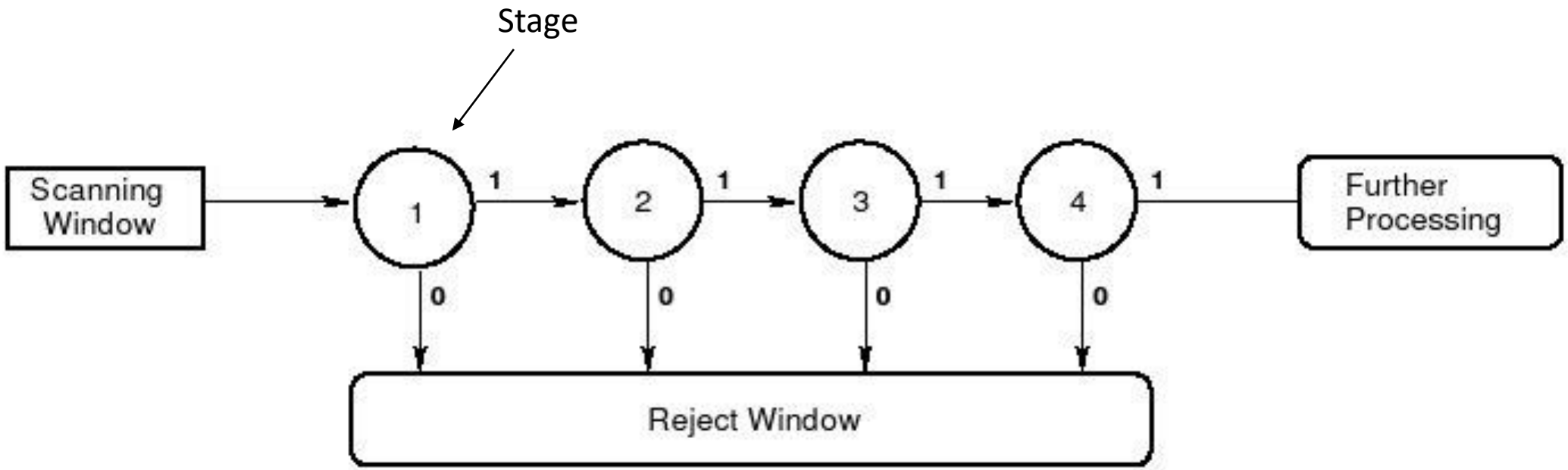
Cascade Classifier



Source: http://photos1.blogger.com/blogger/634/1895/1600/cascade.jpg

Weak Classifier and ML Boosting

- Weak classifier (or weak learners) are classifiers which perform only **slightly better** than a random classifier.
- Boosting is a machine learning ensemble meta-algorithm for primarily reducing bias, and also variance in supervised learning, and a family of machine learning algorithms that convert weak learners to strong ones.
- Discrete Adaboost, Real Adaboost, Gentle Adaboost and Logitboost

Example of a weak classifier

Training set: $\begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$ *Label*

$\begin{bmatrix} 1 & 2 & 3 \\ 100 & 200 & 300 \\ -1 & -2 & -3 \end{bmatrix}$ *Features*

Classifier: *output(i) = sign(i,j) where j = 1*

Output: $\begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$

Why do we even use it?

True Positive and False Positive

- True positive is a positive sample classified as positive ***(IMPORTANT!)***
- False positive is a negative sample classified as positive

$0.9^{25} = 0.07$

$0.95^{25} = 0.27$

$0.995^{25} = 0.88$

$0.5^{25} = 2.98023224E\text{-}8$

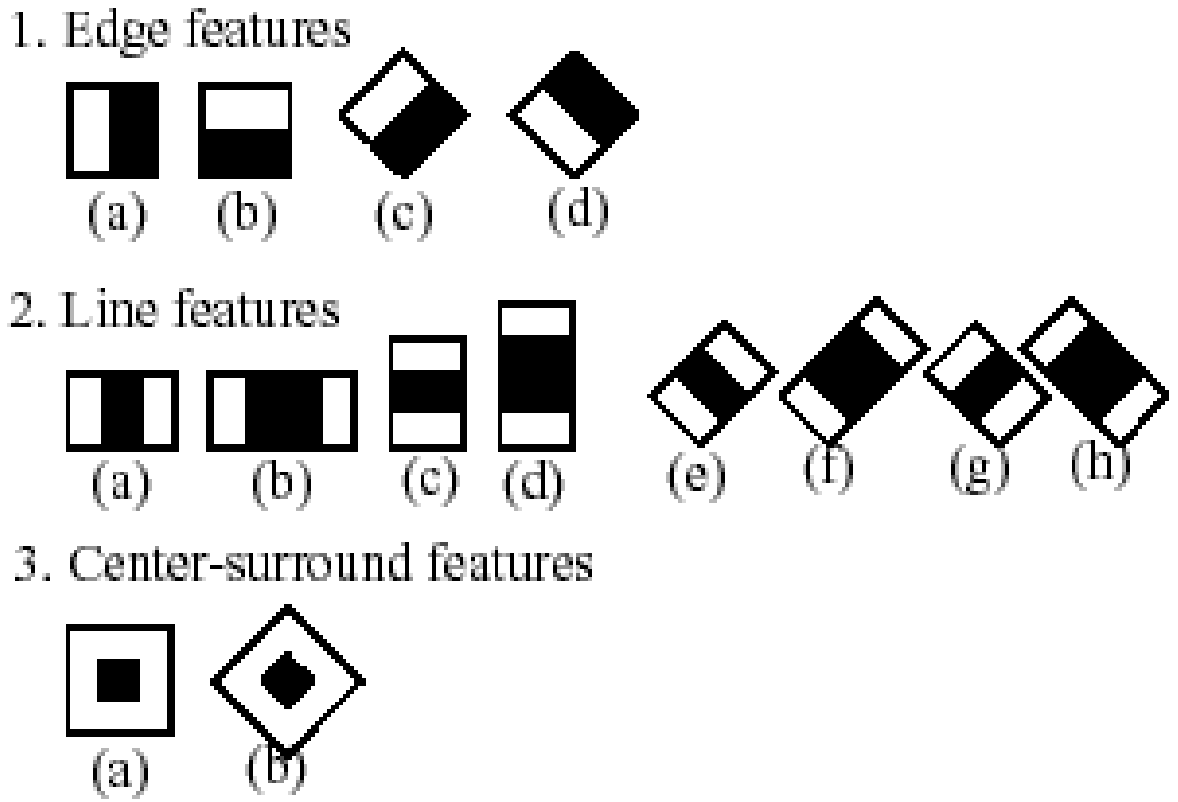
$0.05^{25} = 2.98023224E\text{-}33$

$0.005^{25} = 2.98023224E\text{-}58$

Feature Type

- Haar (Fit us very well)
- LBP (Super fast)

Haar-like feature

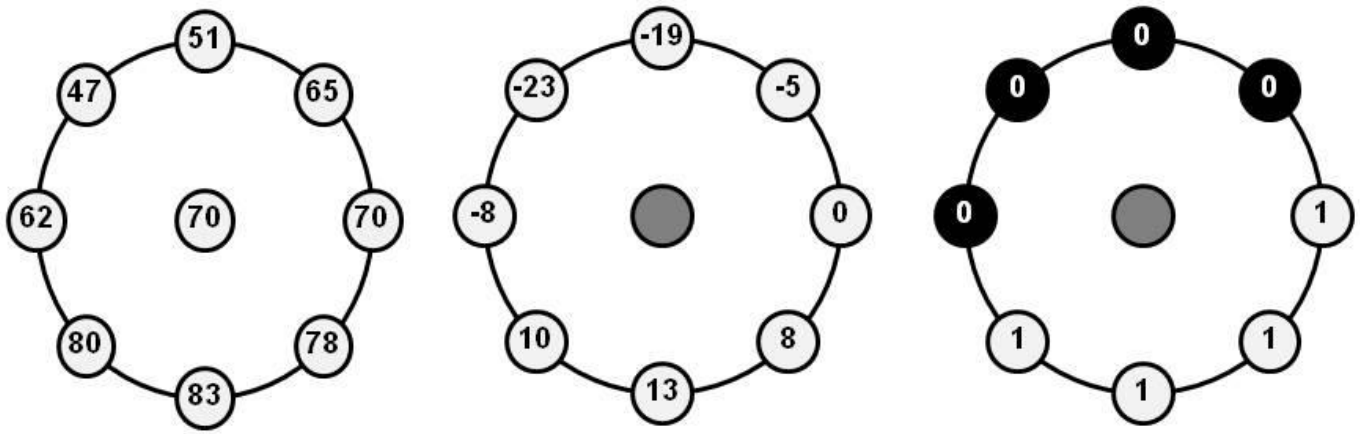


Source: https://docs.opencv.org/2.4/modules/objdetect/doc/cascade_classification.html

LBP (Local Binary Patterns) Feature

The value of the LBP code of a pixel (x_c, y_c) is given by:

$$LBP_{P,R} = \sum_{p=0}^{P-1} s(g_p - g_c)2^p \qquad s(x) = \begin{cases} 1, if\ x \geq 0; \\ 0, otherwise. \end{cases}$$



1. Sample | 2. Difference | 3. Threshold

1*1 + 1*2 + 1*4 + 1*8 + 0*16 + 0*32 + 0*64 + 0*128 = 15

4. Multiply by powers of two and sum

Project

- Use cascade classifier to detect armor plates
- Training set is up here:

https://github.com/RoboMaster-Club/cascade-classifier