

Introduction

(SNLP tutorial)

Vilém Zouhar, Awantee Deshpande, Julius Steuer

April 27, 2021

Overview

- Hello
- Topics
- Requirements
- Materials
- Assignments
- Homework
- Zipf's Law
- QA

Hello

Who am I?

Who are you?



Topics

- Language properties, Zipf's Law, Basic statistical formalism
- Information theory (Shannon's game, Code Length, Compression), Entropy
- Language modelling, Backing-off models (interpolation, discounting, smoothing)
- Text classification, Algorithms (kNN, Decision Trees, SVM, ...)
- Word Sense Disambiguation, Algorithms (Dictionary based-, translation-, Collocation-based)
- Information retrieval, Latent Semantic Analysis, Singular Value Decomposition
- Machine Translation, Word alignment
- POS Tagging, Named Entity Recognition
 - ▶ Sequence labeling (Hidden Markov models, Conditional Random Fields)

Requirements

Tutorial Requirements (exam admission)

- 70% of mandatory points (~10 assignments, 10 points each)
- Tutorial points only for exam admission (no final grade influence)

Tutorial Bonus Points

- ~2pts for extra exercises in the assignments
- 1pt for participating and *talking* in a tutorial
- Presenting a solution to the assignment (~5 points)
 - ▶ Let individual tutors known if you wish to present (in the respective tutor's channel)
 - ▶ Every group can present *at most* once

Final Project

- 25% of the final grade
- Details TBD

Transfer from last year

- Possible
- Do project and exam

What's available

- Lectures by Prof. Klakow (recorded)
- Tutorials (not recorded, but allowed for private sharing)
- Corrected homework
- Consultations
 - ▶ Only in specific cases
 - ▶ By default **no** email and **no** personal chat
 - ▶ Ask questions during the lecture / tutorials
- Public forum (please use Piazza)
 - ▶ Ask questions
 - ▶ Other students will also benefit from the answers
 - ▶ You can answer someone else's issue

Assignments

- Mandatory groups of 2
- Usually 3 exercises per assignment + a possible bonus question
- Jupyter notebook templates
 - ▶ Assignment + solution in the same notebook
 - ▶ Can use Google Colab or local runtime
 - ▶ Write solutions in Python files and import them
 - ▶ Submitted notebook must only contain your analysis and outputs
- Only one submission per group
 - ▶ Submit through Teams

Dates / Times

- Lecture: Fridays 8:30-10:00
- Tutorials:
 - ▶ Awantee: Tuesday 14:15-15:45
 - ▶ Julius: Tuesday 12:15-13:45
 - ▶ Vilém: Thursday 16:00-17:30
- Assignments
 - ▶ Released (usually) Friday 23:59 (available in Teams)
 - ▶ Deadline (next) Friday 23:59 (submit in Teams)
- Exam: 23rd. Jul. (8:00-10:00)
- Project Deadline: Sometime in August

Tutorial Content

- Review of the topics covered in class
- Presentation of the past assignment
- Discussing doubts in current assignment

Current Homework

- Exercise 1: Notebook instructions
- Exercise 2: Stick breaking
- Exercise 3: Zipf's law at word level
- Bonus: Zipf's law at character level

Languages

Language

$L \subseteq \Sigma^*$ (all possible substrings by elements of alphabet Σ)

- $\Sigma_1 = \{a, b, \dots, z, \ddot{u}, \ddot{a}, \ddot{o}\}$
- $\Sigma_2 = \{A, G, C, T\}$
- $\Sigma_3 = \{\text{def}, \text{True}, :, \text{print}, \dots\}$
- $\Sigma_4 = \{\text{SELECT}, \text{INSERT}, \text{DROP}, \dots\}$
- $\Sigma_5 = \{\text{hallo}, \text{ja}, \text{nein}, \dots\}$
- $\Sigma_6 = \{+, -, =, 1, 2, 3, \dots\}$
- $\Sigma_7 = \{+, -, =, 1, 2, 3, \dots\}$
- 'Oberfläche' $\in L_1$ (German words)
- '..GATTCCAATCAG' $\in L_2$ (DNA)
- 'while True: f()' $\in L_3$ (Python)
- 'SELECT * FROM tbl;' $\in L_4$ (SQL)
- 'Wie geht's dir?' $\in L_5$ (German)
- '4=5' $\in L_6$ (arithmetics)
- '1=2+=3333=' $\in L_7$ (???)

Usually defined by the alphabet and production rules (Automata and Grammar).

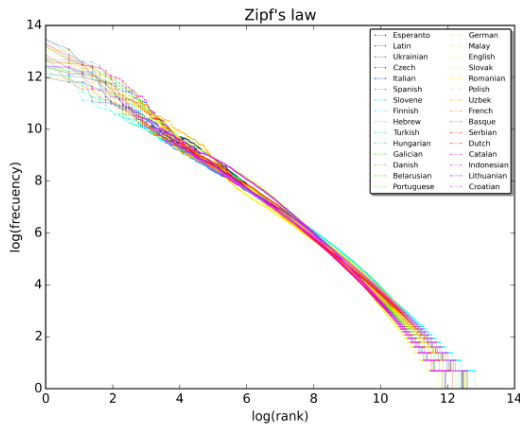
Zipf's Law

- ① Sort words/entries by frequency $f(x)$
- ② $r(x) = \text{rank} = \text{position in the sorted list}$
 - Then $f(x) \propto \frac{1}{r(x)^\gamma}$ (γ parameter)
- ③ Most common entry m .
 - Then $f(x) = \frac{f(m)}{r(x)^\gamma}$

Rank	Frequency	Predicted ($\gamma = 0.7$)
4	606	$1507/4^{0.7} = 571$
5	490	$1507/5^{0.7} = 488$
...		
11	261	$1507/11^{0.7} = 281$
12	252	$1507/12^{0.7} = 264$

Rank	Word [3]	Frequency
1	the	1507
2	and	714
3	to	703
4	a	606
5	of	490
6	she	484
7	said	416
8	it	346
9	in	345
10	was	328
11	I	261
12	you	252
13	as	237
14	Alice	221

Zipf's Law



We are plotting:

$$\log\left(\frac{C}{\exp(x)^\gamma}\right)$$
$$\log(C) - \gamma \log \exp(x)$$
$$\log(C) - \gamma x$$

Figure 1: log-log plot of Zipf's Law applied to natural languages [4]

Zipf's Law Notes

- Works beyond natural languages
- DNA subsequences of fixed lengths
- Code (programming languages)
- Population of cities (frequency is city population)

Rank	City	Population
1	New York, N.Y.	8,491,079
2	Los Angeles, Calif.	3,928,864
3	Chicago, Ill.	2,722,389
4	Houston, Tex.	2,239,558
5	Philadelphia, Pa.	1,560,297
6	Phoenix, Ariz.	1,537,058
7	San Antonio, Tex.	1,436,697
8	San Diego, Calif.	1,381,069
9	Dallas, Tex.	1,381,069

Mandelbrot Distribution

$$f(x) = \frac{m}{(c + r(x))^B}$$

Parameters to determine:

- m - Normalising term
- $c \geq 0$
- $B > 1$

Resources

- ① Course Website: <https://www.lsv.uni-saarland.de/statistical-natural-language-processing-summer-2021/>
- ② Piazza: <https://piazza.com/uni-saarland.de/spring2021/snlp>
- ③ Teams channel: <https://teams.microsoft.com/l/channel/19%3ac27c6662bea5450ebd05aad405690742%40thread.tacv2/General?groupId=4aab09db-6c09-4284-bfb0-2a94317c1d57&tenantId=67610027-1ac3-49b6-8641-ccd83ce1b01f>