# Image Processing and Computer Vision

Course Summary

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## 1 Modelling and Image

For coordinates $x_1, x_2, \ldots, x_m$ and colour values $c_1, c_2, \ldots, c_n$, an image encodes a function $f : \mathcal{R}^m \to \mathcal{R}^n$ mapping between these variables, $m$ is the image dimensionality and $n$ is the number of colour channels.

## 2 Convolutions

## 3 Hough Transforms

Given an image $\underset{m \times n}{I}$ and a shape described by $p$ parameters, the Hough transform $H$ is a $p$-dimensional space that maps every possible instance of the given shape to a value indicating its presence in $I$. The process of detecting shapes in images using Hough transforms is to find shapes that have values in the transform greater than some threshold.

### 3.1 Line Detecting

Lines are characteristic of two parameters; the $r$ and $\varphi$ values of the equation $r = x \sin \varphi + y \cos \varphi$. This means the Hough transform for a given image is two-dimensional.

### 3.2 Circle Detecting

### 3.3 Generalised Hough Transform

## 4 Viola-Jones Object Detection

### 4.1 Integral Image

The integral image $\underset{m \times n}{II}$ is a transformation of an image $\underset{m \times n}{I}$ where each entry defined by the following recursive relationship,

$$ii(x, y) = \begin{cases} 0 & \text{if } x \notin [0, n) \text{ or } y \notin [0, m) \\ I_{x,y} + ii(x-1, y) + ii(x, y-1) - ii(x-1, y-1) & \text{otherwise} \end{cases}$$

Through memoization, $II$ is computed in $O(mn)$ time (and $II$ is the resultant memoization table).