11.a)Implemented in code hmm\_new

B) When SHIFT =3

Screen%20Shot%202019-02-09%20at%2011.20.12%20AM.png

Since my plaintext has space included I have denoted it by \*.

PT: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z \*

CT: d e f g h i j k l m n o p q r s t u v w x y z \* a b c

Final value of pi matrix

0.0 1.0

Final value of b matrix

0.036776 | 0.000000 y A

0.000000 | 0.000000 z B

**0.000000 | 0.352434 \* C**

**0.008040 | 0.182117 a D**

0.030969 | 0.000000 b E

0.030144 | 0.017470 c F

0.061939 | 0.000000 d G

**0.000000 | 0.149266 e H**

0.032905 | 0.000000 f I

0.063675 | 0.000213 g J

0.096774 | 0.000005 h K

**0.000000 | 0.130608 I L**

0.000000 | 0.000000 j M

0.019356 | 0.000000 k N

0.073838 | 0.005914 l O

0.040647 | 0.000000 m P

0.121942 | 0.000000 n Q

**0.000000 | 0.120242 o R**

0.040641 | 0.000007 p S

0.001936 | 0.000000 q T

0.079359 | 0.000000 r U

0.086289 | 0.000870 s V

0.110046 | 0.014814 t W

**0.008593 | 0.026040 u X**

0.009678 | 0.000000 v Y

0.042583 | 0.000000 w Z

0.003871 | 0.000000 x \*

So,the state 1 corresponds to vowel and white space(highlighted ones) and state 2 corresponds to consonants.

c)Diagraph matrix based on 100000 english plain text including white space.

Normalised Diagraph matrix

5.26362E-4 0.02234532 0.04584362 0.04084318 0.0012281779 0.007118419 0.021856554 0.0017044102 0.03427619 0.001140451 0.010928277 0.10103643 0.027195368 0.18920206 6.2662136E-4 0.019700976 1.8798641E-4 0.10594914 0.0936047 0.14424825 0.01084055 0.020315066 0.0063915383 0.0015916183 0.02194428 0.0013785671 0.067975886 Row Stochastic sum--->0.9999999924912117

0.07575848 0.0124468915 0.0017952247 0.0017952247 0.28448328 0.002034588 0.0039494946 0.0052659926 0.058703847 0.011369756 8.9761236E-4 0.14876428 0.005026629 0.002034588 0.10232781 0.001675543 2.992041E-4 0.05505356 0.01962779 0.005684878 0.09807911 0.0028125187 7.1808987E-4 0.0038896536 0.07767339 2.992041E-4 0.017533362 Row Stochastic sum--->1.0000000047730282

0.122994006 0.016199358 0.016411312 0.001059771 0.14697511 3.633501E-4 3.0279174E-4 0.13988978 0.0645552 1.5139587E-4 0.040210743 0.03924181 8.478169E-4 6.055835E-4 0.19015321 5.753043E-4 0.0012717253 0.03887846 0.005208018 0.09807424 0.032459274 1.5139587E-4 4.2390844E-4 1.5139587E-4 0.010446315 1.8167504E-4 0.03221704 Row Stochastic sum--->0.9999999912251951

0.03707715 0.006045188 0.003022594 0.011813304 0.15221278 0.0036774892 0.0056673638 0.00513841 0.09997229 0.0015868618 4.7857736E-4 0.010679832 0.0052139745 0.006725271 0.043147527 0.0025188283 4.5338908E-4 0.019823179 0.029696984 0.012443012 0.031611294 0.0045842673 0.005188786 1.2594141E-4 0.0124682 1.2594141E-4 0.48850155 Row Stochastic sum--->0.9999999903084245

0.04967338 0.0024674565 0.030107714 0.082296 0.025892476 0.012281923 0.008976163 0.002831248 0.012416367 3.954257E-4 0.0013286304 0.034670927 0.024745742 0.09159641 0.006856682 0.011775778 0.0033532102 0.12789649 0.0818294 0.032069024 0.0019138604 0.01682932 0.009964728 0.011609699 0.01017035 3.5588315E-4 0.3056957 Row Stochastic sum--->0.9999999911524355

0.058070455 0.0011296126 0.0018826877 0.0014224751 0.074136056 0.050832566 5.8572507E-4 0.0015898251 0.10074471 4.1837504E-4 2.0918752E-4 0.022759601 0.0011296126 9.6226257E-4 0.17283073 0.0013388001 2.0918752E-4 0.068990044 0.0033051628 0.03485064 0.03284244 2.9286253E-4 0.0011296126 2.0918752E-4 0.0031378127 2.0918752E-4 0.3647812 Row Stochastic sum--->1.0000000167929102

0.06681526 0.0027354236 0.0022288638 0.0018236159 0.15855326 0.0029380477 0.011448255 0.10085609 0.07132364 0.0020262399 2.5327998E-4 0.029025884 0.0063319993 0.022339294 0.05754521 0.0025834558 3.0393596E-4 0.09021833 0.022440607 0.01960387 0.029380478 5.0655997E-4 0.0029380477 2.5327998E-4 0.006889215 3.5459196E-4 0.28828326 Row Stochastic sum--->0.9999999863503035

0.14294353 0.0011527705 0.0018519919 6.4252777E-4 0.48265174 7.3701714E-4 5.291405E-4 8.5040444E-4 0.1325119 3.5905963E-4 3.2126388E-4 0.002116562 0.0023811324 0.005291405 0.075856075 7.55915E-4 3.9685538E-4 0.012756066 0.0034205155 0.022431778 0.011584398 2.6457026E-4 0.0016630131 9.4489376E-5 0.0075402525 4.1575328E-4 0.088479854 Row Stochastic sum--->0.9999999816718628

0.027786957 0.009610428 0.072666466 0.03501791 0.03897048 0.019908259 0.027073115 2.643859E-4 0.0014541225 1.1897365E-4 0.0054066917 0.058601134 0.035533465 0.25772336 0.08218436 0.010020225 0.0012426138 0.03304824 0.11611829 0.11488889 0.0011368594 0.027509352 2.511666E-4 0.002511666 7.931577E-5 0.0069665685 0.013906699 Row Stochastic sum--->0.9999999969004421

0.11612176 0.0028184892 0.0028184892 0.0028184892 0.20011275 0.0028184892 0.0028184892 0.0028184892 0.06257046 0.0028184892 0.0028184892 0.0028184892 0.0028184892 0.0028184892 0.26719278 0.0028184892 0.0028184892 0.006764374 0.0028184892 0.003382187 0.27621195 0.0028184892 0.0028184892 0.0028184892 0.0028184892 0.0028184892 0.014092446 Row Stochastic sum--->0.9999999976716936

0.02631579 0.002583145 0.0017759121 0.004036164 0.330804 0.0041976105 0.00516629 0.01453019 0.13852115 0.0029060382 0.001130126 0.024216983 0.0032289312 0.07636423 0.010978366 0.002583145 9.686794E-4 0.0027445916 0.057959314 0.007265095 0.0029060382 0.0012915725 0.0046819504 8.072328E-4 0.011947045 8.072328E-4 0.25928319 Row Stochastic sum--->0.9999999954015948

0.093958944 0.0038475073 0.0036363637 0.061067447 0.15953079 0.012504399 0.0013372434 0.0011260997 0.12032845 2.346041E-4 0.005489736 0.11542522 0.0063108504 0.0015483871 0.09541349 0.0059120236 2.1114369E-4 0.002627566 0.02456305 0.022475073 0.026604105 0.005958944 0.0032140762 1.1730205E-4 0.08652199 1.8768328E-4 0.1398475 Row Stochastic sum--->0.9999999909705366

0.17831635 0.032783046 0.0022245639 3.9027436E-4 0.2470827 0.0017562347 0.0016391523 8.586036E-4 0.1089646 2.7319207E-4 2.7319207E-4 0.0017172073 0.030870702 0.0029660852 0.105452135 0.067010105 1.9513718E-4 0.009171448 0.031768333 0.0025367835 0.038481053 3.122195E-4 0.0011708231 1.9513718E-4 0.013932794 1.9513718E-4 0.11946298 Row Stochastic sum--->0.9999999911669875

0.038004685 0.0018572676 0.044907067 0.14223343 0.083951265 0.0073874895 0.113570526 0.0026057188 0.041497458 0.0013583002 0.006001469 0.008440865 0.0040055993 0.010298133 0.049411636 0.0017602461 5.959889E-4 0.0018711278 0.0565635 0.121540144 0.009300198 0.004975814 0.0026472993 2.9106432E-4 0.012668229 5.266878E-4 0.23172878 Row Stochastic sum--->0.9999999876599759

0.009192975 0.01874646 0.024617603 0.019609105 0.003965597 0.11071484 0.008716589 0.0027424423 0.008806716 7.725189E-4 0.0071715508 0.037338413 0.05593037 0.17774373 0.025557501 0.02492661 1.5450378E-4 0.12843128 0.02918834 0.042424165 0.09682237 0.020162744 0.034737602 0.0022145542 0.004519236 5.5363856E-4 0.104238555 Row Stochastic sum--->1.0000000087748049

0.11289799 9.732586E-4 4.6345647E-4 4.171108E-4 0.18505816 0.0012513325 5.098021E-4 0.02790008 0.046762757 2.3172823E-4 6.024934E-4 0.093293786 0.009222783 4.171108E-4 0.13078742 0.059554156 2.3172823E-4 0.1739352 0.021179961 0.031329658 0.040876858 2.780739E-4 0.0016220976 2.3172823E-4 0.0034759233 2.3172823E-4 0.056263614 Row Stochastic sum--->1.0000000007858034

0.0042123 0.0042123 0.00505476 0.0042123 0.0042123 0.00505476 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.00505476 0.8820556 0.0042123 0.0042123 0.0042123 0.0042123 0.0042123 0.01010952 Row Stochastic sum--->0.9999999757856131

0.08167509 0.003695054 0.015707979 0.021802418 0.23697934 0.0054705995 0.012380831 0.0034071277 0.08650585 2.3993857E-4 0.011980933 0.012828716 0.021626463 0.020458763 0.10202188 0.0071661654 1.2796724E-4 0.014636253 0.056305587 0.051618785 0.01573997 0.008301875 0.002703308 1.11971334E-4 0.02980037 1.9195086E-4 0.17651482 Row Stochastic sum--->1.0000000038053258

0.032286983 0.0026589278 0.018961955 0.0020207851 0.105673395 0.003980795 9.724079E-4 0.04287711 0.071396016 3.038775E-4 0.005074754 0.009070743 0.008827641 0.004710101 0.0523277 0.022623679 0.0011699282 0.0018384587 0.052677162 0.14028503 0.037726387 5.469795E-4 0.0076729064 7.596937E-5 0.0058648353 3.3426523E-4 0.36804122 Row Stochastic sum--->1.000000009975338

0.046077132 0.001209177 0.0037773403 8.2395243E-4 0.102138 0.0012947824 4.7082995E-4 0.30463767 0.109928094 1.4980952E-4 1.8191157E-4 0.009587809 0.0038094423 0.001005864 0.09518255 0.0011021701 8.560545E-5 0.035322946 0.032326754 0.020085178 0.019571545 2.5681633E-4 0.007736592 5.35034E-5 0.017217396 2.3541498E-4 0.18573171 Row Stochastic sum--->0.9999999959436536

0.031536113 0.027866589 0.052862957 0.027539602 0.038148526 0.0050138063 0.037567213 3.996512E-4 0.03168144 2.9065541E-4 7.266386E-4 0.106270894 0.036295597 0.1198227 0.004105508 0.048285134 2.1799158E-4 0.1458727 0.13192123 0.12440053 3.633193E-4 7.629705E-4 3.633193E-4 0.0012352855 0.0017439326 7.266386E-4 0.023979073 Row Stochastic sum--->1.0000000148575054

0.09407115 6.916996E-4 6.916996E-4 5.9288536E-4 0.63083005 5.9288536E-4 4.9407117E-4 6.916996E-4 0.19515811 4.9407117E-4 4.9407117E-4 4.9407117E-4 5.9288536E-4 4.9407117E-4 0.050296444 7.905138E-4 4.9407117E-4 0.0013833992 0.0015810276 8.893281E-4 0.0024703557 4.9407117E-4 4.9407117E-4 4.9407117E-4 0.0045454544 4.9407117E-4 0.009189723 Row Stochastic sum--->1.0000000214204192

0.21874827 0.0013257471 0.0014914655 0.0025962547 0.16538695 9.390709E-4 4.419157E-4 0.16085732 0.17041375 2.761973E-4 0.0012152682 0.0054134675 8.838314E-4 0.039717175 0.10059106 0.0017676628 2.761973E-4 0.0147489365 0.014251782 0.00513727 0.0014914655 3.3143678E-4 6.076341E-4 2.761973E-4 0.0013257471 2.761973E-4 0.08921173 Row Stochastic sum--->0.9999999989231583

0.10689813 0.0027409776 0.08908177 0.004568296 0.064869806 0.0086797625 0.008222933 0.02284148 0.13065326 0.0068524443 0.0027409776 0.005481955 0.003654637 0.003654637 0.010050251 0.23024212 0.002284148 0.004568296 0.005481955 0.16171768 0.010507081 0.003654637 0.002284148 0.002284148 0.017359525 0.002284148 0.08634079 Row Stochastic sum--->0.9999999990686774

0.021926671 0.008327343 0.0071890727 0.006829619 0.05751258 0.0070093456 0.0035945363 0.005212078 0.025281573 7.189073E-4 9.5854304E-4 0.0076683443 0.012820513 0.0061107115 0.06829619 0.01575605 4.1936256E-4 0.011262881 0.058351304 0.02426312 0.0017373592 8.3872513E-4 0.00844716 2.9954468E-4 7.788162E-4 7.788162E-4 0.63761085 Row Stochastic sum--->1.000000016152626

0.18112488 0.005719733 0.004766444 0.004766444 0.42040038 0.005719733 0.004766444 0.005719733 0.10867493 0.004766444 0.004766444 0.022878932 0.0066730217 0.004766444 0.05624404 0.0066730217 0.004766444 0.005719733 0.005719733 0.005719733 0.0066730217 0.004766444 0.004766444 0.004766444 0.019065777 0.04957102 0.04003813 Row Stochastic sum--->0.9999999958090484

0.11377565 0.046123102 0.05007727 0.030876633 0.02584599 0.04246736 0.017106315 0.051510792 0.06717826 0.0052757794 0.0049080737 0.022264855 0.040383693 0.020820677 0.071841195 0.042430054 0.0018172129 0.027780442 0.06871303 0.16260591 0.011841194 0.0062669865 0.05971223 7.993605E-5 0.007380762 2.5046628E-4 6.6613377E-4 Row Stochastic sum--->1.0000000023210305

11.d)I tested all with caesers cipher since it is convenient to validate.

Caesers cipher(shift of 3)

Hence Plaintext to Cipher text mapping is:

Screen%20Shot%202019-02-09%20at%2011.20.12%20AM.png

Pt: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z \*

CT: d e f g h i j k l m n o p q r s t u v w x y z \* a b c

Since my plaintext has space included I have denoted it by \*.

T=1000 Restarts=500

Final value of b matrix

P=a------> C=d-------->0.9927955494132692

P=b------> C=e-------->0.7183487515788692

P=c------> C=f-------->0.5828768572911597

P=d------> C=g-------->0.8213678630288404

P=e------> C=h-------->0.8012835217752436

P=f------> C=i-------->0.7389033141341376

P=g------> C=j-------->1.0

P=h------> C=k-------->0.9079583914662778

P=i------> C=l-------->0.9998648803901087

**P=j------> C=e-------->0.7868851252251595**

P=k------> C=n-------->0.9114261089236971

P=l------> C=o-------->1.0

P=m------> C=p-------->0.9272160689077378

P=n------> C=q-------->0.9074093344215488

P=o------> C=r-------->0.8219909144612054

P=p------> C=s-------->0.8810987640871363

P=q------> C=t-------->0.8467481856591311

P=r------> C=u-------->0.8816658777850984

P=s------> C=v-------->0.7777555475021002

P=t------> C=w-------->0.7690977114753413

P=u------> C=x-------->0.8398643382273491

P=v------> C=y-------->0.5394133780283057

P=w------> C=z-------->0.8218218137103867

**P=x------> C=u-------->0.7242472875704583**

P=y------> C=a-------->0.871521928386287

**P=z------> C=p-------->0.6846940953880006**

P=\*------> C=c-------->0.9999999573519239 c

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=24/27

14.a)Implemented in code hmm\_new1

b)T=1000 Restarts =100

Final value of b matrix

P=a------> C=d-------->0.9999999999991129

P=b------> C=e-------->0.6591042225683762

P=c------> C=f-------->0.4229222430326472

P=d------> C=g-------->0.9507114273636709

P=e------> C=h-------->0.9843479197240947

P=f------> C=i-------->0.6443718960460982

P=g------> C=j-------->0.7074387342678542

P=h------> C=k-------->0.9887664851724817

P=i------> C=l-------->0.9999906144944264

**P=j------> C=a-------->0.8109167455682632**

**P=k------> C=w-------->0.5808461194929125**

P=l------> C=o-------->0.9330607850239687

P=m------> C=p-------->0.6933591758754144

P=n------> C=q-------->0.8598401372416627

P=o------> C=r-------->1.0

P=p------> C=s-------->0.632216961195429

P=q------> C=t-------->0.7109198732213262

P=r------> C=u-------->0.8883150039869266

P=s------> C=v-------->0.9948977413943725

P=t------> C=w-------->0.9755642826486275

P=u------> C=x-------->0.9629772495723893

P=v------> C=y-------->0.6941678273621655

P=w------> C=z-------->0.8366197134165715

P=x------> C=\*-------->0.8409574809991391

P=y------> C=a-------->0.6971022542169545

**P=z------> C=g-------->0.8824257871015868**

P=\*------> C=c-------->0.9999999998083889

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=24/27

T=1000 Restarts =10

Final value of b matrix

P=a------> C=d-------->0.9999999999978209

P=b------> C=e-------->0.6521580935983394

P=c------> C=f-------->0.4787108199144699

P=d------> C=g-------->0.9505411555989381

P=e------> C=h-------->0.9856869852956128

P=f------> C=i-------->0.6201022869716519

P=g------> C=j-------->0.7340957676160561

P=h------> C=k-------->0.9878137257917303

P=i------> C=l-------->0.9983129354346365

**P=j------> C=a-------->0.5965450455149023**

**P=k------> C=w-------->0.9209053359444284**

P=l------> C=o-------->0.9343044243800138

P=m------> C=p-------->0.6863643463653455

P=n------> C=q-------->0.8600307530299661

P=o------> C=r-------->1.0

P=p------> C=s-------->0.6356101266839149

P=q------> C=t-------->0.68435596619938

P=r------> C=u-------->0.8810327704454372

P=s------> C=v-------->0.9999998375353887

P=t------> C=w-------->0.9709482008022119

P=u------> C=x-------->0.9116710559192404

P=v------> C=y-------->0.6934004736036139

P=w------> C=z-------->0.8357210542475481

P=x------> C=\*-------->0.8335040341486513

P=y------> C=a-------->0.6970949398028816

**P=z------> C=g-------->0.8650221056755197**

P=\*------> C=c-------->0.9999996811488069

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=24/27

T=1000 Restarts =1

P=a------> C=z-------->0.29944274642183755

P=b------> C=c-------->0.7776934102065068

P=c------> C=x-------->0.37622171038993524

P=d------> C=q-------->0.31897958412462013

P=e------> C=w-------->0.20238873031113655

P=f------> C=u-------->0.5815669661938889

P=g------> C=i-------->0.8193893165099415

P=h------> C=q-------->0.5651261383634036

P=i------> C=w-------->0.5037954411556328

P=j------> C=x-------->1.0

P=k------> C=s-------->0.9999999999999997

P=l------> C=l-------->0.524100722773459

P=m------> C=c-------->0.9999999998553821

P=n------> C=c-------->1.0

P=o------> C=v-------->0.6303057665954394

P=p------> C=c-------->0.692221306372136

P=q------> C=c-------->1.0

P=r------> C=c-------->0.9645614769569533

P=s------> C=k-------->0.9999985500009038

P=t------> C=d-------->0.5672204882117009

P=u------> C=w-------->0.985705775038747

P=v------> C=c-------->0.6870375090975664

P=w------> C=x-------->0.5409844111542585

P=x------> C=y-------->0.47901272642164056

P=y------> C=p-------->0.3997706635062243

P=z------> C=c-------->0.9977951248188109

P=\*------> C=h-------->0.6080027074583246

None is correct Accuracy is 0.

T=1000 Restarts =1000

Final value of b matrix

P=a------> C=d-------->0.9999999999981061

P=b------> C=e-------->0.6588844289655401

P=c------> C=f-------->0.4226530700264851

P=d------> C=g-------->0.950755806045571

P=e------> C=h-------->0.9843113670619805

P=f------> C=i-------->0.6446502007026527

P=g------> C=j-------->0.7086594812323936

P=h------> C=k-------->0.9888939498916253

P=i------> C=l-------->0.9999878794894609

**P=j------> C=a-------->0.8141991574200991**

**P=k------> C=w-------->0.5811867538886937**

P=l------> C=o-------->0.9332643794093257

P=m------> C=p-------->0.693287475362554

P=n------> C=q-------->0.8597266288082563

P=o------> C=r-------->1.0

P=p------> C=s-------->0.6320887923696175

P=q------> C=t-------->0.7109408675594934

P=r------> C=u-------->0.8877331112822112

P=s------> C=v-------->0.9953936729311905

P=t------> C=w-------->0.9755841482136008

P=u------> C=x-------->0.9630746292514863

P=v------> C=y-------->0.6941113192385651

P=w------> C=z-------->0.8367053435949324

P=x------> C=\*-------->0.840964009954583

P=y------> C=a-------->0.697777026226355

**P=z------> C=g-------->0.8834790102717561**

P=\*------> C=c-------->0.9999999999993915

3 are incorrect Accuracy is 24/27

c)

T=400 Restarts=100

Caesers cipher(shift of 3)

Hence Plaintext to Cipher text mapping is:

Screen%20Shot%202019-02-09%20at%2011.20.12%20AM.png

Since my plaintext has space included I have denoted it by \*.

Pt: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z \*

CT: d e f g h i j k l m n o p q r s t u v w x y z \* a b c

Final value of b matrix

P=a------> C=d-------->0.9999995541762952

P=b------> C=e-------->0.6585303736287325

**P=c------> C=o-------->0.45335025615973956**

P=d------> C=g-------->0.9475799750807945

P=e------> C=h-------->1.0

P=f------> C=i-------->0.898663189144667

P=g------> C=j-------->0.6855959500211334

P=h------> C=k-------->0.9531798139061666

P=i------> C=l-------->0.681801431064193

**P=j------> C=f-------->0.5701826376826065**

**P=k------> C=o-------->0.9469943350046932**

**P=l------> C=s-------->0.4594954559338421**

P=m------> C=p-------->0.6167993039304358

P=n------> C=q-------->0.9526443481906836

P=o------> C=r-------->0.93845407381282

**P=p------> C=f-------->0.8443205832817086**

**P=q------> C=d-------->0.5905352812275504**

P=r------> C=u-------->1.0

P=s------> C=v-------->0.9999999999999992

P=t------> C=w-------->1.0

P=u------> C=x-------->0.9141459669506266

**P=v------> C=p-------->0.39086195942571017**

P=w------> C=z-------->0.9113562212650171

P=x------> C=\*-------->1.0

P=y------> C=a-------->0.6882981528549049

**P=z------> C=s-------->0.9999178897728908**

P=\*------> C=c-------->0.9833873179059275

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=19/27

T=400 Restarts=10

Final value of b matrix

P=a------> C=d-------->0.9838253235205311

P=b------> C=e-------->0.4508208220063228

**P=c------> C=j-------->0.3759365781160691**

P=d------> C=g-------->0.8637356642506209

P=e------> C=h-------->1.0

P=f------> C=i-------->0.8653110108113257

P=g------> C=j-------->0.5533982250557031

P=h------> C=k-------->0.95261973519798

P=i------> C=l-------->0.6773391847344823

**P=j------> C=e-------->0.9999999999993161**

**P=k------> C=r-------->0.7344318986836544**

**P=l------> C=s-------->0.40314997125155816**

P=m------> C=p-------->0.591605913878261

P=n------> C=q-------->0.9027969453410214

P=o------> C=r-------->0.9999999999999873

**P=p------> C=f-------->0.9509107206502946**

**P=q------> C=d-------->0.5907956098529933**

P=r------> C=u-------->1.0

P=s------> C=v-------->0.9999999999920056

P=t------> C=w-------->1.0

P=u------> C=x-------->0.8499706092773326

**P=v------> C=p-------->0.3303199623283379**

P=w------> C=z-------->0.9078457229914384

P=x------> C=\*-------->1.0

**P=y------> C=v-------->0.4995689197737436**

**P=z------> C=q-------->0.9999999960322192**

P=\*------> C=c-------->1.0

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=18/27

T=400 Restarts=1

Final value of b matrix

P=a------> C=k-------->0.8479024337961165

P=b------> C=z-------->1.0

P=c------> C=r-------->1.0

P=d------> C=v-------->0.8798709046510378

P=e------> C=q-------->0.5223133613256337

P=f------> C=v-------->0.5677051906557445

**P=g------> C=d-------->0.6459862683249215**

P=h------> C=r-------->0.7008039966990156

P=i------> C=u-------->0.46720651007487257

P=j------> C=d-------->0.7718297079420878

P=k------> C=i-------->0.78497128653379

P=l------> C=d-------->0.9999999999283843

P=m------> C=w-------->0.9999989879728813

P=n------> C=h-------->0.7495726072647206

P=o------> C=x-------->0.4909768201990937

P=p------> C=e-------->0.38027911942468984

P=q------> C=w-------->0.9999999999999992

P=r------> C=h-------->0.5574240027195161

P=s------> C=h-------->0.45348067997233876

P=t------> C=f-------->0.3306735546219649

P=u------> C=s-------->0.33959947148811753

P=v------> C=l-------->1.0

P=w------> C=w-------->1.0

P=x------> C=d-------->1.0

P=y------> C=g-------->0.6295186052614814

P=z------> C=l-------->1.0

P=\*------> C=c-------->0.9275502195221514

Only one is correct the(highlighted one).Accuracy 1/27.

T=400 Restarts=1000

Final value of b matrix

P=a------> C=d-------->0.9091516574569213

**P=b------> C=i-------->0.46154654020974506**

P=c------> C=f-------->0.6004603574643255

P=d------> C=g-------->0.6730621702552769

P=e------> C=h-------->0.8972519278006171

P=f------> C=i-------->0.47469438651247503

P=g------> C=j-------->0.7072426907457999

P=h------> C=k-------->0.7230944427115903

P=i------> C=l-------->0.9515668686657616

**P=j------> C=z-------->0.9854051287488004**

**P=k------> C=w-------->1.0**

P=l------> C=o-------->0.9999999891900416

**P=m------> C=q-------->0.9627891144747741**

P=n------> C=q-------->0.732548671639162

P=o------> C=r-------->0.9999999992263381

P=p------> C=s-------->0.9834783978649916

**P=q------> C=r-------->1.0**

P=r------> C=u-------->0.8811220723630228

P=s------> C=v-------->0.9990955304599551

P=t------> C=w-------->0.7478172271502254

P=u------> C=x-------->0.9748637624541906

P=v------> C=y-------->0.758351383862874

P=w------> C=z-------->0.5937856204689645

P=x------> C=\*-------->0.6097824223590911

**P=y------> C=g-------->0.5779635107657828**

**P=z------> C=p-------->1.0**

P=\*------> C=c-------->0.981513241065989

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=20/27

d)T=300 Restarts=100

Final value of b matrix

P=a------> C=d-------->0.8473719794982187

**P=b------> C=i-------->0.47286177328509715**

P=c------> C=f-------->0.6296569436221302

P=d------> C=g-------->0.5794282905075502

P=e------> C=h-------->0.8974562622340875

**P=f------> C=x-------->0.37395540564277796**

P=g------> C=j-------->0.30876406858766803

P=h------> C=k-------->0.807610621185945

P=i------> C=l-------->0.8453247928230339

**P=j------> C=a-------->0.7458969337249639**

**P=k------> C=w-------->0.9999999999996585**

P=l------> C=o-------->0.9887529932849499

**P=m------> C=q-------->0.8947651208703186**

P=n------> C=q-------->0.5138297259918885

P=o------> C=r-------->0.9999999999999034

**P=p------> C=v-------->0.9999981224787895**

**P=q------> C=r-------->1.0**

P=r------> C=u-------->0.6963367030356851

P=s------> C=v-------->0.654827478206305

P=t------> C=w-------->0.7276156714847135

P=u------> C=x-------->0.9132113820505725

**P=v------> C=e-------->0.5765710121137181**

P=w------> C=z-------->0.7551171326831261

**P=x------> C=y-------->1.0**

**P=y------> C=g-------->0.6346798111919397**

**P=z------> C=p-------->1.0**

P=\*------> C=c-------->0.999999693219726

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=16/27

T=300 Restarts=10

Final value of b matrix

P=a------> C=h-------->0.5516494627778652

P=b------> C=k-------->0.6341232797549693

P=c------> C=c-------->0.9999448119389344

P=d------> C=c-------->0.6670994906673338

P=e------> C=h-------->0.469390353434799

**P=f------> C=c-------->0.9999932270003803**

P=g------> C=c-------->0.8760523236265445

P=h------> C=k-------->0.2251586419289099

P=i------> C=h-------->0.5918687872879408

P=j------> C=d-------->0.9997811731732054

P=k------> C=s-------->0.998145972478318

P=l------> C=v-------->0.5516234231954648

P=m------> C=e-------->0.6318156836709137

P=n------> C=u-------->0.27012952986116706

P=o------> C=r-------->0.9036059332332269

P=p------> C=u-------->0.9999984337884482

P=q------> C=r-------->1.0

P=r------> C=q-------->0.6654146438180395

P=s------> C=o-------->0.8466701402700891

P=t------> C=c-------->1.0

P=u------> C=x-------->0.9999999999988501

P=v------> C=p-------->0.5821816947417295

P=w------> C=k-------->0.9999999993839755

P=x------> C=d-------->1.0

**P=y------> C=v-------->0.7677960238244945**

P=z------> C=y-------->1.0

P=\*------> C=w-------->0.41551827199768987

So accuracy is very low as only 2 mappings (highlighted ones) are correct. Accuracy 2/27.

T=300 Restarts=1000

Final value of b matrix

P=a------> C=d-------->0.9999992604153358

P=b------> C=e-------->0.7287538922844123

P=c------> C=f-------->0.7306550105871378

P=d------> C=g-------->0.8231139479449704

P=e------> C=h-------->0.92660578951505

**P=f------> C=q-------->0.6577977897889727**

P=g------> C=j-------->0.5692075359617779

P=h------> C=k-------->0.8949811750443085

P=i------> C=l-------->0.8303196890948482

**P=j------> C=v-------->0.9816685497415316**

**P=k------> C=w-------->1.0**

P=l------> C=o-------->0.9648198008440761

**P=m------> C=v-------->0.6708014358672661**

P=n------> C=q-------->0.9999912657238372

P=o------> C=r-------->0.9999999928784774

P=p------> C=s-------->0.9998356177236878

**P=q------> C=r-------->1.0**

P=r------> C=u-------->0.9755391901031982

P=s------> C=v-------->0.459902113405475

P=t------> C=w-------->0.7134994046777402

P=u------> C=x-------->0.9999966223709146

P=v------> C=y-------->0.8417131325851288

P=w------> C=z-------->0.40837721279439326

P=x------> C=\*-------->0.7444717569390483

**P=y------> C=g-------->0.6620437044726594**

**P=z------> C=y-------->1.0**

P=\*------> C=c-------->0.97329040483021

So apart from the highlighted ones,rest plaintext ciphertext mappings are predicted correctly.

Hence accuracy=20/27

15.To denote zodiac symbols in program I used numbers.

I found 57 distinct symbols in the zodiac cipher (considering the alphabets into the symbol count).

a)After 1000 restarts

Here possible mappings mean only those probabilities with value greater than 0.1

Final B matrix

Possible mappings of a

[2, 12, 49, 54]

Possible mappings of b

[36, 40, 53]

Possible mappings of c

[25, 29, 52]

Possible mappings of d

[23, 34, 37]

Possible mappings of e

[6, 8, 10, 32, 33, 56]

Possible mappings of f

[3, 45, 46]

Possible mappings of g

[0, 37]

Possible mappings of h

[5, 14, 18, 48]

Possible mappings of i

[13, 28, 51, 55]

Possible mappings of j

[13]

Possible mappings of k

[6, 36, 53]

Possible mappings of l

[17, 36, 39, 50]

Possible mappings of m

[27, 34, 40]

Possible mappings of n

[0, 24, 35]

Possible mappings of o

[7, 16, 21, 40]

Possible mappings of p

[10, 11, 12, 42]

Possible mappings of q

[33, 43, 44]

Possible mappings of r

[5, 20, 34]

Possible mappings of s

[1, 40, 43, 44]

Possible mappings of t

[9, 43, 44, 47]

Possible mappings of u

[1, 31]

Possible mappings of v

[19, 22]

Possible mappings of w

[3, 4, 30]

Possible mappings of x

[27]

Possible mappings of y

[19, 53]

Possible mappings of z

[19]

No of Incorrect Prediction-->290

No of correct Prediction-->117

b)took too much time

c)took too much time