Криптографія

Комп'ютерний практикум №1

Виконали:

студенти III курсу

групи ФБ-82

Ясинський Н.

Кравчук В.

Перевірив:

Чорний О.М.

_____

Київ 2020

Робота №1. Експериментальна оцінка ентропії на символ джерела відкритого тексту

- Мета роботи: Засвоєння понять ентропії на символ джерела та його надлишковості, вивчення та порівняння різних моделей джерела відкритого тексту для наближеного визначення ентропії, набуття практичних навичок щодо оцінки ентропії на символ джерела.
- Дата: 20.09.2020

Завдання до виконання:

0. Уважно прочитати методичні вказівки до виконання комп'ютерного практикуму.

1. Написати програми для підрахунку частот букв і частот біграм в тексті, а також підрахунку H1 та H2 за безпосереднім означенням. Підрахувати частоти букв та біграм, а також значення H1 та H2 на довільно обраному тексті російською мовою достатньої довжини (щонайменше 1Мб), де імовірності замінити відповідними частотами. Також одержати значення H1 та H2 на тому ж тексті, в якому вилучено всі пробіли.

2. За допомогою програми CoolPinkProgram оцінити значення (10) H, (20) H, (30) H .

3. Використовуючи отримані значення ентропії, оцінити надлишковість російської

мови в різних моделях джерела.

Виконання роботи:

Частота без пробілів	
о	0,113
ф	0,0835
ч	0,0801
е	0,0668
б	0,0567
ш	0,052
м	0,0503
ь	0,0456
н	0,045
х	0,0361
ж	0,0302
р	0,03
п	0,0285
в	0,0257
я	0,0235
и	0,0204
ю	0,0203
д	0,0189
з	0,0178
щ	0,0176
а	0,014
й	0,0116
с	0,0102
э	0,0092
т	0,0085
к	0,0066
ц	0,004
г	0,0031
л	0,0028

Частота з пробілами	
_	0,1751
о	0,0932
а	0,0689
е	0,0661
и	0,0551
н	0,0544
т	0,0468
с	0,0429
л	0,0415
в	0,0376
р	0,0371
к	0,0297
м	0,0249
д	0,0247
у	0,0235
п	0,0212
я	0,0194
ь	0,0169
г	0,0167
ы	0,0156
з	0,0147
б	0,0145
ч	0,0116
й	0,0095
ж	0,0085
ш	0,0076
ю	0,0055
щ	0,0023
ф	0,0018

Біграми (з перетином, з пропусками)

н:1.44%	ну:0.27%	у :0.64%	ч:0.51%	чт:0.34%	то:1.27%	о :2.05%	к:1.08%	кн:0.22%	ня:0.33%	яз:0.15%
зь:0.11%	ь :1.02%	г:0.49%	ге:0.06%	ен:0.67%	уя:0.01%	я :1.11%	и:1.05%	и :1.75%	л:0.25%	
лу:0.12%	ук:0.09%	кк:0.00%	ка:0.74%	а :1.66%	с:1.53%	ст:1.02%	та :0.53%	ал:0.84%	ли:0.61%	
не:0.87%	не:0.87%	е :1.61%	б:0.73%	бо:0.22%	ол:0.66%	ль:0.34%	ьш:0.04%	ше:0.22%	а к:0.43%	к :0.48%
п:1.51%	по:0.83%	ом:0.48%	ме:0.27%	ес:0.34%	ть:0.51%	ья:0.04%	ф:0.08%	фа:0.02%	ам:0.27%	
ми:0.35%	ил:0.49%	ии:0.06%	бу:0.14%	уо:0.01%	он:0.66%	на :1.00%	ап:0.07%	па:0.11%	а р:0.24%	
рт:0.07%	те:0.45%	ет:0.36%	т :0.45%	я:0.15%	в:1.46%	ва :0.56%	м :0.72%	вп:0.03%	пе:0.23%	
ер:0.64%	ре:0.58%	ед:0.22%	д :0.10%	го:0.86%	ов:0.77%	во:0.71%	ор:0.60%	рю:0.02%	ю :0.34%	
е:0.38%	сл:0.22%	вы:0.26%	ы :0.41%	м:0.58%	мн:0.11%	ск:0.44%	аж:0.12%	же:0.35%	у:0.37%	
а с:0.37%	с :0.30%	ой:0.35%	йн:0.03%	оз:0.08%	зв:0.07%	ит:0.33%	се:0.34%	еб:0.11%	бе:0.19%	
з:0.40%	за:0.53%	ащ:0.02%	щи:0.06%	ищ:0.01%	ща :0.04%	ат:0.44%	вс:0.30%	га:0.10%	ад:0.20%	
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Біграми (з перетином, без пропусків)

ну:0.35%	уч:0.13%	чт:0.41%	то:1.58%	ок:0.32%	кн:0.32%	ня:0.40%	яз:0.22%	зь:0.13%	ьг:0.04%	ге:0.07%
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ше:0.26%	ек:0.22%	ак:0.67%	кп:0.04%	по:1.00%	ом:0.66%	ме:0.34%	ес:0.62%	ть:0.62%	ья:0.07%	
яп:0.11%	яф:0.01%	фа:0.02%	ам:0.42%	ми:0.49%	ии:0.20%	иб:0.14%	бу:0.17%	уо:0.05%	он:1.05%	
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мв:0.08%	вп:0.10%	пе:0.27%	ер:0.83%	ре:0.70%	ед:0.36%	дг:0.01%	го:1.05%	ов:1.18%	во:0.90%	
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же:0.43%	еч:0.16%	оу:0.06%	ун:0.12%	св:0.24%	ой:0.42%	йн:0.10%	ае:0.16%	ып:0.06%	оз:0.16%	
зв:0.10%	ит:0.48%	се:0.42%	бе:0.24%	ез:0.21%	за:0.64%	ащ:0.03%	щи:0.08%	ищ:0.01%	ща:0.05%	
ат:0.62%	ьв:0.14%	вс:0.43%	ег:0.45%	га:0.12%	ад:0.32%	до:0.42%	ос:0.97%	ти:0.42%	еу:0.06%	
уж:0.16%	жа:0.17%	сы:0.05%	ьэ:0.01%	эт:0.26%	ог:0.60%	оа:0.02%	ан:0.78%	нт:0.10%	их:0.20%	
хр:0.02%	ри:0.64%	ис:0.54%	пр:0.73%	ра:0.96%	ав:0.56%	оя:0.11%	ве:0.51%	юч:0.02%	оо:0.23%	
сб:0.02%	зн:0.20%	аю:0.09%	юв:0.03%	ыу:0.01%	др:0.24%	ру:0.35%	уг:0.17%	гм:0.00%	мо:0.49%	
йв:0.08%	ем:0.58%	рн:0.10%	ны:0.36%	ый:0.19%	йр:0.04%	аб:0.16%	бк:0.03%	кв:0.07%	ыг:0.02%	
уз:0.11%	зд:0.09%	тв:0.31%	ву:0.09%	уй:0.01%	йт:0.07%	ея:0.06%	ви:0.42%	иж:0.06%	жу:0.02%	
сп:0.22%	пу:0.07%	юс:0.05%	са:0.17%	ди:0.32%	сь:0.38%	ьи:0.10%	ир:0.13%	сс:0.12%	аз:0.53%	

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зо:0.08%	ху:0.02%	ут:0.19%	мс:0.11%	кр:0.22%	сн:0.12%	мл:0.03%	ке:0.06%	мб:0.03%	об:0.51%
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ям:0.08%	жд:0.08%	уи:0.07%	нш:0.01%	ео:0.15%	лн:0.11%	см:0.14%	яс:0.22%	ьт:0.06%	йи:0.06%
ул:0.20%	лы:0.14%	ыб:0.09%	ба:0.13%	ош:0.16%	дш:0.01%	ши:0.22%	ий:0.17%	йк:0.09%	ьс:0.22%
тл:0.04%	ыр:0.05%	мх:0.01%	хи:0.05%	ца:0.07%	дв:0.11%	мш:0.01%	мм:0.02%	нд:0.15%	чу:0.07%
лк:0.18%	хб:0.02%	шм:0.00%	нг:0.04%	ыс:0.13%	мф:0.00%	нц:0.06%	цу:0.06%	зс:0.03%	мя:0.06%
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рж:0.04%	хп:0.04%	йо:0.06%	бд:0.00%	юм:0.02%	ту:0.20%	ьч:0.05%	дь:0.09%	ьл:0.02%	яо:0.09%
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ээ:0.00%	кф:0.00%	лж:0.05%	дп:0.02%	кс:0.06%	лр:0.03%	яе:0.05%	нб:0.03%	нз:0.02%	уе:0.03%
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щт:0.00%	вю:0.00%	цр:0.00%	пц:0.00%	сщ:0.00%	тй:0.00%	вй:0.00%	жр:0.00%	цф:0.00%	пв:0.00%

Біграми (без перетину, з пропусками)

н:1.44%	у :0.63%	чт:0.33%	о :2.06%	кн:0.23%	яз:0.16%	ь :1.04%	ге:0.06%	ну:0.27%	я :1.13%	и :1.74%
лу:0.13%	кк:0.00%	а :1.66%	ст:1.03%	ал:0.84%	не:0.88%	б:0.73%	ол:0.64%	ьш:0.04%	е :1.62%	
ка:0.74%	к :0.49%	по:0.85%	ме:0.27%	ья:0.05%	п:1.50%	ом:0.47%	ес:0.34%	ть:0.50%	фа:0.02%	
ми:0.34%	ли:0.62%	бу:0.13%	он:0.64%	ап:0.07%	ар:0.23%	те:0.44%	ет:0.36%	я:0.15%	в:1.46%	
ам:0.27%	пе:0.23%	ре:0.58%	д :0.10%	го:0.87%	во:0.71%	рю:0.02%	е:0.39%	сл:0.23%	вы:0.26%	
м:0.56%	ск:0.44%	аж:0.12%	на:0.98%	с :0.31%	йн:0.04%	ы :0.41%	зв:0.07%	ит:0.34%	се:0.34%	
бе:0.18%	з:0.41%	ащ:0.02%	ищ:0.01%	ат:0.45%	вс:0.30%	га:0.10%	до:0.34%	уж:0.13%	ас:0.37%	
эт:0.22%	ог:0.46%	ан:0.48%	ти:0.33%	хр:0.01%	ис:0.28%	та:0.53%	ра:0.79%	ер:0.64%	ю :0.34%	
а:0.28%	нт:0.06%	их:0.15%	ри:0.53%	_ :1.63%	ва:0.56%	бо:0.22%	ль:0.33%	ше:0.21%	зн:0.16%	
аю:0.08%	д:0.67%	ру:0.30%	г :0.08%	мо:0.36%	й :0.76%	у:0.36%	же:0.35%	ве:0.41%	рн:0.07%	
ый:0.16%	р:0.39%	аб:0.07%	к:1.06%	ак:0.44%	зд:0.07%	тв:0.21%	уй:0.01%	др:0.20%	ав:0.31%	
ву:0.07%	йт:0.03%	ви:0.32%	жу:0.02%	ч:0.52%	то:1.25%	уг:0.11%	с:1.51%	ад:0.19%	сс:0.07%	
зы:0.05%	ла:0.66%	и:1.05%	юл:0.00%	г:0.48%	од:0.43%	из:0.17%	ло:0.61%	вн:0.13%	р :0.13%	
фр:0.04%	ей:0.21%	бл:0.07%	иж:0.03%	ен:0.66%	им:0.29%	тр:0.27%	иц:0.13%	ма:0.29%	фе:0.01%	
ро:0.65%	еч:0.09%	ая:0.27%	но:0.83%	ин:0.33%	ов:0.76%	ня:0.32%	зя:0.05%	ил:0.47%	ия:0.14%	
м :0.72%	пр:0.60%	ие:0.22%	ха:0.08%	вш:0.11%	ег:0.33%	че:0.30%	шл:0.04%	ял:0.09%	ьк:0.10%	
дн:0.15%	ее:0.14%	ыл:0.21%	пп:0.01%	о:1.17%	ор:0.59%	гр:0.13%	ип:0.03%	п :0.00%	бы:0.35%	
л :0.75%	гд:0.09%	уп:0.06%	от:0.65%	яв:0.02%	ко:0.81%	ед:0.23%	ки:0.23%	еж:0.09%	ур:0.07%	
л :0.75%	гд:0.09%	уп:0.06%	от:0.65%	яв:0.02%	ко:0.81%	ед:0.23%	ки:0.23%	еж:0.09%	ур:0.07%	
ых:0.08%	в :0.56%	за:0.51%	пи:0.07%	со:0.24%	чк:0.03%	ах:0.09%	аз:0.42%	ос:0.61%	нн:0.28%	
сн:0.06%	ым:0.15%	л:0.23%	з :0.10%	зл:0.02%	ич:0.11%	ех:0.09%	аф:0.05%	зь:0.10%	ид:0.17%	
ни:0.69%	уч:0.07%	рс:0.03%	кт:0.05%	ив:0.26%	шк:0.03%	ае:0.08%	т :0.45%	уд:0.19%	оч:0.14%	
да:0.38%	ны:0.30%	нч:0.02%	бя:0.05%	ду:0.16%	н :0.45%	ое:0.21%	ж:0.18%	па:0.11%	де:0.41%	
см:0.10%	уг:0.13%	яс:0.09%	лы:0.12%	ба:0.11%	дш:0.01%	ий:0.13%	тл:0.02%	ыр:0.04%	хи:0.02%	
ца:0.06%	дв:0.08%	ши:0.18%	му:0.23%	нд:0.10%	ир:0.05%	чу:0.06%	лк:0.07%	аш:0.09%	х :0.31%	
ез:0.11%	ыс:0.07%	ф:0.08%	нц:0.05%	уз:0.07%	ке:0.05%	т:0.67%	ды:0.06%	ем:0.38%	ок:0.16%	
ци:0.02%	ям:0.04%	ры:0.13%	св:0.18%	ой:0.34%	ся:0.29%	чи:0.12%	ел:0.61%	ек:0.10%	ош:0.12%	
вл:0.10%	оц:0.01%	ку:0.15%	ою:0.08%	уш:0.07%	си:0.16%	яю:0.01%	щу:0.01%	жд:0.07%	лс:0.14%	
]вь:0.02%	сп:0.15%	зм:0.02%	яя:0.02%	хо:0.24%	б :0.02%	шь:0.03%	ож:0.16%	ьс:0.09%	мя:0.04%	
ув:0.08%	сь:0.31%	юс:0.01%	гл:0.16%	ын:0.03%	ср:0.02%	мн:0.12%	ум:0.08%	шн:0.03%	ик:0.17%	
йе:0.00%	рв:0.02%	вя:0.02%	тс:0.08%	тм:0.01%	ие:0.09%	ря:0.10%	ещ:0.06%	об:0.32%	ьт:0.01%	
еш:0.08%	ча :0.21%	ьц:0.01%	ев:0.13%	х:0.12%	щи:0.07%	уо:0.01%	рт:0.06%	сж:0.00%	мы:0.07%	
чь:0.02%	вт:0.02%	ты:0.15%	чн:0.05%	ье:0.13%	сы:0.04%	дт:0.04%	дц:0.02%	гу:0.07%	ш:0.10%	

ои:0.07%	еи:0.02%	жи:0.11%	ьв:0.10%	ги:0.08%	оп:0.10%	ьп:0.05%	иу:0.00%	еб:0.11%	сд:0.03%
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жа:0.14%	ьн:0.10%	са:0.14%	бр:0.12%	ус:0.12%	э:0.24%	иа:0.01%	жк:0.01%	вд:0.03%	кр:0.18%
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ии:0.06%	уэ:0.00%	зс:0.01%	уб:0.05%	мп:0.02%	вр:0.04%	нг:0.02%	дп:0.01%	аг:0.09%	ле:0.34%
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ьч:0.01%	сч:0.03%	рь:0.09%	би:0.07%	дд:0.00%	пу:0.06%	яч:0.01%	пы:0.02%	су:0.06%	дс:0.03%
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зу:0.03%	ц:0.02%	ач:0.07%	фу:0.01%	нк:0.02%	нр:0.00%	ун:0.03%	вз:0.05%	яд:0.07%	вк:0.02%
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яи:0.00%	мк:0.01%	дх:0.01%	мс:0.01%	зб:0.01%	зк:0.01%	хн:0.01%	хь:0.00%	лл:0.01%	рц:0.01%
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юк:0.00%	ио:0.02%	юз:0.00%	ощ:0.01%	зч:0.00%	оу:0.00%	цв:0.00%	фы:0.00%	кв:0.02%	лг:0.01%
жо:0.00%	ыц:0.00%	сц:0.00%	тт:0.01%	фо:0.00%	уа:0.01%	зе:0.03%	сб:0.01%	ьз:0.01%	лт:0.00%
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ьп:0.00%	йм:0.00%	хс:0.00%	рщ:0.01%	жч:0.00%	фл:0.01%	ьа:0.00%	чл:0.00%	пт:0.00%	тщ:0.00%
лп:0.01%	тх:0.00%	йб:0.00%	ыи:0.00%	юр:0.01%	ьд:0.00%	оа:0.00%	бг:0.00%	уу:0.00%	бм:0.00%
ьи:0.01%	ф :0.02%	ьв:0.00%	чо:0.01%	вц:0.00%	лд:0.03%	дю:0.00%	шт:0.02%	вч:0.00%	жс:0.00%
вб:0.00%	кш:0.00%	дб:0.00%	зп:0.00%	тю:0.00%	сф:0.00%	тг:0.00%	бш:0.00%	жь:0.00%	шв:0.00%
мм:0.00%	жл:0.00%	нл:0.00%	еа:0.00%	эг:0.00%	бч:0.00%	нз:0.00%	гч:0.00%	ьо:0.00%	шп:0.00%
хм:0.00%	эк:0.00%	хе:0.00%	э :0.00%	яб:0.00%	ьф:0.00%	жю:0.00%	сз:0.00%	нв:0.00%	лф:0.00%
кз:0.00%	эм:0.00%	ь:0.00%	эр:0.00%	жэ:0.00%	рэ:0.00%	чэ:0.00%	щр:0.00%	лэ:0.00%	сэ:0.00%
дэ:0.00%	вэ:0.00%	ыщ:0.00%	ыу:0.00%	оэ:0.00%	ыж:0.00%	вщ:0.00%	фт:0.00%	рр:0.00%	цд:0.00%
уф:0.00%	тф:0.00%	дз:0.00%	бю:0.00%	лб:0.00%	жж:0.00%	лщ:0.00%	гт:0.00%	эз:0.00%	жг:0.00%
бт:0.00%	дч:0.00%	тш:0.00%	пс:0.00%	фс:0.00%	мц:0.00%	й:0.00%	гм:0.00%	эп:0.00%	тз:0.00%
мб:0.00%	вг:0.00%	цг:0.00%	дф:0.00%	мш:0.00%	фк:0.00%	кц:0.00%	эс:0.01%	цт:0.00%	зш:0.00%
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ьщ:0.00%	эц:0.00%	рф:0.00%	йр:0.00%	шр:0.00%	цн:0.00%	лм:0.00%	йо:0.00%	эш:0.00%	шш:0.00%
хп:0.00%	уц:0.00%	нф:0.00%	хх:0.00%	мж:0.00%	ьр:0.00%	юя:0.00%	лв:0.00%	зц:0.00%	йщ:0.00%

Біграми (без перетину, без пропусків)

ну:0.36%	чт:0.42%	ок:0.33%	ня:0.40%	зь:0.13%	ге:0.07%	яи:0.10%	лу:0.16%	кк:0.05%	а с:0.64%	та :0.65%
ли:0.79%	не :1.05%	бо:0.28%	ль:0.42%	ше:0.26%	ка:0.90%	кп:0.04%	ом:0.66%	ес:0.63%	ть:0.63%	
яп:0.11%	яф:0.01%	ам:0.41%	ил:0.60%	ии:0.20%	бу:0.17%	он:1.06%	он:1.06%	а п:0.27%	те:0.55%	
тя:0.08%	ва:0.69%	мв:0.09%	пе:0.27%	ре:0.71%	дг:0.01%	ов:1.18%	ор:0.76%	юе:0.01%	сл:0.28%	
ив:0.54%	ым:0.19%	ск:0.56%	аж:0.16%	ет:0.49%	еч:0.16%	то:1.59%	ун:0.12%	во:0.90%	йн:0.10%	
а е:0.17%	ып:0.07%	оз:0.15%	се:0.42%	бе:0.23%	за:0.65%	щи:0.08%	ща :0.05%	вс:0.42%	ег:0.45%	
ад:0.32%	ос:0.94%	ти:0.44%	еу:0.05%	жа:0.16%	сы:0.05%	эт:0.26%	ог:0.60%	оа:0.02%	нт:0.11%	
их:0.21%	ри:0.66%	ст:1.27%	ра :0.95%	яв:0.16%	ер:0.83%	юч:0.03%	а н:0.78%	хр:0.03%	ис:0.55%	
сб:0.02%	ол:0.82%	ьш:0.05%	ен:0.98%	ез:0.20%	на :1.23%	юв:0.03%	ыу:0.01%	же:0.43%	др:0.24%	

уг:0.17%	мо:0.50%	йв:0.07%	ны:0.36%	йр:0.04%	аб:0.15%	кв:0.06%	ыг:0.02%	ит:0.48%	уз:0.11%
ав:0.57%	ву:0.09%	йт:0.07%	ея:0.06%	ви:0.42%	жу:0.02%	оя:0.11%	сп:0.23%	аю:0.09%	са:0.18%
ди:0.32%	сь:0.38%	ир:0.13%	аз:0.53%	ыв:0.17%	ай:0.10%	кг:0.02%	ию:0.03%	ле:0.46%	го:1.05%
да:0.48%	из:0.25%	ве:0.52%	яа:0.03%	нн:0.38%	ло:0.86%	вн:0.21%	аш:0.12%	фр:0.06%	ей:0.26%
ип:0.27%	бл:0.08%	иж:0.06%	мп:0.10%	ат:0.61%	цы:0.01%	ма:0.34%	иф:0.01%	ед:0.35%	тр:0.33%
ая:0.37%	жн:0.13%	ои:0.23%	чи:0.15%	но:1.02%	зя:0.06%	си:0.22%	вы:0.32%	ех:0.13%	ее:0.19%
че:0.36%	ак:0.68%	ля:0.21%	ла:0.81%	ьк:0.21%	од:0.64%	йу:0.02%	еб:0.22%	ыл:0.26%	гр:0.17%
пк:0.01%	аг:0.16%	пп:0.01%	бы:0.42%	лт:0.04%	уп:0.13%	от:0.89%	ят:0.22%	ки:0.32%	ми:0.51%
уо:0.05%	де:0.53%	ин:0.57%	ев:0.35%	ых:0.10%	аи:0.15%	зд:0.09%	ув:0.16%	пи:0.09%	со:0.31%
чк:0.03%	ах:0.13%	зо:0.08%	ху:0.03%	сн:0.13%	ке:0.07%	ем:0.57%	зр:0.03%	хе:0.01%	иу:0.06%
сг:0.01%	фи:0.08%	кн:0.33%	яз:0.22%	ьн:0.24%	вв:0.04%	ид:0.31%	ич:0.19%	уч:0.12%	ие:0.31%
ек:0.22%	уб:0.09%	йб:0.05%	ой:0.42%	иш:0.06%	ко:0.99%	пу:0.07%	га:0.12%	яб:0.05%	уд:0.24%
нь:0.12%	ын:0.10%	ус:0.22%	ям:0.08%	еж:0.13%	ду:0.17%	иа:0.04%	ро:0.81%	ча:0.26%	лн:0.12%
см:0.14%	ут:0.18%	яс:0.22%	ьт:0.06%	ул:0.19%	ыб:0.09%	дш:0.02%	ий:0.16%	ьс:0.21%	св:0.23%
лы:0.15%	ыр:0.05%	мх:0.01%	ца:0.07%	вп:0.10%	дв:0.10%	мш:0.01%	му:0.30%	нд:0.15%	хб:0.02%
хи:0.05%	зв:0.09%	хо:0.30%	нг:0.04%	зы:0.06%	мф:0.00%	нц:0.06%	ык:0.05%	ум:0.14%	ал:1.06%
ыи:0.04%	им:0.41%	ац:0.01%	ия:0.20%	ры:0.17%	йс:0.17%	тв:0.30%	ся:0.37%	ку:0.19%	по:1.01%
до:0.41%	лк:0.18%	па:0.14%	вл:0.14%	це:0.14%	ук:0.18%	ою:0.10%	юю:0.13%	ющ:0.04%	зн:0.19%
ме:0.36%	жд:0.08%	ыс:0.14%	уи:0.07%	оу:0.06%	лс:0.24%	ян:0.23%	еп:0.32%	ье:0.20%	йд:0.08%
ру:0.34%	гу:0.10%	еи:0.15%	зм:0.04%	яя:0.04%	вк:0.08%	пр:0.72%	уш:0.10%	шк:0.04%	об:0.51%
гд:0.11%	еш:0.10%	ьр:0.02%	оо:0.25%	мя:0.06%	ьу:0.03%	чу:0.07%	юс:0.05%	ьа:0.07%	дн:0.21%
ик:0.34%	гл:0.19%	оп:0.35%	мн:0.20%	ьд:0.04%	оч:0.27%	ьз:0.04%	тз:0.01%	йи:0.06%	зе:0.04%
тм:0.03%	ни:0.83%	йп:0.09%	ьв:0.14%	рк:0.04%	вя:0.02%	тс:0.15%	ые:0.12%	ох:0.09%	кб:0.07%
ыю:0.03%	ьч:0.03%	кз:0.01%	ещ:0.07%	ел:0.75%	ши:0.23%	мс:0.11%	ьх:0.01%	мч:0.04%	рт:0.09%
гс:0.02%	ыт:0.09%	ож:0.24%	сж:0.01%	йг:0.03%	шн:0.04%	мт:0.03%	вт:0.07%	ял:0.12%	яч:0.05%
кт:0.08%	пь:0.08%	дт:0.06%	бр:0.15%	рд:0.05%	ба:0.13%	рн:0.11%	тб:0.03%	ао:0.15%	жи:0.13%
ео:0.16%	лг:0.03%	бя:0.06%	сд:0.05%	вр:0.08%	хп:0.04%	йо:0.07%	бд:0.00%	ту:0.20%	иб:0.15%
ьл:0.02%	яо:0.09%	ош:0.16%	ею:0.04%	рж:0.05%	зг:0.07%	ио:0.20%	вш:0.14%	ьи:0.10%	ью:0.07%
кр:0.23%	ое:0.31%	эн:0.01%	зи:0.04%	тк:0.08%	жк:0.01%	хч:0.01%	вб:0.03%	ьэ:0.02%	ще:0.14%
ач:0.14%	лю:0.10%	йз:0.02%	иг:0.11%	иц:0.16%	еа:0.02%	шл:0.05%	тн:0.16%	дл:0.07%	ха:0.10%
рл:0.01%	эз:0.00%	кф:0.00%	лж:0.05%	ьц:0.01%	лр:0.03%	яе:0.05%	уж:0.16%	нб:0.03%	ьо:0.08%
бь:0.01%	бщ:0.02%	мы:0.07%	мк:0.08%	ый:0.19%	ья:0.07%	юн:0.04%	юд:0.05%	лв:0.08%	бн:0.03%
чн:0.06%	хф:0.00%	йл:0.04%	сэ:0.01%	аа:0.04%	оф:0.07%	сх:0.03%	еэ:0.03%	ьм:0.07%	зл:0.02%
дз:0.01%	ыд:0.03%	су:0.10%	ют:0.06%	сс:0.12%	йк:0.08%	ря:0.13%	жт:0.00%	дц:0.02%	бж:0.00%
мл:0.03%	нв:0.06%	рь:0.10%	ьп:0.11%	дм:0.02%	кч:0.01%	ьб:0.06%	кл:0.05%	юб:0.05%	шу:0.03%
юя:0.01%	юм:0.02%	пы:0.02%	шб:0.00%	рю:0.02%	юп:0.03%	дс:0.05%	йш:0.02%	вм:0.03%	кд:0.03%
шч:0.00%	гн:0.04%	ьг:0.03%	ци:0.03%	вь:0.02%	юа:0.01%	рч:0.01%	мд:0.04%	ух:0.05%	йм:0.05%
кс:0.06%	ищ:0.02%	юю:0.01%	тп:0.06%	рг:0.04%	ау:0.06%	гв:0.02%	уэ:0.01%	дь:0.08%	бк:0.03%
вз:0.08%	йч:0.03%	нс:0.10%	иэ:0.03%	хэ:0.00%	ящ:0.02%	цо:0.05%	ги:0.10%	мм:0.02%	шо:0.03%
бв:0.01%	зт:0.01%	хд:0.02%	хв:0.04%	зу:0.03%	вч:0.03%	юц:0.01%	фу:0.01%	нк:0.06%	йж:0.01%
фе:0.02%	уа:0.03%	нр:0.02%	мг:0.04%	як:0.12%	цу:0.06%	вд:0.06%	гп:0.01%	ды:0.07%	уф:0.00%
яг:0.07%	юи:0.04%	рз:0.01%	мь:0.00%	ша:0.15%	чь:0.02%	дя:0.04%	юк:0.03%	ьч:0.05%	зю:0.02%
йя:0.01%	сч:0.05%	хс:0.04%	лл:0.02%	яц:0.01%	йа:0.02%	хн:0.04%	юу:0.01%	фа:0.03%	рс:0.05%
лб:0.04%	ях:0.03%	нп:0.07%	лз:0.02%	яд:0.13%	цв:0.01%	ыз:0.02%	ец:0.03%	ур:0.10%	зк:0.03%
тц:0.02%	мр:0.03%	ця:0.00%	би:0.09%	ущ:0.02%	яу:0.03%	нч:0.03%	оэ:0.04%	юж:0.01%	юз:0.01%
яж:0.07%	лх:0.00%	юэ:0.01%	лч:0.07%	зп:0.02%	нж:0.00%	тч:0.04%	уу:0.01%	юр:0.02%	яр:0.03%
ты:0.18%	рш:0.03%	хм:0.02%	мз:0.02%	рх:0.02%	кэ:0.01%	мб:0.03%	аэ:0.03%	лп:0.09%	тл:0.03%
ср:0.03%	хя:0.01%	кю:0.00%	ащ:0.03%	кх:0.01%	яй:0.00%	кя:0.01%	юл:0.01%	мэ:0.01%	дк:0.03%
йэ:0.01%	нз:0.02%	тд:0.04%	мж:0.01%	цк:0.03%	уе:0.03%	ощ:0.01%	йц:0.01%	уя:0.02%	рв:0.04%
шь:0.05%	рп:0.03%	щь:0.00%	пя:0.04%	яш:0.01%	вэ:0.03%	хк:0.02%	мц:0.00%	лм:0.01%	гк:0.02%
хг:0.01%	йе:0.01%	вг:0.04%	тт:0.03%	рц:0.01%	гэ:0.00%	щн:0.01%	фн:0.00%	тх:0.01%	чо:0.01%
ьж:0.01%	юф:0.00%	яэ:0.02%	лэ:0.01%	юо:0.03%	хц:0.00%	фы:0.00%	рб:0.02%	ню:0.02%	хл:0.02%
тэ:0.01%	ыя:0.01%	сц:0.00%	жо:0.01%	шф:0.00%	цб:0.00%	цз:0.00%	дч:0.01%	рф:0.00%	оц:0.02%
бх:0.01%	жм:0.00%	зб:0.02%	юг:0.02%	гз:0.01%	щу:0.01%	зс:0.03%	нш:0.01%	еф:0.01%	ыа:0.01%
сю:0.02%	зз:0.01%	жс:0.00%	вх:0.01%	гя:0.00%	дб:0.01%	шв:0.00%	чш:0.01%	жб:0.01%	хж:0.00%
ыэ:0.01%	нх:0.00%	уй:0.01%	рм:0.03%	аф:0.07%	чл:0.00%	кж:0.02%	цг:0.00%	жь:0.00%	гг:0.00%
яю:0.01%	тщ:0.00%	юх:0.00%	йф:0.01%	дд:0.01%	йю:0.00%	эм:0.00%	цс:0.00%	цп:0.00%	бм:0.00%
цч:0.00%	дх:0.01%	тф:0.00%	зч:0.00%	пн:0.01%	чр:0.00%	жг:0.00%	фо:0.01%	рр:0.01%	цн:0.01%
дж:0.00%	цт:0.00%	бб:0.00%	бс:0.01%	жэ:0.00%	пм:0.00%	цм:0.00%	дп:0.02%	вж:0.00%	хт:0.01%
жч:0.01%	тж:0.01%	ыж:0.01%	кц:0.00%	рэ:0.00%	пт:0.01%	жп:0.00%	эг:0.00%	нэ:0.01%	лф:0.00%
сз:0.01%	нл:0.00%	йх:0.01%	бг:0.00%	шп:0.01%	чс:0.00%	шт:0.02%	рщ:0.01%	фв:0.00%	вц:0.01%
нм:0.01%	дю:0.00%	мю:0.01%	чм:0.00%	шм:0.00%	кш:0.00%	бз:0.00%	тю:0.01%	сф:0.00%	ээ:0.00%
гб:0.01%	фп:0.00%	жя:0.00%	тш:0.00%	чп:0.00%	бш:0.00%	уц:0.00%	хз:0.00%	жл:0.00%	гт:0.00%

пс:0.00%	гм:0.00%	лш:0.01%	щд:0.00%	юш:0.01%	фс:0.00%	пч:0.00%	эк:0.01%	бч:0.00%	гч:0.00%
фм:0.00%	эй:0.00%	ьф:0.00%	чг:0.00%	фт:0.00%	дэ:0.00%	хш:0.00%	вф:0.00%	хх:0.00%	жю:0.00%
оь:0.00%	пэ:0.00%	эр:0.01%	щр:0.00%	чэ:0.00%	ыщ:0.00%	щз:0.00%	бэ:0.00%	мщ:0.00%	жх:0.00%
цд:0.00%	фб:0.00%	лц:0.00%	лщ:0.00%	бт:0.00%	жз:0.00%	фь:0.00%	йй:0.00%	чз:0.00%	цл:0.00%
бп:0.00%	зх:0.00%	эп:0.00%	дф:0.00%	шг:0.00%	гф:0.00%	фк:0.00%	чч:0.00%	эс:0.01%	пг:0.00%
ыю:0.00%	чб:0.00%	фл:0.01%	жж:0.00%	эв:0.00%	бц:0.00%	хщ:0.00%	нф:0.00%	чх:0.00%	йщ:0.00%
зш:0.00%	шр:0.00%	чв:0.00%	ьщ:0.00%	вщ:0.00%	ыьф:0.00%	фя:0.00%	жв:0.00%	эш:0.00%	эх:0.00%
шш:0.00%	пш:0.00%	эф:0.00%	щт:0.00%	вю:0.00%	гш:0.00%	ыц:0.00%	эи:0.00%	пц:0.00%	сщ:0.00%

	Ентропія	Надлишковість
Монограми без пробілу	4.47015631662864	0.1286597612491379
Монограми з пробілом	4.3567011937543105	0.10596873667427198
Біаграми без пробілу(пер.)	4.152531277856013	0.1694937444287975
Біаграми без пробілу(не пер.)	4.152055152416359	0.16958896951672808
Біаграми з пробілом(пер.)	3.973237501024201	0.2053524997951598
Біаграми з пробілом(не пер.)	3.972747401443976	0.20545051971120487
H(10)	2.37143006239603< H < 2.86791993994523	0.498168121485616<R<0.4321103530840761
H(20)	2.241996315965< H < 2.78111918856318	0.562467041765822<R<0.45641599538121005
H(30)	1.48647655731029< H <2.13166338028599	0.766907558273706<R<0.5742147241851099

Оцінки для H(10),H(20),H(30)

Window 1

Лабороторная работа №1 ✕

Произольная часть текста:
ения_были

Использованные буквы:

Вероятности:

Порядок n-граммы:
- 5 символов
- 10 символов
- 15 символов
- 20 символов
- 25 символов
- 30 символов
- 35 символов
- 40 символов
- 45 символов
- 50 символов

Введенный символ:

Символ по счету:

Номер эксперимента: 51

Поле ввода символов:

Продолжить   Другой

Неравенство для энтропии:
2,37143006239603< H < 2,86791993994523

Двоичная таблица угаданных символов:
```
1000000000000000000000000000000000
0100000000000000000000000000000000
1000000000000000000000000000000000
0000000000000000001000000000000000
0000000000000000000000000001000
```

q [1] = 0,46
q [2] = 0,16
q [3] = 0
q [4] = 0,04
q [5] = 0
q [6] = 0,02
q [7] = 0,02
q [8] = 0
q [9] = 0
q [10] = 0,02
q [11] = 0
q [12] = 0
q [13] = 0
q [14] = 0,02
q [15] = 0,02
q [16] = 0
q [17] = 0
q [18] = 0
q [19] = 0
q [20] = 0,02
q [21] = 0,04
q [22] = 0,02
q [23] = 0
q [24] = 0
q [25] = 0,02
q [26] = 0,02
q [27] = 0,06
q [28] = 0
q [29] = 0,04
q [30] = 0
q [31] = 0
q [32] = 0,02

Строка состояния:

Window 2

Лабороторная работа №1 ✕

Произольная часть текста:
животные_то_есть_че

Использованные буквы:

Вероятности:

Порядок n-граммы:
- 5 символов
- 10 символов
- 15 символов
- 20 символов
- 25 символов
- 30 символов
- 35 символов
- 40 символов
- 45 символов
- 50 символов

Введенный символ:

Символ по счету:

Номер эксперимента: 51

Поле ввода символов:

Продолжить   Другой

Неравенство для энтропии:
2,24199631515965< H < 2,78111918856318

Двоичная таблица угаданных символов:
```
0000000000000000001000000000000000
0100000000000000000000000000000000
1000000000000000000000000000000000
1000000000000000000000000000000000
0000000000000100000000000000000000
```

q [1] = 0,54
q [2] = 0,04
q [3] = 0
q [4] = 0
q [5] = 0,02
q [6] = 0,02
q [7] = 0,02
q [8] = 0,06
q [9] = 0
q [10] = 0,04
q [11] = 0
q [12] = 0
q [13] = 0,02
q [14] = 0
q [15] = 0,02
q [16] = 0,02
q [17] = 0,02
q [18] = 0,04
q [19] = 0
q [20] = 0,04
q [21] = 0
q [22] = 0,02
q [23] = 0
q [24] = 0,02
q [25] = 0,02
q [26] = 0,04
q [27] = 0
q [28] = 0
q [29] = 0
q [30] = 0
q [31] = 0
q [32] = 0

Строка состояния:

Window 3

Лабороторная работа №1 ✕

Произольная часть текста:
ь_мне_самому_не_удается_как_с

Использованные буквы:

Вероятности:

Порядок n-граммы:
- 5 символов
- 10 символов
- 15 символов
- 20 символов
- 25 символов
- 30 символов
- 35 символов
- 40 символов
- 45 символов
- 50 символов

Введенный символ:

Символ по счету:

Номер эксперимента: 51

Поле ввода символов:

Продолжить   Другой

Неравенство для энтропии:
1,48647655731029< H < 2,13166338028599

Двоичная таблица угаданных символов:
```
1000000000000000000000000000000000
0000000000000000000000010000
1000000000000000000000000000000000
0000010000000000000000000000000000
1000000000000000000000000000000000
```

q [1] = 0,64
q [2] = 0,1
q [3] = 0,02
q [4] = 0
q [5] = 0
q [6] = 0,04
q [7] = 0,02
q [8] = 0,02
q [9] = 0
q [10] = 0
q [11] = 0,02
q [12] = 0
q [13] = 0
q [14] = 0
q [15] = 0
q [16] = 0
q [17] = 0,02
q [18] = 0,02
q [19] = 0,04
q [20] = 0
q [21] = 0,02
q [22] = 0
q [23] = 0
q [24] = 0
q [25] = 0,02
q [26] = 0
q [27] = 0
q [28] = 0,02
q [29] = 0
q [30] = 0
q [31] = 0
q [32] = 0

Строка состояния:

Висновки

У даному лабораторному практикумі ми:

- засвоїли поняття ентропії на символ джерела та його надлишковості;

- вивчили та порівняли різні моделі джерела відкритого тексту для наближеного визначення ентропії;

- набули практичних навичок щодо оцінки ентропії на символ джерела.