCGTTGCC-1	TCTGTAAGTAGTCAAG-1	TCTGTGTTCCGGTGTG-1	
##	3	0	4	0
## TCTGTTGCATTACGCC-1	TGAAAGGCACCATCAC-1	TGAACATTCCAGGTGCG-1	TGAACATTCTAGCGCG-1	
##	1	2	0	0
## TGAACCCAGGTAATGA-1	TGAACCCAGTGTCAAT-1	TGAACCTGTTACTCT-1	TGAACCTGTTGCCCT-1	
##	0	0	0	1
## TGAATAGAGTAGCACC-1	TGACACGCAAGTGAGA-1	TGACCAATCGAATTAC-1	TGACCTAAGCGAACGA-1	
##	0	1	0	0
## TGACCTAAGTCATCTC-1	TGACTCCCATGGCTGA-1	TGAGAACAGAACGCTAA-1	TGAGATGGTATGGACA-1	
##	0	2	1	2
## TGAGCAAGTAATCGAG-1	TGAGGCCACATGATCCC-1	TGAGCGAAGGTGACAG-1	TGAGCGAAGTAACCCA-1	
##	0	1	0	1
## TGAGCGGGTGAGACCG-1	TGAGGAACATCGCTAC-1	TGAGGCAAGCATCGGT-1	TGAGGTGAGGAGCTAG-1	
##	0	2	0	0
## TGAGTAAAGTGATTG-1	TGATAGCCAGCCATCT-1	TGATAGCCATTGCCG-1	TGATCCCCATGACTAA-1	
##	0	0	3	2
## TGATCCTTCGCTTGAA-1	TGATGAAAGCGATCCG-1	TGATGAAAGGCAATCC-1	TGATGCCAGCCATCGG-1	
##	2	3	0	0
## TGATGGTCATTAGCCC-1	TGATTCCCTCCATGCC-1	TGATTGGTCCCATGAA-1	TGATTTCCATGGCTCT-1	
##	1	2	2	2
## TGCAAACCATCCACTA-1	TGCAAATTCTGAGAC-1	TGCAATGTCCCCATGC-1	TGCACAGCACCATCAC-1	
##	0	1	0	1
## TGCACCTCAAATCCAA-1	TGCACCTCATTACCGC-1	TGCACGTAGCCTGAAC-1	TGCACGTAGGATTGCG-1	
##	2	1	0	0
## TGCAGTCAGCGATACC-1	TGCATATAGATAGTCT-1	TGCATCAAGCCGACAT-1	TGCATCCCACCTATCA-1	
##	3	1	0	0
## TGCATCCCATGACGGC-1	TGCCAGACAATATCGA-1	TGCCATAAGCCCTTCA-1	TGCCCGAAGTCGACGT-1	
##	2	2	0	1
## TGCCCTTGTAAATTGCG-1	TGCCGTAGTTCGGGTC-1	TGCCCTGCTCAGCAATT-1	TGCCCTGCTCAGGGAAT-1	
##	1	1	1	4
## TGCCTGCTCCCTGTA-1	TGCGACTAGGCGATTC-1	TGCGATGCAAGTCGGC-1	TGCGGGTCACATACTT-1	
##	2	0	0	1
## TGCTAAGTCGCGATAC-1	TGCTAAGTCGTGCTAA-1	TGCTAAGTCTATGAGT-1	TGCTATGAGCAGGTAG-1	
##	1	1	2	0
## TGCTATGAGGCGAAGC-1	TGCTCCGCAACTATCT-1	TGCTGCCTCGAGGTCT-1	TGCTGGGTCCGTGAGT-1	
##	0	1	0	3
## TGCTGGGTCTGTCTGT-1	TGGAACCTCCCATTAC-1	TGGACGAAGTAGCCCG-1	TGGACTCAGGGCTAA-1	
##	0	2	0	0
## TGGACTCAGTCAGGTC-1	TGGACTCAGTGTCCGG-1	TGGATGGAGATTCCAG-1	TGGATTTAGCCAGCAT-1	

```

##          3          0          0          0
## TGGATTAGCTTACCT-1 TGGCACTAGCCAACTA-1 TGGCCATAGCGATGCT-1 TGGCCTGAGCCACGCA-1
##          4          1          0          3
## TGGCTAATCCTGCCAC-1 TGGCTGACAAACCAAC-1 TGGCTGACAAACTGCG-1 TGGGAACGTCAACCTG-1
##          1          2          1          0
## TGGGATAGTGAACCAA-1 TGGGCTTAGGCGATGA-1 TGGGGCTCAATGACAC-1 TGGGGCTCATTGCGCT-1
##          0          3          1          2
## TGGGTAAAGCGTAAG-1 TGGGTGAAGTTAACGT-1 TGGTACGCAAGCCTCT-1 TGGTAGGAGGTCATTG-1
##          3          0          2          0
## TGGTATTAGTATCTCC-1 TGGTCACAGGTTCCCTT-1 TGGTCCTCATTACTCG-1 TGGTGGTCGTAACTG-1
##          0          0          2          0
## TGGTGGTCCTGATGG-1 TGGTTATAGGAGTACG-1 TGGTTCAAGTCGCTAA-1 TGGTTCCCATGGCTCT-1
##          2          0          0          2
## TGGTTCCCATGGTCTC-1 TGGTTTAGTAGTCCTG-1 TGGTTTAGTGCAACTT-1 TGGTTTGAGAATCCAT-1
##          2          0          1          3
## TGGTTTGAGATAGCCC-1 TGGTTTGAGGTGGAGC-1 TGGTTTGAGGTTCCGG-1 TGGTTTGAGTAATCAC-1
##          1          3          3          1
## TGTAACTAGCAATCTG-1 TGTAACTAGGTAAACGG-1 TGTAAGCCATCGTTCA-1 TGTACCTTCATCGGG-1
##          0          1          3          0
## TGTACCTTCGAGTGTC-1 TGTACGATCATGACGC-1 TGTACGATCGACTAAT-1 TGTACTTCAATCCTAT-1
##          1          0          0          3
## TGTACTTCATCCGTGCG-1 TGTACTTCATTCCGAC-1 TGTAGAGGTGGACACG-1 TGTAGCCAGTTAGGCC-1
##          3          0          0          0
## TGTAGTTAGAAGGGCC-1 TGTATGGTCCCGCGCAA-1 TGTATTCCATGACTCC-1 TGTCACTTCCCATGCC-1
##          3          0          2          1
## TGTCACTTCCGCTGTC-1 TGTCAAGGCAAATGGCT-1 TGTCACTGAGCGACTGT-1 TGTCAAAGCGGATTC-1
##          0          3          0          0
## TGTCAAAGGTACGCT-1 TGTCAAAGGTGGATG-1 TGTCCCATCCCGTTCA-1 TGTCCCTAGCAGGTT-1
##          1          0          2          1
## TGTCTGTTCGCTCACC-1 TGTGAGGAGTCAGGAG-1 TGTGCCCTCACTAGAT-1
##          1          0          0          2
## TGTGCCCTCATGTCTC-1
##          2
## Levels: 0 1 2 3 4

```

UMAP Embedding

Generate a UMAP plot to visualize clustering in reduced dimensions.

```
pbmc_sparse <- RunUMAP(pbmc_sparse, dims = 1:15)
```

```

## Warning: The default method for RunUMAP has changed from calling Python UMAP via reticulate to the R
## To use Python UMAP via reticulate, set umap.method to 'umap-learn' and metric to 'correlation'
## This message will be shown once per session

## 16:11:21 UMAP embedding parameters a = 0.9922 b = 1.112

## 16:11:21 Read 1877 rows and found 15 numeric columns

## 16:11:21 Using Annoy for neighbor search, n_neighbors = 30

## 16:11:21 Building Annoy index with metric = cosine, n_trees = 50

```

```

## 0%   10   20   30   40   50   60   70   80   90   100%
## [----|----|----|----|----|----|----|----|----|----|
## ****|*****|*****|*****|*****|*****|*****|*****|*****|*****|
## 16:11:22 Writing NN index file to temp file /var/folders/pp/z15j_rhn22z16k937sk24y340000gn/T//RtmpAE
## 16:11:22 Searching Annoy index using 1 thread, search_k = 3000
## 16:11:22 Annoy recall = 100%
## 16:11:22 Commencing smooth kNN distance calibration using 1 thread with target n_neighbors = 30
## 16:11:23 Found 2 connected components, falling back to 'spca' initialization with init_sdev = 1
## 16:11:23 Using 'irlba' for PCA
## 16:11:23 PCA: 2 components explained 51.39% variance
## 16:11:23 Scaling init to sdev = 1
## 16:11:23 Commencing optimization for 500 epochs, with 72652 positive edges
## 16:11:25 Optimization finished

DimPlot(pbmc_sparse, reduction = "umap")

```

