Features of the Bioconductor Packages

Truc Huynh

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Objectives

- Explore features of the Bioconductor Packages
- Query/read/Analyze sequence data

Description

Write R code to do each of the following tasks:

Question 1:

Retrieve the sequence SARS coronavirus MA15 ExoN1 () with accession number FJ882953 from the ACNUC "genbank".

```
# Choose the ACNUC
choosebank("genbank")
My_Que <- query("My_Que", "AC=FJ882953")

# write to fasta file
write.fasta(getSequence(My_Que[['req']][[1]]),getName(My_Que[['req']][[1]]),"
SARS.fasta")
```

Question 2:

Find and plot all potential start and stop codons in the first 1000 bases in the sequence. Use a blue color for the start codons and orange for the stop codons your plot.

Plot potential start and stop sequences.

```
# Get the sequence to vector of characters
My_Seq <- read.fasta("SARS.fasta", as.string = TRUE)

# Convert vector of characters to string
My_SeqS <- My_Seq$FJ882953[1:1000]

# measure length
length(My_SeqS)

## [1] 1000

# conversion of a vector of chars into a string
My_SeqS <- c2s(My_SeqS)
```

```
# find potential start and stop
findPotentialStartsAndStops2(My_SeqS)
```

```
## $positions
##    [1]    13    26    37    48    66    71    89    96    99   115   129
195
##   [13]   212   223   227   295   306   355   369   384   387   418   429
439
##   [25]   448   450   456   484   500   523   531   555   585   598   607
610
##   [37]   628   633   645   654   655   660   664   679   688   696   697
715
##   [49]   720   739   751   759   780   807   820   860   883   922   927
928
##   [61]   933   934   952   961   964   997  1015  1033  1057  1090  1105
1115
##   [73]  1162  1169  1185  1187  1188  1192  1195  1206  1207  1216  1236
1249
##   [85]  1264  1272  1279  1294  1312  1314  1320  1323  1328  1333  1366
1372
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1698
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1948
##  [133]  1976  2018  2025  2028  2068  2089  2110  2113  2119  2131  2143
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##  [253]  3528  3535  3553  3564  3565  3628  3693  3694  3708  3709  3722
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```
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"tga"
## [1921] "tag" "tag" "tag" "atg" "tag" "tga" "tag" "taa" "taa" "taa" "tag"
"taa"
## [1933] "atg" "atg" "taa" "tag" "taa" "atg" "tga" "atg" "taa" "atg" "tag"
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## [1945] "tga" "tga" "atg" "tga" "taa" "tga" "taa" "taa" "tga" "taa" "taa"
"tga"
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"atg"
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"atg"
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"tag"
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"atg"
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"tga"
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"taa"
```

```
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"tga"
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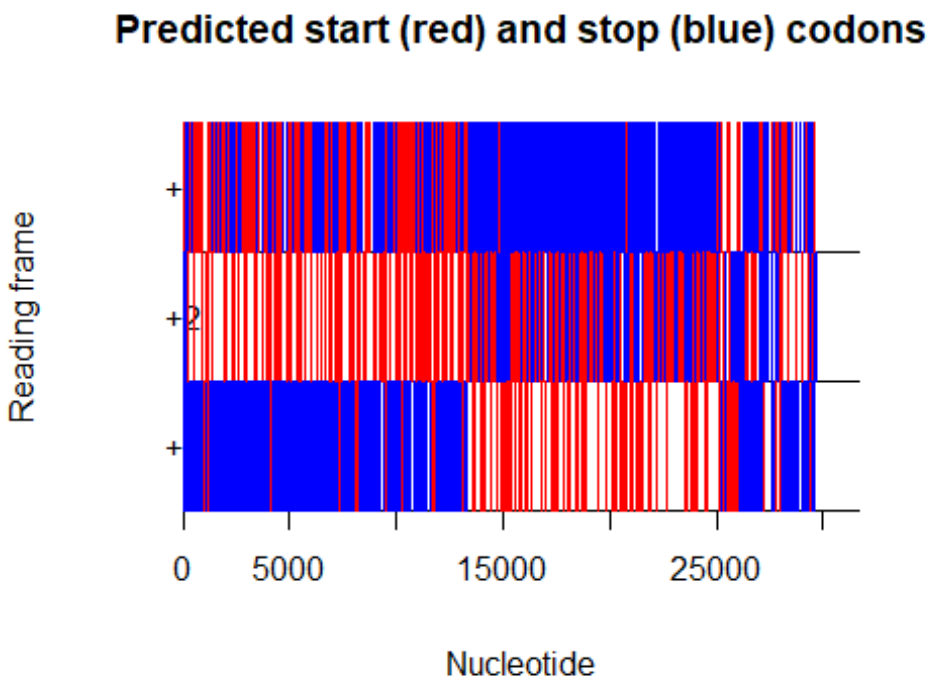
plotPotentialStartsAndStops(My_SeqS)

## [1]     1 31646
```



Question 3:

Find and Plot the potential ORF in the reverse complement of the last 1000 nucleotides in the sequence. Use a green shade in your plot.

```
findORFsinSeq(My_SeqS)
```

```
## [[1]]
##   [1]    66   227   369   429   555   654   696  1033  1192  1206  1216
1294
##  [13]  1314  1333  1438  1464  1566  1635  1884  2113  2157  2254  2265
2466
##  [25]  2583  2658  2742  2766  2845  2922  2955  3270  3283  3336  3360
3399
##  [37]  3441  3507  3528  3834  3864  4020  4122  4153  4198  4215  4296
4327
##  [49]  4335  4407  4479  4518  4596  4926  4995  5122  5161  5229  5370
5484
##  [61]  5515  5623  5631  5751  5922  5950  6048  6378  6432  6531  6669
6784
##  [73]  6948  7336  7347  7440  7461  7650  7773  7788  7801  7932  8037
8116
##  [85]  8227  8241  8280  8412  8553  8665  8790  9018  9096  9121  9166
9180
##  [97]  9282  9384  9510  9538  9588  9660  9873 10029 10294 10302 10371
10378
## [109] 10491 10554 10564 10629 10662 10683 10767 10776 10812 10843 10983
```

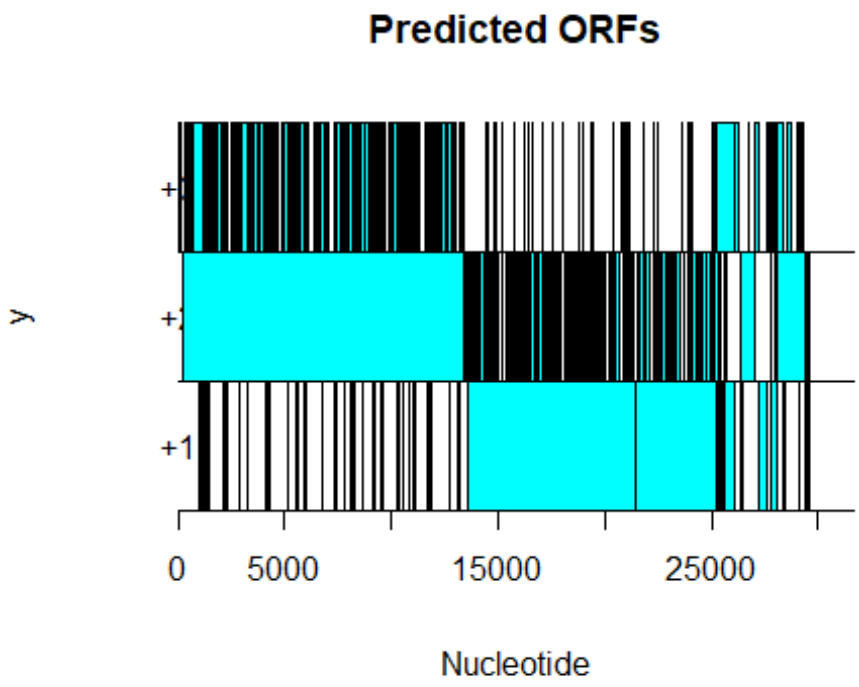
```
11026
## [121] 11152 11211 11259 11295 11589 11664 11710 11827 11844 12018 12066
12111
## [133] 12282 12387 12582 12651 12733 12924 13132 13150 13230 13341 13418
13511
## [145] 13561 13577 13652 13718 13790 13856 13913 13970 14105 14150 14339
14405
## [157] 14453 14514 14543 14666 14783 14856 14879 14894 14969 15155 15195
15353
## [169] 15446 15488 15611 15704 15726 15803 15866 15926 16058 16203 16220
16271
## [181] 16377 16385 16416 16433 16461 16475 16626 16667 16742 16787 16865
16907
## [193] 17052 17060 17079 17115 17192 17210 17249 17291 17498 17538 17573
17750
## [205] 17873 17915 18045 18131 18215 18302 18494 18602 18659 18765 18779
18833
## [217] 18920 18972 18986 19040 19175 19202 19295 19325 19359 19391 19455
19523
## [229] 19619 19796 19883 19928 20000 20168 20357 20379 20411 20483 20678
20811
## [241] 20852 20919 20945 20978 21080 21114 21143 21209 21353 21454 21521
21584
## [253] 21647 21818 21834 21917 22064 22250 22314 22442 22470 22577 22628
22694
## [265] 22889 22967 23114 23219 23375 23643 23666 23888 23909 23916 23933
24054
## [277] 24119 24332 24419 24572 24779 24980 25032 25140 25169 25230 25294
25361
## [289] 25433 25555 25577 25607 25651 26079 26360 26413 26718 27036 27193
27235
## [301] 27600 27604 27741 27776 27826 27921 27953 28016 28082 28092 28405
28477
## [313] 28545 29071 29085 29214 29286 29357 29377 29507 29590
##
## [[2]]
##   [1]    98 13375   386   458   647   662  1187  1059  1197  1238  1251
1314
##  [13]  1322  1368  1479  1565  1589  1700  2030  2121  2252  2265  2342
2582
##  [25]  2600  2672  2747  2855  2892  2936  3257  3329  3291  3356  3374
3440
##  [37]  3458  3527  3743  3839  4016  4055  4133  4173  4239  4259  4319
4341
##  [49]  4349  4448  4514  4577  4661  4991  5108  5160  5169  5354  5444
5549
##  [61]  5532  5634  5675  5894  5981  5958  6059  6416  6503  6596  6812
6804
##  [73]  7034  7398  7388  7448  7646  7730  7781  7850  7821  8018  8147
8142
```

```
##  [85]  8235  8267  8303  8420  8717  8673  8975  9083  9140  9165  9177
9230
##  [97]  9299  9416  9578  9630  9608  9731 10007 10292 10344 10337 10478
10386
## [109] 10547 10628 10593 10652 10673 10733 10775 10808 10913 10869 11138
11046
## [121] 11160 11225 11291 11339 11627 11753 11739 11847 11933 12062 12098
12185
## [133] 12350 12551 12590 12833 12741 12980 13149 13161 13328 13358 13480
13531
## [145] 21447 13651 13690 13759 13831 13867 13939 14008 14146 14320 14386
14410
## [157] 14500 14573 14644 14749 14812 14864 14890 14950 15004 15160 15200
15445
## [169] 15478 15598 15658 15790 15737 15847 15898 16048 16135 16223 16252
16309
## [181] 16385 16423 16430 16456 16466 16657 16646 16690 16786 16810 16870
17041
## [193] 17072 17095 17084 17120 17209 17242 17281 17365 17512 17576 17608
17854
## [205] 17899 17944 18053 18205 18259 18415 18517 18655 18760 18782 18829
18841
## [217] 18970 19001 19021 19159 19195 19249 19309 19369 19400 19432 19475
19618
## [229] 19765 19810 19906 19939 20014 20263 20395 20399 20428 20671 20713
20852
## [241] 20884 20936 20968 21022 21142 21179 21169 21292 21361 25221 21565
21616
## [253] 21775 21907 21839 22063 22069 22396 22325 22576 22493 22618 22636
22888
## [265] 22945 23068 23167 23365 23497 23651 23689 23902 23923 23927 24007
24113
## [277] 24277 24388 24424 24742 24979 25072 25115 25169 25291 26054 25416
25429
## [289] 25453 25563 25594 25654 26115 26309 27025 26478 26744 27227 27216
27603
## [301] 27734 27618 27860 27817 28080 27953 27997 28063 29350 28388 28461
28491
## [313] 28757 29097 29144 29261 29318 29389 29454 29590 29625
##
## [[3]]
##   [1]    33 13149    18    30    93     9   492    27     6    33    36
21
##  [13]     9    36    42   102    24    66   147     9    96    12    78
117
##  [25]    18    15     6    90    48    15   303    60     9    21    15
42
##  [37]    18    21   216     6   153    36    12    21    42    45    24
15
##  [49]    15    42    36    60    66    66   114    39     9   126    75
```

```
66
##  [61]    18    12    45   144    60     9    12    39    72    66   144
21
##  [73]    87    63    42     9   186    81     9    63    21    87   111
27
##  [85]     9    27    24     9   165     9   186    66    45    45    12
51
##  [97]    18    33    69    93    21    72   135   264    51    36   108
9
## [109]    57    75    30    24    12    51     9    33   102    27   156
21
## [121]     9    15    33    45    39    90    30    21    90    45    33
75
## [133]    69   165     9   183     9    57    18    12    99    18    63
21
## [145]  7887    75    39    42    42    12    27    39    42   171    48
6
## [157]    48    60   102    84    30     9    12    57    36     6     6
93
## [169]    33   111    48    87    12    45    33   123    78    21    33
39
## [181]     9    39    15    24     6   183    21    24    45    24     6
135
## [193]    21    36     6     6    18    33    33    75    15    39    36
105
## [205]    27    30     9    75    45   114    24    54   102    18    51
9
## [217]    51    30    36   120    21    48    15    45    42    42    21
96
## [229]   147    15    24    12    15    96    39    21    18   189    36
42
## [241]    33    18    24    45    63    66    27    84     9  3768    45
33
## [253]   129    90     6   147     6   147    12   135    24    42     9
195
## [265]    57   102    54   147   123     9    24    15    15    12    75
60
## [277]   159    57     6   171   201    93    84    30   123   825   123
69
## [289]    21     9    18    48   465   231   666    66    27   192    24
369
## [301]   135    15   120    42   255    33    45    48  1269   297    57
15
## [313]   213    27    60    48    33    33    78    84    36
```

```
plotORFsinSeq(My_SeqS)
```

```
## Contacting Delphi...the oracle is unavailable.
## We apologize for any inconvenience.
```



Question 4:

Extract and translate one potential gene. What is the length of the resultant protein sequence?

```
 Seq_T <- seqinr::translate(s2c(substring(My_SeqS,66,98)))

# get the Length of the potential sequences
length(Seq_T)

## [1] 11
```

Question 5:

For the whole sequence, identify the significant ORFs. Use at least 20 random sequences. Justify your answer.

```
# sequences is pass a a DNA sequences
generateSeqsWithMultinomialModel <- function(sequence, index)
{
  My_Base1 <- count(sequence, 1)

  # Calculate the percentage in sequences
  Pro_Seq <-
    c((My_Base1["a"] / sum(My_Base1) * 100),
      (My_Base1["g"] / sum(My_Base1) * 100),
      (My_Base1["c"] / sum(My_Base1) * 100),
```

```
      (My_Base1["t"] / sum(My_Base1) * 100)
    )
  My_Rad_Seq = {
  }
  for (i in 1:index) {
    My_Rad_Seq <- c (My_Rad_Seq,
                     c2s(sample(
                       c('a', 'c', 'g', 't'),
                       length(sequence),
                       replace = TRUE,
                       prob = Pro_Seq
                     )))
  }
  return (My_Rad_Seq)
}

#generate random sequences
randseqs <- generateSeqsWithMultinomialModel(getSequence(My_Que$req[[1]]),
20)
# find ORF
randseqorflengths <- numeric() # Tell R that we want to make a new vector of
numbers
for (i in 1:20)
{
  # print(i) # Test the loop travelse
  randseq <- randseqs[i] # Get the ith random sequence
  mylist <- findORFsinSeq(randseq) # Find ORFs in "randseq"
  lengths <- mylist[[3]] # Find the lengths of ORFs in "randseq"
  randseqorflengths <- append(randseqorflengths, lengths,
after=length(randseqorflengths))
}

# plot a histogram of the lengths of the ORFs real vs. random
par(mfrow = c(1,2)) # Make a picture with two plots side-by-side (one row,
two columns)
bins <- seq(0,11000,50) # Set the bins for the histogram
hist(randseqorflengths, breaks=bins, col="red", xlim=c(0,1000))

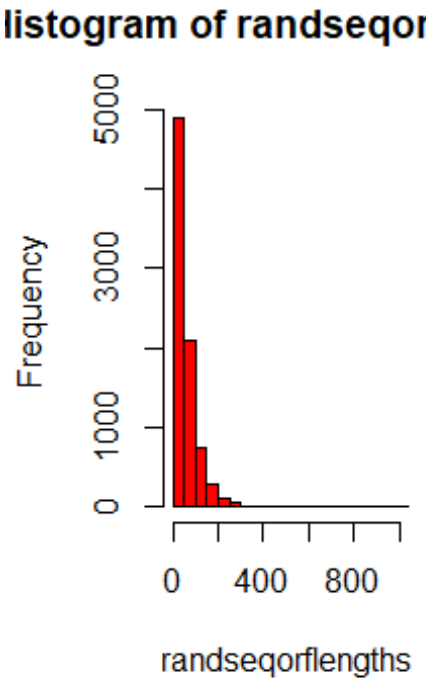
#find the longest random gene
x = max(randseqorflengths)

#use it as a threshold, and discard all ORFs found in the real sequence that
are shorter than this
summary(randseqorflengths > x)

##    Mode   FALSE
## logical    8119

#find and use the 99th quantile as a threshold
quantile(randseqorflengths, probs=c(0.99))
```

```
## 99%
## 225
```



Hint:

define and use a function generateSeqsWithMultinomialModel

Notes:

- Handwritten answers are not allowed!
- Use Rmarkdown (https://rmarkdown.rstudio.com/) and provide a neatly formatted "pdf" file showing both code and output.
- Include your name as a comment at the beginning of the script file.