License Plate Detection using Viola-Jones Algorithm and MPI

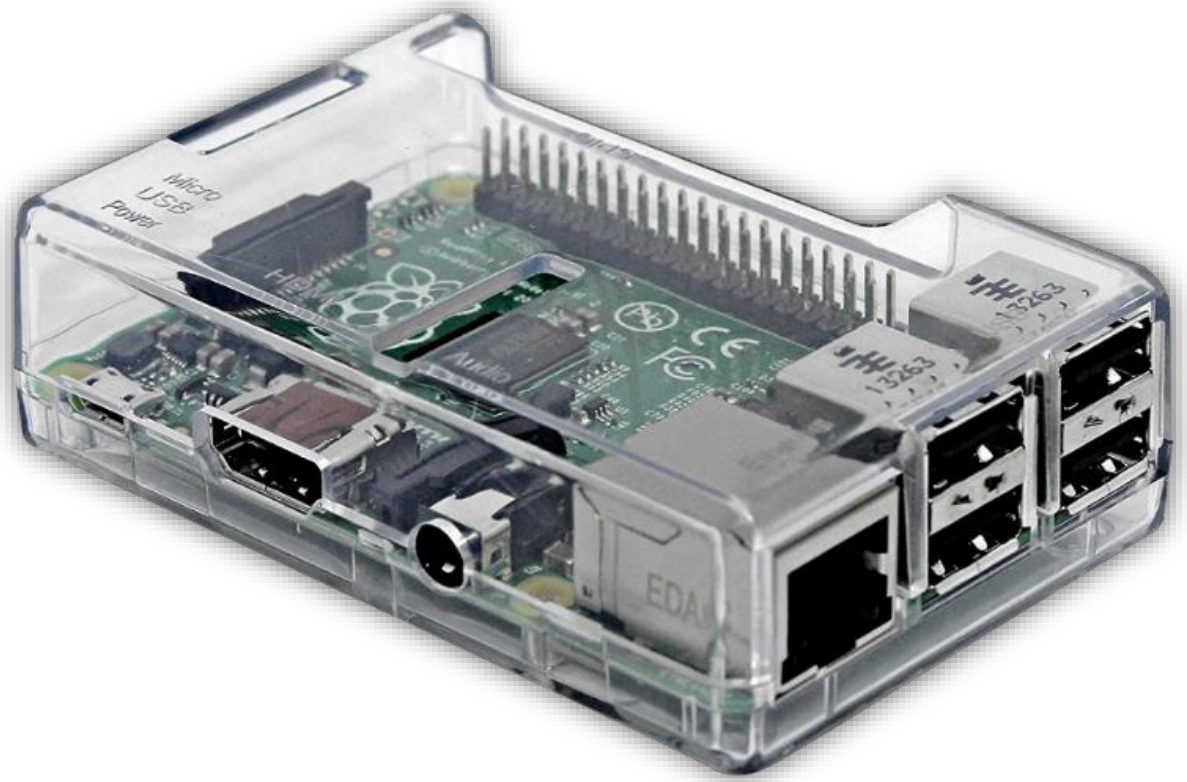
Elias A. Perdomo Hourné

Technological University of Havana “José Antonio Echeverría”
Automation and Computing Department
Faculty of Automation and Biomedical Engeeniring

Image and Video Processing for Intelligent Transportation Systems

System Description

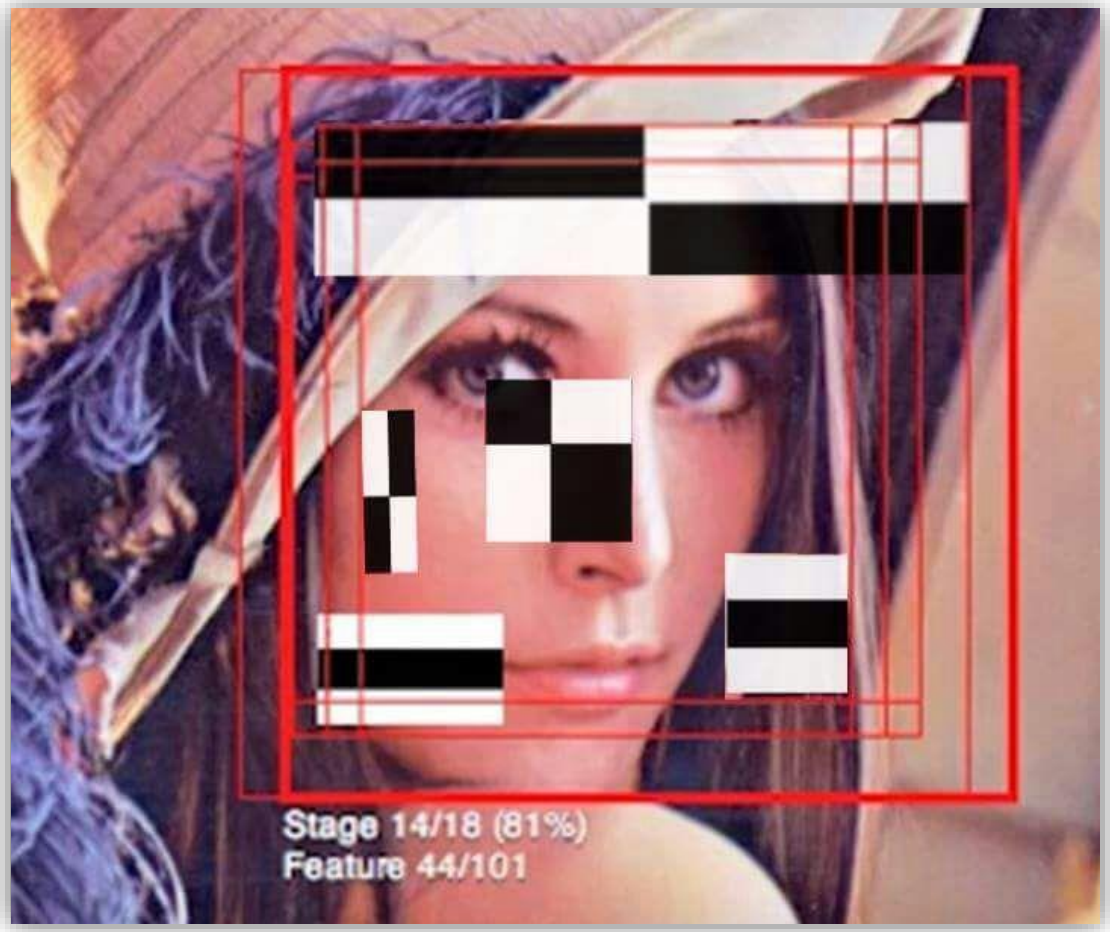
Used Platforms



Object Detection Algorithm (Viola Jones)

Main contributions :

- Integral Image
- Adaboost Features
- Cascade of classifiers



Integral Image

5	**2**	**3**	4	1
1	**5**	**4**	2	3
2	2	1	3	4
3	5	6	4	5
4	1	3	2	6

5	7	10	14	15
6	13	**20**	26	30
8	17	25	34	42
11	25	39	52	65
15	30	47	62	81

$$5 + 2 + 3 + 1 + 5 + 4 = 20$$

Integral Image

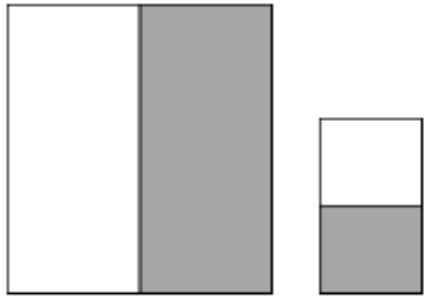
5	2	3	4	1
1	**5**	**4**	**2**	3
2	**2**	**1**	**3**	4
3	5	6	4	5
4	1	3	2	6

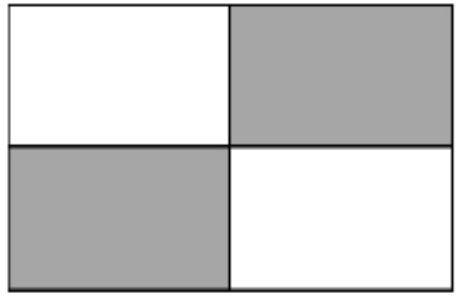
5	7	10	**14**	15
6	13	20	26	30
8	17	25	**34**	42
11	25	39	52	65
15	30	47	62	81

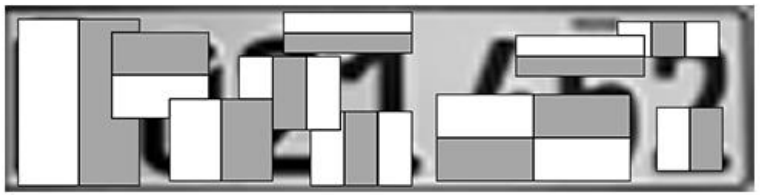
$$5 + 4 + 2 + 2 + 1 + 3 = 17$$

$$34 - 8 - 14 + 5 = 17$$

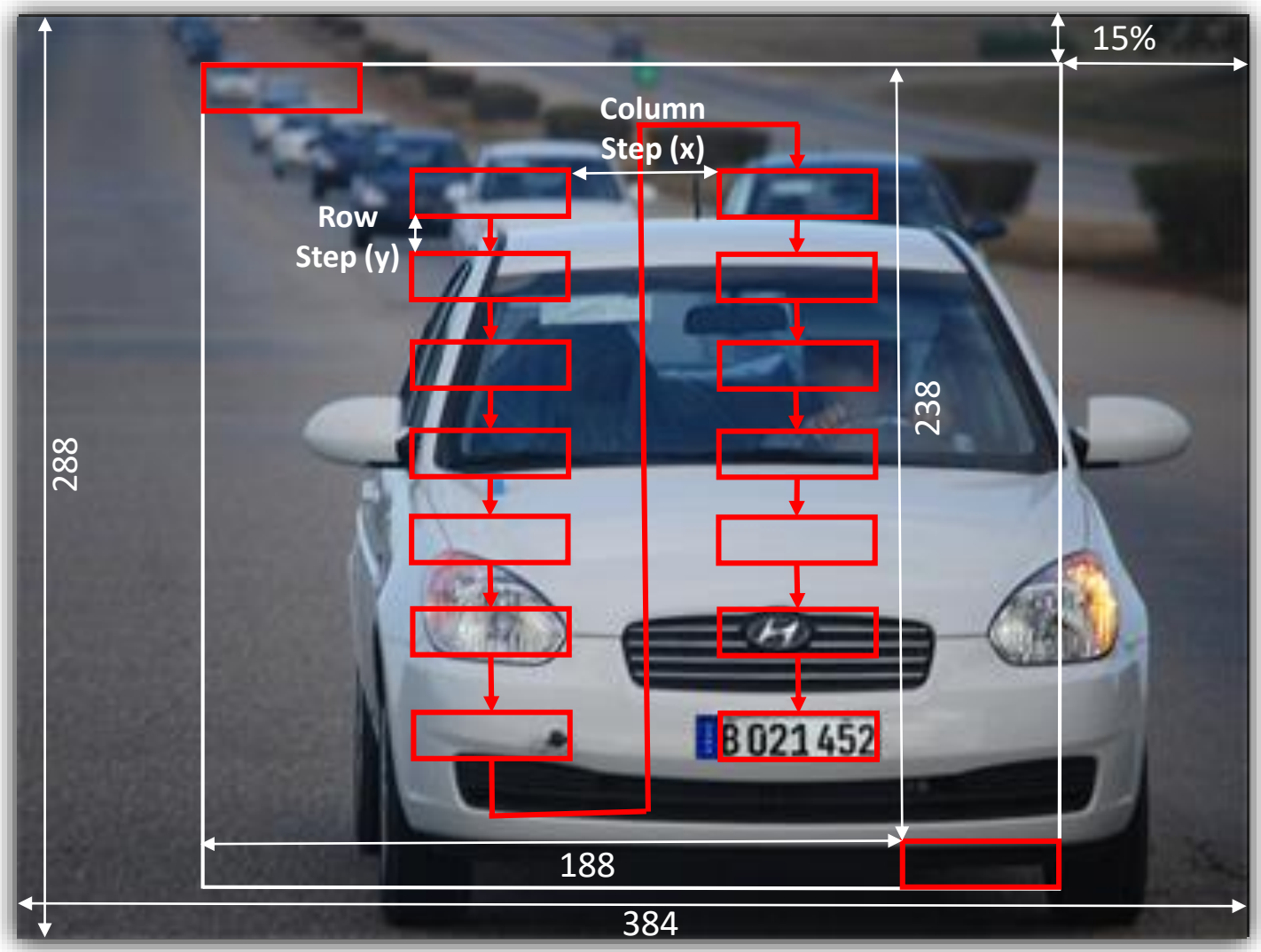
Adaboost Features







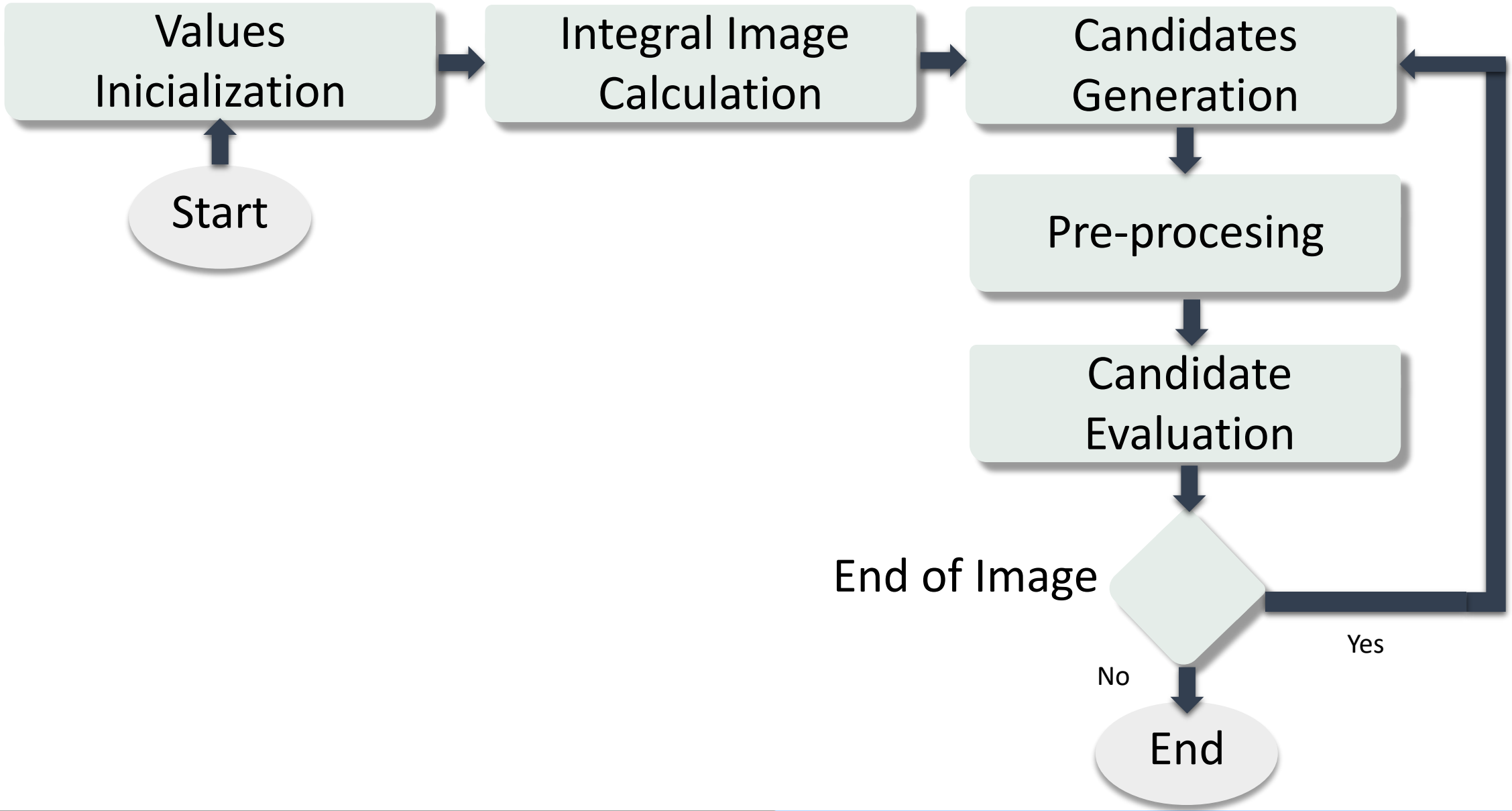
Sliding window



Amount of windows:

- Step 1:
  238*188=44744
- Step 1,5:
  158*125=19750
- Step 2:
  119*94=11186

Algorithm

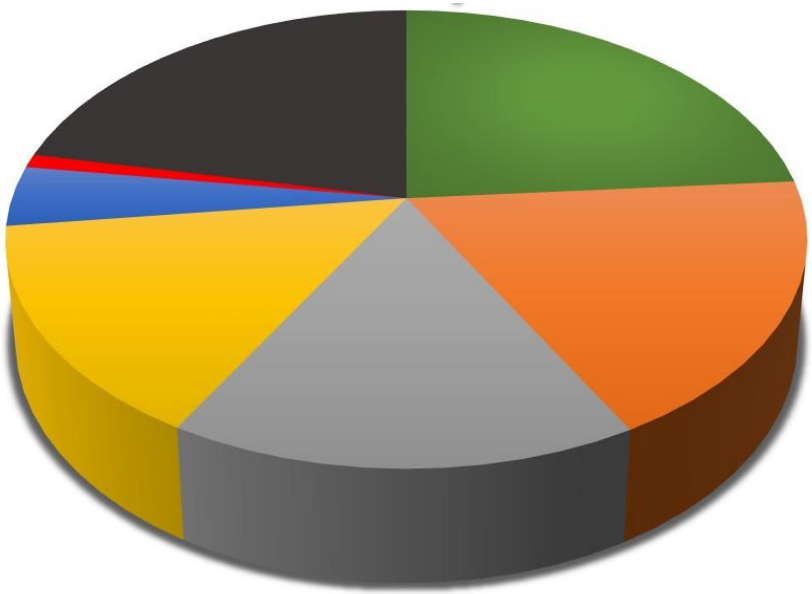

Values Inicialization
Integral Image Calculation
Candidates Generation
Start
Pre-procesing
Candidate Evaluation
End of Image
Yes
No
End

Performance analysis by functions (*profiling*)

Name	%Time	Calls
GetSumRect	23,77 %	153044 (66,67 %)
TreeObjectDetection	18,31 %	56482 (24,60 %)
GetIntegralImages	16,07 %	1
OneScaleObjectDetection	14,90 %	20034 (8,73 %)
GetGrayImage	4,25 %	1
HaarCascadeObjectDetection	0,94 %	1
Init_Configuration	0,00 %	1
End_Configuration	0,00 %	1
others	21,76 %	-

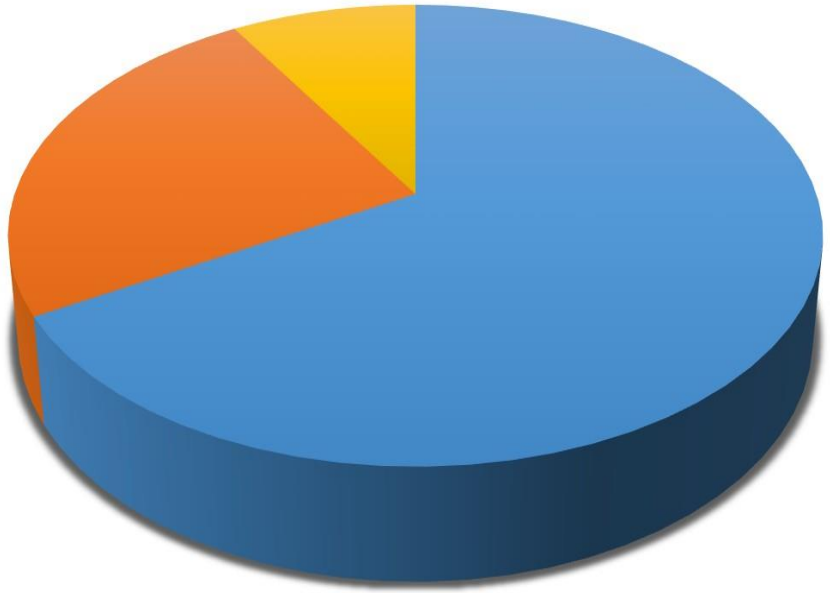
Performance analysis by functions (*profiling*)

%Time



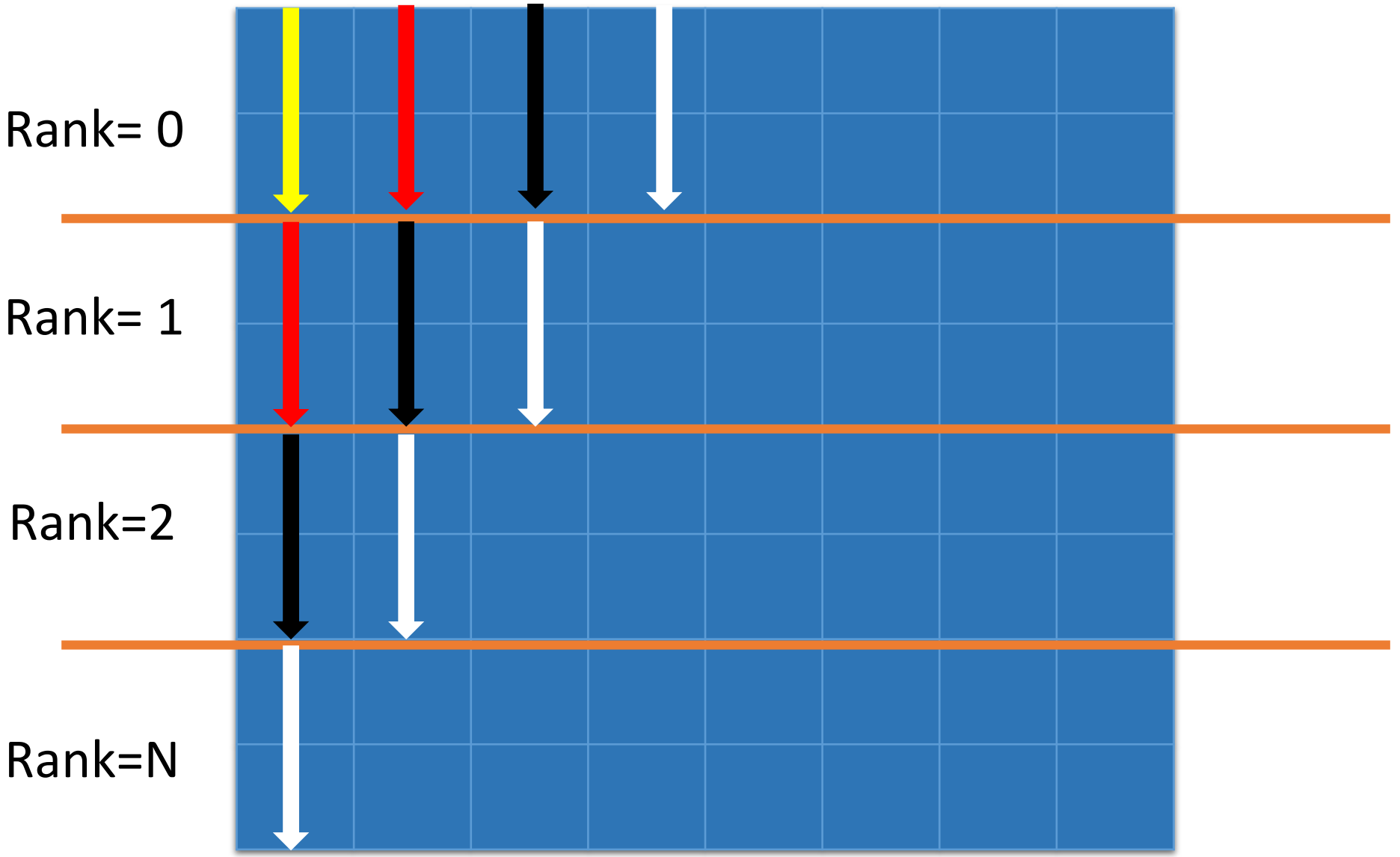
- GetSumRect
- GetIntegralImages
- GetGrayImage
- otros
- TreeObjectDetection
- OneScaleObjectDetection
- HaarCascadeObjectDetectio

Calls



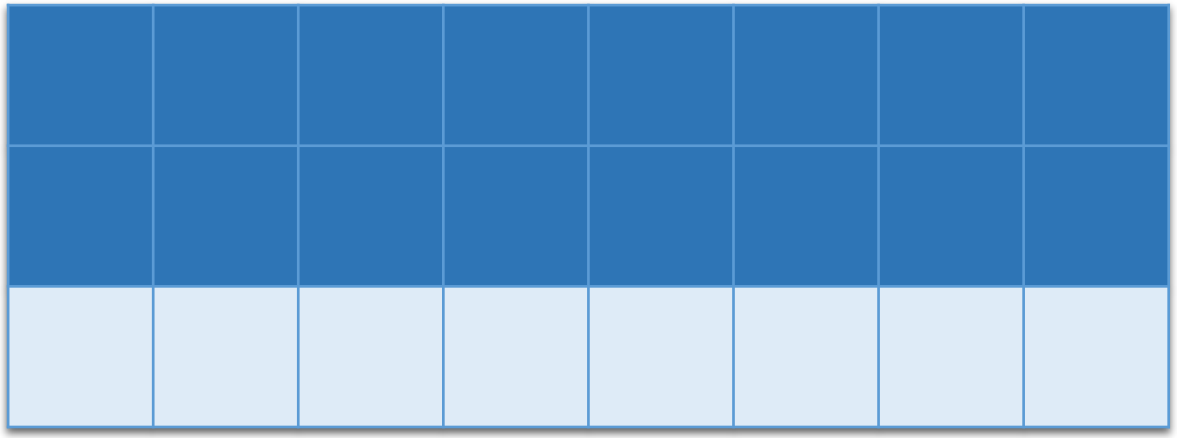
- GetSumRect
- TreeObjectDetection
- OneScaleObjectDetection

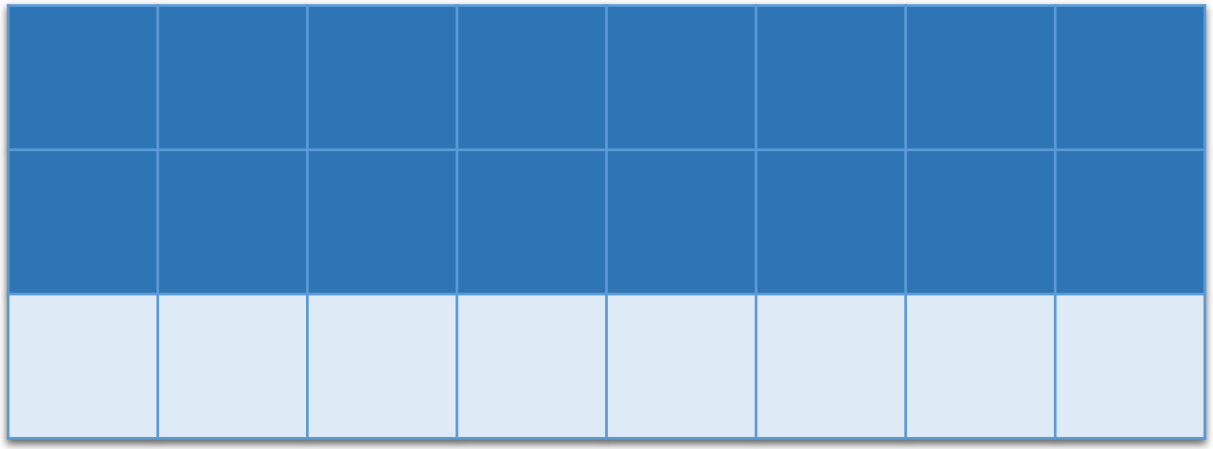
Calculating Integral Image with MPI



Calculating Integral Image with MPI

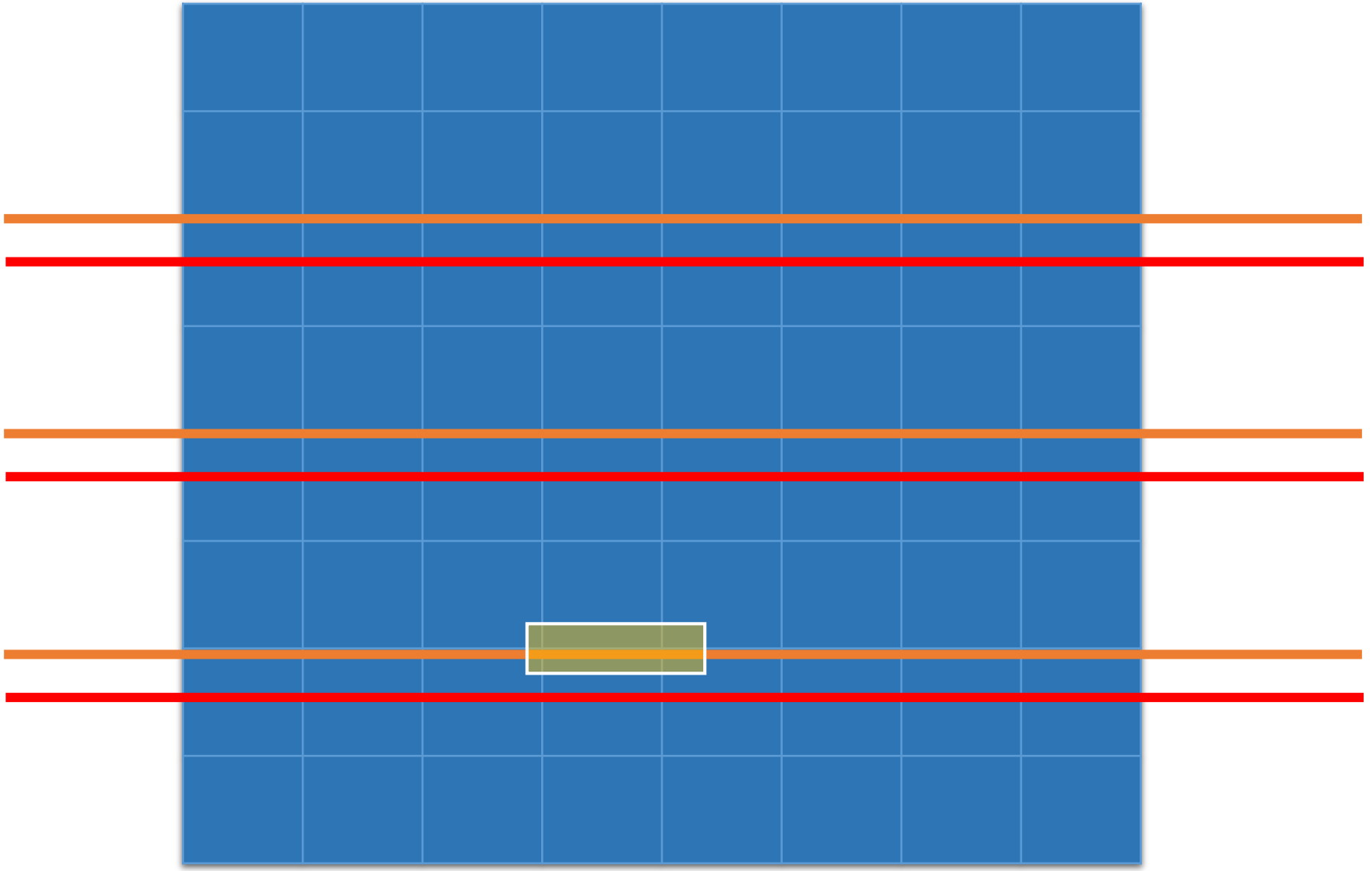
Rank= i

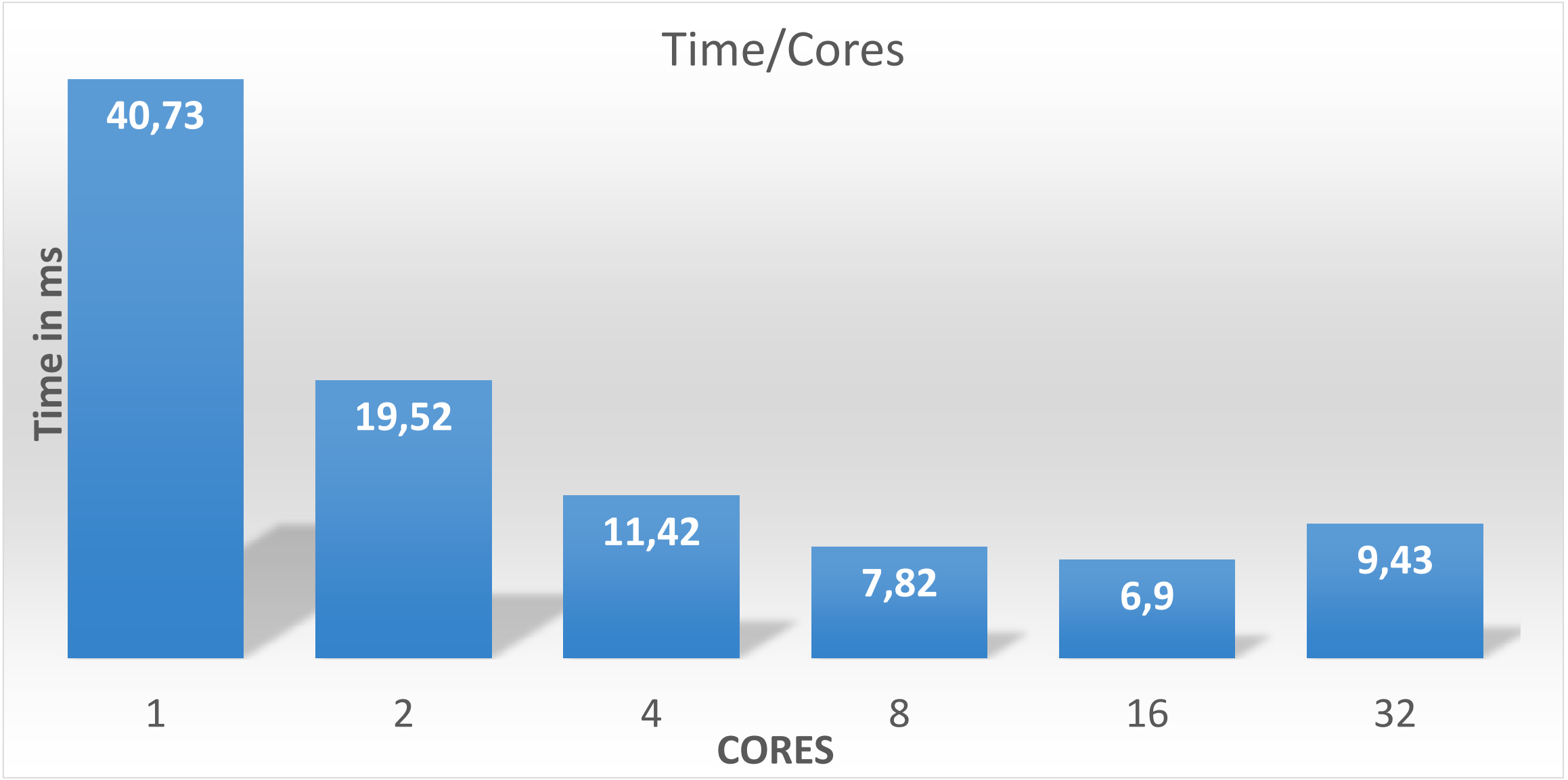


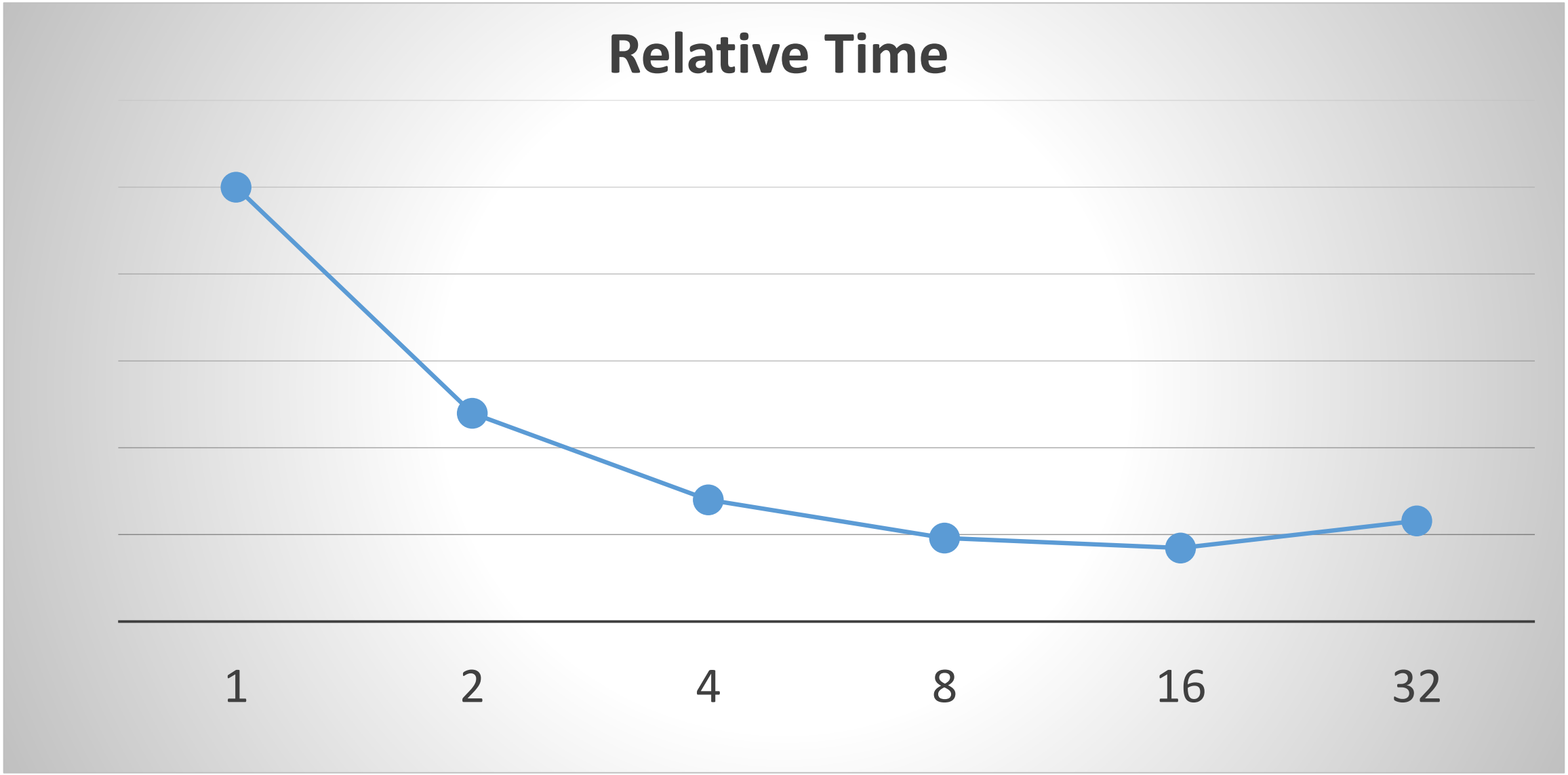


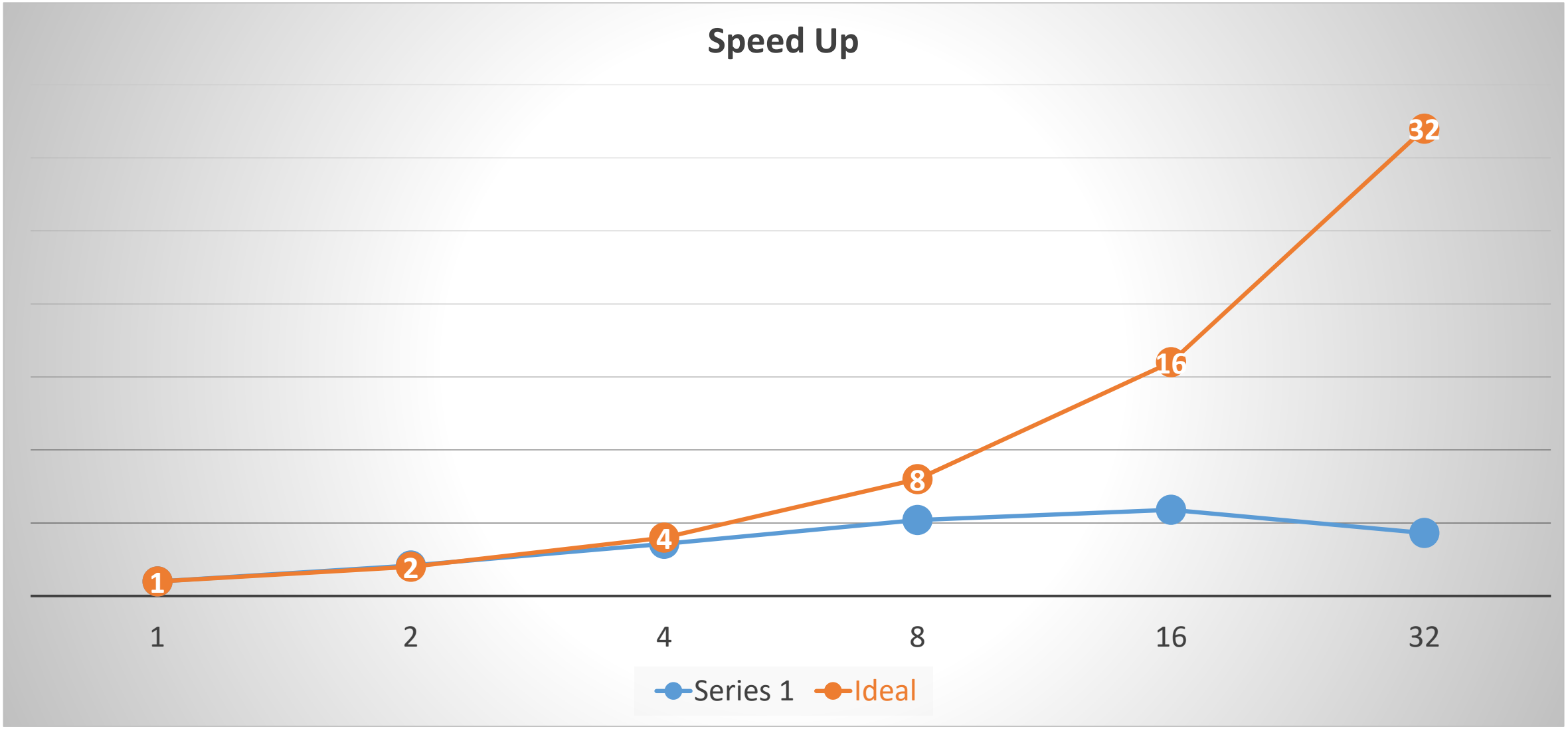
Rank= i + 1

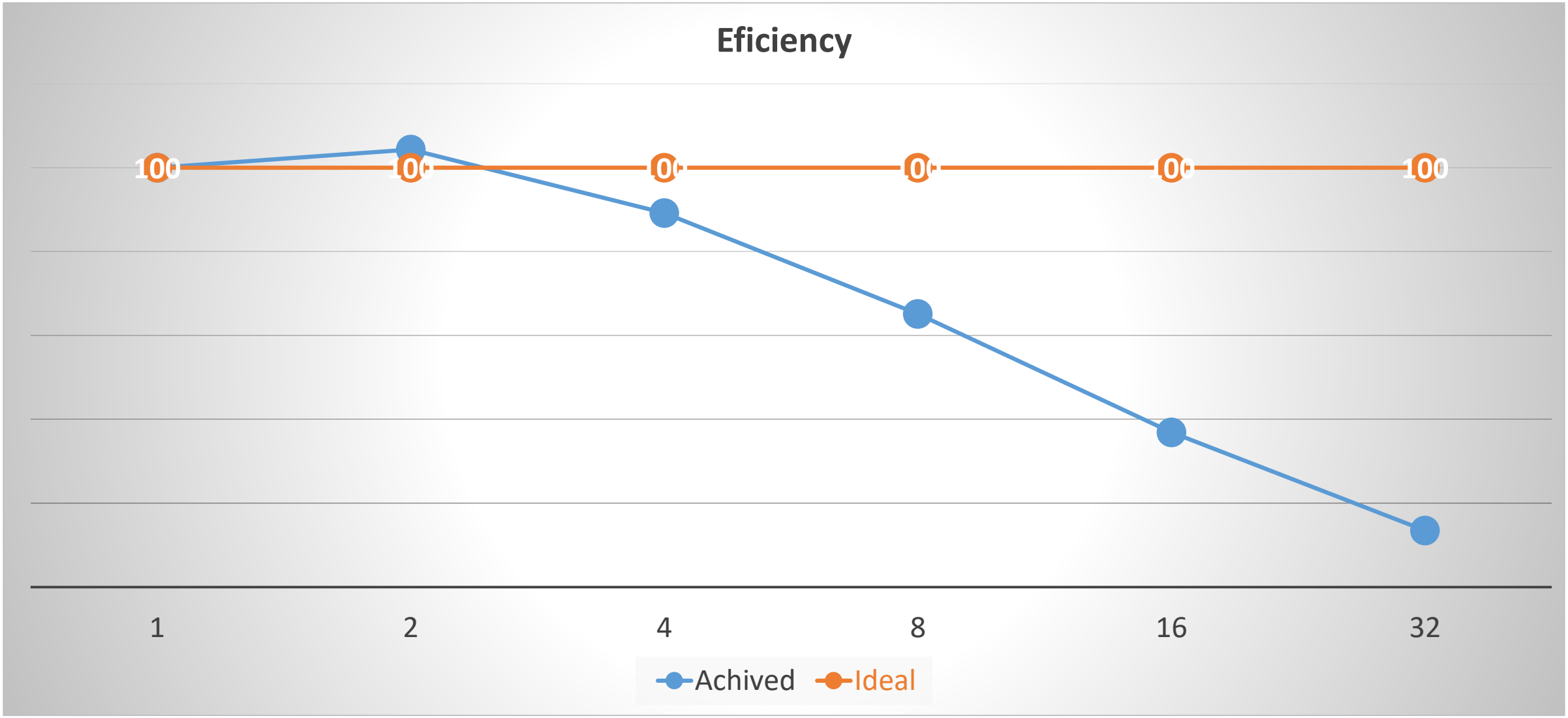
Adaboost Evaluation with MPI




Time/Cores
Time in ms
40,73
19,52
11,42
7,82
6,9
9,43
1
2
4
8
16
32
CORES


Relative Time
1
2
4
8
16
32


Speed Up
1
2
4
8
16
32
1
2
4
8
16
32
Series 1
Ideal


Eficiency
100
100
0
0
0
100
1
2
4
8
16
32
Achived
Ideal

Detection Results

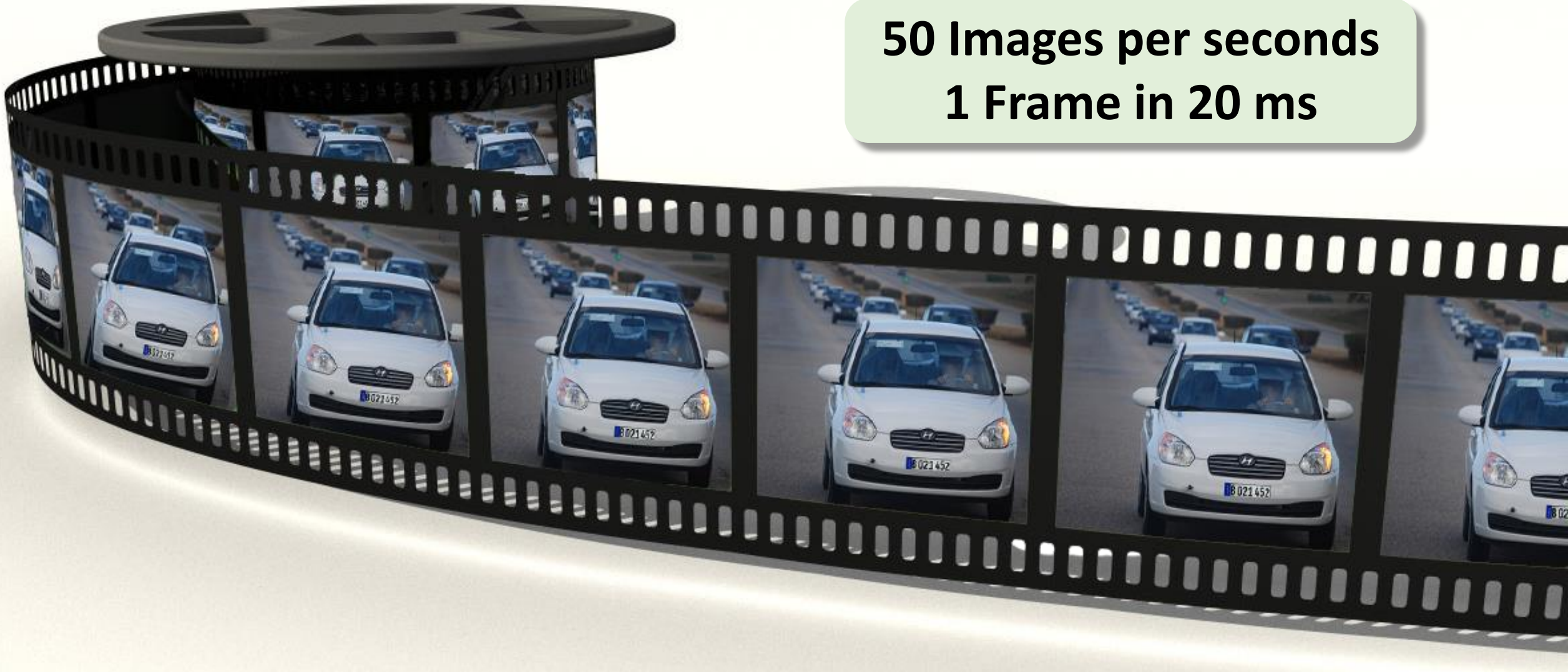
Y=206 X=211

Y=206 X=211

Y=208 X=213

Paso 1.5

Real time artificial vision system



50 Images per seconds
1 Frame in 20 ms

Conclusions

- MPI is working well and detecting the license plate correctly.
- The program is scaling well in order of the amount of ranks and the size of the matrix.
- The time results are suitable for real time artificial systems.

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