Problem specification

The task to be carried out lies within **Image Classification**. Having one or a collection of images, the goal is to assign a corresponding label for each image so that it identifies an object analyzed in the image.

Valid input for finding a solution requires that an image can represent any single object from a predefined category, multiple objects per image not being allowed. Correct output represents a category, from the predefined set, that the object in the image belongs to.

Data format

The input data is defined by a set of images that have the same width X and height Y and N-bit color depth. An image contains $X \cdot Y$ values in the range of $\{0, 1, \ldots, 2^N - 1\}$.

Training data sets contain an additional string value, the label, for each image. The set of labels is finite and, typically, small. Images and, subsequently, associated labels are related, in the sense that they represent categories of objects from a broad or specific domain, such as: the set of digits, a set of different animal species, a set of car models etc.

The output represents a list of indices for string values from a subset of the input label set, corresponding to the list of images that was fed as input.

Learning problem

The task is a **Supervised Learning** (SL) one, as the data is completely labeled. The learning system uses predictive modelling in attempting to improve over the task of classifying images by learning patterns from already classified images. Its performance is given by minimising the error rate in providing the correct output labels for unlabeled input data.

The target function to be learned is:

$$f : \{0, 1, \ldots, 2^N - 1\}^k \to \{0, 1, \ldots, L - 1\}, k = X \cdot Y, L = |\text{ label set }|$$

$$f(\text{image}) = \text{label index}$$