

Prepoznavanje nonograma i njihovo rešavanje

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Šta je nonogram?

- **Nonograms**, also known as **Japanese crosswords**, are picture logic puzzles in which cells in a grid must be colored or left blank according to numbers at the side of the grid to reveal a hidden picture.

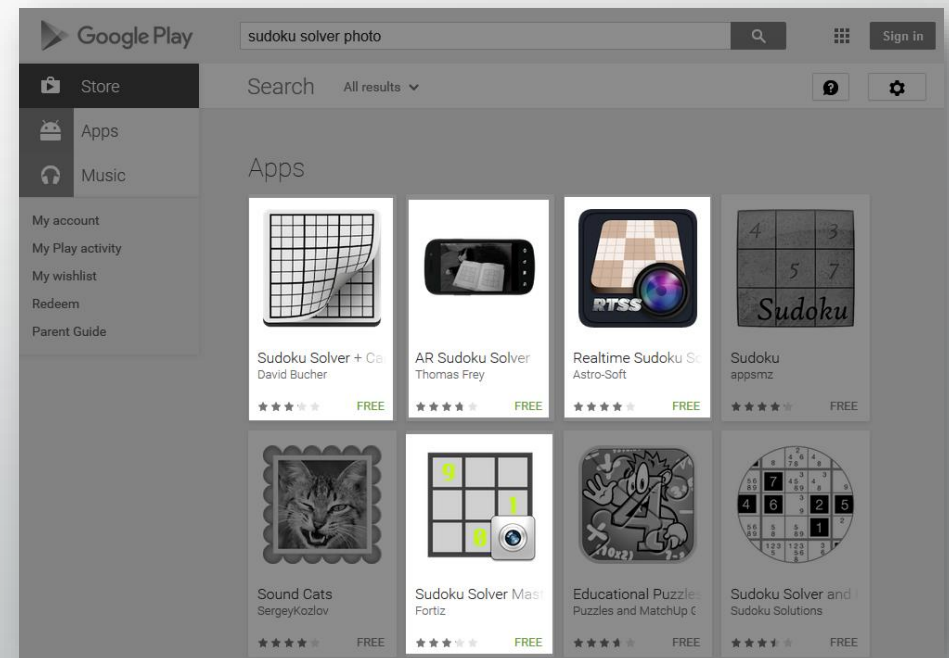
					1
		3	2	1	3
2	1				
	2				
1	3				
	2				
	2				

					1
		3	2	1	3
2	1	■	■		■
	2	■	■		
1	3	■		■	■
	2			■	■
	2			■	■

Motivacija

- Bubble Cup 7 - round 1
- Challenge problem - NP complete
- <http://www.spoj.com/problems/JCROSS/>
- C++ rešenje
- Oko 2000 linija koda

- Postoje slične aplikacije za rešavanje soudokua



Slična rešenja

- An efficient algorithm for solving nonograms
Chiung-Hsueh Yu, Hui-Lung Lee, Ling-Hwei Chen
<http://debut.cis.nctu.edu.tw/Publications/pdfs/J54.pdf>
- Object detection algorithms analysis and implementation for augmented reality system
Rasa Zavistanavičiūtė, KAUNAS, 2012
 - Blob detection, Edge detection, Canny edge detector, Double thresholding, Sobel...
- IBM - Printed Character Recognition (PCR)
<https://www.research.ibm.com/haifa/projects/image/ocr/pcr.html>

Algoritam



Pronalaženje nonograma

- Binarizacija slike
 - Threshold
 - Canny edge detector
 - Image derivate
- Random sample consensus (RANSAC)
- Ramer–Douglas–Peucker algorithm

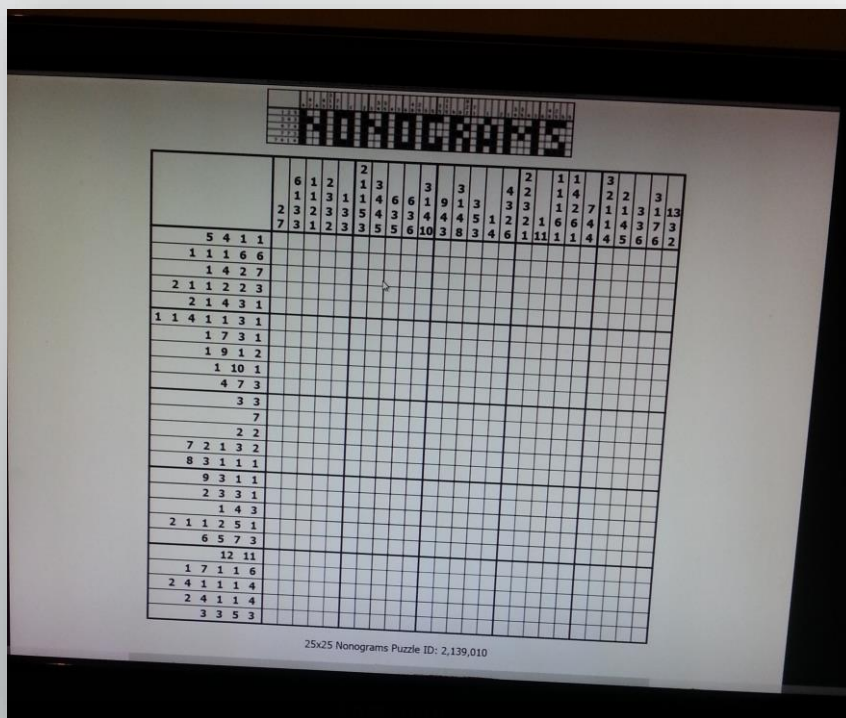
[illegible]

						3
				1	5	1
		3	5	8	3	1
	3					
2	2					
	5					
	5					
	3					
	1					
	1					
	3					
	2					
	3					

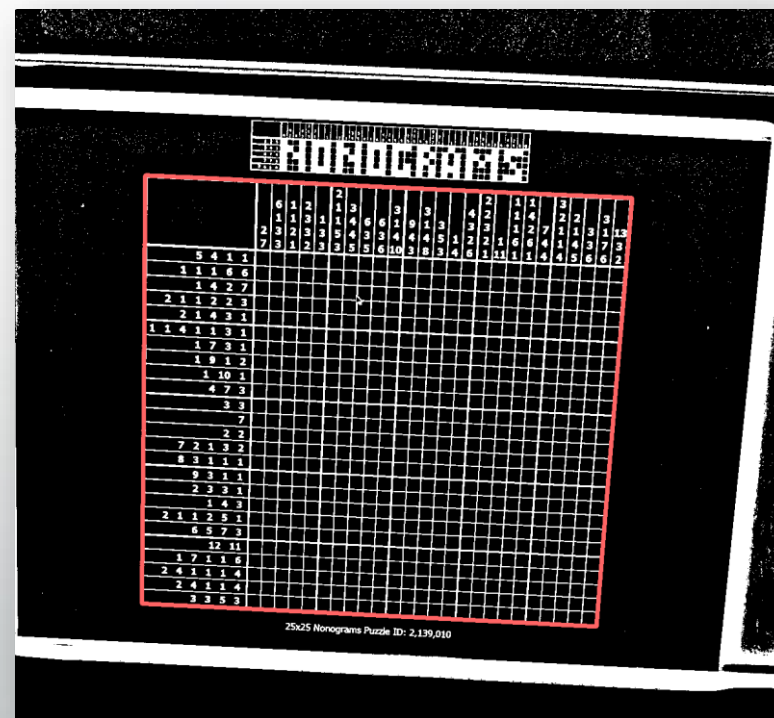
[illegible]

Pronalaženje nonograma

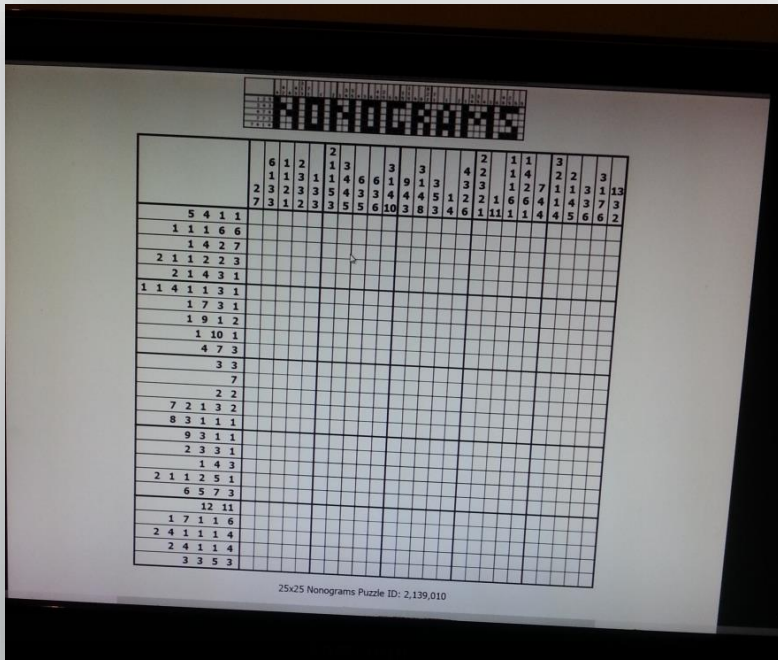
Originalna slika



Adaptive threshold + selection

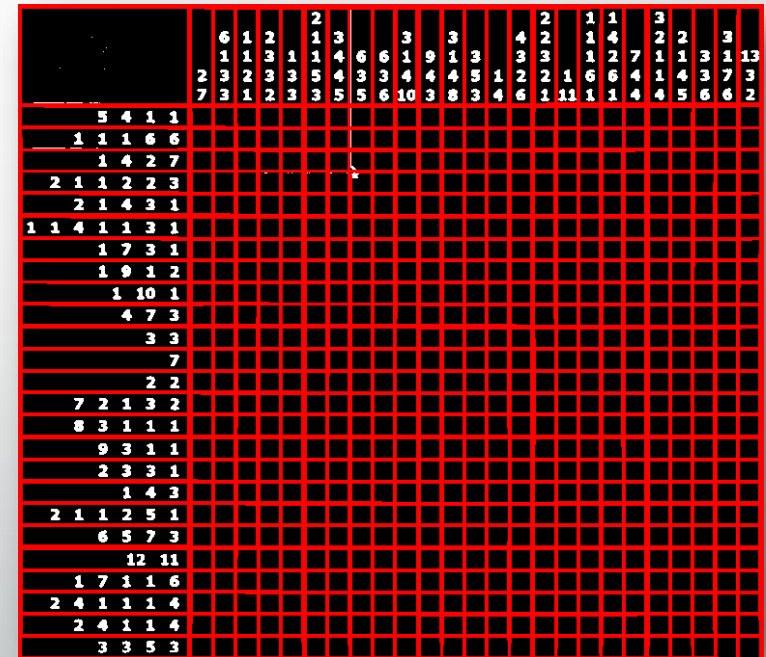


Ispravljanje perspektive

[illegible]

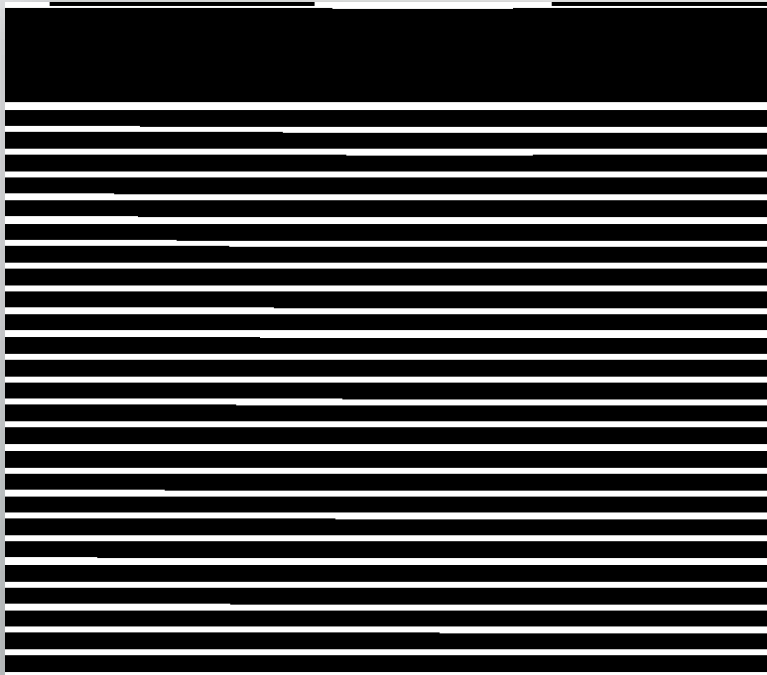
Detekcija linija

- Standardna rešenja
 - Hough Line Transform
 - Probabilistic Hough Line Transform
- Kerneli $n \times m$, $n \gg m$ ili $m \gg n$
 - Blur
 - Fixed Threshold

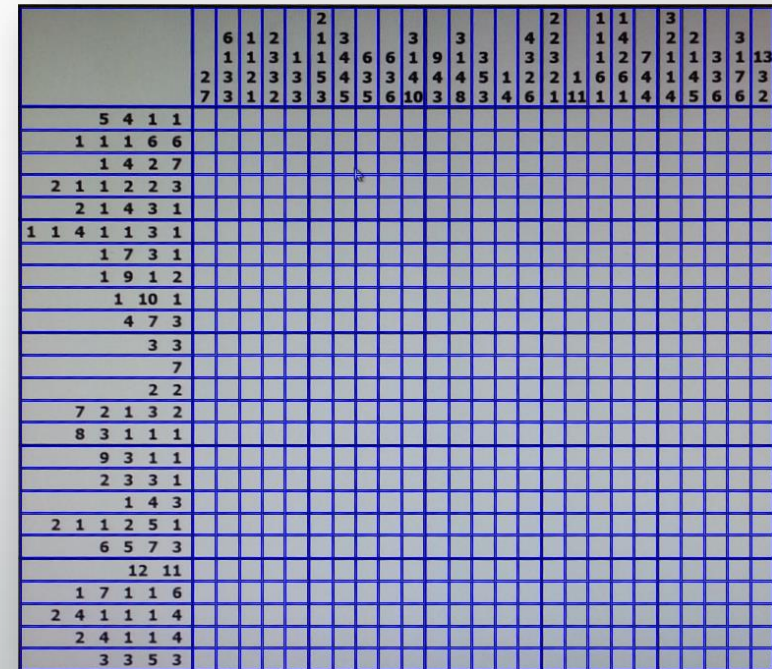


Detekcija linija

Kerneli $n \times m$



Pravougaonici



Detekcija cifri

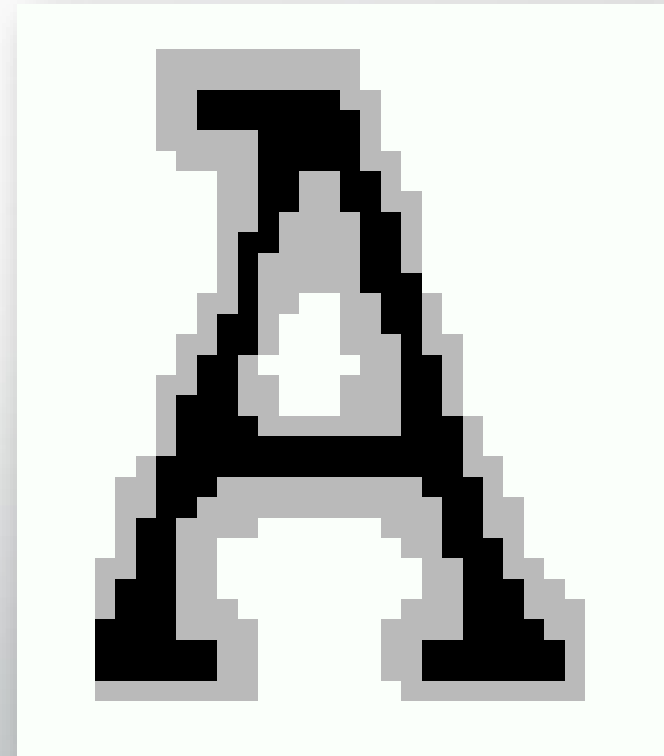
- Dve cifre ili dva broja?
- k-means
- DBSCAN
- Dilate + contours

			5	4	1	1		
		1	1	1	6	6		
			1	4	2	7		
	2	1	1	2	2	3		
		2	1	4	3	1		
1	1	4	1	1	3	1		
			1	7	3	1		
			1	9	1	2		

2							
1	3			3		3	
1	4	6	6	1	9	1	
5	4	3	3	4	4	4	
3	5	5	6	10	3	8	

Prepoznavanje cifri

- Printed Character Recognition (PCR)
- Character masks
- Data set
- Mala greška
- Jedan font



Maske

0

1

2

3

4

5

6

7

8

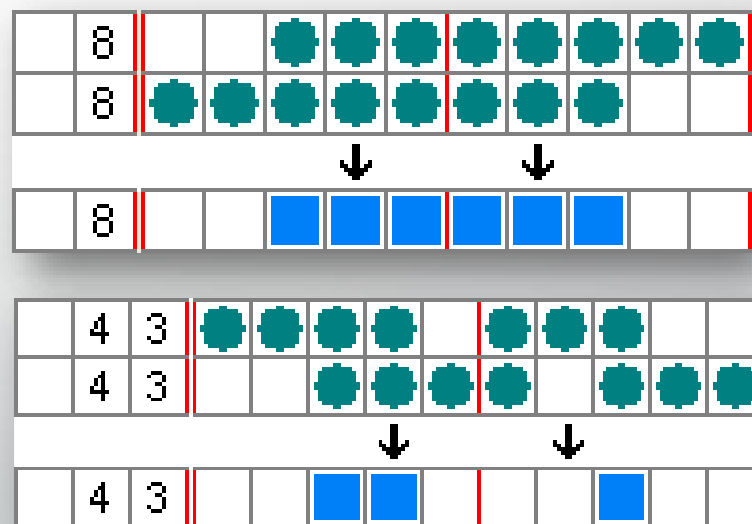
9

Rešavanje

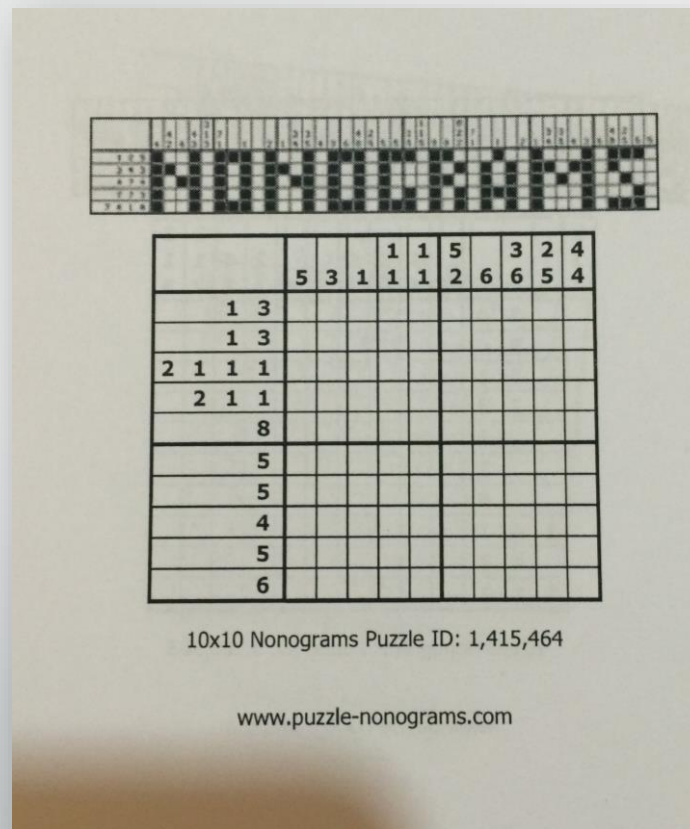
Algoritmi

- Genetski algoritmi
- Depth first search
- Logička pravila
 - Cython

Simple boxing



Prikazivanje rešenja

[illegible]

Verifikacija

- <http://www.puzzle-nonograms.com/>
- Do 20 x 20
- Crno beli nonogrami

Rezultati i performanse

Samsung I8750

Veličina	Rezultat
5X5	5/5 - 100%
10X10	5/5 - 100%
15X15	3/5 - 60%
20X20	1/5 - 20%
25X25	1/5 - 20%

Huawei P7

Veličina	Rezultat
5X5	5/5 - 100%
10X10	5/5 - 100%
15X15	5/5 - 100%
20X20	5/5 - 100%
25X25	2/5 - 40%

iPhone 5S

Veličina	Rezultat
5X5	5/5 - 100%
10X10	5/5 - 100%
15X15	5/5 - 100%
20X20	5/5 - 100%
25X25	3/5 - 60%

Neuspješni testovi

[illegible]

			5	7	3
	6	1	3	2	2
			3	6	1
				3	3
			2	1	3
				3	5
			2	8	4
		2	6	1	8
	1	1	2	11	

Neuspešni testivi

[illegible]

					4	5	7	5	10	10	1
					5	5	4	6	6	5	5
1	10	3	3								
4	8	1	1	3							
	4	7	3	1							
3	2	3	1	6 ₇							
		2	6	3							
1	2	1	7	2 ₇							
	4	1	2	4 ₇							
		7	3	1							
		3	2	2 ₇							
			3	1 ₁							
			3	3 ₁							
	4	4	1	2							
5	1	1	1	1							
	4	3	1	1							
		6	1	5 ₇							
			4	6							
			5	4							

Neuspješni testovi

[illegible][illegible]

Neuspješni testovi

[illegible]

2	3	6	13	6	3
2	4	4	1	4	5
2	2	3	5	7	3



Hvala na pažnji

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