HW4

November 8, 2018

```
In [1]: words = []
        for line in open("hw4_vocab.txt"):
          words.append(line.split()[0])

        counts = []
        for line in open("hw4_unigram.txt"):
          counts.append(int(line.split()[0]))

        bigram = []
        for line in open("hw4_bigram.txt"):
          bigram.append([int (x) for x in line.split()])
```

```
In [2]: unigram = list(zip(words, counts))
```

0.0.1 (a)

```
In [3]: probabilities = []
        for i in range(0, 499):
            probabilities.append([words[i], counts[i]/sum(counts)])
```

```
In [4]: [v for v in probabilities if v[0][0] == 'N' or v[0][0] == 'n']
```

```
Out[4]: [['NINETEEN', 0.0028588174836726445],
         ['NOT', 0.0021457733600835156],
         ['NEW', 0.001900350279776441],
         ['NINE', 0.0017613053303564415],
         ['NINETY', 0.0012920576727483372],
         ['NO', 0.0010485914217056834],
         ['NOW', 0.0007126160671875371],
         ['N.', 0.0006647838218553515],
         ['NATIONAL', 0.0005965149408928713],
         ['NEXT', 0.0004287902125662047З],
         ['NEWS', 0.0004290959671387705],
         ['NUMBER', 0.0003488781974804209],
         ['NORTH', 0.0002554640604701336],
         ['NEVER', 0.0002425367571420538],
         ['NIGHT', 0.00023650727697105726],
         ['NEARLY', 0.0002124871977502921],
         ['NEAR', 0.00021042029683974764],
         ['NEED', 0.00020837785629500844]]
```

0.0.2 (b)

```
In [5]: words[35]
```

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Out[5]: 'HAVE'
```

```
In [6]: biDist = [[words[v[1]-1],v[2]] for v in bigram if v[0] == 36]
```

```
In [7]: s = sum([v[1] for v in biDist])
        biDist = [[v[0],v[1]/s] for v in biDist]
```

```
In [8]: biDist = sorted(biDist, key=lambda x: x[1])
```

```
In [9]: biDist[-10:]
```

```
Out[9]: [['AN', 0.010897736780882022],
         ['HAD', 0.01128956551907104],
         ['SAID', 0.013040550192853207],
         ['NOT', 0.01344462357911063],
         ['NO', 0.015738454317258833],
         ['THE', 0.028934103385645192],
         ['A', 0.06311299769392462],
         ['TO', 0.08213301769351646],
         ['BEEN', 0.17246178649415317],
         ['<UNK>', 0.4116813942572601]]
```

0.0.3 (c)

```
In [10]: import math

         def probUnigram(word):
             return probabilities[words.index(word)][1]

         def probBigram(word, evidence):
             dist = [[words[v[1]-1],v[2]] for v in bigram if v[0] == words.index(evidence)+1]
             psum = sum([v[1] for v in dist])
             prob = [v[1] for v in dist if v[0] == word]
             if len(prob) == 0:
                 return 0
             else:
                 return prob[0]/psum
```

```
In [11]: def logLikelihoods(sentence):
             lu = 1
             lb = 1
             sent = sentence.split()

             for i in range(0, len(sent)):
                 lu = lu * probUnigram(sent[i])
                 if i == 0:
```

```
            lb = lb * probBigram(sent[i], "<s>")
        else:
            lb = lb * probBigram(sent[i], sent[i-1])
    if lu != 0:
        lu = math.log(lu)
    else:
        lu = "UNDEFINED"

    if lb != 0:
        lb = math.log(lb)
    else:
        lb = "UNDEFINED"
    return lu, lb
```

```
In [12]: lu, lb = logLikelihoods("TEN BILLION DOLLARS DIDN'T LAST VERY LONG")
         print(lu)
         print(lb)
```

```
-50.562145130091004
-43.04832187498447
```

0.0.4 (d)

```
In [13]: lu, lb = logLikelihoods("THE RECENT OFFICIALS SAID THEY INCORPORATED PRICES")
         print(lu)
         print(lb)
```

```
-44.72653897141283
UNDEFINED
```

```
In [14]: print(probBigram("THE", "<s>"))
         print(probBigram("RECENT", "THE"))
         print(probBigram("OFFICIALS", "RECENT"))
         print(probBigram("SAID", "OFFICIALS"))
         print(probBigram("THEY", "SAID"))
         print(probBigram("INCORPORATED", "THEY"))
         print(probBigram("PRICES", "INCORPORATED"))
```

```
0.15865263383617936
0.0007153649126219887
0
0.22033277138459284
0.020327686493360808
1.1064884482606001e-05
0
```

0.0.5 (e)

```
In [15]: def mixedProb(word, evidence, l):
             return (1-l)*probUnigram(word) + l*probBigram(word, evidence)

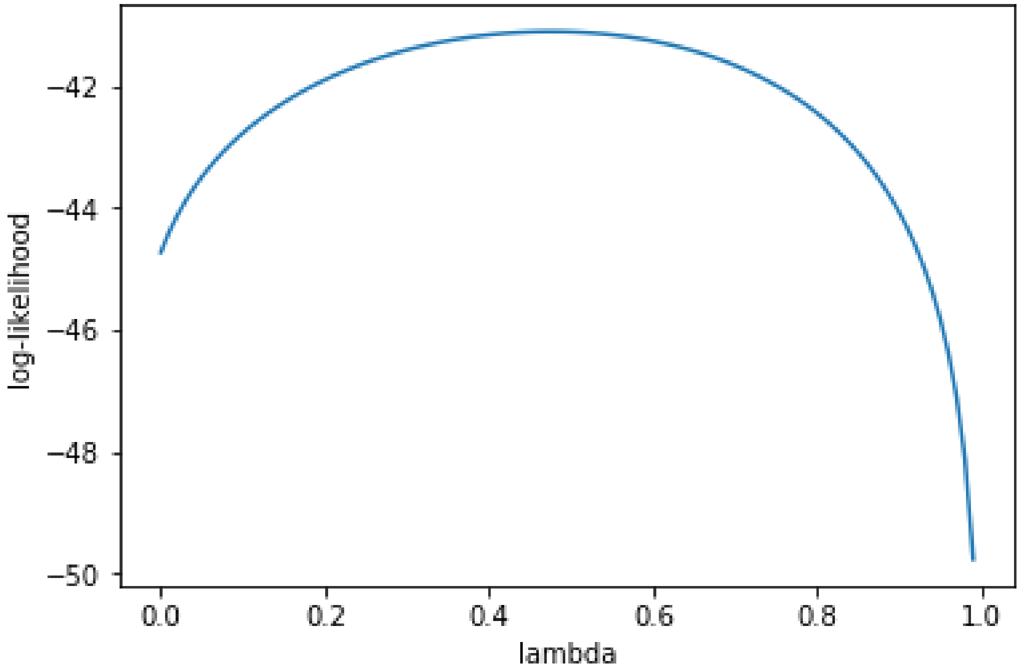
         def mixedLL(sentence, l):
             lm = 1
             sent = sentence.split()

             for i in range(0, len(sent)):
                 if i == 0:
                     lm = lm * mixedProb(sent[i], "<s>", l)
                 else:
                     lm = lm * mixedProb(sent[i], sent[i-1], l)
             return math.log(lm)
```

```
In [16]: lambdas = [i/100 for i in range(0,100)]
         lls = [mixedLL("THE RECENT OFFICIALS SAID THEY INCORPORATED PRICES", l) for l in lambda
```

```
In [17]: import matplotlib.pyplot as plt
```

```
In [18]: plt.plot(lambdas, lls)
         plt.xlabel('lambda')
         plt.ylabel('log-likelihood')
         plt.show()
```



```
In [19]: lambdas[lls.index(max(lls))]
```

```
Out[19]: 0.48
```