

Lab 10 (November 6 2016)

CCOD

Potapiuk Aleksei, AS-36

I choose 33 Russian letters: $I = \{ \text{А, Б, В, Г, Д, Е, Ё, Ж, З, И, Й, К, Л, М, Н, О, П, Р, С, Т, У, Ф, Х, Ц, Ч, Ш, Щ, Ъ, Ы, Ь, Э, Ю, Я} \}$.

R0:

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		А	Б	В	Г	Д	Е	Ё	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ	Ъ	Ы	Ь	Э	Ю	Я
1	А	1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	Б	0.1	1	0.9	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.6	0.1	0.1	0.1
3	В	0.2	0.9	1	0.1	0.1	0.6	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
4	Г	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5	Д	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
6	Е	0.1	0.1	0.6	0.1	0.1	1	0.9	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7	Ё	0.1	0.1	0.1	0.1	0.1	0.9	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
8	Ж	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
9	З	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.1	0.1
10	И	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.9	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
11	Й	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9	1	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
12	К	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.7	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
13	Л	0.8	0.1	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.8	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14	М	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.7	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
15	Н	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.6	0.1	0.2	0.1	0.1	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
16	О	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.6	0.1
17	П	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.6	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
18	Р	0.1	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
19	С	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
20	Т	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
21	У	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
22	Ф	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
23	Х	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
24	Ц	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	1	0.1	0.7	0.9	0.1	0.1	0.1	0.1	0.1	0.1	0.1
25	Ч	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
26	Ш	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.1	1	0.9	0.1	0.1	0.1	0.1	0.1	0.1	0.1
27	Щ	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.1	0.9	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
28	Ъ	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.8	0.9	0.1	0.1	0.1	0.1
29	Ы	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	1	0.8	0.1	0.1	0.1	0.1	0.1
30	Ь	0.1	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.8	1	0.1	0.1	0.1	0.1	0.1
31	Э	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1
32	Ю	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1
33	Я	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1

After modifying this matrix and replacing all values less than 0.55 and main diagonal by 0 we get such matrix:

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
		А	Б	В	Г	Д	Е	Ё	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ	Ъ	Ы	Ь	Э	Ю	Я	
1	А	0	0	0	0	0.7	0	0	0	0	0	0	0	0.8	0	0.6	0	0.8	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	
2	Б	0	0	0.9	0	0	0.6	0.6	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.6	0.7	0.8	0	0	
3	В	0	0.9	0	0	0	0.6	0.6	0	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.6	0.7	0.8	0	0	
4	Г	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5	Д	0.7	0	0	0	0	0	0	0	0	0	0	0	0.7	0	0.6	0	0.7	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0
6	Е	0	0.6	0.6	0	0	0	0.9	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.6	0.6	0.6	0	0	
7	Ё	0	0.6	0.6	0	0	0.9	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.6	0.6	0.6	0	0	
8	Ж	0	0	0	0	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	З	0	0.8	0.9	0	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.6	0.6	0.9	0	0	
10	И	0	0	0	0	0	0	0	0	0	0	0.9	0	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11	Й	0	0	0	0	0	0	0	0	0	0	0.9	0	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12	К	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13	Л	0.8	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0.6	0	0.8	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0
14	М	0	0	0	0	0	0	0	0	0	0.7	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15	Н	0.6	0	0	0	0.6	0	0	0	0	0	0	0	0.6	0	0	0	0.6	0	0	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0
16	О	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0	
17	П	0.8	0	0	0	0.7	0	0	0	0	0	0	0	0.8	0	0.6	0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0
18	Р	0	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19	С	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Т	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	У	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Ф	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	Х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Ц	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0.9	0	0	0	0	0	0
25	Ч	0.6	0	0	0	0.6	0	0	0	0	0	0	0	0.6	0	0.8	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Ш	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0	0	0.9	0	0	0	0	0
27	Щ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0	0.9	0	0	0	0	0	0
28	Ъ	0	0.6	0.6	0	0	0.6	0.6	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0.9	0.6	0	0
29	Ы	0	0.6	0.6	0	0	0.6	0.6	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0.8	0.6	0	0
30	Ь	0	0.6	0.6	0	0	0.6	0.6	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0.8	0	0.6	0	0
31	Э	0	0.8	0.8	0	0	0.6	0.6	0	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.6	0.6	0	0	0
32	Ю	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	Я	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1-st cluster

First, set $I = \{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33\}$, and $C = \{ \}$
Then find maximum value: $a_{2,3} = 0.9$, put index to $C = \{ \}$: $C = \{2, 3\}$, then find index of the columns, where sum is maximum:

$\text{Max}_9 = \text{Max}_{31} = 1.6$ $C_1 = \{2,3,9,31\} \Rightarrow \text{Б, В, З, Э}$, After find index of the columns, where sum is maximum:
 $\text{Max}_{28} = \text{Max}_{29} = \text{Max}_{30} = 2.4$

Then final $C_1 = \{2,3,9,28,29,30,31\} \Rightarrow \text{Б, В, З, Ъ, Ы, Ь, Э}$.

$I = I - C = \{1,4,5,6,7,8,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,32,33\}$

$C = \{ \}$

2-nd cluster

set $I = \{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33\}$, and $C = \{ \}$ Then
Again find maximum value: $a_{6,7} = 0.9$, put index to $C = \{ \}$: $C = \{7\}$, find index of the columns, where sum is maximum: $\text{Max}_6 = 0.9$

Final $C_2 = \{6,7\} \Rightarrow \text{Е, Ё}$.

$I = I - C =$

$\{1,4,5,8,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,32, 33\}$ $C = \{ \}$

3-rd cluster

Like in previous cluster, find maximum value: $a_{13,17} = 0.8$, then put index to $C = \{ \}$: $C = \{13, 17\}$, find index of the columns, where sum is maximum: $\text{Max}_1 = 1.6$

$C_2 = \{1, 13, 17\} \Rightarrow \text{А, Л, П}$, then find index of the columns, where sum is maximum: $\text{Max}_5 = 1.4$

So, final $C3 = \{1, 5, 13, 17\} \Rightarrow A, Д, Л, П$.

$I = I - C = \{4, 8, 10, 11, 12, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 32, 33\}$

$C = \{\}$

4-th cluster

Again find maximum value: $a_{18} = 0.8$, put index to $C = \{\}$: $C = \{18\}$, find index of the columns, where sum is maximum: $Max4 = 0.8$

Final $C4 = \{4, 18\} \Rightarrow Г, Р$.

$I = I - C = \{8, 10, 11, 12, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 32, 33\}$

$C = \{\}$

5-th cluster

Find maximum value: $a_{12} = 0.7$, put index to $C = \{\}$: $C = \{12\}$, find index of the columns, where sum is maximum: $Max8 = 0.7$

Final $C5 = \{8, 12\} \Rightarrow Ж, К$.

$I = I - C = \{10, 11, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 32, 33\}$

$C = \{\}$

6-th cluster

Again find maximum value: $a_{11} = 0.9$, put index to $C = \{\}$: $C = \{11\}$, find index of the columns, where sum is maximum: $Max_{10} = 0.9$ $C5 = \{10, 11\} \Rightarrow И, Ё$, then find index of the columns, where sum is maximum: $Max_{14} = 1.4$ final $C6 = \{10, 11, 14\} \Rightarrow И, Ё, М$.

$I = I - C = \{15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 32, 33\}$

$C = \{\}$

7-th cluster

We find maximum value: $a_2 = 0.8$, put index to $C = \{\}$: $C = \{25\}$, find index of the columns, where sum is maximum: $Max_{15} = 0.8$

Final $C7 = \{15, 25\} \Rightarrow Н, Ч$.

$I = I - C = \{16, 19, 20, 21, 22, 23, 24, 26, 27, 32, 33\}$

$C = \{\}$

8-th cluster

find maximum value: $a_{32} = 0.6$, put index to $C = \{\}$: $C = \{32\}$, find index of the columns, where sum is maximum: $Max_{16} = 0.6$

$C7 = \{16, 32\} \Rightarrow О, Ю$. then find index of the columns, where sum is maximum:

$Max_{19} = 1.2$

$C8 = \{16, 19, 32\} \Rightarrow О, С, Ю$.

$I = I - C = \{20, 21, 22, 23, 24, 26, 27, 33\}$ C

$= \{\}$

9-th cluster

Find maximum value: $a_{26} = a_{27} = 0.9$, put index to $C = \{\}$: $C = \{26, 27\}$, find index of the columns, where sum is maximum: $Max_{24} = 1.8$

Final $C9 = \{24, 26, 27\} \Rightarrow Ц, Ш, Щ$.

$I = I - C = \{20, 21, 22, 23, 33\}$

$C = \{\}$

And the last 5 clusters are: $C_{10} = \{20\} \Rightarrow Т$, $C_{11} = \{21\} \Rightarrow У$, $C_{12} = \{22\} \Rightarrow Ф$, $C_{13} = \{23\} \Rightarrow Х$, $C_{14} = \{33\} \Rightarrow Я$

So we have: $C = \{$

$\{ Б, В, З, Ъ, Ы, Ь, Э \}$

$\{ Е, Ё \}$

$\{ А, Д, Л, П \}$

$\{ Г, Р \}$

$\{ Ж, К \}$

$\{ И, Й, М \}$

$\{ Н, Ч \}$

$\{ О, С, Ю \}$

$\{ Ц, Ш, Щ \}$

$\{ Т \}$

$\{ У \}$

$\{ Ф \}$

$\{ Х \}$

$\{ Я \}$

$\}$