Mrna, Mirna and Methylation data liver cancer, differentially expressed analysis

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R Markdown

Loading all the necessary libraries for the differentially expressed analysis of Mirna MRNA Methylation data

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.3.1
```

```
## Warning: package 'forcats' was built under R version 4.3.1
```

```
## Warning: package 'lubridate' was built under R version 4.3.1
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.2     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.2     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.1
## -- 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
```

```
library(RColorBrewer)
library(ggrepel)
```

```
## Warning: package 'ggrepel' was built under R version 4.3.1
```

```
library(DESeq2)
```

```
## Loading required package: S4Vectors
## Loading required package: stats4
## Loading required package: BiocGenerics
##
## Attaching package: 'BiocGenerics'
##
## The following objects are masked from 'package:lubridate':
```

```
##
##     intersect, setdiff, union
##
## The following objects are masked from 'package:dplyr':
##
##     combine, intersect, setdiff, union
##
## The following objects are masked from 'package:stats':
##
##     IQR, mad, sd, var, xtabs
##
## The following objects are masked from 'package:base':
##
##     anyDuplicated, aperm, append, as.data.frame, basename, cbind,
##     colnames, dirname, do.call, duplicated, eval, evalq, Filter, Find,
##     get, grep, grepl, intersect, is.unsorted, lapply, Map, mapply,
##     match, mget, order, paste, pmax, pmax.int, pmin, pmin.int,
##     Position, rank, rbind, Reduce, rownames, sapply, setdiff, sort,
##     table, tapply, union, unique, unsplit, which.max, which.min
##
##
## Attaching package: 'S4Vectors'
##
## The following objects are masked from 'package:lubridate':
##
##     second, second<-
##
## The following objects are masked from 'package:dplyr':
##
##     first, rename
##
## The following object is masked from 'package:tidyr':
##
##     expand
##
## The following object is masked from 'package:utils':
##
##     findMatches
##
## The following objects are masked from 'package:base':
##
##     expand.grid, I, unname
##
## Loading required package: IRanges
##
## Attaching package: 'IRanges'
##
## The following object is masked from 'package:lubridate':
##
##     %within%
##
## The following objects are masked from 'package:dplyr':
##
##     collapse, desc, slice
```

```
##
## The following object is masked from 'package:purrr':
##
##     reduce
##
## The following object is masked from 'package:grDevices':
##
##     windows
##
## Loading required package: GenomicRanges
## Loading required package: GenomeInfoDb

## Warning: package 'GenomeInfoDb' was built under R version 4.3.1

## Loading required package: SummarizedExperiment
## Loading required package: MatrixGenerics
## Loading required package: matrixStats
##
## Attaching package: 'matrixStats'
##
## The following object is masked from 'package:dplyr':
##
##     count
##
##
## Attaching package: 'MatrixGenerics'
##
## The following objects are masked from 'package:matrixStats':
##
##     colAlls, colAnyNAs, colAnys, colAvgsPerRowSet, colCollapse,
##     colCounts, colCummaxs, colCummins, colCumprods, colCumsums,
##     colDiffs, colIQRDiffs, colIQRs, colLogSumExps, colMadDiffs,
##     colMads, colMaxs, colMeans2, colMedians, colMins, colOrderStats,
##     colProds, colQuantiles, colRanges, colRanks, colSdDiffs, colSds,
##     colSums2, colTabulates, colVarDiffs, colVars, colWeightedMads,
##     colWeightedMeans, colWeightedMedians, colWeightedSds,
##     colWeightedVars, rowAlls, rowAnyNAs, rowAnys, rowAvgsPerColSet,
##     rowCollapse, rowCounts, rowCummaxs, rowCummins, rowCumprods,
##     rowCumsums, rowDiffs, rowIQRDiffs, rowIQRs, rowLogSumExps,
##     rowMadDiffs, rowMads, rowMaxs, rowMeans2, rowMedians, rowMins,
##     rowOrderStats, rowProds, rowQuantiles, rowRanges, rowRanks,
##     rowSdDiffs, rowSds, rowSums2, rowTabulates, rowVarDiffs, rowVars,
##     rowWeightedMads, rowWeightedMeans, rowWeightedMedians,
##     rowWeightedSds, rowWeightedVars
##
## Loading required package: Biobase
## Welcome to Bioconductor
##
##     Vignettes contain introductory material; view with
##     'browseVignettes()'. To cite Bioconductor, see
##     'citation("Biobase")', and for packages 'citation("pkgname")'.
##
##
## Attaching package: 'Biobase'
```

```
##
## The following object is masked from 'package:MatrixGenerics':
##
##     rowMedians
##
## The following objects are masked from 'package:matrixStats':
##
##     anyMissing, rowMedians
```

```
library(data.table)
```

```
##
## Attaching package: 'data.table'
##
## The following object is masked from 'package:SummarizedExperiment':
##
##     shift
##
## The following object is masked from 'package:GenomicRanges':
##
##     shift
##
## The following object is masked from 'package:IRanges':
##
##     shift
##
## The following objects are masked from 'package:S4Vectors':
##
##     first, second
##
## The following objects are masked from 'package:lubridate':
##
##     hour, isoweek, mday, minute, month, quarter, second, wday, week,
##     yday, year
##
## The following objects are masked from 'package:dplyr':
##
##     between, first, last
##
## The following object is masked from 'package:purrr':
##
##     transpose
```

```
library(RTCGAToolbox)
library(dplyr)
library(tibble)
'if (!require("BiocManager", quietly = TRUE))
    install.packages("BiocManager")

BiocManager::install("limma")'
```

```
## [1] "if (!require(\"BiocManager\", quietly = TRUE))\n    install.packages(\"BiocManager\")\n\nBiocMa
```

```
library(limma)
```

```
##
## Attaching package: 'limma'
##
## The following object is masked from 'package:DESeq2':
##
##     plotMA
##
## The following object is masked from 'package:BiocGenerics':
##
##     plotMA
```

```
'if (!require("BiocManager", quietly = TRUE))
    install.packages("BiocManager")

BiocManager::install("MethylMix")'
```

```
## [1] "if (!require(\"BiocManager\", quietly = TRUE))\n    install.packages(\"BiocManager\")\n\nBiocMa
```

```
library(ggrepel)
library(MethylMix)
#library(DESeq2)
```

Reading the mirna and mrna files, and making the syntax of the sample names in both mirna and mrna files same as that in the survival file.

```
mirna_data<-fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/mirna")
```

```
## Warning in fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project
## pitch/liver/mirna"): Detected 424 column names but the data has 425 columns
## (i.e. invalid file). Added 1 extra default column name for the first column
## which is guessed to be row names or an index. Use setnames() afterwards if this
## guess is not correct, or fix the file write command that created the file to
## create a valid file.
```

```
mrna_data<-fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/exp")
```

```
## Warning in fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project
## pitch/liver/exp"): Detected 423 column names but the data has 424 columns (i.e.
## invalid file). Added 1 extra default column name for the first column which is
## guessed to be row names or an index. Use setnames() afterwards if this guess is
## not correct, or fix the file write command that created the file to create a
## valid file.
```

```
survival_data<-fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/survival")
#fixing sample names for mirna and mrna data
for(i in 2: length(colnames(mirna_data)))
{
  colnames(mirna_data)[i]<-gsub("\\.", "-", colnames(mirna_data)[i])
```

```
  #group$sample[i]<-gsub("\\.", "-", group$sample[i])
  #print(colnames(mirna)[i])
}

for(i in 2: length(colnames(mrna_data)))
{
  colnames(mrna_data)[i]<-gsub("\\.", "-", colnames(mrna_data)[i])
  #group$sample[i]<-gsub("\\.", "-", group$sample[i])
  #print(colnames(mirna)[i])
}
```

storing the common samples in the mirna and survival data in mirna_data1 mirna_data1<-select(mirna_data, all_of(intersect(colnames(mirna_data),survival_data$PatientID))) $storing the common samples in the mrna and survival data in$ $-select(mrna_data, all_of(intersect(colnames(mrna_data), survival_data$PatientID)))$ storing the common samples in the survival data and mirna in survival_mirna

selecting the samples which are common in mirna and survival file

```
survival_mirna<-data.frame(PatientID=intersect(survival_data$PatientID,colnames(mirna_data)))
survival_mirna$Death=NA
survival_mirna$Survival=NA
survival_mirna$co=NA
for(i in survival_mirna$PatientID)
{
  for(j in survival_data$PatientID)
  {
    if(i==j)
    {
      survival_mirna$Death[survival_mirna$PatientID==i]=survival_data$Death[survival_data$PatientID==j]
      survival_mirna$Survival[survival_mirna$PatientID==i]=survival_data$Survival[survival_data$Patient
      survival_mirna$co[survival_mirna$PatientID==i]=1
    }
  }
}
#The row having no death/survival data is removed
survival_mirna$co[is.na(survival_mirna$Death)| is.na(survival_mirna$Survival) | is.na(survival_mirna$Pa
#Removing rows from sur data set where co == 0, i.e. those samples are not present in our methylation d
survival_mirna<-survival_mirna[survival_mirna$co!=0,]
#storing the common samples in the mirna and survival data in mirna_data1
mirna_data1<-select(mirna_data, all_of(intersect(colnames(mirna_data),survival_mirna$PatientID)))
```

selecting the samples which are common in mrna and survival file

```
survival_mrna<-data.frame(PatientID=intersect(survival_data$PatientID,colnames(mrna_data)))
survival_mrna$Death=NA
survival_mrna$Survival=NA
survival_mrna$co=NA
for(i in survival_mrna$PatientID)
{
  for(j in survival_data$PatientID)
  {
    if(i==j)
    {
```

```
      survival_mrna$Death[survival_mrna$PatientID==i]=survival_data$Death[survival_data$PatientID==j]
      survival_mrna$Survival[survival_mrna$PatientID==i]=survival_data$Survival[survival_data$PatientID=
      survival_mrna$co[survival_mrna$PatientID==i]=1
    }
  }
}
#The row having no death/survival data is removed
survival_mrna$co[is.na(survival_mrna$Death)| is.na(survival_mrna$Survival) | is.na(survival_mrna$Patien
#Removing rows from sur data set where co == 0, i.e. those samples are not present in our methylation d
survival_mrna<-survival_mrna[survival_mrna$co!=0,]
#storing the common samples in the mrna and survival data in mrna_data1
mrna_data1<-select(mrna_data, all_of(intersect(colnames(mrna_data),survival_mrna$PatientID)))
```

Conducting DEseq based differentially expressed analysis on mirna data

```
#mirna_data2<-as.matrix(mirna_data1)
mirna_data2<-round(mirna_data1)
mirna_data2<-as.matrix(mirna_data2)
sur_mir<-data.frame(PatientID=survival_mirna$PatientID,Death=survival_mirna$Death)
#row.names(sur_mir)<-survival_mirna$PatientID
mirna_deseq<-DESeqDataSetFromMatrix(countData = mirna_data2[],colData = sur_mir,design = ~ Death)
```

```
## converting counts to integer mode

##   the design formula contains one or more numeric variables with integer values,
##   specifying a model with increasing fold change for higher values.
##   did you mean for this to be a factor? if so, first convert
##   this variable to a factor using the factor() function
```

```
mirna_estimate<-estimateSizeFactors(mirna_deseq)
mirna_des<-DESeq(mirna_estimate)
```

```
## using pre-existing size factors

## estimating dispersions

## gene-wise dispersion estimates

## mean-dispersion relationship

## final dispersion estimates

## fitting model and testing

## -- replacing outliers and refitting for 156 genes
## -- DESeq argument 'minReplicatesForReplace' = 7
## -- original counts are preserved in counts(dds)

## estimating dispersions

## fitting model and testing
```

```
mirna_result<-results(mirna_des)
mirna_result
```

```
## log2 fold change (MLE): Death
## Wald test p-value: Death
## DataFrame with 1046 rows and 6 columns
##         baseMean log2FoldChange     lfcSE       stat     pvalue      padj
##        <numeric>      <numeric> <numeric>  <numeric>  <numeric> <numeric>
## 1        7968.04    -0.00671509 0.0640728 -0.1048042 0.91653117 0.9569664
## 2       15903.42    -0.00492610 0.0642372 -0.0766861 0.93887327 0.9581520
## 3        7987.47    -0.00575931 0.0640767 -0.0898815 0.92838140 0.9572729
## 4        8144.18     0.27625984 0.0888647  3.1087692 0.00187868 0.0160984
## 5        2715.71     0.04559520 0.1117975  0.4078374 0.68339303 0.8340153
## ...          ...            ...       ...        ...        ...       ...
## 1042     7.47337      0.0315411 0.1290511   0.244408 0.80691473 0.9002650
## 1043    12.96381     -0.0862599 0.2056755  -0.419398 0.67492533 0.8340153
## 1044    59.79467      0.1301957 0.0793693   1.640378 0.10092657 0.2833927
## 1045   959.33757     -0.1717443 0.1197870  -1.433748 0.15164426 0.3521832
## 1046 12363.42934      0.2722771 0.1030972   2.640975 0.00826679 0.0507234
```

```
mirna_result_filter <- mirna_result[which(mirna_result$padj < 0.1 & abs(mirna_result$log2FoldChange) > 1
mirna_result_filter
```

```
## log2 fold change (MLE): Death
## Wald test p-value: Death
## DataFrame with 4 rows and 6 columns
##     baseMean log2FoldChange     lfcSE      stat      pvalue       padj
##    <numeric>      <numeric> <numeric> <numeric>   <numeric>  <numeric>
## 1    2.67301        1.01941  0.287290   3.54837 3.87622e-04 0.00458687
## 2 2798.40483       -1.00064  0.264436  -3.78404 1.54306e-04 0.00213028
## 3    3.88611       -1.99312  0.504239  -3.95272 7.72674e-05 0.00132420
## 4    5.21128       -2.33709  0.669387  -3.49139 4.80512e-04 0.00555382
```

```
mirna_data3<-data.frame(V1=mirna_data$V1,mirna_data1,mirna_result)
mirna_data4<-mirna_data3[which(mirna_data3$padj < 0.1& abs(mirna_data3$log2FoldChange) > 1), ]
write.csv(mirna_data4,file = "Differ_mirna_padj0.08_log2fold0.05.csv")
```

Building volcano plot for the differentially express data, with the labeling of the up and down regulated mirna

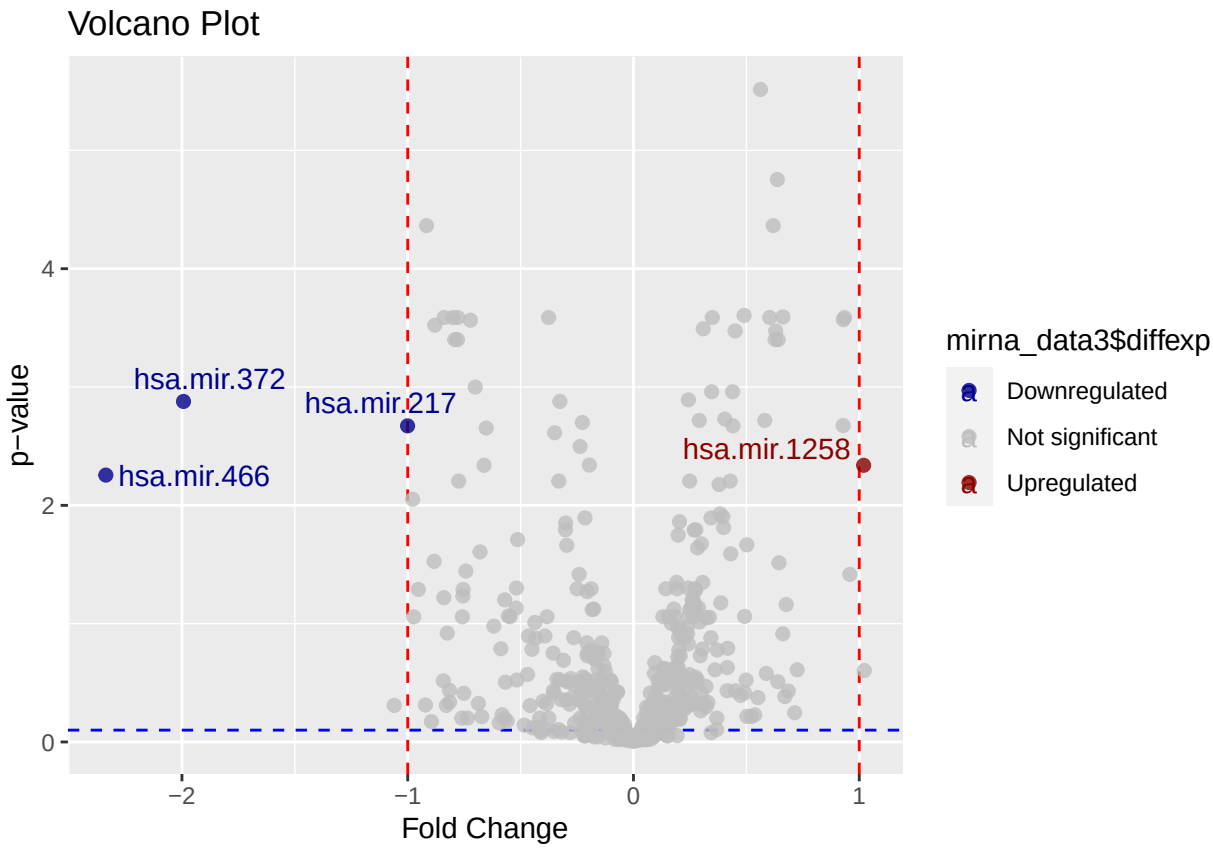
```
mirna_data3 <- mirna_data3[!is.na(mirna_data3$padj), ]


mirna_data3$diffexp<-NaN
res_gen<-mirna_data3$V1
#res_gen
mirna_data3$names<-NaN
for(i in 1:nrow(mirna_data3))
{
  if(mirna_data3$padj[i]<0.1 & mirna_data3$log2FoldChange[i] > 1)
  {
```

```
    mirna_data3$diffexp[i]<-"UP"
    mirna_data3$names[i]<-res_gen[i]
  }
  else if(mirna_data3$padj[i]<0.1 & mirna_data3$log2FoldChange[i] < -1)
  {
    mirna_data3$diffexp[i]<-"DOWN"
    mirna_data3$names[i]<-res_gen[i]
  }
}


ggplot(data.frame(mirna_data3$log2FoldChange,mirna_data3$padj),aes(x = mirna_data3$log2FoldChange,y = -l
  geom_vline(xintercept = c(-1,1),col = "red", linetype ='dashed')+
  geom_hline(yintercept = 0.1,col='blue',linetype='dashed')+
  geom_point(alpha = 0.8, size = 2)+
  scale_color_manual(values = c("darkblue", "grey", "darkred"),
                     labels = c("Downregulated", "Not significant", "Upregulated"))+
  labs(x = "Fold Change", y = "p-value", title = "Volcano Plot")+
  geom_text_repel(aes(label = ifelse(mirna_data3$diffexp != "UP" & mirna_data3$diffexp != "DOWN", "",mi
```

```
## Warning in geom_text_repel(aes(label = ifelse(mirna_data3$diffexp != "UP" & :
## Ignoring unknown aesthetics: max.overlaps
```



Conducting Limma based differentially expressed analysis on mirna data

```
mirna_limma<-as.matrix(mirna_data1)

design_matrix<-model.matrix(~ Death, data = survival_mirna)
normalized_data <- normalizeBetweenArrays(mirna_limma, method = "quantile")
fit <- lmFit(normalized_data, design_matrix)
eb_fit <- eBayes(fit)
```

```
## Warning: Zero sample variances detected, have been offset away from zero
```

```
result_table <- topTable(eb_fit, number = 5000)
```

```
## Removing intercept from test coefficients
```

```
result_table$adj.P.Val <- p.adjust(result_table$P.Value, method = "BH")
mirna_limma1<-data.frame(V1=mirna_data$V1,mirna_data1,result_table)
result_table[which(result_table$adj.P.Val<0.05)]
```

```
##              logFC      AveExpr            t      P.Value  adj.P.Val          B
## 626   7.697190e+01 1.742779e+02  4.108469958 4.797620e-05 0.03320276 -0.2119914
## 4     1.955712e+03 8.137665e+03  3.998189040 7.551390e-05 0.03320276 -0.6428711
## 305  -1.465534e+00 2.390099e+00 -3.933952604 9.788711e-05 0.03320276 -0.8888461
## 310   4.300961e+02 2.458275e+03  3.868673254 1.269704e-04 0.03320276 -1.1350235
## 971  -2.290481e+01 9.401237e+01 -3.748402517 2.031162e-04 0.04249190 -1.5785284
## 85    2.152300e+00 3.115652e+00  3.668362858 2.757871e-04 0.04807889 -1.8664219
## 464   2.056888e+00 5.815252e+00  3.564054476 4.074906e-04 0.06089074 -2.2328565
## 942   1.096269e-01 2.502531e-01  3.330190973 9.452307e-04 0.11756966 -3.0181692
## 734   1.191603e+00 1.769229e+00  3.299100493 1.053372e-03 0.11756966 -3.1187722
## 475   4.402405e+00 1.132682e+01  3.244961740 1.269515e-03 0.11756966 -3.2918165
## 286   9.714359e+01 2.031679e+02  3.241456493 1.284838e-03 0.11756966 -3.3029266
## 195   4.846963e+00 1.210984e+01  3.204323356 1.458012e-03 0.11756966 -3.4199207
## 478   4.695870e+00 2.257977e+01  3.192940082 1.515275e-03 0.11756966 -3.4555287
## 168   9.983701e-02 1.213909e-01  3.180798447 1.578639e-03 0.11756966 -3.4933759
## 976  -1.640568e+01 6.564743e+01 -3.161220362 1.685989e-03 0.11756966 -3.5541143
## 110   1.530194e+00 3.932414e+00  3.098506046 2.076883e-03 0.12857140 -3.7462688
## 292  -1.974594e+00 7.415521e+00 -3.096655569 2.089593e-03 0.12857140 -3.7518828
## 810  -3.475528e+02 1.621863e+03 -3.067022715 2.303121e-03 0.13383692 -3.8413465
## 311   1.957224e+02 1.294002e+03  2.962403295 3.227482e-03 0.17768138 -4.1506162
## 587  -4.683933e-01 2.647464e+00 -2.878963793 4.195621e-03 0.21533035 -4.3898964
## 243  -1.653493e+03 1.059336e+04 -2.869322143 4.323076e-03 0.21533035 -4.4171226
## 891  -3.889235e-01 1.437869e+00 -2.851413862 4.569196e-03 0.21724452 -4.4674593
## 1022  1.224574e-02 7.364554e-03  2.768148143 5.889309e-03 0.24963882 -4.6975186
## 242  -1.271660e+03 8.757397e+03 -2.757017590 6.089773e-03 0.24963882 -4.7277741
## 759   1.817487e+00 8.357789e+00  2.748427970 6.248669e-03 0.24963882 -4.7510424
## 1006  3.569627e-02 2.682091e-02  2.734115779 6.521762e-03 0.24963882 -4.7896569
## 248   5.562407e+01 3.732956e+02  2.729538124 6.611356e-03 0.24963882 -4.8019664
## 521  -3.113951e-02 2.715218e-02 -2.715703339 6.888922e-03 0.24963882 -4.8390479
## 893   9.262641e+01 2.668546e+02  2.708336655 7.040966e-03 0.24963882 -4.8587186
## 747  -2.679678e+00 1.670909e+01 -2.699744604 7.222118e-03 0.24963882 -4.8815962
## 30    7.893837e+00 2.767824e+01  2.691564526 7.398474e-03 0.24963882 -4.9033117
## 582  -2.363236e-01 1.006897e+00 -2.674583415 7.777003e-03 0.25014706 -4.9481878
## 227   2.840506e-01 6.493648e-01  2.669579157 7.891829e-03 0.25014706 -4.9613602
```

```
## 842  -4.791754e-01 1.921266e+00 -2.602971792 9.572064e-03 0.29448174 -5.1344150
## 474   9.605933e+00 4.799363e+01  2.586754269 1.002683e-02 0.29965890 -5.1759098
## 11    2.829618e+01 2.719453e+02  2.568025126 1.057597e-02 0.30729080 -5.2235183
## 903   4.202625e+00 7.015639e+00  2.519534385 1.212446e-02 0.34276165 -5.3452215
## 182   1.072643e+04 5.357221e+04  2.483846009 1.338976e-02 0.36857066 -5.4333553
## 284   7.706780e-01 4.421092e+00  2.463549545 1.416044e-02 0.37296878 -5.4829337
## 411   5.354399e-01 2.297687e+00  2.460361703 1.428499e-02 0.37296878 -5.4906847
## 546  -1.051773e-02 9.211281e-03 -2.451927013 1.461924e-02 0.37296878 -5.5111462
## 863   2.520646e-01 2.362327e-01  2.427658880 1.561981e-02 0.38900773 -5.5696369
## 400  -2.027898e-02 1.845998e-02 -2.393352914 1.713729e-02 0.41315687 -5.6513554
## 206  -3.024599e+01 2.429990e+02 -2.380096514 1.775757e-02 0.41315687 -5.6826298
## 439   1.109206e-01 3.371172e-01  2.377284794 1.789164e-02 0.41315687 -5.6892414
## 613   2.711487e-01 1.023283e+00  2.371517739 1.816942e-02 0.41315687 -5.7027787
## 939   1.594895e+01 8.585628e+01  2.342868587 1.960627e-02 0.43048432 -5.7695533
## 289  -1.461618e+03 2.775492e+03 -2.335129559 2.001111e-02 0.43048432 -5.7874557
## 469   3.939474e+00 3.252322e+01  2.324166312 2.059714e-02 0.43048432 -5.8127176
## 169   3.566722e-01 5.200168e-01  2.312650730 2.122881e-02 0.43048432 -5.8391276
## 288  -3.512720e+01 6.171727e+01 -2.312471796 2.123876e-02 0.43048432 -5.8395369
## 970  -4.472198e-01 2.409611e+00 -2.306562233 2.156958e-02 0.43048432 -5.8530393
## 23    5.067558e+00 1.305858e+01  2.299847397 2.195094e-02 0.43048432 -5.8683408
## 104   3.721860e-01 2.134696e+00  2.295104230 2.222386e-02 0.43048432 -5.8791231
## 155  -4.975775e-02 9.789043e-02 -2.269795206 2.373073e-02 0.44694392 -5.9362892
## 758   1.565809e+00 8.616033e+00  2.266583670 2.392816e-02 0.44694392 -5.9434990
## 236  -1.174234e-02 1.309804e-02 -2.253206605 2.476599e-02 0.44715937 -5.9734228
## 287  -3.084933e+01 5.893337e+01 -2.252755453 2.479469e-02 0.44715937 -5.9744290
## 586  -2.548031e-01 1.365317e+00 -2.237897990 2.575598e-02 0.45220644 -6.0074553
## 25   -2.019382e+01 1.618444e+02 -2.230258705 2.626273e-02 0.45220644 -6.0243534
## 293  -4.316925e-01 7.214774e-01 -2.228635553 2.637150e-02 0.45220644 -6.0279365
## 978  -1.411223e-01 2.049737e-01 -2.194301438 2.876571e-02 0.48397264 -6.1031330
## 179  -1.627868e+02 1.754853e+03 -2.189030781 2.914940e-02 0.48397264 -6.1145755
## 604   4.071894e-03 1.578102e-03  2.171998854 3.041966e-02 0.48587808 -6.1513676
## 343   2.327595e-02 3.037688e-02  2.171932417 3.042470e-02 0.48587808 -6.1515106
## 16   -1.848422e+01 1.200860e+02 -2.167374586 3.077267e-02 0.48587808 -6.1613084
## 748  -1.992824e+00 1.272339e+01 -2.162840621 3.112221e-02 0.48587808 -6.1710349
## 280  -2.639446e+00 4.297361e+00 -2.133773803 3.344532e-02 0.51034123 -6.2329176
## 309   2.849621e-01 1.883863e+00  2.131116283 3.366496e-02 0.51034123 -6.2385345
## 425  -2.512028e-02 2.837306e-02 -2.115098481 3.501520e-02 0.52322711 -6.2722448
## 480  -6.427087e+01 3.989000e+02 -2.064337021 3.960482e-02 0.58347388 -6.3774296
## 445  -1.218785e-01 5.976740e-01 -2.041568962 4.182434e-02 0.59806869 -6.4237950
## 538   1.152097e+00 5.603228e+00  2.037825082 4.219924e-02 0.59806869 -6.4313708
## 479   2.416222e-01 4.230576e-01  2.036716551 4.231079e-02 0.59806869 -6.4336114
## 314   3.964700e+02 4.711250e+03  2.026039879 4.339805e-02 0.60525813 -6.4551296
## 451  -2.378279e-02 4.764346e-02 -2.001308125 4.600791e-02 0.63321410 -6.5045491
## 728  -7.464148e+00 1.123863e+01 -1.978895263 4.848647e-02 0.64526279 -6.5488206
## 980  -7.128440e-01 6.408389e+00 -1.976473490 4.876090e-02 0.64526279 -6.5535750
## 667   1.975399e-03 7.655853e-04  1.975247411 4.890034e-02 0.64526279 -6.5559798
## 1012  9.331286e-03 3.616431e-03  1.963079497 5.030243e-02 0.64526279 -6.5797666
## 928  -1.678056e+00 6.964168e+00 -1.961113447 5.053212e-02 0.64526279 -6.5835965
## 892  -1.480561e-01 8.207389e-01 -1.960664792 5.058465e-02 0.64526279 -6.5844699
## 745  -1.262880e+00 8.917682e+00 -1.948800311 5.199077e-02 0.64988303 -6.6074966
## 1046  2.808489e+03 1.320606e+04  1.947145611 5.218946e-02 0.64988303 -6.6106972
## 8    -3.257824e+00 2.871184e+01 -1.931512158 5.409830e-02 0.66572736 -6.6408040
## 421   1.493892e-02 2.046167e-02  1.909427735 5.689417e-02 0.67136891 -6.6829277
## 303   2.027918e+02 1.640028e+03  1.907771403 5.710864e-02 0.67136891 -6.6860678
```

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## 826  -6.973495e-02 1.866696e-01 -1.907312102 5.716823e-02 0.67136891 -6.6869381
## 256   2.166385e+02 1.208200e+03  1.903930246 5.760861e-02 0.67136891 -6.6933397
## 37   -1.947987e-01 4.759393e-01 -1.895964744 5.865704e-02 0.67136891 -6.7083735
## 90    5.343425e-03 3.702382e-03  1.891193028 5.929269e-02 0.67136891 -6.7173498
## 174  -3.359884e+01 6.272427e+01 -1.887619475 5.977247e-02 0.67136891 -6.7240576
## 233   2.687183e-02 4.133261e-02  1.882358194 6.048473e-02 0.67136891 -6.7339107
## 211  -1.541834e+02 1.198959e+03 -1.872405525 6.185141e-02 0.67136891 -6.7524757
## 962  -7.418561e-01 5.141784e+00 -1.870012221 6.218385e-02 0.67136891 -6.7569256
## 910  -4.868679e-02 1.440136e-01 -1.869190973 6.229826e-02 0.67136891 -6.7584512
## 847  -1.223626e-01 8.086470e-01 -1.867550318 6.252736e-02 0.67136891 -6.7614972
## 489   3.491649e-02 9.509301e-02  1.852319002 6.468781e-02 0.67136891 -6.7896489
## 240  -6.115133e+01 6.449103e+02 -1.848237127 6.527719e-02 0.67136891 -6.7971548
## 338  -5.086305e-01 3.638796e+00 -1.844010916 6.589208e-02 0.67136891 -6.8049090
## 323  -4.329594e+01 3.863816e+02 -1.843698762 6.593769e-02 0.67136891 -6.8054811
## 98   -5.073791e-03 3.683532e-03 -1.833737610 6.740679e-02 0.67136891 -6.8236855
## 181   3.653627e+02 1.836914e+03  1.828805158 6.814419e-02 0.67136891 -6.8326638
## 265  -2.849545e+01 6.357296e+01 -1.826008631 6.856522e-02 0.67136891 -6.8377436
## 696   4.461830e-03 2.619073e-03  1.822250020 6.913447e-02 0.67136891 -6.8445590
## 501  -4.427915e-02 9.997148e-02 -1.819920959 6.948916e-02 0.67136891 -6.8487753
## 322  -4.039481e+01 3.574353e+02 -1.817980241 6.978586e-02 0.67136891 -6.8522845
## 913  -8.850564e-03 8.510884e-03 -1.816955533 6.994294e-02 0.67136891 -6.8541359
## 725  -4.913852e+00 7.155138e+00 -1.816837800 6.996100e-02 0.67136891 -6.8543485
## 62   -1.398711e-02 1.678206e-02 -1.811305703 7.081424e-02 0.67337907 -6.8643253
## 160   7.942974e+00 6.904622e+01  1.777965266 7.613953e-02 0.69479886 -6.9238181
## 6     4.843691e+01 5.022204e+02  1.773402396 7.689321e-02 0.69479886 -6.9318755
## 916   9.811181e-03 1.120419e-02  1.767905306 7.780928e-02 0.69479886 -6.9415554
## 467  -2.768900e-01 6.749313e-01 -1.767702639 7.784323e-02 0.69479886 -6.9419117
## 898   5.151566e-03 1.996540e-03  1.767143352 7.793696e-02 0.69479886 -6.9428948
## 423   2.057272e-03 7.973159e-04  1.761983313 7.880613e-02 0.69479886 -6.9519504
## 739  -3.743226e+00 1.134971e+01 -1.761384786 7.890746e-02 0.69479886 -6.9529991
## 825  -5.890599e-02 1.868852e-01 -1.756823957 7.968308e-02 0.69479886 -6.9609788
## 954  -1.719528e-01 1.091588e+00 -1.754054493 8.015708e-02 0.69479886 -6.9658143
## 721   3.488483e+02 9.811517e+02  1.741971525 8.225211e-02 0.69479886 -6.9868234
## 508  -8.775190e+00 8.614453e+01 -1.738944985 8.278379e-02 0.69479886 -6.9920633
## 599   1.964860e+01 1.523871e+01  1.738889942 8.279349e-02 0.69479886 -6.9921585
## 486   4.384584e-02 1.336776e-01  1.738129492 8.292753e-02 0.69479886 -6.9934737
## 963   2.825527e+00 2.305486e+01  1.735667703 8.336267e-02 0.69479886 -6.9977272
## 219  -6.489750e-03 3.974584e-03 -1.730712343 8.424420e-02 0.69479886 -7.0062713
## 932  -9.916288e-03 1.276822e-02 -1.729893113 8.439067e-02 0.69479886 -7.0076815
## 509  -8.533613e+00 8.416165e+01 -1.729448108 8.447031e-02 0.69479886 -7.0084472
## 619  -1.957162e+01 4.739665e+01 -1.726368359 8.502319e-02 0.69479886 -7.0137414
## 185  -4.288918e+00 2.190984e+01 -1.717163621 8.669315e-02 0.70295373 -7.0295091
## 853   4.797838e-01 1.988627e+00  1.700694160 8.974736e-02 0.71357009 -7.0575139
## 197   3.237718e+02 3.023678e+03  1.692915798 9.121976e-02 0.71357009 -7.0706477
## 335   1.579785e+00 7.546328e+00  1.688940329 9.197978e-02 0.71357009 -7.0773374
## 192   2.069173e-01 5.111059e-01  1.687575111 9.224196e-02 0.71357009 -7.0796311
## 244   6.575857e+00 4.519096e+01  1.680295268 9.365017e-02 0.71357009 -7.0918312
## 1035  2.511350e-01 1.823214e+00  1.677614801 9.417301e-02 0.71357009 -7.0963103
## 966  -1.332492e+00 3.335944e+00 -1.677359473 9.422294e-02 0.71357009 -7.0967365
## 276   1.672607e+02 5.873654e+02  1.676003224 9.448849e-02 0.71357009 -7.0989998
## 488   1.201361e-01 5.910788e-01  1.675484270 9.459026e-02 0.71357009 -7.0998653
## 278  -2.274505e-01 2.003133e+00 -1.673395448 9.500078e-02 0.71357009 -7.1033464
## 418  -2.218889e-02 4.980529e-02 -1.670832157 9.550651e-02 0.71357009 -7.1076125
## 969   4.017033e-02 1.651922e-01  1.666549924 9.635621e-02 0.71481272 -7.1147248
```

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## 622  -1.144151e+01 1.445419e+01 -1.661186469 9.742899e-02 0.71768117 -7.1236076
## 466  -2.334988e-01 6.292115e-01 -1.639962042 1.017685e-01 0.73821752 -7.1584817
## 548   2.756364e-01 1.082532e+00  1.636268378 1.025393e-01 0.73821752 -7.1645056
## 365   1.010357e+00 5.633838e+00  1.632374366 1.033569e-01 0.73821752 -7.1708417
## 577  -1.321020e+01 3.133277e+01 -1.630910687 1.036656e-01 0.73821752 -7.1732195
## 362   4.760112e-01 3.615843e+00  1.628522091 1.041708e-01 0.73821752 -7.1770952
## 572  -4.597621e-02 1.490219e-01 -1.621409583 1.056871e-01 0.73821752 -7.1886029
## 457   8.838405e-02 3.869575e-01  1.620686489 1.058422e-01 0.73821752 -7.1897700
## 306   4.297931e+00 4.406577e+01  1.620589823 1.058629e-01 0.73821752 -7.1899260
## 463  -1.024767e-02 6.276085e-03 -1.614050475 1.072743e-01 0.74182906 -7.2004571
## 606  -6.042515e-03 5.228564e-03 -1.611635536 1.077993e-01 0.74182906 -7.2043356
## 485   1.959362e+01 9.327074e+01  1.605522844 1.091372e-01 0.74311665 -7.2141271
## 307   1.070114e+02 1.462986e+03  1.604296244 1.094072e-01 0.74311665 -7.2160874
## 258  -2.047732e+00 1.457096e+01 -1.594197663 1.116508e-01 0.74391414 -7.2321709
## 271   1.185259e-02 5.521390e-03  1.593316137 1.118484e-01 0.74391414 -7.2335702
## 1013  2.603602e+01 1.631239e+01  1.590417071 1.125000e-01 0.74391414 -7.2381663
## 422   1.566159e-03 6.069801e-04  1.588974455 1.128254e-01 0.74391414 -7.2404503
## 1003  5.942866e-02 8.586788e-02  1.587845284 1.130806e-01 0.74391414 -7.2422367
## 204  -4.980538e+00 1.016961e+01 -1.578766405 1.151493e-01 0.74767500 -7.2565537
## 372   8.456830e-02 4.418705e-01  1.577693821 1.153956e-01 0.74767500 -7.2582398
## 368   1.286377e-02 1.968561e-02  1.575350070 1.159354e-01 0.74767500 -7.2619202
## 458   6.208357e-02 2.644071e-01  1.569884094 1.172019e-01 0.74767500 -7.2704823
## 543   2.631123e-01 1.792429e+00  1.569779419 1.172263e-01 0.74767500 -7.2706460
## 1011 -2.605332e+01 5.733806e+01 -1.565528214 1.182190e-01 0.74943699 -7.2772845
## 578   3.239044e+00 5.598432e+00  1.561715890 1.191149e-01 0.75056736 -7.2832226
## 737  -1.353565e+01 3.042687e+01 -1.554945118 1.207191e-01 0.75612105 -7.2937334
## 341   1.110985e+03 1.826545e+04  1.540885624 1.241045e-01 0.76676725 -7.3154149
## 361  -1.427858e-02 2.612142e-02 -1.537448249 1.249434e-01 0.76676725 -7.3206862
## 1004  4.970938e+00 3.128774e+01  1.535714429 1.253682e-01 0.76676725 -7.3233406
## 701  -1.381530e+01 2.287014e+01 -1.532237584 1.262235e-01 0.76676725 -7.3286546
## 724   1.008551e+02 9.268931e+02  1.531600891 1.263806e-01 0.76676725 -7.3296264
## 482   5.282769e+00 4.878298e+00  1.526507531 1.276430e-01 0.76676725 -7.3373864
## 454  -7.576770e-01 4.382551e+00 -1.524105943 1.282417e-01 0.76676725 -7.3410364
## 849  -7.541383e-02 4.352029e-01 -1.523939431 1.282832e-01 0.76676725 -7.3412893
## 814  -6.235785e-01 2.124944e+00 -1.511015456 1.315433e-01 0.77210801 -7.3608321
## 685  -1.822503e-02 4.396723e-02 -1.509219676 1.320013e-01 0.77210801 -7.3635346
## 568  -7.934683e-01 2.895538e+00 -1.509132557 1.320236e-01 0.77210801 -7.3636656
## 193  -1.026571e+04 1.144144e+05 -1.508718559 1.321294e-01 0.77210801 -7.3642881
## 340  -2.091988e+03 1.549516e+04 -1.501673318 1.339397e-01 0.77833859 -7.3748562
## 308   8.341420e+02 1.016994e+04  1.495333788 1.355851e-01 0.78283340 -7.3843239
## 876   1.553442e-02 2.662211e-02  1.492941776 1.362100e-01 0.78283340 -7.3878859
## 382   1.696002e-02 3.623262e-02  1.486506254 1.379023e-01 0.78822859 -7.3974413
## 986  -3.770151e+00 1.172820e+01 -1.479646840 1.397240e-01 0.79136862 -7.4075810
## 366  -1.444556e-02 2.854454e-02 -1.476618396 1.405341e-01 0.79136862 -7.4120430
## 902   2.514665e-03 1.585211e-03  1.474867094 1.410043e-01 0.79136862 -7.4146191
## 865  -4.121012e+01 6.626691e+01 -1.473107133 1.414779e-01 0.79136862 -7.4172049
## 912  -6.210876e-03 3.803790e-03 -1.469725556 1.423915e-01 0.79224228 -7.4221648
## 1010  1.981213e-01 1.153574e-01  1.462465826 1.443682e-01 0.79640417 -7.4327747
## 564   2.669892e-02 6.936211e-02  1.461392264 1.446623e-01 0.79640417 -7.4343393
## 610   1.436377e-01 9.127191e-02  1.455674502 1.462364e-01 0.79643216 -7.4426529
## 506   8.240943e-01 4.460906e+00  1.452192797 1.472014e-01 0.79643216 -7.4476996
## 302   4.931811e+00 4.008783e+01  1.451929663 1.472745e-01 0.79643216 -7.4480805
## 1015  5.574964e-01 3.032901e-01  1.450353692 1.477130e-01 0.79643216 -7.4503605
## 544   2.345441e-03 1.210597e-03  1.443476059 1.496386e-01 0.80106924 -7.4602818
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## 1014  1.475631e-01 7.636367e-02  1.441102491 1.503076e-01 0.80106924 -7.4636949
## 321   7.462862e+02 8.437822e+03  1.436812077 1.515226e-01 0.80106924 -7.4698504
## 253   6.101509e-03 4.778426e-03  1.434811499 1.520917e-01 0.80106924 -7.4727144
## 516   7.351940e-03 1.010535e-02  1.433722350 1.524023e-01 0.80106924 -7.4742719
## 135  -7.290921e-02 5.251683e-01 -1.429193268 1.536988e-01 0.80317676 -7.4807362
## 731  -3.197318e+00 9.569910e+00 -1.426245002 1.545472e-01 0.80317676 -7.4849333
## 620  -1.720901e+01 3.583802e+01 -1.424307352 1.551068e-01 0.80317676 -7.4876871
## 312   7.871401e+01 7.160822e+02  1.419854381 1.563986e-01 0.80561130 -7.4940015
## 848  -3.951153e-03 2.822571e-03 -1.417389081 1.571173e-01 0.80561130 -7.4974890
## 689  -1.771462e+01 2.925691e+01 -1.409155951 1.595357e-01 0.80884635 -7.5090922
## 14   -7.902542e+02 7.097855e+03 -1.408302951 1.597879e-01 0.80884635 -7.5102905
## 811  -6.029599e+00 1.375368e+01 -1.399496915 1.624088e-01 0.80884635 -7.5226196
## 967  -3.013370e-01 9.137991e-01 -1.397209808 1.630949e-01 0.80884635 -7.5258092
## 28    3.267726e-03 2.383839e-03  1.395549362 1.635943e-01 0.80884635 -7.5281216
## 409   6.769406e-03 8.971642e-03  1.393107724 1.643308e-01 0.80884635 -7.5315169
## 1016  8.688284e-02 4.706275e-02  1.387246911 1.661088e-01 0.80884635 -7.5396430
## 1044  5.674778e+00 6.681927e+01  1.384146378 1.670553e-01 0.80884635 -7.5439282
## 31    4.512377e-02 1.691528e-01  1.382859265 1.674494e-01 0.80884635 -7.5457043
## 91   -1.339237e-02 2.926151e-02 -1.379934136 1.683477e-01 0.80884635 -7.5497347
## 380  -2.333143e-01 7.917431e-01 -1.374999124 1.698714e-01 0.80884635 -7.5565152
## 740  -1.982883e+00 4.501038e+00 -1.373891256 1.702149e-01 0.80884635 -7.5580340
## 542  -4.155982e-01 6.274089e-01 -1.370978922 1.711203e-01 0.80884635 -7.5620209
## 718   5.376594e-01 5.486185e+00  1.370232830 1.713528e-01 0.80884635 -7.5630410
## 481   1.217086e+00 1.006686e+00  1.369181957 1.716807e-01 0.80884635 -7.5644768
## 938   1.101996e+00 1.404006e+01  1.368630226 1.718531e-01 0.80884635 -7.5652301
## 344   8.282735e-03 1.339700e-02  1.360523563 1.744006e-01 0.80884635 -7.5762650
## 605   2.520614e-01 1.886943e+00  1.360364217 1.744509e-01 0.80884635 -7.5764813
## 854   4.731352e-03 4.995724e-03  1.355025680 1.761443e-01 0.80884635 -7.5837118
## 161  -7.482712e+00 5.607264e+01 -1.353190775 1.767292e-01 0.80884635 -7.5861905
## 393  -1.247990e-03 7.643190e-04 -1.351984936 1.771143e-01 0.80884635 -7.5878176
## 712  -8.241857e-01 2.420600e+00 -1.351444234 1.772872e-01 0.80884635 -7.5885467
## 440   6.316823e-02 4.609256e-01  1.348964996 1.780816e-01 0.80884635 -7.5918863
## 914   1.095495e-03 4.245700e-04  1.347692185 1.784905e-01 0.80884635 -7.5935984
## 176   1.531826e-01 3.133891e-01  1.347459838 1.785652e-01 0.80884635 -7.5939108
## 763   4.313593e-02 4.820249e-02  1.346676731 1.788172e-01 0.80884635 -7.5949632
## 566  -7.924131e-01 2.617515e+00 -1.346079548 1.790095e-01 0.80884635 -7.5957653
## 290  -1.320651e-01 5.475903e-01 -1.343093545 1.799736e-01 0.80884635 -7.5997709
## 813   2.196123e+01 2.727224e+02  1.342476574 1.801732e-01 0.80884635 -7.6005974
## 443  -4.931264e-03 4.428595e-03 -1.328787376 1.846461e-01 0.81822478 -7.6188394
## 381   7.327924e-02 4.045587e-01  1.308316992 1.914878e-01 0.81822478 -7.6457721
## 294  -9.114151e+03 1.563736e+05 -1.306265916 1.921835e-01 0.81822478 -7.6484478
## 97    1.287070e+00 8.008944e+00  1.304005882 1.929523e-01 0.81822478 -7.6513913
## 453  -1.766312e-03 1.081760e-03 -1.303932734 1.929772e-01 0.81822478 -7.6514864
## 437  -7.356399e-02 4.802824e-01 -1.297302802 1.952456e-01 0.81822478 -7.6600917
## 556  -4.202322e+00 1.379691e+01 -1.296526494 1.955125e-01 0.81822478 -7.6610964
## 565  -2.825771e+03 8.179812e+03 -1.293708233 1.964837e-01 0.81822478 -7.6647390
## 988   2.811375e-03 2.635205e-03  1.287843242 1.985161e-01 0.81822478 -7.6722943
## 377  -4.042691e-03 2.475906e-03 -1.285592385 1.993001e-01 0.81822478 -7.6751848
## 113  -2.932228e-01 2.716896e+00 -1.284373340 1.997257e-01 0.81822478 -7.6767482
## 94   -4.498193e-03 3.726996e-03 -1.283199619 2.001361e-01 0.81822478 -7.6782520
## 575  -8.523001e-01 2.058053e+00 -1.282289898 2.004547e-01 0.81822478 -7.6794167
## 817  -9.595871e-02 7.944152e-01 -1.281058972 2.008862e-01 0.81822478 -7.6809913
## 173  -1.801548e+00 3.412528e+00 -1.279828094 2.013185e-01 0.81822478 -7.6825643
## 873   2.083926e-01 4.607449e-01  1.279206214 2.015371e-01 0.81822478 -7.6833584
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## 533  -4.750836e-03 4.181252e-03 -1.276748790 2.024028e-01 0.81822478 -7.6864929
## 730  -5.517151e-01 2.160244e+00 -1.276118431 2.026253e-01 0.81822478 -7.6872960
## 828   1.089154e+00 5.476790e-01  1.275443907 2.028635e-01 0.81822478 -7.6881549
## 823  -8.727303e-01 6.375009e+00 -1.272755240 2.038154e-01 0.81822478 -7.6915741
## 134  -8.797770e-02 6.016334e-01 -1.272132213 2.040364e-01 0.81822478 -7.6923653
## 927  -7.896445e-03 1.026003e-02 -1.264892084 2.066177e-01 0.81822478 -7.7015324
## 59   -2.117418e-02 6.789920e-02 -1.264703548 2.066853e-01 0.81822478 -7.7017704
## 172  -3.719836e-01 9.281120e-01 -1.264306213 2.068277e-01 0.81822478 -7.7022719
## 567  -4.302148e-01 1.359092e+00 -1.260708668 2.081201e-01 0.81822478 -7.7068056
## 353   2.660066e-03 1.030935e-03  1.257989516 2.091008e-01 0.81822478 -7.7102237
## 408   2.015480e-03 7.811190e-04  1.257755250 2.091855e-01 0.81822478 -7.7105179
## 957   1.406776e-03 5.452099e-04  1.257176852 2.093946e-01 0.81822478 -7.7112439
## 291  -9.445848e+00 3.239343e+01 -1.257069142 2.094335e-01 0.81822478 -7.7113790
## 526   1.211427e-03 4.695004e-04  1.256784222 2.095366e-01 0.81822478 -7.7117365
## 655   1.202233e-03 4.659371e-04  1.256760908 2.095450e-01 0.81822478 -7.7117658
## 490   9.860489e-04 3.821529e-04  1.256011447 2.098164e-01 0.81822478 -7.7127057
## 657   7.785737e-04 3.017439e-04  1.254631972 2.103164e-01 0.81822478 -7.7144343
## 530   6.251198e-04 2.422713e-04  1.252620774 2.110471e-01 0.81822478 -7.7169511
## 588   5.730605e-04 2.220952e-04  1.251549693 2.114369e-01 0.81822478 -7.7182898
## 105   1.461374e-03 9.211572e-04  1.244445199 2.140360e-01 0.81822478 -7.7271408
## 644   3.791112e-04 1.469283e-04  1.243026809 2.145577e-01 0.81822478 -7.7289019
## 679   3.791112e-04 1.469283e-04  1.243026809 2.145577e-01 0.81822478 -7.7289019
## 329   1.116462e-01 4.501136e-02  1.238861449 2.160950e-01 0.81822478 -7.7340621
## 878   3.175528e-04 1.230707e-04  1.236695599 2.168974e-01 0.81822478 -7.7367384
## 392   1.437663e-02 4.598919e-02  1.236281315 2.170512e-01 0.81822478 -7.7372498
## 217   2.077914e+03 9.726152e+03  1.234960431 2.175419e-01 0.81822478 -7.7388792
## 858  -6.084684e-02 2.398657e-01 -1.229539308 2.195642e-01 0.81822478 -7.7455484
## 881   1.650192e-01 1.403687e+00  1.228983117 2.197725e-01 0.81822478 -7.7462310
## 862   5.528952e-03 4.423315e-03  1.227983086 2.201473e-01 0.81822478 -7.7474575
## 435   1.307080e-01 3.913672e-01  1.224438800 2.214793e-01 0.81822478 -7.7517966
## 921  -8.067965e-03 1.525407e-02 -1.222126981 2.223512e-01 0.81822478 -7.7546201
## 328   1.291555e-01 5.457787e-02  1.220382430 2.230109e-01 0.81822478 -7.7567472
## 552  -6.156942e+00 2.108780e+01 -1.220320288 2.230344e-01 0.81822478 -7.7568229
## 430   3.478691e-03 2.267630e-03  1.215030766 2.250431e-01 0.81822478 -7.7632538
## 1009  4.460305e-01 4.414338e+00  1.213951767 2.254545e-01 0.81822478 -7.7645622
## 609   3.443067e-02 1.497911e-01  1.210692338 2.267003e-01 0.81822478 -7.7685077
## 494   1.601654e-02 3.580573e-02  1.207713760 2.278432e-01 0.81822478 -7.7721039
## 441  -9.932392e-03 1.419602e-02 -1.206909362 2.281525e-01 0.81822478 -7.7730736
## 223   2.012415e+01 3.339670e+02  1.206547695 2.282917e-01 0.81822478 -7.7735094
## 491  -1.964381e+00 2.271152e+01 -1.206085030 2.284698e-01 0.81822478 -7.7740667
## 295  -1.477860e+01 1.410272e+02 -1.203517625 2.294601e-01 0.81822478 -7.7771553
## 662   1.779367e-02 5.001252e-02  1.203468643 2.294790e-01 0.81822478 -7.7772142
## 716  -1.455547e-02 2.867486e-02 -1.203440540 2.294899e-01 0.81822478 -7.7772479
## 143   1.233966e+00 1.216740e+01  1.201565512 2.302151e-01 0.81822478 -7.7794993
## 111   7.396158e-02 3.757254e-01  1.200849550 2.304925e-01 0.81822478 -7.7803581
## 1045 -9.285812e+01 9.623568e+02 -1.200156260 2.307613e-01 0.81822478 -7.7811892
## 812  -1.369644e+00 1.782974e+00 -1.194841341 2.328294e-01 0.82118564 -7.7875446
## 122  -2.391653e-01 3.611510e-01 -1.193978275 2.331665e-01 0.82118564 -7.7885740
## 177   7.370557e-02 2.536360e-01  1.189301252 2.349991e-01 0.82323547 -7.7941394
## 26    1.644016e+03 1.639102e+04  1.188478568 2.353226e-01 0.82323547 -7.7951161
## 40   -1.486248e-01 2.537699e-01 -1.182967481 2.374973e-01 0.82614339 -7.8016418
## 777  -7.938258e+00 1.017020e+01 -1.182370770 2.377336e-01 0.82614339 -7.8023465
## 776  -8.349018e+00 1.063872e+01 -1.176234823 2.401733e-01 0.82614339 -7.8095730
## 330   5.631712e-03 2.550929e-03  1.175478323 2.404753e-01 0.82614339 -7.8104613
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## 367   1.913431e-01 4.672087e-01  1.173668768 2.411989e-01 0.82614339 -7.8125840
## 503   4.020780e+00 1.017095e+01  1.171151863 2.422077e-01 0.82614339 -7.8155310
## 345  -1.401469e-02 4.505946e-02 -1.169025419 2.430624e-01 0.82614339 -7.8180159
## 356   8.309360e-03 1.916285e-02  1.168051678 2.434545e-01 0.82614339 -7.8191523
## 561  -7.731456e+00 5.600094e+00 -1.164407849 2.449257e-01 0.82614339 -7.8233965
## 208   3.146374e+01 5.116444e+02  1.162217222 2.458132e-01 0.82614339 -7.8259416
## 557  -5.371460e+00 3.424476e+00 -1.162001895 2.459006e-01 0.82614339 -7.8261916
## 29    2.554639e-02 1.227463e-01  1.161387526 2.461499e-01 0.82614339 -7.8269044
## 38   -4.606269e-02 1.731399e-01 -1.160719275 2.464214e-01 0.82614339 -7.8276793
## 896  -4.907129e-02 2.167635e-01 -1.157151295 2.478742e-01 0.82690399 -7.8318093
## 984   4.186024e-02 2.551077e-01  1.154397536 2.489996e-01 0.82690399 -7.8349882
## 616  -1.369499e-02 2.857319e-02 -1.152787621 2.496592e-01 0.82690399 -7.8368431
## 201   3.753588e-02 2.708901e-01  1.140541589 2.547166e-01 0.82690399 -7.8508689
## 1033 -1.426780e-02 4.495486e-02 -1.137497583 2.559847e-01 0.82690399 -7.8543322
## 164   2.737657e-03 1.990089e-03  1.137324518 2.560569e-01 0.82690399 -7.8545289
## 756   4.551785e+00 2.914124e+00  1.137235471 2.560941e-01 0.82690399 -7.8546300
## 460  -2.697536e+00 7.377742e+00 -1.132369363 2.581311e-01 0.82690399 -7.8601461
## 935  -7.413596e+00 6.783255e+01 -1.131876737 2.583379e-01 0.82690399 -7.8607032
## 778  -1.543473e+00 2.186795e+00 -1.129535900 2.593224e-01 0.82690399 -7.8633471
## 484  -3.278521e-03 3.139699e-03 -1.128918011 2.595826e-01 0.82690399 -7.8640441
## 597   5.205250e-04 3.268423e-04  1.127040431 2.603747e-01 0.82690399 -7.8661597
## 68   -2.209949e-03 1.353462e-03 -1.126693537 2.605212e-01 0.82690399 -7.8665502
## 17   -2.337388e+03 3.019319e+04 -1.121606771 2.626763e-01 0.82690399 -7.8722626
## 950  -8.693874e-04 5.324478e-04 -1.121489819 2.627260e-01 0.82690399 -7.8723936
## 859   2.960281e-01 3.928919e+00  1.121294228 2.628091e-01 0.82690399 -7.8726127
## 953  -5.510371e-03 7.944268e-03 -1.120541191 2.631293e-01 0.82690399 -7.8734560
## 627   1.609330e+01 2.061631e+02  1.119218416 2.636924e-01 0.82690399 -7.8749358
## 1029 -1.535968e-01 2.177376e-01 -1.116990164 2.646429e-01 0.82690399 -7.8774247
## 283  -4.603085e-03 4.439289e-03 -1.112257528 2.666694e-01 0.82690399 -7.8826946
## 768   5.771211e+00 4.322291e+00  1.111742319 2.668907e-01 0.82690399 -7.8832670
## 456  -6.527271e-02 4.027178e-01 -1.111196636 2.671252e-01 0.82690399 -7.8838729
## 766   6.001436e+00 4.383533e+00  1.109931125 2.676695e-01 0.82690399 -7.8852770
## 247  -2.451643e+01 9.078704e+01 -1.108499245 2.682864e-01 0.82690399 -7.8868637
## 3     3.119966e+02 7.828338e+03  1.106074494 2.693331e-01 0.82690399 -7.8895461
## 754   2.910603e+00 2.113264e+00  1.103642641 2.703858e-01 0.82690399 -7.8922304
## 906  -1.893106e-03 1.159414e-03 -1.103028672 2.706520e-01 0.82690399 -7.8929072
## 844  -1.756499e-02 8.369098e-02 -1.102045281 2.710788e-01 0.82690399 -7.8939904
## 1000 -1.098199e+00 2.177800e+01 -1.101968689 2.711121e-01 0.82690399 -7.8940748
## 764   3.219182e-02 4.204642e-02  1.100121123 2.719152e-01 0.82690399 -7.8961072
## 9     9.155535e+02 1.355240e+04  1.099532190 2.721715e-01 0.82690399 -7.8967543
## 354  -6.689640e-04 4.097004e-04 -1.098740671 2.725163e-01 0.82690399 -7.8976235
## 767   6.192934e+00 4.508892e+00  1.096720197 2.733978e-01 0.82690399 -7.8998395
## 171  -1.938613e+00 6.722244e+00 -1.096346842 2.735609e-01 0.82690399 -7.9002485
## 222  -7.563737e+00 1.330462e+02 -1.094617872 2.743171e-01 0.82690399 -7.9021409
## 799  -1.290098e+00 2.166867e+00 -1.090315264 2.762051e-01 0.82778840 -7.9068372
## 755   2.772492e+00 2.078065e+00  1.088248567 2.771151e-01 0.82778840 -7.9090865
## 65    5.372119e-03 8.844936e-03  1.086534533 2.778714e-01 0.82778840 -7.9109488
## 1041 -9.178964e-01 2.817903e+00 -1.086450008 2.779087e-01 0.82778840 -7.9110405
## 27    2.895546e+03 1.987633e+04  1.084048318 2.789709e-01 0.82778840 -7.9136448
## 427  -5.669745e-03 9.065448e-03 -1.081831423 2.799538e-01 0.82778840 -7.9160436
## 723  -6.862392e-01 9.278907e+00 -1.081389122 2.801502e-01 0.82778840 -7.9165216
## 827  -7.397980e-02 7.768658e-01 -1.074836639 2.830705e-01 0.83096560 -7.9235803
## 86    3.151845e+01 3.681393e+02  1.073798834 2.835350e-01 0.83096560 -7.9246944
## 273  -7.613725e+01 7.622700e+02 -1.073634136 2.836087e-01 0.83096560 -7.9248711
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## 264  -1.594680e+02 1.195130e+03 -1.065495569 2.872694e-01 0.83561183 -7.9335693
## 452  -4.936672e+01 4.986206e+02 -1.063663547 2.880978e-01 0.83561183 -7.9355182
## 342   8.033935e-01 1.620187e+00  1.061843700 2.889224e-01 0.83561183 -7.9374509
## 112  -4.731070e-02 3.325316e-01 -1.057567672 2.908660e-01 0.83561183 -7.9419790
## 1001 -2.818946e-02 6.799443e-02 -1.055324463 2.918891e-01 0.83561183 -7.9443472
## 438   1.520350e-02 7.077364e-02  1.055200656 2.919457e-01 0.83561183 -7.9444778
## 591  -1.128276e-03 6.910014e-04 -1.055077946 2.920017e-01 0.83561183 -7.9446072
## 1040 -1.214994e-02 3.689965e-02 -1.050873576 2.939264e-01 0.83561183 -7.9490313
## 889   2.210165e-02 8.916863e-02  1.048763146 2.948957e-01 0.83561183 -7.9512455
## 765   9.747730e-02 1.688299e-01  1.048568756 2.949851e-01 0.83561183 -7.9514492
## 119  -8.052193e-04 4.931487e-04 -1.045025769 2.966176e-01 0.83561183 -7.9551556
## 1024 -1.759590e+02 1.589391e+03 -1.042801054 2.976457e-01 0.83561183 -7.9574766
## 541   7.404163e-02 3.855231e-01  1.038780709 2.995098e-01 0.83561183 -7.9616584
## 603   1.096502e-02 3.609978e-02  1.037712689 3.000063e-01 0.83561183 -7.9627666
## 167   9.796353e-01 5.517068e+00  1.036471468 3.005840e-01 0.83561183 -7.9640531
## 127   3.401238e+00 2.643635e+01  1.036268631 3.006785e-01 0.83561183 -7.9642632
## 507  -2.738374e-03 2.455664e-03 -1.029251397 3.039593e-01 0.83561183 -7.9715062
## 67   -9.955701e-04 6.097271e-04 -1.023349505 3.067370e-01 0.83561183 -7.9775601
## 75    4.202900e-02 1.612733e-01  1.021454124 3.076326e-01 0.83561183 -7.9794970
## 346  -1.258900e-01 5.078144e-01 -1.021026429 3.078350e-01 0.83561183 -7.9799335
## 216  -7.459842e-01 7.523428e+00 -1.018857260 3.088626e-01 0.83561183 -7.9821448
## 221  -1.066565e+01 2.003290e+01 -1.017834824 3.093477e-01 0.83561183 -7.9831855
## 231  -2.670583e-01 1.285503e+00 -1.016019995 3.102101e-01 0.83561183 -7.9850302
## 726   8.802344e+01 3.358959e+02  1.014731554 3.108233e-01 0.83561183 -7.9863378
## 515   2.563162e-02 1.437540e-01  1.013975376 3.111835e-01 0.83561183 -7.9871044
## 326   9.242154e-01 1.001819e+01  1.013067713 3.116163e-01 0.83561183 -7.9880240
## 331   7.196886e-03 4.237054e-03  1.012597096 3.118409e-01 0.83561183 -7.9885004
## 790  -1.651350e+00 2.788600e+00 -1.012166770 3.120463e-01 0.83561183 -7.9889358
## 416   2.330563e-02 1.193700e-01  1.012106369 3.120752e-01 0.83561183 -7.9889969
## 383  -2.668205e-03 1.932294e-03 -1.009401385 3.133686e-01 0.83561183 -7.9917298
## 327  -3.940789e-01 1.814387e+00 -1.006547289 3.147372e-01 0.83561183 -7.9946053
## 743   3.116747e+00 4.278537e+00  1.005348794 3.153130e-01 0.83561183 -7.9958104
## 241  -1.619430e+01 2.370881e+02 -1.005310860 3.153313e-01 0.83561183 -7.9958486
## 203   7.875036e-03 2.120067e-02  1.005013536 3.154742e-01 0.83561183 -7.9961473
## 50   -4.217710e-01 7.329410e-01 -1.004391557 3.157735e-01 0.83561183 -7.9967719
## 668  -5.277704e+00 2.573038e+01 -1.003822649 3.160473e-01 0.83561183 -7.9973429
## 720  -1.082124e+00 1.629093e+01 -1.001818405 3.170134e-01 0.83561183 -7.9993520
## 402   9.715247e-02 3.523806e-01  1.001704077 3.170685e-01 0.83561183 -7.9994665
## 274   8.226278e+00 2.250293e+01  1.001028437 3.173946e-01 0.83561183 -8.0001428
## 753   2.593325e+01 2.324371e+01  1.000910518 3.174516e-01 0.83561183 -8.0002607
## 792  -2.950156e+01 4.139991e+01 -0.998638351 3.185501e-01 0.83561183 -8.0025315
## 39   -1.334524e-02 2.637341e-02 -0.998232135 3.187468e-01 0.83561183 -8.0029369
## 282  -7.616415e-02 8.637182e-01 -0.995576376 3.200344e-01 0.83594133 -8.0055834
## 281  -1.877891e-01 2.730553e-01 -0.994677944 3.204708e-01 0.83594133 -8.0064771
## 419   4.519141e-03 8.155173e-03  0.987134120 3.241504e-01 0.84004699 -8.0139496
## 165  -2.450847e+00 3.188190e+00 -0.985546913 3.249280e-01 0.84004699 -8.0155146
## 985   3.646371e-02 2.055859e-01  0.984160824 3.256082e-01 0.84004699 -8.0168793
## 137   3.040216e-02 2.114781e-01  0.983819652 3.257757e-01 0.84004699 -8.0172149
## 695   3.696734e-03 5.046664e-03  0.983240415 3.260603e-01 0.84004699 -8.0177844
## 498  -2.796186e+00 3.287152e+01 -0.977874320 3.287045e-01 0.84319889 -8.0230445
## 708  -5.891195e-01 6.091857e+00 -0.977486893 3.288959e-01 0.84319889 -8.0234231
## 317  -6.726883e-01 4.960215e+00 -0.975453131 3.299021e-01 0.84371051 -8.0254085
## 940  -4.537014e-03 6.163667e-03 -0.967294213 3.339587e-01 0.85037005 -8.0333317
## 512  -7.972423e-02 8.414345e-01 -0.962273013 3.364712e-01 0.85037005 -8.0381749
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## 815  -1.528961e-02 1.776261e-02 -0.962015561 3.366003e-01 0.85037005 -8.0384226
## 611  -2.827477e-03 4.311899e-03 -0.961217651 3.370008e-01 0.85037005 -8.0391897
## 968  -1.304122e-03 1.100278e-03 -0.960419949 3.374015e-01 0.85037005 -8.0399559
## 1     2.623022e+02 7.622519e+03  0.957469687 3.388860e-01 0.85037005 -8.0427845
## 933   3.742619e-03 4.725231e-03  0.954992515 3.401358e-01 0.85037005 -8.0451528
## 285   1.584226e+00 1.780764e+01  0.953332524 3.409749e-01 0.85037005 -8.0467363
## 1021 -2.869180e-03 1.757201e-03 -0.952920997 3.411831e-01 0.85037005 -8.0471285
## 993   9.100376e-02 8.233351e-01  0.950560047 3.423794e-01 0.85037005 -8.0493751
## 576  -1.764457e+01 7.414316e+01 -0.947250327 3.440608e-01 0.85037005 -8.0525152
## 420   5.306212e-03 1.268872e-02  0.946176781 3.446074e-01 0.85037005 -8.0535314
## 593   1.233034e-01 9.882259e-01  0.945617856 3.448921e-01 0.85037005 -8.0540600
## 934  -3.101138e-01 4.533053e+00 -0.945067388 3.451727e-01 0.85037005 -8.0545803
## 560  -1.087712e+02 6.848853e+01 -0.940749948 3.473787e-01 0.85037005 -8.0586507
## 395   2.380386e-03 2.170244e-03  0.940153955 3.476839e-01 0.85037005 -8.0592111
## 407   3.996313e-03 6.018076e-03  0.939180048 3.481830e-01 0.85037005 -8.0601261
## 212   8.195047e+01 7.998082e+02  0.938145842 3.487135e-01 0.85037005 -8.0610968
## 299   4.491855e-02 3.186492e-01  0.936934285 3.493357e-01 0.85037005 -8.0622326
## 213  -1.577752e+01 2.239155e+02 -0.936766472 3.494219e-01 0.85037005 -8.0623897
## 388   1.200223e-02 3.363177e-02  0.936461753 3.495785e-01 0.85037005 -8.0626751
## 187   9.413822e+00 9.501475e+01  0.931400648 3.521863e-01 0.85281210 -8.0674014
## 975  -1.626347e-03 9.960401e-04 -0.930087784 3.528647e-01 0.85281210 -8.0686232
## 232   2.776180e+01 6.337838e+02  0.927595318 3.541551e-01 0.85281210 -8.0709381
## 786  -1.939954e+01 2.851915e+01 -0.927497267 3.542059e-01 0.85281210 -8.0710291
## 476  -2.714436e+00 5.704788e+01 -0.925935283 3.550162e-01 0.85281210 -8.0724765
## 220   5.526208e+02 3.620885e+03  0.925053146 3.554743e-01 0.85281210 -8.0732929
## 130  -1.798701e-03 1.267190e-03 -0.911467164 3.625768e-01 0.86335216 -8.0857680
## 952  -4.398087e-01 2.044101e+00 -0.911427631 3.625976e-01 0.86335216 -8.0858040
## 471  -9.791408e+00 4.752252e+01 -0.911232758 3.627002e-01 0.86335216 -8.0859816
## 919   2.413241e-03 2.662933e-03  0.909411567 3.636592e-01 0.86335216 -8.0876395
## 738  -4.344797e-01 2.263043e+00 -0.908775457 3.639946e-01 0.86335216 -8.0882178
## 1032  6.112047e-01 3.322303e+00  0.903454073 3.668075e-01 0.86684575 -8.0930397
## 19   -8.373279e-01 1.322106e+01 -0.902855228 3.671249e-01 0.86684575 -8.0935805
## 719   3.575345e-01 5.450190e+00  0.899680621 3.688104e-01 0.86821626 -8.0964418
## 990   2.009357e+00 4.332966e+01  0.897358284 3.700465e-01 0.86821626 -8.0985286
## 791  -8.680081e-02 1.598967e-01 -0.897078749 3.701955e-01 0.86821626 -8.0987794
## 751   3.889103e-01 3.987703e-01  0.890464227 3.737311e-01 0.87100241 -8.1046918
## 101  -1.864438e+02 9.529262e+02 -0.886833409 3.756807e-01 0.87100241 -8.1079186
## 941   6.361722e-03 1.567737e-02  0.886214206 3.760138e-01 0.87100241 -8.1084676
## 782   1.080129e+01 1.191460e+01  0.885307769 3.765018e-01 0.87100241 -8.1092706
## 270  -8.355649e-01 9.233520e-01 -0.883725893 3.773543e-01 0.87100241 -8.1106699
## 246  -4.055780e-01 1.129615e+00 -0.883680669 3.773787e-01 0.87100241 -8.1107099
## 537   2.871561e-01 2.292504e+00  0.883595194 3.774248e-01 0.87100241 -8.1107854
## 920   1.438272e-03 1.951911e-03  0.882445971 3.780450e-01 0.87100241 -8.1118003
## 801  -6.966542e-02 1.414214e-01 -0.880118250 3.793031e-01 0.87184811 -8.1138520
## 570  -7.058014e-01 4.100045e+00 -0.878684909 3.800791e-01 0.87184811 -8.1151126
## 255   8.968535e+01 1.096571e+03  0.872960208 3.831881e-01 0.87489460 -8.1201272
## 175   4.095526e-01 1.067466e+00  0.869828514 3.848955e-01 0.87489460 -8.1228566
## 612  -1.647208e-02 8.023228e-02 -0.868763155 3.854773e-01 0.87489460 -8.1237829
## 79   -5.389417e-02 4.861494e-01 -0.868450035 3.856485e-01 0.87489460 -8.1240550
## 415  -4.709323e-03 1.167068e-02 -0.867563878 3.861330e-01 0.87489460 -8.1248243
## 500  -1.351810e-03 1.145456e-03 -0.867028901 3.864257e-01 0.87489460 -8.1252884
## 519   7.592056e-03 1.595389e-02  0.865013349 3.875297e-01 0.87549912 -8.1270342
## 24    2.438754e+01 5.596221e+02  0.861632575 3.893858e-01 0.87779653 -8.1299535
## 121  -1.231794e-01 2.579139e-01 -0.858452416 3.911368e-01 0.87893314 -8.1326892
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## 1019  3.613834e-01 1.069670e+00  0.853872115 3.936670e-01 0.87893314 -8.1366116
## 12    7.563814e-03 1.549110e-02  0.851748432 3.948435e-01 0.87893314 -8.1384231
## 126  -9.636395e-03 3.456312e-02 -0.849169939 3.962749e-01 0.87893314 -8.1406166
## 769   5.146764e-02 6.383981e-02  0.846572483 3.977199e-01 0.87893314 -8.1428195
## 749   1.654283e-01 1.370227e+00  0.846455836 3.977849e-01 0.87893314 -8.1429183
## 64   -5.934496e-03 1.043903e-02 -0.846238759 3.979058e-01 0.87893314 -8.1431020
## 315   1.870298e-03 1.416076e-03  0.844779848 3.987191e-01 0.87893314 -8.1443359
## 446   6.440458e-02 8.723712e-01  0.844754551 3.987332e-01 0.87893314 -8.1443573
## 5     1.596487e+02 2.659481e+03  0.842659952 3.999026e-01 0.87893314 -8.1461250
## 194  -7.995556e+00 2.268812e+02 -0.841055225 4.007999e-01 0.87893314 -8.1474764
## 595   1.147489e-02 1.142719e-02  0.840222775 4.012659e-01 0.87893314 -8.1481764
## 138  -6.896351e-01 2.910346e+00 -0.840192668 4.012827e-01 0.87893314 -8.1482017
## 375   1.030725e-02 3.576121e-02  0.839529876 4.016540e-01 0.87893314 -8.1487585
## 991  -9.320487e+00 3.325856e+01 -0.833117130 4.052565e-01 0.88496506 -8.1541233
## 729   4.203351e+01 2.073036e+02  0.827267753 4.085593e-01 0.88802430 -8.1589811
## 502  -5.769800e-03 1.487917e-02 -0.827048752 4.086833e-01 0.88802430 -8.1591623
## 230   1.051980e-02 4.489290e-02  0.822399156 4.113206e-01 0.88802430 -8.1629983
## 324   1.346074e+02 2.355022e+03  0.821058349 4.120830e-01 0.88802430 -8.1641005
## 235  -9.812774e-02 1.657785e-01 -0.820645569 4.123179e-01 0.88802430 -8.1644395
## 229  -2.262791e-02 1.412524e-01 -0.819318515 4.130736e-01 0.88802430 -8.1655280
## 448   6.862863e-01 4.232331e+00  0.816944506 4.144275e-01 0.88802430 -8.1674710
## 1002  1.463484e+00 2.978007e+00  0.809727771 4.185593e-01 0.88802430 -8.1733430
## 254   5.056447e+01 6.719398e+02  0.805654326 4.209022e-01 0.88802430 -8.1766345
## 846  -1.120814e-02 6.243094e-02 -0.804502829 4.215659e-01 0.88802430 -8.1775620
## 805  -5.914742e+00 9.534258e+00 -0.801527973 4.232834e-01 0.88802430 -8.1799519
## 788  -2.773694e-01 6.016248e-01 -0.796057104 4.264526e-01 0.88802430 -8.1843240
## 225  -3.394456e-01 5.553457e+00 -0.795969430 4.265035e-01 0.88802430 -8.1843938
## 20   -1.649009e-03 1.009920e-03 -0.795157332 4.269752e-01 0.88802430 -8.1850402
## 319  -1.566560e-03 9.594242e-04 -0.795134910 4.269882e-01 0.88802430 -8.1850581
## 583  -1.495706e-03 9.160306e-04 -0.795112607 4.270012e-01 0.88802430 -8.1850758
## 948  -1.439312e-03 8.814928e-04 -0.795092454 4.270129e-01 0.88802430 -8.1850918
## 882  -1.066776e-03 6.533368e-04 -0.794869095 4.271427e-01 0.88802430 -8.1852695
## 972  -8.125158e-04 4.976173e-04 -0.794510765 4.273509e-01 0.88802430 -8.1855544
## 904  -7.866499e-04 4.817760e-04 -0.794453765 4.273840e-01 0.88802430 -8.1855997
## 428  -7.666061e-04 4.695004e-04 -0.794405580 4.274121e-01 0.88802430 -8.1856380
## 525  -7.607879e-04 4.659371e-04 -0.794390877 4.274206e-01 0.88802430 -8.1856497
## 43   -7.162182e-04 4.386408e-04 -0.794266130 4.274931e-01 0.88802430 -8.1857488
## 742  -6.323729e-01 1.160758e+00 -0.791311427 4.292130e-01 0.88802430 -8.1880924
## 510   1.658123e-03 2.449011e-03  0.790230462 4.298432e-01 0.88802430 -8.1889476
## 496   2.839253e-02 1.811046e-01  0.790137276 4.298975e-01 0.88802430 -8.1890213
## 1005 -1.037673e-01 7.787990e-02 -0.789632408 4.301921e-01 0.88802430 -8.1894203
## 994  -3.015989e-04 1.847113e-04 -0.789227111 4.304286e-01 0.88802430 -8.1897404
## 429  -6.896653e-03 2.365456e-02 -0.787209905 4.316070e-01 0.88870262 -8.1913312
## 955  -1.241146e-03 7.769360e-04 -0.784357886 4.332763e-01 0.89038704 -8.1935734
## 793  -5.890757e+00 1.237874e+01 -0.778653904 4.366260e-01 0.89551146 -8.1980335
## 359  -1.759859e-02 1.258079e-01 -0.776616554 4.378261e-01 0.89621553 -8.1996186
## 116  -7.671274e+00 1.500010e+02 -0.774915560 4.388295e-01 0.89651505 -8.2009389
## 53    8.206552e-03 3.989030e-02  0.767721775 4.430878e-01 0.89815620 -8.2064908
## 675  -1.320475e-04 8.087117e-05 -0.764824468 4.448095e-01 0.89815620 -8.2087122
## 982   2.115007e-01 1.949567e+00  0.764747944 4.448550e-01 0.89815620 -8.2087708
## 569  -1.013626e+00 8.349488e+00 -0.763135519 4.458149e-01 0.89815620 -8.2100033
## 339  -3.313743e+01 8.228877e+02 -0.759711144 4.478573e-01 0.89815620 -8.2126123
## 21    3.957168e+00 1.833718e+01  0.756688629 4.496645e-01 0.89815620 -8.2149053
## 2     4.689754e+02 1.629358e+04  0.756361805 4.498602e-01 0.89815620 -8.2151528
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## 313   9.300442e+01 2.540048e+03  0.754285325 4.511044e-01 0.89815620 -8.2167221
## 22    4.072414e+00 1.864188e+01  0.753830896 4.513770e-01 0.89815620 -8.2170650
## 158   4.749510e-01 1.183021e+01  0.752787275 4.520033e-01 0.89815620 -8.2178517
## 965  -1.071567e+01 5.121502e+01 -0.752374842 4.522509e-01 0.89815620 -8.2181623
## 995  -1.094764e-04 6.704776e-05 -0.752050231 4.524459e-01 0.89815620 -8.2184066
## 447  -5.435354e+00 9.145529e+01 -0.751782625 4.526067e-01 0.89815620 -8.2186080
## 497  -1.842356e-02 1.588234e-01 -0.751366485 4.528567e-01 0.89815620 -8.2189209
## 917   3.317157e-02 2.059397e-01  0.750656024 4.532838e-01 0.89815620 -8.2194548
## 762   1.895293e-02 4.733399e-02  0.750510435 4.533714e-01 0.89815620 -8.2195642
## 320  -8.840583e-01 5.227318e+00 -0.747654708 4.550906e-01 0.89844784 -8.2217047
## 592   4.634665e-03 1.276888e-02  0.747412746 4.552365e-01 0.89844784 -8.2218857
## 717   6.033104e-03 1.552692e-02  0.745345521 4.564835e-01 0.89921240 -8.2234297
## 72   -6.659930e+00 3.154128e+01 -0.741702373 4.586860e-01 0.90185249 -8.2261402
## 198   1.895756e+01 3.887796e+02  0.727943603 4.670574e-01 0.91634196 -8.2362576
## 887  -1.115767e+00 2.088015e+01 -0.726717596 4.678075e-01 0.91634196 -8.2371499
## 304  -5.877930e+01 1.665235e+03 -0.725215579 4.687273e-01 0.91642758 -8.2382411
## 450  -5.160109e-03 1.236416e-02 -0.721654667 4.709120e-01 0.91898126 -8.2408191
## 852   1.876613e-03 3.294443e-03  0.718036119 4.731378e-01 0.92107362 -8.2434259
## 804  -2.451235e-01 6.275702e-01 -0.715268806 4.748440e-01 0.92107362 -8.2454106
## 600  -1.701628e-03 2.423096e-03 -0.714834680 4.751119e-01 0.92107362 -8.2457213
## 266  -1.053979e+01 1.088379e+01 -0.713701742 4.758116e-01 0.92107362 -8.2465311
## 202  -2.258115e-02 1.792890e-01 -0.710499205 4.777925e-01 0.92107362 -8.2488134
## 532   8.264547e-04 7.711046e-04  0.710287794 4.779234e-01 0.92107362 -8.2489637
## 640  -3.217942e-03 2.349908e-03 -0.709925014 4.781482e-01 0.92107362 -8.2492215
## 761  -4.689085e+00 1.051856e+01 -0.703183606 4.823345e-01 0.92428279 -8.2539885
## 760  -4.607494e+00 1.045465e+01 -0.703138926 4.823623e-01 0.92428279 -8.2540199
## 624  -6.355021e-03 1.840003e-02 -0.702973881 4.824650e-01 0.92428279 -8.2541360
## 1034 -6.983598e-02 1.090426e+00 -0.700721585 4.838683e-01 0.92527650 -8.2557181
## 470  -4.242682e+01 1.216118e+02 -0.697930455 4.856104e-01 0.92691325 -8.2576716
## 196  -4.711337e+01 4.814786e+02 -0.692450696 4.890405e-01 0.93176016 -8.2614843
## 334  -8.571435e+00 6.865786e+01 -0.686800415 4.925910e-01 0.93681843 -8.2653842
## 148  -2.227784e-03 4.453216e-03 -0.683141167 4.948977e-01 0.93949729 -8.2678928
## 855  -5.099140e-02 2.288198e-01 -0.680447365 4.965996e-01 0.94102017 -8.2697311
## 272  -1.621350e-03 2.794074e-03 -0.678335546 4.979359e-01 0.94158946 -8.2711671
## 551   1.371969e-02 2.384895e-02  0.677128880 4.987003e-01 0.94158946 -8.2719856
## 523  -1.610456e-03 3.150712e-03 -0.671616890 5.022002e-01 0.94357615 -8.2757061
## 465   1.808198e+00 4.067030e+01  0.670410969 5.029676e-01 0.94357615 -8.2765160
## 623   3.516571e-01 5.997655e+00  0.669864924 5.033153e-01 0.94357615 -8.2768823
## 162   2.854817e+00 8.249832e+01  0.669494778 5.035511e-01 0.94357615 -8.2771304
## 775  -5.708519e-01 1.486968e+00 -0.668377749 5.042630e-01 0.94357615 -8.2778783
## 483   9.412259e-02 2.321516e+00  0.659629650 5.098563e-01 0.94853037 -8.2836925
## 95   -9.532507e-03 1.688920e-02 -0.658150357 5.108054e-01 0.94853037 -8.2846681
## 87   -2.850716e+01 6.648861e+02 -0.657212803 5.114073e-01 0.94853037 -8.2852853
## 386   1.754026e-02 1.486126e-01  0.656792441 5.116774e-01 0.94853037 -8.2855618
## 207   1.298942e+01 2.825740e+02  0.655009435 5.128235e-01 0.94853037 -8.2867324
## 499   1.930183e-02 1.625217e-01  0.654442631 5.131881e-01 0.94853037 -8.2871038
## 785  -4.426562e+00 8.381536e+00 -0.654333558 5.132583e-01 0.94853037 -8.2871753
## 209   5.184859e-01 1.181410e+01  0.644903886 5.193448e-01 0.95777632 -8.2933070
## 224   6.745099e-01 4.066781e+00  0.642183928 5.211073e-01 0.95777632 -8.2950592
## 625  -5.677935e+00 1.880191e+02 -0.640506869 5.221956e-01 0.95777632 -8.2961358
## 795  -6.398656e-01 1.666306e+00 -0.640019266 5.225122e-01 0.95777632 -8.2964483
## 15    9.905888e+02 2.361913e+04  0.639065865 5.231316e-01 0.95777632 -8.2970587
## 301  -7.678240e-03 4.622671e-02 -0.637799638 5.239548e-01 0.95777632 -8.2978679
## 259  -1.514925e+01 2.499988e+02 -0.636698926 5.246710e-01 0.95777632 -8.2985700
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## 946   2.188512e-02 2.182052e-01  0.619824204 5.357127e-01 0.97401846 -8.3091829
## 1028 -4.039751e-03 1.316007e-02 -0.618865455 5.363435e-01 0.97401846 -8.3097773
## 909  -1.248878e-01 2.641771e-01 -0.618837434 5.363620e-01 0.97401846 -8.3097947
## 54    1.440013e-01 2.812006e+00  0.617059245 5.375330e-01 0.97445330 -8.3108947
## 364  -3.537793e-02 3.587132e-01 -0.614159564 5.394454e-01 0.97480621 -8.3126817
## 226   1.659067e+00 2.386213e+01  0.610277288 5.420112e-01 0.97480621 -8.3150611
## 417   1.174885e-02 9.694513e-02  0.609792250 5.423322e-01 0.97480621 -8.3153573
## 261  -1.537489e+01 1.412987e+02 -0.608768094 5.430103e-01 0.97480621 -8.3159820
## 979   1.318343e-02 2.184965e-02  0.608315922 5.433098e-01 0.97480621 -8.3162575
## 183   2.697118e+01 2.402281e+02  0.608301475 5.433193e-01 0.97480621 -8.3162663
## 1042 -6.013718e-01 8.641389e+00 -0.603197188 5.467061e-01 0.97920297 -8.3193616
## 584   3.982303e-03 1.699203e-02  0.594858948 5.522610e-01 0.98512309 -8.3243621
## 989  -6.955032e-03 4.066290e-02 -0.594249479 5.526681e-01 0.98512309 -8.3247249
## 1018  1.359323e+02 6.257192e+02  0.593997067 5.528368e-01 0.98512309 -8.3248751
## 210  -8.489347e+01 1.527419e+03 -0.591973817 5.541895e-01 0.98585415 -8.3260762
## 757   7.020462e-03 1.102738e-02  0.589100192 5.561136e-01 0.98668827 -8.3277751
## 923   1.096398e-03 1.533338e-03  0.587827697 5.569667e-01 0.98668827 -8.3285248
## 200  -2.686009e+00 1.091143e+01 -0.587050151 5.574883e-01 0.98668827 -8.3289821
## 998  -7.364660e-01 1.871207e+01 -0.584917152 5.589204e-01 0.98755185 -8.3302335
## 856  -1.162163e-01 6.151588e-01 -0.581656406 5.611130e-01 0.98923945 -8.3321377
## 899  -1.308872e-02 5.511976e-02 -0.578781230 5.630499e-01 0.98923945 -8.3338079
## 424   1.443227e-03 1.899736e-03  0.578016146 5.635658e-01 0.98923945 -8.3342509
## 141  -1.580694e-01 4.151373e-01 -0.577878818 5.636584e-01 0.98923945 -8.3343304
## 518  -4.461163e-03 1.602751e-02 -0.576321192 5.647096e-01 0.98942420 -8.3352304
## 103  -2.222045e-01 1.163216e+00 -0.572648730 5.671917e-01 0.98967300 -8.3373427
## 794  -8.492264e-01 2.513061e+00 -0.570248710 5.688167e-01 0.98967300 -8.3387159
## 868  -5.941127e-03 1.639098e-02 -0.569567632 5.692782e-01 0.98967300 -8.3391045
## 1036  1.918766e-03 4.926231e-03  0.569382881 5.694035e-01 0.98967300 -8.3392098
## 615  -7.449382e-02 9.098373e-01 -0.569118996 5.695824e-01 0.98967300 -8.3393602
## 10    2.264997e+01 8.801104e+02  0.567633208 5.705901e-01 0.98977983 -8.3402057
## 184   6.412173e+01 1.255269e+03  0.562975966 5.737544e-01 0.99240084 -8.3428417
## 100  -7.141076e+01 6.493578e+02 -0.562617044 5.739986e-01 0.99240084 -8.3430440
## 888  -1.915206e-01 1.121695e+00 -0.553472673 5.802370e-01 1.00000000 -8.3481533
## 907   8.039751e-03 6.599758e-02  0.548902684 5.833666e-01 1.00000000 -8.3506754
## 369  -3.408811e-03 1.230856e-02 -0.548790489 5.834435e-01 1.00000000 -8.3507371
## 513  -5.150347e-01 1.072267e+01 -0.547499380 5.843291e-01 1.00000000 -8.3514457
## 573  -1.536016e+00 2.569945e+01 -0.547240566 5.845068e-01 1.00000000 -8.3515875
## 781  -4.612784e+00 1.291984e+01 -0.546663382 5.849029e-01 1.00000000 -8.3519036
## 690   1.351176e-03 2.307068e-03  0.544331185 5.865051e-01 1.00000000 -8.3531775
## 133   2.155172e-03 3.906459e-03  0.542334779 5.878781e-01 1.00000000 -8.3542636
## 925   1.365158e-01 6.066721e-01  0.536165181 5.921308e-01 1.00000000 -8.3575949
## 32    3.081939e-03 7.725717e-03  0.534025699 5.936088e-01 1.00000000 -8.3587412
## 1025  1.004192e+03 2.112582e+04  0.528941884 5.971277e-01 1.00000000 -8.3614467
## 139   2.110336e-01 5.038982e+00  0.526695804 5.986854e-01 1.00000000 -8.3626338
## 549  -1.024303e-02 1.016893e-01 -0.525416274 5.995736e-01 1.00000000 -8.3633078
## 800   2.526447e-01 7.557593e-01  0.522558725 6.015594e-01 1.00000000 -8.3648071
## 722   1.682546e+01 2.889305e+02  0.519253015 6.038603e-01 1.00000000 -8.3665314
## 405   5.884000e-03 3.186637e-02  0.518374857 6.044722e-01 1.00000000 -8.3669876
## 495  -2.348436e-03 5.652296e-03 -0.518144258 6.046329e-01 1.00000000 -8.3671073
## 816   9.108544e-03 6.148322e-02  0.516569640 6.057310e-01 1.00000000 -8.3679230
## 806   1.518355e-02 5.203855e-02  0.512110021 6.088456e-01 1.00000000 -8.3702199
## 505   3.308432e-01 7.443275e+00  0.506962872 6.124493e-01 1.00000000 -8.3728462
## 798  -1.470236e+00 4.830834e+00 -0.505510229 6.134681e-01 1.00000000 -8.3735826
## 61    5.585652e-03 3.918757e-02  0.491762117 6.231468e-01 1.00000000 -8.3804475
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## 879   1.442024e-03 2.915388e-03  0.490423168 6.240929e-01 1.00000000 -8.3811059
## 809   4.629526e-01 1.698042e+00  0.490127877 6.243017e-01 1.00000000 -8.3812509
## 803  -3.267722e-01 1.266530e+00 -0.487779362 6.259630e-01 1.00000000 -8.3824009
## 741   7.094375e-01 2.252243e+01  0.485987197 6.272320e-01 1.00000000 -8.3832747
## 66   -7.181924e-03 4.246884e-02 -0.485385316 6.276584e-01 1.00000000 -8.3835674
## 387  -2.644253e-02 3.920840e-01 -0.484921637 6.279870e-01 1.00000000 -8.3837927
## 783  -2.109929e-02 8.324494e-02 -0.484154260 6.285310e-01 1.00000000 -8.3841651
## 88    1.365732e+00 3.495001e+01  0.481077775 6.307140e-01 1.00000000 -8.3856519
## 373   6.676742e-03 3.977583e-02  0.480446013 6.311627e-01 1.00000000 -8.3859561
## 517  -3.802109e-03 1.606730e-02 -0.479835157 6.315967e-01 1.00000000 -8.3862498
## 585   8.433638e-03 5.278418e-02  0.477795739 6.330464e-01 1.00000000 -8.3872277
## 504   1.866694e-03 6.255927e-03  0.477744582 6.330828e-01 1.00000000 -8.3872522
## 774  -1.384576e+00 4.015098e+00 -0.475436571 6.347252e-01 1.00000000 -8.3883538
## 1027  2.966467e+02 6.436938e+03  0.474215143 6.355952e-01 1.00000000 -8.3889346
## 884   2.025949e-02 1.301782e-01  0.470877561 6.379748e-01 1.00000000 -8.3905141
## 1017  1.214436e+02 6.601544e+02  0.470073891 6.385484e-01 1.00000000 -8.3908927
## 634  -3.310469e-04 4.146762e-04 -0.469743139 6.387845e-01 1.00000000 -8.3910484
## 974  -2.900341e-02 4.229440e-01 -0.466527515 6.410820e-01 1.00000000 -8.3925559
## 752   1.229670e-02 3.013978e-02  0.460138866 6.456568e-01 1.00000000 -8.3955204
## 107  -1.376792e-03 3.979419e-03 -0.459817629 6.458872e-01 1.00000000 -8.3956684
## 455  -3.611279e-02 6.936721e-01 -0.453008417 6.507787e-01 1.00000000 -8.3987808
## 883   3.022761e-03 1.321020e-02  0.451204468 6.520772e-01 1.00000000 -8.3995976
## 983   5.556929e-01 1.840911e+01  0.447802473 6.545287e-01 1.00000000 -8.4011292
## 237  -6.866846e-03 6.993846e-02 -0.444566110 6.568644e-01 1.00000000 -8.4025754
## 473   1.091265e+00 3.996703e+01  0.442902412 6.580664e-01 1.00000000 -8.4033147
## 574  -1.555129e+02 1.281023e+03 -0.442183834 6.585858e-01 1.00000000 -8.4036332
## 238   1.935615e-02 1.687434e-01  0.439243667 6.607129e-01 1.00000000 -8.4049310
## 406   1.974391e-03 6.294572e-03  0.432663043 6.654837e-01 1.00000000 -8.4078042
## 260  -1.279018e+01 1.564701e+02 -0.431907332 6.660324e-01 1.00000000 -8.4081314
## 124  -7.750785e-03 5.695300e-02 -0.431016112 6.666798e-01 1.00000000 -8.4085165
## 702  -7.113248e-04 9.997399e-04 -0.427938491 6.689172e-01 1.00000000 -8.4098404
## 77   -2.291215e-03 1.329744e-02 -0.425154334 6.709439e-01 1.00000000 -8.4110298
## 404  -7.824559e-03 7.488179e-02 -0.424643268 6.713162e-01 1.00000000 -8.4112473
## 384   7.352856e-04 1.496258e-03  0.424432872 6.714694e-01 1.00000000 -8.4113367
## 396   3.211668e-02 7.274434e-01  0.417129550 6.767987e-01 1.00000000 -8.4144147
## 1043 -9.852929e-01 1.422911e+01 -0.412142540 6.804471e-01 1.00000000 -8.4164857
## 337  -2.234273e+01 7.494676e+02 -0.409586410 6.823201e-01 1.00000000 -8.4175376
## 547  -6.838531e-04 1.404868e-03 -0.408385857 6.832004e-01 1.00000000 -8.4180294
## 869   8.154076e-02 2.254908e+00  0.404492633 6.860583e-01 1.00000000 -8.4196143
## 96   -6.259859e-04 1.712632e-03 -0.404204648 6.862698e-01 1.00000000 -8.4197309
## 520   5.206053e-02 1.550423e-01  0.401606413 6.881798e-01 1.00000000 -8.4207795
## 199  -1.403746e-01 7.792399e-01 -0.401278120 6.884213e-01 1.00000000 -8.4209115
## 545  -1.337468e-02 2.504389e-01 -0.401203420 6.884762e-01 1.00000000 -8.4209415
## 733   3.319953e-02 3.046241e-01  0.400294703 6.891448e-01 1.00000000 -8.4213062
## 436  -1.071269e-02 1.632223e-01 -0.398009465 6.908273e-01 1.00000000 -8.4222199
## 602  -1.580692e-02 1.782465e-01 -0.394851705 6.931546e-01 1.00000000 -8.4234737
## 228  -1.718669e-01 4.337473e+00 -0.389558873 6.970620e-01 1.00000000 -8.4255530
## 1008 -1.352900e+01 4.341473e+02 -0.388167840 6.980903e-01 1.00000000 -8.4260948
## 188  -9.296755e+01 1.865049e+03 -0.388082386 6.981535e-01 1.00000000 -8.4261280
## 157   1.562927e-02 4.478100e-02  0.387958412 6.982451e-01 1.00000000 -8.4261762
## 563  -2.752744e+00 1.049297e+02 -0.387487762 6.985932e-01 1.00000000 -8.4263590
## 76    3.047727e-01 2.227099e+00  0.386184734 6.995572e-01 1.00000000 -8.4268639
## 797  -1.427105e+00 6.356247e+00 -0.386045914 6.996599e-01 1.00000000 -8.4269176
## 180   1.082345e+01 5.141908e+01  0.383065726 7.018666e-01 1.00000000 -8.4280655
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## 262   7.208778e+01 3.412232e+02  0.380927884 7.034511e-01 1.00000000 -8.4288835
## 621  -1.200645e+00 1.271988e+01 -0.380699056 7.036208e-01 1.00000000 -8.4289708
## 550  -5.215354e-03 1.769994e-02 -0.380162616 7.040186e-01 1.00000000 -8.4291752
## 234   2.898371e-01 1.612352e+00  0.380076996 7.040821e-01 1.00000000 -8.4292078
## 56   -1.699975e-03 5.972760e-03 -0.379887547 7.042227e-01 1.00000000 -8.4292799
## 459   6.609081e-03 7.485713e-02  0.378641413 7.051472e-01 1.00000000 -8.4297533
## 389  -8.943136e-03 1.194432e-01 -0.373321804 7.090990e-01 1.00000000 -8.4317567
## 394  -1.136700e-03 2.762751e-03 -0.371346796 7.105682e-01 1.00000000 -8.4324932
## 555   4.222232e-03 3.967738e-02  0.370544091 7.111656e-01 1.00000000 -8.4327915
## 159   5.570288e+01 2.310335e+03  0.368903268 7.123874e-01 1.00000000 -8.4333992
## 554  -1.661727e-02 4.202532e-01 -0.366766136 7.139798e-01 1.00000000 -8.4341866
## 789  -7.023507e-01 2.894884e+00 -0.366650870 7.140658e-01 1.00000000 -8.4342289
## 336  -7.398825e+02 2.485497e+04 -0.363147688 7.166789e-01 1.00000000 -8.4355094
## 376   1.134737e-02 2.095865e-01  0.359282573 7.195659e-01 1.00000000 -8.4369079
## 589  -1.408269e-03 4.293706e-03 -0.356548580 7.216104e-01 1.00000000 -8.4378881
## 63    4.096426e-03 2.314271e-02  0.355608648 7.223138e-01 1.00000000 -8.4382233
## 433   1.159296e-02 2.290266e-01  0.354101440 7.234422e-01 1.00000000 -8.4387591
## 715  -1.428137e-02 2.003764e-01 -0.348766350 7.274411e-01 1.00000000 -8.4406372
## 524   5.860952e-02 1.510690e+00  0.342706196 7.319925e-01 1.00000000 -8.4427360
## 412   8.793312e-03 7.456134e-02  0.342544546 7.321140e-01 1.00000000 -8.4427915
## 714   1.831380e-03 8.304860e-03  0.342095393 7.324518e-01 1.00000000 -8.4429455
## 838   1.680805e-05 6.514125e-06  0.341415659 7.329630e-01 1.00000000 -8.4431782
## 598   2.315912e-02 6.021298e-01  0.339918404 7.340894e-01 1.00000000 -8.4436891
## 1030  7.489296e-02 1.327545e+00  0.337465935 7.359358e-01 1.00000000 -8.4445212
## 71    2.148900e-03 1.055792e-02  0.337445315 7.359513e-01 1.00000000 -8.4445282
## 704  -6.810663e-04 1.258713e-03 -0.335756799 7.372234e-01 1.00000000 -8.4450975
## 937   5.048076e-02 2.043763e+00  0.335098388 7.377197e-01 1.00000000 -8.4453187
## 462   9.527633e-01 4.461573e+01  0.334773039 7.379649e-01 1.00000000 -8.4454279
## 922  -1.691707e-02 1.861561e-01 -0.330246159 7.413801e-01 1.00000000 -8.4469357
## 205   1.327810e+01 2.705391e+02  0.328460622 7.427286e-01 1.00000000 -8.4475248
## 787  -2.574730e+00 1.313348e+01 -0.328375862 7.427926e-01 1.00000000 -8.4475527
## 750   2.511235e+00 9.693000e+01  0.326735298 7.440323e-01 1.00000000 -8.4480910
## 117   2.331688e+00 9.536917e+01  0.326607130 7.441292e-01 1.00000000 -8.4481329
## 843   1.471438e-02 3.450903e-01  0.324518418 7.457086e-01 1.00000000 -8.4488141
## 947  -2.681580e-04 5.801439e-04 -0.321573641 7.479371e-01 1.00000000 -8.4497671
## 114  -6.188804e-03 8.791384e-02 -0.317641331 7.509163e-01 1.00000000 -8.4510261
## 374  -5.149032e-03 6.989417e-02 -0.315028479 7.528979e-01 1.00000000 -8.4518541
## 945  -1.216294e-03 3.664273e-03 -0.313614897 7.539706e-01 1.00000000 -8.4522992
## 732   1.643054e-02 2.280934e-01  0.305421901 7.601975e-01 1.00000000 -8.4548395
## 60   -2.384728e-03 1.913778e-02 -0.305054674 7.604770e-01 1.00000000 -8.4549518
## 539   3.996981e-02 1.047916e+00  0.303588281 7.615933e-01 1.00000000 -8.4553989
## 297   1.367580e+01 2.002586e+02  0.302444888 7.624640e-01 1.00000000 -8.4557460
## 511   3.864952e-02 9.390389e-01  0.299227881 7.649155e-01 1.00000000 -8.4567155
## 83    5.522242e-03 1.011816e-01  0.294616027 7.684341e-01 1.00000000 -8.4580873
## 796  -3.083377e-01 1.690505e+00 -0.290388964 7.716633e-01 1.00000000 -8.4593259
## 735   5.109971e-02 2.210948e+00  0.289227535 7.725513e-01 1.00000000 -8.4596631
## 822   7.225585e-04 2.472007e-03  0.285074157 7.757291e-01 1.00000000 -8.4608579
## 257   2.455018e+00 6.471457e+01  0.284168054 7.764229e-01 1.00000000 -8.4611163
## 399   3.228482e-03 3.998578e-02  0.283262018 7.771168e-01 1.00000000 -8.4613738
## 398   6.884317e-03 1.520575e-01  0.279939964 7.796626e-01 1.00000000 -8.4623110
## 239   6.793465e+02 4.682471e+04  0.270969689 7.865487e-01 1.00000000 -8.4647864
## 102  -9.782717e-02 1.139654e+00 -0.267810981 7.889775e-01 1.00000000 -8.4656388
## 390   1.109423e-03 4.294442e-03  0.267113797 7.895138e-01 1.00000000 -8.4658256
## 468  -4.071858e-01 1.932060e+01 -0.262545984 7.930304e-01 1.00000000 -8.4670376
```

```
## 170  -3.235479e+01 4.125138e+02 -0.261319509 7.939754e-01 1.00000000 -8.4673594
## 277  -1.060355e-01 1.281158e+00 -0.258855751 7.958745e-01 1.00000000 -8.4680014
## 442  -1.968966e-03 1.683553e-02 -0.258606795 7.960665e-01 1.00000000 -8.4680659
## 379   2.774110e-03 3.769441e-02  0.257753556 7.967245e-01 1.00000000 -8.4682866
## 1026  7.596366e-01 2.024971e+01  0.256094535 7.980044e-01 1.00000000 -8.4687136
## 951  -1.064738e-02 2.769862e-01 -0.253310607 8.001533e-01 1.00000000 -8.4694240
## 780   1.932178e-01 1.431966e+00  0.252233670 8.009850e-01 1.00000000 -8.4696967
## 156   5.526188e-02 1.234023e+00  0.250378803 8.024180e-01 1.00000000 -8.4701637
## 414   7.850531e-03 1.880631e-01  0.249982695 8.027241e-01 1.00000000 -8.4702630
## 618  -2.364291e-03 2.668355e-02 -0.243586894 8.076708e-01 1.00000000 -8.4718443
## 808  -7.213738e+00 4.720216e+01 -0.241271840 8.094632e-01 1.00000000 -8.4724066
## 128   1.739246e-02 6.871202e-01  0.239813695 8.105927e-01 1.00000000 -8.4727580
## 772   1.274636e+00 7.455790e+00  0.233123949 8.157798e-01 1.00000000 -8.4743428
## 851   2.357346e-03 3.508957e-02  0.232726827 8.160879e-01 1.00000000 -8.4744355
## 131  -9.093375e-02 9.701515e-01 -0.228002206 8.197565e-01 1.00000000 -8.4755259
## 371   2.601967e-03 2.404751e-02  0.227935978 8.198079e-01 1.00000000 -8.4755411
## 861  -4.522531e-04 1.960141e-03 -0.221520810 8.247956e-01 1.00000000 -8.4769854
## 514   7.089234e-03 1.590755e-01  0.213870562 8.307527e-01 1.00000000 -8.4786540
## 744  -6.984289e+00 4.200826e+02 -0.207452728 8.357578e-01 1.00000000 -8.4800085
## 820   2.977338e-03 4.301432e-02  0.206084376 8.368258e-01 1.00000000 -8.4802920
## 901   2.247740e-01 2.549420e+01  0.204174745 8.383167e-01 1.00000000 -8.4806845
## 850  -1.850566e-02 7.285487e-01 -0.203145026 8.391210e-01 1.00000000 -8.4808946
## 779   2.593939e-01 2.254496e+00  0.196710238 8.441503e-01 1.00000000 -8.4821835
## 51    1.862831e-03 2.690600e-02  0.196410029 8.443851e-01 1.00000000 -8.4822426
## 958   5.440379e-04 2.016672e-03  0.193033923 8.470266e-01 1.00000000 -8.4829013
## 74    2.814166e-02 1.936042e+00  0.190845747 8.487395e-01 1.00000000 -8.4833221
## 80   -1.017846e-02 4.078718e-01 -0.190622956 8.489139e-01 1.00000000 -8.4833647
## 527  -4.389659e-03 1.035586e-01 -0.189683976 8.496492e-01 1.00000000 -8.4835436
## 391  -2.382301e-03 4.284665e-02 -0.189562961 8.497440e-01 1.00000000 -8.4835666
## 885   1.435906e+00 1.483972e+02  0.188465610 8.506035e-01 1.00000000 -8.4837744
## 279   3.689188e-03 1.933364e-02  0.188074818 8.509097e-01 1.00000000 -8.4838481
## 413   8.983389e-03 4.995536e-01  0.187544744 8.513249e-01 1.00000000 -8.4839478
## 214   1.211390e-01 5.266605e+00  0.185427716 8.529839e-01 1.00000000 -8.4843434
## 300  -1.754593e-02 1.059218e+00 -0.179569241 8.575781e-01 1.00000000 -8.4854146
## 215  -5.781977e-01 3.551337e+01 -0.178866472 8.581296e-01 1.00000000 -8.4855408
## 363  -3.231068e-03 8.020657e-02 -0.178692384 8.582662e-01 1.00000000 -8.4855720
## 1039  8.917653e-02 6.270639e+00  0.177604093 8.591203e-01 1.00000000 -8.4857662
## 594  -1.353092e-03 1.909596e-02 -0.175440884 8.608185e-01 1.00000000 -8.4861488
## 13   -3.075879e-01 1.097947e+01 -0.170922066 8.643681e-01 1.00000000 -8.4869329
## 727   6.815565e-01 8.162495e+01  0.170856585 8.644196e-01 1.00000000 -8.4869441
## 44    3.011687e-04 1.211364e-03  0.170315397 8.648449e-01 1.00000000 -8.4870366
## 397  -1.475383e-03 2.872705e-02 -0.163072435 8.705405e-01 1.00000000 -8.4882463
## 977   1.389036e-02 3.981722e-01  0.162298158 8.711498e-01 1.00000000 -8.4883725
## 93    2.053505e-02 7.888419e-01  0.161332753 8.719096e-01 1.00000000 -8.4885290
## 355  -7.333310e-04 6.755044e-03 -0.158151033 8.744145e-01 1.00000000 -8.4890382
## 997  -9.908921e-03 4.537897e-01 -0.157336472 8.750560e-01 1.00000000 -8.4891670
## 895   6.586538e-01 5.828827e+01  0.154077780 8.776231e-01 1.00000000 -8.4896754
## 360   2.015237e-03 3.395915e-02  0.152605406 8.787834e-01 1.00000000 -8.4899016
## 908   2.434988e-01 1.795538e+01  0.150958598 8.800815e-01 1.00000000 -8.4901520
## 136  -7.536359e-03 1.052390e-01 -0.150918531 8.801131e-01 1.00000000 -8.4901581
## 864   3.065506e-01 8.843355e+00  0.150812747 8.801965e-01 1.00000000 -8.4901741
## 831   4.716380e-04 3.257880e-03  0.146713820 8.834289e-01 1.00000000 -8.4907850
## 403   1.140841e-03 1.972692e-02  0.146137911 8.838833e-01 1.00000000 -8.4908695
## 492  -7.704308e-02 5.154280e+00 -0.144524121 8.851566e-01 1.00000000 -8.4911045
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## 872   1.715244e-03 3.158967e-02  0.142558340 8.867080e-01 1.00000000 -8.4913872
## 614   8.124800e-03 5.938976e-01  0.140197212 8.885720e-01 1.00000000 -8.4917217
## 129  -7.575817e-04 1.106586e-02 -0.139611357 8.890346e-01 1.00000000 -8.4918038
## 123  -6.864338e-03 3.902716e-01 -0.138511492 8.899032e-01 1.00000000 -8.4919571
## 949  -8.848193e-03 4.863080e-01 -0.137581367 8.906378e-01 1.00000000 -8.4920857
## 770  -8.064850e-02 9.962698e-01 -0.134321034 8.932136e-01 1.00000000 -8.4925298
## 596   1.814914e-03 6.129277e-02  0.133571482 8.938060e-01 1.00000000 -8.4926304
## 434  -5.002060e-03 1.958392e-01 -0.132179800 8.949059e-01 1.00000000 -8.4928157
## 444  -2.073324e-03 6.731733e-02 -0.131691678 8.952918e-01 1.00000000 -8.4928802
## 49   -2.094711e+02 2.576537e+04 -0.130774747 8.960167e-01 1.00000000 -8.4930008
## 55   -1.576811e-02 7.988789e-01 -0.128308108 8.979671e-01 1.00000000 -8.4933210
## 890  -1.219722e-02 1.098263e+00 -0.127192384 8.988496e-01 1.00000000 -8.4934638
## 771  -7.854920e-02 9.725630e-01 -0.125936173 8.998433e-01 1.00000000 -8.4936231
## 385   1.448962e-03 4.438580e-02  0.125604091 9.001060e-01 1.00000000 -8.4936649
## 432  -8.616103e-04 1.300373e-02 -0.123175753 9.020274e-01 1.00000000 -8.4939676
## 931  -7.586669e-03 3.871498e-01 -0.120729967 9.039632e-01 1.00000000 -8.4942664
## 218   1.135651e-03 2.637144e-02  0.119476724 9.049553e-01 1.00000000 -8.4944172
## 802   3.246700e-01 4.329957e+00  0.116142872 9.075953e-01 1.00000000 -8.4948108
## 617  -9.761180e-03 9.588097e-01 -0.108911150 9.133254e-01 1.00000000 -8.4956261
## 522   1.743484e-02 9.557850e-01  0.108227489 9.138674e-01 1.00000000 -8.4957005
## 493  -6.970369e-02 9.767269e+00 -0.106799259 9.149997e-01 1.00000000 -8.4958544
## 70   -9.299385e-03 6.513180e-01 -0.105575373 9.159701e-01 1.00000000 -8.4959846
## 631   5.922273e-04 4.590426e-03  0.104908935 9.164986e-01 1.00000000 -8.4960549
## 571   9.528498e+00 1.204371e+03  0.096767439 9.229577e-01 1.00000000 -8.4968775
## 89   -2.902567e+01 5.905212e+03 -0.095688796 9.238138e-01 1.00000000 -8.4969815
## 472  -1.123947e+01 6.021514e+02 -0.094276359 9.249350e-01 1.00000000 -8.4971159
## 773  -3.261300e-01 5.175642e+00 -0.092238868 9.265526e-01 1.00000000 -8.4973063
## 296   2.494251e-01 3.641088e+01  0.089748335 9.285304e-01 1.00000000 -8.4975333
## 664   2.916641e-03 1.960282e-01  0.088614733 9.294307e-01 1.00000000 -8.4976346
## 964  -7.430410e-01 1.665892e+01 -0.088566749 9.294688e-01 1.00000000 -8.4976389
## 73   -5.278655e-02 1.976573e+00 -0.085682160 9.317603e-01 1.00000000 -8.4978907
## 263  -2.258917e-02 5.453411e-01 -0.085191138 9.321504e-01 1.00000000 -8.4979327
## 275   6.928822e+02 2.040365e+05  0.083029458 9.338680e-01 1.00000000 -8.4981149
## 477   6.408636e-01 1.117382e+02  0.079950220 9.363153e-01 1.00000000 -8.4983663
## 981   5.652280e+00 2.813173e+02  0.076795186 9.388234e-01 1.00000000 -8.4986141
## 528  -1.471009e-04 2.138302e-03 -0.075824889 9.395948e-01 1.00000000 -8.4986883
## 7     5.780937e+00 9.864281e+02  0.074420570 9.407115e-01 1.00000000 -8.4987940
## 915  -2.409388e-03 2.296257e-01 -0.071295097 9.431971e-01 1.00000000 -8.4990222
## 84   -7.707495e-04 2.734256e-02 -0.070375375 9.439287e-01 1.00000000 -8.4990874
## 860  -1.454079e-02 2.958461e+00 -0.068795489 9.451854e-01 1.00000000 -8.4991976
## 252   2.889978e-02 7.778904e+00  0.057098337 9.544943e-01 1.00000000 -8.4999354
## 900  -4.263755e-01 1.102001e+02 -0.055895938 9.554515e-01 1.00000000 -8.5000034
## 1007  1.064481e-02 2.146543e+00  0.055047699 9.561269e-01 1.00000000 -8.5000506
## 245   4.483205e-01 1.699605e+01  0.054708540 9.563969e-01 1.00000000 -8.5000692
## 461  -6.663545e-02 5.523689e+00 -0.051354878 9.590674e-01 1.00000000 -8.5002474
## 118  -1.189685e-04 2.205048e-03 -0.049391535 9.606310e-01 1.00000000 -8.5003465
## 871  -6.507999e-05 9.412368e-04 -0.046112022 9.632431e-01 1.00000000 -8.5005034
## 487  -1.089908e+00 5.866959e+02 -0.046002964 9.633299e-01 1.00000000 -8.5005085
## 178   7.022983e-01 1.875875e+02  0.045915512 9.633996e-01 1.00000000 -8.5005125
## 536  -1.461270e-04 4.861972e-03 -0.040528416 9.676913e-01 1.00000000 -8.5007458
## 746   2.203896e-01 6.998469e+01  0.040275793 9.678926e-01 1.00000000 -8.5007560
## 897  -1.565365e-04 5.310750e-03 -0.036197372 9.711423e-01 1.00000000 -8.5009123
## 540  -7.850825e-04 1.228566e-01 -0.031308074 9.750389e-01 1.00000000 -8.5010776
## 807  -3.321719e-03 1.381916e-01 -0.028262319 9.774665e-01 1.00000000 -8.5011685
```

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## 132   1.151206e-02 1.064919e+00  0.024599186 9.803865e-01 1.00000000 -8.5012656
## 52    5.634977e-03 1.502726e+00  0.024155978 9.807398e-01 1.00000000 -8.5012764
## 999  -1.586407e-01 2.563939e+01 -0.022619500 9.819646e-01 1.00000000 -8.5013124
## 298   5.716533e-01 1.870359e+02  0.021572330 9.827994e-01 1.00000000 -8.5013356
## 607   1.741695e-03 6.545235e-01  0.018168157 9.855134e-01 1.00000000 -8.5014033
## 784   5.065543e-02 4.731400e+00  0.017365988 9.861530e-01 1.00000000 -8.5014176
## 926   1.159450e-02 1.116348e+01  0.013040246 9.896019e-01 1.00000000 -8.5014835
## 553   1.108272e-03 6.896349e-01  0.011942610 9.904771e-01 1.00000000 -8.5014973
## 562  -7.082413e-01 1.488202e+03 -0.008051341 9.935799e-01 1.00000000 -8.5015362
## 601  -6.593267e-05 7.732352e-02 -0.002668902 9.978718e-01 1.00000000 -8.5015652
## 18    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 33    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 34    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 35    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 36    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 41    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 42    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 45    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 46    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 47    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 48    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 57    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 58    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 69    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 78    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 81    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 92    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 99    0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 106   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 108   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 109   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 115   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 120   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 125   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 140   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 142   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 144   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 145   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 146   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 147   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 152   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 153   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 189   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 190   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 191   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 249   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
```

```
## 250   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 267   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 268   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 269   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 316   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 325   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 333   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 347   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 349   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
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## 358   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 370   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 378   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 401   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 410   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 426   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 431   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 449   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 529   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 531   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 534   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 535   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 558   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 559   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 579   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 580   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 581   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 590   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 608   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 628   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 629   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 630   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 632   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 633   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 635   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 636   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 637   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 638   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 639   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 641   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 642   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 643   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 645   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 646   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 647   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 648   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 649   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
```

```
## 650   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 651   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 652   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 653   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 654   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 656   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 658   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 659   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 660   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 661   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 663   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 665   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 666   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 669   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 670   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 671   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 672   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 673   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 674   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 676   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 677   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 678   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 680   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 681   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 682   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 683   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 684   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 686   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 687   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 688   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 691   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 692   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 693   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 694   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 697   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 698   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 699   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 700   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 703   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 705   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 706   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 707   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 709   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 710   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 711   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 713   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 736   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 818   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 819   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 821   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 824   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 829   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 830   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 832   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
```

```
## 833   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 834   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 835   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 836   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 837   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 839   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 840   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 841   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 845   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 857   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 866   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 867   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 870   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 874   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 875   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 877   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 880   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 886   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 894   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 905   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 911   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 918   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 924   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 929   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 930   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 936   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 943   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 944   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 956   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 959   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 960   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 961   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 973   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 987   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 992   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 996   0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 1020  0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 1023  0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 1031  0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 1037  0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
## 1038  0.000000e+00 0.000000e+00  0.000000000 1.000000e+00 1.00000000 -8.5015687
```

Building volcano plot for the visualization of the up and down regulated genes(DEseq worked better than Limma based on the distribution of data in volcano plot)

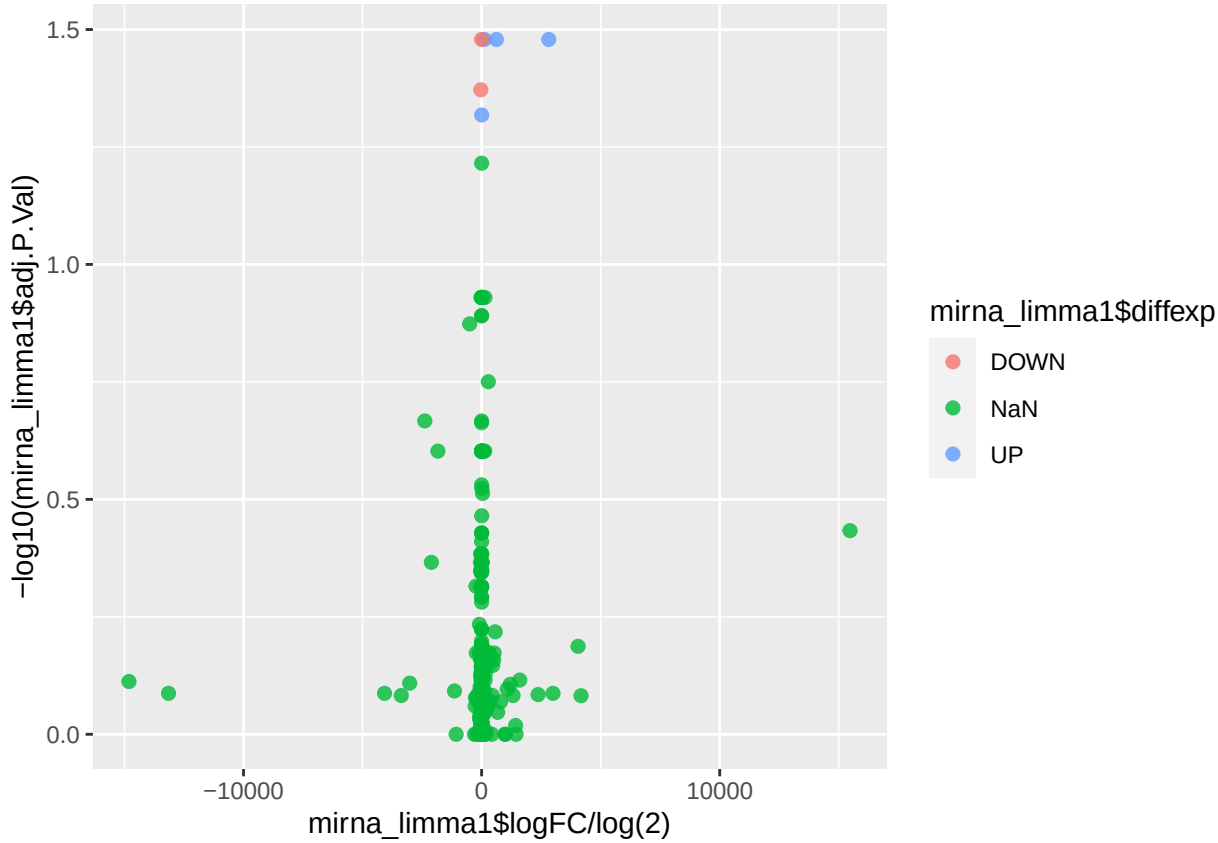
```
mirna_limma1 <- mirna_limma1[!is.na(mirna_limma1$adj.P.Val), ]


mirna_limma1$diffexp<-NaN
res_gen<-mirna_limma1$V1
#res_gen
mirna_limma1$names<-NaN
for(i in 1:nrow(mirna_limma1))
{
```

```
  if(mirna_limma1$adj.P.Val[i]<0.05 & mirna_limma1$logFC[i]/log(2) > 1)
  {
    mirna_limma1$diffexp[i]<-"UP"
    mirna_limma1$names[i]<-res_gen[i]
    print(mirna_limma1$names[i])
  }
  else if(mirna_limma1$adj.P.Val[i]<0.05 & mirna_limma1$logFC[i]/log(2) < -1)
  {
    mirna_limma1$diffexp[i]<-"DOWN"
    mirna_limma1$names[i]<-res_gen[i]
    print(mirna_limma1$names[i])
  }
}
```

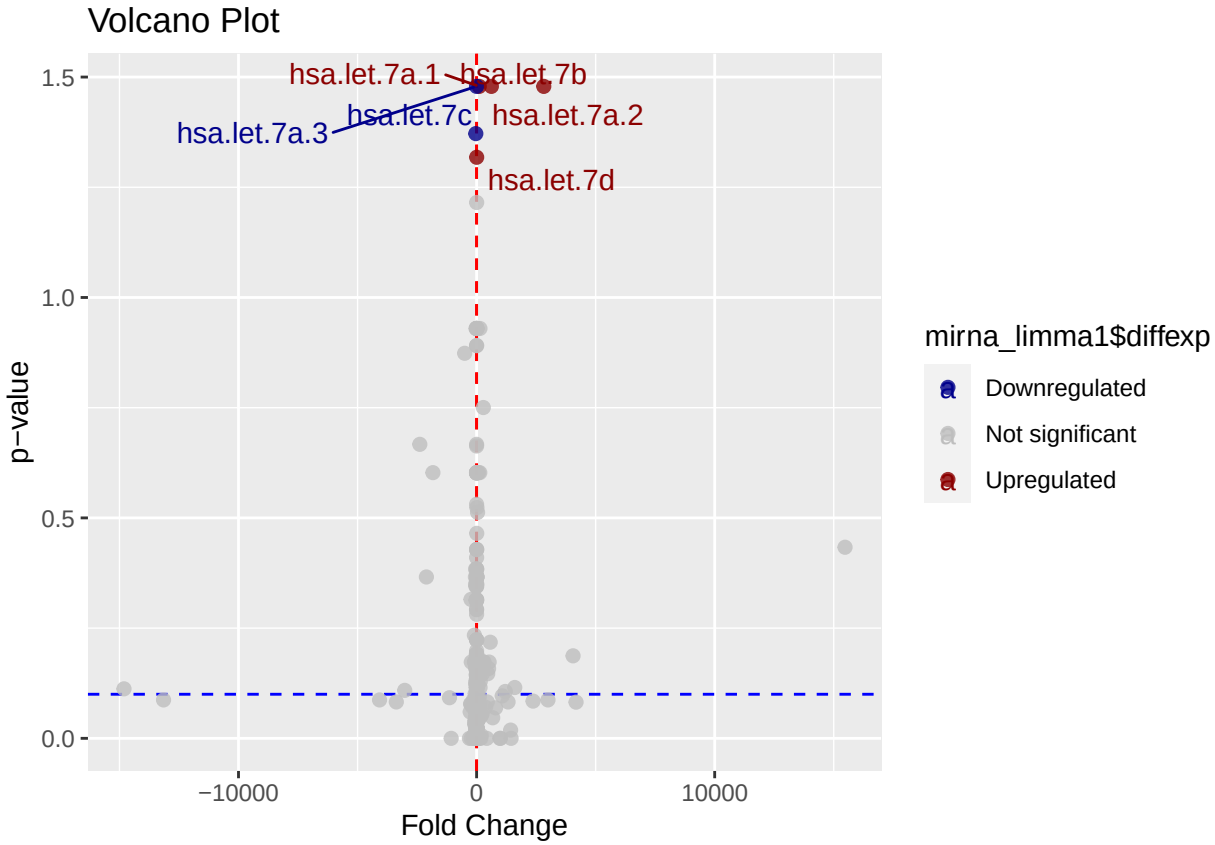
```
## [1] "hsa.let.7a.1"
## [1] "hsa.let.7a.2"
## [1] "hsa.let.7a.3"
## [1] "hsa.let.7b"
## [1] "hsa.let.7c"
## [1] "hsa.let.7d"
```

```
ggplot(data.frame(mirna_limma1$logFC/log(2),mirna_limma1$adj.P.Val),aes(x = mirna_limma1$logFC/log(2),y
  geom_point(alpha = 0.8, size = 2)
```



```
ggplot(data.frame(mirna_limma1$logFC/log(2),mirna_limma1$adj.P.Val),aes(x = mirna_limma1$logFC/log(2),y
  geom_vline(xintercept = c(-1,1),col = "red", linetype ='dashed')+
  geom_hline(yintercept = 0.1,col='blue',linetype='dashed')+
  geom_point(alpha = 0.8, size = 2)+
  scale_color_manual(values = c("darkblue", "grey", "darkred"),
                     labels = c("Downregulated", "Not significant", "Upregulated"))+
  labs(x = "Fold Change", y = "p-value", title = "Volcano Plot")+
  geom_text_repel(aes(label = ifelse(mirna_limma1$diffexp != "UP" & mirna_limma1$diffexp != "DOWN", "",m
```

```
## Warning in geom_text_repel(aes(label = ifelse(mirna_limma1$diffexp != "UP" & :
## Ignoring unknown aesthetics: max.overlaps
```



Conducting DEseq based differentially expressed analysis on the MRNA data

```
mrna_data2<-round(mrna_data1)
mrna_data2<-as.matrix(mrna_data2)
sur_mrn<-data.frame(PatientID=survival_mrna$PatientID,Death=survival_mrna$Death)
#row.names(sur_mir)<-survival_mirna$PatientID
mrna_deseq<-DESeqDataSetFromMatrix(countData = mrna_data2,colData = sur_mrn,design = ~ Death)
```

```
## converting counts to integer mode
```

```
##   the design formula contains one or more numeric variables with integer values,
##   specifying a model with increasing fold change for higher values.
```

```
##   did you mean for this to be a factor? if so, first convert
##   this variable to a factor using the factor() function
```

```
mrna_estimate<-estimateSizeFactors(mrna_deseq)
mrna_des<-DESeq(mrna_estimate)
```

```
## using pre-existing size factors

## estimating dispersions

## gene-wise dispersion estimates

## mean-dispersion relationship

## final dispersion estimates

## fitting model and testing

## -- replacing outliers and refitting for 3120 genes
## -- DESeq argument 'minReplicatesForReplace' = 7
## -- original counts are preserved in counts(dds)

## estimating dispersions

## fitting model and testing
```

```
mrna_result<-results(mrna_des)
mrna_result
```

```
## log2 fold change (MLE): Death
## Wald test p-value: Death
## DataFrame with 20531 rows and 6 columns
##          baseMean log2FoldChange     lfcSE      stat     pvalue      padj
##         <numeric>      <numeric> <numeric> <numeric>  <numeric> <numeric>
## 1         0.059655      0.0363372 1.0062077  0.036113 0.97119226        NA
## 2         4.306723     -0.3354919 0.1574811 -2.130363 0.03314167 0.2334080
## 3         4.481233     -0.2605446 0.1304435 -1.997375 0.04578445 0.2731878
## 4        93.771058      0.1646386 0.0561130  2.934056 0.00334564 0.0649924
## 5      1163.673365      0.1154445 0.0479113  2.409544 0.01597246 0.1598258
## ...            ...            ...       ...       ...        ...       ...
## 20527  3742.98363      0.0630377 0.0774010  0.814431 0.41539814 0.7552017
## 20528   686.58844     -0.1404530 0.0601110 -2.336562 0.01946198 0.1786036
## 20529   562.86270      0.0709398 0.0509726  1.391723 0.16400618 0.5114769
## 20530     6.91842      0.4883490 0.1653800  2.952890 0.00314814 0.0626061
## 20531    95.91193     -0.1537932 0.1894066 -0.811973 0.41680688 0.7563504
```

```
mrna_result_filter <- mrna_result[which(mrna_result$padj < 0.05 & abs(mrna_result$log2FoldChange) > 1),
mrna_result_filter
```

```
## log2 fold change (MLE): Death
## Wald test p-value: Death
## DataFrame with 181 rows and 6 columns
##      baseMean log2FoldChange     lfcSE      stat      pvalue        padj
##     <numeric>      <numeric> <numeric> <numeric>   <numeric>   <numeric>
## 1    10.00285        1.24614  0.360186   3.45972 5.40730e-04 0.020619564
## 2   105.15280        1.07372  0.266186   4.03371 5.49039e-05 0.004524078
## 3   164.50590       -1.12469  0.269804  -4.16853 3.06573e-05 0.002919681
## 4     1.36286        1.22476  0.246296   4.97271 6.60221e-07 0.000174499
## 5     2.52251       -1.11108  0.299825  -3.70575 2.10764e-04 0.011347717
## ...       ...            ...       ...       ...         ...         ...
## 177   8.41103        1.00461  0.243251   4.12992 3.62892e-05  0.00330230
## 178   6.32900        1.01533  0.225748   4.49761 6.87217e-06  0.00105033
## 179  53.06356        1.06091  0.287457   3.69067 2.23665e-04  0.01177474
## 180  24.59882       -1.10756  0.290712  -3.80982 1.39070e-04  0.00861621
## 181  19.90095        1.37406  0.329100   4.17521 2.97706e-05  0.00287864
```

```
mrna_data3<-data.frame(V1=mrna_data$V1,mrna_data1,mrna_result)
mrna_data4<-mrna_data3[which(mrna_data3$padj < 0.05 & abs(mrna_data3$log2FoldChange) > 1), ]
write.csv(mrna_data4,file = "Differ_mrna_padj0.05_log2fold1.csv")
```

Building volcano plot for the visualization of the up and down regulated mrna

```
mrna_data3 <- mrna_data3[!is.na(mrna_data3$padj), ]


mrna_data3$diffexp<-NaN
res_gen<-mrna_data3$V1
#res_gen
mrna_data3$names<-NaN
for(i in 1:nrow(mrna_data3))
{
  if(mrna_data3$padj[i]<0.05 & mrna_data3$log2FoldChange[i] > 1)
  {
    mrna_data3$diffexp[i]<-"UP"
    mrna_data3$names[i]<-res_gen[i]
    print(mrna_data3$names[i])
  }
  else if(mrna_data3$padj[i]<0.05 & mrna_data3$log2FoldChange[i] < -1)
  {
    mrna_data3$diffexp[i]<-"DOWN"
    mrna_data3$names[i]<-res_gen[i]
    print(mrna_data3$names[i])
  }
}
```

```
## [1] "ABCB5.340273"
## [1] "ABP1.26"
## [1] "ACTN2.88"
## [1] "ACTN3.89"
## [1] "ADIG.149685"
## [1] "ALDH3B2.222"
## [1] "ALOX15B.247"
```

```
## [1] "AMHR2.269"
## [1] "ANO2.57101"
## [1] "APOL5.80831"
## [1] "AQP6.363"
## [1] "ARHGAP36.158763"
## [1] "ARHGDIG.398"
## [1] "ART3.419"
## [1] "ART5.116969"
## [1] "BMPER.168667"
## [1] "C12orf36.283422"
## [1] "C14orf180.400258"
## [1] "C1QTNF3.114899"
## [1] "C1orf111.284680"
## [1] "C20orf114.92747"
## [1] "C21orf62.56245"
## [1] "C4orf7.260436"
## [1] "CACNA1I.8911"
## [1] "CALB1.793"
## [1] "CALCA.796"
## [1] "CAPN6.827"
## [1] "CBLN4.140689"
## [1] "CCBE1.147372"
## [1] "CCL23.6368"
## [1] "CDC20B.166979"
## [1] "CDK5R2.8941"
## [1] "CEACAM5.1048"
## [1] "CHGB.1114"
## [1] "CHIA.27159"
## [1] "CHL1.10752"
## [1] "CHODL.140578"
## [1] "CLEC4GP1.440508"
## [1] "CLEC4G.339390"
## [1] "CLEC4M.10332"
## [1] "CLSTN2.64084"
## [1] "COL22A1.169044"
## [1] "CPA1.1357"
## [1] "CPNE6.9362"
## [1] "CRHBP.1393"
## [1] "CSDC2.27254"
## [1] "CSF3.1440"
## [1] "CXCL14.9547"
## [1] "CXCL5.6374"
## [1] "CYP19A1.1588"
## [1] "CYP1A1.1543"
## [1] "CYP26A1.1592"
## [1] "CYP26B1.56603"
## [1] "DAPL1.92196"
## [1] "DIO2.1734"
## [1] "DLK1.8788"
## [1] "DPF1.8193"
## [1] "DRD1.1812"
## [1] "DUSP13.51207"
## [1] "DYNC1I1.1780"
## [1] "EPHA8.2046"
```

```
## [1] "EPO.2056"
## [1] "ESRP1.54845"
## [1] "FCGR2B.2213"
## [1] "FCGR2C.9103"
## [1] "FCN2.2220"
## [1] "FCN3.8547"
## [1] "FIGF.2277"
## [1] "FREM1.158326"
## [1] "FRMD1.79981"
## [1] "GAGE4.2576"
## [1] "GDNF.2668"
## [1] "GLP2R.9340"
## [1] "GPR110.266977"
## [1] "GPR123.84435"
## [1] "GRIN3B.116444"
## [1] "GRM8.2918"
## [1] "GSC.145258"
## [1] "GUCA2A.2980"
## [1] "HAMP.57817"
## [1] "HAVCR1.26762"
## [1] "HOXA11.3207"
## [1] "HOXC6.3223"
## [1] "HOXC8.3224"
## [1] "HRASLS.57110"
## [1] "HSPB3.8988"
## [1] "IGFN1.91156"
## [1] "IL13RA2.3598"
## [1] "IL1RL1.9173"
## [1] "INSM1.3642"
## [1] "IRX2.153572"
## [1] "KBTBD12.166348"
## [1] "KCNJ16.3773"
## [1] "KCNJ9.3765"
## [1] "KLK3.354"
## [1] "KRT1.3848"
## [1] "KRT4.3851"
## [1] "KRT5.3852"
## [1] "KRT85.3891"
## [1] "KRTAP1.1.81851"
## [1] "LEP.3952"
## [1] "LHB.3972"
## [1] "LOC100131726.100131726"
## [1] "LOC389332.389332"
## [1] "LOC642597.642597"
## [1] "LRFN5.145581"
## [1] "LUZP2.338645"
## [1] "MACC1.346389"
## [1] "MAG.4099"
## [1] "MARCO.8685"
## [1] "MGAT4C.25834"
## [1] "MSC.9242"
## [1] "MT1B.4490"
## [1] "MYCN.4613"
## [1] "MYH1.4619"
```

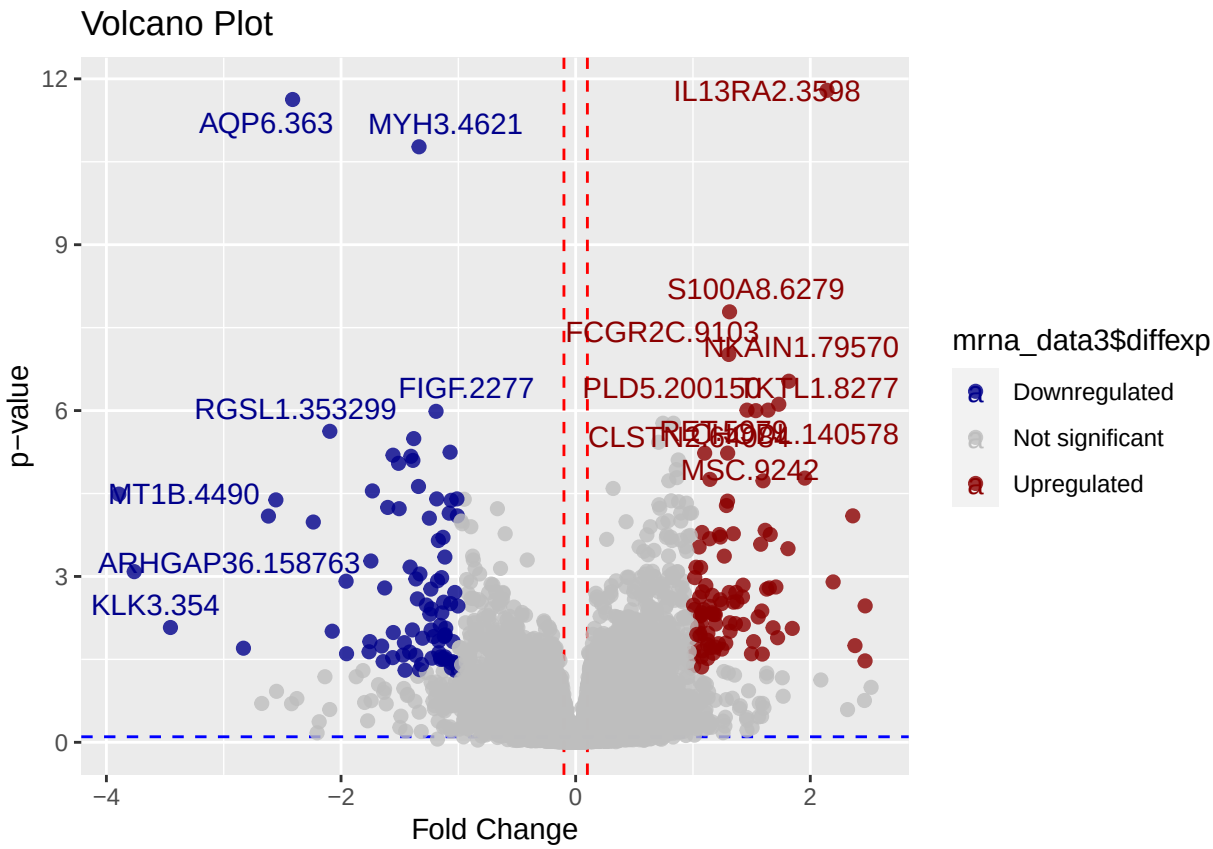
```
## [1] "MYH3.4621"
## [1] "MYH4.4622"
## [1] "MYT1L.23040"
## [1] "NCRNA00162.378825"
## [1] "NEFM.4741"
## [1] "NKAIN1.79570"
## [1] "NKX2.5.1482"
## [1] "NROB1.190"
## [1] "OCA2.4948"
## [1] "ODAM.54959"
## [1] "OPN4.94233"
## [1] "P2RY4.5030"
## [1] "PAEP.5047"
## [1] "PAGE4.9506"
## [1] "PCDHGB2.56103"
## [1] "PCSK1.5122"
## [1] "PGC.5225"
## [1] "PLA2G4F.255189"
## [1] "PLD5.200150"
## [1] "POU2F3.25833"
## [1] "PRAMEF1.65121"
## [1] "PRAMEF9.343070"
## [1] "PROK1.84432"
## [1] "PRSS21.10942"
## [1] "PVALB.5816"
## [1] "PZP.5858"
## [1] "RAB25.57111"
## [1] "REG3A.5068"
## [1] "REG3G.130120"
## [1] "REN.5972"
## [1] "RET.5979"
## [1] "RGSL1.353299"
## [1] "RPS6KA6.27330"
## [1] "RSPO2.340419"
## [1] "RYR2.6262"
## [1] "S100A8.6279"
## [1] "SAGE1.55511"
## [1] "SCN2B.6327"
## [1] "SGCZ.137868"
## [1] "SLC16A11.162515"
## [1] "SLC1A7.6512"
## [1] "SLC6A19.340024"
## [1] "SLC9A3.6550"
## [1] "SLITRK2.84631"
## [1] "SMYD1.150572"
## [1] "SNORD15B.114599"
## [1] "SOX21.11166"
## [1] "SPARCL1.8404"
## [1] "SPINK5.11005"
## [1] "STAB2.55576"
## [1] "STAC2.342667"
## [1] "STMN4.81551"
## [1] "TBX4.9496"
## [1] "TEDDM1.127670"
```

```
## [1] "TERT.7015"
## [1] "TG.7038"
## [1] "TKTL1.8277"
## [1] "TMC4.147798"
## [1] "TREM1.54210"
## [1] "TRIM50.135892"
## [1] "TRIM54.57159"
## [1] "UPK1A.11045"
## [1] "VIPR2.7434"
## [1] "VTCN1.79679"
## [1] "ZNF385D.79750"
## [1] "ZPLD1.131368"
```

```
ggplot(data.frame(mrna_data3$log2FoldChange,mrna_data3$padj),aes(x = mrna_data3$log2FoldChange,y = -log
  geom_vline(xintercept = c(-0.1,0.1),col = "red", linetype ='dashed')+
  geom_hline(yintercept = 0.1,col='blue',linetype='dashed')+
  geom_point(alpha = 0.8, size = 2)+
  scale_color_manual(values = c("darkblue", "grey", "darkred"),
                     labels = c("Downregulated", "Not significant", "Upregulated"))+
  labs(x = "Fold Change", y = "p-value", title = "Volcano Plot")+
  geom_text_repel(aes(label = ifelse(mrna_data3$diffexp != "UP" & mrna_data3$diffexp != "DOWN", "",mrna
```

```
## Warning in geom_text_repel(aes(label = ifelse(mrna_data3$diffexp != "UP" & :
## Ignoring unknown aesthetics: max.overlaps
```

```
## Warning: ggrepel: 164 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



Reading methylation data and based on partitioning, conducting the analysis below first on the subset of first 3000 methylation cg probes. And after obtaining the desired analysis, moving on to the analysis of second partion, i.e. for 1000 to 4000 cg probes and then 2000 to 5000 cg probes. the selection of the partition is conducted manually by mentioning the subsetting while fetching the data.

```
methyl<-data.frame(fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/methy"))
```

```
## Warning in fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project
## pitch/liver/methy"): Detected 429 column names but the data has 430 columns
## (i.e. invalid file). Added 1 extra default column name for the first column
## which is guessed to be row names or an index. Use setnames() afterwards if this
## guess is not correct, or fix the file write command that created the file to
## create a valid file.
```

```
#the beta values are converted into m values as the analysis of methylation data require m values
mval<-log2(methyl[2:ncol(methyl)] / (1 - methyl[2:ncol(methyl)]))
methyl[2:ncol(methyl)]<-mval
#the subsetting of the data to conduct anaylsis subset wise
#after the analysis of first 3000, the analysis of 1000 to 4000 and 2000 to 5000 cg probes is conducted
methyl<-methyl[1:3000,]
sur<-data.frame(fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/survival"))

#In the survival data there are many NA present, removing the samples that have NA in Death column
sur$co=1
sur$co[is.na(sur$Death)| is.na(sur$Survival) | is.na(sur$PatientID)]<-0
sur<-sur[sur$co!=0,]
```

```
#the synatax of the names of the samples in the survival data and methylation data is made same

for(i in 2: length(colnames(methyl)))
{
  colnames(methyl)[i]<-gsub("\\.", "-", colnames(methyl)[i])
  #group$sample[i]<-gsub("\\.", "-", group$sample[i])
  #print(colnames(mirna)[i])
}
#The samples which are common in the datasets
all_common<-intersect(colnames(methyl),sur$PatientID)

#Dataframe made up of the common samples in all three datasets
methyl_com<-data.frame(methyl[,as.character(all_common)])
sur_com<-sur[sur$PatientID %in% all_common,]
sur_com<-sur_com[,1:3]
methyl_com=data.frame(CPGnames=methyl$V1,methyl_com)
row.names(methyl_com)=methyl_com$CPGnames
methyl_com=methyl_com[,-1]
for(i in 1:nrow(sur_com))
{
  if(sur_com$Death[i]==1)
  {
    sur_com$Group[i]='Dead'
  }
  else if(sur_com$Death[i]==0)
  {
    sur_com$Group[i]='Alive'
  }
}
```

Now we have common elements in all the three datasets

```
cpgnames<-methyl[,1]
#cpgnames
probe<-data.frame(fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/GPL8490-65.txt"))
#intersect(methyl$V1,probe$ID)
```

loading champ library for the methylation analysis using champ

```
'if (!requireNamespace("BiocManager", quietly = TRUE))
    install.packages("BiocManager")
BiocManager::install("ChAMP")'
```

```
## [1] "if (!requireNamespace(\"BiocManager\", quietly = TRUE))\n    install.packages(\"BiocManager\")\n
```

```
library(ChAMP)
```

```
## Loading required package: minfi
```

```
## Loading required package: Biostrings
```

```
## Loading required package: XVector

##
## Attaching package: 'XVector'

## The following object is masked from 'package:purrr':
##
##     compact

##
## Attaching package: 'Biostrings'

## The following object is masked from 'package:base':
##
##     strsplit

## Loading required package: bumphunter

## Loading required package: foreach

## Warning: package 'foreach' was built under R version 4.3.1

##
## Attaching package: 'foreach'

## The following objects are masked from 'package:purrr':
##
##     accumulate, when

## Loading required package: iterators

## Warning: package 'iterators' was built under R version 4.3.1

## Loading required package: parallel

## Loading required package: locfit

## locfit 1.5-9.8    2023-06-11

##
## Attaching package: 'locfit'

## The following object is masked from 'package:purrr':
##
##     none

## Setting options('download.file.method.GEOquery'='auto')

## Setting options('GEOquery.inmemory.gpl'=FALSE)
```

```
## Loading required package: ChAMPdata

## Loading required package: DMRcate

##

## Loading required package: Illumina450ProbeVariants.db

## Loading required package: IlluminaHumanMethylationEPICmanifest

## Loading required package: DT

## Warning: package 'DT' was built under R version 4.3.1

## Loading required package: RPMM

## Warning: package 'RPMM' was built under R version 4.3.1

## Loading required package: cluster

## No methods found in package 'RSQLite' for request: 'dbListFields' when loading 'lumi'

## Warning: replacing previous import 'plyr::mutate' by 'plotly::mutate' when
## loading 'ChAMP'

## Warning: replacing previous import 'plyr::rename' by 'plotly::rename' when
## loading 'ChAMP'

## Warning: replacing previous import 'plyr::arrange' by 'plotly::arrange' when
## loading 'ChAMP'

## Warning: replacing previous import 'plyr::summarise' by 'plotly::summarise'
## when loading 'ChAMP'

##

## Warning: replacing previous import 'plotly::subplot' by 'Hmisc::subplot' when
## loading 'ChAMP'

## Warning: replacing previous import 'plyr::summarize' by 'Hmisc::summarize' when
## loading 'ChAMP'

## Warning: replacing previous import 'plyr::is.discrete' by 'Hmisc::is.discrete'
## when loading 'ChAMP'

## Warning: replacing previous import 'GenomicRanges::sort' by 'globaltest::sort'
## when loading 'ChAMP'
```

```
## Warning: replacing previous import 'plotly::last_plot' by 'ggplot2::last_plot'
## when loading 'ChAMP'

## Warning: replacing previous import 'globaltest::model.matrix' by
## 'stats::model.matrix' when loading 'ChAMP'

## Warning: replacing previous import 'globaltest::p.adjust' by 'stats::p.adjust'
## when loading 'ChAMP'

## >> Package version 2.21.1 loaded <<
##        ___ _      _   __  __ ___
##       / __| |_   /_\ |  \/  | _ \
##      | (__| ' \ / _ \| |\/| |  _/
##       \___|_||_/_/ \_\_|  |_|_|
##       ------------------------------
##     If you have any question or suggestion about ChAMP, please email to champ450k@gmail.com.
##     Thank you for citating ChAMP:
##
##     Yuan Tian, Tiffany J Morris, Amy P Webster, Zhen Yang, Stephan Beck, Andrew Feber, Andrew E Tesc
##      --------------------------
```

conducting champ analysis using m values

```
champ_result<-data.frame(champ.DMP(beta = methyl_com, pheno = sur_com$Group,adjPVal = 1))
```

```
## [==========================]

## [<<<<< ChAMP.DMP START >>>>>]

## ----------------------------

## !!! Important !!! New Modification has been made on champ.DMP():

##     (1): In this version champ.DMP() if your pheno parameter contains more than two groups of phenot

##     (2): champ.DMP() now support numeric as pheno, and will do linear regression on them. So covaria

## --------------------------------

##
## [ Section 1:  Check Input Pheno Start ]

##   You pheno is character type.

##     Your pheno information contains following groups. >>

##     <Dead>:166 samples.

##     <Alive>:257 samples.
```

```
##     [The power of statistics analysis on groups contain very few samples may not strong.]

##     pheno contains only 2 phenotypes

##     compare.group parameter is NULL, two pheno types will be added into Compare List.

##     Dead_to_Alive compare group : Dead, Alive

##
## [ Section 1:  Check Input Pheno Done ]

##
## [ Section 2:  Find Differential Methylated CpGs Start ]

##   ----------------------------

##   Start to Compare : Dead, Alive

##   Contrast Matrix

##         Contrasts
## Levels   pDead-pAlive
##   pAlive           -1
##   pDead             1

##   You have found 3000 significant MVPs with a BH adjusted P-value below 1.

##   Calculate DMP for Dead and Alive done.

##
## [ Section 2:  Find Numeric Vector Related CpGs Done ]

##
## [ Section 3:  Match Annotation Start ]

##
## [ Section 3:  Match Annotation Done ]

## [<<<<<< ChAMP.DMP END >>>>>>]

## [============================]

## [You may want to process DMP.GUI() or champ.GSEA() next.]
```

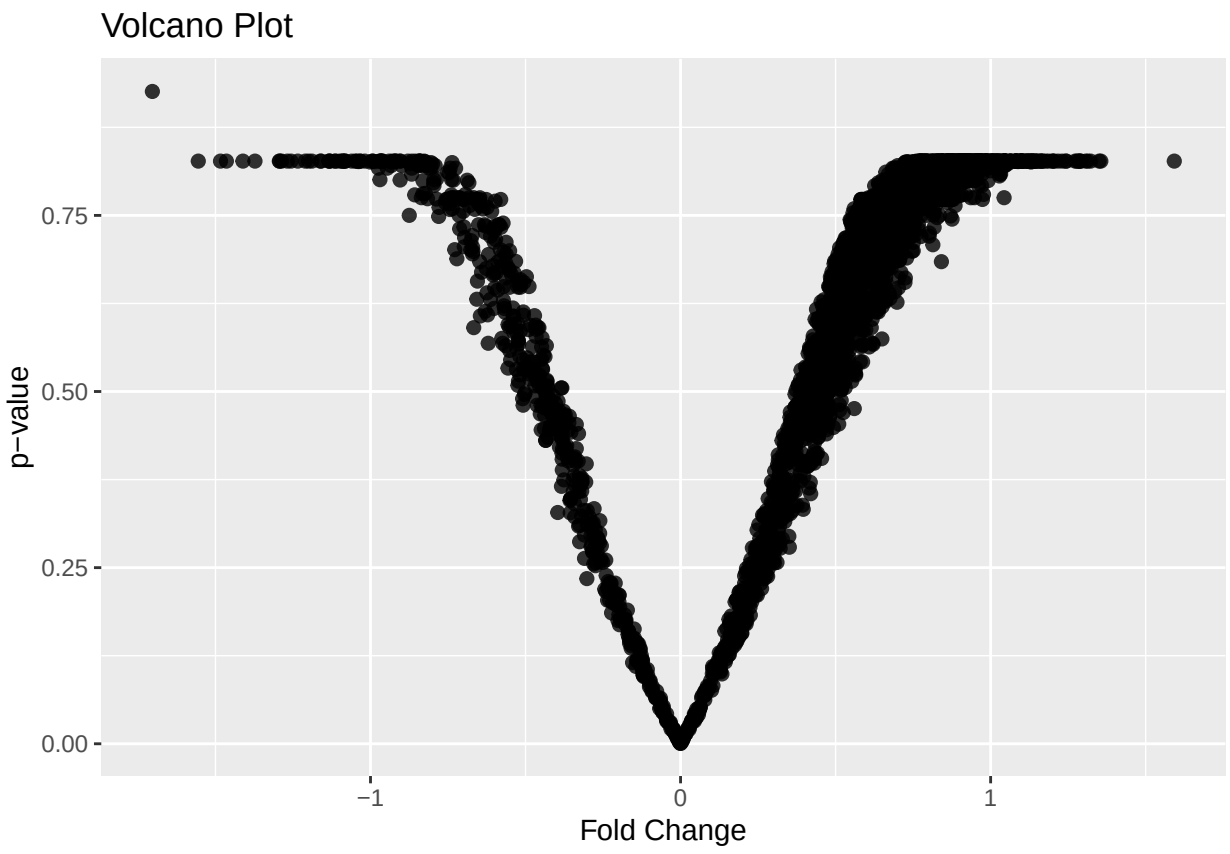
```
#champ_dataout<-result_table[which(result_table$adj.P.Val<0.1 & abs(result_table$l2fc) > 1), ]
#write.csv(champ_result,file = "champgenes.csv")
```

THE VOLCANO PLOT FOR CHAMP NOT SO GOOD

```
champ_result$l2fc<-champ_result$Dead_to_Alive.logFC/log(2)
'champ_result$diffexp<-NaN
for(i in 1:nrow(champ_result))
{
  if(champ_result$Dead_to_Alive.adj.P.Val[i]>0.1 & champ_result$l2fc[i] > 0.1)
  {
    champ_result$diffexp[i]<-"UP"
  }
  else if(champ_result$Dead_to_Alive.adj.P.Val[i]>0.1 & champ_result$l2fc[i] < -0.1)
  {
    champ_result$diffexp[i]<-"DOWN"
  }
}'
```

```
## [1] "champ_result$diffexp<-NaN\nfor(i in 1:nrow(champ_result))\n{\n  if(champ_result$Dead_to_Alive.a
```

```
ggplot(data.frame(champ_result$l2fc,champ_result$Dead_to_Alive.adj.P.Val),aes(x = champ_result$l2fc,y =
  #geom_vline(xintercept = c(-0.025,0.025),col = "red", linetype ='dashed')+
  #geom_hline(yintercept = 0.3,col='blue',linetype='dashed')+
  geom_point(alpha = 0.8, size = 2)+
  #scale_color_manual(values = c("#00AFBB", "grey", "#FFDB6D"),
                      #labels = c("Downregulated", "Not significant", "Upregulated"))+
  labs(x = "Fold Change", y = "p-value", title = "Volcano Plot")
```



```
#champ_methyl<-data.frame(methyl_com[as.character(row.names(champ_result)),])
#write.csv(champ_methyl,file = "Champ_methyl_padj0.194.csv")
```

conducting limma analysis for m values of the methylation data

```
'if (!require("BiocManager", quietly = TRUE))
    install.packages("BiocManager")

BiocManager::install("limma")'
```

```
## [1] "if (!require(\"BiocManager\", quietly = TRUE))\n    install.packages(\"BiocManager\")\n\nBiocMa
```

```
library(limma)
```

```
mirna_limma<-as.matrix(methyl_com)

design_matrix<-model.matrix(~ Group, data = sur_com)
normalized_data <- normalizeBetweenArrays(methyl_com, method = "quantile")
fit <- lmFit(normalized_data, design_matrix)
eb_fit <- eBayes(fit)
result_table <- topTable(eb_fit, number = 3000)
```

```
## Removing intercept from test coefficients
```

```
result_table$adj.P.Val <- p.adjust(result_table$P.Value, method = "BH")
#reslt_final_methy<-data.frame()
```

building the volcano plot to visualize the differentally expressed cg probes

```
result_table$l2fc<-result_table$logFC/log(2)
result_table$diffexp<-NaN
res_gen<-row.names(result_table)
result_table$names<-NaN
for(i in 1:nrow(result_table))
{
  if(result_table$adj.P.Val[i]<0.1 & result_table$l2fc[i] > 1)
  {
    result_table$diffexp[i]<-"UP"
    result_table$names[i]<-res_gen[i]
  }
  else if(result_table$adj.P.Val[i]<0.1 & result_table$l2fc[i] < -1)
  {
    result_table$diffexp[i]<-"DOWN"
    result_table$names[i]<-res_gen[i]
  }
}
```

```
ggplot(data.frame(result_table$l2fc,result_table$adj.P.Val),aes(x = result_table$l2fc,y = -log10(result
  geom_vline(xintercept = c(-1,1),col = "red", linetype ='dashed')+
  geom_hline(yintercept = 0.1,col='blue',linetype='dashed')+
```

```
  geom_point(alpha = 0.8, size = 2)+
  scale_color_manual(values = c("darkblue", "grey", "darkred"),
                     labels = c("Downregulated", "Not significant", "Upregulated"))+
  labs(x = "Fold Change", y = "p-value", title = "Volcano Plot")+
  geom_text_repel(aes(label = ifelse(result_table$diffexp != "UP" & result_table$diffexp != "DOWN", "",
```

```
## Warning in geom_text_repel(aes(label = ifelse(result_table$diffexp != "UP" & :
## Ignoring unknown aesthetics: max.overlaps
```

```
## Warning: ggrepel: 14 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```


```
#methyl_sort<-methyl[order(methyl$V1),]
#row_methyl_com <- order(row.names(methyl_com))
#row_methyl_com
# Sort the dataframe based on the row index
#methyl_com <- df[row_order, ]
result_table<-rownames_to_column(result_table,var="V1")


methdata_out<-data.frame(V1=methyl$V1,methyl_com)
meth_sort<-methdata_out[order(methdata_out$V1),]
result_table_sort<- result_table[order(result_table$V1),]
```

```
combine_meth<-data.frame(methdata_out,result_table_sort)
meth_dataout<-combine_meth[which(combine_meth$adj.P.Val<0.1 & abs(combine_meth$l2fc) > 1), ]
write.csv(meth_dataout,file = "meth143.csv")
```

```
'num<-which(result_table$adj.P.Val<0.1)
for(i in num)
{
  reslt_final_methy<-rbind(reslt_final_methy,result_table[i,])
}
result_methyl<-data.frame(methyl_com[as.character(row.names(reslt_final_methy)),])
write.csv(result_methyl,file = "limma_methylpadj0.1logfc0.05.csv")'
```

```
## [1] "num<-which(result_table$adj.P.Val<0.1)\nfor(i in num)\n{\n  reslt_final_methy<-rbind(reslt_final
```

```
diff_mir<-fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/Code/Final/Differ_mirna_padj
diff_mir<-diff_mir[,2:ncol(diff_mir)]
diff_mrn<-fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/Code/Final/Differ_mrna_padj0
diff_mrn<-diff_mrn[,2:ncol(diff_mrn)]
diff_meth1<-fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/Code/Final/Differ_meth_pad
diff_meth1<-diff_meth1[,2:ncol(diff_meth1)]
#diff_meth2<-fread("C:/Users/bless/OneDrive/MS_Studies/DS/Project pitch/liver/Code/limma_methylpadj0.1l
```

Fetching the similar samples in mirna, mrna and methylation data in reference to survival data

```
options(scipen = 999)

allcom1<-intersect(colnames(diff_mir),colnames(diff_mrn))
#allcom2<-intersect(colnames(diff_meth1),colnames(diff_meth2))
allcom3<-intersect(allcom1,colnames(diff_meth1))
#allcom3
for(i in 1: nrow(sur_com))
{
  sur_com$PatientID[i]<-gsub("\\-", ".", sur_com$PatientID[i])
  #group$sample[i]<-gsub("\\.", "-", group$sample[i])
  #print(colnames(mirna)[i])
}
allcom4<-data.frame(sample=intersect(allcom3,sur_com$PatientID))
#allcom4
diff_meth1_1<-subset(diff_meth1, select = allcom4$sample)
diff_meth1_1<-data.frame(V1=diff_meth1$V1,diff_meth1_1)
write.csv(diff_meth1_1,file = "Diff_methyl.csv")
#diff_meth2_1<-subset(diff_meth2,select = allcom4$sample)
#diff_meth2_1<-data.frame(V1=diff_meth2$V1,diff_meth2_1)
#write.csv(diff_meth2_1,file = "Diff_methyl_limma.csv")
sur_com_1<-sur_com[sur_com$PatientID %in% colnames(diff_meth1_1),]
sur_com_1<-sur_com_1[!duplicated(sur_com_1$PatientID), ]
write.csv(sur_com_1,file = "survival_common1.csv")
diff_mir_1<-subset(diff_mir, select = allcom4$sample)
diff_mir_1<-data.frame(V1=diff_mir$V1,diff_mir_1)
write.csv(diff_mir_1,file = "Diff_mirna.csv")
diff_mrn_1<-subset(diff_mrn, select = allcom4$sample)
diff_mrn_1<-data.frame(V1=diff_mrn$V1,diff_mrn_1)
write.csv(diff_mrn_1,file = "Diff_mrna.csv")
```

```
#'arg' should be one of "none", "scale", "quantile", "Aquantile", "Gquantile", "Rquantile", "Tquantile"
#normalized_mir_data <- normalizeBetweenArrays(diff_mir_1, method = "quantile")
```

```
#intersect(diff_meth1_1$V1,row.names(reslt_final_methy))
```

```
'vv<-colnames(diff_meth1_1)
vv
for(i in 1:nrow(sur_com_1))
{
  for(j in 1:nrow(vv))
  {
    print(sur_com_1$PatientID[i])
  }
}
for(j in 1:nrow(vv))
{
  print(j)
}'
```

```
## [1] "vv<-colnames(diff_meth1_1)\nvv\nfor(i in 1:nrow(sur_com_1))\n{\n  for(j in 1:nrow(vv))\n  {\n
```

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

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