

Homework 2

2. Decoding

The transitions are initialized in the function `get_fst_mtm()` of `fst_wrapper.py`.

```
1  if initialize:
2      for state in m.states:
3          for transition in m.transitions_from[state].keys():
4              if transition.a[0] == transition.a[1]:
5                  m.reweight_transition(transition, 100)
6              else:
7                  m.reweight_transition(transition, 1)
8  m.normalize_cond()
```

All transitions that keep the same character are initialized to 100 while all other transitions are initialized to 1. These transitions are then normalized to sum to 1, thus giving transitions that make no change 100x more likely than other transitions. This is due to the fact that old english and modern english are both the same language and thus the changes are not overly dramatic.

8.86% accuracy, results at [data/decode-tmp.new](#)

3. Training

The model was able to learn some transitions that were not simply characters going to themselves as in part 2, and was able to weight certain transitions, such as awry punctuation like converting a '-' to a period, or converting 'v's to 'u's as these two characters were interchangeable in old English.

Iteration 1:

7.3970% accuracy, results at [data/train-tmp.new](#)

First 10 lines:

```
1 [Horatio] Now cracke a Noble heart.
2 -89.83092152819509
3 Goodnight sweet Prince,
4 -77.12060199752953
5 And flights of Angels sing thee to thy rest,
6 -109.10997512429091
7 Why do's the Drumme come hither?
8 -86.18359274566141
9 Enter Fortinbras and English ambassador, with Drumme,
10 -156.12781560358673
11 Colours, and attendants.
12 -66.248922068638
```

13 [Fortinbras] Where is this sight?
 14 -80.87133001097192
 15 [Horatio] What is it ye would see.
 16 -82.15324530609718
 17 If ought of woe, or wonder, cease your search.
 18 -117.35498057849564
 19 [Fortinbras] His quarry criis on havocke. Oh proud death,
 20 -166.49225305214557

probabilities of trasition weights ≥ 0.1

1 q0 -(')', 'ε')-> q1 = 0.3597188895514344
 2 q0 -('"'', 'ε')-> q1 = 0.27496623246714
 3 q0 -(':', 'ε')-> q1 = 0.3382856731303626
 4 q0 -('(', 'ε')-> q1 = 0.47957715435981435
 5 q0 -(', ', 'ε')-> q1 = 0.25568763878043166
 6 q0 -('-', 'ε')-> q1 = 0.532716616605171
 7 q0 -('"'', 'ε')-> q1 = 0.9387577254271708
 8 q1 -('</s>', '</s>')-> q2 = 1.0
 9 q0 -('</s>', '</s>')-> q2 = 0.9681427326939159
 10 q1 -('b', 'b')-> q0 = 0.7455670809643882
 11 q1 -('k', 'u')-> q0 = 0.5904370068394074
 12 q1 -('g', 'G')-> q0 = 0.16607271465187431
 13 q1 -('\n', '\n')-> q0 = 0.9995659632621646
 14 q0 -('; ', ',')-> q0 = 0.3032999800456482
 15 q1 -('A', 'A')-> q0 = 0.2827322913633982
 16 q0 -('j', 'I')-> q0 = 0.20523109258028707
 17 q1 -('o', 's')-> q0 = 0.10458058607261479
 18 q1 -('T', 'T')-> q0 = 0.7714663654402387
 19 q1 -('"'', '"')-> q0 = 0.49707976449167257
 20 q1 -('I', 'I')-> q0 = 0.4264597917496238
 21 q0 -('n', 'n')-> q0 = 0.947041316866974
 22 q0 -('L', 'L')-> q0 = 0.9269426021945398
 23 q0 -('z', 'z')-> q0 = 0.8202149732251762
 24 q1 -('h', 'l')-> q0 = 0.14842560956128398
 25 q1 -('a', 'a')-> q0 = 0.2664395345566687
 26 q1 -('1', '.')-> q0 = 0.47110568244933343
 27 q1 -('T', 'o')-> q0 = 0.11030393255330365
 28 q1 -('[', 'E')-> q0 = 0.164659644061396
 29 q0 -(' ', ' ')-> q0 = 0.9612044292930426
 30 q1 -('.', '\n')-> q0 = 0.1993492518391949
 31 q1 -('?', '?')-> q0 = 0.595701765004441
 32 q1 -('[', 'r')-> q0 = 0.3291547929738795
 33 q0 -('!', ':')-> q0 = 0.15107911810282243
 34 q1 -('A', 'J')-> q0 = 0.2827322913633982
 35 q0 -('B', 'B')-> q0 = 0.8211084667367914
 36 q1 -('d', 'd')-> q0 = 0.24400577582365116
 37 q0 -('A', 'A')-> q0 = 0.8586064514282477
 38 q0 -('y', 'y')-> q0 = 0.899113624301053
 39 q1 -('I', 'n')-> q0 = 0.14220064044175923
 40 q1 -('m', 'r')-> q0 = 0.15347569886638576

41 q0 -('l', 'l')-> q0 = 0.8852180876751129
42 q0 -('j', 'i')-> q0 = 0.7524879462775432
43 q1 -('T', 't')-> q0 = 0.11030393255330365
44 q0 -('-', '-')-> q0 = 0.3151296717026709
45 q0 -(';', ':')-> q0 = 0.3032999800456482
46 q1 -('[', '.')-> q0 = 0.164659644061396
47 q0 -('è', 'e')-> q0 = 0.9666020345610521
48 q0 -('!', '?')-> q0 = 0.16052126791706714
49 q0 -('J', 'I')-> q0 = 0.9590182950533379
50 q1 -(',', ',')-> q0 = 0.4411814470406872
51 q1 -('i', 'e')-> q0 = 0.245339052514144
52 q1 -('P', 'F')-> q0 = 0.7744203790337816
53 q1 -('O', 'O')-> q0 = 0.47110568244933293
54 q1 -('V', 'V')-> q0 = 0.7744203790337812
55 q1 -('W', 'w')-> q0 = 0.5510864009024223
56 q0 -('x', 'x')-> q0 = 0.9607645333243306
57 q0 -('D', 'D')-> q0 = 0.9002653381618432
58 q0 -('r', 'r')-> q0 = 0.9380503275488439
59 q1 -('c', 'c')-> q0 = 0.447247379140871
60 q1 -('W', 'r')-> q0 = 0.11030543637339026
61 q1 -('d', 't')-> q0 = 0.557712549179138
62 q0 -(';', ';')-> q0 = 0.2671936992373759
63 q0 -('u', 'u')-> q0 = 0.8880336183404903
64 q0 -('Y', 'Y')-> q0 = 0.7890369842527746
65 q0 -('E', 'E')-> q0 = 0.9336031991667355
66 q1 -('s', 's')-> q0 = 0.8016767596545891
67 q1 -('p', 'r')-> q0 = 0.11721816175087381
68 q0 -('i', 'i')-> q0 = 0.9209873418359891
69 q1 -('!', 'l')-> q0 = 0.14139611252985027
70 q1 -('p', 'o')-> q0 = 0.11721816175087381
71 q0 -('G', 'G')-> q0 = 0.8872483692534047
72 q1 -('m', 'o')-> q0 = 0.42199104304651575
73 q1 -('p', ' ')-> q0 = 0.11721816175087381
74 q1 -('p', 'a')-> q0 = 0.11721816175087381
75 q0 -('N', 'N')-> q0 = 0.9316730814058034
76 q0 -('c', 'c')-> q0 = 0.839402849423004
77 q1 -('l', 'e')-> q0 = 0.7277365454527024
78 q0 -('H', 'H')-> q0 = 0.9248577249604764
79 q0 -('B', 'b')-> q0 = 0.12693799568139313
80 q0 -('v', 'u')-> q0 = 0.8033220264008664
81 q1 -('E', 'n')-> q0 = 0.774420379033781
82 q0 -('w', 'w')-> q0 = 0.9257959403079434
83 q0 -(')', ')')-> q0 = 0.3597188895514344
84 q0 -('W', 'W')-> q0 = 0.887698817819945
85 q1 -('i', 'i')-> q0 = 0.26286201891041167
86 q1 -('u', 'u')-> q0 = 0.14874176975666806
87 q0 -('P', 'P')-> q0 = 0.9156371434084024
88 q1 -('x', 'l')-> q0 = 0.3231625548483961
89 q1 -('n', '&')-> q0 = 0.19120096307472279
90 q0 -('C', 'C')-> q0 = 0.9381423615442893
91 q1 -('r', 'r')-> q0 = 0.49250182878623927

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92 q1 -('c', 'e')-> q0 = 0.10323739595429227
93 q0 -('h', 'h')-> q0 = 0.9427346976554106
94 q1 -('W', 'W')-> q0 = 0.22050067750564828
95 q0 -('V', 'V')-> q0 = 0.965208011627539
96 q1 -('k', 'k')-> q0 = 0.19694350011537712
97 q1 -('!', '.')-> q0 = 0.14139611252985027
98 q1 -('H', 'C')-> q0 = 0.16465432455746098
99 q1 -('u', 'e')-> q0 = 0.10625019148023096
100 q1 -('h', 'h')-> q0 = 0.12863684753724772
101 q1 -('1', '!')-> q0 = 0.47110568244933343
102 q1 -('v', 'e')-> q0 = 0.37159279675502277
103 q0 -('K', 'K')-> q0 = 0.9550680417028363
104 q0 -(',', ',')-> q0 = 0.5834587360652109
105 q1 -(' ', ' ')-> q0 = 0.9635200717493726
106 q1 -('!', 'd')-> q0 = 0.2826509702020284
107 q0 -('p', 'p')-> q0 = 0.8637226787690538
108 q0 -(')', ':')-> q0 = 0.239852548481313
109 q1 -('O', 'o')-> q0 = 0.47110568244933293
110 q0 -('o', 'o')-> q0 = 0.9483980495810537
111 q1 -('A', ' ')-> q0 = 0.14143679343066545
112 q1 -('H', 'e')-> q0 = 0.32914415928019924
113 q1 -('o', 'e')-> q0 = 0.1278181343611638
114 q1 -('e', 'i')-> q0 = 0.1145484378899028
115 q0 -('.', ':')-> q0 = 0.14476909770312704
116 q1 -('.', '.')-> q0 = 0.6477729625497057
117 q1 -('N', 'N')-> q0 = 0.6459043023513512
118 q1 -('u', 'o')-> q0 = 0.3187080828624164
119 q1 -(',', ' ')-> q0 = 0.18577405177477702
120 q1 -('N', 'n')-> q0 = 0.3231135465535745
121 q1 -('v', ' ')-> q0 = 0.12394681424584397
122 q1 -('[', 'o')-> q0 = 0.164659644061396
123 q1 -('-', ' ')-> q0 = 0.4843717359624278
124 q0 -('Q', 'Q')-> q0 = 0.9663459855901614
125 q0 -('?', '?')-> q0 = 0.8332369966846097
126 q0 -('q', 'Q')-> q0 = 0.24966930780302835
127 q1 -('e', '"')-> q0 = 0.20826562720030914
128 q0 -('g', 'g')-> q0 = 0.9032244006260104
129 q0 -('a', 'a')-> q0 = 0.9212811639519521
130 q1 -('S', 'S')-> q0 = 0.9685482405291755
131 q1 -(']', 'n')-> q0 = 0.1327704739559698
132 q0 -('k', 'k')-> q0 = 0.921282121566659
133 q1 -(']', '.')-> q0 = 0.19912253490348095
134 q0 -('f', 'f')-> q0 = 0.8743696473377387
135 q0 -('!', '.')-> q0 = 0.4012960881803072
136 q0 -('e', 'e')-> q0 = 0.924263335555006
137 q1 -('Y', 'Y')-> q0 = 0.7744203790337812
138 q1 -('g', 'g')-> q0 = 0.27675096500300683
139 q1 -('k', 'x')-> q0 = 0.19694350011537712
140 q0 -('"'', '"')-> q0 = 0.5527657364055704
141 q0 -('q', 'q')-> q0 = 0.6865723921631463
142 q1 -('J', 'I')-> q0 = 0.7744203790337814
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143 q1 -('n', 'n')-> q0 = 0.33894044638322174
144 q0 -('Y', 'y')-> q0 = 0.17847991973651467
145 q1 -('à', 'a')-> q0 = 0.7744203790337806
146 q0 -(':', ':')-> q0 = 0.31412413658794686
147 q0 -('R', 'R')-> q0 = 0.8848853736043875
148 q1 -('w', 'w')-> q0 = 0.6502463347252113
149 q1 -('z', 'e')-> q0 = 0.9238932230060333
150 q0 -('T', 'T')-> q0 = 0.8674726378326741
151 q0 -('U', 'V')-> q0 = 0.9075718638469712
152 q0 -('S', 'S')-> q0 = 0.8672057494839808
153 q1 -('C', ' ')-> q0 = 0.1657497160696754
154 q1 -('"'', 't')-> q0 = 0.16574847671185414
155 q1 -('-', ',')-> q0 = 0.12302077978341308
156 q1 -('H', 'o')-> q0 = 0.32914415928019924
157 q1 -('i', 'a')-> q0 = 0.15772422053280552
158 q1 -('y', 'I')-> q0 = 0.8320004804207121
159 q0 -('M', 'M')-> q0 = 0.9116823086946146
160 q1 -('-', '.')-> q0 = 0.24603387124860956
161 q0 -('\n', '\n')-> q0 = 0.9668144073128064
162 q1 -('K', ' ')-> q0 = 0.774420379033781
163 q1 -('a', 't')-> q0 = 0.17319035992056642
164 q1 -('x', '.')-> q0 = 0.3231625548483961
165 q1 -('C', 'C')-> q0 = 0.3314165986980367
166 q1 -('B', 'b')-> q0 = 0.7744203790337819
167 q1 -('v', 'u')-> q0 = 0.4954157880096122
168 q0 -('s', 's')-> q0 = 0.9120083695103264
169 q1 -('e', 'e')-> q0 = 0.1197549484071476
170 q0 -('[', '[')-> q0 = 0.9573958125624927
171 q0 -('F', 'F')-> q0 = 0.8750340535901621
172 q1 -('G', 'G')-> q0 = 0.9413663579900224
173 q1 -('p', 'p')-> q0 = 0.4101171166506085
174 q1 -('o', 'o')-> q0 = 0.24400587580390884
175 q1 -('f', 'f')-> q0 = 0.7341732331971111
176 q0 -(':', ':')-> q0 = 0.2658010635031154
177 q0 -('O', 'O')-> q0 = 0.8347409702882578
178 q1 -('f', 'u')-> q0 = 0.10492683662791369
179 q0 -('(', '(')-> q0 = 0.47957715435981435
180 q1 -('I', 'i')-> q0 = 0.21326542826872535
181 q0 -('b', 'b')-> q0 = 0.8687004121999611
182 q0 -('v', 'v')-> q0 = 0.10776348198785948
183 q0 -(']', ']')-> q0 = 0.9626943041410417
184 q1 -('t', 't')-> q0 = 0.358272129533722
185 q1 -('L', 'L')-> q0 = 0.6459043023513497
186 q1 -('!', 'e')-> q0 = 0.4239058278742065
187 q1 -('C', 'H')-> q0 = 0.1657497160696754
188 q0 -('m', 'm')-> q0 = 0.9060996020597428
189 q1 -('x', 'i')-> q0 = 0.3231625548483961
190 q1 -('D', 'D')-> q0 = 0.7744203790337804
191 q0 -('!', ',')-> q0 = 0.16052126791706714
192 q0 -('.', '.')-> q0 = 0.6569866244217303
193 q1 -('A', 'a')-> q0 = 0.2827322913633982

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194 q1 -('L', 'l')-> q0 = 0.32311354655357366
195 q1 -('r', 'e')-> q0 = 0.1547959377868466
196 q1 -('W', 's')-> q0 = 0.11030543637339026
197 q0 -('t', 't')-> q0 = 0.9468002292839584
198 q1 -('F', 's')-> q0 = 0.19693404660140199
199 q1 -('l', 'l')-> q0 = 0.15207294477520164
200 q1 -('R', ' ')-> q0 = 0.7744203790337806
201 q0 -('d', 'd')-> q0 = 0.9353787053182467
202 q1 -('H', ' ')-> q0 = 0.16465432455746098
203 q1 -('g', 'e')-> q0 = 0.2214118398274406
204 q1 -('h', '0')-> q0 = 0.29684132474155595
205 q1 -(']', 't')-> q0 = 0.2654745958509921
206 q1 -('F', 'F')-> q0 = 0.7871459744777318
207 q1 -('[', 'l')-> q0 = 0.164659644061396
208 q0 -('I', 'I')-> q0 = 0.9379244310243153
209 q1 -('o', 't')-> q0 = 0.11619936021688929

```

Iteration 2:

7.3972% accuracy

First 10 lines:

```

1 [Horatio] Now cracke a Noble heart.
2 -89.81963918716613
3 Goodnight sweet Prince,
4 -77.14201320688588
5 And flights of Angels sing thee to thy rest,
6 -109.10279611750909
7 Why do's the Drumme come hither?
8 -86.13109631103117
9 Enter Fortinbras and English ambassador, with Drumme,
10 -156.07167007225843
11 Colours, and attendants.
12 -66.24605549602671
13 [Fortinbras] Where is this sight?
14 -80.86381551941848
15 [Horatio] What is it ye would see.
16 -82.14512188091149
17 If ought of woe, or wonder, cease your search.
18 -117.34300087851676
19 [Fortinbras] His quarry criis on havocke. Oh proud death,
20 -166.47283439678984

```

probabilities of transition weights ≥ 0.1

```

1 q0 -(')', 'ε')-> q1 = 0.36148788752324856
2 q0 -('"', 'ε')-> q1 = 0.276197747881278
3 q0 -(':', 'ε')-> q1 = 0.3385749757265481
4 q0 -('(', 'ε')-> q1 = 0.4819618491034335
5 q0 -(',', 'ε')-> q1 = 0.25633037798244823
6 q0 -('-', 'ε')-> q1 = 0.5300667035682014

```

```
7 q0 -('', 'ε')-> q1 = 0.9390843765699706
8 q1 -('</s>', '</s>')-> q2 = 1.0
9 q0 -('</s>', '</s>')-> q2 = 0.9681542220166196
10 q1 -('b', 'b')-> q0 = 0.7478687697570667
11 q1 -('k', 'u')-> q0 = 0.45906224314482985
12 q1 -('g', 'G')-> q0 = 0.1576366236111697
13 q1 -('\n', '\n')-> q0 = 0.9997850610660709
14 q0 -('; ', ',')-> q0 = 0.303377696802646
15 q1 -('u', 'l')-> q0 = 0.10105807069060967
16 q1 -('A', 'A')-> q0 = 0.28432712571702395
17 q0 -('j', 'I')-> q0 = 0.20530009860866869
18 q1 -('o', 's')-> q0 = 0.11760638174040072
19 q1 -('T', 'T')-> q0 = 0.7747880245609055
20 q1 -('"'', '"')-> q0 = 0.4768579348224664
21 q1 -('I', 'I')-> q0 = 0.4275496677846425
22 q0 -('n', 'n')-> q0 = 0.9470380952381529
23 q0 -('L', 'L')-> q0 = 0.9271002548474797
24 q0 -('z', 'z')-> q0 = 0.8205269436256762
25 q1 -('h', 'l')-> q0 = 0.1455884114489717
26 q1 -('a', 'a')-> q0 = 0.26163342579874427
27 q1 -('1', '. ')-> q0 = 0.489475552251843
28 q1 -('T', 'o')-> q0 = 0.11073143612216069
29 q1 -('[', 'E')-> q0 = 0.1657472373927646
30 q0 -(' ', ' ')-> q0 = 0.9613782343188827
31 q1 -('.', '\n')-> q0 = 0.19482050509719076
32 q1 -('?', '?')-> q0 = 0.6292988337689115
33 q1 -('[', 'r')-> q0 = 0.33141164258293415
34 q1 -('?', 'S')-> q0 = 0.10492683662791366
35 q0 -('!', ':')-> q0 = 0.15110376061474878
36 q1 -('A', ']')-> q0 = 0.28432712571702395
37 q0 -('B', 'B')-> q0 = 0.8212312832888277
38 q1 -('d', 'd')-> q0 = 0.26050582041773157
39 q0 -('A', 'A')-> q0 = 0.8586717795510991
40 q0 -('y', 'y')-> q0 = 0.8996422239345804
41 q1 -('I', 'n')-> q0 = 0.14254030670830387
42 q1 -('m', 'r')-> q0 = 0.15667303025074306
43 q0 -('l', 'l')-> q0 = 0.8852190005950039
44 q0 -('à', 'a')-> q0 = 0.758543395316585
45 q0 -('j', 'i')-> q0 = 0.7527539936152375
46 q1 -('T', 't')-> q0 = 0.11073143612216069
47 q0 -('-', '-')-> q0 = 0.31578517901057596
48 q0 -('-', ' ')-> q0 = 0.10150365445295033
49 q0 -('; ', ':')-> q0 = 0.303377696802646
50 q1 -('[', '. ')-> q0 = 0.1657472373927646
51 q0 -('è', 'e')-> q0 = 0.9673919909355047
52 q0 -('!', '?')-> q0 = 0.16054759809320998
53 q0 -('J', 'I')-> q0 = 0.9641262278397554
54 q1 -(', ', ',')-> q0 = 0.4874144596239813
55 q1 -('i', 'e')-> q0 = 0.22509736974449768
56 q1 -('P', 'F')-> q0 = 0.6459043023513488
57 q1 -('O', 'O')-> q0 = 0.4894755522518377
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```
58 q1 -('V', 'V')-> q0 = 0.9413663579900222
59 q1 -('W', 'w')-> q0 = 0.5534376220991876
60 q0 -('x', 'x')-> q0 = 0.9610081189550485
61 q0 -('D', 'D')-> q0 = 0.9005412286661013
62 q0 -('r', 'r')-> q0 = 0.9391557555273953
63 q1 -('c', 'c')-> q0 = 0.463740618422626
64 q1 -('W', 'r')-> q0 = 0.11073179500254718
65 q1 -('d', 't')-> q0 = 0.5270637167080549
66 q0 -(';',';')-> q0 = 0.2672617342780753
67 q0 -('u', 'u')-> q0 = 0.8876328515947918
68 q0 -('Y', 'Y')-> q0 = 0.7893056250816068
69 q0 -('E', 'E')-> q0 = 0.9337996509010487
70 q1 -('s', 's')-> q0 = 0.8027910295814892
71 q1 -('p', 'r')-> q0 = 0.12098991838080995
72 q0 -('i', 'i')-> q0 = 0.9209444467621741
73 q1 -('!', 'l')-> q0 = 0.14219506232952664
74 q1 -('p', 'o')-> q0 = 0.12098991838080995
75 q0 -('G', 'G')-> q0 = 0.8873669661793698
76 q1 -('m', 'o')-> q0 = 0.4112348841764598
77 q0 -('N', 'N')-> q0 = 0.9318795767930255
78 q0 -('c', 'c')-> q0 = 0.8390546086379707
79 q1 -('l', 'e')-> q0 = 0.7148004119869393
80 q0 -('H', 'H')-> q0 = 0.9249061086669945
81 q0 -('B', 'b')-> q0 = 0.1269553053296206
82 q0 -('v', 'u')-> q0 = 0.8034320383095528
83 q1 -('E', 'n')-> q0 = 0.9413663579900224
84 q1 -('P', 'h')-> q0 = 0.32311354655357327
85 q0 -('w', 'w')-> q0 = 0.9256625337390273
86 q0 -(')','')-> q0 = 0.36148788752324856
87 q0 -('W', 'W')-> q0 = 0.8877779924608079
88 q1 -('i', 'i')-> q0 = 0.27911857763486153
89 q1 -('u', 'u')-> q0 = 0.15719520583704322
90 q0 -('P', 'P')-> q0 = 0.9180489745403054
91 q1 -('x', 'l')-> q0 = 0.32913352709374666
92 q1 -('n', '&')-> q0 = 0.1810240205376556
93 q0 -('C', 'C')-> q0 = 0.9382921067511752
94 q1 -('r', 'r')-> q0 = 0.4858907313918264
95 q0 -('h', 'h')-> q0 = 0.9430810518960654
96 q1 -('W', 'W')-> q0 = 0.2214082517767073
97 q0 -('V', 'V')-> q0 = 0.9667159852577413
98 q1 -('k', 'k')-> q0 = 0.3825646188914005
99 q1 -('!', '.')-> q0 = 0.14219506232952664
100 q1 -('H', 'C')-> q0 = 0.16574599811240312
101 q1 -('u', 'e')-> q0 = 0.1347403517784698
102 q1 -('h', 'h')-> q0 = 0.12617727029381395
103 q1 -('1', '!')-> q0 = 0.489475552251843
104 q1 -('v', 'e')-> q0 = 0.3981674560876543
105 q0 -('K', 'K')-> q0 = 0.9554915489489678
106 q0 -(',','(',')')-> q0 = 0.5827597210657406
107 q1 -(' ',' ')-> q0 = 0.9649414520002411
108 q1 -('!', 'd')-> q0 = 0.2843190626588886
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109 q0 -('p', 'p')-> q0 = 0.8628687098498754
110 q0 -(')', ':')-> q0 = 0.24101200432936473
111 q1 -('u', ' ')-> q0 = 0.10105807069060967
112 q1 -('0', 'o')-> q0 = 0.48947555522518377
113 q0 -('o', 'o')-> q0 = 0.9492809105226678
114 q1 -('A', ' ')-> q0 = 0.14219909486622465
115 q1 -('H', 'e')-> q0 = 0.33140916464154174
116 q1 -('o', 'e')-> q0 = 0.1293664319119322
117 q1 -('e', 'i')-> q0 = 0.11703090685079252
118 q0 -('.', ':')-> q0 = 0.14454930768678864
119 q1 -('.', '.')-> q0 = 0.6574613745943317
120 q1 -('N', 'N')-> q0 = 0.6580813136196124
121 q1 -('u', 'o')-> q0 = 0.2357871950420502
122 q1 -(',', ' ')-> q0 = 0.17060298115535516
123 q1 -('N', 'n')-> q0 = 0.3291228964141075
124 q1 -('v', ' ')-> q0 = 0.1327667188187629
125 q1 -('[', 'o')-> q0 = 0.1657472373927646
126 q1 -('-', ' ')-> q0 = 0.48263813697855346
127 q0 -('Q', 'Q')-> q0 = 0.9672668666517417
128 q0 -('?', '?')-> q0 = 0.8323461684792022
129 q0 -('q', 'Q')-> q0 = 0.24975968946131644
130 q1 -('e', '"')-> q0 = 0.20353013149649474
131 q0 -('g', 'g')-> q0 = 0.903216667743711
132 q0 -('a', 'a')-> q0 = 0.9218507945894623
133 q1 -('S', 'S')-> q0 = 0.9870078539292495
134 q1 -(']', 'n')-> q0 = 0.13306064823036437
135 q0 -('k', 'k')-> q0 = 0.921741519180222
136 q1 -(']', '.')-> q0 = 0.19957434392162374
137 q0 -('f', 'f')-> q0 = 0.8743930809910898
138 q0 -('!', '.')-> q0 = 0.40136545379397054
139 q0 -('e', 'e')-> q0 = 0.9247103054255914
140 q1 -('?', ':')-> q0 = 0.10492683662791366
141 q1 -('Y', 'Y')-> q0 = 0.9413663579900222
142 q1 -('g', 'g')-> q0 = 0.3415153713662418
143 q1 -('k', 'x')-> q0 = 0.1530717461311122
144 q0 -('""', '"')-> q0 = 0.5523947875650184
145 q0 -('q', 'q')-> q0 = 0.6868300403863093
146 q1 -('J', 'I')-> q0 = 0.7744203790337814
147 q1 -('n', 'n')-> q0 = 0.378500282118244
148 q0 -('Y', 'y')-> q0 = 0.17853705072425843
149 q1 -('à', 'a')-> q0 = 0.7744203790337806
150 q0 -(':', '.')-> q0 = 0.31439191256976456
151 q0 -('R', 'R')-> q0 = 0.8851518904883128
152 q1 -('w', 'w')-> q0 = 0.6331130093251053
153 q1 -('z', 'e')-> q0 = 0.9263111735836629
154 q0 -('T', 'T')-> q0 = 0.8675248778962338
155 q0 -('U', 'V')-> q0 = 0.9085432912376012
156 q0 -('S', 'S')-> q0 = 0.8673605955336802
157 q1 -('C', ' ')-> q0 = 0.1662262714305257
158 q1 -('""', 't')-> q0 = 0.17343046970499848
159 q1 -('-', ',')-> q0 = 0.12257762257006442

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160 q1 -('H', 'o')-> q0 = 0.33140916464154174
161 q1 -('i', 'a')-> q0 = 0.14406555790895195
162 q1 -('y', 'I')-> q0 = 0.8326738022520065
163 q0 -('M', 'M')-> q0 = 0.9118301763994643
164 q1 -('-', '.')-> q0 = 0.24515141470912455
165 q0 -('\n', '\n')-> q0 = 0.9668342968858376
166 q1 -('K', ' ')-> q0 = 0.9413663579900224
167 q1 -('a', 't')-> q0 = 0.16100776525206179
168 q1 -('x', '.')-> q0 = 0.32913352709374666
169 q1 -('C', 'C')-> q0 = 0.33241099667973906
170 q1 -('B', 'b')-> q0 = 0.941366357990022
171 q1 -('v', 'u')-> q0 = 0.46451764040487714
172 q0 -('s', 's')-> q0 = 0.9120346938063556
173 q1 -('e', 'e')-> q0 = 0.12211909653583383
174 q0 -('[', '[')-> q0 = 0.9574367122788279
175 q0 -('F', 'F')-> q0 = 0.8752211461601921
176 q1 -('e', 't')-> q0 = 0.12211909653583383
177 q1 -('G', 'G')-> q0 = 0.9786295070006662
178 q1 -('p', 'p')-> q0 = 0.4838689537643939
179 q1 -('o', 'o')-> q0 = 0.24108690854148138
180 q1 -('f', 'f')-> q0 = 0.7618074926473832
181 q0 -(':', ':')-> q0 = 0.26602578625619744
182 q0 -('O', 'O')-> q0 = 0.8348365461186914
183 q0 -('(', '(')-> q0 = 0.4819618491034335
184 q1 -('"'', 'f')-> q0 = 0.1300836889739316
185 q1 -('I', 'i')-> q0 = 0.21379264697738853
186 q0 -('b', 'b')-> q0 = 0.8687311710211036
187 q0 -('v', 'v')-> q0 = 0.10771814348188731
188 q0 -(']', '])-> q0 = 0.962735680373084
189 q1 -('t', 't')-> q0 = 0.3583816684829737
190 q1 -('L', 'L')-> q0 = 0.6580813136196116
191 q1 -('!', 'e')-> q0 = 0.42644306298825063
192 q1 -('C', 'H')-> q0 = 0.1662262714305257
193 q0 -('m', 'm')-> q0 = 0.9061270801316583
194 q1 -('?', ' ')-> q0 = 0.10492683662791366
195 q1 -('t', 'e')-> q0 = 0.1037454124063355
196 q1 -('x', 'i')-> q0 = 0.32913352709374666
197 q1 -('D', 'D')-> q0 = 0.9413663579900227
198 q0 -('!', ',')-> q0 = 0.16054759809320998
199 q0 -('.', '.')-> q0 = 0.656921694546723
200 q1 -('A', 'a')-> q0 = 0.28432712571702395
201 q1 -('L', 'l')-> q0 = 0.32912289641410714
202 q1 -('r', 'e')-> q0 = 0.15965447226101628
203 q1 -('W', 's')-> q0 = 0.11073179500254718
204 q0 -('t', 't')-> q0 = 0.94690644607736
205 q1 -('F', 's')-> q0 = 0.19862691930606163
206 q1 -('l', 'l')-> q0 = 0.1773605341011044
207 q1 -('R', ' ')-> q0 = 0.9413663579900227
208 q0 -('d', 'd')-> q0 = 0.9348938152255716
209 q1 -('H', ' ')-> q0 = 0.16574599811240312
210 q1 -('g', 'e')-> q0 = 0.21017340868404744
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211 q1 -( 'h', '0')-> q0 = 0.29117197011265455
212 q1 -( ']', 't')-> q0 = 0.29934488745851273
213 q1 -( 'F', 'F')-> q0 = 0.794209885741029
214 q1 -( '[', 'l')-> q0 = 0.1657472373927646
215 q0 -( 'I', 'I')-> q0 = 0.9379763659734897
216 q1 -( 'o', 't')-> q0 = 0.11760638174040072
217 q1 -( 'a', 'o')-> q0 = 0.11404912366360996
```