



# Windows 9 corp.

---

Floor counting and window recognition challenge

-Nicolas Oulianov  
-Mateusz Blommaert  
-Krzysztof Kamiński  
-Juan Pablo Usuga Cadavid

# Content

---

- 01 Business problem
- 02 Perspective distortion fix
- 03 K-means approach
- 04 Edge projection
- 05 Conclusion



1

Business problem

# Business problem

---



How many floors has this building ?  
How many windows ?



# Business problem

---



And now ?



# Business problem

---

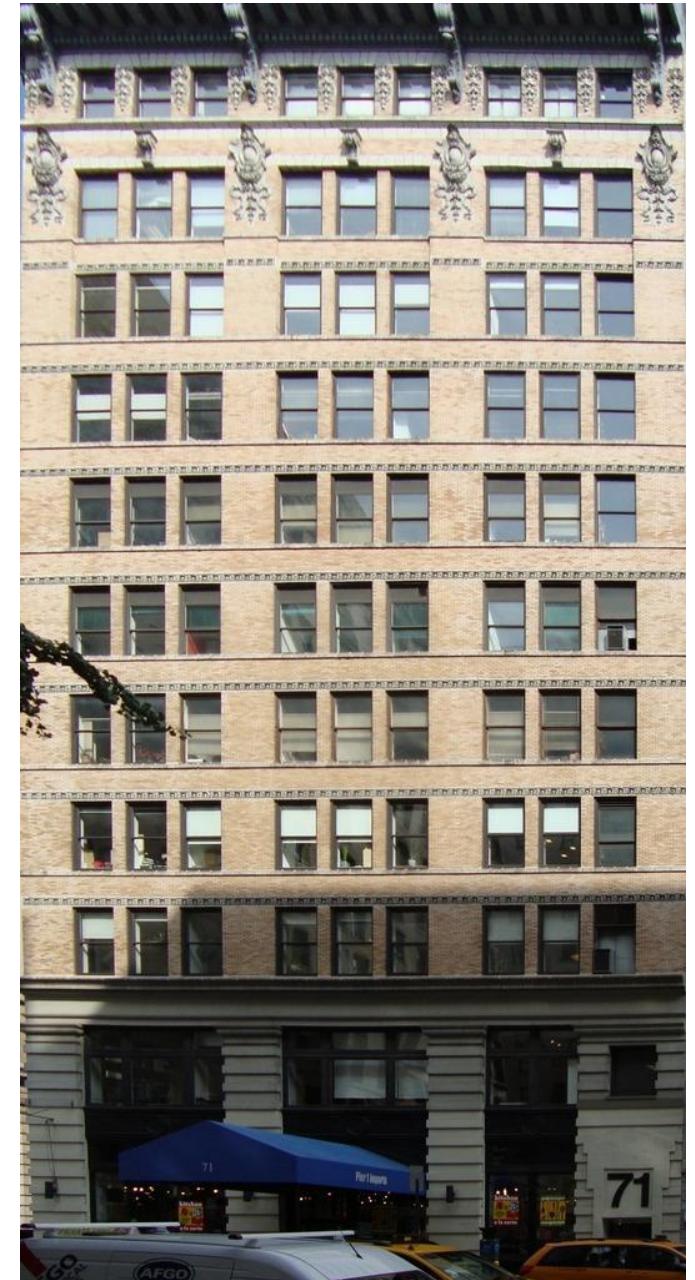
## Window tax

From Wikipedia, the free encyclopedia

The **window tax** was a [property tax](#) based on the number of [windows](#) in a house. It was a significant social, cultural, and architectural force in England, France, Ireland and Scotland during the 18th and 19th centuries. To [avoid the tax](#) some houses from the period can be seen to have bricked-up window-spaces (ready to be glazed or reglazed at a later date). In [England and Wales](#) it was introduced in 1696 and was repealed in 1851, 156 years after first being introduced. France (established 1798, repealed 1926) and Scotland both had window taxes for similar reasons.



# Goal : Count the number of floors on façades of modern buildings





2

Perspective  
distortion fix

# Problem definition

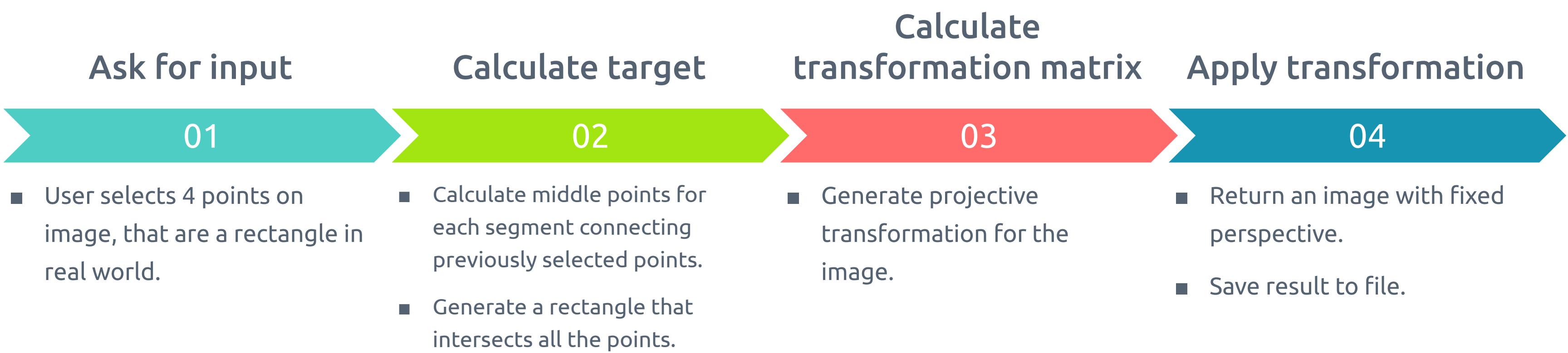
---



Photos taken from the ground

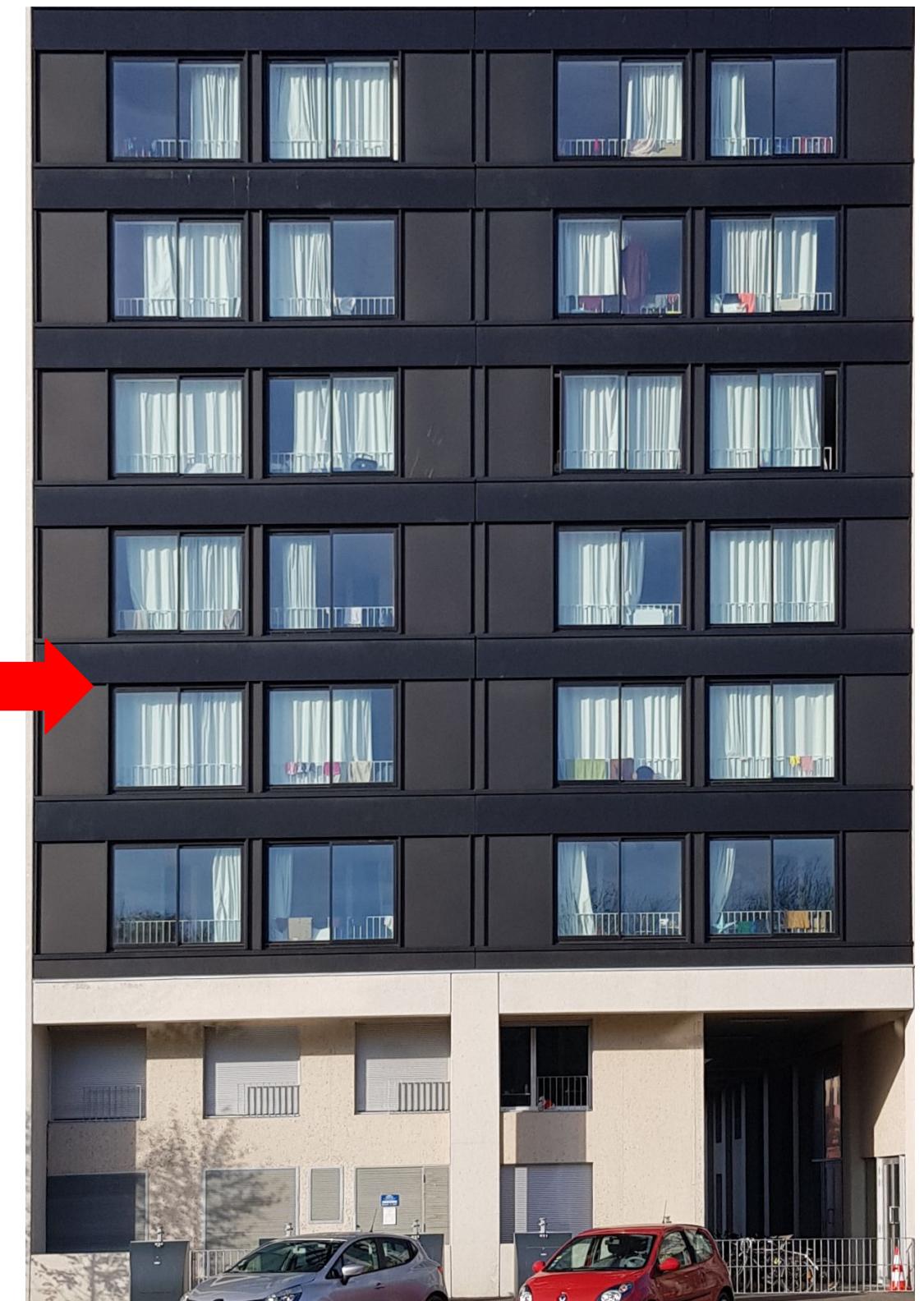
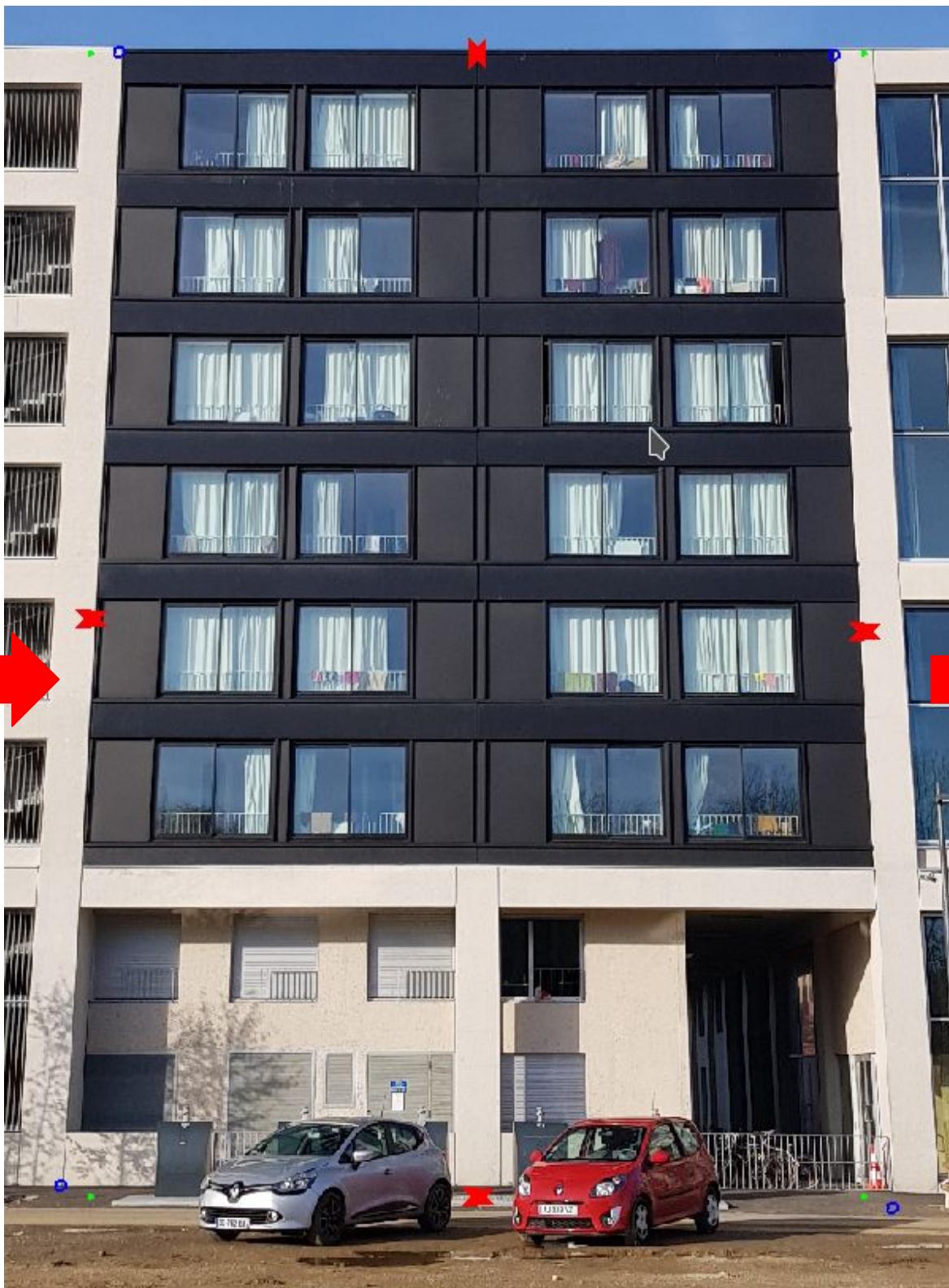
Rectangles malformed by the perspective

# Algorithm



# User Interface

---



# Examples

---



# Examples

---



# Examples

---

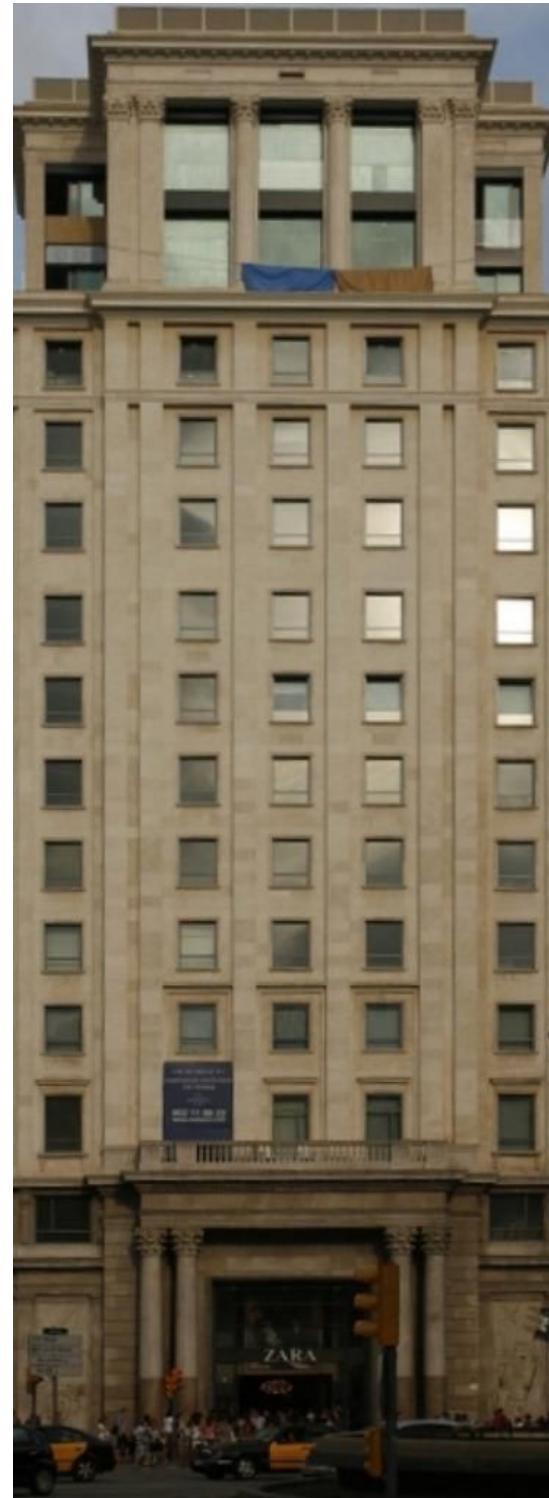




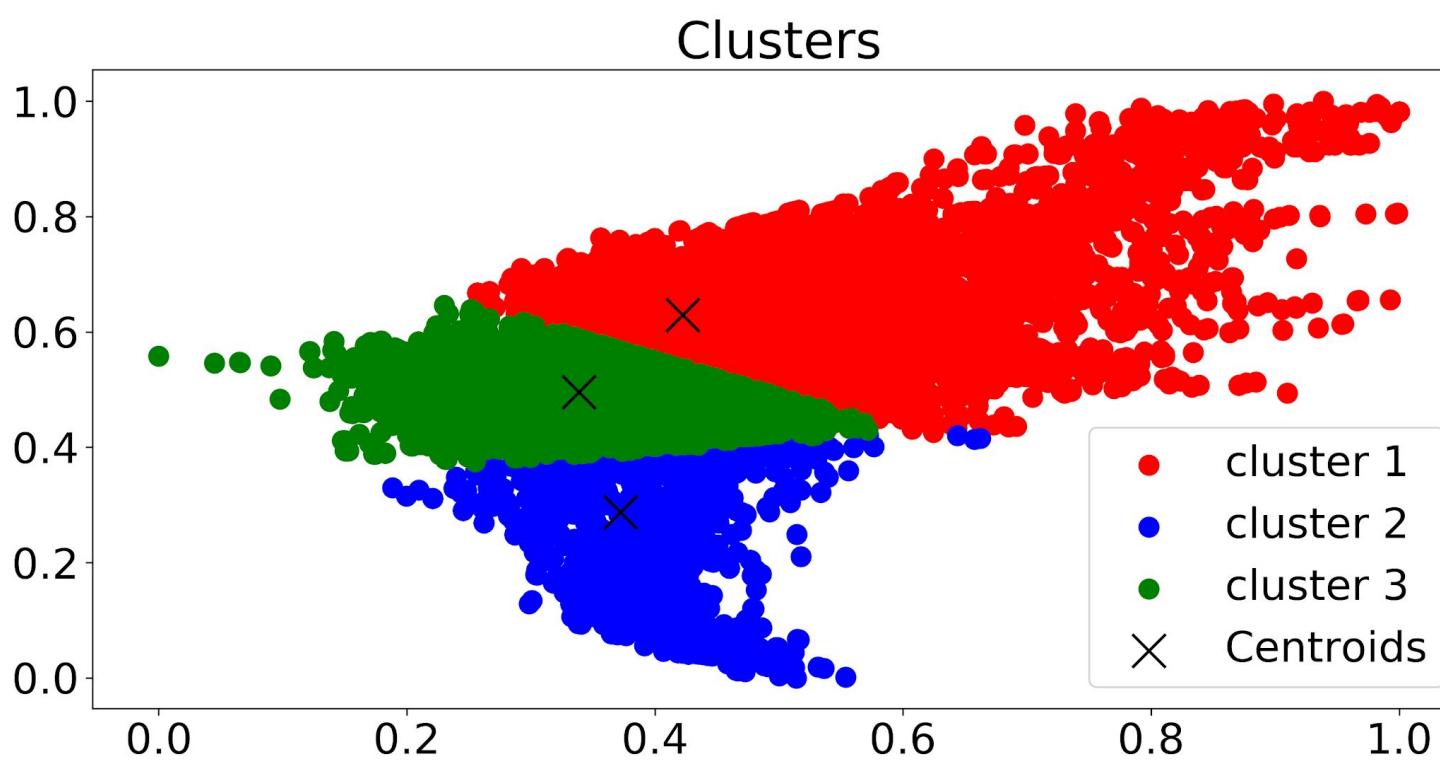
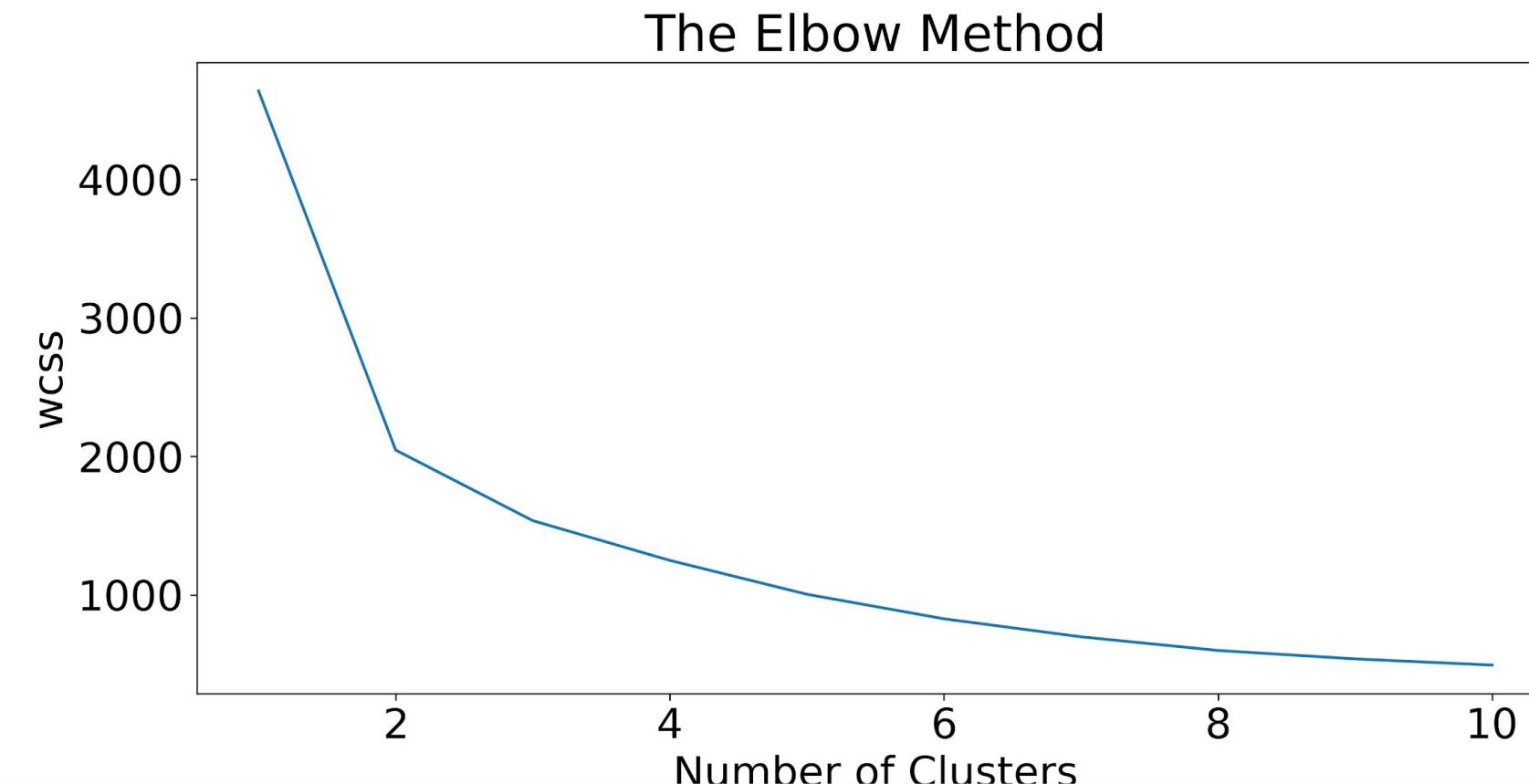
3

K-means approach

# Color space reduction using K-means



CIE L\*a\*b  
space

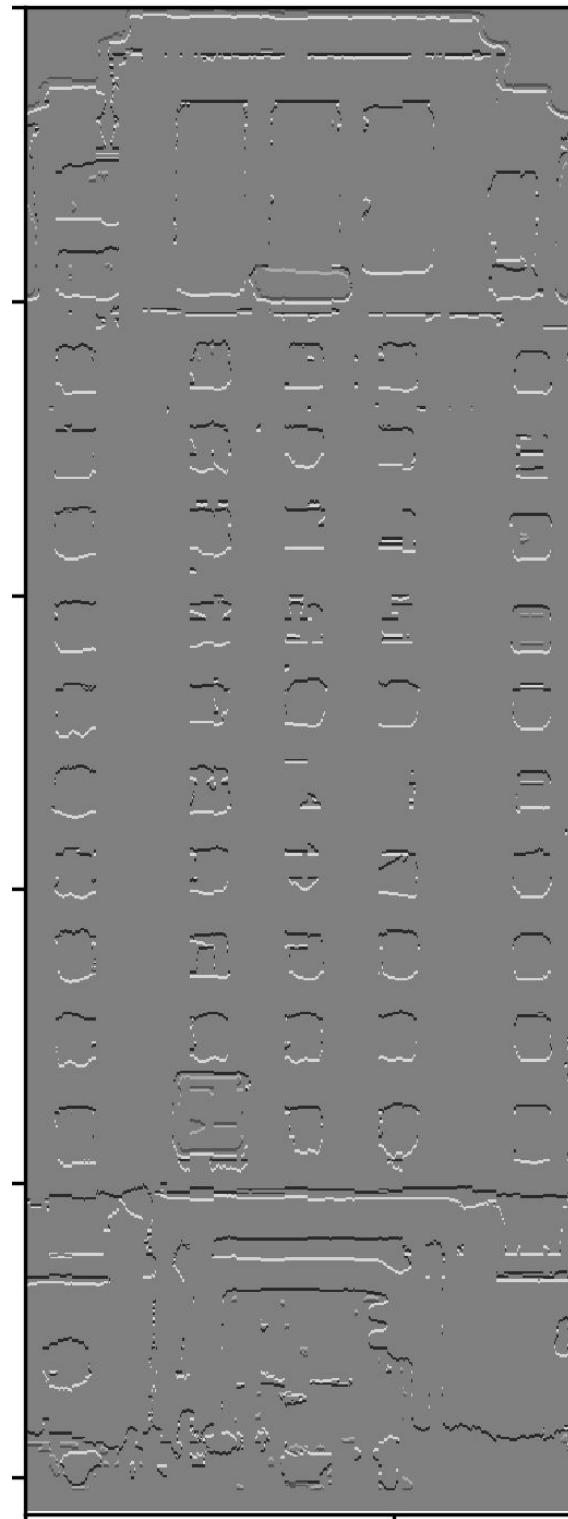


# Computing K-means

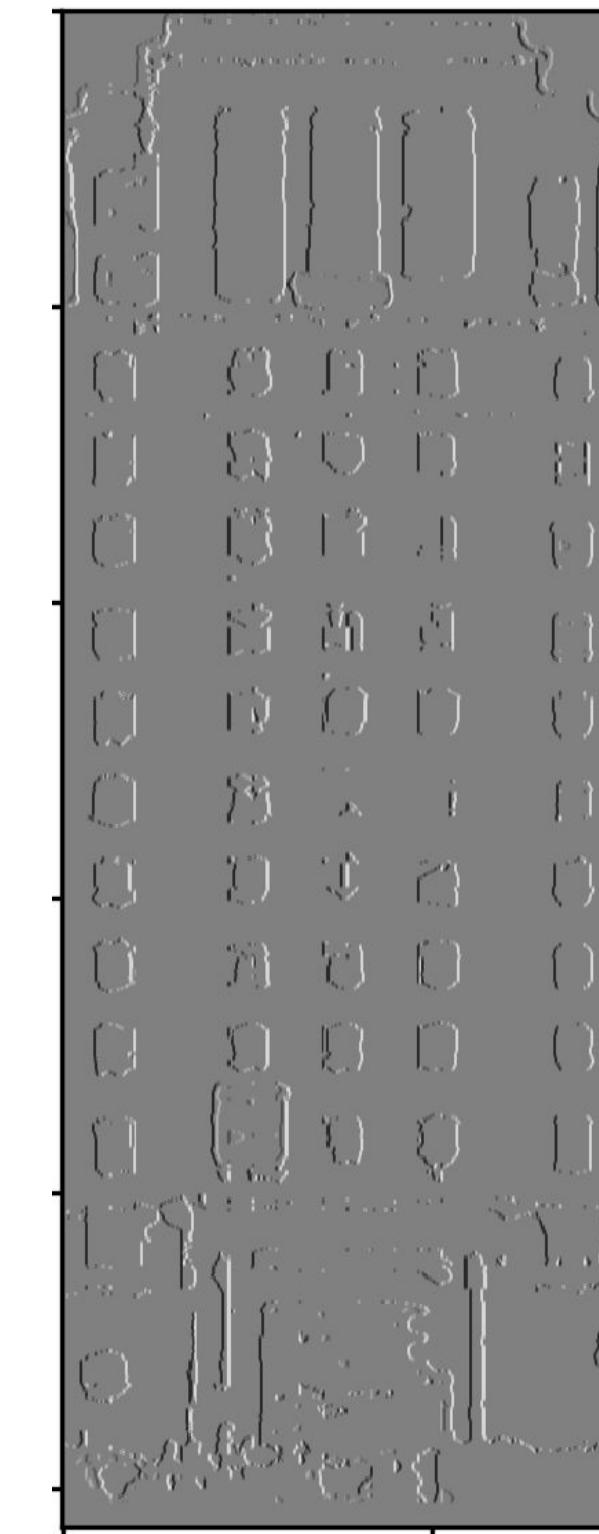


Floors & Window detection - ATHENS

# Identifying edges from a three-color image



Detect horizontal  
edges (parallel to x)

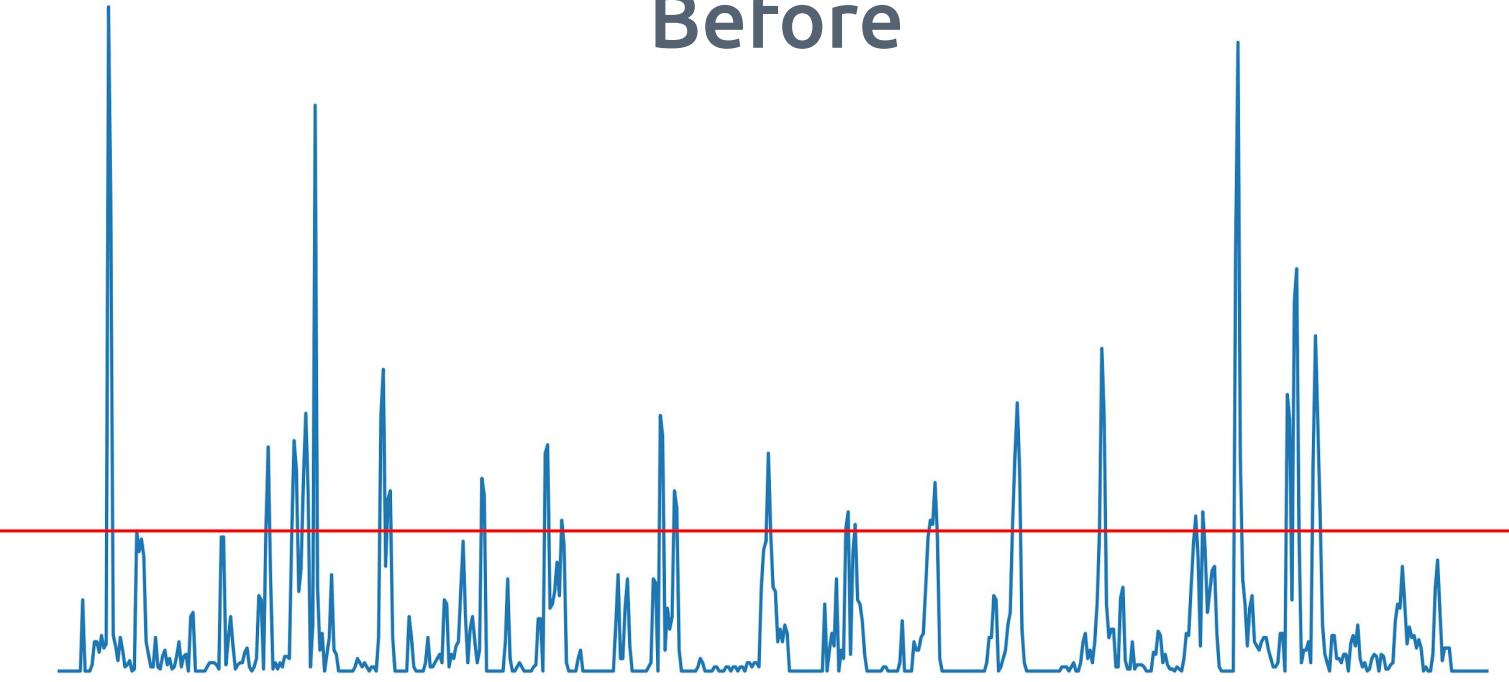


Detect vertical edges  
(parallel to y)

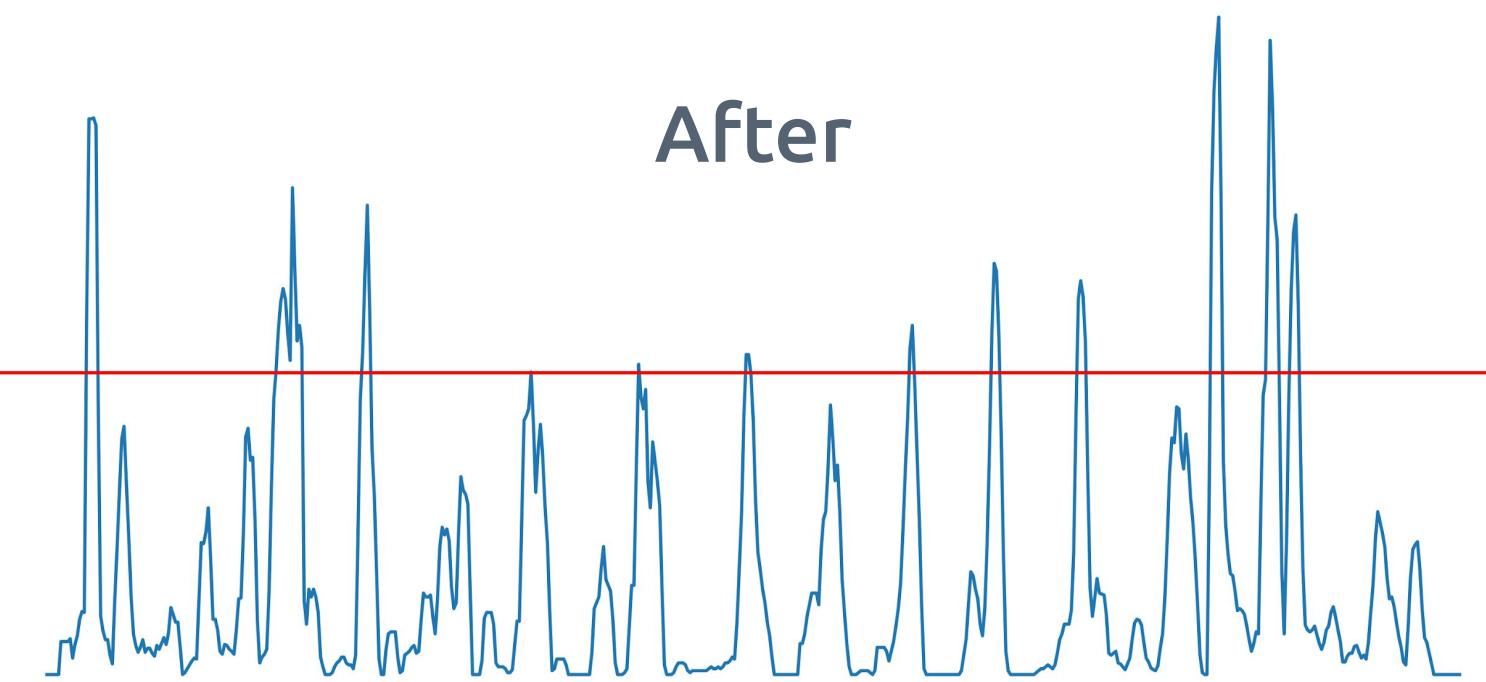
# Counting



Before

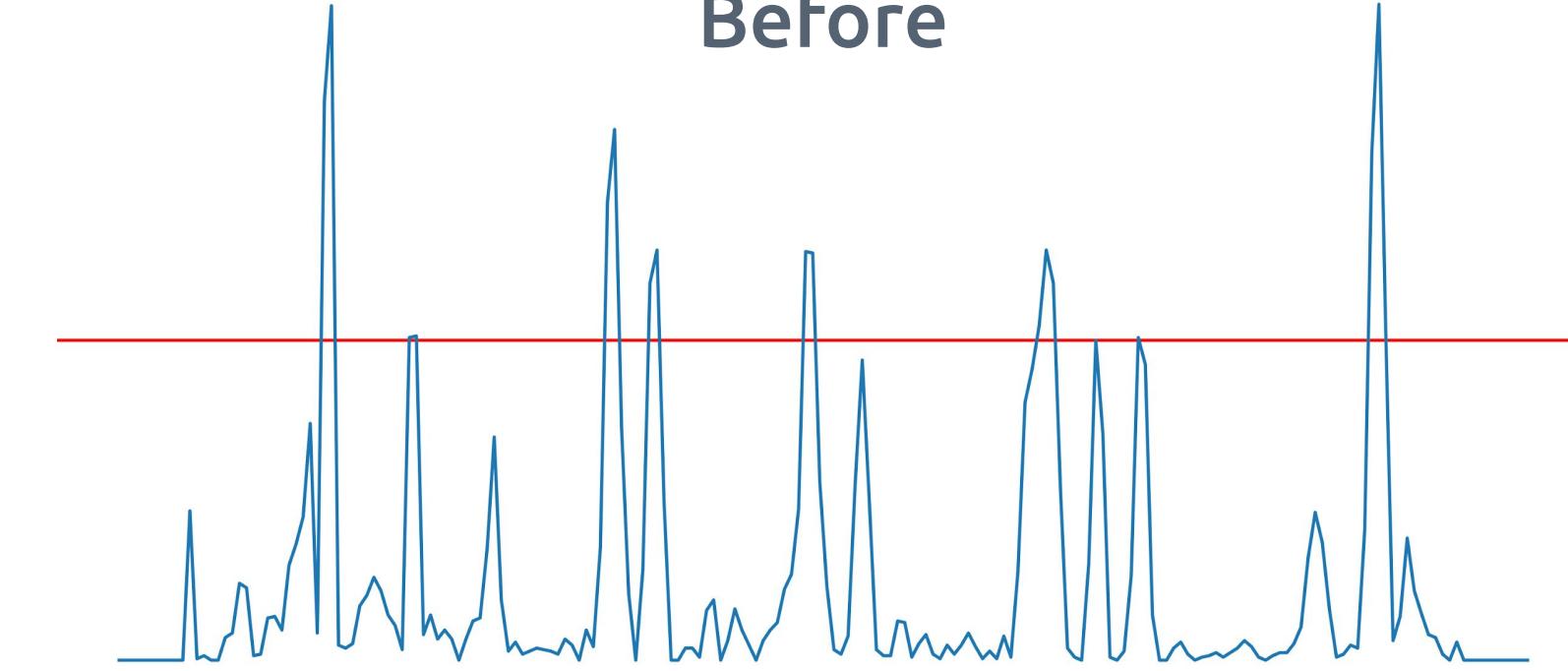


After

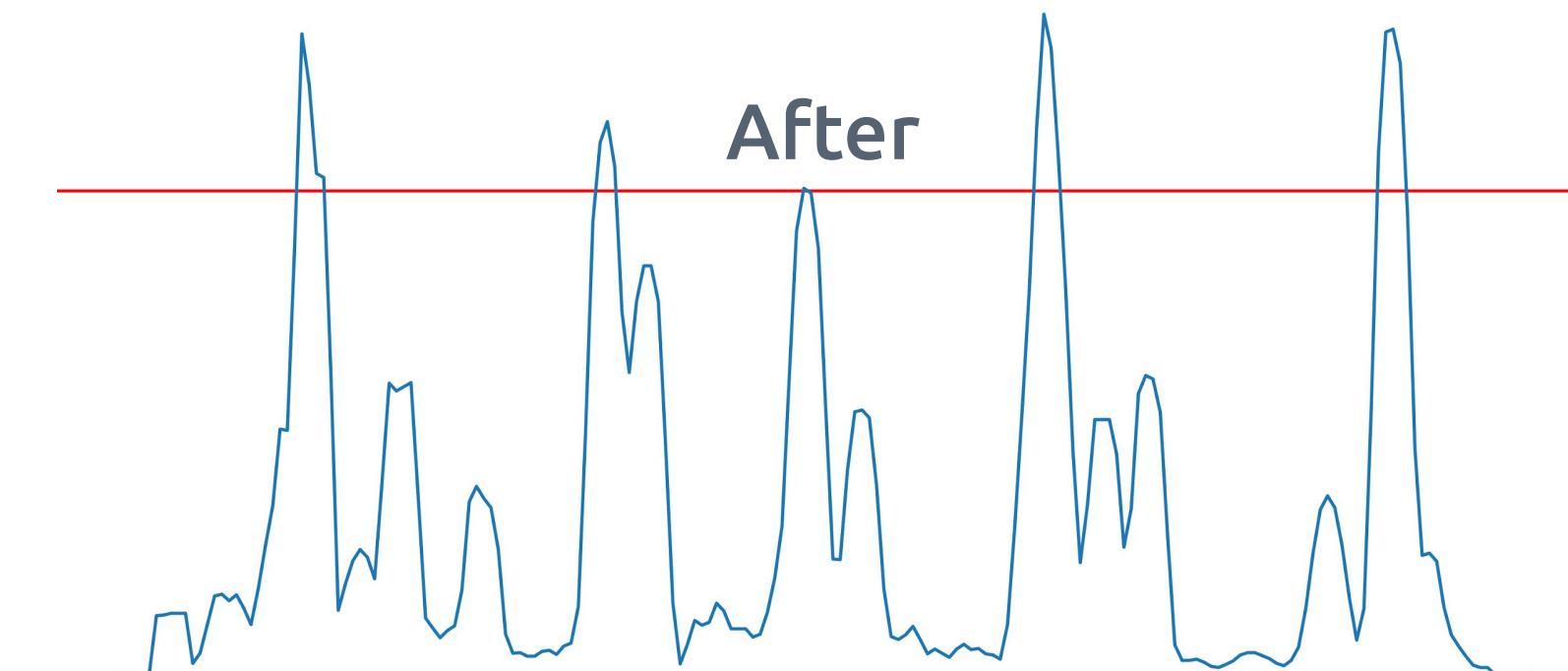


Moving average for  
floors

Before



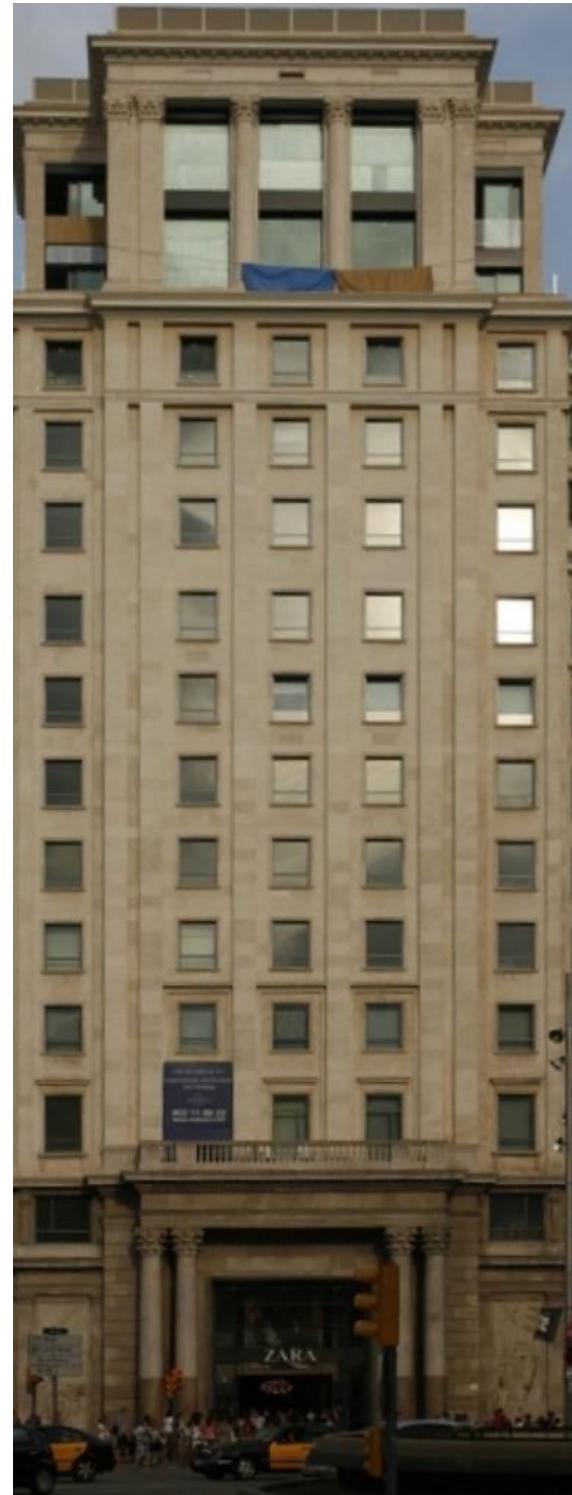
After



Moving average for  
windows

# Counting

---



The number of floors using the quantile on the moving average is: 12  
The number of windows using the quantile on the moving average is: 60



4

Edge Projection

# Edge Detection

---



Image Pre-processing



Comparison of techniques



Morphological Operations

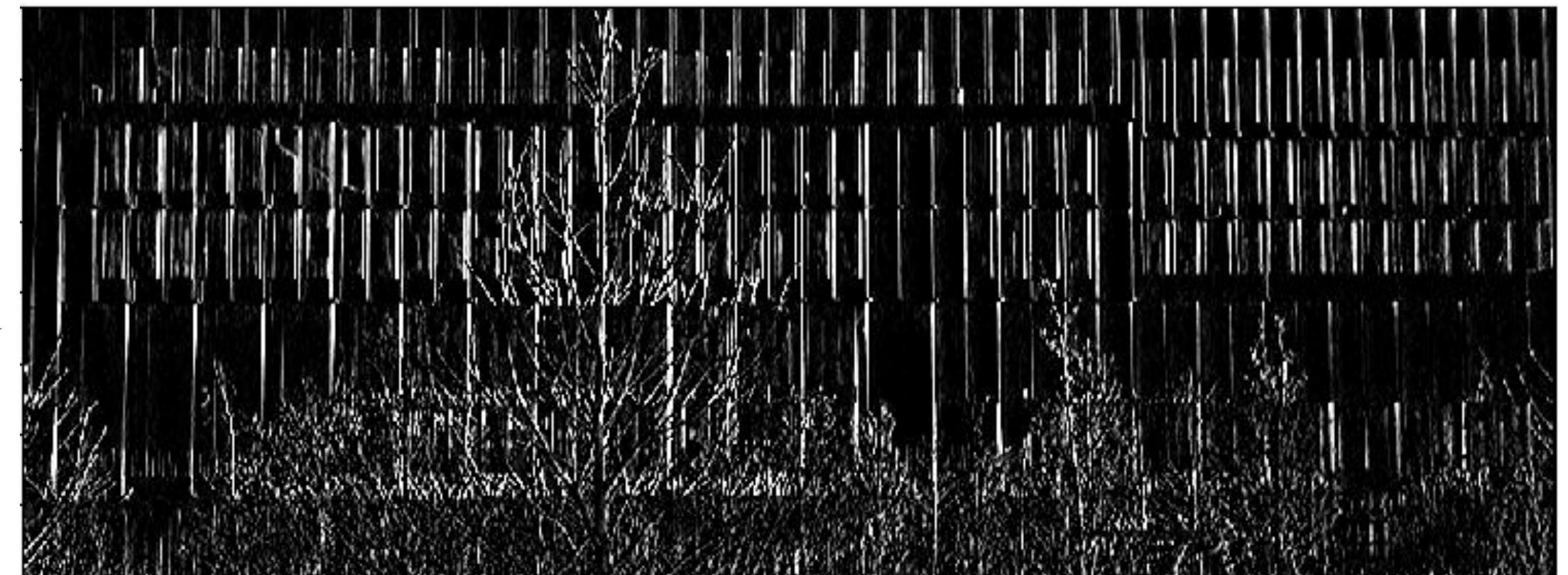
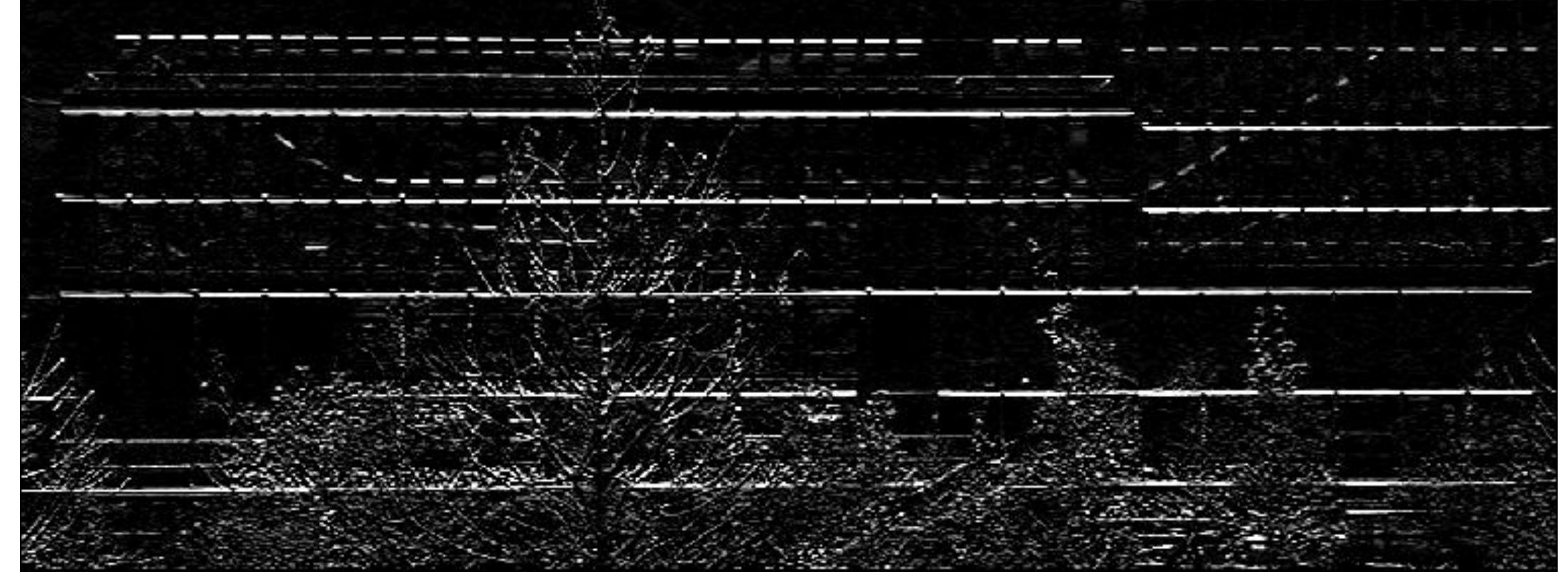


Edge Projection

# Computing horizontal and vertical gradients

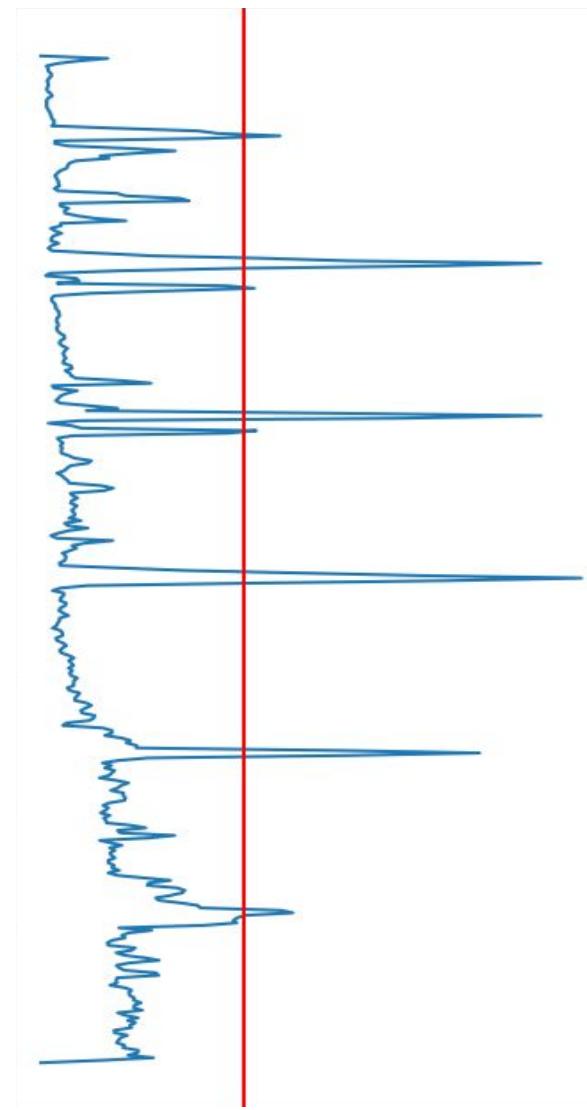


Grayscale  
+ Histogram  
equalization



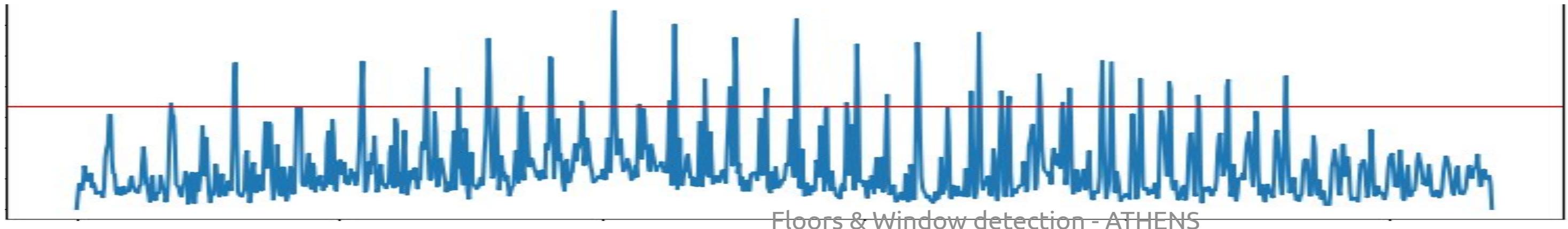
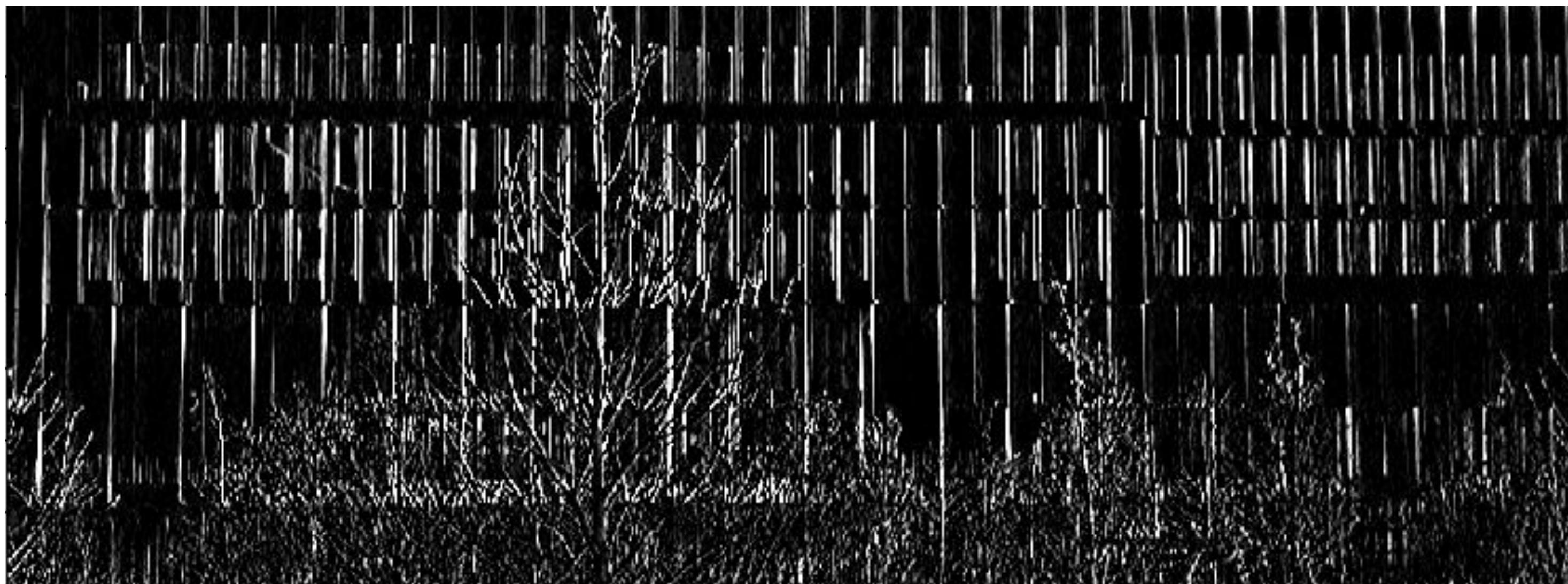
# Axis projection (horizontal)

---



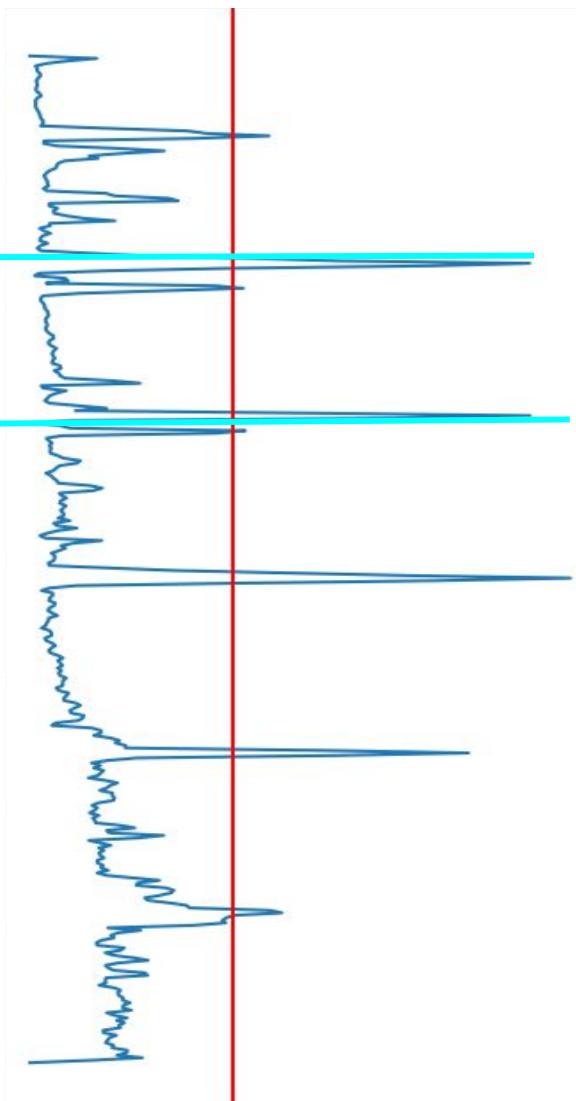
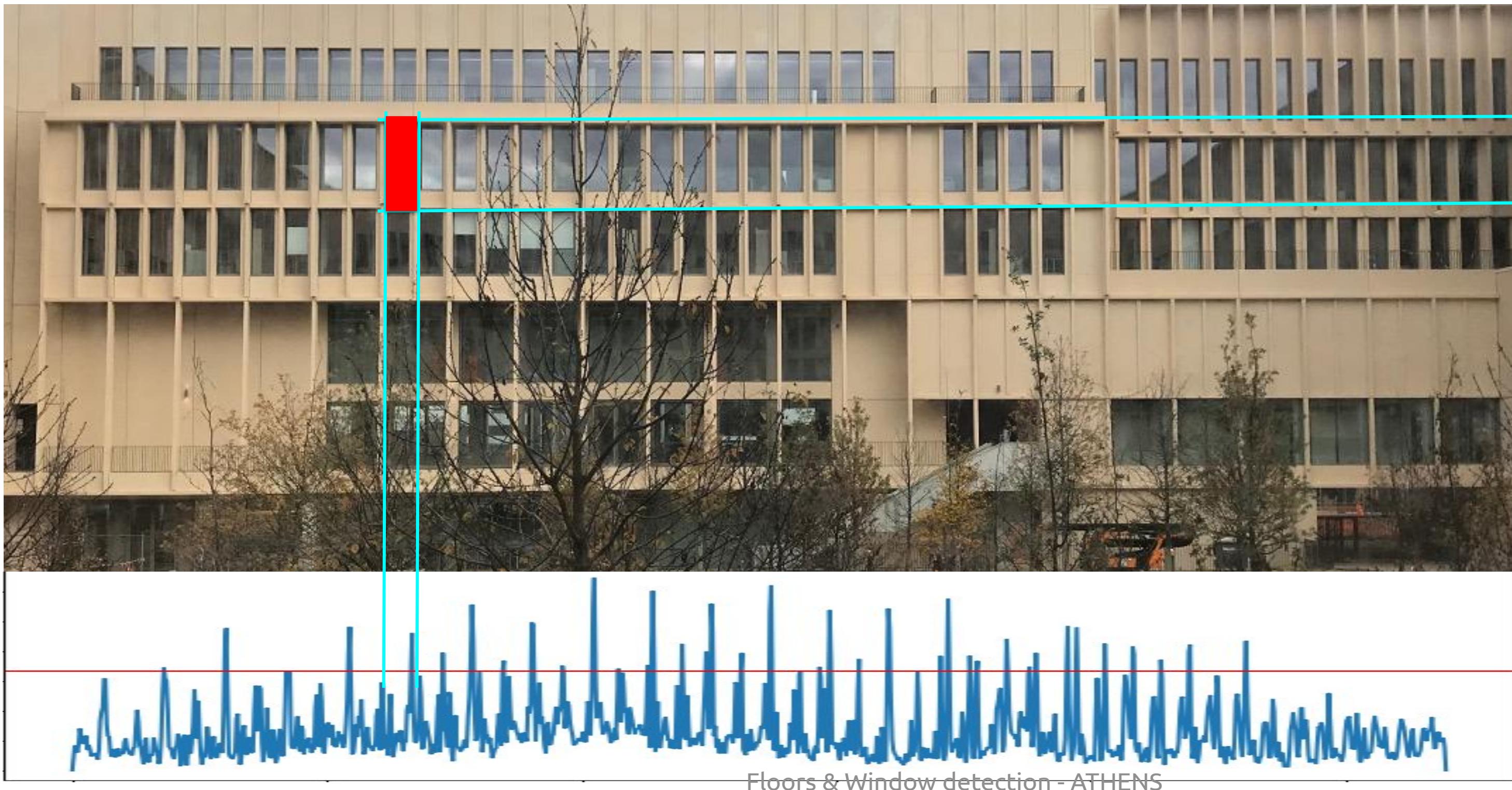
# Axis projection (vertical)

---



# Inferring “probable” window position from peaks

---



# For every box, do a horizontal matching search

---

Due to noise, we get **a lot** of “probable” windows. We need a metric to filter them.



First, we filter by the box size (only keep large boxes).

Then, we count the number of times “similar” shapes, on the picture, are seen on the same line of the image. We assume that a window will be repeated many times on the same line.

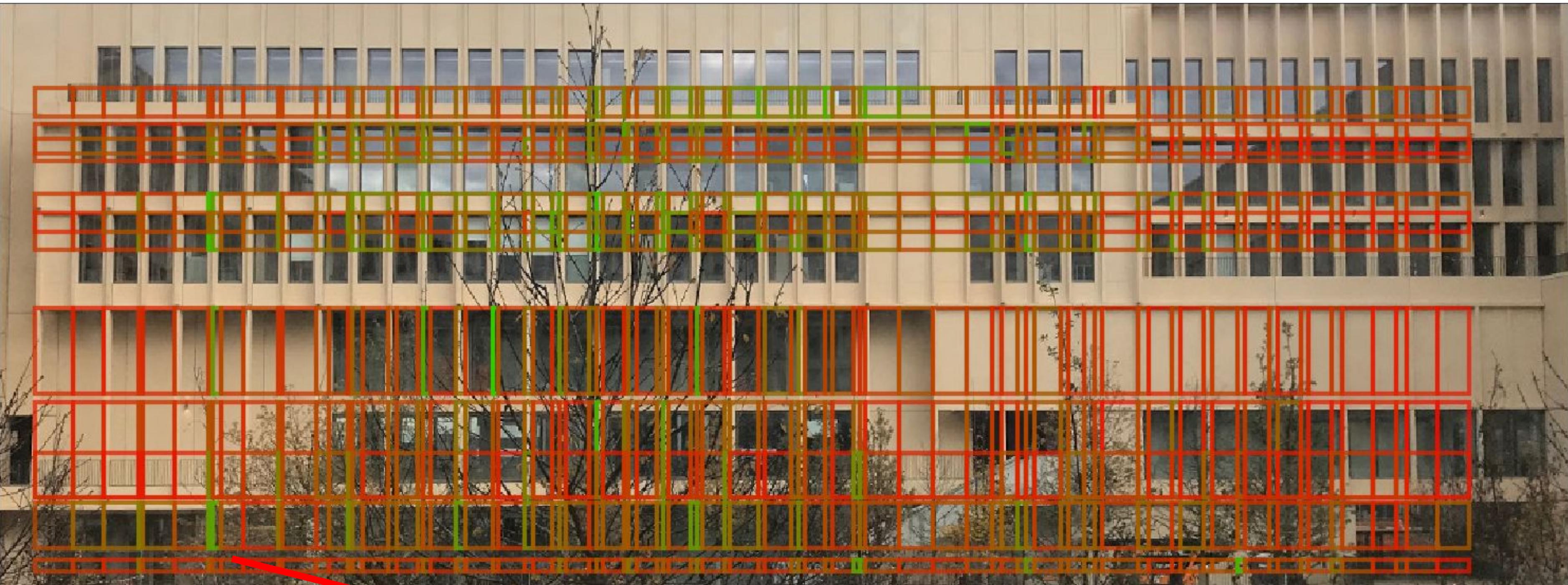
# Window boxes plotting

---



Green = Good pattern matching score

# Floors number approximation



Approximate number of floors =  
Building height / largest window height

```
>>> nicolas('img/cropped telecom.jpg')
Finding and scoring boxes...
Number of floors guessed : 5.461538461538462
```



# 5

Conclusion

# Goal achieved !

---

We counted the number of floors of Telecom Paris' building ! Mission's achieved !...

Almost : our methods don't generalize well.



# Conclusion

---

- A though problem (PhD thesis on the topic !)
- Hard to generalize
- Working with convolutional neural networks looks amazing
- Very interesting experience

# Thank you!



Any questions?