BCB546 - R Assignment

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Part I

Data Inspection

Attributes of fang_et_al_genotypes.txt

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.0.4
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.0 --
```

```
## v ggplot2 3.3.2     v purrr   0.3.4
## v tibble  3.0.4     v dplyr   1.0.4
## v tidyr   1.1.2     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1
```

```
## Warning: package 'tidyr' was built under R version 4.0.4
```

```
## Warning: package 'readr' was built under R version 4.0.4
```

```
## Warning: package 'purrr' was built under R version 4.0.4
```

```
## Warning: package 'dplyr' was built under R version 4.0.4
```

```
## Warning: package 'stringr' was built under R version 4.0.4
```

```
## Warning: package 'forcats' was built under R version 4.0.4
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(tidyr)
```

To load the fang_et_al_genotypes.txt data file into R

```
fang_data = read_tsv("fang_et_al_genotypes.txt")
```

```
##
## -- Column specification --------------------------------------------------------
## cols(
##   .default = col_character()
## )
## i Use `spec()` for the full column specifications.
```

To get the file size

```
file.size("fang_et_al_genotypes.txt")
```

```
## [1] 11051939
```

To get all the file info

```
file.info("fang_et_al_genotypes.txt", extra_cols = TRUE)
```

```
##                               size isdir mode               mtime
## fang_et_al_genotypes.txt 11051939 FALSE  666 2021-03-10 17:55:08
##                                      ctime               atime exe
## fang_et_al_genotypes.txt 2021-03-18 18:13:47 2021-03-24 23:30:19  no
```

To compactly display the internal structure of the R object

```
str(fang_data)
```

```
## tibble [2,782 x 986] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ Sample_ID     : chr [1:2782] "SL-15" "SL-16" "SL-11" "SL-12" ...
##  $ JG_OTU        : chr [1:2782] "T-aust-1" "T-aust-2" "T-brav-1" "T-brav-2" ...
##  $ Group         : chr [1:2782] "TRIPS" "TRIPS" "TRIPS" "TRIPS" ...
##  $ abph1.20      : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ abph1.22      : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ ae1.3         : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ ae1.4         : chr [1:2782] "G/G" "?/?" "G/G" "G/G" ...
##  $ ae1.5         : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ an1.4         : chr [1:2782] "C/C" "C/C" "?/?" "C/C" ...
##  $ ba1.6         : chr [1:2782] "?/?" "A/G" "G/G" "G/G" ...
##  $ ba1.9         : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ bt2.5         : chr [1:2782] "?/?" "?/?" "C/C" "C/C" ...
##  $ bt2.7         : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ bt2.8         : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ Fea2.1        : chr [1:2782] "C/C" "C/C" "?/?" "?/?" ...
##  $ Fea2.5        : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ id1.3         : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ lg2.11        : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ lg2.2         : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ pbf1.1        : chr [1:2782] "?/?" "T/T" "T/T" "T/T" ...
##  $ pbf1.2        : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ pbf1.3        : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ pbf1.5        : chr [1:2782] "?/?" "?/?" "A/A" "A/A" ...
##  $ pbf1.6        : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ pbf1.7        : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ pbf1.8        : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00003.11   : chr [1:2782] "?/?" "?/?" "C/C" "?/?" ...
##  $ PZA00004.2    : chr [1:2782] "T/T" "T/T" "?/?" "T/T" ...
##  $ PZA00005.8    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00005.9    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00006.13   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00006.14   : chr [1:2782] "?/?" "G/G" "G/G" "G/G" ...
##  $ PZA00008.1    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00010.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00013.10   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00013.11   : chr [1:2782] "C/C" "C/C" "C/T" "C/T" ...
##  $ PZA00013.9    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00015.4    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00017.1    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00018.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
```

```
##  $ PZA00029.11   : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00029.12   : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00030.11   : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00031.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00041.3    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00042.2    : chr [1:2782] "?/?" "T/T" "?/?" "?/?" ...
##  $ PZA00042.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00043.7    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00045.1    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00047.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00049.12   : chr [1:2782] "?/?" "?/?" "T/T" "T/T" ...
##  $ PZA00050.9    : chr [1:2782] "A/A" "A/A" "?/?" "?/?" ...
##  $ PZA00051.2    : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00058.5    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00058.6    : chr [1:2782] "T/T" "?/?" "T/T" "T/T" ...
##  $ PZA00060.2    : chr [1:2782] "?/?" "?/?" "C/C" "C/C" ...
##  $ PZA00061.1    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00065.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00069.4    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00070.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00078.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00079.1    : chr [1:2782] "C/C" "?/?" "C/C" "C/C" ...
##  $ PZA00081.17   : chr [1:2782] "?/?" "T/T" "T/T" "T/T" ...
##  $ PZA00084.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00084.3    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00086.8    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00088.3    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00090.2    : chr [1:2782] "A/A" "A/A" "?/?" "?/?" ...
##  $ PZA00092.1    : chr [1:2782] "?/?" "?/?" "T/T" "?/?" ...
##  $ PZA00092.5    : chr [1:2782] "?/?" "C/C" "C/C" "?/?" ...
##  $ PZA00093.2    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00096.26   : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00097.13   : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00098.14   : chr [1:2782] "?/?" "?/?" "C/C" "?/?" ...
##  $ PZA00100.10   : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00100.12   : chr [1:2782] "T/T" "?/?" "T/T" "T/T" ...
##  $ PZA00100.14   : chr [1:2782] "?/?" "A/A" "A/A" "A/A" ...
##  $ PZA00100.9    : chr [1:2782] "C/C" "C/C" "C/C" "?/?" ...
##  $ PZA00103.20   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00106.9    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00107.18   : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00108.12   : chr [1:2782] "?/?" "C/C" "C/C" "C/C" ...
##  $ PZA00108.14   : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00108.15   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00109.3    : chr [1:2782] "A/A" "A/A" "?/?" "?/?" ...
##  $ PZA00109.5    : chr [1:2782] "A/A" "?/?" "A/A" "?/?" ...
##  $ PZA00111.2    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00111.4    : chr [1:2782] "C/C" "?/?" "C/C" "C/C" ...
##  $ PZA00111.5    : chr [1:2782] "?/?" "?/?" "A/A" "A/A" ...
##  $ PZA00111.6    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00111.8    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00114.3    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00116.2    : chr [1:2782] "C/T" "C/T" "C/T" "C/T" ...
##  $ PZA00119.4    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
```

```
##  $ PZA00120.4    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00123.1    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00125.2    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00131.14   : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00132.17   : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##   [list output truncated]
##  - attr(*, "spec")=
##   .. cols(
##   ..   Sample_ID = col_character(),
##   ..   JG_OTU = col_character(),
##   ..   Group = col_character(),
##   ..   abph1.20 = col_character(),
##   ..   abph1.22 = col_character(),
##   ..   ae1.3 = col_character(),
##   ..   ae1.4 = col_character(),
##   ..   ae1.5 = col_character(),
##   ..   an1.4 = col_character(),
##   ..   ba1.6 = col_character(),
##   ..   ba1.9 = col_character(),
##   ..   bt2.5 = col_character(),
##   ..   bt2.7 = col_character(),
##   ..   bt2.8 = col_character(),
##   ..   Fea2.1 = col_character(),
##   ..   Fea2.5 = col_character(),
##   ..   id1.3 = col_character(),
##   ..   lg2.11 = col_character(),
##   ..   lg2.2 = col_character(),
##   ..   pbf1.1 = col_character(),
##   ..   pbf1.2 = col_character(),
##   ..   pbf1.3 = col_character(),
##   ..   pbf1.5 = col_character(),
##   ..   pbf1.6 = col_character(),
##   ..   pbf1.7 = col_character(),
##   ..   pbf1.8 = col_character(),
##   ..   PZA00003.11 = col_character(),
##   ..   PZA00004.2 = col_character(),
##   ..   PZA00005.8 = col_character(),
##   ..   PZA00005.9 = col_character(),
##   ..   PZA00006.13 = col_character(),
##   ..   PZA00006.14 = col_character(),
##   ..   PZA00008.1 = col_character(),
##   ..   PZA00010.5 = col_character(),
##   ..   PZA00013.10 = col_character(),
##   ..   PZA00013.11 = col_character(),
##   ..   PZA00013.9 = col_character(),
##   ..   PZA00015.4 = col_character(),
##   ..   PZA00017.1 = col_character(),
##   ..   PZA00018.5 = col_character(),
##   ..   PZA00029.11 = col_character(),
##   ..   PZA00029.12 = col_character(),
##   ..   PZA00030.11 = col_character(),
##   ..   PZA00031.5 = col_character(),
##   ..   PZA00041.3 = col_character(),
##   ..   PZA00042.2 = col_character(),
```

```
##   ..   PZA00042.5 = col_character(),
##   ..   PZA00043.7 = col_character(),
##   ..   PZA00045.1 = col_character(),
##   ..   PZA00047.2 = col_character(),
##   ..   PZA00049.12 = col_character(),
##   ..   PZA00050.9 = col_character(),
##   ..   PZA00051.2 = col_character(),
##   ..   PZA00058.5 = col_character(),
##   ..   PZA00058.6 = col_character(),
##   ..   PZA00060.2 = col_character(),
##   ..   PZA00061.1 = col_character(),
##   ..   PZA00065.2 = col_character(),
##   ..   PZA00069.4 = col_character(),
##   ..   PZA00070.5 = col_character(),
##   ..   PZA00078.2 = col_character(),
##   ..   PZA00079.1 = col_character(),
##   ..   PZA00081.17 = col_character(),
##   ..   PZA00084.2 = col_character(),
##   ..   PZA00084.3 = col_character(),
##   ..   PZA00086.8 = col_character(),
##   ..   PZA00088.3 = col_character(),
##   ..   PZA00090.2 = col_character(),
##   ..   PZA00092.1 = col_character(),
##   ..   PZA00092.5 = col_character(),
##   ..   PZA00093.2 = col_character(),
##   ..   PZA00096.26 = col_character(),
##   ..   PZA00097.13 = col_character(),
##   ..   PZA00098.14 = col_character(),
##   ..   PZA00100.10 = col_character(),
##   ..   PZA00100.12 = col_character(),
##   ..   PZA00100.14 = col_character(),
##   ..   PZA00100.9 = col_character(),
##   ..   PZA00103.20 = col_character(),
##   ..   PZA00106.9 = col_character(),
##   ..   PZA00107.18 = col_character(),
##   ..   PZA00108.12 = col_character(),
##   ..   PZA00108.14 = col_character(),
##   ..   PZA00108.15 = col_character(),
##   ..   PZA00109.3 = col_character(),
##   ..   PZA00109.5 = col_character(),
##   ..   PZA00111.2 = col_character(),
##   ..   PZA00111.4 = col_character(),
##   ..   PZA00111.5 = col_character(),
##   ..   PZA00111.6 = col_character(),
##   ..   PZA00111.8 = col_character(),
##   ..   PZA00114.3 = col_character(),
##   ..   PZA00116.2 = col_character(),
##   ..   PZA00119.4 = col_character(),
##   ..   PZA00120.4 = col_character(),
##   ..   PZA00123.1 = col_character(),
##   ..   PZA00125.2 = col_character(),
##   ..   PZA00131.14 = col_character(),
##   ..   PZA00132.17 = col_character(),
##   ..   PZA00132.18 = col_character(),
```

```
##   ..   PZA00132.3 = col_character(),
##   ..   PZA00135.6 = col_character(),
##   ..   PZA00137.2 = col_character(),
##   ..   PZA00139.14 = col_character(),
##   ..   PZA00140.10 = col_character(),
##   ..   PZA00140.6 = col_character(),
##   ..   PZA00140.9 = col_character(),
##   ..   PZA00142.6 = col_character(),
##   ..   PZA00148.2 = col_character(),
##   ..   PZA00153.3 = col_character(),
##   ..   PZA00153.6 = col_character(),
##   ..   PZA00163.4 = col_character(),
##   ..   PZA00164.1 = col_character(),
##   ..   PZA00164.2 = col_character(),
##   ..   PZA00164.3 = col_character(),
##   ..   PZA00166.1 = col_character(),
##   ..   PZA00166.3 = col_character(),
##   ..   PZA00170.1 = col_character(),
##   ..   PZA00170.3 = col_character(),
##   ..   PZA00170.4 = col_character(),
##   ..   PZA00174.1 = col_character(),
##   ..   PZA00174.2 = col_character(),
##   ..   PZA00175.2 = col_character(),
##   ..   PZA00176.8 = col_character(),
##   ..   PZA00177.4 = col_character(),
##   ..   PZA00178.3 = col_character(),
##   ..   PZA00182.3 = col_character(),
##   ..   PZA00182.4 = col_character(),
##   ..   PZA00184.1 = col_character(),
##   ..   PZA00184.4 = col_character(),
##   ..   PZA00188.1 = col_character(),
##   ..   PZA00188.3 = col_character(),
##   ..   PZA00191.5 = col_character(),
##   ..   PZA00192.6 = col_character(),
##   ..   PZA00192.7 = col_character(),
##   ..   PZA00193.2 = col_character(),
##   ..   PZA00198.39 = col_character(),
##   ..   PZA00200.11 = col_character(),
##   ..   PZA00200.17 = col_character(),
##   ..   PZA00200.9 = col_character(),
##   ..   PZA00201.2 = col_character(),
##   ..   PZA00204.1 = col_character(),
##   ..   PZA00210.1 = col_character(),
##   ..   PZA00210.6 = col_character(),
##   ..   PZA00211.7 = col_character(),
##   ..   PZA00212.1 = col_character(),
##   ..   PZA00213.19 = col_character(),
##   ..   PZA00214.1 = col_character(),
##   ..   PZA00216.9 = col_character(),
##   ..   PZA00218.1 = col_character(),
##   ..   PZA00218.6 = col_character(),
##   ..   PZA00219.7 = col_character(),
##   ..   PZA00220.11 = col_character(),
##   ..   PZA00220.12 = col_character(),
```

```
##   ..   PZA00221.7 = col_character(),
##   ..   PZA00225.8 = col_character(),
##   ..   PZA00226.7 = col_character(),
##   ..   PZA00227.8 = col_character(),
##   ..   PZA00230.5 = col_character(),
##   ..   PZA00232.24 = col_character(),
##   ..   PZA00234.21 = col_character(),
##   ..   PZA00235.6 = col_character(),
##   ..   PZA00235.8 = col_character(),
##   ..   PZA00237.2 = col_character(),
##   ..   PZA00237.7 = col_character(),
##   ..   PZA00237.8 = col_character(),
##   ..   PZA00238.3 = col_character(),
##   ..   PZA00240.9 = col_character(),
##   ..   PZA00241.6 = col_character(),
##   ..   PZA00243.27 = col_character(),
##   ..   PZA00245.14 = col_character(),
##   ..   PZA00245.16 = col_character(),
##   ..   PZA00245.17 = col_character(),
##   ..   PZA00245.18 = col_character(),
##   ..   PZA00245.19 = col_character(),
##   ..   PZA00249.2 = col_character(),
##   ..   PZA00250.1 = col_character(),
##   ..   PZA00251.1 = col_character(),
##   ..   PZA00254.3 = col_character(),
##   ..   PZA00255.15 = col_character(),
##   ..   PZA00255.17 = col_character(),
##   ..   PZA00256.16 = col_character(),
##   ..   PZA00256.21 = col_character(),
##   ..   PZA00256.23 = col_character(),
##   ..   PZA00257.11 = col_character(),
##   ..   PZA00257.22 = col_character(),
##   ..   PZA00261.6 = col_character(),
##   ..   PZA00263.14 = col_character(),
##   ..   PZA00266.5 = col_character(),
##   ..   PZA00270.3 = col_character(),
##   ..   PZA00273.1 = col_character(),
##   ..   PZA00274.7 = col_character(),
##   ..   PZA00277.17 = col_character(),
##   ..   PZA00277.9 = col_character(),
##   ..   PZA00280.14 = col_character(),
##   ..   PZA00287.1 = col_character(),
##   ..   PZA00289.11 = col_character(),
##   ..   PZA00294.20 = col_character(),
##   ..   PZA00296.6 = col_character(),
##   ..   PZA00297.2 = col_character(),
##   ..   PZA00297.3 = col_character(),
##   ..   PZA00297.4 = col_character(),
##   ..   PZA00298.4 = col_character(),
##   ..   PZA00298.5 = col_character(),
##   ..   PZA00299.2 = col_character(),
##   ..   PZA00300.12 = col_character(),
##   ..   PZA00300.13 = col_character(),
##   ..   PZA00300.14 = col_character(),
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```
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##   ..   PZA00303.21 = col_character(),
##   ..   PZA00307.12 = col_character(),
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##   ..   PZA00307.17 = col_character(),
##   ..   PZA00309.2 = col_character(),
##   ..   PZA00310.5 = col_character(),
##   ..   PZA00314.6 = col_character(),
##   ..   PZA00314.8 = col_character(),
##   ..   PZA00315.1 = col_character(),
##   ..   PZA00315.6 = col_character(),
##   ..   PZA00318.2 = col_character(),
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##   ..   PZA00326.18 = col_character(),
##   ..   PZA00326.19 = col_character(),
##   ..   PZA00332.8 = col_character(),
##   ..   PZA00332.9 = col_character(),
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##   ..   PZA00346.3 = col_character(),
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##   ..   PZA00364.6 = col_character(),
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##   ..   PZA00370.5 = col_character(),
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##   ..   PZA00381.4 = col_character(),
##   ..   PZA00381.5 = col_character(),
##   ..   PZA00382.17 = col_character(),
##   ..   PZA00385.3 = col_character(),
##   ..   PZA00386.3 = col_character(),
##   ..   PZA00390.6 = col_character(),
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```
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##   ..   PZA00411.5 = col_character(),
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##   ..   PZA00413.21 = col_character(),
##   ..   PZA00417.2 = col_character(),
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##   ..   PZA00425.9 = col_character(),
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##   ..   PZA00442.6 = col_character(),
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##   ..   PZA00444.5 = col_character(),
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##   ..   PZA00459.5 = col_character(),
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##   ..   PZA00460.5 = col_character(),
##   ..   PZA00460.7 = col_character(),
##   ..   PZA00462.2 = col_character(),
##   ..   PZA00463.3 = col_character(),
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##   ..   PZA00486.2 = col_character(),
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##   ..   PZA00499.3 = col_character(),
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##   ..   PZA00503.5 = col_character(),
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##   ..   PZA00510.3 = col_character(),
##   ..   PZA00514.1 = col_character(),
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##   ..   PZA00514.7 = col_character(),
##   ..   PZA00515.14 = col_character(),
##   ..   PZA00516.3 = col_character(),
##   ..   PZA00517.6 = col_character(),
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##   ..   PZA00538.8 = col_character(),
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##   ..   PZA00547.18 = col_character(),
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##   ..   PZA00562.4 = col_character(),
##   ..   PZA00565.3 = col_character(),
##   ..   PZA00566.5 = col_character(),
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##   ..   PZA00578.1 = col_character(),
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##   ..   PZA00610.18 = col_character(),
##   ..   PZA00610.9 = col_character(),
##   ..   PZA00613.22 = col_character(),
##   ..   PZA00614.12 = col_character(),
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##   ..   PZA00626.3 = col_character(),
##   ..   PZA00626.4 = col_character(),
##   ..   PZA00630.9 = col_character(),
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##   ..   PZA00719.2 = col_character(),
##   ..   PZA00719.3 = col_character(),
##   ..   PZA00720.2 = col_character(),
##   ..   PZA00720.3 = col_character(),
##   ..   PZA00721.4 = col_character(),
##   ..   PZA00721.5 = col_character(),
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##   ..   PZA00726.6 = col_character(),
##   ..   PZA00726.7 = col_character(),
##   ..   PZA00726.9 = col_character(),
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##   ..   PZA00727.12 = col_character(),
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##   ..   PZA00729.19 = col_character(),
##   ..   PZA00730.2 = col_character(),
##   ..   PZA00731.6 = col_character(),
##   ..   PZA00731.7 = col_character(),
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##   ..   PZA01149.3 = col_character(),
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##   ..   PZA01420.3 = col_character(),
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##   ..   PZA01782.4 = col_character(),
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##   ..   PZA02820.6 = col_character(),
##   ..   PZA02822.2 = col_character(),
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##   ..   PZA02850.4 = col_character(),
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##   ..   PZA02865.11 = col_character(),
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##   ..   PZA02869.8 = col_character(),
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##   ..   PZA02962.13 = col_character(),
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##   ..   PZA02970.9 = col_character(),
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##   ..   PZA03062.7 = col_character(),
##   ..   PZA03063.17 = col_character(),
##   ..   PZA03063.18 = col_character(),
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##   ..   PZA03102.9 = col_character(),
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##   ..   PZA03283.2 = col_character(),
##   ..   PZA03284.3 = col_character(),
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##   ..   PZA03296.6 = col_character(),
##   ..   PZA03296.7 = col_character(),
##   ..   PZA03298.1 = col_character(),
##   ..   PZA03298.2 = col_character(),
##   ..   PZA03301.2 = col_character(),
##   ..   PZA03301.4 = col_character(),
##   ..   PZA03302.1 = col_character(),
##   ..   PZA03305.6 = col_character(),
##   ..   PZA03305.7 = col_character(),
##   ..   PZA03311.2 = col_character(),
##   ..   PZA03311.3 = col_character(),
##   ..   PZA03311.4 = col_character(),
##   ..   PZA03311.5 = col_character(),
##   ..   PZA03312.1 = col_character(),
##   ..   PZA03312.2 = col_character(),
```

```
##   ..   PZA03316.2 = col_character(),
##   ..   PZA03317.1 = col_character(),
##   ..   PZA03319.3 = col_character(),
##   ..   PZA03319.4 = col_character(),
##   ..   PZA03320.3 = col_character(),
##   ..   PZA03320.4 = col_character(),
##   ..   PZA03328.5 = col_character(),
##   ..   PZA03329.1 = col_character(),
##   ..   PZA03329.2 = col_character(),
##   ..   PZA03333.3 = col_character(),
##   ..   PZA03335.2 = col_character(),
##   ..   PZA03335.3 = col_character(),
##   ..   PZA03337.1 = col_character(),
##   ..   PZA03338.5 = col_character(),
##   ..   PZA03340.2 = col_character(),
##   ..   PZA03342.2 = col_character(),
##   ..   PZA03344.4 = col_character(),
##   ..   PZA03344.5 = col_character(),
##   ..   PZA03344.6 = col_character(),
##   ..   PZA03345.1 = col_character(),
##   ..   PZA03345.2 = col_character(),
##   ..   PZA03345.4 = col_character(),
##   ..   PZA03347.1 = col_character(),
##   ..   PZA03348.1 = col_character(),
##   ..   PZA03349.1 = col_character(),
##   ..   PZA03349.9 = col_character(),
##   ..   PZA03767.1 = col_character(),
##   ..   PZA03767.4 = col_character(),
##   ..   PZA03767.5 = col_character(),
##   ..   PZA03773.2 = col_character(),
##   ..   PZA03773.3 = col_character(),
##   ..   PZA03774.1 = col_character(),
##   ..   PZA03774.10 = col_character(),
##   ..   PZA03774.2 = col_character(),
##   ..   PZA03774.4 = col_character(),
##   ..   PZA03774.5 = col_character(),
##   ..   PZA03774.6 = col_character(),
##   ..   PZA03774.8 = col_character(),
##   ..   PZA03774.9 = col_character(),
##   ..   PZA03775.1 = col_character(),
##   ..   PZA03775.11 = col_character(),
##   ..   PZA03775.2 = col_character(),
##   ..   PZA03775.3 = col_character(),
##   ..   PZA03775.4 = col_character(),
##   ..   PZA03775.6 = col_character(),
##   ..   PZA03775.7 = col_character(),
##   ..   PZA03775.8 = col_character(),
##   ..   PZA03775.9 = col_character(),
##   ..   PZA03781.1 = col_character(),
##   ..   PZA03781.2 = col_character(),
##   ..   PZA03781.3 = col_character(),
##   ..   PZA03781.4 = col_character(),
##   ..   PZA03781.5 = col_character(),
##   ..   PZA03781.6 = col_character(),
```

```
##   ..   PZA03781.7 = col_character(),
##   ..   PZA03781.8 = col_character(),
##   ..   PZA03782.1 = col_character(),
##   ..   PZA03782.3 = col_character(),
##   ..   PZA03786.1 = col_character(),
##   ..   PZA03786.2 = col_character(),
##   ..   PZA03789.1 = col_character(),
##   ..   PZA03789.2 = col_character(),
##   ..   PZA03789.4 = col_character(),
##   ..   PZB00011.4 = col_character(),
##   ..   PZB00011.5 = col_character(),
##   ..   PZB00041.2 = col_character(),
##   ..   PZB00041.4 = col_character(),
##   ..   PZB00049.2 = col_character(),
##   ..   PZB00049.4 = col_character(),
##   ..   PZB00049.7 = col_character(),
##   ..   PZB00055.1 = col_character(),
##   ..   PZB00060.4 = col_character(),
##   ..   PZB00062.6 = col_character(),
##   ..   PZB00062.7 = col_character(),
##   ..   PZB00062.8 = col_character(),
##   ..   PZB00067.2 = col_character(),
##   ..   PZB00067.3 = col_character(),
##   ..   PZB00067.4 = col_character(),
##   ..   PZB00067.5 = col_character(),
##   ..   PZB00078.1 = col_character(),
##   ..   PZB00081.2 = col_character(),
##   ..   PZB00081.4 = col_character(),
##   ..   PZB00081.5 = col_character(),
##   ..   PZB00081.7 = col_character(),
##   ..   PZB00092.1 = col_character(),
##   ..   PZB00092.4 = col_character(),
##   ..   PZB00093.3 = col_character(),
##   ..   PZB00093.4 = col_character(),
##   ..   PZB00093.6 = col_character(),
##   ..   PZB00096.2 = col_character(),
##   ..   PZB00096.3 = col_character(),
##   ..   PZB00136.3 = col_character(),
##   ..   PZB00140.1 = col_character(),
##   ..   PZB00145.2 = col_character(),
##   ..   PZB00149.2 = col_character(),
##   ..   PZB00149.4 = col_character(),
##   ..   PZB00153.1 = col_character(),
##   ..   PZB00153.2 = col_character(),
##   ..   PZB00153.3 = col_character(),
##   ..   PZB00153.5 = col_character(),
##   ..   PZB00160.1 = col_character(),
##   ..   PZB00160.2 = col_character(),
##   ..   PZB00160.4 = col_character(),
##   ..   PZB00165.2 = col_character(),
##   ..   PZB00165.6 = col_character(),
##   ..   PZB00169.4 = col_character(),
##   ..   PZB00169.6 = col_character(),
##   ..   PZB00175.1 = col_character(),
```

```
##   ..   PZB00175.2 = col_character(),
##   ..   PZB00175.3 = col_character(),
##   ..   PZB00175.4 = col_character(),
##   ..   PZB00175.5 = col_character(),
##   ..   PZB00180.1 = col_character(),
##   ..   PZB00180.2 = col_character(),
##   ..   PZB00183.3 = col_character(),
##   ..   PZB00188.6 = col_character(),
##   ..   PZB00207.3 = col_character(),
##   ..   PZB00221.3 = col_character(),
##   ..   PZB00221.8 = col_character(),
##   ..   PZB00229.3 = col_character(),
##   ..   PZB00232.1 = col_character(),
##   ..   PZB00232.2 = col_character(),
##   ..   PZB00232.4 = col_character(),
##   ..   PZB00232.5 = col_character(),
##   ..   PZB00379.3 = col_character(),
##   ..   PZB00379.4 = col_character(),
##   ..   PZB00379.5 = col_character(),
##   ..   PZB00393.7 = col_character(),
##   ..   PZB00409.3 = col_character(),
##   ..   PZB00416.2 = col_character(),
##   ..   PZB00416.5 = col_character(),
##   ..   PZB00454.2 = col_character(),
##   ..   PZB00454.3 = col_character(),
##   ..   PZB00454.4 = col_character(),
##   ..   PZB00454.5 = col_character(),
##   ..   PZB00498.2 = col_character(),
##   ..   PZB00498.4 = col_character(),
##   ..   PZB00598.1 = col_character(),
##   ..   PZB00598.2 = col_character(),
##   ..   PZB00603.3 = col_character(),
##   ..   PZB00603.4 = col_character(),
##   ..   PZB00603.5 = col_character(),
##   ..   PZB00607.2 = col_character(),
##   ..   PZB00761.1 = col_character(),
##   ..   PZB00761.2 = col_character(),
##   ..   PZB00849.2 = col_character(),
##   ..   PZB00849.3 = col_character(),
##   ..   PZB00849.4 = col_character(),
##   ..   PZB00859.1 = col_character(),
##   ..   PZB01109.2 = col_character(),
##   ..   PZB01109.3 = col_character(),
##   ..   PZB01110.1 = col_character(),
##   ..   PZB01110.2 = col_character(),
##   ..   PZB01110.3 = col_character(),
##   ..   PZB01111.6 = col_character(),
##   ..   PZB01111.7 = col_character(),
##   ..   PZB01111.8 = col_character(),
##   ..   PZB01112.3 = col_character(),
##   ..   PZB01112.4 = col_character(),
##   ..   PZB01112.5 = col_character(),
##   ..   PZB01112.6 = col_character(),
##   ..   PZB01113.4 = col_character(),
```

```
##   ..   PZB01114.1 = col_character(),
##   ..   PZB01114.3 = col_character(),
##   ..   PZB01115.1 = col_character(),
##   ..   PZB01115.5 = col_character(),
##   ..   PZB01115.6 = col_character(),
##   ..   PZB01116.2 = col_character(),
##   ..   PZB01221.1 = col_character(),
##   ..   PZB01222.1 = col_character(),
##   ..   PZB01222.3 = col_character(),
##   ..   PZB01223.3 = col_character(),
##   ..   PZB01223.4 = col_character(),
##   ..   PZB01223.7 = col_character(),
##   ..   PZB01225.1 = col_character(),
##   ..   PZB01225.2 = col_character(),
##   ..   PZB01225.4 = col_character(),
##   ..   PZB01228.1 = col_character(),
##   ..   PZB01228.3 = col_character(),
##   ..   PZB01228.4 = col_character(),
##   ..   PZB01233.2 = col_character(),
##   ..   PZB01233.3 = col_character(),
##   ..   PZB01238.5 = col_character(),
##   ..   PZB01238.6 = col_character(),
##   ..   PZB01427.1 = col_character(),
##   ..   PZB01427.3 = col_character(),
##   ..   PZB01463.2 = col_character(),
##   ..   PZB01463.3 = col_character(),
##   ..   PZB01463.4 = col_character(),
##   ..   PZD00003.1 = col_character(),
##   ..   PZD00003.3 = col_character(),
##   ..   PZD00007.1 = col_character(),
##   ..   PZD00008.3 = col_character(),
##   ..   PZD00011.1 = col_character(),
##   ..   PZD00011.3 = col_character(),
##   ..   PZD00011.4 = col_character(),
##   ..   PZD00012.1 = col_character(),
##   ..   PZD00012.2 = col_character(),
##   ..   PZD00012.3 = col_character(),
##   ..   PZD00012.4 = col_character(),
##   ..   PZD00012.5 = col_character(),
##   ..   PZD00013.3 = col_character(),
##   ..   PZD00013.4 = col_character(),
##   ..   PZD00014.3 = col_character(),
##   ..   PZD00017.1 = col_character(),
##   ..   PZD00019.1 = col_character(),
##   ..   PZD00020.2 = col_character(),
##   ..   PZD00020.3 = col_character(),
##   ..   PZD00020.4 = col_character(),
##   ..   PZD00020.6 = col_character(),
##   ..   PZD00021.2 = col_character(),
##   ..   PZD00021.4 = col_character(),
##   ..   PZD00021.5 = col_character(),
##   ..   PZD00022.1 = col_character(),
##   ..   PZD00022.3 = col_character(),
##   ..   PZD00022.4 = col_character(),
```

```
##   ..   PZD00024.2 = col_character(),
##   ..   PZD00025.1 = col_character(),
##   ..   PZD00025.2 = col_character(),
##   ..   PZD00030.1 = col_character(),
##   ..   PZD00030.4 = col_character(),
##   ..   PZD00030.5 = col_character(),
##   ..   PZD00030.6 = col_character(),
##   ..   PZD00034.3 = col_character(),
##   ..   PZD00043.1 = col_character(),
##   ..   PZD00043.2 = col_character(),
##   ..   PZD00043.3 = col_character(),
##   ..   PZD00043.4 = col_character(),
##   ..   PZD00044.2 = col_character(),
##   ..   PZD00044.3 = col_character(),
##   ..   PZD00044.4 = col_character(),
##   ..   PZD00045.1 = col_character(),
##   ..   PZD00045.2 = col_character(),
##   ..   PZD00045.3 = col_character(),
##   ..   PZD00045.4 = col_character(),
##   ..   PZD00049.3 = col_character(),
##   ..   PZD00049.4 = col_character(),
##   ..   PZD00049.5 = col_character(),
##   ..   PZD00051.1 = col_character(),
##   ..   PZD00052.3 = col_character(),
##   ..   PZD00052.4 = col_character(),
##   ..   PZD00062.2 = col_character(),
##   ..   PZD00066.1 = col_character(),
##   ..   PZD00067.1 = col_character(),
##   ..   PZD00067.2 = col_character(),
##   ..   PZD00067.3 = col_character(),
##   ..   PZD00068.1 = col_character(),
##   ..   PZD00069.2 = col_character(),
##   ..   PZD00069.3 = col_character(),
##   ..   PZD00069.4 = col_character(),
##   ..   PZD00069.5 = col_character(),
##   ..   PZD00073.1 = col_character(),
##   ..   PZD00073.2 = col_character(),
##   ..   PZD00073.6 = col_character(),
##   ..   PZD00074.1 = col_character(),
##   ..   PZD00075.1 = col_character(),
##   ..   PZD00075.2 = col_character(),
##   ..   PZD00076.1 = col_character(),
##   ..   PZD00076.2 = col_character(),
##   ..   PZD00076.4 = col_character(),
##   ..   PZD00077.10 = col_character(),
##   ..   PZD00077.5 = col_character(),
##   ..   PZD00077.7 = col_character(),
##   ..   PZD00077.8 = col_character(),
##   ..   PZD00078.2 = col_character(),
##   ..   Ra2_ORF.1 = col_character(),
##   ..   Ra2_ORF.2 = col_character(),
##   ..   Ra2_ORF.4 = col_character(),
##   ..   Ra2_promoter.1 = col_character(),
##   ..   Ra2_promoter.2 = col_character(),
```

```
##   ..   Ra2_promoter.3 = col_character(),
##   ..   sh2.5 = col_character(),
##   ..   sh2.6 = col_character(),
##   ..   sh2.7 = col_character(),
##   ..   sh2.9 = col_character(),
##   ..   su1.4 = col_character(),
##   ..   su1.5 = col_character(),
##   ..   su1.7 = col_character(),
##   ..   tb1.17 = col_character(),
##   ..   tb1.18 = col_character(),
##   ..   tb1.19 = col_character(),
##   ..   tb1.5 = col_character(),
##   ..   te1.3 = col_character(),
##   ..   te1.4 = col_character(),
##   ..   zagl1.1 = col_character(),
##   ..   zagl1.6 = col_character(),
##   ..   zap1.2 = col_character(),
##   ..   zen1.1 = col_character(),
##   ..   zen1.2 = col_character(),
##   ..   zen1.4 = col_character(),
##   ..   zfl2.6 = col_character(),
##   ..   zmm3.4 = col_character()
##   .. )
```

To get an idea about the data frame by viewing the first and last few rows

```
head(fang_data)
```

```
## # A tibble: 6 x 986
##   Sample_ID JG_OTU Group abph1.20 abph1.22 ae1.3 ae1.4 ae1.5 an1.4 ba1.6 ba1.9
##   <chr>     <chr>  <chr> <chr>    <chr>    <chr> <chr> <chr> <chr> <chr> <chr>
## 1 SL-15     T-aus~ TRIPS ?/?      ?/?      T/T   G/G   T/T   C/C   ?/?   G/G
## 2 SL-16     T-aus~ TRIPS ?/?      ?/?      T/T   ?/?   T/T   C/C   A/G   G/G
## 3 SL-11     T-bra~ TRIPS ?/?      ?/?      T/T   G/G   T/T   ?/?   G/G   G/G
## 4 SL-12     T-bra~ TRIPS ?/?      ?/?      T/T   G/G   T/T   C/C   G/G   G/G
## 5 SL-18     T-cund TRIPS ?/?      ?/?      T/T   G/G   T/T   C/C   ?/?   G/G
## 6 SL-2      T-dac~ TRIPS ?/?      ?/?      T/T   G/G   T/T   C/C   A/G   G/G
## # ... with 975 more variables: bt2.5 <chr>, bt2.7 <chr>, bt2.8 <chr>,
## #   Fea2.1 <chr>, Fea2.5 <chr>, id1.3 <chr>, lg2.11 <chr>, lg2.2 <chr>,
## #   pbf1.1 <chr>, pbf1.2 <chr>, pbf1.3 <chr>, pbf1.5 <chr>, pbf1.6 <chr>,
## #   pbf1.7 <chr>, pbf1.8 <chr>, PZA00003.11 <chr>, PZA00004.2 <chr>,
## #   PZA00005.8 <chr>, PZA00005.9 <chr>, PZA00006.13 <chr>, PZA00006.14 <chr>,
## #   PZA00008.1 <chr>, PZA00010.5 <chr>, PZA00013.10 <chr>, PZA00013.11 <chr>,
## #   PZA00013.9 <chr>, PZA00015.4 <chr>, PZA00017.1 <chr>, PZA00018.5 <chr>,
## #   PZA00029.11 <chr>, PZA00029.12 <chr>, PZA00030.11 <chr>, PZA00031.5 <chr>,
## #   PZA00041.3 <chr>, PZA00042.2 <chr>, PZA00042.5 <chr>, PZA00043.7 <chr>,
## #   PZA00045.1 <chr>, PZA00047.2 <chr>, PZA00049.12 <chr>, PZA00050.9 <chr>,
## #   PZA00051.2 <chr>, PZA00058.5 <chr>, PZA00058.6 <chr>, PZA00060.2 <chr>,
## #   PZA00061.1 <chr>, PZA00065.2 <chr>, PZA00069.4 <chr>, PZA00070.5 <chr>,
## #   PZA00078.2 <chr>, PZA00079.1 <chr>, PZA00081.17 <chr>, PZA00084.2 <chr>,
## #   PZA00084.3 <chr>, PZA00086.8 <chr>, PZA00088.3 <chr>, PZA00090.2 <chr>,
## #   PZA00092.1 <chr>, PZA00092.5 <chr>, PZA00093.2 <chr>, PZA00096.26 <chr>,
## #   PZA00097.13 <chr>, PZA00098.14 <chr>, PZA00100.10 <chr>, PZA00100.12 <chr>,
## #   PZA00100.14 <chr>, PZA00100.9 <chr>, PZA00103.20 <chr>, PZA00106.9 <chr>,
## #   PZA00107.18 <chr>, PZA00108.12 <chr>, PZA00108.14 <chr>, PZA00108.15 <chr>,
```

```
## #   PZA00109.3 <chr>, PZA00109.5 <chr>, PZA00111.2 <chr>, PZA00111.4 <chr>,
## #   PZA00111.5 <chr>, PZA00111.6 <chr>, PZA00111.8 <chr>, PZA00114.3 <chr>,
## #   PZA00116.2 <chr>, PZA00119.4 <chr>, PZA00120.4 <chr>, PZA00123.1 <chr>,
## #   PZA00125.2 <chr>, PZA00131.14 <chr>, PZA00132.17 <chr>, PZA00132.18 <chr>,
## #   PZA00132.3 <chr>, PZA00135.6 <chr>, PZA00137.2 <chr>, PZA00139.14 <chr>,
## #   PZA00140.10 <chr>, PZA00140.6 <chr>, PZA00140.9 <chr>, PZA00142.6 <chr>,
## #   PZA00148.2 <chr>, PZA00153.3 <chr>, PZA00153.6 <chr>, ...
```

```
tail(fang_data)
```

```
## # A tibble: 6 x 986
##   Sample_ID JG_OTU Group abph1.20 abph1.22 ae1.3 ae1.4 ae1.5 an1.4 ba1.6 ba1.9
##   <chr>     <chr>  <chr> <chr>    <chr>    <chr> <chr> <chr> <chr> <chr> <chr>
## 1 SYN262    Zmm-I~ ZMMIL C/C      A/A      T/T   G/G   C/C   C/C   G/G   G/G
## 2 S0398     Zmm-I~ ZMMIL G/G      A/A      T/T   G/G   C/C   C/C   G/G   G/G
## 3 S1636     Zmm-I~ ZMMIL G/G      A/A      T/T   G/G   C/C   C/C   G/G   G/G
## 4 CU0201    Zmm-I~ ZMMIL C/C      A/A      T/T   G/G   C/C   C/C   G/G   G/G
## 5 S0215     Zmm-I~ ZMMIL G/G      A/A      T/T   ?/?   C/C   C/C   G/G   G/G
## 6 CU0202    Zmm-I~ ZMMIL C/C      A/A      T/T   G/G   C/C   C/C   ?/?   G/G
## # ... with 975 more variables: bt2.5 <chr>, bt2.7 <chr>, bt2.8 <chr>,
## #   Fea2.1 <chr>, Fea2.5 <chr>, id1.3 <chr>, lg2.11 <chr>, lg2.2 <chr>,
## #   pbf1.1 <chr>, pbf1.2 <chr>, pbf1.3 <chr>, pbf1.5 <chr>, pbf1.6 <chr>,
## #   pbf1.7 <chr>, pbf1.8 <chr>, PZA00003.11 <chr>, PZA00004.2 <chr>,
## #   PZA00005.8 <chr>, PZA00005.9 <chr>, PZA00006.13 <chr>, PZA00006.14 <chr>,
## #   PZA00008.1 <chr>, PZA00010.5 <chr>, PZA00013.10 <chr>, PZA00013.11 <chr>,
## #   PZA00013.9 <chr>, PZA00015.4 <chr>, PZA00017.1 <chr>, PZA00018.5 <chr>,
## #   PZA00029.11 <chr>, PZA00029.12 <chr>, PZA00030.11 <chr>, PZA00031.5 <chr>,
## #   PZA00041.3 <chr>, PZA00042.2 <chr>, PZA00042.5 <chr>, PZA00043.7 <chr>,
## #   PZA00045.1 <chr>, PZA00047.2 <chr>, PZA00049.12 <chr>, PZA00050.9 <chr>,
## #   PZA00051.2 <chr>, PZA00058.5 <chr>, PZA00058.6 <chr>, PZA00060.2 <chr>,
## #   PZA00061.1 <chr>, PZA00065.2 <chr>, PZA00069.4 <chr>, PZA00070.5 <chr>,
## #   PZA00078.2 <chr>, PZA00079.1 <chr>, PZA00081.17 <chr>, PZA00084.2 <chr>,
## #   PZA00084.3 <chr>, PZA00086.8 <chr>, PZA00088.3 <chr>, PZA00090.2 <chr>,
## #   PZA00092.1 <chr>, PZA00092.5 <chr>, PZA00093.2 <chr>, PZA00096.26 <chr>,
## #   PZA00097.13 <chr>, PZA00098.14 <chr>, PZA00100.10 <chr>, PZA00100.12 <chr>,
## #   PZA00100.14 <chr>, PZA00100.9 <chr>, PZA00103.20 <chr>, PZA00106.9 <chr>,
## #   PZA00107.18 <chr>, PZA00108.12 <chr>, PZA00108.14 <chr>, PZA00108.15 <chr>,
## #   PZA00109.3 <chr>, PZA00109.5 <chr>, PZA00111.2 <chr>, PZA00111.4 <chr>,
## #   PZA00111.5 <chr>, PZA00111.6 <chr>, PZA00111.8 <chr>, PZA00114.3 <chr>,
## #   PZA00116.2 <chr>, PZA00119.4 <chr>, PZA00120.4 <chr>, PZA00123.1 <chr>,
## #   PZA00125.2 <chr>, PZA00131.14 <chr>, PZA00132.17 <chr>, PZA00132.18 <chr>,
## #   PZA00132.3 <chr>, PZA00135.6 <chr>, PZA00137.2 <chr>, PZA00139.14 <chr>,
## #   PZA00140.10 <chr>, PZA00140.6 <chr>, PZA00140.9 <chr>, PZA00142.6 <chr>,
## #   PZA00148.2 <chr>, PZA00153.3 <chr>, PZA00153.6 <chr>, ...
```

To get the dimensions of the data frame

```
dim(fang_data)
```

```
## [1] 2782  986
```

To get the number of rows in the data frame

```
nrow(fang_data)
```

```
## [1] 2782
```

To get the number of columns in the data frame

```
ncol(fang_data)
```

```
## [1] 986
```

To get the structure of the data frame by previewing data in the columns

```
str(fang_data)
```

```
## tibble [2,782 x 986] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ Sample_ID     : chr [1:2782] "SL-15" "SL-16" "SL-11" "SL-12" ...
##  $ JG_OTU        : chr [1:2782] "T-aust-1" "T-aust-2" "T-brav-1" "T-brav-2" ...
##  $ Group         : chr [1:2782] "TRIPS" "TRIPS" "TRIPS" "TRIPS" ...
##  $ abph1.20      : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ abph1.22      : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ ae1.3         : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ ae1.4         : chr [1:2782] "G/G" "?/?" "G/G" "G/G" ...
##  $ ae1.5         : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ an1.4         : chr [1:2782] "C/C" "C/C" "?/?" "C/C" ...
##  $ ba1.6         : chr [1:2782] "?/?" "A/G" "G/G" "G/G" ...
##  $ ba1.9         : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ bt2.5         : chr [1:2782] "?/?" "?/?" "C/C" "C/C" ...
##  $ bt2.7         : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ bt2.8         : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ Fea2.1        : chr [1:2782] "C/C" "C/C" "?/?" "?/?" ...
##  $ Fea2.5        : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ id1.3         : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ lg2.11        : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ lg2.2         : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ pbf1.1        : chr [1:2782] "?/?" "T/T" "T/T" "T/T" ...
##  $ pbf1.2        : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ pbf1.3        : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ pbf1.5        : chr [1:2782] "?/?" "?/?" "A/A" "A/A" ...
##  $ pbf1.6        : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ pbf1.7        : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ pbf1.8        : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00003.11   : chr [1:2782] "?/?" "?/?" "C/C" "?/?" ...
##  $ PZA00004.2    : chr [1:2782] "T/T" "T/T" "?/?" "T/T" ...
##  $ PZA00005.8    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00005.9    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00006.13   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00006.14   : chr [1:2782] "?/?" "G/G" "G/G" "G/G" ...
##  $ PZA00008.1    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00010.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00013.10   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00013.11   : chr [1:2782] "C/C" "C/C" "C/T" "C/T" ...
##  $ PZA00013.9    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00015.4    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00017.1    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00018.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00029.11   : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00029.12   : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00030.11   : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00031.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00041.3    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00042.2    : chr [1:2782] "?/?" "T/T" "?/?" "?/?" ...
```

```
##  $ PZA00042.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00043.7    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00045.1    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00047.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00049.12   : chr [1:2782] "?/?" "?/?" "T/T" "T/T" ...
##  $ PZA00050.9    : chr [1:2782] "A/A" "A/A" "?/?" "?/?" ...
##  $ PZA00051.2    : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00058.5    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00058.6    : chr [1:2782] "T/T" "?/?" "T/T" "T/T" ...
##  $ PZA00060.2    : chr [1:2782] "?/?" "?/?" "C/C" "C/C" ...
##  $ PZA00061.1    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00065.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00069.4    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00070.5    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00078.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00079.1    : chr [1:2782] "C/C" "?/?" "C/C" "C/C" ...
##  $ PZA00081.17   : chr [1:2782] "?/?" "T/T" "T/T" "T/T" ...
##  $ PZA00084.2    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00084.3    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00086.8    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00088.3    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00090.2    : chr [1:2782] "A/A" "A/A" "?/?" "?/?" ...
##  $ PZA00092.1    : chr [1:2782] "?/?" "?/?" "T/T" "?/?" ...
##  $ PZA00092.5    : chr [1:2782] "?/?" "C/C" "C/C" "?/?" ...
##  $ PZA00093.2    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00096.26   : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00097.13   : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00098.14   : chr [1:2782] "?/?" "?/?" "C/C" "?/?" ...
##  $ PZA00100.10   : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00100.12   : chr [1:2782] "T/T" "?/?" "T/T" "T/T" ...
##  $ PZA00100.14   : chr [1:2782] "?/?" "A/A" "A/A" "A/A" ...
##  $ PZA00100.9    : chr [1:2782] "C/C" "C/C" "C/C" "?/?" ...
##  $ PZA00103.20   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00106.9    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00107.18   : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00108.12   : chr [1:2782] "?/?" "C/C" "C/C" "C/C" ...
##  $ PZA00108.14   : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00108.15   : chr [1:2782] "A/A" "A/A" "A/A" "A/A" ...
##  $ PZA00109.3    : chr [1:2782] "A/A" "A/A" "?/?" "?/?" ...
##  $ PZA00109.5    : chr [1:2782] "A/A" "?/?" "A/A" "?/?" ...
##  $ PZA00111.2    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00111.4    : chr [1:2782] "C/C" "?/?" "C/C" "C/C" ...
##  $ PZA00111.5    : chr [1:2782] "?/?" "?/?" "A/A" "A/A" ...
##  $ PZA00111.6    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00111.8    : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##  $ PZA00114.3    : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00116.2    : chr [1:2782] "C/T" "C/T" "C/T" "C/T" ...
##  $ PZA00119.4    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00120.4    : chr [1:2782] "G/G" "G/G" "G/G" "G/G" ...
##  $ PZA00123.1    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00125.2    : chr [1:2782] "?/?" "?/?" "?/?" "?/?" ...
##  $ PZA00131.14   : chr [1:2782] "C/C" "C/C" "C/C" "C/C" ...
##  $ PZA00132.17   : chr [1:2782] "T/T" "T/T" "T/T" "T/T" ...
##   [list output truncated]
```

```
##  - attr(*, "spec")=
##   .. cols(
##   ..   Sample_ID = col_character(),
##   ..   JG_OTU = col_character(),
##   ..   Group = col_character(),
##   ..   abph1.20 = col_character(),
##   ..   abph1.22 = col_character(),
##   ..   ae1.3 = col_character(),
##   ..   ae1.4 = col_character(),
##   ..   ae1.5 = col_character(),
##   ..   an1.4 = col_character(),
##   ..   ba1.6 = col_character(),
##   ..   ba1.9 = col_character(),
##   ..   bt2.5 = col_character(),
##   ..   bt2.7 = col_character(),
##   ..   bt2.8 = col_character(),
##   ..   Fea2.1 = col_character(),
##   ..   Fea2.5 = col_character(),
##   ..   id1.3 = col_character(),
##   ..   lg2.11 = col_character(),
##   ..   lg2.2 = col_character(),
##   ..   pbf1.1 = col_character(),
##   ..   pbf1.2 = col_character(),
##   ..   pbf1.3 = col_character(),
##   ..   pbf1.5 = col_character(),
##   ..   pbf1.6 = col_character(),
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##   ..   pbf1.8 = col_character(),
##   ..   PZA00003.11 = col_character(),
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##   ..   PZA00049.12 = col_character(),
##   ..   PZA00050.9 = col_character(),
```

```
##   ..   PZA00051.2 = col_character(),
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```

```
##   ..   PZA00140.9 = col_character(),
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##   ..   PZA00232.24 = col_character(),
```

```
##   ..   PZA00234.21 = col_character(),
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```

```
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##   ..   PZA00346.2 = col_character(),
##   ..   PZA00346.3 = col_character(),
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##   ..   PZA00370.5 = col_character(),
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##   ..   PZA00381.5 = col_character(),
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##   ..   PZA00390.6 = col_character(),
##   ..   PZA00391.2 = col_character(),
##   ..   PZA00392.3 = col_character(),
##   ..   PZA00392.4 = col_character(),
##   ..   PZA00393.1 = col_character(),
##   ..   PZA00393.4 = col_character(),
##   ..   PZA00394.11 = col_character(),
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##   ..   PZA00471.3 = col_character(),
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##   ..   PZA00527.6 = col_character(),
##   ..   PZA00527.9 = col_character(),
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##   ..   PZA00545.4 = col_character(),
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##   ..   PZA00560.1 = col_character(),
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##   ..   PZA00618.22 = col_character(),
##   ..   PZA00620.2 = col_character(),
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##   ..   PZA02837.5 = col_character(),
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##   ..   PZA02923.7 = col_character(),
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##   ..   PZA03320.4 = col_character(),
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##   ..   PZA03329.1 = col_character(),
##   ..   PZA03329.2 = col_character(),
##   ..   PZA03333.3 = col_character(),
##   ..   PZA03335.2 = col_character(),
##   ..   PZA03335.3 = col_character(),
##   ..   PZA03337.1 = col_character(),
##   ..   PZA03338.5 = col_character(),
##   ..   PZA03340.2 = col_character(),
##   ..   PZA03342.2 = col_character(),
##   ..   PZA03344.4 = col_character(),
##   ..   PZA03344.5 = col_character(),
##   ..   PZA03344.6 = col_character(),
##   ..   PZA03345.1 = col_character(),
##   ..   PZA03345.2 = col_character(),
##   ..   PZA03345.4 = col_character(),
##   ..   PZA03347.1 = col_character(),
##   ..   PZA03348.1 = col_character(),
##   ..   PZA03349.1 = col_character(),
##   ..   PZA03349.9 = col_character(),
##   ..   PZA03767.1 = col_character(),
##   ..   PZA03767.4 = col_character(),
##   ..   PZA03767.5 = col_character(),
##   ..   PZA03773.2 = col_character(),
##   ..   PZA03773.3 = col_character(),
##   ..   PZA03774.1 = col_character(),
##   ..   PZA03774.10 = col_character(),
##   ..   PZA03774.2 = col_character(),
##   ..   PZA03774.4 = col_character(),
##   ..   PZA03774.5 = col_character(),
##   ..   PZA03774.6 = col_character(),
##   ..   PZA03774.8 = col_character(),
##   ..   PZA03774.9 = col_character(),
##   ..   PZA03775.1 = col_character(),
##   ..   PZA03775.11 = col_character(),
##   ..   PZA03775.2 = col_character(),
##   ..   PZA03775.3 = col_character(),
##   ..   PZA03775.4 = col_character(),
##   ..   PZA03775.6 = col_character(),
##   ..   PZA03775.7 = col_character(),
##   ..   PZA03775.8 = col_character(),
##   ..   PZA03775.9 = col_character(),
##   ..   PZA03781.1 = col_character(),
##   ..   PZA03781.2 = col_character(),
##   ..   PZA03781.3 = col_character(),
##   ..   PZA03781.4 = col_character(),
##   ..   PZA03781.5 = col_character(),
##   ..   PZA03781.6 = col_character(),
##   ..   PZA03781.7 = col_character(),
##   ..   PZA03781.8 = col_character(),
##   ..   PZA03782.1 = col_character(),
##   ..   PZA03782.3 = col_character(),
##   ..   PZA03786.1 = col_character(),
##   ..   PZA03786.2 = col_character(),
```

```
##   ..   PZA03789.1 = col_character(),
##   ..   PZA03789.2 = col_character(),
##   ..   PZA03789.4 = col_character(),
##   ..   PZB00011.4 = col_character(),
##   ..   PZB00011.5 = col_character(),
##   ..   PZB00041.2 = col_character(),
##   ..   PZB00041.4 = col_character(),
##   ..   PZB00049.2 = col_character(),
##   ..   PZB00049.4 = col_character(),
##   ..   PZB00049.7 = col_character(),
##   ..   PZB00055.1 = col_character(),
##   ..   PZB00060.4 = col_character(),
##   ..   PZB00062.6 = col_character(),
##   ..   PZB00062.7 = col_character(),
##   ..   PZB00062.8 = col_character(),
##   ..   PZB00067.2 = col_character(),
##   ..   PZB00067.3 = col_character(),
##   ..   PZB00067.4 = col_character(),
##   ..   PZB00067.5 = col_character(),
##   ..   PZB00078.1 = col_character(),
##   ..   PZB00081.2 = col_character(),
##   ..   PZB00081.4 = col_character(),
##   ..   PZB00081.5 = col_character(),
##   ..   PZB00081.7 = col_character(),
##   ..   PZB00092.1 = col_character(),
##   ..   PZB00092.4 = col_character(),
##   ..   PZB00093.3 = col_character(),
##   ..   PZB00093.4 = col_character(),
##   ..   PZB00093.6 = col_character(),
##   ..   PZB00096.2 = col_character(),
##   ..   PZB00096.3 = col_character(),
##   ..   PZB00136.3 = col_character(),
##   ..   PZB00140.1 = col_character(),
##   ..   PZB00145.2 = col_character(),
##   ..   PZB00149.2 = col_character(),
##   ..   PZB00149.4 = col_character(),
##   ..   PZB00153.1 = col_character(),
##   ..   PZB00153.2 = col_character(),
##   ..   PZB00153.3 = col_character(),
##   ..   PZB00153.5 = col_character(),
##   ..   PZB00160.1 = col_character(),
##   ..   PZB00160.2 = col_character(),
##   ..   PZB00160.4 = col_character(),
##   ..   PZB00165.2 = col_character(),
##   ..   PZB00165.6 = col_character(),
##   ..   PZB00169.4 = col_character(),
##   ..   PZB00169.6 = col_character(),
##   ..   PZB00175.1 = col_character(),
##   ..   PZB00175.2 = col_character(),
##   ..   PZB00175.3 = col_character(),
##   ..   PZB00175.4 = col_character(),
##   ..   PZB00175.5 = col_character(),
##   ..   PZB00180.1 = col_character(),
##   ..   PZB00180.2 = col_character(),
```

```
##   ..   PZB00183.3 = col_character(),
##   ..   PZB00188.6 = col_character(),
##   ..   PZB00207.3 = col_character(),
##   ..   PZB00221.3 = col_character(),
##   ..   PZB00221.8 = col_character(),
##   ..   PZB00229.3 = col_character(),
##   ..   PZB00232.1 = col_character(),
##   ..   PZB00232.2 = col_character(),
##   ..   PZB00232.4 = col_character(),
##   ..   PZB00232.5 = col_character(),
##   ..   PZB00379.3 = col_character(),
##   ..   PZB00379.4 = col_character(),
##   ..   PZB00379.5 = col_character(),
##   ..   PZB00393.7 = col_character(),
##   ..   PZB00409.3 = col_character(),
##   ..   PZB00416.2 = col_character(),
##   ..   PZB00416.5 = col_character(),
##   ..   PZB00454.2 = col_character(),
##   ..   PZB00454.3 = col_character(),
##   ..   PZB00454.4 = col_character(),
##   ..   PZB00454.5 = col_character(),
##   ..   PZB00498.2 = col_character(),
##   ..   PZB00498.4 = col_character(),
##   ..   PZB00598.1 = col_character(),
##   ..   PZB00598.2 = col_character(),
##   ..   PZB00603.3 = col_character(),
##   ..   PZB00603.4 = col_character(),
##   ..   PZB00603.5 = col_character(),
##   ..   PZB00607.2 = col_character(),
##   ..   PZB00761.1 = col_character(),
##   ..   PZB00761.2 = col_character(),
##   ..   PZB00849.2 = col_character(),
##   ..   PZB00849.3 = col_character(),
##   ..   PZB00849.4 = col_character(),
##   ..   PZB00859.1 = col_character(),
##   ..   PZB01109.2 = col_character(),
##   ..   PZB01109.3 = col_character(),
##   ..   PZB01110.1 = col_character(),
##   ..   PZB01110.2 = col_character(),
##   ..   PZB01110.3 = col_character(),
##   ..   PZB01111.6 = col_character(),
##   ..   PZB01111.7 = col_character(),
##   ..   PZB01111.8 = col_character(),
##   ..   PZB01112.3 = col_character(),
##   ..   PZB01112.4 = col_character(),
##   ..   PZB01112.5 = col_character(),
##   ..   PZB01112.6 = col_character(),
##   ..   PZB01113.4 = col_character(),
##   ..   PZB01114.1 = col_character(),
##   ..   PZB01114.3 = col_character(),
##   ..   PZB01115.1 = col_character(),
##   ..   PZB01115.5 = col_character(),
##   ..   PZB01115.6 = col_character(),
##   ..   PZB01116.2 = col_character(),
```

```
##   ..   PZB01221.1 = col_character(),
##   ..   PZB01222.1 = col_character(),
##   ..   PZB01222.3 = col_character(),
##   ..   PZB01223.3 = col_character(),
##   ..   PZB01223.4 = col_character(),
##   ..   PZB01223.7 = col_character(),
##   ..   PZB01225.1 = col_character(),
##   ..   PZB01225.2 = col_character(),
##   ..   PZB01225.4 = col_character(),
##   ..   PZB01228.1 = col_character(),
##   ..   PZB01228.3 = col_character(),
##   ..   PZB01228.4 = col_character(),
##   ..   PZB01233.2 = col_character(),
##   ..   PZB01233.3 = col_character(),
##   ..   PZB01238.5 = col_character(),
##   ..   PZB01238.6 = col_character(),
##   ..   PZB01427.1 = col_character(),
##   ..   PZB01427.3 = col_character(),
##   ..   PZB01463.2 = col_character(),
##   ..   PZB01463.3 = col_character(),
##   ..   PZB01463.4 = col_character(),
##   ..   PZD00003.1 = col_character(),
##   ..   PZD00003.3 = col_character(),
##   ..   PZD00007.1 = col_character(),
##   ..   PZD00008.3 = col_character(),
##   ..   PZD00011.1 = col_character(),
##   ..   PZD00011.3 = col_character(),
##   ..   PZD00011.4 = col_character(),
##   ..   PZD00012.1 = col_character(),
##   ..   PZD00012.2 = col_character(),
##   ..   PZD00012.3 = col_character(),
##   ..   PZD00012.4 = col_character(),
##   ..   PZD00012.5 = col_character(),
##   ..   PZD00013.3 = col_character(),
##   ..   PZD00013.4 = col_character(),
##   ..   PZD00014.3 = col_character(),
##   ..   PZD00017.1 = col_character(),
##   ..   PZD00019.1 = col_character(),
##   ..   PZD00020.2 = col_character(),
##   ..   PZD00020.3 = col_character(),
##   ..   PZD00020.4 = col_character(),
##   ..   PZD00020.6 = col_character(),
##   ..   PZD00021.2 = col_character(),
##   ..   PZD00021.4 = col_character(),
##   ..   PZD00021.5 = col_character(),
##   ..   PZD00022.1 = col_character(),
##   ..   PZD00022.3 = col_character(),
##   ..   PZD00022.4 = col_character(),
##   ..   PZD00024.2 = col_character(),
##   ..   PZD00025.1 = col_character(),
##   ..   PZD00025.2 = col_character(),
##   ..   PZD00030.1 = col_character(),
##   ..   PZD00030.4 = col_character(),
##   ..   PZD00030.5 = col_character(),
```

```
##   ..   PZD00030.6 = col_character(),
##   ..   PZD00034.3 = col_character(),
##   ..   PZD00043.1 = col_character(),
##   ..   PZD00043.2 = col_character(),
##   ..   PZD00043.3 = col_character(),
##   ..   PZD00043.4 = col_character(),
##   ..   PZD00044.2 = col_character(),
##   ..   PZD00044.3 = col_character(),
##   ..   PZD00044.4 = col_character(),
##   ..   PZD00045.1 = col_character(),
##   ..   PZD00045.2 = col_character(),
##   ..   PZD00045.3 = col_character(),
##   ..   PZD00045.4 = col_character(),
##   ..   PZD00049.3 = col_character(),
##   ..   PZD00049.4 = col_character(),
##   ..   PZD00049.5 = col_character(),
##   ..   PZD00051.1 = col_character(),
##   ..   PZD00052.3 = col_character(),
##   ..   PZD00052.4 = col_character(),
##   ..   PZD00062.2 = col_character(),
##   ..   PZD00066.1 = col_character(),
##   ..   PZD00067.1 = col_character(),
##   ..   PZD00067.2 = col_character(),
##   ..   PZD00067.3 = col_character(),
##   ..   PZD00068.1 = col_character(),
##   ..   PZD00069.2 = col_character(),
##   ..   PZD00069.3 = col_character(),
##   ..   PZD00069.4 = col_character(),
##   ..   PZD00069.5 = col_character(),
##   ..   PZD00073.1 = col_character(),
##   ..   PZD00073.2 = col_character(),
##   ..   PZD00073.6 = col_character(),
##   ..   PZD00074.1 = col_character(),
##   ..   PZD00075.1 = col_character(),
##   ..   PZD00075.2 = col_character(),
##   ..   PZD00076.1 = col_character(),
##   ..   PZD00076.2 = col_character(),
##   ..   PZD00076.4 = col_character(),
##   ..   PZD00077.10 = col_character(),
##   ..   PZD00077.5 = col_character(),
##   ..   PZD00077.7 = col_character(),
##   ..   PZD00077.8 = col_character(),
##   ..   PZD00078.2 = col_character(),
##   ..   Ra2_ORF.1 = col_character(),
##   ..   Ra2_ORF.2 = col_character(),
##   ..   Ra2_ORF.4 = col_character(),
##   ..   Ra2_promoter.1 = col_character(),
##   ..   Ra2_promoter.2 = col_character(),
##   ..   Ra2_promoter.3 = col_character(),
##   ..   sh2.5 = col_character(),
##   ..   sh2.6 = col_character(),
##   ..   sh2.7 = col_character(),
##   ..   sh2.9 = col_character(),
##   ..   su1.4 = col_character(),
```

```
##   ..   su1.5 = col_character(),
##   ..   su1.7 = col_character(),
##   ..   tb1.17 = col_character(),
##   ..   tb1.18 = col_character(),
##   ..   tb1.19 = col_character(),
##   ..   tb1.5 = col_character(),
##   ..   te1.3 = col_character(),
##   ..   te1.4 = col_character(),
##   ..   zagl1.1 = col_character(),
##   ..   zagl1.6 = col_character(),
##   ..   zap1.2 = col_character(),
##   ..   zen1.1 = col_character(),
##   ..   zen1.2 = col_character(),
##   ..   zen1.4 = col_character(),
##   ..   zfl2.6 = col_character(),
##   ..   zmm3.4 = col_character()
##   .. )
```

To view the column names

```
names(fang_data)
```

```
##   [1] "Sample_ID"      "JG_OTU"         "Group"          "abph1.20"
##   [5] "abph1.22"       "ae1.3"          "ae1.4"          "ae1.5"
##   [9] "an1.4"          "ba1.6"          "ba1.9"          "bt2.5"
##  [13] "bt2.7"          "bt2.8"          "Fea2.1"         "Fea2.5"
##  [17] "id1.3"          "lg2.11"         "lg2.2"          "pbf1.1"
##  [21] "pbf1.2"         "pbf1.3"         "pbf1.5"         "pbf1.6"
##  [25] "pbf1.7"         "pbf1.8"         "PZA00003.11"    "PZA00004.2"
##  [29] "PZA00005.8"     "PZA00005.9"     "PZA00006.13"    "PZA00006.14"
##  [33] "PZA00008.1"     "PZA00010.5"     "PZA00013.10"    "PZA00013.11"
##  [37] "PZA00013.9"     "PZA00015.4"     "PZA00017.1"     "PZA00018.5"
##  [41] "PZA00029.11"    "PZA00029.12"    "PZA00030.11"    "PZA00031.5"
##  [45] "PZA00041.3"     "PZA00042.2"     "PZA00042.5"     "PZA00043.7"
##  [49] "PZA00045.1"     "PZA00047.2"     "PZA00049.12"    "PZA00050.9"
##  [53] "PZA00051.2"     "PZA00058.5"     "PZA00058.6"     "PZA00060.2"
##  [57] "PZA00061.1"     "PZA00065.2"     "PZA00069.4"     "PZA00070.5"
##  [61] "PZA00078.2"     "PZA00079.1"     "PZA00081.17"    "PZA00084.2"
##  [65] "PZA00084.3"     "PZA00086.8"     "PZA00088.3"     "PZA00090.2"
##  [69] "PZA00092.1"     "PZA00092.5"     "PZA00093.2"     "PZA00096.26"
##  [73] "PZA00097.13"    "PZA00098.14"    "PZA00100.10"    "PZA00100.12"
##  [77] "PZA00100.14"    "PZA00100.9"     "PZA00103.20"    "PZA00106.9"
##  [81] "PZA00107.18"    "PZA00108.12"    "PZA00108.14"    "PZA00108.15"
##  [85] "PZA00109.3"     "PZA00109.5"     "PZA00111.2"     "PZA00111.4"
##  [89] "PZA00111.5"     "PZA00111.6"     "PZA00111.8"     "PZA00114.3"
##  [93] "PZA00116.2"     "PZA00119.4"     "PZA00120.4"     "PZA00123.1"
##  [97] "PZA00125.2"     "PZA00131.14"    "PZA00132.17"    "PZA00132.18"
## [101] "PZA00132.3"     "PZA00135.6"     "PZA00137.2"     "PZA00139.14"
## [105] "PZA00140.10"    "PZA00140.6"     "PZA00140.9"     "PZA00142.6"
## [109] "PZA00148.2"     "PZA00153.3"     "PZA00153.6"     "PZA00163.4"
## [113] "PZA00164.1"     "PZA00164.2"     "PZA00164.3"     "PZA00166.1"
## [117] "PZA00166.3"     "PZA00170.1"     "PZA00170.3"     "PZA00170.4"
## [121] "PZA00174.1"     "PZA00174.2"     "PZA00175.2"     "PZA00176.8"
## [125] "PZA00177.4"     "PZA00178.3"     "PZA00182.3"     "PZA00182.4"
## [129] "PZA00184.1"     "PZA00184.4"     "PZA00188.1"     "PZA00188.3"
```

```
## [133] "PZA00191.5"     "PZA00192.6"     "PZA00192.7"     "PZA00193.2"
## [137] "PZA00198.39"    "PZA00200.11"    "PZA00200.17"    "PZA00200.9"
## [141] "PZA00201.2"     "PZA00204.1"     "PZA00210.1"     "PZA00210.6"
## [145] "PZA00211.7"     "PZA00212.1"     "PZA00213.19"    "PZA00214.1"
## [149] "PZA00216.9"     "PZA00218.1"     "PZA00218.6"     "PZA00219.7"
## [153] "PZA00220.11"    "PZA00220.12"    "PZA00221.7"     "PZA00225.8"
## [157] "PZA00226.7"     "PZA00227.8"     "PZA00230.5"     "PZA00232.24"
## [161] "PZA00234.21"    "PZA00235.6"     "PZA00235.8"     "PZA00237.2"
## [165] "PZA00237.7"     "PZA00237.8"     "PZA00238.3"     "PZA00240.9"
## [169] "PZA00241.6"     "PZA00243.27"    "PZA00245.14"    "PZA00245.16"
## [173] "PZA00245.17"    "PZA00245.18"    "PZA00245.19"    "PZA00249.2"
## [177] "PZA00250.1"     "PZA00251.1"     "PZA00254.3"     "PZA00255.15"
## [181] "PZA00255.17"    "PZA00256.16"    "PZA00256.21"    "PZA00256.23"
## [185] "PZA00257.11"    "PZA00257.22"    "PZA00261.6"     "PZA00263.14"
## [189] "PZA00266.5"     "PZA00270.3"     "PZA00273.1"     "PZA00274.7"
## [193] "PZA00277.17"    "PZA00277.9"     "PZA00280.14"    "PZA00287.1"
## [197] "PZA00289.11"    "PZA00294.20"    "PZA00296.6"     "PZA00297.2"
## [201] "PZA00297.3"     "PZA00297.4"     "PZA00298.4"     "PZA00298.5"
## [205] "PZA00299.2"     "PZA00300.12"    "PZA00300.13"    "PZA00300.14"
## [209] "PZA00300.16"    "PZA00301.3"     "PZA00303.19"    "PZA00303.21"
## [213] "PZA00307.12"    "PZA00307.14"    "PZA00307.17"    "PZA00309.2"
## [217] "PZA00310.5"     "PZA00314.6"     "PZA00314.8"     "PZA00315.1"
## [221] "PZA00315.6"     "PZA00318.2"     "PZA00323.3"     "PZA00323.4"
## [225] "PZA00326.16"    "PZA00326.18"    "PZA00326.19"    "PZA00332.8"
## [229] "PZA00332.9"     "PZA00334.2"     "PZA00335.12"    "PZA00337.3"
## [233] "PZA00337.4"     "PZA00337.5"     "PZA00342.9"     "PZA00344.10"
## [237] "PZA00345.15"    "PZA00346.1"     "PZA00346.2"     "PZA00346.3"
## [241] "PZA00349.3"     "PZA00349.5"     "PZA00350.2"     "PZA00352.22"
## [245] "PZA00355.1"     "PZA00355.2"     "PZA00356.9"     "PZA00364.5"
## [249] "PZA00364.6"     "PZA00367.2"     "PZA00369.1"     "PZA00370.1"
## [253] "PZA00370.5"     "PZA00380.5"     "PZA00380.7"     "PZA00381.3"
## [257] "PZA00381.4"     "PZA00381.5"     "PZA00382.17"    "PZA00385.3"
## [261] "PZA00386.3"     "PZA00390.6"     "PZA00391.2"     "PZA00392.3"
## [265] "PZA00392.4"     "PZA00393.1"     "PZA00393.4"     "PZA00394.11"
## [269] "PZA00395.1"     "PZA00395.2"     "PZA00396.12"    "PZA00401.11"
## [273] "PZA00401.6"     "PZA00406.1"     "PZA00407.9"     "PZA00408.7"
## [277] "PZA00409.3"     "PZA00411.1"     "PZA00411.4"     "PZA00411.5"
## [281] "PZA00413.17"    "PZA00413.18"    "PZA00413.21"    "PZA00417.2"
## [285] "PZA00417.3"     "PZA00419.1"     "PZA00420.4"     "PZA00422.2"
## [289] "PZA00422.5"     "PZA00422.6"     "PZA00423.16"    "PZA00423.17"
## [293] "PZA00424.1"     "PZA00425.4"     "PZA00425.9"     "PZA00429.1"
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## [965] "Ra2_promoter.3" "sh2.5"          "sh2.6"          "sh2.7"
## [969] "sh2.9"          "su1.4"          "su1.5"          "su1.7"
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## [977] "te1.3"          "te1.4"          "zagl1.1"        "zagl1.6"
## [981] "zap1.2"         "zen1.1"         "zen1.2"         "zen1.4"
## [985] "zfl2.6"         "zmm3.4"
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To see the class of all the columns

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sapply(fang_data, class)
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##         ba1.9          bt2.5          bt2.7          bt2.8         Fea2.1
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##    "character"    "character"    "character"    "character"    "character"
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##    "character"    "character"    "character"    "character"    "character"
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##     PZA03774.6     PZA03774.8     PZA03774.9     PZA03775.1    PZA03775.11
##    "character"    "character"    "character"    "character"    "character"
##     PZA03775.2     PZA03775.3     PZA03775.4     PZA03775.6     PZA03775.7
##    "character"    "character"    "character"    "character"    "character"
##     PZA03775.8     PZA03775.9     PZA03781.1     PZA03781.2     PZA03781.3
##    "character"    "character"    "character"    "character"    "character"
##     PZA03781.4     PZA03781.5     PZA03781.6     PZA03781.7     PZA03781.8
##    "character"    "character"    "character"    "character"    "character"
##     PZA03782.1     PZA03782.3     PZA03786.1     PZA03786.2     PZA03789.1
##    "character"    "character"    "character"    "character"    "character"
##     PZA03789.2     PZA03789.4     PZB00011.4     PZB00011.5     PZB00041.2
##    "character"    "character"    "character"    "character"    "character"
##     PZB00041.4     PZB00049.2     PZB00049.4     PZB00049.7     PZB00055.1
##    "character"    "character"    "character"    "character"    "character"
##     PZB00060.4     PZB00062.6     PZB00062.7     PZB00062.8     PZB00067.2
##    "character"    "character"    "character"    "character"    "character"
##     PZB00067.3     PZB00067.4     PZB00067.5     PZB00078.1     PZB00081.2
##    "character"    "character"    "character"    "character"    "character"
##     PZB00081.4     PZB00081.5     PZB00081.7     PZB00092.1     PZB00092.4
##    "character"    "character"    "character"    "character"    "character"
##     PZB00093.3     PZB00093.4     PZB00093.6     PZB00096.2     PZB00096.3
##    "character"    "character"    "character"    "character"    "character"
##     PZB00136.3     PZB00140.1     PZB00145.2     PZB00149.2     PZB00149.4
##    "character"    "character"    "character"    "character"    "character"
##     PZB00153.1     PZB00153.2     PZB00153.3     PZB00153.5     PZB00160.1
##    "character"    "character"    "character"    "character"    "character"
##     PZB00160.2     PZB00160.4     PZB00165.2     PZB00165.6     PZB00169.4
##    "character"    "character"    "character"    "character"    "character"
##     PZB00169.6     PZB00175.1     PZB00175.2     PZB00175.3     PZB00175.4
##    "character"    "character"    "character"    "character"    "character"
```

```
##     PZB00175.5     PZB00180.1     PZB00180.2     PZB00183.3     PZB00188.6
##    "character"    "character"    "character"    "character"    "character"
##     PZB00207.3     PZB00221.3     PZB00221.8     PZB00229.3     PZB00232.1
##    "character"    "character"    "character"    "character"    "character"
##     PZB00232.2     PZB00232.4     PZB00232.5     PZB00379.3     PZB00379.4
##    "character"    "character"    "character"    "character"    "character"
##     PZB00379.5     PZB00393.7     PZB00409.3     PZB00416.2     PZB00416.5
##    "character"    "character"    "character"    "character"    "character"
##     PZB00454.2     PZB00454.3     PZB00454.4     PZB00454.5     PZB00498.2
##    "character"    "character"    "character"    "character"    "character"
##     PZB00498.4     PZB00598.1     PZB00598.2     PZB00603.3     PZB00603.4
##    "character"    "character"    "character"    "character"    "character"
##     PZB00603.5     PZB00607.2     PZB00761.1     PZB00761.2     PZB00849.2
##    "character"    "character"    "character"    "character"    "character"
##     PZB00849.3     PZB00849.4     PZB00859.1     PZB01109.2     PZB01109.3
##    "character"    "character"    "character"    "character"    "character"
##     PZB01110.1     PZB01110.2     PZB01110.3     PZB01111.6     PZB01111.7
##    "character"    "character"    "character"    "character"    "character"
##     PZB01111.8     PZB01112.3     PZB01112.4     PZB01112.5     PZB01112.6
##    "character"    "character"    "character"    "character"    "character"
##     PZB01113.4     PZB01114.1     PZB01114.3     PZB01115.1     PZB01115.5
##    "character"    "character"    "character"    "character"    "character"
##     PZB01115.6     PZB01116.2     PZB01221.1     PZB01222.1     PZB01222.3
##    "character"    "character"    "character"    "character"    "character"
##     PZB01223.3     PZB01223.4     PZB01223.7     PZB01225.1     PZB01225.2
##    "character"    "character"    "character"    "character"    "character"
##     PZB01225.4     PZB01228.1     PZB01228.3     PZB01228.4     PZB01233.2
##    "character"    "character"    "character"    "character"    "character"
##     PZB01233.3     PZB01238.5     PZB01238.6     PZB01427.1     PZB01427.3
##    "character"    "character"    "character"    "character"    "character"
##     PZB01463.2     PZB01463.3     PZB01463.4     PZD00003.1     PZD00003.3
##    "character"    "character"    "character"    "character"    "character"
##     PZD00007.1     PZD00008.3     PZD00011.1     PZD00011.3     PZD00011.4
##    "character"    "character"    "character"    "character"    "character"
##     PZD00012.1     PZD00012.2     PZD00012.3     PZD00012.4     PZD00012.5
##    "character"    "character"    "character"    "character"    "character"
##     PZD00013.3     PZD00013.4     PZD00014.3     PZD00017.1     PZD00019.1
##    "character"    "character"    "character"    "character"    "character"
##     PZD00020.2     PZD00020.3     PZD00020.4     PZD00020.6     PZD00021.2
##    "character"    "character"    "character"    "character"    "character"
##     PZD00021.4     PZD00021.5     PZD00022.1     PZD00022.3     PZD00022.4
##    "character"    "character"    "character"    "character"    "character"
##     PZD00024.2     PZD00025.1     PZD00025.2     PZD00030.1     PZD00030.4
##    "character"    "character"    "character"    "character"    "character"
##     PZD00030.5     PZD00030.6     PZD00034.3     PZD00043.1     PZD00043.2
##    "character"    "character"    "character"    "character"    "character"
##     PZD00043.3     PZD00043.4     PZD00044.2     PZD00044.3     PZD00044.4
##    "character"    "character"    "character"    "character"    "character"
##     PZD00045.1     PZD00045.2     PZD00045.3     PZD00045.4     PZD00049.3
##    "character"    "character"    "character"    "character"    "character"
##     PZD00049.4     PZD00049.5     PZD00051.1     PZD00052.3     PZD00052.4
##    "character"    "character"    "character"    "character"    "character"
##     PZD00062.2     PZD00066.1     PZD00067.1     PZD00067.2     PZD00067.3
##    "character"    "character"    "character"    "character"    "character"
```

```
##     PZD00068.1     PZD00069.2     PZD00069.3     PZD00069.4     PZD00069.5
##    "character"    "character"    "character"    "character"    "character"
##     PZD00073.1     PZD00073.2     PZD00073.6     PZD00074.1     PZD00075.1
##    "character"    "character"    "character"    "character"    "character"
##     PZD00075.2     PZD00076.1     PZD00076.2     PZD00076.4    PZD00077.10
##    "character"    "character"    "character"    "character"    "character"
##     PZD00077.5     PZD00077.7     PZD00077.8     PZD00078.2      Ra2_ORF.1
##    "character"    "character"    "character"    "character"    "character"
##      Ra2_ORF.2      Ra2_ORF.4 Ra2_promoter.1 Ra2_promoter.2 Ra2_promoter.3
##    "character"    "character"    "character"    "character"    "character"
##          sh2.5          sh2.6          sh2.7          sh2.9          su1.4
##    "character"    "character"    "character"    "character"    "character"
##          su1.5          su1.7         tb1.17         tb1.18         tb1.19
##    "character"    "character"    "character"    "character"    "character"
##          tb1.5          te1.3          te1.4        zagl1.1        zagl1.6
##    "character"    "character"    "character"    "character"    "character"
##         zap1.2         zen1.1         zen1.2         zen1.4         zfl2.6
##    "character"    "character"    "character"    "character"    "character"
##         zmm3.4
##    "character"
```

By inspecting this file I learned that:

- File size: 11051939 bytes
- Dimension of the dataframe: 2782 x 986
- Number of rows: 2782
- Number of columns: 986

Attributes of snp_position.txt

To load the snp_position.txt data file into R

```
snp_data = read_tsv("snp_position.txt")
```

```
##
## -- Column specification --------------------------------------------------------
## cols(
##   SNP_ID = col_character(),
##   cdv_marker_id = col_double(),
##   Chromosome = col_character(),
##   Position = col_character(),
##   alt_pos = col_character(),
##   mult_positions = col_character(),
##   amplicon = col_character(),
##   cdv_map_feature.name = col_character(),
##   gene = col_character(),
##   `candidate/random` = col_character(),
##   Genaissance_daa_id = col_double(),
##   Sequenom_daa_id = col_double(),
##   count_amplicons = col_double(),
##   count_cmf = col_double(),
##   count_gene = col_double()
## )
```

To get the file size

```
file.size("snp_position.txt")
```

```
## [1] 82763
```

To get all the file info

```
file.info("snp_position.txt", extra_cols = TRUE)
```

```
##                   size isdir mode               mtime               ctime
## snp_position.txt 82763 FALSE  666 2021-03-10 17:55:08 2021-03-18 18:13:47
##                                atime exe
## snp_position.txt 2021-03-24 23:30:20  no
```

To compactly display the internal structure of the R object

```
str(snp_data)
```

```
## tibble [983 x 15] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ SNP_ID              : chr [1:983] "abph1.20" "abph1.22" "ae1.3" "ae1.4" ...
##  $ cdv_marker_id       : num [1:983] 5976 5978 6605 6606 6607 ...
##  $ Chromosome          : chr [1:983] "2" "2" "5" "5" ...
##  $ Position            : chr [1:983] "27403404" "27403892" "167889790" "167889682" ...
##  $ alt_pos             : chr [1:983] NA NA NA NA ...
##  $ mult_positions      : chr [1:983] NA NA NA NA ...
##  $ amplicon            : chr [1:983] "abph1" "abph1" "ae1" "ae1" ...
##  $ cdv_map_feature.name: chr [1:983] "AB042260" "AB042260" "ae1" "ae1" ...
##  $ gene                : chr [1:983] "abph1" "abph1" "ae1" "ae1" ...
##  $ candidate/random    : chr [1:983] "candidate" "candidate" "candidate" "candidate" ...
##  $ Genaissance_daa_id  : num [1:983] 8393 8394 8395 8396 8397 ...
##  $ Sequenom_daa_id     : num [1:983] 10474 10475 10477 10478 10479 ...
##  $ count_amplicons     : num [1:983] 1 0 1 0 0 1 1 0 1 0 ...
##  $ count_cmf           : num [1:983] 1 0 1 0 0 1 0 0 1 0 ...
##  $ count_gene          : num [1:983] 1 0 1 0 0 1 1 0 1 0 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   SNP_ID = col_character(),
##   ..   cdv_marker_id = col_double(),
##   ..   Chromosome = col_character(),
##   ..   Position = col_character(),
##   ..   alt_pos = col_character(),
##   ..   mult_positions = col_character(),
##   ..   amplicon = col_character(),
##   ..   cdv_map_feature.name = col_character(),
##   ..   gene = col_character(),
##   ..   `candidate/random` = col_character(),
##   ..   Genaissance_daa_id = col_double(),
##   ..   Sequenom_daa_id = col_double(),
##   ..   count_amplicons = col_double(),
##   ..   count_cmf = col_double(),
##   ..   count_gene = col_double()
##   .. )
```

To get an idea about the data frame by viewing the first and last few rows

```
head(snp_data)
```

```
## # A tibble: 6 x 15
```

```
##   SNP_ID cdv_marker_id Chromosome Position alt_pos mult_positions amplicon
##   <chr>          <dbl> <chr>      <chr>    <chr>   <chr>          <chr>
## 1 abph1~          5976 2          27403404 <NA>    <NA>           abph1
## 2 abph1~          5978 2          27403892 <NA>    <NA>           abph1
## 3 ae1.3           6605 5          1678897~ <NA>    <NA>           ae1
## 4 ae1.4           6606 5          1678896~ <NA>    <NA>           ae1
## 5 ae1.5           6607 5          1678898~ <NA>    <NA>           ae1
## 6 an1.4           5982 1          2404985~ <NA>    <NA>           an1
## # ... with 8 more variables: cdv_map_feature.name <chr>, gene <chr>,
## #   `candidate/random` <chr>, Genaissance_daa_id <dbl>, Sequenom_daa_id <dbl>,
## #   count_amplicons <dbl>, count_cmf <dbl>, count_gene <dbl>
```

```
tail(snp_data)
```

```
## # A tibble: 6 x 15
##   SNP_ID cdv_marker_id Chromosome Position alt_pos mult_positions amplicon
##   <chr>          <dbl> <chr>      <chr>    <chr>   <chr>          <chr>
## 1 zap1.2          3514 2          2331285~ <NA>    <NA>           zap1
## 2 zen1.1          3519 unknown    unknown  <NA>    <NA>           zen1
## 3 zen1.2          3520 unknown    unknown  <NA>    <NA>           zen1
## 4 zen1.4          3521 unknown    unknown  <NA>    <NA>           zen1
## 5 zfl2.6          6463 2          12543294 <NA>    <NA>           zfl2
## 6 zmm3.4          3527 9          16966348 <NA>    <NA>           zmm3
## # ... with 8 more variables: cdv_map_feature.name <chr>, gene <chr>,
## #   `candidate/random` <chr>, Genaissance_daa_id <dbl>, Sequenom_daa_id <dbl>,
## #   count_amplicons <dbl>, count_cmf <dbl>, count_gene <dbl>
```

To get the dimensions of the data frame

```
dim(snp_data)
```

```
## [1] 983  15
```

To get the number of rows in the data frame

```
nrow(snp_data)
```

```
## [1] 983
```

To get the number of columns in the data frame

```
ncol(snp_data)
```

```
## [1] 15
```

To get the structure of the data frame by previewing data in the columns

```
str(snp_data)
```

```
## tibble [983 x 15] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ SNP_ID              : chr [1:983] "abph1.20" "abph1.22" "ae1.3" "ae1.4" ...
##  $ cdv_marker_id       : num [1:983] 5976 5978 6605 6606 6607 ...
##  $ Chromosome          : chr [1:983] "2" "2" "5" "5" ...
##  $ Position            : chr [1:983] "27403404" "27403892" "167889790" "167889682" ...
##  $ alt_pos             : chr [1:983] NA NA NA NA ...
##  $ mult_positions      : chr [1:983] NA NA NA NA ...
##  $ amplicon            : chr [1:983] "abph1" "abph1" "ae1" "ae1" ...
##  $ cdv_map_feature.name: chr [1:983] "AB042260" "AB042260" "ae1" "ae1" ...
##  $ gene                : chr [1:983] "abph1" "abph1" "ae1" "ae1" ...
##  $ candidate/random    : chr [1:983] "candidate" "candidate" "candidate" "candidate" ...
```

```
##  $ Genaissance_daa_id  : num [1:983] 8393 8394 8395 8396 8397 ...
##  $ Sequenom_daa_id     : num [1:983] 10474 10475 10477 10478 10479 ...
##  $ count_amplicons     : num [1:983] 1 0 1 0 0 1 1 0 1 0 ...
##  $ count_cmf           : num [1:983] 1 0 1 0 0 1 0 0 1 0 ...
##  $ count_gene          : num [1:983] 1 0 1 0 0 1 1 0 1 0 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   SNP_ID = col_character(),
##   ..   cdv_marker_id = col_double(),
##   ..   Chromosome = col_character(),
##   ..   Position = col_character(),
##   ..   alt_pos = col_character(),
##   ..   mult_positions = col_character(),
##   ..   amplicon = col_character(),
##   ..   cdv_map_feature.name = col_character(),
##   ..   gene = col_character(),
##   ..   `candidate/random` = col_character(),
##   ..   Genaissance_daa_id = col_double(),
##   ..   Sequenom_daa_id = col_double(),
##   ..   count_amplicons = col_double(),
##   ..   count_cmf = col_double(),
##   ..   count_gene = col_double()
##   .. )
```

To view the column names

```
names(snp_data)
```

```
##  [1] "SNP_ID"               "cdv_marker_id"        "Chromosome"
##  [4] "Position"             "alt_pos"              "mult_positions"
##  [7] "amplicon"             "cdv_map_feature.name" "gene"
## [10] "candidate/random"     "Genaissance_daa_id"   "Sequenom_daa_id"
## [13] "count_amplicons"      "count_cmf"            "count_gene"
```

To see the class of all the columns

```
sapply(snp_data, class)
```

```
##               SNP_ID        cdv_marker_id           Chromosome
##          "character"            "numeric"          "character"
##             Position              alt_pos       mult_positions
##          "character"          "character"          "character"
##             amplicon cdv_map_feature.name                 gene
##          "character"          "character"          "character"
##     candidate/random   Genaissance_daa_id      Sequenom_daa_id
##          "character"            "numeric"            "numeric"
##      count_amplicons            count_cmf           count_gene
##            "numeric"            "numeric"            "numeric"
```

By inspecting this file I learned that:

- File size: 82763 bytes
- Dimension of the dataframe: 983 x 15
- Number of rows: 983
- Number of columns: 15

Data Processing

snp_data data frame was formatted such that the first column is "SNP_ID", the second column is "Chromosome", the third column is "Position".

```
snp_data <- snp_data[c(1,3,4)]
```

For maize

Filtered out maize data (Group = ZMMIL, ZMMLR, and ZMMMR) and "maize" data frame created.

```
maize <- fang_data %>% filter(Group=="ZMMIL"|Group=="ZMMLR"|Group=="ZMMMR")
```

Genotype data ("maize") were transposed using t() function so that the columns become rows. "stringsAsFactors = FALSE" prevents converting character columns to factors.

```
maize <- as.data.frame(t(maize), stringsAsFactors = FALSE)
```

rownames() function is the function that uses to get and set row names for data frames.

```
SNP_ID <- rownames(maize)
rownames(maize) <- NULL
```

cbind() function stands for column binding and it is normally used to combine vectors, matrices or data frames by columns. It splits matrix columns in data frame arguments and "stringsAsFactors = FALSE" prevents converting character columns to factors.

```
maize <- cbind(SNP_ID, maize, stringsAsFactors = FALSE)
```

First row was changed into SNP_ID and column 1, column 2, and column 3 were removed.

```
names(maize) <-  c("SNP_ID",maize[1,-1])
maize <- maize[-c(1,2,3), ]
```

Transposed maize genotype data and snp data were merged by SNP_ID.

```
merged_maize <- merge(snp_data, maize, by="SNP_ID")
```

A directory was Created for storing generated files for maize.

```
dir.create("maize_data")
```

mutate() function spcially can add new variables while preserving existing ones. arrange() function arranges rows by variables. Data were sorted based on position and were written to the ouputs as csv files. 10 files were generated (1 for each chromosome) with SNPs ordered based on increasing position values and with missing data.

```
for(i in c(1:10)){
  maize_data <- merged_maize %>% filter(Chromosome==i) %>% mutate(Position_new=as.numeric(Position)) %>%
  maize_data$Position_new <- NULL
  write.csv(maize_data, paste0("maize_chr_asc",i,".csv"), row.names = FALSE)
}
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

Data were sorted based on position and were written to the ouputs as csv files. 10 files were generated (1 for each chromosome) with SNPs ordered based on decreasing position values and with missing data.

```
for(i in c(1:10)){
  maize_data <- merged_maize %>% filter(Chromosome==i)%>% mutate(Position_new=as.numeric(Position)) %>%
  maize_data$Position_new <- NULL
  maize_data[maize_data == "?/?"] <- "-/-"
  write.csv(maize_data, paste0("maize_chr_dsc",i,".csv"), row.names = FALSE)
}
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

For Teosinte

Filtered out teosinte data (Group = ZMPBA, ZMPIL, and ZMPJA) and "teosinte" data frame created.

```
teosinte <- fang_data %>% filter(Group=="ZMPJA"|Group=="ZMPIL"|Group=="ZMPBA")
```

Genotype data ("teosinte") were transposed using t() function so that the columns become rows. "stringsAsFactors = FALSE" prevents converting character columns to factors.

```
teosinte <- as.data.frame(t(teosinte), stringsAsFactors = FALSE)
```

rownames() function is the function that uses to get and set row names for data frames.

```
SNP_ID <- rownames(teosinte)
rownames(teosinte) <- NULL
```

cbind() function stands for column binding and it is normally used to combine vectors, matrices or data frames by columns. It splits matrix columns in data frame arguments and "stringsAsFactors = FALSE" prevents converting character columns to factors.

```
teosinte <- cbind(SNP_ID, teosinte, stringsAsFactors = FALSE)
```

First row was changed into SNP_ID and column 1, column 2, and column 3 were removed.

```
names(teosinte) <-  c("SNP_ID", teosinte[1,-1])
teosinte <- teosinte[-c(1,2,3), ]
```

Transposed teosinte genotype data and snp data were merged by SNP_ID.

```
merged_teosinte <- merge(snp_data, teosinte, by="SNP_ID")
```

A directory was Created for storing generated files for teosinte.

```
dir.create("teosinte_data")
```

mutate() function spcially can add new variables while preserving existing ones. arrange() function arranges rows by variables. Data were sorted based on position and were written to the ouputs as csv files. 10 files were generated (1 for each chromosome) with SNPs ordered based on increasing position values and with missing data.

```
for(i in c(1:10)){
  teosinte_data <- merged_teosinte %>% filter(Chromosome==i) %>% mutate(Position_new=as.numeric(Positio
  teosinte_data$Position_new <- NULL
  write.csv(teosinte_data, paste0("teosinte_chr_asc",i,".csv"), row.names = FALSE)
}
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

Data were sorted based on position and were written to the ouputs as csv files. 10 files were generated (1 for each chromosome) with SNPs ordered based on decreasing position values and with missing data.

```
for(i in c(1:10)){
  teosinte_data <- merged_teosinte %>% filter(Chromosome==i)%>% mutate(Position_new=as.numeric(Position
  teosinte_data$Position_new <- NULL
  teosinte_data[teosinte_data == "?/?"]<-"-/-"
  write.csv(teosinte_data, paste0("teosinte_chr_dsc",i,".csv"), row.names = FALSE)
}
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

Part II

SNPs per chromosome

Plotting the total number of SNPs in the dataset on each chromosome.

is.numeric function checks whether its argument is numerical or not and is.na function checks whether there are missing values. "!" symbol reverses the function of is.na.

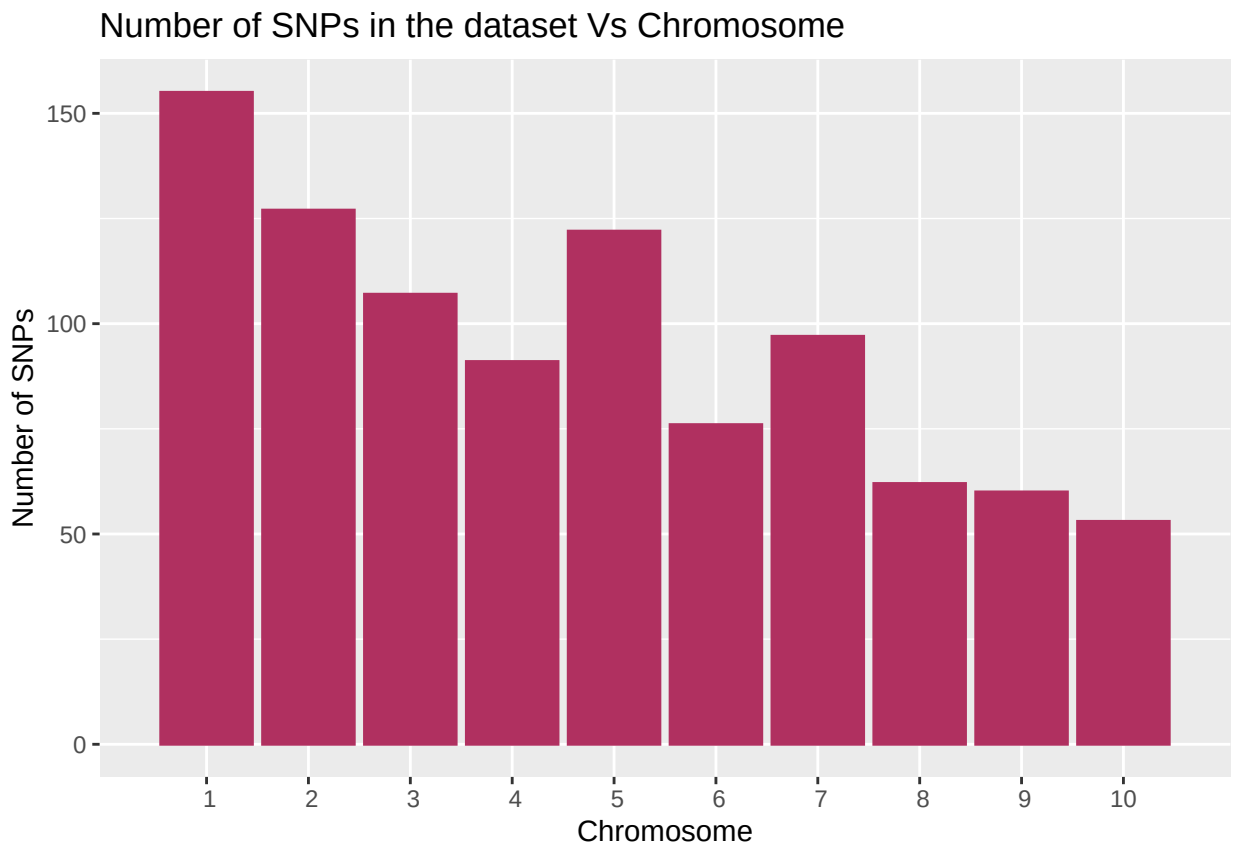
```
snp_data_n <- snp_data[!is.na(as.numeric(snp_data$Chromosome)),]
```

```
## Warning in `[.tbl_df`(snp_data, !is.na(as.numeric(snp_data$Chromosome)), : NAs
## introduced by coercion
```

geom_bar() function was used to plot the bar chart. scale_x_discrete() function was used to set the values for discrete x aesthetic. labs() function was used to label the x and y axes of the graph. Bar chart was colored according to the "Chromosome". ggtitle() function was used to give a title to the graph.

```
ggplot(data = snp_data_n) + geom_bar(mapping = aes(as.numeric(Chromosome)), color = "maroon", fill = "ma
```

```
## Warning: Continuous limits supplied to discrete scale.
## Did you mean `limits = factor(...)` or `scale_*_continuous()`?
```



Plotting the distribution of SNPs on chromosomes.

Reshaping the original data using the pivot_longer() function in the tidyr package. Sample_ID, JG_OTU and Group columns were selected. "names_to" specifies the name of the column as "SNP_ID" and the column was created from the data stored in the column names of "fang_data" data frame. "values_to" specifies the name of the column as "NT" and the column was created from the data stored in cell values.

```
fang_pivot <- fang_data %>% pivot_longer(!c(Sample_ID, JG_OTU, Group), names_to="SNP_ID", values_to= "N
```

fang_pivot data frame was merged by SNP_ID.

```
merged_fang_Pivot <- merge(fang_pivot, snp_data, by="SNP_ID")
```

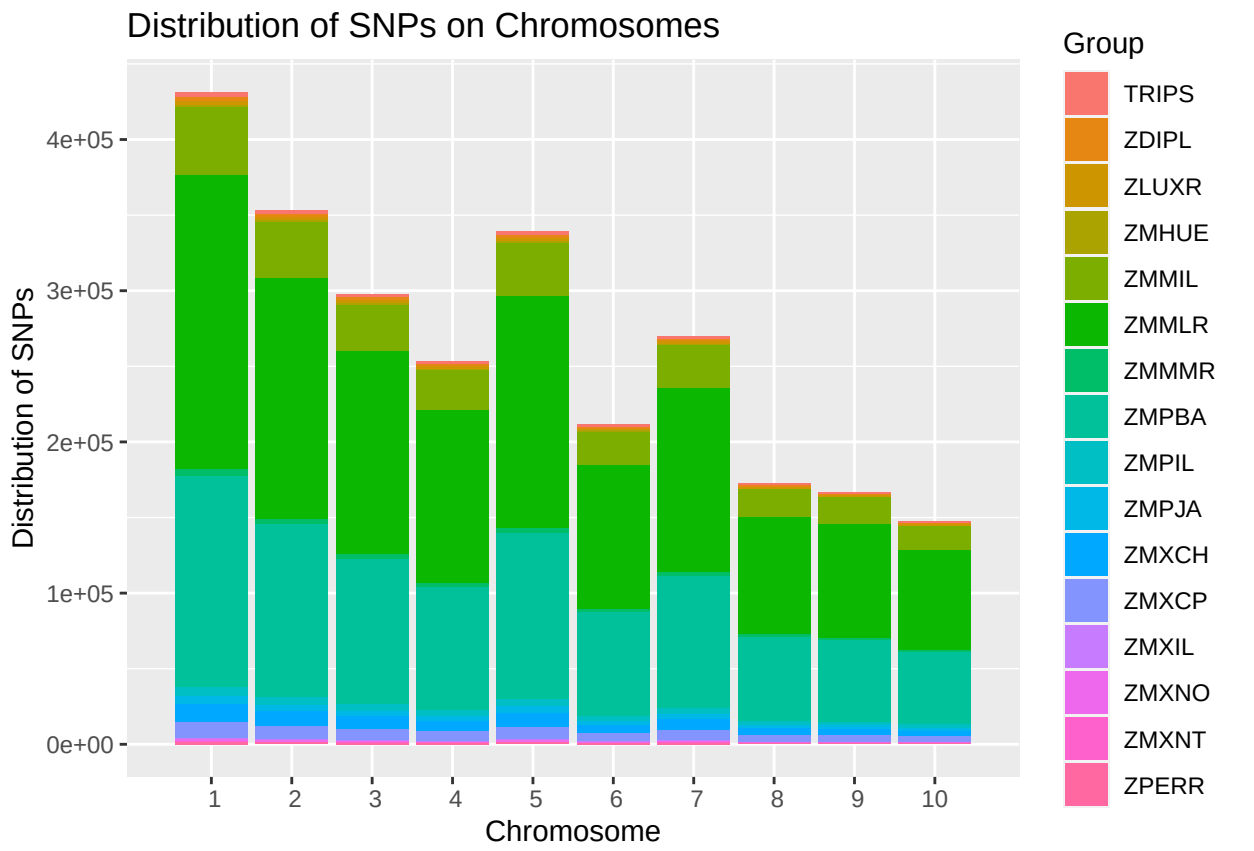
```
merged_fang_Pivot_n <- merged_fang_Pivot[!is.na(as.numeric(merged_fang_Pivot$Chromosome)),]
```

```
## Warning in `[.data.frame`(merged_fang_Pivot, !
## is.na(as.numeric(merged_fang_Pivot$Chromosome)), : NAs introduced by coercion
```

Bar chart was colored and shaded according to the "Group". x and y axes were labeled as Chromosome and Distribition of SNPs.

```
ggplot(data = merged_fang_Pivot_n) + geom_bar(mapping = aes(as.numeric(Chromosome), fill=Group)) + ggti
```

```
## Warning: Continuous limits supplied to discrete scale.
## Did you mean `limits = factor(...)` or `scale_*_continuous()`?
```



Missing data and amount of heterozygosity

Creating a new column named "homo_or_hetero" and indicating all the sites as "Heterozygous".

```
merged_fang_Pivot$homo_or_hetero <- "Heterozygous"
```

Check for the missing data and replace the sites with "Missing Data" in the "homo_or_hetero" column.

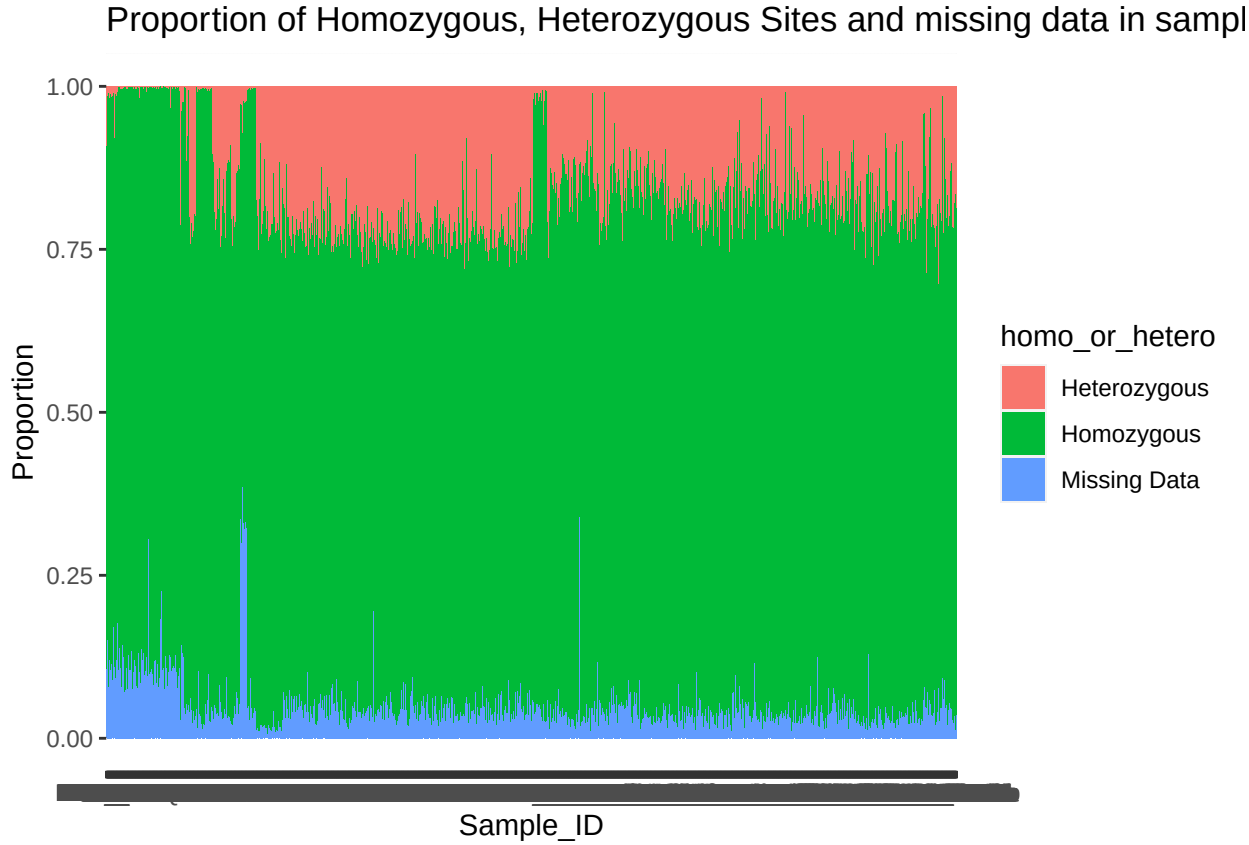
```
merged_fang_Pivot$homo_or_hetero[merged_fang_Pivot$NT == "?/?"] <- "Missing Data"
```

Check for the homozygous sites and replace the sites with "Homozygous" in the "homo_or_hetero" column.

```
merged_fang_Pivot$homo_or_hetero[merged_fang_Pivot$NT %in% c("A/A", "C/C", "G/G", "T/T")] <- "Homozygous
```

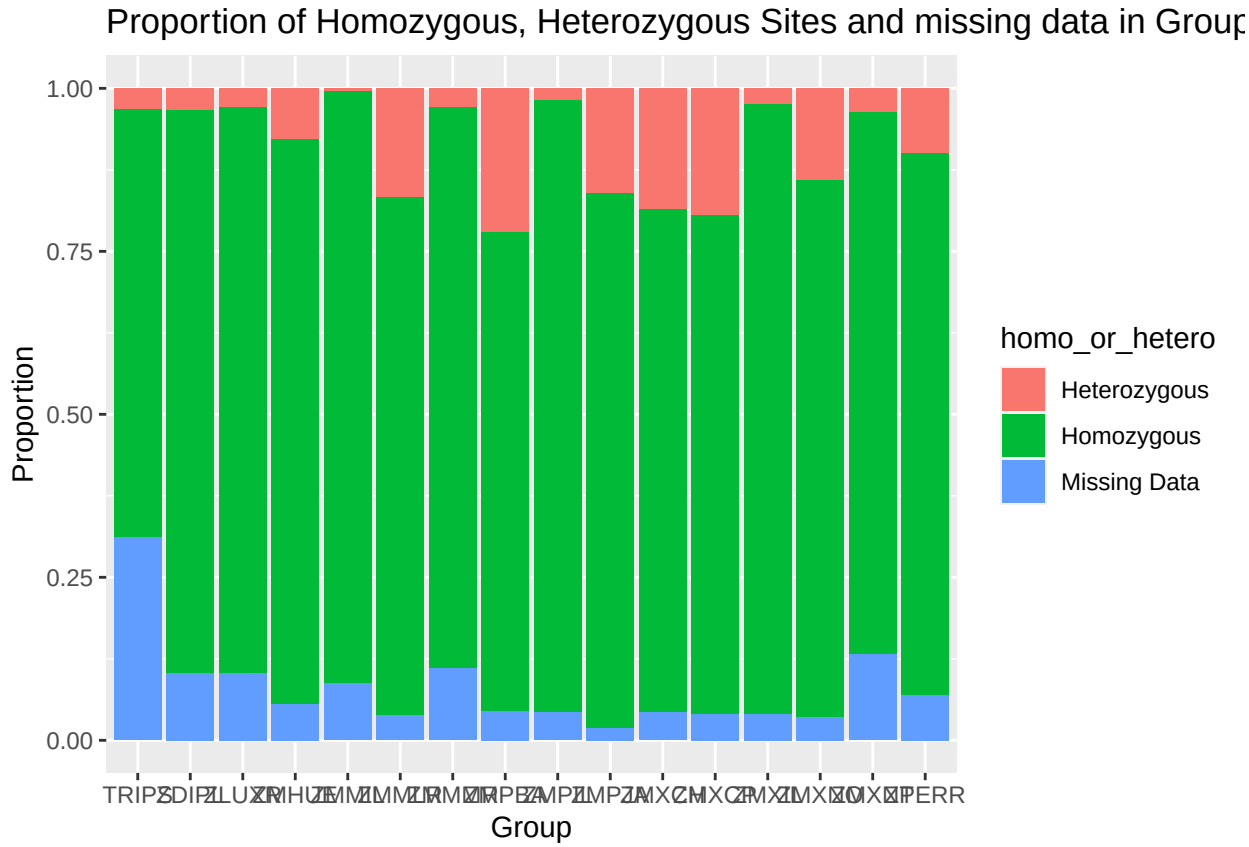
Proportion of homozygous and heterozygous sites as well as missing data in each sample was plotted using ggplot and height of the individual bars were normalized using ggplot's "position adjustment" option. Graph was labeled and titled using labs() and ggtitle() function.

```
ggplot(data = merged_fang_Pivot) + geom_bar(mapping=aes(x = Sample_ID, fill = homo_or_hetero), position
```



Proportion of homozygous and heterozygous sites as well as missing data in each Group was plotted using ggplot and height of the individual bars were normalized using ggplot's "position adjustment" option. Graph was labeled using labs() function.

```
ggplot(data = merged_fang_Pivot) + geom_bar(mapping = aes(x = Group, fill = homo_or_hetero), position =
```



My own visualization

Loading data again since previous data frame was manipulated.

```
snp_data_new = read_tsv("snp_position.txt")
```

```
##
## -- Column specification --------------------------------------------------------
## cols(
##   SNP_ID = col_character(),
##   cdv_marker_id = col_double(),
##   Chromosome = col_character(),
##   Position = col_character(),
##   alt_pos = col_character(),
##   mult_positions = col_character(),
##   amplicon = col_character(),
##   cdv_map_feature.name = col_character(),
##   gene = col_character(),
##   `candidate/random` = col_character(),
##   Genaissance_daa_id = col_double(),
##   Sequenom_daa_id = col_double(),
##   count_amplicons = col_double(),
##   count_cmf = col_double(),
##   count_gene = col_double()
## )
```

New data frame was created selecting only the Chromosome column and gene column.

```
gene_distribution <- snp_data_new %>% select(Chromosome, gene)
```

Duplicate rows which match same gene for same chromosome were removed in order to make the data frame simple for counting genes.

```
deduped.data <- unique( gene_distribution[ , 1:2 ] )
```

Genes per chromosome were counted using count() function.

```
gene_count <- count(deduped.data, Chromosome)
```

Bar plot was generated using ggplot(). "stat='identity' " was included since y values were calculated in the previous step and they were provided separately in the aes() function.

```
ggplot(gene_count, aes(x = Chromosome, y = n, fill = Chromosome)) + geom_bar(stat='identity') + ggtitle
```