2、What Is Deep Learning

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hierarchical learning 层学习：where simple concepts are learned in the lower layers and more abstract patterns in the higher layers of the networkm, allows us to completely remove the hand-designed feature extracting process and treat CNNs as end-to-end learners. Each layer in the network uses the output of previous layes as “building blocks”to construct increasingly more abstract concepts. There layers are learned automatically – there is no hand-crafted feature engineering taking place in out network.

神经网络的历史：McCulloch and Pitts (binary classifier) -> Rosenblatt (Perceptron algorithm) -> Rumelhart (backpropagation algorithm) -> LeCun (Convolutional Neural Network)

Filter in lower levels of the network represent edges and corners, while higher level layers use the edges and corners to learn more abstract concepts useful for discriminating between image classes.

Histogram of Oriented Gradients (HOG)用于detecting objects in images.

CNN：instead of hand-defining a set of rules and algorithms to extract features from an image, there features are instead automatically learned from the training process.

the goal of machine learning: computers should be able to learn from experience of the problem they are trying to solve.

There is no consensus amongst experts on exactly what makes a neural network “deep”; however, we know that:

1. Deep learning algorithms learn in a hierarchical fashion and therefore stack multiple layers on top of each other to learn increasingly more abstract concepts.
2. A network should have >2 layers to be considered “deep”
3. A network with >10 layers is considered very deep

3、Image Fundamentals

The origin point (0,0) corresponds to the **upper-left** corner of the images. As we move down and to the right, both the x and y values increase, where we go x columns to the right and y rows down.

OpenCV and scikit-image represent RGB images as multi-dimensional NumPy arrays with shape (height, width, depth).

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| --- |
| 1. **import** cv2 2. img = cv2.imread('example.jpg') 3. **print**(img.shape)  # 图像尺寸为1024\*768，而shape为(768,1024,3) 4. cv2.imshow("Image", img) 5. cv2.waitKey(0) 6. (b, g, r) = img[20, 100] |

aspect ratio: the ratio of the width to the height of the image.

Ignoring the aspect ratio can lead to images that look compressed and distorted. To prevent this behavior, we simple scale the width and height of an image by equal amounts when resizing an image.

Most neural networks and Convolutional Neural Networks applied to the task of image classification assume a fixed size input, meaning that the dimensions of all images you pass through the network must be the same. Common choices for width and height image sizes inputted to Convolutional Neural Networks include 32\*32, 64\*64, 224\*224, 227\*227, 256\*256, and 299\*299.

How are we supposed to preprocess these images?

1. simply ignore the aspect ratio and deal with the distortion
2. resizing the image along its shortest dimension and then taking the center crop.

4、Image Classification Basics

The goal of an image classification system is to take an input image and assign a label to it from our categories set.

In the context of image classification, our dataset is a collection of images. Each image is, therefore, a data point.

have to handle factors of variation: viewpoint variation, scale variation, deformation, occlusion variation, illumination, background clutter (背景杂波), intra-class variation.

canonical adj. 权威的

always consider the scope of your image classifier.