Rapid Object Detection using a Boosted Cascade of Simple Features

K138573
Yuuki Nagahama
Endo Lab

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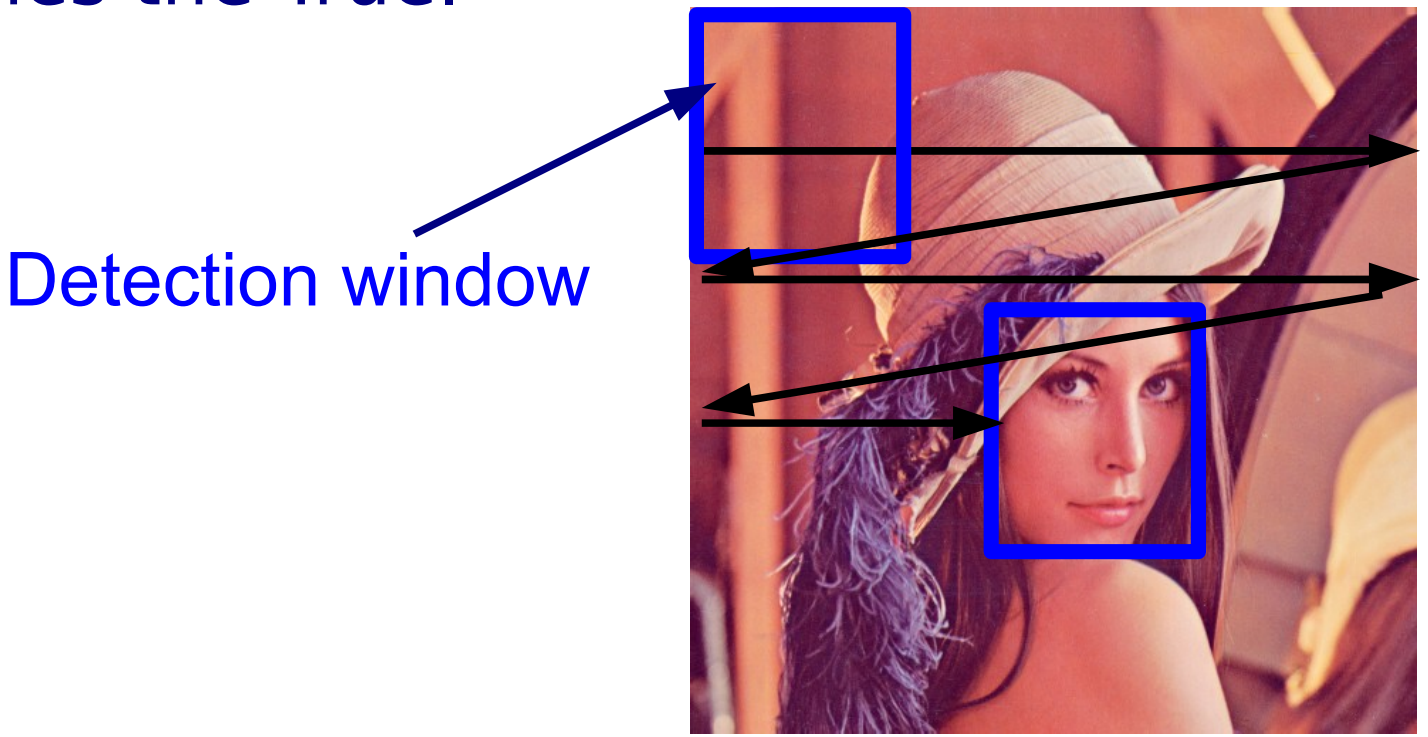
Introduction

- Rapid Object Detection using a Boosted Cascade of Simple Features
  - Paul Viola, Michael Jones
  - Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, pp.511-518, (2001).
- Introduced High-speed face detection technique.

Method of the Face Detection

- While moving a face Detection window.
- if there is a face in Detection window,it becomes the True.



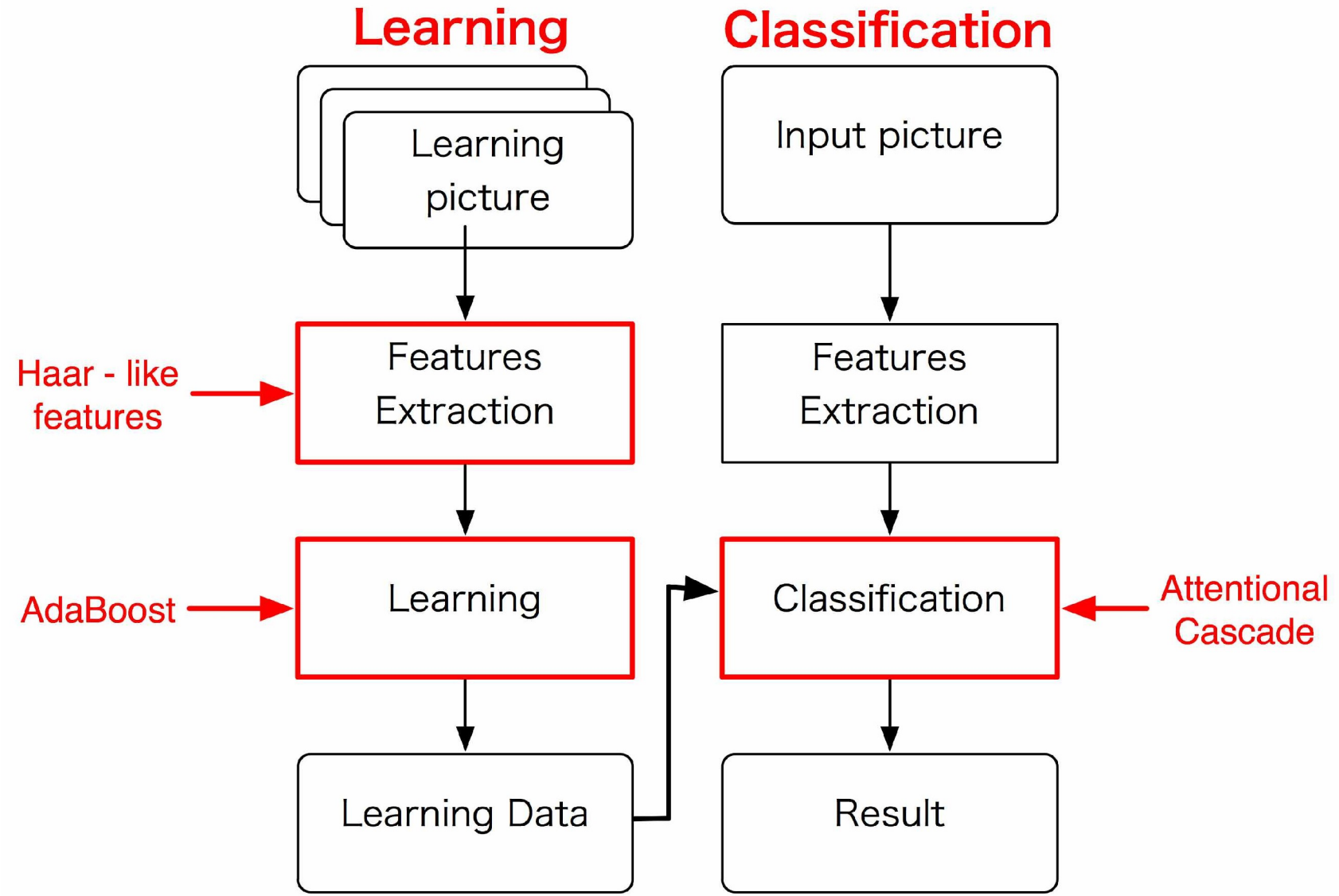
Problem of the Face Detection

- Problem : Too many search ranges.
- Example :
  - picture size 640×480
  - Detection window Size 64×64
  - Searching 240,609 windows
- In addition, It is necessary to change detection window size.
  - Detection window Size 63×63,62×62,...
- It is necessary to reduce computational complexity.

Problem solution of the Face Detection

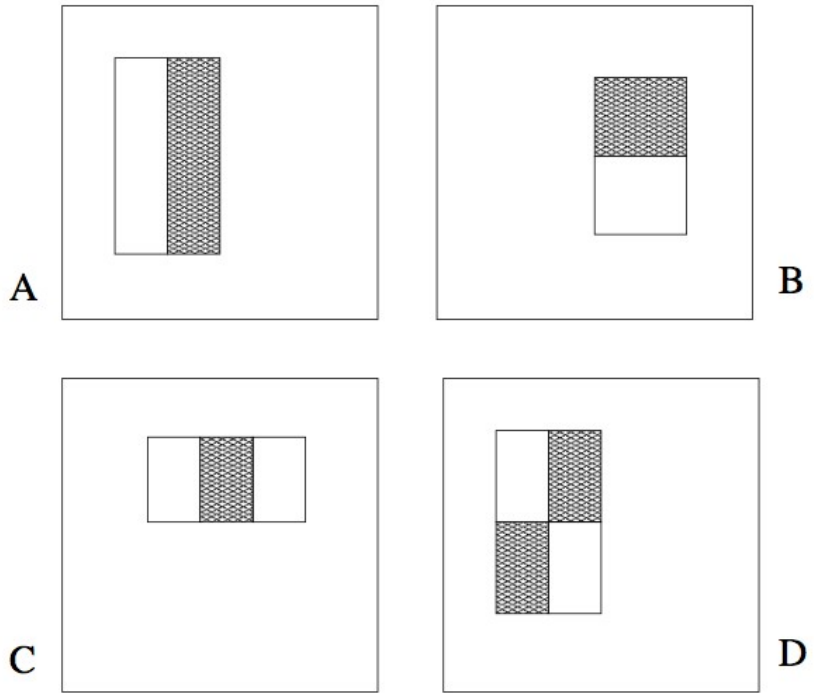
- Solution
  - Haar-like features
    - Feature using a brightness difference
  - AdaBoost (Machine learning)
    - Learning Classification functions.
  - Attentional Cascade
    - omitting a search.

Flow chart


Learning
Classification
Learning picture
Input picture
Haar - like features
Features Extraction
Features Extraction
AdaBoost
Learning
Classification
Attentional Cascade
Learning Data
Result

Haar-like features

- A value of Haar-Like features is the value that pulled the sum of pixel of the white domain from the black domain.



Integral image

- It is necessary to calculate the sum of pixel in the range for Haar-like features.
- The sum of pixel is found with an integral image briefly.

1	2	3	4
3	4	6	7
2	4	6	8
4	3	2	1

1	3	6	10
4	10	19	30
6	16	31	50
10	23	40	60

- 4+6+...+1=41
- 60-10-10+1=41

AdaBoost

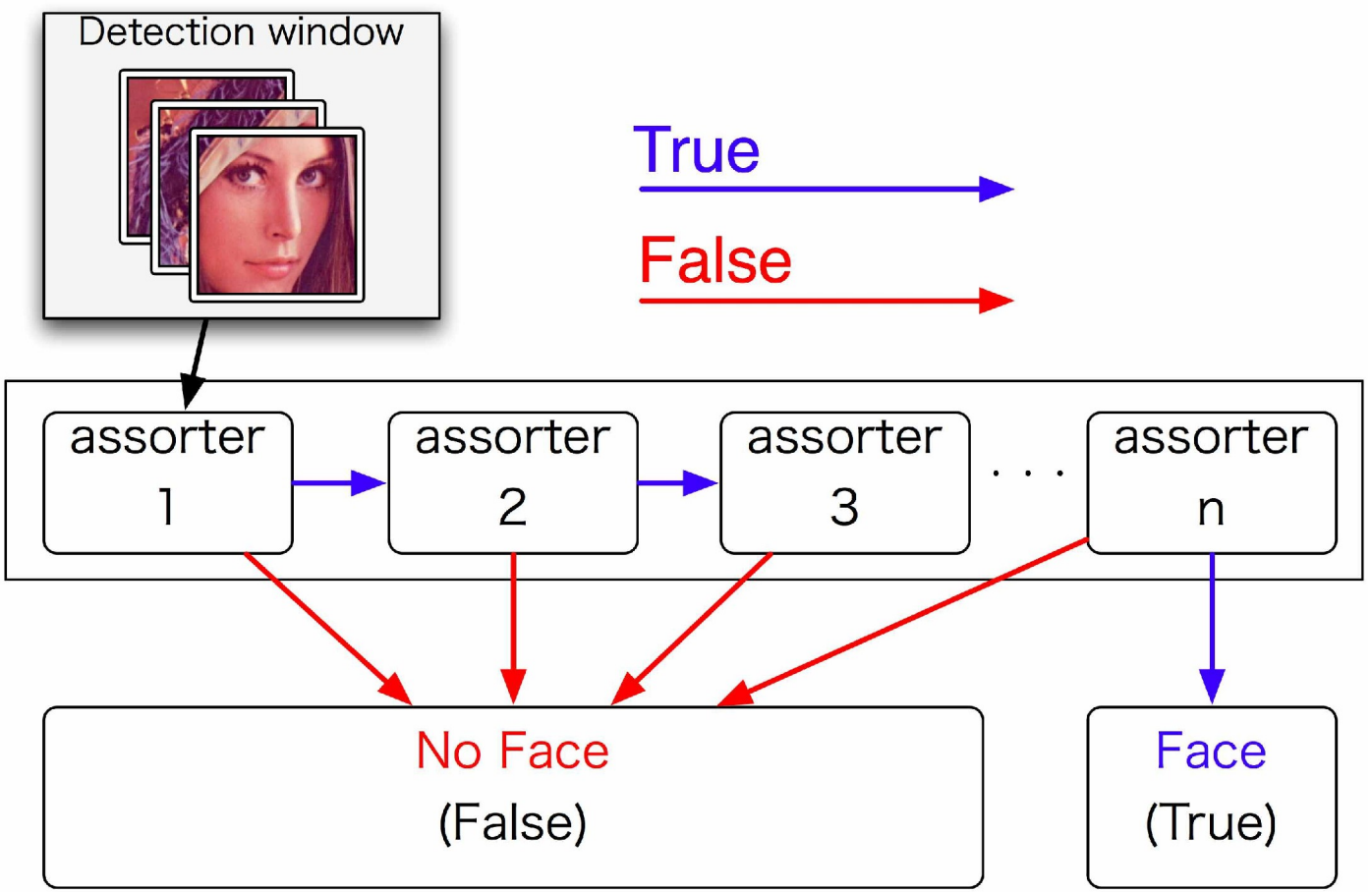
how to choose Haar-like features assorter

- Use Ada Boost Machine learning algorithm
  - 1. classifying sample images in plural assorters.
  - 2. Choose the assorter which is high in a correct answer rate.
  - 3. Update the weight of the sample image.
    - Correct … make light
    - Wrong … make heavy
  - 4. Repeat 1～3

The Attentional Cascade

- Classify detection window with plural assorters.
  - if classified as face with the last assorter, it is face.
  - If not the image of the face, move to next detection window.
- Passing the image which is not a face efficiently.

The Attentional Cascade



Summary

- Face Detection has much computational complexity.
  - Necessary to reduce computational complexity.
- Three solutions
  - Haar-like features
    - Easily calculate in Integral image.
  - AdaBoost (Machine learning)
    - Choose an effective assorter by learning.
  - Attentional Cascade
    - Omitting a search.

Demo Movie

- OpenCV Face Detection: Visualized on Vimeo
- http://vimeo.com/12774628