Introduction to Programming for Scientists

Lecture 6

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```
class TwoColMatrix(list):
    """ A class based on inner class: List."""
    def __init__(self, infile):
        try:
            self.data = open(infile).read().split(None)
        except:
            print 'Input Data Reading Error!'
        self.data = [float(i) for i in self.data]

    def write(self, outfile):
        try:
            output = open(outfile, 'w')
        except:
            print 'Output File Opening Error!'

        for i in range(len(self.data)):
            if i%2 == 0: output.write(str(self.data[i]) + '\t')
            else: output.write(str(self.data[i]) + '\n')

        output.close()

    def Y_hist(self):
        value = self.data[1::2]
        histogram.hist(value)

    def Y_multiply(self, constant):
        new = []
        for i in range(len(self.data)):
            if i % 2 == 1: new.append(self.data[i] * constant)
            else: new.append(self.data[i])
        self.data = new
```

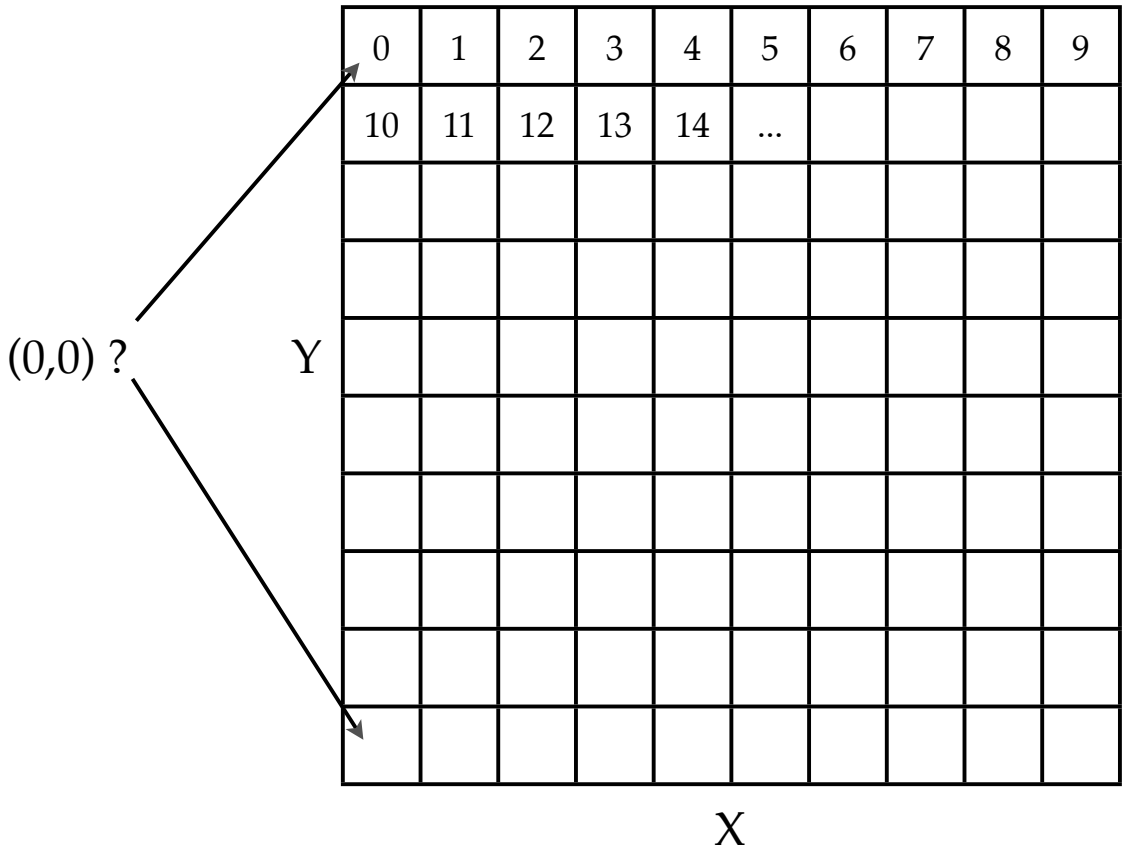
Arrays

- Efficient storage of many objects of the same type
- from array import array
- x=array(type,initializer)

Type code	C Type	Python Type	Minimum size in bytes
'c'	char	character	1
'b'	signed char	int	1
'B'	unsigned char	int	1
'u'	Py_UNICODE	Unicode character	2
'h'	signed short	int	2
'H'	unsigned short	int	2
'i'	signed int	int	2
'I'	unsigned int	long	2
'l'	signed long	int	4
'L'	unsigned long	long	4
'f'	float	float	4
'd'	double	float	8

Images

Pixel stored at location x+nx*y (row major)
or y+ny*x (column major, less common)



Color Images

Interleaved, 3x3 image, row-major

R	G	B	R	G	B	R	G	B
R	G	B	R	G	B	R	G	B
R	G	B	R	G	B	R	G	B

Planar, 3x3 image, row-major

R	R	R
R	R	R
R	R	R
G	G	G
G	G	G
G	G	G
B	B	B
B	B	B
B	B	B

PIL - Image Modes

- 1 (1-bit pixels, black and white, stored with one pixel per byte)
- L (8-bit pixels, black and white)
- P (8-bit pixels, mapped to any other mode using a colour palette)
- RGB (3x8-bit pixels, true colour)
- RGBA (4x8-bit pixels, true colour with transparency mask)
- RGBX (3x8-bit pixels, true colour with padding byte)
- CMYK (4x8-bit pixels, colour separation)
- YCbCr (3x8-bit pixels, colour video format)
- I (32-bit signed integer pixels
- F (32-bit floating point pixels)

HDR Imaging

PIL - File Formats*

Fmt	Bits	Loss	Cmpr	Notes
BMP	8 or less			
GIF	8 total, cmap		X	
IM	all modes !			LabEye & IFUNC
JPEG	8	X	X	
PCX	8 or less			
PNG	8		X	
PPM	8			PBM,PGM,PPM
TIFF	8	R	R	
EPS				Needs GS to read most
PDF				Write only

* - The most common ones

PIL

- from PIL import Image
- im=Image.open("file.jpg")
- data="\0"*(128*128*4) # string of zero pixels
- data=array("c",data) # convert to an array object
- im=Image.frombuffer("RGBX",(128,128),data)
- im=Image.frombuffer("RGBX",(128,128),data,"raw","RGBX",0,1)
- im.show() # machine specific display
- pix=im.load() # for pixel access
- pix[x,y] # access pixel at x,y
- im.save(filename,[format],[options])

PIL

- im2=im.crop(x0,y0,x1,y1) # a cropped version of im
- im2=im.filter(filt) # various filters
- im2=im.histogram() # compute histogram as list
- im.paste(im2,(x0,y0,x1,y1)) # paste one image into another
- im2=im.resize((w,h),filt) # NEAREST, BILINEAR, TRILINEAR, ANTIALIAS
- im2=im.rotate(angle)
- im2=im.thumbnail(maxsize,ANTIALIAS)
- im2.transpose(meth) # FLIP_LEFT_RIGHT, FLIP_TOP_BOTTOM, ROTATE_90, ROTATE_180, or ROTATE_270

PIL

- ImageChops - invert(a), lighter(a,b), darker(a,b), add(a,b), subtract (a,b), difference(a,b), screen(a,b)
- ImageDraw
  - a=Image.new("RGBA",(128,128))
  - draw=ImageDraw.Draw(a)
  - draw.line((x0,y0,x1,y1),fill="red"), point, rectangle, arc, chord, ellipse, text
- ImageFilter - BLUR, CONTOUR, DETAIL, EDGE_ENHANCE, EDGE_ENHANCE_MORE, EMBOSS, FIND_EDGES, SMOOTH, SMOOTH_MORE, SHARPEN
- etc.

PIL Attributes

- im.format
- im.mode
- im.size
- im.info

Homework 6

1. Write a program to read all of the JPEG images in the current directory, do something interesting to each (change it's size, filter it, etc.), and write it back to disk in PNG format. Just send me the program, not the images.

2. Tell me what you plan to do for your class project. Remember the sole requirement is that the project do something 'useful'. I will let you know if I think it's over/under ambitious.

3. Install SciPy on your laptop (www.scipy.org) and numpy if you don't already have it (import numpy to check).