

CS354

Nathan Sprague

March 26, 2019

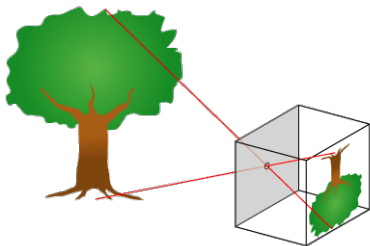
Computer Vision and Image Processing

- Computer Vision:
 - Working backward from an image of a scene to a description of the scene. The description could include:
 - 3D structure
 - Object labels
 - Complex descriptions: "The boy is sneaking up on his mother"
 - All of these are hard.

Computer Vision and Image Processing

- Computer Vision:
 - Working backward from an image of a scene to a description of the scene. The description could include:
 - 3D structure
 - Object labels
 - Complex descriptions: "The boy is sneaking up on his mother"
 - All of these are hard.
- Image processing:
 - Low level image transformations
 - blurring, sharpening, resizing etc.
 - Computer vision generally involves some initial image processing.

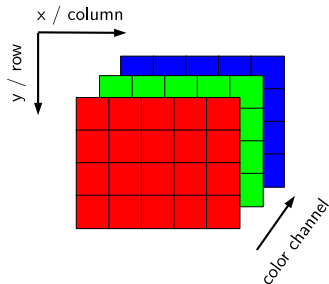
Image Formation



<http://commons.wikimedia.org/wiki/File:Pinhole-camera.png>

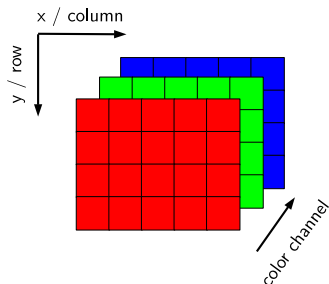
- OpenCV is an old and widely used computer vision library
- Default computer vision library used with ROS
- Written mostly in C++, with Python bindings
- Python OpenCV uses numpy arrays to represent images

Image Representations



- Color images are often stored as a collection of RGB triples
- (0, 0, 0) is black, (255, 255, 255) is white.
- **RGB Color Model**

Images In Numpy



- We will work with images stored as three-dimensional numpy arrays:
 - `img[row, col, color]`
- `img[0, 0, 0]` - Upper-left red value
- `img[3, 4, 2]` - Lower-right blue value
- `img[0:1, 0:2, :]` - Crop of upper left corner

Arithmetic with Images

- Many low level operations on image can be performed either with OpenCV *or* with numpy:
- [OpenCV Arithmetic Tutorial](#)
- By default, images are 8-bit unsigned integers (which can lead to unexpected results.)

Why is Computer Vision Hard?

- Let's look at some balloons...

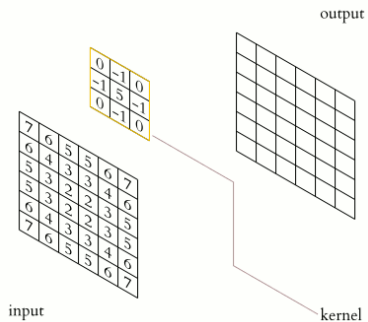
Why is Computer Vision Hard?

- Let's look at some balloons...
- Computer vision is hard (in part) because there is no simple mapping from an object to its pixel-level appearance
- Appearance is influenced by
 - Lighting
 - Viewing angle and distance
 - Camera properties

Image Processing - Convolutions

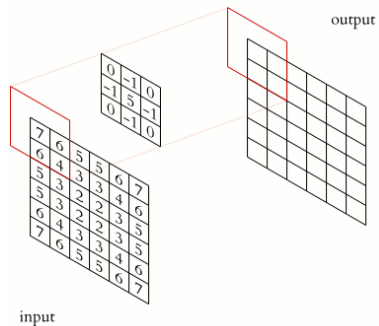
- Many low-level image processing tasks can be handled with the convolution operator:
 - Image Convolutions

Image Processing - Convolution Example



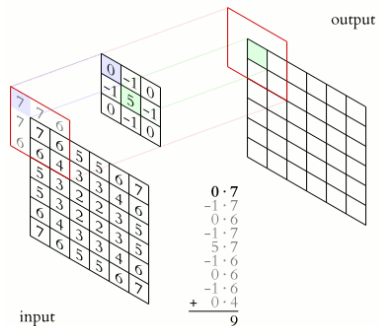
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Image Processing - Convolution Example



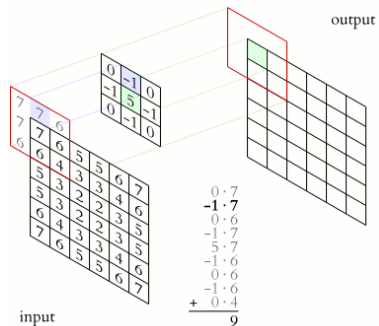
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Image Processing - Convolution Example



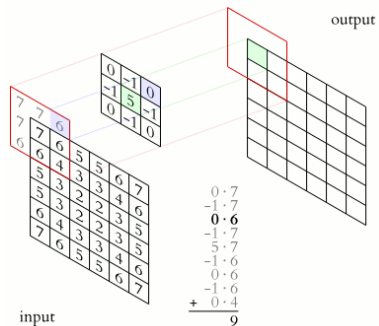
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Image Processing - Convolution Example



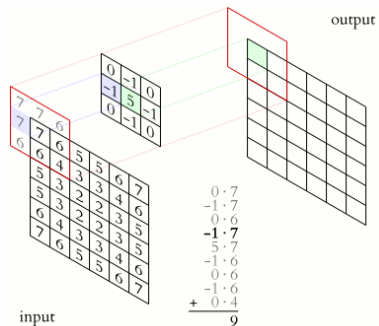
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Image Processing - Convolution Example



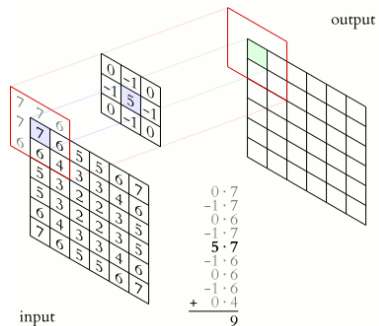
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Image Processing - Convolution Example



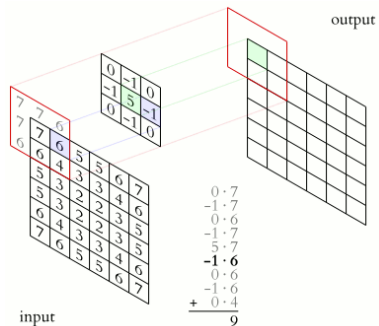
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Image Processing - Convolution Example



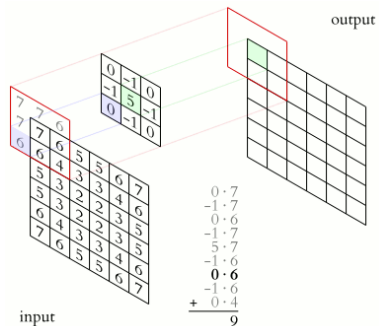
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Image Processing - Convolution Example



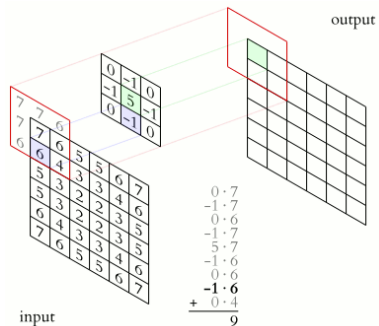
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Image Processing - Convolution Example



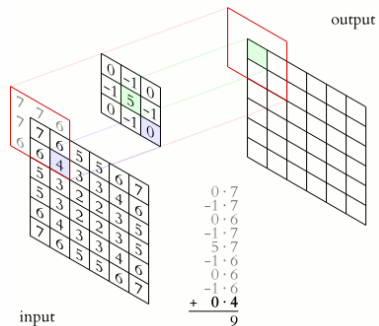
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Image Processing - Convolution Example



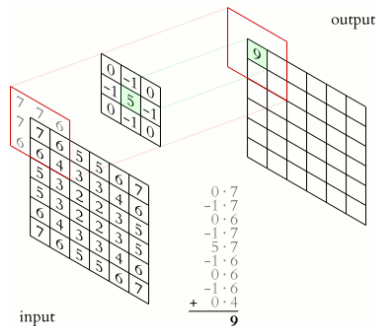
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Image Processing - Convolution Example



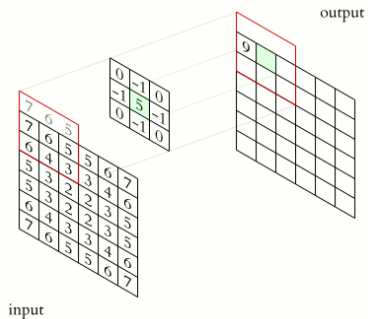
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Image Processing - Convolution Example



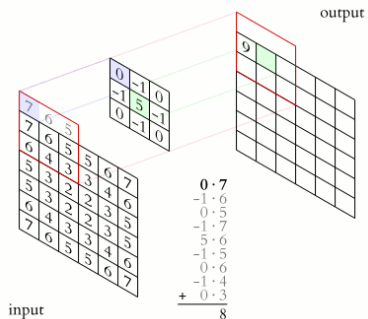
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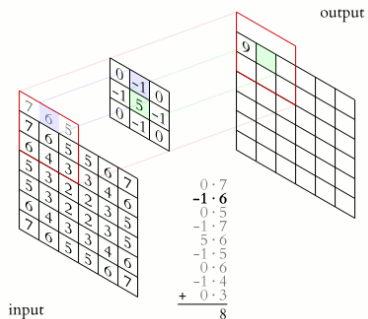
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Image Processing - Convolution Example



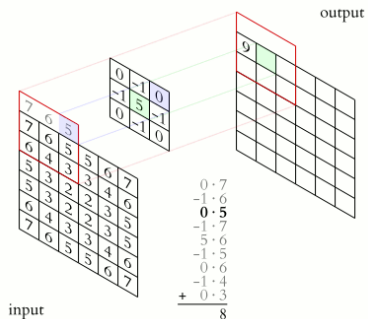
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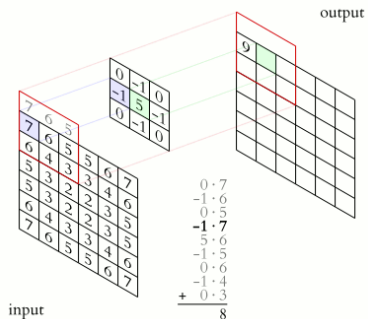
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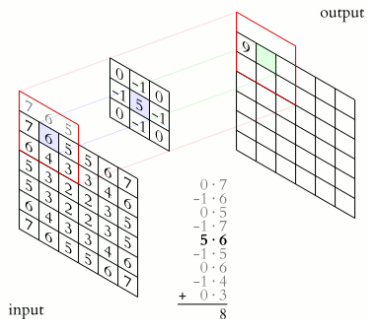
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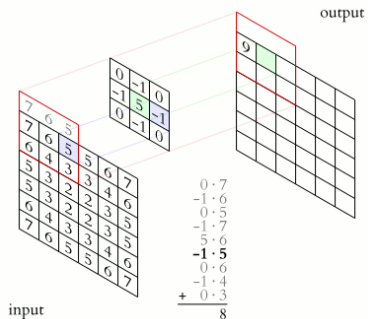
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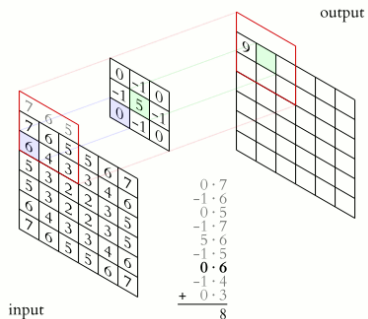
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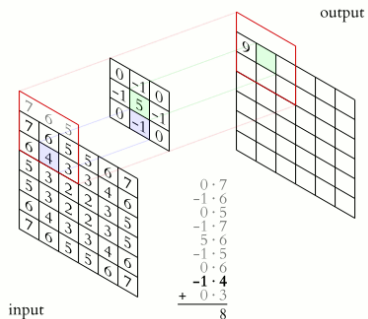
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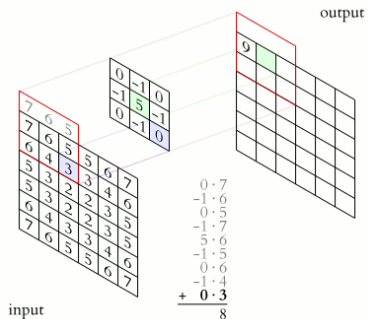
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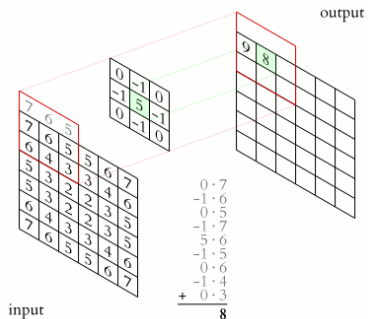
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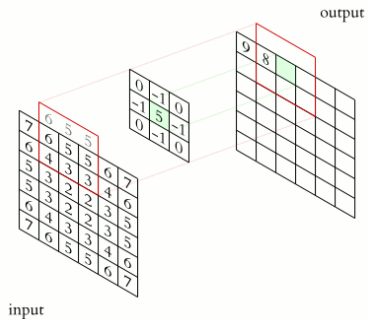
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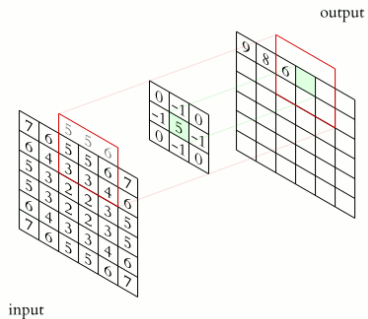
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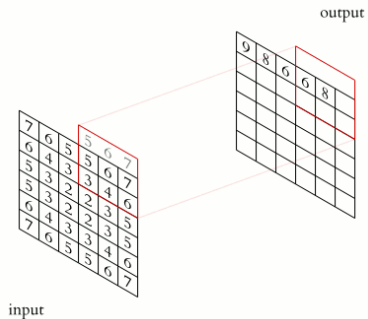
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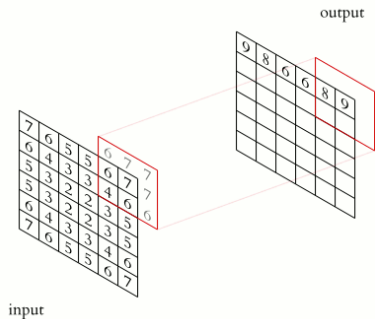
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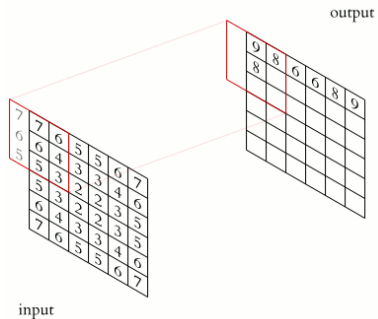
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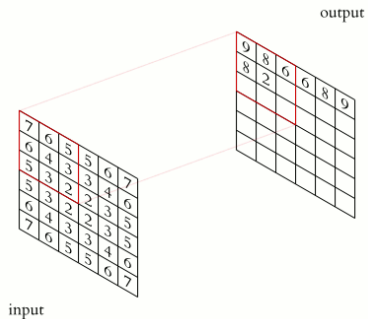
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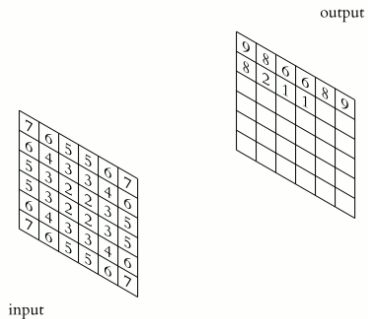
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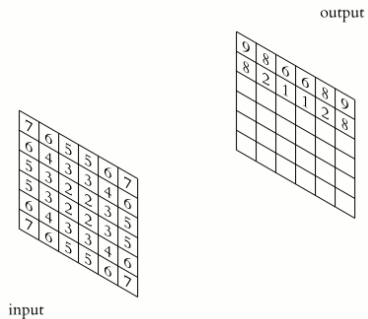
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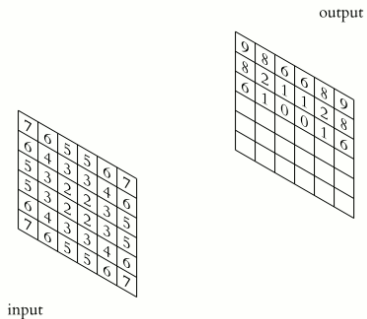
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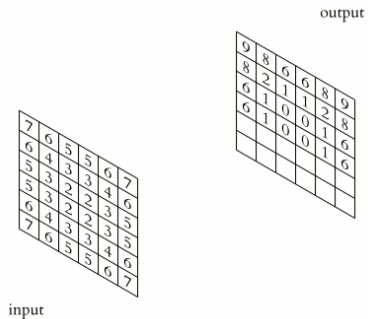
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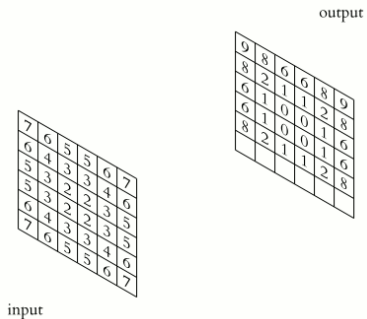
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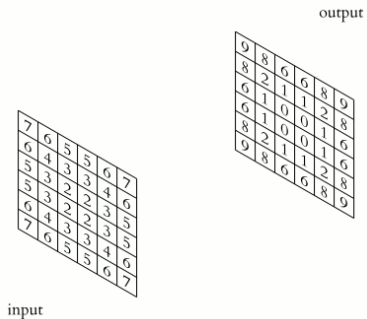
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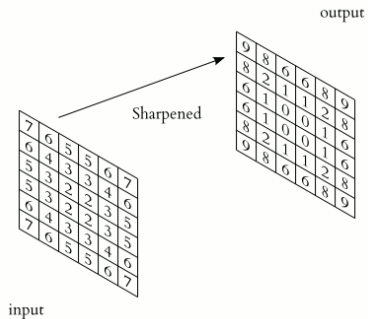
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