

Lab 11 Structural bioinformatics (pt2)

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```
results_dir <- "HIVPrdimer_23119/"
```

```
# File names for all PDB models
pdb_files <- list.files(path=results_dir,
                        pattern="*.pdb",
                        full.names = TRUE)
```

```
# Print our PDB file names
basename(pdb_files)
```

```
[1] "HIVPrdimer_23119_unrelaxed_rank_001_alphafold2_multimer_v3_model_1_seed_000.pdb"
[2] "HIVPrdimer_23119_unrelaxed_rank_002_alphafold2_multimer_v3_model_5_seed_000.pdb"
[3] "HIVPrdimer_23119_unrelaxed_rank_003_alphafold2_multimer_v3_model_4_seed_000.pdb"
[4] "HIVPrdimer_23119_unrelaxed_rank_004_alphafold2_multimer_v3_model_2_seed_000.pdb"
[5] "HIVPrdimer_23119_unrelaxed_rank_005_alphafold2_multimer_v3_model_3_seed_000.pdb"
```

```
library(bio3d)
```

Warning: package 'bio3d' was built under R version 4.3.1

```
# Read all data from Models
# and superpose/fit coords
pdbs <- pdbaln(pdb_files, fit=TRUE, exefile="msa")
```

Reading PDB files:

```
HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_001_alphafold2_multimer_v3_model_1_seed_000
HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_002_alphafold2_multimer_v3_model_5_seed_000
```

HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_003_alphafold2_multimer_v3_model_4_seed_000
HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_004_alphafold2_multimer_v3_model_2_seed_000
HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_005_alphafold2_multimer_v3_model_3_seed_000
.....

Extracting sequences

pdb/seq: 1 name: HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_001_alphafold2_multimer_v3_model_1_seed_000
pdb/seq: 2 name: HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_002_alphafold2_multimer_v3_model_2_seed_000
pdb/seq: 3 name: HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_003_alphafold2_multimer_v3_model_3_seed_000
pdb/seq: 4 name: HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_004_alphafold2_multimer_v3_model_4_seed_000
pdb/seq: 5 name: HIVPrdimer_23119/HIVPrdimer_23119_unrelaxed_rank_005_alphafold2_multimer_v3_model_5_seed_000

pdbs

```

1 . . . . 50
[Truncated_Name:1]HIVPrdimer PQITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGI
[Truncated_Name:2]HIVPrdimer PQITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGI
[Truncated_Name:3]HIVPrdimer PQITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGI
[Truncated_Name:4]HIVPrdimer PQITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGI
[Truncated_Name:5]HIVPrdimer PQITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGI
*****
1 . . . . 50

51 . . . . 100
[Truncated_Name:1]HIVPrdimer GGFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNFP
[Truncated_Name:2]HIVPrdimer GGFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNFP
[Truncated_Name:3]HIVPrdimer GGFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNFP
[Truncated_Name:4]HIVPrdimer GGFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNFP
[Truncated_Name:5]HIVPrdimer GGFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNFP
*****
51 . . . . 100

101 . . . . 150
[Truncated_Name:1]HIVPrdimer QITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGIG
[Truncated_Name:2]HIVPrdimer QITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGIG
[Truncated_Name:3]HIVPrdimer QITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGIG
[Truncated_Name:4]HIVPrdimer QITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGIG
[Truncated_Name:5]HIVPrdimer QITLWQRPLVTIKIGGQLKEALLDTGADDTVLEEMSLPGRWKPKMIGGIG
*****
101 . . . . 150

```

```

                                151          .          .          .          .          198
[Truncated_Name:1]HIVPrdimer  GFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNF
[Truncated_Name:2]HIVPrdimer  GFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNF
[Truncated_Name:3]HIVPrdimer  GFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNF
[Truncated_Name:4]HIVPrdimer  GFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNF
[Truncated_Name:5]HIVPrdimer  GFIKVRQYDQILIEICGHKAIGTVLVGPTPVNIIGRNLLTQIGCTLNF
                                *****
                                151          .          .          .          .          198

```

Call:

```
pdbaln(files = pdb_files, fit = TRUE, exefile = "msa")
```

Class:

```
pdb, fasta
```

Alignment dimensions:

```
5 sequence rows; 198 position columns (198 non-gap, 0 gap)
```

```
+ attr: xyz, resno, b, chain, id, ali, resid, sse, call
```

```
rd <- rmsd(pdb, fit=T)
```

Warning in rmsd(pdb, fit = T): No indices provided, using the 198 non NA positions

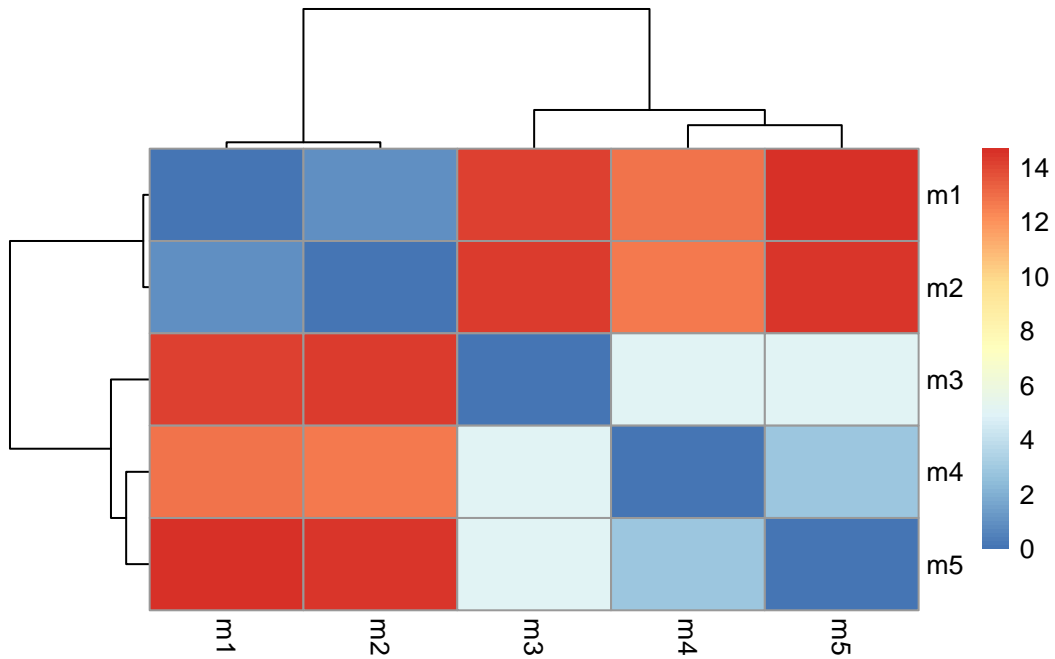
```
range(rd)
```

```
[1] 0.000 14.689
```

```
library(pheatmap)
```

Warning: package 'pheatmap' was built under R version 4.3.2

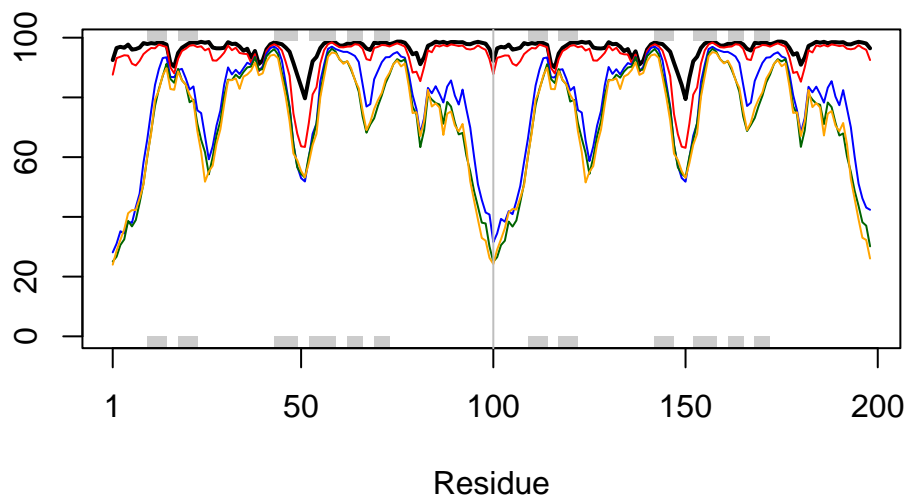
```
colnames(rd) <- paste0("m",1:5)
rownames(rd) <- paste0("m",1:5)
pheatmap(rd)
```



```
pdb <- read.pdb("1hsg")
```

Note: Accessing on-line PDB file

```
plotb3(pdb$b[1,], typ="l", lwd=2, sse=pdb)
points(pdb$b[2,], typ="l", col="red")
points(pdb$b[3,], typ="l", col="blue")
points(pdb$b[4,], typ="l", col="darkgreen")
points(pdb$b[5,], typ="l", col="orange")
abline(v=100, col="gray")
```



```
core <- core.find(pdb)
```

```
core size 197 of 198 vol = 6154.839
core size 196 of 198 vol = 5399.676
core size 195 of 198 vol = 5074.795
core size 194 of 198 vol = 4802.518
core size 193 of 198 vol = 4520.256
core size 192 of 198 vol = 4305.362
core size 191 of 198 vol = 4089.792
core size 190 of 198 vol = 3886.145
core size 189 of 198 vol = 3758.321
core size 188 of 198 vol = 3620.18
core size 187 of 198 vol = 3496.698
core size 186 of 198 vol = 3389.985
core size 185 of 198 vol = 3320.114
core size 184 of 198 vol = 3258.683
core size 183 of 198 vol = 3208.591
core size 182 of 198 vol = 3156.736
core size 181 of 198 vol = 3141.668
core size 180 of 198 vol = 3136.574
core size 179 of 198 vol = 3155.52
core size 178 of 198 vol = 3185.362
```

core size 177 of 198 vol = 3204.487
core size 176 of 198 vol = 3211.978
core size 175 of 198 vol = 3234.993
core size 174 of 198 vol = 3244.062
core size 173 of 198 vol = 3237.845
core size 172 of 198 vol = 3218.77
core size 171 of 198 vol = 3180.743
core size 170 of 198 vol = 3130.369
core size 169 of 198 vol = 3067.881
core size 168 of 198 vol = 2989.546
core size 167 of 198 vol = 2928.272
core size 166 of 198 vol = 2851.193
core size 165 of 198 vol = 2780.877
core size 164 of 198 vol = 2708.433
core size 163 of 198 vol = 2636.516
core size 162 of 198 vol = 2563.25
core size 161 of 198 vol = 2478.024
core size 160 of 198 vol = 2404.793
core size 159 of 198 vol = 2330.997
core size 158 of 198 vol = 2250.477
core size 157 of 198 vol = 2159.432
core size 156 of 198 vol = 2070.759
core size 155 of 198 vol = 1983.579
core size 154 of 198 vol = 1917.913
core size 153 of 198 vol = 1842.556
core size 152 of 198 vol = 1775.398
core size 151 of 198 vol = 1695.133
core size 150 of 198 vol = 1632.173
core size 149 of 198 vol = 1570.391
core size 148 of 198 vol = 1497.238
core size 147 of 198 vol = 1434.802
core size 146 of 198 vol = 1367.706
core size 145 of 198 vol = 1302.596
core size 144 of 198 vol = 1251.985
core size 143 of 198 vol = 1207.976
core size 142 of 198 vol = 1167.112
core size 141 of 198 vol = 1118.27
core size 140 of 198 vol = 1081.664
core size 139 of 198 vol = 1029.75
core size 138 of 198 vol = 981.766
core size 137 of 198 vol = 944.446
core size 136 of 198 vol = 899.224
core size 135 of 198 vol = 859.402

core size 134 of 198	vol = 814.694
core size 133 of 198	vol = 771.862
core size 132 of 198	vol = 733.807
core size 131 of 198	vol = 702.053
core size 130 of 198	vol = 658.757
core size 129 of 198	vol = 622.574
core size 128 of 198	vol = 578.29
core size 127 of 198	vol = 543.07
core size 126 of 198	vol = 510.934
core size 125 of 198	vol = 481.595
core size 124 of 198	vol = 464.672
core size 123 of 198	vol = 451.721
core size 122 of 198	vol = 430.417
core size 121 of 198	vol = 409.141
core size 120 of 198	vol = 378.942
core size 119 of 198	vol = 348.325
core size 118 of 198	vol = 324.738
core size 117 of 198	vol = 312.394
core size 116 of 198	vol = 300.89
core size 115 of 198	vol = 279.976
core size 114 of 198	vol = 263.434
core size 113 of 198	vol = 250.263
core size 112 of 198	vol = 229.592
core size 111 of 198	vol = 209.929
core size 110 of 198	vol = 196.379
core size 109 of 198	vol = 180.628
core size 108 of 198	vol = 167.088
core size 107 of 198	vol = 155.875
core size 106 of 198	vol = 142.595
core size 105 of 198	vol = 128.924
core size 104 of 198	vol = 114.054
core size 103 of 198	vol = 100.936
core size 102 of 198	vol = 90.431
core size 101 of 198	vol = 81.972
core size 100 of 198	vol = 74.017
core size 99 of 198	vol = 66.855
core size 98 of 198	vol = 59.525
core size 97 of 198	vol = 52.263
core size 96 of 198	vol = 43.699
core size 95 of 198	vol = 35.813
core size 94 of 198	vol = 28.888
core size 93 of 198	vol = 20.692
core size 92 of 198	vol = 14.975

```

core size 91 of 198  vol = 9.146
core size 90 of 198  vol = 5.232
core size 89 of 198  vol = 3.53
core size 88 of 198  vol = 2.657
core size 87 of 198  vol = 1.998
core size 86 of 198  vol = 1.333
core size 85 of 198  vol = 1.141
core size 84 of 198  vol = 1.012
core size 83 of 198  vol = 0.891
core size 82 of 198  vol = 0.749
core size 81 of 198  vol = 0.618
core size 80 of 198  vol = 0.538
core size 79 of 198  vol = 0.479
FINISHED: Min vol ( 0.5 ) reached

```

```

core.inds <- print(core, vol=0.5)

```

```

# 80 positions (cumulative volume <= 0.5 Angstrom^3)
  start end length
1    10  25     16
2    27  48     22
3    53  94     42

```

```

xyz <- pdbfit(pdb, core.inds, outpath="corefit_structures")

```

```

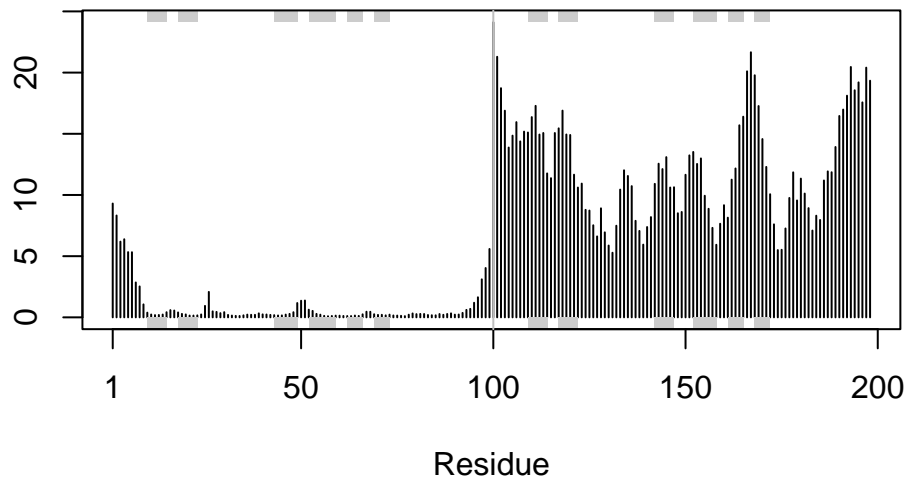
rf <- rmsf(xyz)

```

```

plotb3(rf, sse=pdb)
abline(v=100, col="gray", ylab="RMSF")

```

```
library(jsonlite)
```

Warning: package 'jsonlite' was built under R version 4.3.1

```
# Listing of all PAE JSON files
pae_files <- list.files(path=results_dir,
                        pattern=".*model.*\\.json",
                        full.names = TRUE)

pae1 <- read_json(pae_files[1],simplifyVector = TRUE)
pae5 <- read_json(pae_files[5],simplifyVector = TRUE)

attributes(pae1)
```

```
$names
[1] "plddt"    "max_pae" "pae"      "ptm"      "iptm"
```

```
head(pae1$plddt)
```

```
[1] 92.50 96.56 96.94 96.62 97.69 96.00
```

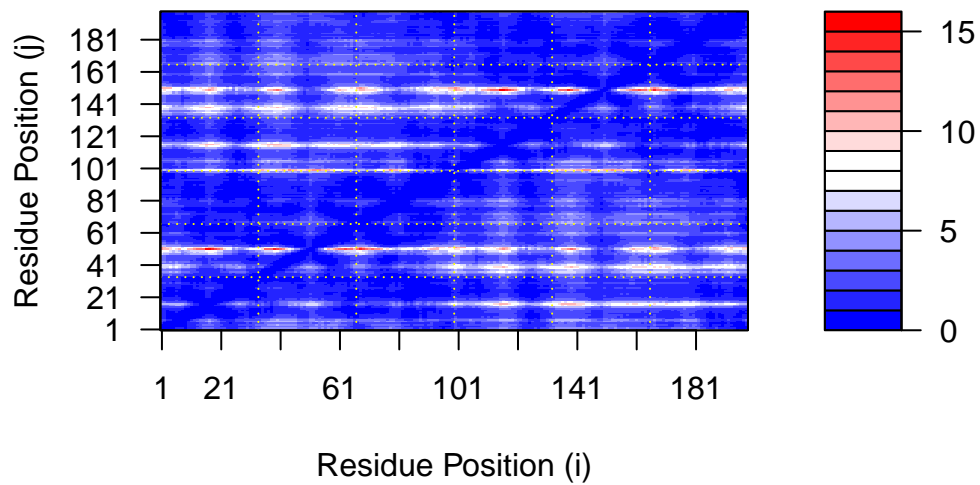
```
pae1$max_pae
```

```
[1] 15.54688
```

```
pae5$max_pae
```

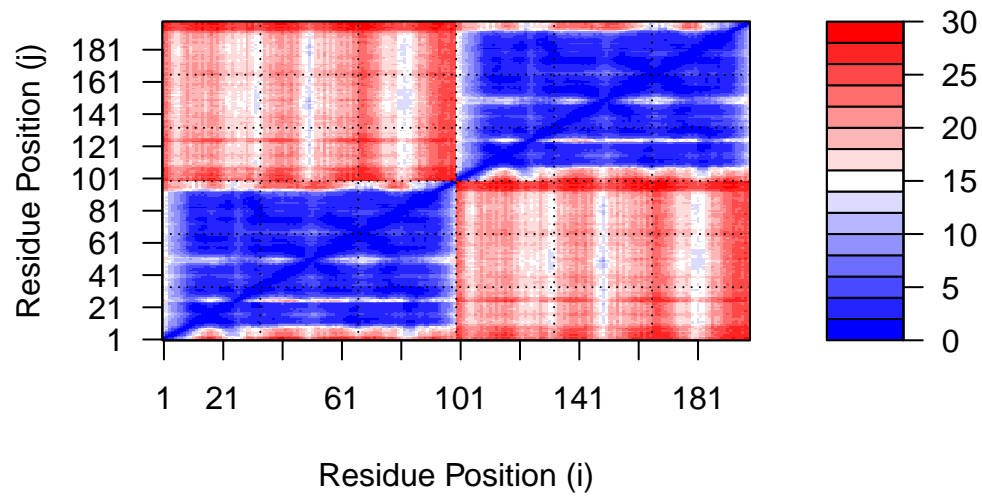
```
[1] 29.29688
```

```
plot.dmat(pae1$pae,  
          xlab="Residue Position (i)",  
          ylab="Residue Position (j)")
```

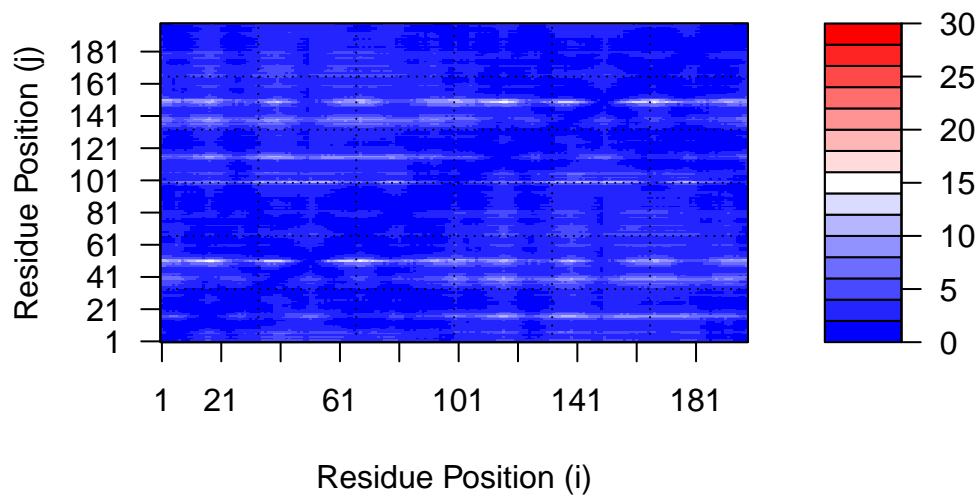


```
plot.dmat(pae5$pae,  
          xlab="Residue Position (i)",  
          ylab="Residue Position (j)",  
          grid.col = "black",
```

```
zlim=c(0,30))
```



```
plot.dmat(pae1$pae,  
  xlab="Residue Position (i)",  
  ylab="Residue Position (j)",  
  grid.col = "black",  
  zlim=c(0,30))
```



```
aln_file <- list.files(path=results_dir,
                       pattern=".a3m$",
                       full.names = TRUE)

aln_file
```

```
[1] "HIVPrdimer_23119/HIVPrdimer_23119.a3m"
```

```
aln <- read.fasta(aln_file[1], to.upper = TRUE)
```

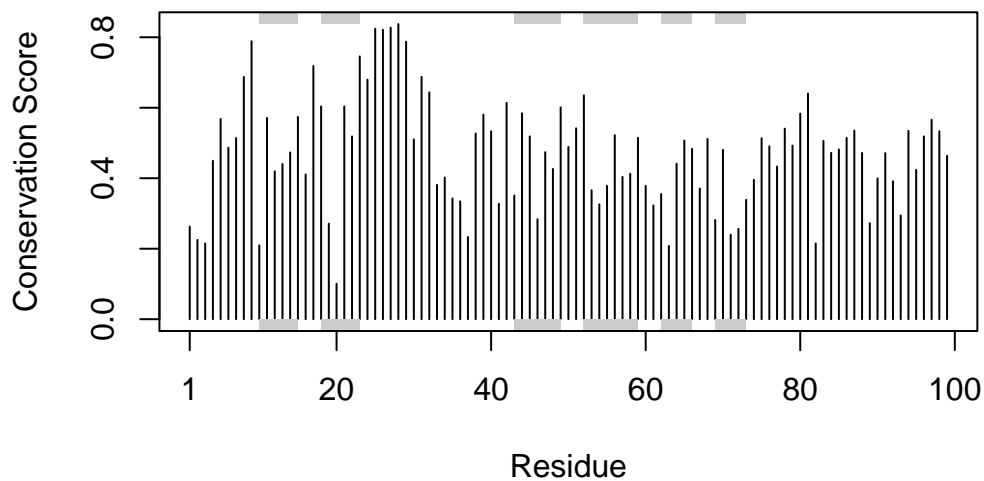
```
[1] " ** Duplicated sequence id's: 101 **"
[2] " ** Duplicated sequence id's: 101 **"
```

```
dim(aln$ali)
```

```
[1] 5378 132
```

```
sim <- conserv(aln)
```

```
plotb3(sim[1:99], sse=trim.pdb(pdb, chain="A"),
       ylab="Conservation Score")
```



```
con <- consensus(aln, cutoff = 0.9)
con$seq
```

```
[1] "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-"
[19] "-" "-" "-" "-" "-" "-" "D" "T" "G" "A" "-" "-" "-" "-" "-" "-" "-"
[37] "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-"
[55] "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-"
[73] "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-"
[91] "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-"
[109] "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-" "-"
[127] "-" "-" "-" "-" "-" "-"
```

```
m1.pdb <- read.pdb(pdb_files[1])
occ <- vec2resno(c(sim[1:99], sim[1:99]), m1.pdb$atom$resno)
write.pdb(m1.pdb, o=occ, file="m1_conserv.pdb")
```