Intermediate report part a - step 3

Julian Main(10541578), Yorick de Boer(10786015), Amor Frans(10897844)

February 16, 2016

Introduction

For this assignment we constructed a bigram language model based on the trainings corpus. The user can choose whether it wants to use smoothing on the traingsdata or not. There are two smoothings added to the model: (1) Add-one smoothing which will add one to the counter of a sentence/word if the sentence/word is not counted in the trainings corpus and (2) Good-turing smoothing which uses a standard Good-Turing formula to smooth the trainings-data.

Method

Question 1 :
For question 1 we used the program of step 2. The python script could be executed with the command:

```
    python3.4 a1-step3.py -train-corpus [path] -test-corpus [path] -n [value] -smoothing
[no|add1|gt]
```

Question 2 :
The python script could be executed with the command:

```
python3.4 a1-step3.py -train-corpus [path] -test-corpus [path] -n [value] -smoothing
[no|add1|gt]
```

To make a add-one smoothing program we used the following steps:
- *Get paragraph*
Use a insert start-stop method separate each paragraph in corpus
- *Count ngrams in paragraph*
Use the collections module to count the ngrams of each paragraph.
- *Add one if count is zero*
If the count returns a None then we add one to the counter, according to the

rules of the add-one smoothing.

- Compute probability

To compute the probability we use the following formula: $\frac{the count of the ngram}{the count of the n-1 gram added with the vocabulary size}$

If the count of the n-1 gram is null then the divisor is only the vocabulary size.

To retract the count of the n-1 gram we also used the collections module.

Question 3 :

The python script could be executed with the command:

```
python3.4 a1-step3.py -train-corpus [path] -test-corpus [path] -n [value] -smoothing
[no|add1|gt]
```

To make a good-turing smoothing program we used the following steps:

- Get paragraph

Use a insert start-stop method separate each paragraph in corpus

- Make a count dictionary

To make a good-turing smoothing we we first retracted how many times each count occurred. We did by making a dictionary how many times each count occurred.Then using a get statement we can retract the value of the counts. *- Count the ngram*

Use the collections module to count the ngrams of each paragraph

- Use the good-turing algorithm

As given in the assignment we only used the smoothing on counts k if $k \leq 5$.

The formula given in the assignment:

$r^* = \frac{(r+1)\frac{n_r+1}{n_r} - r(k+1)\frac{(n_{k+1})}{n_1}}{1-(k+1)\frac{n_{k+1}}{n_1}}$. Using the method from the first action where we

made a dictionary for each count we can solve this equation.

- Compute probability

To compute the probability we use the following formula: *the count of the ngram the count of the n-1 gram added with t*

If the count of the n-1 gram is null then the divisor is only the vocabulary size.

To retract the count of the n-1 gram we also used the collections module.

Results

Question 2 :

Execute the program with the command:

```
 python a1_step3.py -n 2 -smoothing add1 austen.txt ja-pers-clean.txt
```

to see the results for this question. **Question 3 :**

(a)

percentage of sentences assigned zero probability using no smoothing: 0.31037827352085356

percentage of sentences assigned zero probability using add-1 smoothing: 0.31037827352085356

percentage of sentences assigned zero probability good turing smoothing: 0.028128031037827354

Output probabilities:

e-07, 3.974166041474985e-12, 2.196058548889562e-12, 2.4435323577344104e-173, 1.2687186017179182e-22, 1.0662900982618058e-99, 1.0371362295021483e-113, 1, 1.5853014117784715e-115, 7.217800331643056e-260, 3.4137784302160565e-63, 0.0, 1.9223738767830318e-41, 2.983251105593473e-178, 2.4569665442709954e-160, 0.0, 1.4307848649189902e-24, 9.085879778422319e-126, 4.5899989535008626e-151, 2.653623550711697e-116, 4.344584217460401e-259, 4.804959217972987e-119, 0.0, 7.451596841408804e-82, 1.1647697150623053e-73, 2.196058548889562e-12, 2.334326012208205e-96, 3.40305618099831e-300, 2.7609842516965746e-185, 1.0203789688571675e-247, 1.4588815261770657e-185, 8.316436975929572e-87, 8.770864564885226e-180, 1.6444548962618815e-47, 1.303963912352297e-124, 7.921168437721782e-150, 3.8782954060938226e-165, 1.139487524403174e-108, 2.110609647614592e-93, 3.0107745585708797e-111, 2.0655790685126675e-187, 8.998515596028385e-256, 7.419210937020614e-75, 2.196058548889562e-12, 3.137853860977097e-50, 6.004079629672395e-53, 3.600214107782885e-13, 5.081537637399784e-308, 9.494946878368126e-37, 1.0481180929780173e-35, 2.579968243651909e-177, 1.2921468566552986e-159, 3.6599887453125364e-06, 4.107636306205382e-82, 1, 3.6025549028921416e-59, 4.5316759064164855e-60, 3.4098410675216864e-24, 9.471217448291052e-12, 0.0, 0.0, 1.5553639780684972e-231, 1.4661959351498418e-17, 5.682899454909508e-18, 3.0437247438423472e-33, 2.6373283905093593e-24, 1.2282643831085458e-160, 1.9834118863938197e-172, 5.882607412147326e-127, 2.40367876037254e-18, 8.653758183671296e-31, 2.3485069557519434e-92, 2.0015024710217814e-06, 6.000178420499581e-07, 1.2009371935201481e-12, 2.320173091847477e-47, 6.137014587407681e-52, 7.518485678136113e-159, 2.1773954924674468e-122, 1.921180318317482e-141, 8.377631915981182e-41, 1.0404620483451127e-81, 2.196058548889562e-12, 6.2323372604718825e-174, 9.412890925867083e-97, 3.923969715533859e-167, 1.4422246435492666e-201, 3.659559282549938e-305, 4.132585794251641e-75, 0.0, 0.0, 3.5005383176022813e-99, 0.0, 1.3627765697900316e-75, 4.959751243781957e-41, 2.196058548889562e-12, 2.0271130468700575e-69, 2.914706015393513e-121, 1.9166103862463005e-35, 2.7502966308306705e-112, 5.905593691878134e-35, 1.6767103745030589e-164, 5.125950544162512e-86, 6.292528662879751e-63, 2.097810953018139e-41, 3.03292877787825e-65, 1.8886175961133593e-146, 1.731021203719227e-192, 7.724599882894984e-40, 3.5517353064876795e-250, 1.4422501427800499e-24, 5.192409310988616e-37, 8.195568865994801e-17, 2.540807784130806e-46, 1.6123492739735646e-192, 1.2596675066228015e-177, 4.6378292813561806e-269, 4.9174875453460224e-23, 1.954291201209034e-34, 7.414934953069061e-57, 7.4781214292807e-50, 9.471217448291052e-12, 2.8015602879062624e-65, 2.2448435843028387e-36, 6.377966094949761e-94, 2.244843584302838e-36, 4.010637906299089e-51, 1.3200535551169726e-103, 3.6599887453125364e-06, 6.924112550053068e-153, 1.5803119927319295e-44, 3.600214107782885e-13, 1.7182827602069164e-36, 3.134234742459258e-11, 1.7866481918469052e-74, 8.769993474269297e-96, 9.220085212091515e-34, 2.9759392383986456e-47, 1.1627016105757434e-47, 1.9602226381397775e-183, 7.118913579096365e-267, 1.7661126405860535e-50, 2.196058548889562e-12, 5.887044963940026e-272, 1.3693096567704002e-35, 2.553237459578462e-165, 7.607216312137444e-86, 0.0, 1.5980125035644086e-130, 5.458634712457478e-165, 1.0636288818886574e-292, 7.347572781132657e-254, 2.142345134917951e-234, 3.84985884658864e-68, 4.6520005590962837e-169, 5.734951375027457e-234, 7.214680645205899e-83, 5.941629449347956e-171, 4.501172823565854e-127, 3.4055884334564824e-206, 1.3086807483484668e-222, 1.2009371935201481e-12, 1.0391867283128223e-17, 3.6599887453125364e-06, 6.891916270063163e-115, 1.7811540909480162e-28, 5.323601121674967e-23,

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