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HANDONG GLOBAL UNIVERSITY
WORLD CHANGING

Image Features & Matching

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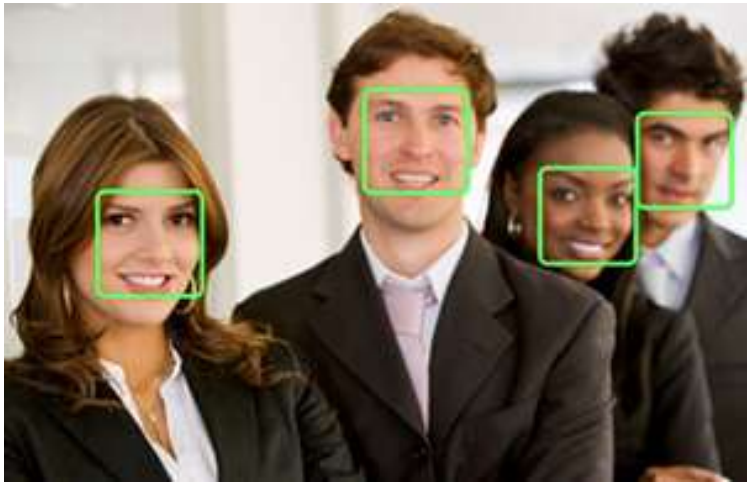
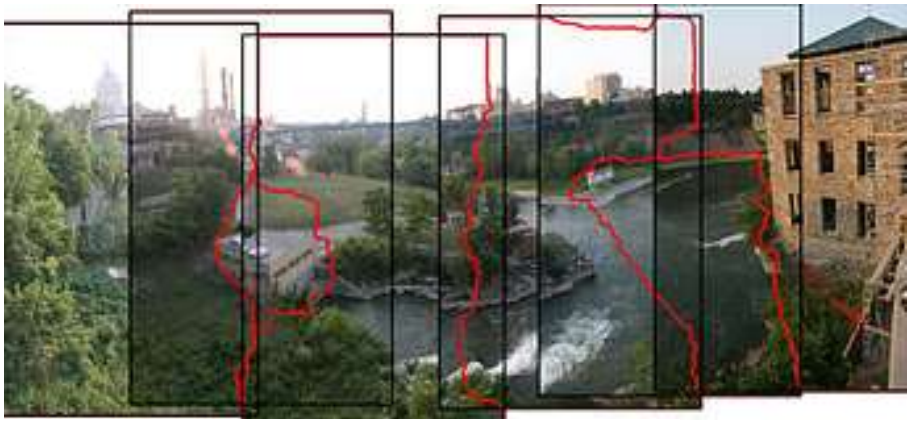
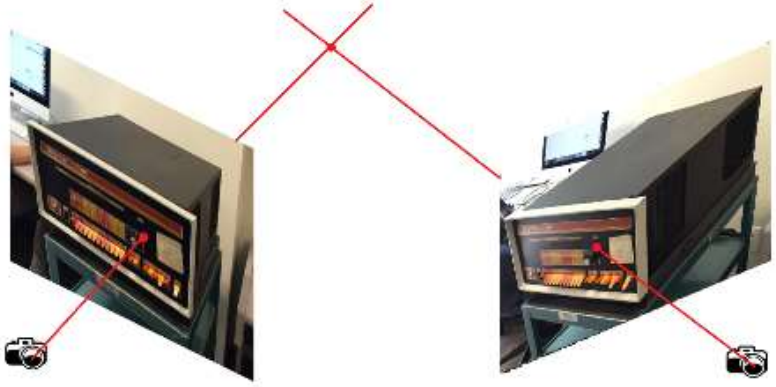
What is an image feature?

- An image feature is a piece of information that is relevant for solving the computational task related to a certain application.
- Features may be specific structures in the image such as points, edges, or objects.
- Features may also be the result of a general neighborhood operation or feature detection applied to the image.

Why do we need to extract a feature?

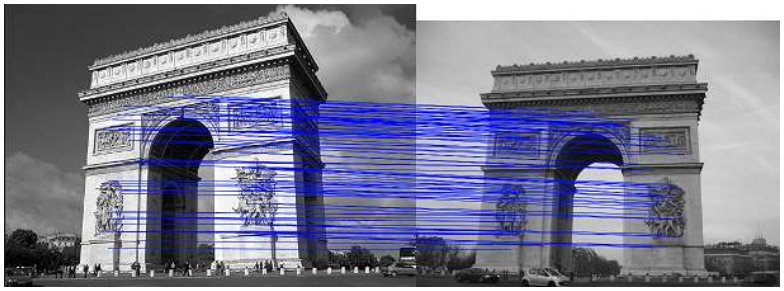






What is a good feature?

- A good feature should be invariant to….
  - Illumination
  - Translation
  - Scale
  - Rotation
  - Perspective transform



https://www.semanticscholar.org/paper/Illumination-Invariant-Imaging-%3A-Applications-in-%2C-Maddern-Stewart/7647e5bc73a61a2a9201e26b682e25e2877f4681

https://stats.stackexchange.com/questions/207195/translational-variance-in-convolutional-neural-networks

http://www.ismailsirma.com/visualsfm-3d-construction-of-images

What is a good feature?

- A good feature should be computationally inexpensive
- A good feature should be memory efficient

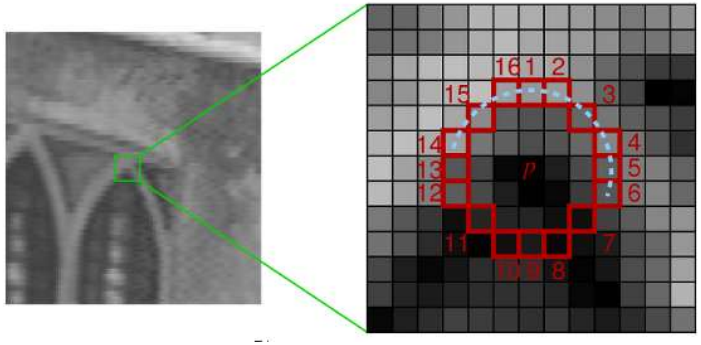
Several Images features

- Widely used feature extractor & descriptor

명칭	detector	descriptor
Harris Corner(1988)	o	x
Shi & Tomasi(1994) (goodFeaturesToTrack)	o	x
SIFT(1999)	o	o
MSER(2004)	o	o
SURF(2006)	o	o
FAST(2006)	o	x
ORB (FAST+BRISK)	o	o
AGAST(2010)	o	o
BRIEF(2012)	o	o
AKAZE(2012) (KAZE)	o	o

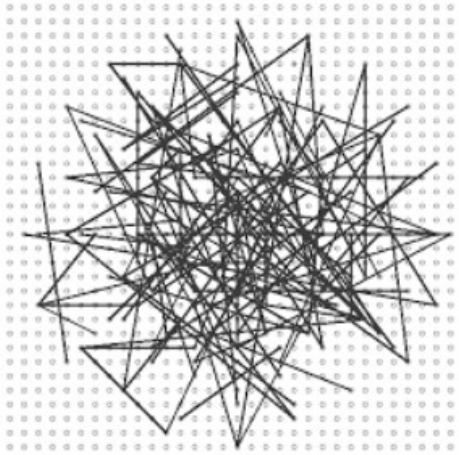
ORB

- oFast detector + r-BRIEF descriptor
  - FAST
    - Determines the corner by having more than N consecutive pixels whose intensities are higher(or lower)
    - 9 consecutive pixels when the radius is 3



ORB

- oFast detector + r-BRIEF descriptor
  - BRIEF
    - A bit string descriptor of an image patch constructed from a set of binary intensity tests



$$Where\ \tau(p;x,y)\ is\ defined\ as:$$

$$\tau(p;x,y) = \begin{cases} 1 & : p(x) < p(y) \\ 0 & : p(x) \geq p(y) \end{cases}$$

$$p(x)\ is\ the\ \text{int}ensity\ value\ at\ pixel\ x.$$

https://medium.com/data-breach/introduction-to-brief-binary-robust-independent-elementary-features-436f4a31a0e6

  - ORB is known to be fast and illumination/rotation-invariant

Image matching

- Image matching by Feature matching
  - Process
    1. Find features in input images by the feature extractor
    2. Describe each feature-by-feature descriptor
    3. Compare the similarity between features in input images
    4. Extract good matchings
  - What is a good matching?
    - A matching between features A and B is good when only A and B are similar
    - Good matching can be estimated by Nearest-Neighbor-Distance Ration(NNDR)

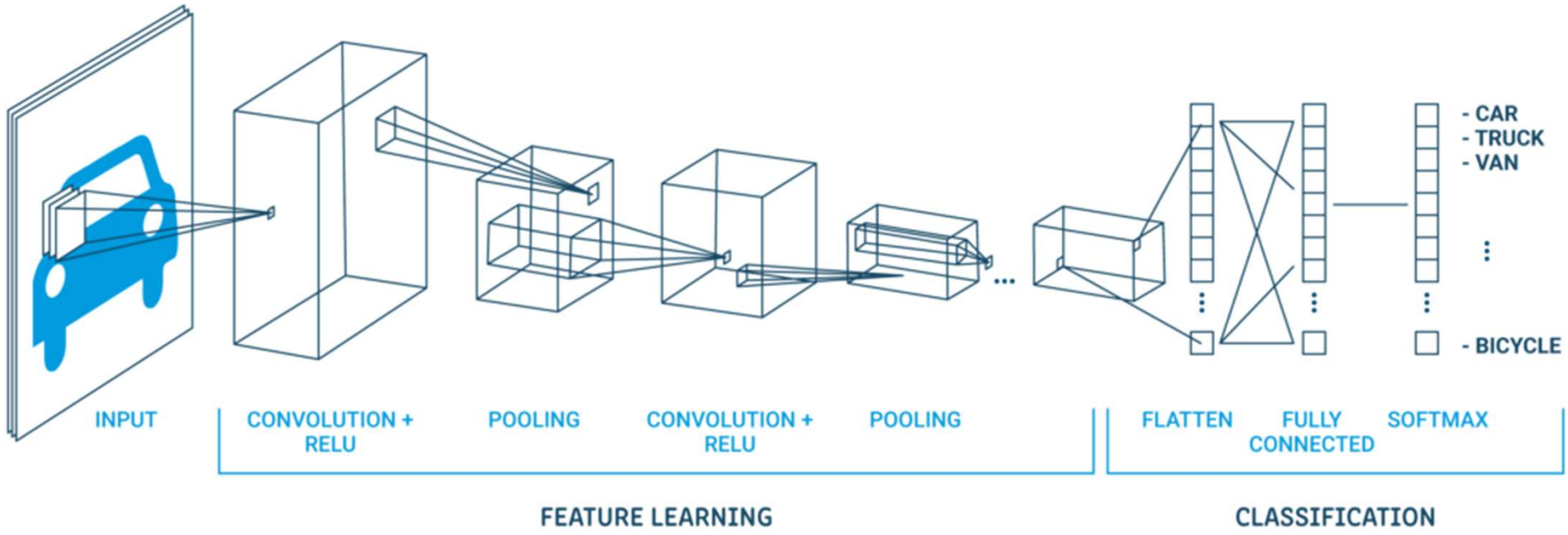
$$NNDR(Nearest\ neighbor\ distance\ ratio)$$

$$= \frac{distance\ to\ best\ match}{distance\ to\ second\ best\ match}$$

Convolutional Neural Network

- The features that were explained before are called hand-crafted features because humans invented them
- Nowadays, features using convolutional neural network(CNN) are widely used

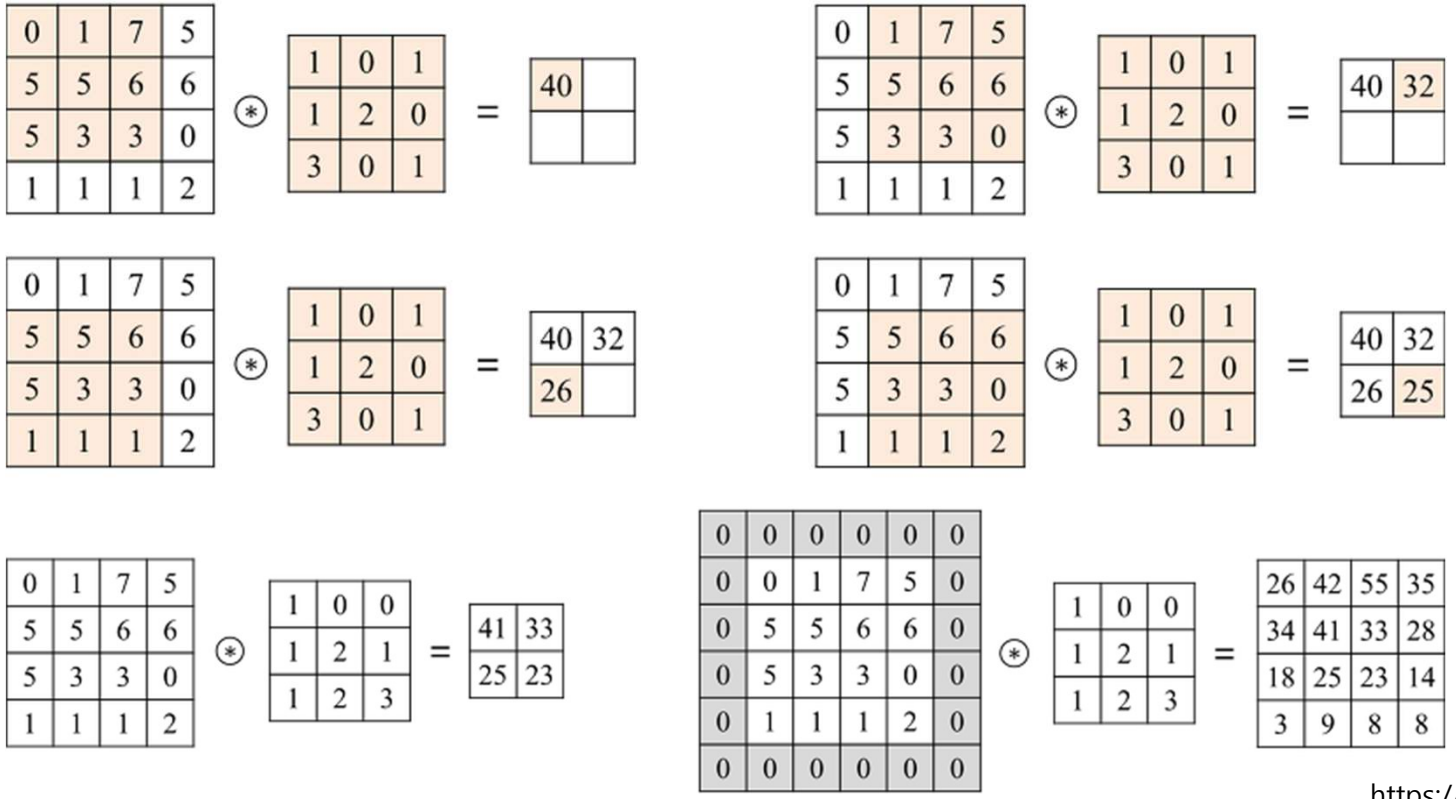
Convolutional Neural Network



https://medium.com/@RaghavPrabhu/understanding-of-convolutional-neural-network-cnn-deep-learning-99760835f148

Convolutional Neural Network

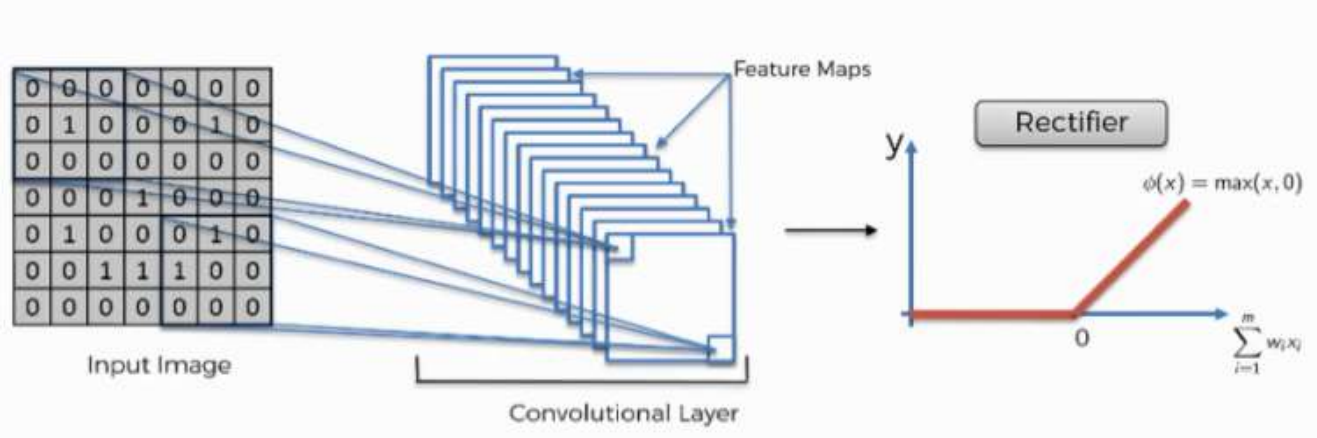
- Convolution



https://untitledtblog.tistory.com/150

Convolutional Neural Network

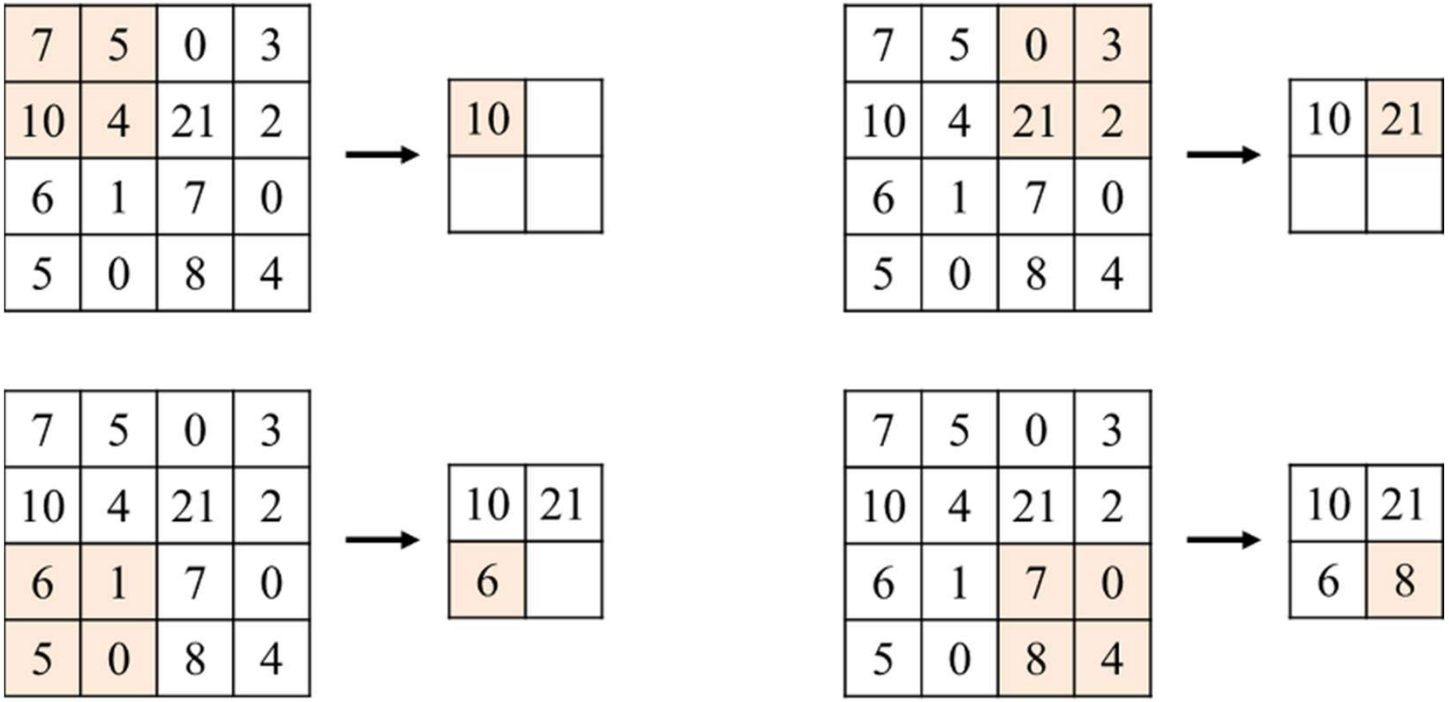
- Relu
  - Relu is a kind of non-linear function, and it is widely used as an activation function in neural network
  - It is to increase the non-linearity in images



https://www.superdatascience.com/blogs/convolutional-neural-networks-cnn-step-1b-relu-layer/

Convolutional Neural Network

- Pooling



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