Working with images in Python

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Presentation outline

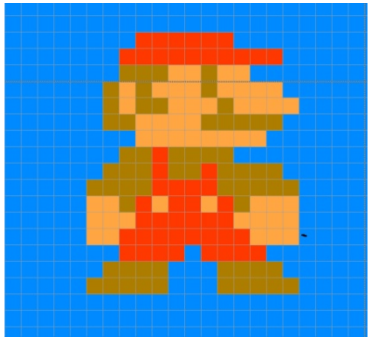
- PIL
- Open/Save images in Python
- Convert images between different formats
- Simple pixel-level manipulations
- Image processing libraries: Mahotas & Scikit-Image

PIL- Python Image Library

- Create, load, modify and convert image files
- Simple filtering and enhancement algorithms
- Supports all common image formats (JPEG, BMP, TIFF, ...)

https://pypi.python.org/pypi/Pillow/2.0.0

Step 1: load/visualize/save an image

Generic code	Example
from PIL import Image	from PIL import Image
original=Image.open("filename")	original=Image.open("test.jpg")
original.show()	original.show()
original.save("destination","filetype")	original.save("mario","png")
	

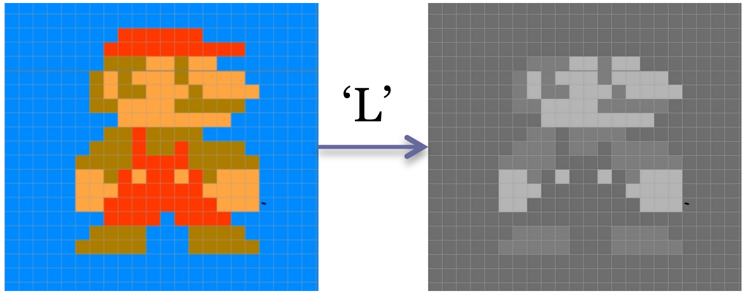
Step 2: format conversion

Generic code

```
from PIL import Image
original=Image.open("filename")

converted_img=original.convert('L')

converted_img.show()
converted_img.save("destination","filetype")
```



The *mode* of an image describes the way it represents colors. Each mode is represented by a string:

Mode	Bands	Description
"1"	1	Black and white (monochrome), one bit per pixel.
"L"	1	Gray scale, one 8-bit byte per pixel.
"P"	1	Palette encoding: one byte per pixel, with a palette of class `ImagePalette` translating the pixels to colors. This mode is experimental; refer to the online documentation[6].
"RGB"	3	True red-green-blue color, three bytes per pixel.
"RGBA"	4	True color with a transparency band, four bytes per pixel, with the A channel varying from 0 for transparent to 255 for opaque.
"CMYK"	4	Cyan-magenta-yellow-black color, four bytes per pixel.
"YCbCr"	3	Color video format, three 8-bit pixels.
"I"	1	32-bit integer pixels.
"F"	1	32-bit float pixels.

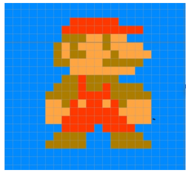
Step 3: import/export to ndarray

Generic code

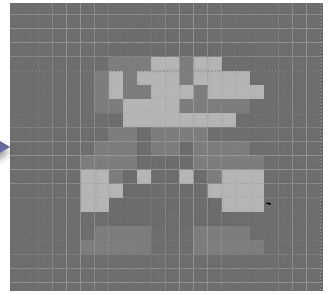
```
from PIL import Image
original=Image.open("filename")
converted_img=original.convert('L')

import numpy as np
ndarr=np.array(converted_img)
imported_img=Image.fromarray(ndarr)

imported_img.show()
imported_img.save("destination","filetype")
```



'L'



np.array

Image.fromarray

```
array([[133, 105, 114, ..., 110, 114, 108],
       [193, 110, 107, ..., 110, 103, 113],
       [131, 109, 110, ..., 111, 115, 106],
       ...,
       [123, 113, 112, ..., 114, 107, 110],
       [202, 114, 107, ..., 108, 114, 113],
       [127, 107, 108, ..., 108, 114, 106]], dtype=uint8)
```

Step 4: low-level pixel manipulation

Simple manipulation

```
from PIL import Image
original=Image.open("filename")
converted_img=original.convert('L')
import numpy as np
ndarr=np.array(converted_img)

ndarr[1:5,1:5]=0

imported_img=Image.fromarray(ndarr)
imported_img.show()
imported_img.save("destination","filetype")
```

Selecting and manipulating pixels below a given threshold

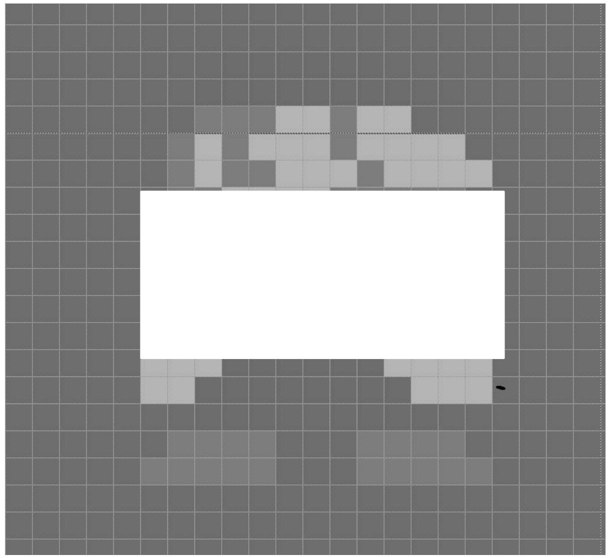
```
from PIL import Image
original=Image.open("filename")
converted_img=original.convert('L')
import numpy as np
ndarr=np.array(converted_img)

threshold=150
ndarr[ndarr<threshold]=0

imported_img=Image.fromarray(ndarr)
imported_img.show()
imported_img.save("destination","filetype")
```

Exercise 1

- Download an image from Internet and load it
- Convert it to gray scale
- Set to 0 all pixels with intensity greater than 150
- Visualize or save the result
- Set to 255 all pixels within a rectangle of arbitrary size at the center of the image



Tip: converting an array of booleans into an image

The trick: convert booleans to integers

from PIL import Image
original=Image.open(“filename”)
converted_img=original.convert(‘L’)
import numpy as np
ndarr=np.array(converted_img)

ndarr=ndarr<100

~~**imported_img=Image.fromarray(ndarr)**~~
ndarr=ndarr.astype(np.uint8)

imported_img=Image.fromarray(ndarr)
imported_img.show()
imported_img.save(“destination”,”filetype”)

Image processing and computer vision in Python

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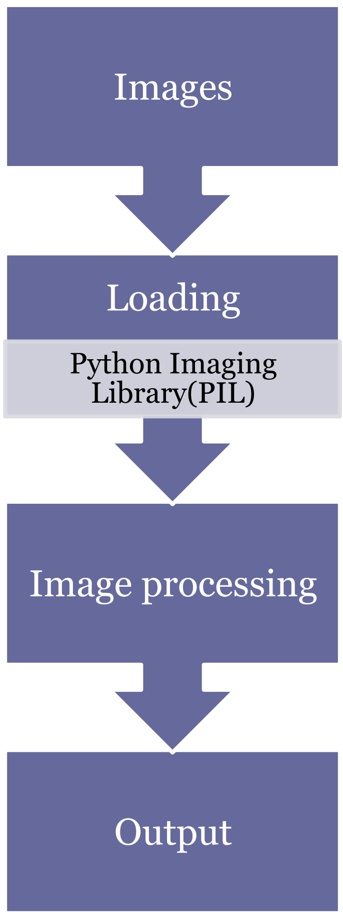
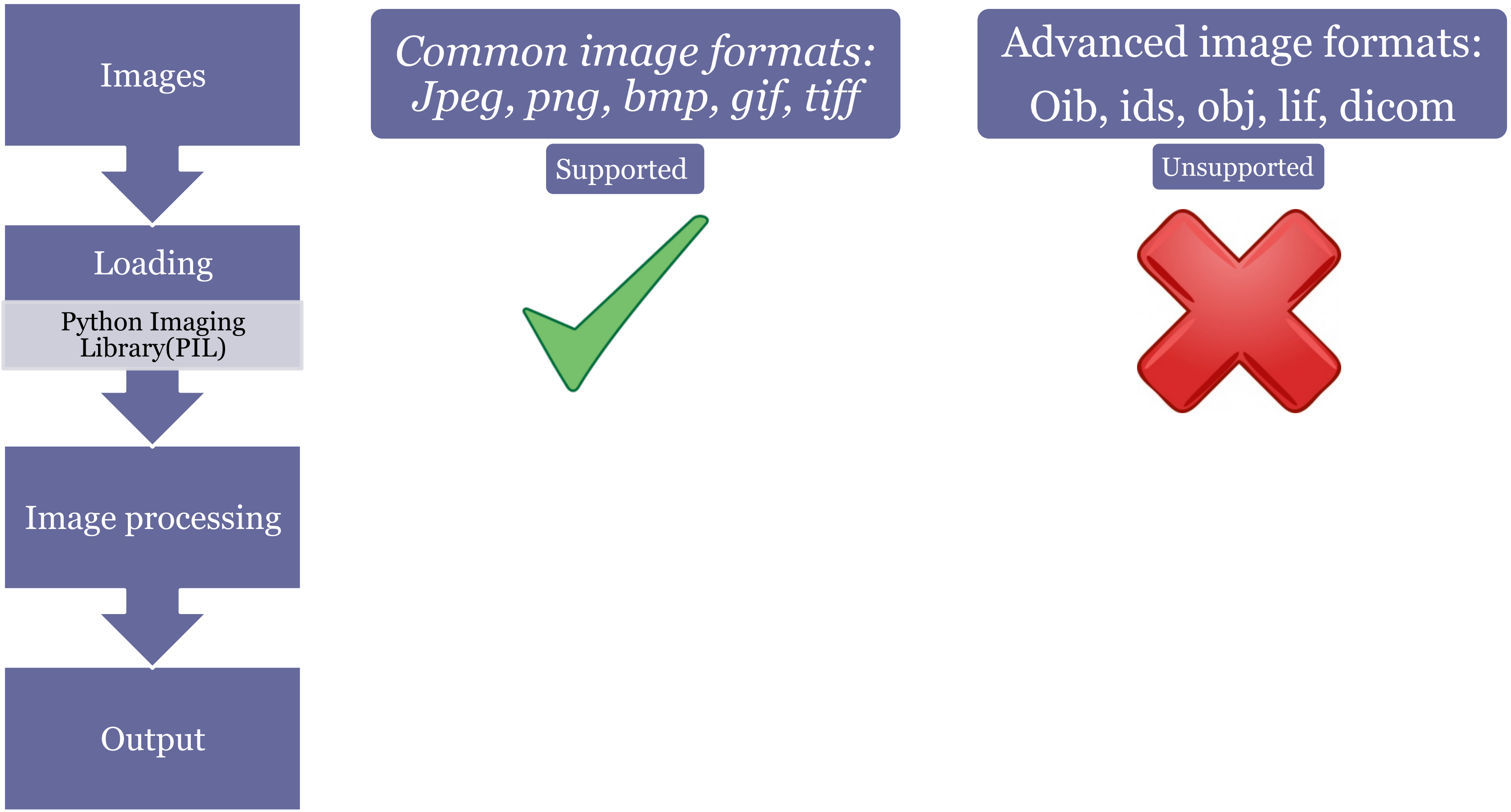
Typical image processing workflow



Formats directly supported by PIL



Importing formats not directly supported

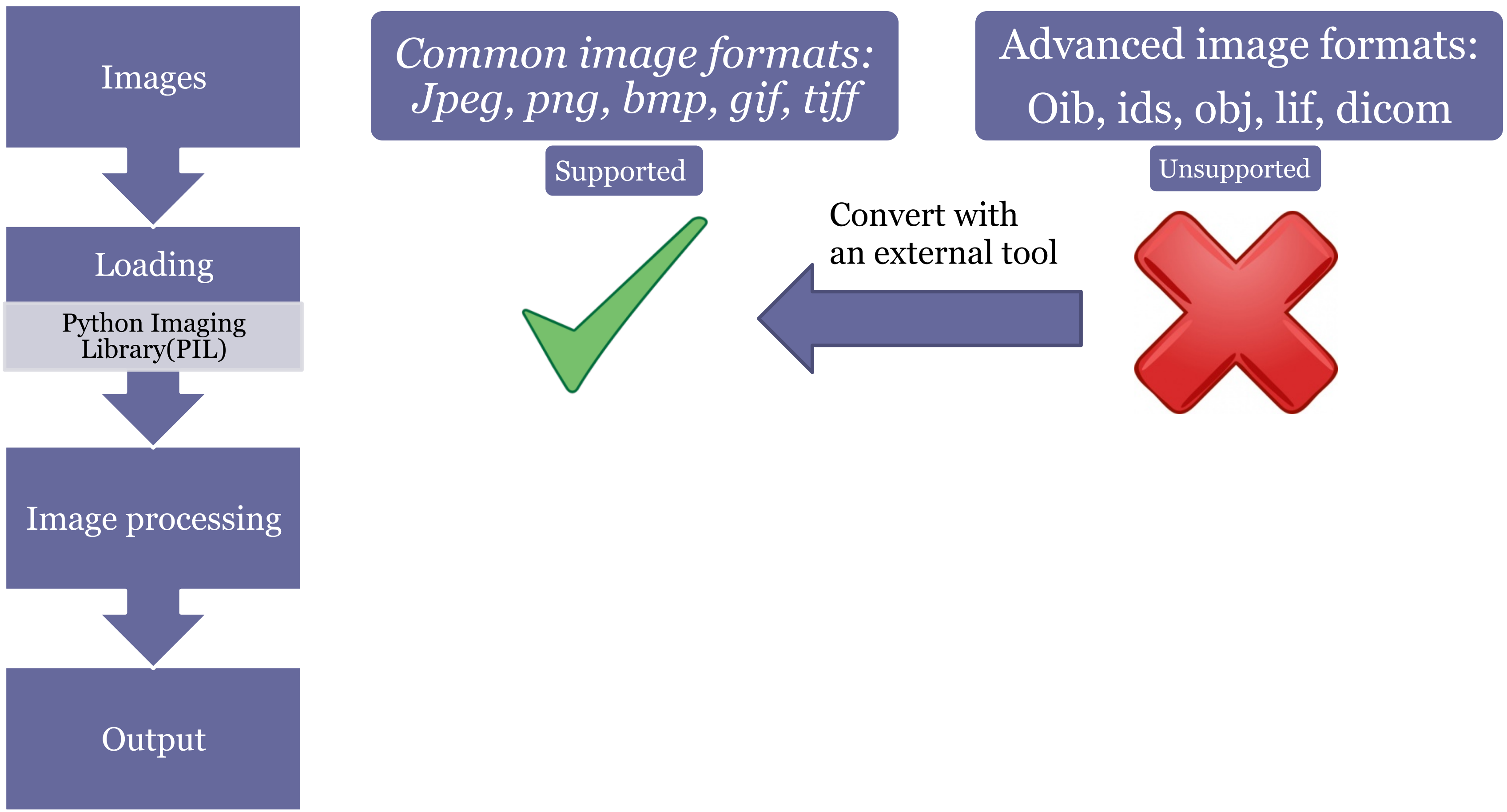
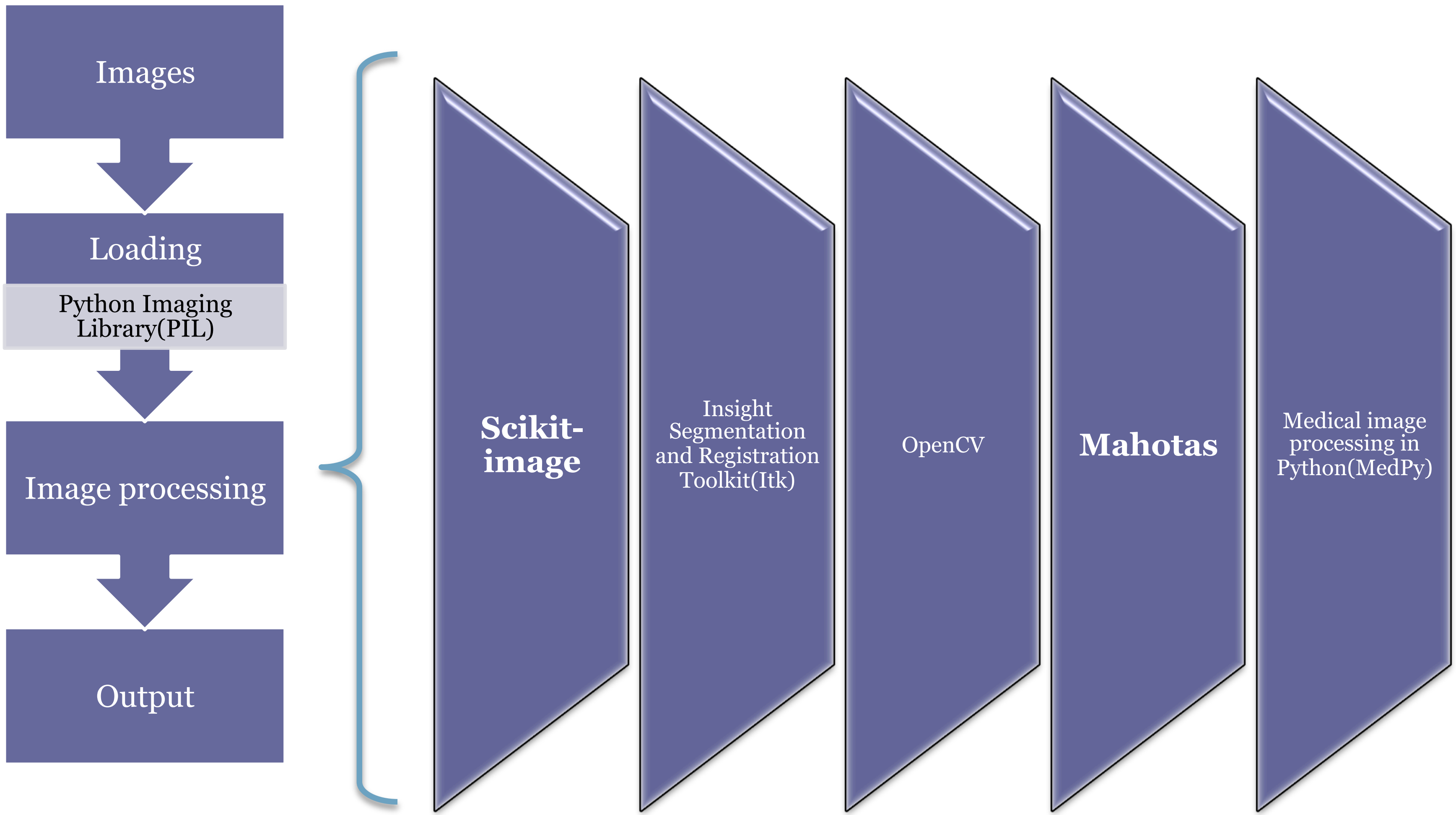


Image processing libraries



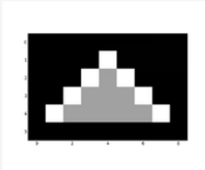
scikit-image
image processing in python

Home Download Gallery Documentation Source

Image processing in Python

scikit-image is a collection of algorithms for image processing. It is available free of charge and free of restriction. We pride ourselves on high-quality, peer-reviewed code, written by an active community of volunteers.

Download

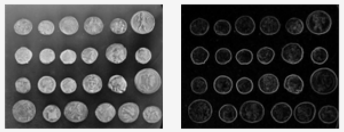


Getting Started

Filtering an image with `scikit-image` is easy! For more examples, please visit our gallery.

```
from skimage import data, io, filter

image = data.coins() # or any NumPy array!
edges = filter.sobel(image)
io.imshow(edges)
```



Mahotas

Python Computer Vision Library

This library of fast computer vision algorithms (all implemented in C++) operates over numpy arrays for convenience.

Notable algorithms:

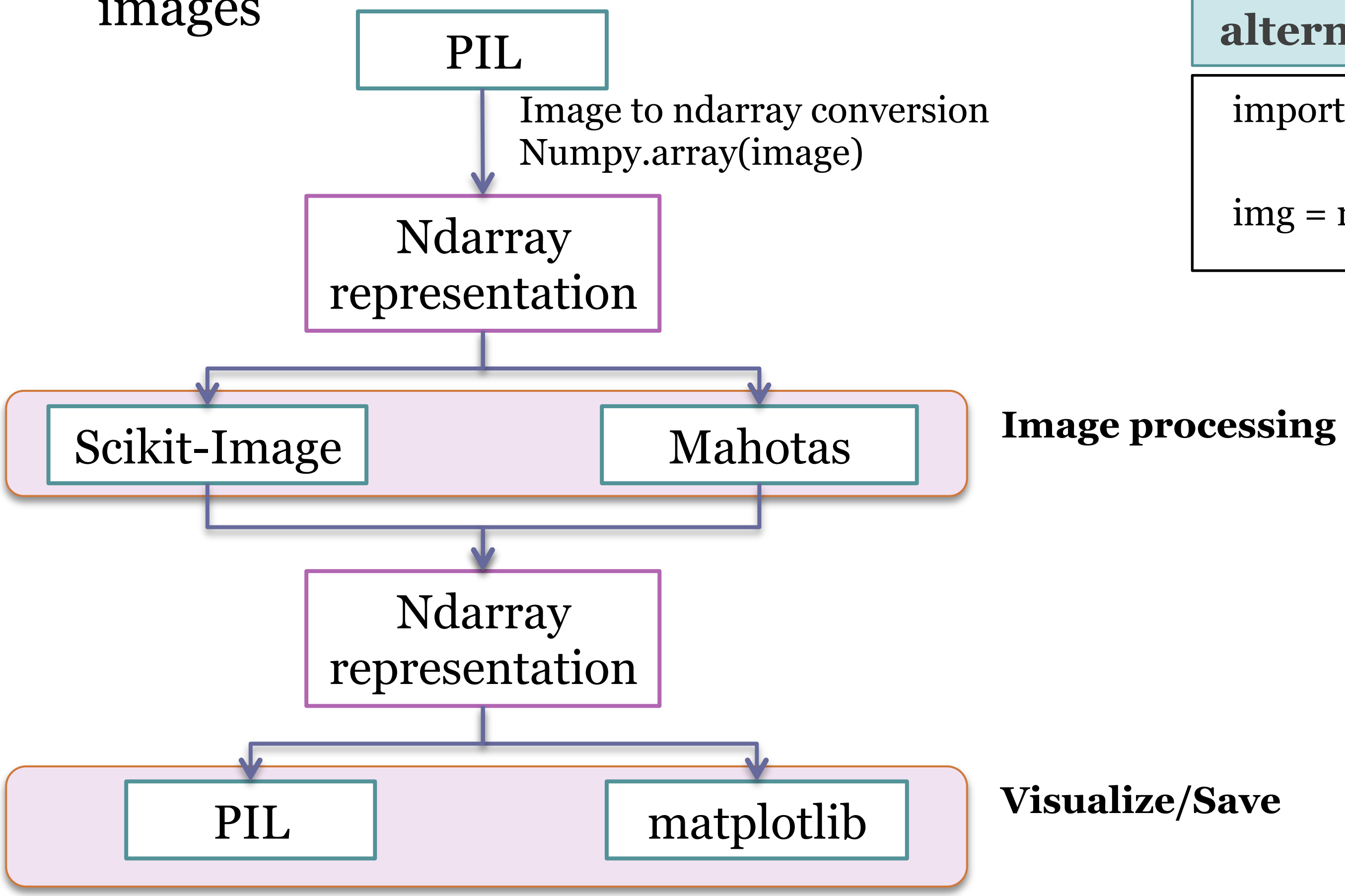
- watershed.
- convex points calculations.
- hit & miss. thinning.
- Zernike & Haralick, LBP, and TAS features.
- freeimage based numpy image loading (requires freeimage libraries to be installed).
- Speeded-Up Robust Features (SURF), a form of local features.
- thresholding.
- convolution.
- Sobel edge detection.
- spline interpolation

http://scikit-image.org/

http://pythonhosted.org/mahotas/api.html

From PIL to Scikit/Mahotas

- Both libraries can work on ndarray representation of images



Loading images: an alternative for mahotas

```
import mahotas

img = mahotas.imread('test.jpg‘)
```

Matplotlib: visualizing ndarray images

Generic code

```
from PIL import Image
import numpy as np

original=Image.open("filename")
converted_img=original.convert('L')
ndarr=np.array(converted_img)

import pyplot
pylab.imshow(tmp)
pylab.show()
```

Directly plot ndarrays

No need to convert back to PIL images

Can plot any type of image (even booleans)

Convolutions with scipy

```
from PIL import Image
import numpy as np

original = Image.open('colored.tif')
bw = original.convert('L')
bw.show()

import scipy.ndimage

tmp = numpy.array(bw)

kernel = np.array([[1.0/9,1.0/9,1.0/9],[1.0/9,1.0/9,1.0/9],[1.0/9,1.0/9,1.0/9]])

tmp = scipy.ndimage.filters.convolve(tmp, kernel)

tmpimage = Image.fromarray(tmp)

tmpimage.show()
```

Median filter with Scikit-image

```
from PIL import Image
import numpy as np

original = Image.open('easy.tif')
bw = original.convert('L')
bw.show()
tmp = numpy.array(bw)


from skimage import filter

processed_ndarr = filter.median_filter(tmp) # median filter

temp = Image.fromarray(processed_ndarr)

temp.show()
```

Otsu with Mahotas

```
from PIL import Image
import numpy as np

original = Image.open('colored.tif')
bw = original.convert('L')
bwarray = numpy.array(bw)

import mahotas

threshold = mahotas.otsu(bwarray)

bwarray[bwarray<threshold] = 0

bwarray[bwarray>=threshold] = 255

img_bw_thresholded = Image.fromarray(bwarray)
img_bw_thresholded.show()
bw.show()
```