

Duc Minh Le

Question 1:

$$P(AA | AA) = 1.0$$

$$P(M | AA) = 0.0$$

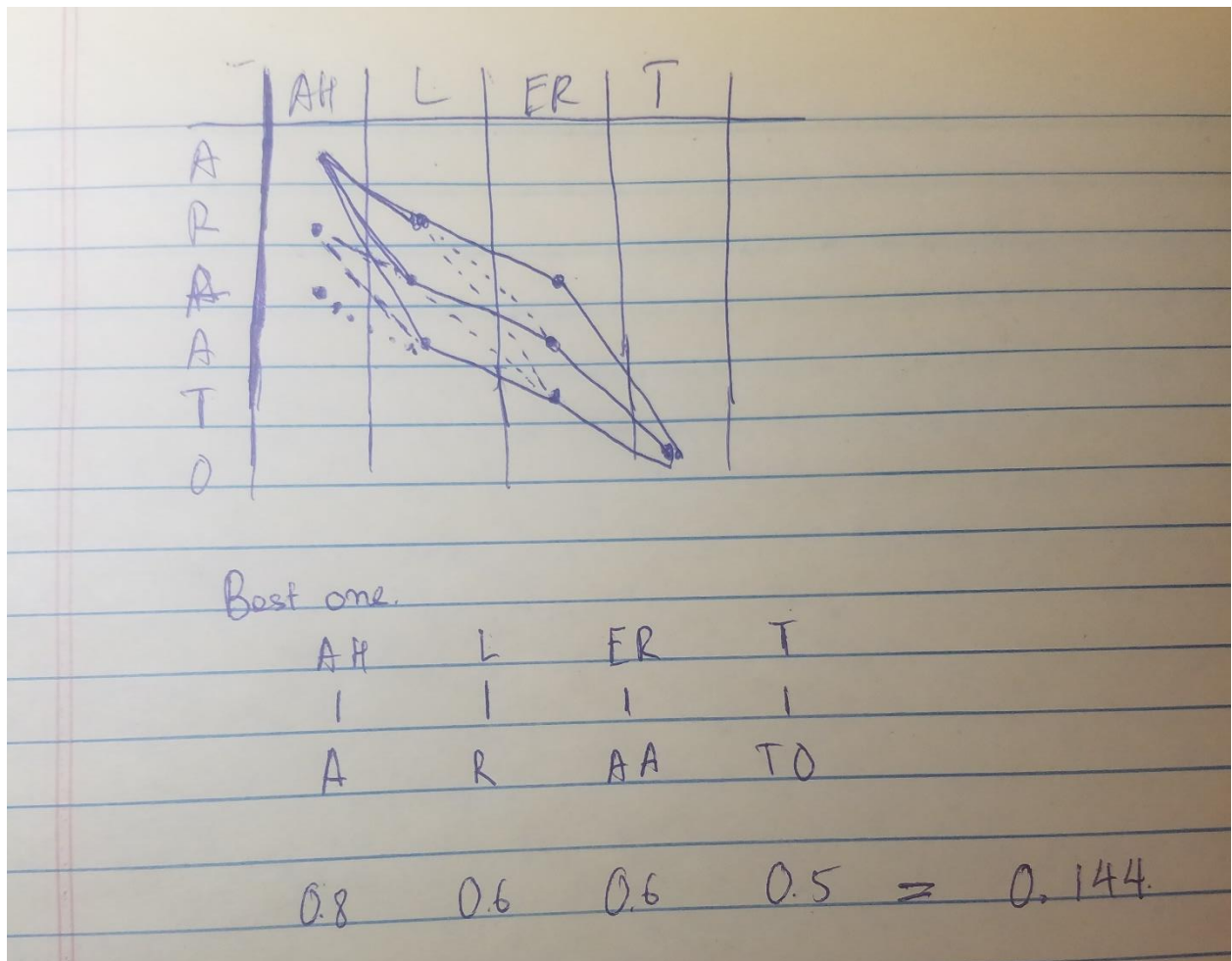
$$P(A | AA) = 0.0$$

$$P(T | T) = 0.33$$

$$P(TO | T) = 0.67$$

$$P(S | T) = 0.0$$

Question 2:



Question 3:

" EY " B " AH " L " " A " B " E " R " U " 1 2 3 4 4 " EY " B " AH " L " " A " B " E " R " U " 1 2 3 3 4 " EY " B " AH " L " " A " B " E " R " U " 1 2 2 3 4 " EY " B " AH " L " " A " B " E " R " U " 1 1 2 3 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 2 3 4 4 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 2 3 3 4 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 2 3 3 3 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 2 2 3 4 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 2 2 2 3 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 1 2 3 4 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 1 2 3 3 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 1 2 2 3 4 " AH " B " AW " T " " A " B " A " U " T " O " 1 1 1 2 3 4	" AH " K " EY " SH " AH " " A " K " A " SH " I " A " 1 2 3 4 5 5 " AH " K " EY " SH " AH " " A " K " A " SH " I " A " 1 2 3 4 4 5 " AH " K " EY " SH " AH " " A " K " A " SH " I " A " 1 2 3 3 4 5 " AH " K " EY " SH " AH " " A " K " A " SH " I " A " 1 2 2 3 4 5 " AH " K " EY " SH " AH " " A " K " A " SH " I " A " 1 1 2 3 4 5 " EY " S " " E " E " S " U " 1 2 2 2 " EY " S " " E " E " S " U " 1 1 2 2 " EY " S " " E " E " S " U " 1 1 1 2 " AE " S " AH " T " OW " N " " A " S " E " T " O " N " 1 2 3 4 5 6
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Question 4:

Iter 1

```
((("EY", ["A"]), ("B", ["B"]), ("AH", ["E"]), ("L", ["R", "U"]))) 0.7055331337167089
((("AH", ["A"]), ("B", ["B"]), ("AW", ["A", "U"]), ("T", ["T", "O"]))) 0.6105988143164557
((("AH", ["A"]), ("K", ["K"]), ("EY", ["A"]), ("SH", ["SH", "I"]), ("AH", ["A"]))) 0.9337147925021705
((("EY", ["E", "E"]), ("S", ["S", "U"]))) 0.8435620239124157
((("AE", ["A"]), ("S", ["S"]), ("AH", ["E"]), ("T", ["T"]), ("OW", ["O"]), ("N", ["N"]))) 1.0
```

Iter 2

```
((("EY", ["A"]), ("B", ["B"]), ("AH", ["E"]), ("L", ["R", "U"]))) 0.9779450858537589
((("AH", ["A"]), ("B", ["B"]), ("AW", ["A", "U"]), ("T", ["T", "O"]))) 0.9731091018443341
((("AH", ["A"]), ("K", ["K"]), ("EY", ["A"]), ("SH", ["SH", "I"]), ("AH", ["A"]))) 0.9981740505800589
((("EY", ["E", "E"]), ("S", ["S", "U"]))) 0.9974489197176026
((("AE", ["A"]), ("S", ["S"]), ("AH", ["E"]), ("T", ["T"]), ("OW", ["O"]), ("N", ["N"]))) 1.0
```

Iter 3

```
((("EY", ["A"]), ("B", ["B"]), ("AH", ["E"]), ("L", ["R", "U"]))) 0.999681334734887
((("AH", ["A"]), ("B", ["B"]), ("AW", ["A", "U"]), ("T", ["T", "O"]))) 0.9958439745750437
((("AH", ["A"]), ("K", ["K"]), ("EY", ["A"]), ("SH", ["SH", "I"]), ("AH", ["A"]))) 0.9999418511601904
((("EY", ["E", "E"]), ("S", ["S", "U"]))) 0.9999780106707825
((("AE", ["A"]), ("S", ["S"]), ("AH", ["E"]), ("T", ["T"]), ("OW", ["O"]), ("N", ["N"]))) 1.0
```

Iter 4

```
((("EY", ["A"]), ("B", ["B"]), ("AH", ["E"]), ("L", ["R", "U"]))) 0.999999064527038
((("AH", ["A"]), ("B", ["B"]), ("AW", ["A", "U"]), ("T", ["T", "O"]))) 0.9980608605658378
((("AH", ["A"]), ("K", ["K"]), ("EY", ["A"]), ("SH", ["SH", "I"]), ("AH", ["A"]))) 0.999979379262994
((("EY", ["E", "E"]), ("S", ["S", "U"]))) 0.9999998193010048
((("AE", ["A"]), ("S", ["S"]), ("AH", ["E"]), ("T", ["T"]), ("OW", ["O"]), ("N", ["N"]))) 1.0
```

Iter 5

```
((("EY", ["A"]), ("B", ["B"]), ("AH", ["E"]), ("L", ["R", "U"]))) 0.9999999979430988
((("AH", ["A"]), ("B", ["B"]), ("AW", ["A", "U"]), ("T", ["T", "O"]))) 0.9991048104259115
((("AH", ["A"]), ("K", ["K"]), ("EY", ["A"]), ("SH", ["SH", "I"]), ("AH", ["A"]))) 0.9999999246114584
((("EY", ["E", "E"]), ("S", ["S", "U"]))) 0.9999999985151161
((("AE", ["A"]), ("S", ["S"]), ("AH", ["E"]), ("T", ["T"]), ("OW", ["O"]), ("N", ["N"]))) 1.0
```

Question 5:

Accuracy: 0.9988822652757079

Question 6:

echo "A" "N" "J" "I" "R" "A" "N" "A" "I" "T" "O" | carmel -srilEWk 5 eword.wfsa eword-epron.wfst epron-jpron-unsupervised.wfst

Input line 1: "A" "N" "J" "I" "R" "A" "N" "A" "I" "T" "O"

(185 states / 365 arcs reduce-> 22/202)

(32007 states / 43490 arcs reduce-> 23126/33756)

(20416 states / 28336 arcs reduce-> 17975/25869)

"ANGELA" "NIGHT"

"ANGELA" "MIGHT"

"ANGELA" "KNIGHT"

"ANGELA" "NATO"

"ENGINE" "NIGHT"

```
echo "S" "U" "CH" "I" "I" "B" "E" "N" "R" "A" "R" "U" "Z" "U" | carmel -srilEWk 5 eword.wfsa eword-epron.wfst  
epron-jpron-unsupervised.wfst
```

```
Input line 1: "S" "U" "CH" "I" "I" "B" "E" "N" "R" "A" "R" "U" "Z" "U"
```

```
(187 states / 388 arcs reduce-> 29/230)
```

```
(20132 states / 27484 arcs reduce-> 13454/20088)
```

```
(11741 states / 16662 arcs reduce-> 10441/15354)
```

```
"STEPHENS" "NEWS"
```

```
"STEPHEN" "RAILS"
```

```
"STEVENS" "NEWS"
```

```
"STEVEN" "RAILS"
```

```
"STEPHEN" "AROUSE"
```

```
echo "D" "O" "N" "A" "R" "U" "D" "O" "T" "O" "R" "A" "N" "P" "U" | carmel -srilEWk 5 eword.wfsa eword-epron.wfst  
epron-jpron-unsupervised.wfst
```

```
Input line 1: "D" "O" "N" "A" "R" "U" "D" "O" "T" "O" "R" "A" "N" "P" "U"
```

```
(219 states / 425 arcs reduce-> 30/236)
```

```
(34929 states / 47437 arcs reduce-> 25202/36862)
```

```
(22135 states / 30728 arcs reduce-> 19424/27971)
```

```
"DONALD" "TRUMP"
```

```
"DONALD" "TRAMP"
```

```
"DONALD" "TRUMPED"
```

```
"DONALD" "TRUMPS"
```

```
"DONALD" "AUTO" "LUMP"
```

```
echo "SH" "Y" "E" "R" "I" "R" "U" "S" "A" "N" "D" "O" "B" "A" "A" "G" "U" | carmel -srilEWk 5 eword.wfsa eword-  
epron.wfst epron-jpron-unsupervised.wfst
```

```
Input line 1: "SH" "Y" "E" "R" "I" "R" "U" "S" "A" "N" "D" "O" "B" "A" "A" "G" "U"
```

```
(251 states / 484 arcs reduce-> 35/268)
```

```
(42040 states / 57225 arcs reduce-> 30071/43994)
```

```
(26522 states / 36896 arcs reduce-> 23366/33716)
```

```
"SHERRILL" "SANDBERG"
```

```
"CHERYL" "SANDBERG"
```

```
"SHARE" "IL" "SANDBERG"
```

```
"SHARE" "ILL" "SANDBERG"
```

```
"SHARE" "NEW" "SANDBERG"
```

Question 7:

Accuracy: 0.7920796184947129

Question 8:

No Reset:

10 loops: 0.8035662450756791

20 loops: 0.8098279079411155

50 loops: 0.817043334024466

10 loops:

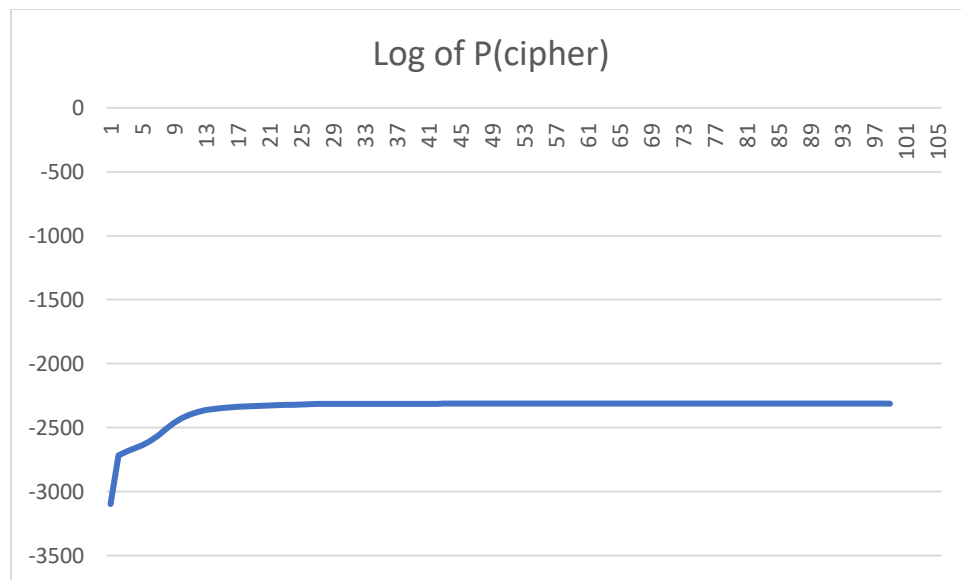
5 resets: 0.8035662450756791

10 resets: 0.8035662450756791

15 resets: 0.8223512336719884

Conclusion: Yes, better result is achievable with more iterations and/or random restarts.

Question 9:



Question 10:

Deciphered texts of 5 iterations:

THED THERED HE T THED THEATED THE HE THEATED HE THERED THED THED THE THE THED THE HE THERE
THERE THERE THED THE THATHED HE HE THERE THATHED T THATHED HE T THED HE HE THEROUTHE THED THE
THED THED HE T THEATED THEREROUTHE THERE THERED THE THE THATHED T THEROUTHE HE THERE THE

THERE T THEATHED THERED HE THE THEATHED THE THEROUTHED HE THERE HE THEATHED HE THERE HE HE THERE
THEATHED HE THERE HE THE THEROUTHE THE HE HE THED THED THE THATHED THEROUTHE THERE THED
THEATHED THERED THE THERE THE THED THEROUTHE THERE THEROUTHE THEATHED THERED THERED HE THE
THEROUTHE THED THEROUTHED THED THE THERE THE HE THERE THERED THE THATHED THEATHED THE THE
THERE THERED THED THE THEROUTHE HE THED THATHED THERE THE T THED HE THED THERE THERE HE THE
THEATHED HE THATHED THED T THERE THEREROUTHE HE THE THERE THERED HE THED THERED HE THE
THEROUTHEROUTHE HE THATHED THE THERE THED THERE THATHED THE THERED HE THATHED HE THERED THED
THE THERE HE THERED THEREROUTHED THATHED THEROUTHED THE THE THED THE THEROUTHE

THED THERED HE T THED THERITHE THE HE THESTHED HE THERED THED THED THE THE THED THE HE THERE THERE
THAND THED THE THERERE HE HE THAND THATHED T WATHERE HE T THED HE HE THATHERED THED THE THED
THED BE T THANTHED THEREROUTHE THEND THERED THE THE THATHED T THERERERED HE THERE THE THAND T
WATHERED THERED HE THE THATHERE THE THEROUTHED HE THERE BE THATHERE HE THAND HE HE ATHED
THANTHED HE THERE HE THE THERITHED THE HE BE THED THED THE THERERE THERITHED THERE THED THEATHED
THERED THE THERE THE THED THEROUTHE WATHE THANTHERE THERERED THERED THATHE BE THE THERITHED
THED THATHESTHE THED THE THERE THE BE THAND THERED THE THATHED THATHERE THE THE THAND THERED
THED THE THEROUTHE HE THED THERERE THAND THE T THED HE THED THAND WATHE HE THE THANTHED HE
THATHED THED T THERE THEREROUTHE HE THE THERE THERED HE THED THERED BE THE THERITHEROUTHED HE
THERIND THE THERE THED ITHE THATHED THE THERED HE THERERE HE THERED THED THE THERE HE WATHED
THEREROUTHED THATHED THEROUTHED THE THE THED THE THERITHED

THED ATHAND HE T THED THERATHE IND HE THERITHE MY THATHE THED THED THE THE THED IND HE WATHE
THERE THAND THED THE THERERE HE HE THAND THATHED T WATHERE MY T THED HE HE INTATHED THAT THE
ITHE THED MY T THANTHED THEREATHAND THEND THERED THE THE THATHED T THEDERERED MY THEDE IND
THAND T WATHERED INTHE MY THE THATHERE THE THESTHATHE MY WATHE BE THATHEND HE THAND HE HE
ATHED THANTHED HE THERE MY IND THERITHED THE TH BE THED ITHE THE WATHERE THERETHED THERE THED
THANTHED WATHED IND THERE THE THED THEROUTHE WATHE THANGHERE THERERED THERED THATHE MY THE
THEATHAND THAT THATHESTHE THED IND WATHE THE BE THAND THERED THE THATHED THATHERE THE THE
THAND ATHAND THED THE THEROUTHE MY THED WATHERE THAND IND T THED MY THED THAND WATHE HE THE
THATHAND HE THATHED THED T THERE HEDERERITHE MY THE THERE BERIND TH THED THERED MY THE
THERITHATHEATHE MY THERIND THE THERI THED ITHE THATHED THE HEATHE MY WATHERE HE THERED THED
IND THEM MY HE WATHED ATHEREROUTHE THATHED THATHERIND THE THE THED THE THANTHERE

THED ATHAND HE T THED THERATHE IND HE THERATHE MY THATHE THED THAN THE THE THED IND HE ITHE
THERE THAND THED THE BUTHERE HE HE THAND THEREDE T WATHERE MY T WAND HE HE INTATHED THAT THE
ITHE THED MY T THATHEND THEREATHIND THEND THEAND THE THE THEMERE T WANDERERED MY THEDE IND
THAND T WATHERED ANTHED MY THE THATHERE THE MERERITHAN MY WATHE BE THATHEND HE THAND HE HE
ATHED THANTHED HE THERE MY IND THERATHED THE TH BE THED ITHE THE WATHERE THERETHED THERE THED
THANTHED THANDE IND THERE THE THED THEROUTHE WATHE THANGHERE THERERED THEAND THATHE MY THE
THEATHAND THAT THATHESTHE THED IND WATHE THE BE THAND ANDEND THE THATHED THATHERE THE THE
THAND ATHAND WATH THE THANOUTHE MY THED WATHERE THAND IND T THED MY THED THAND BUTHE HE THE
THATHAND HE THATHED WATH T THERE HEDERERITHE MY THE THERE MYOTHE TH THAN THAVED MY THE
THERATHATHEATHE MY THERIND THE THEAT HERE ITHE THATHED THE HEATHE MY WATHERE HE THERED THED
IND THEM MY IN WATHED ATHEREROUTHE THATHED BOUTHERIND THE THE WATH THE THANGHERE

THAS ATHIND AS T THED THERATHE IND AT THERATHE MY THATHE THED THIN THE THE THED IND AS ITHEED THERE
 WAVED THED AND BERITHE IT HE THAND THAREDE T JUTHERE MY T WAND AT AS TOFOUTHED THAT THE THAN
 THED MY T STHEREND THEREXTHIND THENDE THEAND AND WAD THEMERE T WANDERERED MY THEDE IND THAND
 T WATHEAND ANTHEDE MY THE WANHERE THE MERERITHAN MY WATHE BE THATHEND AS THIND HE IT ATHED
 THINTHEDE HE THERE MY IND WAREATHED THE TH BE THED NGHE THE WATHERE THERETHED THERE THED
 THANHAD STHEDE IND THERE THE THED THEROUTHE WATHE THANGHERE THERERED THEAND THATHE MY THE
 THEATHAND THAT THATHESTHE THED IND BEVER THE BE THAND ANDEND THE BOUTHED THAINTHE THE THE
 THAND ATHIND WATH THE THANHAIN MY THAS WATHERE THAND IND T THED MY HIND THAND BUTHE HE THE
 THATHIND AS WAVERED WATH T THERE ANDERERITHE MY THE THERE MYOTHE TH WAVE THAVED MY THE
 HANGATHATHEATHE MY INGHIND THE THOUT HERE ITHEED INTHAND THE HEATHE MY WATHERE HE THERED THED
 IND THEM IN INTHED ATHEREROUTHE THATHED BOUTHERIND THE THE WATH AND THINGHERE

THAS ATHIND AS T THED WANGUTHE IND AT THESATHE MY WASTHE THED THIN THE THI THED IND AS MBOUT
 THERE WAVED THED AND BERISTH IT IS THAND OUTHEDE T JUTHERE MY T WAND AT AS TOFOUTHED THAT THE
 THAN AIND MY T STHEREND THEREXTHIND THENDE HALAND AND WAY THEMORE T WANDERERED MY THEDE IND
 THAND T WATHEAND OUTHED MY THE WANHERE THE MERERITHAN MY WATHE BE THATHEND AS THIND HE IT
 HEAST STEWATH IS THERE MY IND WAREATHED THE TH BE THEN NGHE THE WATHERE OUTHEWAND THERE
 THED THANHAD THINDE IND THERE THE THED WASERITHE WATHE THANDINGE THEANGED THEAND THATHE MY
 THE THEASAVED THAT THATHESTHE THED IND BEVER THE BE THAND ANDEND THE BEASTHE THEMESTH BUT THE
 THAND ATHIND WATH THE TOREXTHAN MY THAS WATHERE THAND IND T WAND MY HIND THAND BEATH IN THE
 THATHAST AS WAVERED WATH T DENDE ANDENGHATHE MY THE THERE MYOTHE TH WATH THAVED MY THE
 HANGACOUTHEATHE MY INGHIND THE THOUT HERE ITHEN ISTHAND THE HEATHE MY WATHERE HE THERED THED
 IND THEM IN INTHED ATHEREROUTHE THACAVE BOUTHERIND THE THE WATH AND THARERERE

Question 11:

After 100 Iteration:

THIS ISHAND IS I VERY SINGULAR ONE IT CONSISTS OF HITTHE EMEY THAN THE SEA SAND AND IS ATOUT THREE WALES LONG
 ITS BREASTH AT NO POINT EXCKEDS I QUARTER OF I WALE IT IS SEPARATED FROM THE WAIN HAND MY I SCARCEMY
 PERCEPLITHE CREED OOWING ITS WAY THROUGH I WALDERNESS OF REEDS AND SHIME I FAVORITE RESORT OF THE WARSTHEN
 THE VEVELATION AS WIGHT BE SUPPOSED IS SCANT OR AT HEAST DWARBISH NO TREES OF ANY WAGNITUDE ARE TO BE SEEN
 NEAR THE WESTERN EXTREMALY WHERE FORT WOULLIE STANDS AND WHERE ARE SOME WASERATHE FRAME BUIDINGS
 TENANTED JURING SUMBER MY THE BUGITIVES FROM CHARMESTON JUST AND BEVER WAY BE FOUND INDEED THE BRISTHY
 PALLELO BUT THE WHOME ISHAND WITH THE EXCEPLION OF THIS WESTERN POINT AND I HINE OF HARD WHITE BEACH ON
 THE SEACOAST IS COVERED WITH I DENSE UNDERGROUTH OF THE SWEED MYOTHE SO MUCH PRIZED MY THE
 HORTICULLURISTS OF ENGHAND THE SHOUT HERE OFTEN ALLAINS THE HEAGHT OF FIFTEEN OR THENTY BEED AND FORMY AN
 ALLOST IMPENETRATHE COPPICE BURTHENING THE AIR WITH ITS FRIGRANCE

Question 12:

Substitution table

original: A B 0.03846153846153846 D 0.25011262554473856 M 0.6840837657651452 Q 0.06579659011942897 original: B	original: K B 0.03846153846153846 N 0.045449347656833915 P 0.05209269813245435 Q 0.3806685936587556 S 0.5072474057463239	original: S B 0.03846153846153846 H 0.04334015017256756 N 0.95665976458123 original: T B 0.03846153846153846
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B 0.03846153846153846 L 0.5046982080108456 N 0.04621760057591821 P 0.12763362666971215 R 0.030775840762670113 Y 0.29067474133466825 original: C B 0.03846153846153846 I 0.8570342473607785 N 0.1429586104312593 original: D B 0.03846153846153846 H 0.6702439314949041 N 0.08689756388065323 O 0.08151722521367506 S 0.13593634231986493 V 0.02540491883461436 original: E B 0.03846153846153846 Q 0.9994988280440031 original: F B 0.03846153846153846 Y 0.9999999307764458 original: G B 0.03846153846153846 H 0.09274422964378544 T 0.9068988377627346 original: H A 0.030580083806157114 B 0.03846153846153846 F 0.17451987479603293 G 0.7664989548971223 W 0.028394856086975815 original: I B 0.03846153846153846 D 0.6872354091383064 M 0.3127617654820192 original: J B 0.03846153846153846 H 0.6787190430392488 N 0.32117691684360705	original: L B 0.03846153846153846 F 0.3440821819596102 P 0.0651555736653841 S 0.4395566216475707 W 0.1493606255280218 original: M B 0.03846153846153846 F 0.23407241942247214 L 0.13390688983951457 O 0.07261599354559045 P 0.5525965194108414 original: N B 0.03846153846153846 F 0.033656593117837176 O 0.9106894848577991 W 0.055653804033586086 original: O B 0.03846153846153846 D 0.015928729077565974 E 0.9416914837327649 W 0.04237961211325939 original: P B 0.03846153846153846 I 0.019024000699857508 R 0.9809759983386046 original: Q B 0.03846153846153846 H 0.38025221711522034 Z 0.6197476806255261 original: R B 0.03846153846153846 O 0.01801806054416551 W 0.9819819367757323	G 0.01969629257299576 L 0.07113908307834037 S 0.9091536476280997 original: U A 0.04940273482404921 B 0.03846153846153846 C 0.8580650060072563 D 0.06430559305966943 M 0.028220261055685803 original: V B 0.03846153846153846 F 0.06861434926419961 J 0.03842830107602761 K 0.7996811601320593 T 0.09245173714563247 original: W A 0.6160607613679495 B 0.03846153846153846 F 0.017677306172460265 J 0.044589816854263345 P 0.301651955557178 R 0.017042249492190572 original: X B 0.03846153846153846 R 0.12743660325518041 U 0.8725633967448193 original: Y B 0.03846153846153846 N 0.3262553088580819 X 0.6736213035410267 original: Z B 0.03846153846153846 J 1.0 original: " " " " 1.0
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