



МІНІСТЕРСТВО ОСВІТИ І НАУКИ, МОЛОДІ ТА СПОРТУ УКРАЇНИ
НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ УКРАЇНИ
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ»
ФІЗИКО-ТЕХНІЧНИЙ ІНСТИТУТ

Криптографія

Комп'ютерний практикум №1

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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 H_1 та H_2 за безпосереднім означенням. Підрахувати частоти букв та біграм, а також значення H_1 та H_2 на довільно обраному тексті російською мовою достатньої довжини (щонайменше 1Мб), де імовірності замінити відповідними частотами. Також одержати значення H_1 та H_2 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:

1. Програмний код:

```
2. import numpy as np
import math
f = open("text.txt", "r", encoding="utf-8")
b_symb = list()
b_bigram1 = list()
b_bigram2 = list()
b_symb_ws = list()
b_bigram1_ws = list()
b_bigram2_ws = list()
text = list()
text_ws = list()
alf = "абвгдеёжзийклмнопрстуфхцчшщъыьэюя "
```

```
def entropy(symb,n):
    dict_text = dict()
    for i in symb:
        if i not in dict_text:
```

```

        dict_text[i] = 1
    else:
        dict_text[i]+=1
for i,k in dict_text.items():
    dict_text[i] = k/len(symb)
probs = np.array(list(dict_text.values()))
ent = - probs.dot(np.log2(probs))
ent = ent
ent *= 1/n
return ent,dict_text

for i in f:
    i = i.replace("\n", "").lower().replace("ë","e").replace("ᵇ","b")
    for k in i:
        if k in alf:
            text.append(k)

for symb in text:
    b_symb.append(symb)

for i in range(0,len(text)-1,2):
    bigram1 = text[i]+text[i+1]
    b_bigram1.append(bigram1)

for i in range(0,len(text)-1):
    bigram2 = text[i]+text[i+1]
    b_bigram2.append(bigram2)

for i in text:
    if i != " ":
        text_ws.append(i)

for symb in text_ws:
    b_symb_ws.append(symb)

for i in range(0,len(text_ws)-1,2):
    bigram1 = text[i]+text[i+1]
    b_bigram1_ws.append(bigram1)

for i in range(0,len(text_ws)-1):
    bigram2 = text[i]+text[i+1]
    b_bigram2_ws.append(bigram2)
def print_dict(dict_values):
    pro = 0
    string = " "
    count = 0
    for i,b in dict_values.items():

        string += i + ":" + str("{:.2f}".format(b*100))+"%"+" "
        if count == len(dict_values)-1:
            print(string)
        if pro==14:
            print(string)
            pro = 0
            string = " "
        pro+=1

redundancy = lambda x: 1 - (x / math.log2(32))

print("symb:")
H1,dict_values = entropy(b_symb,1)
print_dict(dict_values)
print("H1:"+str(H1))

```

```

print("R:"+str(H1))
print("bigram1:")
H2,dict_values = entropy(b_bigram1,2)
print_dict(dict_values)
print("H2:"+str(H2))
print("R:"+str(H2))
print("bigram2:")
H2,dict_values = entropy(b_bigram2,2)
print_dict(dict_values)
print("H2:"+str(H2))
print("R:"+str(H2))
print("symb_ws:")
H1,dict_values = entropy(b_symb_ws,1)
print_dict(dict_values)
print("H1:"+str(H1))
print("R:"+str(H1))
print("bigram1_ws:")
H2,dict_values = entropy(b_bigram1_ws,2)
print_dict(dict_values)
print("H2:"+str(H2))
print("R:"+str(H2))
print("bigram2_ws:")
H2,dict_values = entropy(b_bigram2_ws,2)
print_dict(dict_values)
print("H2:"+str(H2))
print("R:"+str(H2))

```

Частота монограм:

н:6.59% у:2.85% ч:1.40% т:5.67% о:11.30% к:3.61% я:2.35% з:1.78% ь:2.04% г:2.03%
е:8.01%

и:6.68% л:5.03% а:8.35% с:5.20% б:1.76% ш:0.92% п:2.57% м:3.02% ф:0.22% р:4.50%

в:4.56% д:3.00% ю:0.66% ы:1.89% ж:1.02% й:1.16% щ:0.28% э:0.31% х:0.85% ц:0.40%

H1: 4.47015631662864

R:0.12865976124913792

Частота монограм з пропусками :

_:17.51% н:5.44% у:2.35% ч:1.16% т:4.68% о:9.32% к:2.97% я:1.94% з:1.47% ь:1.69%
г:1.67% е:6.61% и:5.51% л:4.15% а:6.89%

с:4.29% б:1.45% ш:0.76% п:2.12% м:2.49% ф:0.18% р:3.71% в:3.76% д:2.47% ю:0.55%
ы:1.56% ж:0.85% й:0.95% щ:0.23%

H1:4.3567011937543105

R:0.10596873667427198

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% е :1.61% б:0.73% бо:0.22% ол:0.66% ль:0.34% ьш:0.04% ше:0.22% ак: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% ар: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%
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лх:0.00% йф:0.00% гш:0.00% цл:0.00% шр:0.00% ьщ:0.00% эц:0.00% цн:0.00% йр:0.00% нп:0.00%
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H2:3.973237501024201
R:0.2053524997951598

Біграми(з перетином, без пропусків)

bigram2_ws:

ну:0.35% үч: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%
ен:0.96% уя:0.02% яи:0.11% ил:0.62% лу:0.16% үк:0.18% кк:0.05% ка:0.91% ас:0.64% ст:1.27%
та:0.65% ал:1.05% ли:0.78% ин:0.59% не:1.06% еб:0.23% бо:0.28% ол:0.83% ль:0.41% ьш:0.05%
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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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H2:4.152531277856013

R:0.1694937444287975

Біграми(без перетином, з пропусками)

bigram1:

н:1.44% ү: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%
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H2:3.972747401443976
R:0.20545051971120487

Біграми(без перетинном, без пропусків)

bigram1_ws:

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% ас: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%
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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%
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H2:4.152055152416359

R:0.16958896951672808

Оцінки для $H(10), H(20), H(30)$

The screenshot displays a software interface for a laboratory work session. The main window has a title bar "Лабораторная работа №1".

Main Content Area:

- Произвольная часть текста:** A text box containing "ения_были".
- Использованные буквы:** An empty text box.
- Порядок n-граммы:** A dropdown menu with options from "5 символов" to "50 символов". "18 символов" is selected.
- Введенный символ:** An empty text box.
- Символ по счету:** An empty text box.
- Номер эксперимента:** A text box containing "51".
- Поле ввода символов:** An empty text box.
- Buttons:** "Продолжить" (Continue) and "Другой" (Other).
- Неравенство для энтропии:** A text box displaying the inequality $2,37143006239603 < H < 2,86791993994523$.
- Двоичная таблица угаданных символов:** A scrollable area showing a binary matrix of 0s and 1s.

Right Panel (Вероятности):

A vertical list of probabilities labeled q[1] through q[32].

Label	Value
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

Bottom Left:

Строка состояния: An empty status bar at the bottom left.

Лабораторная работа №1

Произвольная часть текста:
животные_to_есть_че

Использованные буквы:

Порядок n-граммы: 5 символов 10 символов 15 символов <u>20 символов</u> 25 символов 30 символов 35 символов 40 символов 45 символов 50 символов	Введенный символ: * Символ по счету: * Номер эксперимента: 51 Поле ввода символов: <input type="text"/> <div> Продолжить Другой </div>	Неравенство для энтропии: $2,24199631515965 < H < 2,78111918856318$ Двоичная таблица угаданных символов: <pre> 00000000000000000000100000000000 ^ 010000000000000000000000000000000 100000000000000000000000000000000 100000000000000000000000000000000 000000000000000100000000000000000 v </pre>
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Строка состояния:
