Algorithmic Approaches for Biological Data, Lecture #12

Katherine St. John

City University of New York American Museum of Natural History

2 March 2016

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• File Overview:

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- File Overview:
 - Standard I/O

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- File Overview:
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 - CSV reader

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• File Overview:

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- matplotlib's imread()

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- File Overview:
 - Standard I/O
 - CSV reader
 - matplotlib's imread()
 - The urllib reader

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Image: A math a math



- File Overview:
 - Standard I/O
 - CSV reader
 - matplotlib's imread()
 - The urllib reader
- Structured Data files: CSV, PNG (Image), SQL, FASTA & friends

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Standard File Input/Output

infile.	txt
Hello	!
This	is
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Image: A math a math

Standard File Input/Output



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• Text files are multi-lined strings.

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- Text files are multi-lined strings.
- \bullet Lines are indicated by '\n' characters.

• Opening a file:



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 Opening a file: infile = open('data.txt', 'r')



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• Opening a file: infile = open('data.txt', 'r') outfile = open('log.txt', 'w')



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 - infile.read(): reads the entire file into a single string.

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- Writing to a file: outfile.write(s)

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7	DOT 98 SKE	L Ceyx lepidus Solorr	on Isla New G	eorgia Vella Lavella	Oula River	camp			07 47 30 S	156 37 30 E	Paul R. Swee	8-May 04		PRS-269
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 - rows separated by new lines ('\n')
- Rows look like:

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• Built-in package for reading CSV files. To use it:

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2	DOT 84 FLU	II Ceyx lepidus	Solomon Isl	a New Ger	irgia Vella Lave	la Oula Riv	er camp			07.47	30.5	156 37 30 E	Paul R. Swee	7-May-04		PRS-267
3	DOT 85 SKE	L Ceyx lepidus	Solomon Isl	a New Ger	irgia Vella Lave	la Oula Riv	er camp			07.47	30.5	156 37 30 E	Paul R. Swee	6-May-04		PRS-261
-4	DOT 92 SKE	L Ceyx lepidus	Solomon Isl	a New Ger	irgia Vella Lave	la Oula Riv	er camp			07.47	30 S	156 37 30 E	Paul R. Swee	7-May-04		PRS-26
S	DOT 93 SKE	L Alcedo atthe	Solomon Isl	a New Ger	irgia Vella Lave	la Oula Riv	er camp			07.47	30 S	156 37 30 E	Paul R. Swee	6-May-04		PRS-26
6	DOT 95 SKE	L Alcedo atthe	Solomon Isl	a New Ger	rgia Vella Lave	la Oula Riv	er carrip			07 47	30 S	156 37 30 E	Paul R. Swee	5-May-04		PRS-263
7	DOT 98 SKE	L Ceyx lepidus	Solomon Isl	a New Ger	rgia Vella Lave	la Oula Riv	er carrip			07 47	30 S	156 37 30 E	Paul R. Swee	8-May-04		PRS-265
8	DOT 102 FU	U Ceyx lepidus	Solomon Isl	a New Ger	rgia Vella Lave	la Oula Riv	er carrip			07 47	30 S	156 37 30 E	Paul R. Swee	5-May-04		PRS-264
9	DOT 104	Todiramphu	Solomon Isl	a New Ger	rgia Vella Lave	la Oula Riv	er carrp			07 47	30.5	156 37 30 E		4-May-04		PRS-263
10	DOT 109	Alcedo atthis	Solomon Isl	a New Cer	reia Vella Lavel	a Oula Rh	er carro			07.47	30.5	156 37 30 E		6-May-04		PRS-265
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8	DOT 102 FL	U Ceyx lepidus	Solomon Is	a New Geo	rgia Vella Lavei	la Oula R	ver carrp				07 47	30 S	156 37 30 E	Paul R. Swee	S-May-04		PRS-264
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-4	DOT 92 SKE	L Ceyx lepidus	Solomon Is	a New Geo	rgia Vella Lave	la Oula R	ver carrip				07.47	30 S	156 37 30 E	Paul R. Swee	7-May-04		PRS-267
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s	DOT 93 SKE	L Alcedo atth	k Solomon Isla	New Geo	rgia Vella Lavel	a Oula Ri	ver camp				07.47	30 S	156 37 30 E	Paul R. Swee	6-May 04		PRS-26
6	DOT 95 SKE	L Alcedo atth	is Solomon Isla	a New Geo	rgia Vella Lavell	a Oula Ri	ver camp				07 47	30 S	156 37 30 E	Paul R. Swee	5-May-04		PRS-26
	DOT 98 SKE	L Ceyx lepidu	s Solomon Isla	a New Geo	rgia Vella Lavell	a Oula Ri	ver carrip				07 47	30.5	156 37 30 E	Paul R. Swee	8-May-04		PRS-26
8	DOT 102 FI	U Ceyx lepidu	s Solomon Isla	a New Geo	rgia Vella Lavell	a Oula Ri	ver carrip				07 47	30.5	156 37 30 E	Paul R. Swee	5-May-04		PRS-26
9	DOT 104	Todiramph.	solomon Isla	a New Geo	rgia Vella Lavell	a Oula Ri	ver carrip				07.47	30.5	156 37 30 E		4-May-04		PRS-26
10	DOT 109	Alcedo atth	is Solomon Isla	a New Geo	rgia Vella Lavell	a Oula Ri	ver carrip				07.47	30.5	156 37 30 E		6-May-04		PRS-26
	007116	Constant Pro-	Colores to be	Marriel Care	sale Malle Local	- O-1+ B					07.47	35.6	166 37 30 6		7.24		086.36

- At top of file, include: import csv
- Open the file normally: f = open("in.csv", "rU") "rU" avoids errors with different newlines, and accepts all variants.
- Create a reader: reader = csv.DictReader(f) Uses column names in first line of csv file to access row data.
- Read in lines from reader: for row in reader:
- To access individual entries in a row:

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2	DOT 84 FUL	II Ceyx lepidu	s Solomon Isla	New Geo	ingia Vella Lavell	a Oula R	ver carro				07.47	30.5	156 37 30 E	Paul R. Swee	7-May-04		PRS-26
3	DOT 85 SKI	L Ceyx lepidu	s Solomon Isla	New Geo	risia Vella Lavell	a Oula R	ver carro				07 47	30.5	156 37 30 E	Paul R. Swee	6-May-04		PRS-26
4	DOT 92 SK	L Ceyx leoidu	s Solomon Isla	New Geo	risia Vella Lavell	a Oula R	ver carro				07 47	30.5	156 37 30 E	Paul R. Swee	7-May-04		PRS-26
s	DOT 93 SKE	L Alcedo atth	k Solomon Isla	New Geo	rgia Vella Lavel	a Oula Ri	ver camp				07.47	30 S	156 37 30 E	Paul R. Swee	6-May 04		PRS-26
6	DOT 95 SKE	L Alcedo atth	is Solomon Isla	a New Geo	rgia Vella Lavell	a Oula Ri	ver camp				07 47	30 S	156 37 30 E	Paul R. Swee	5-May-04		PRS-26
	DOT 98 SKE	L Ceyx lepidu	s Solomon Isla	a New Geo	rgia Vella Lavell	a Oula Ri	ver carrip				07 47	30.5	156 37 30 E	Paul R. Swee	8-May-04		PRS-26
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- Create a reader: reader = csv.DictReader(f) Uses column names in first line of csv file to access row data.
- Read in lines from reader: for row in reader:
- To access individual entries in a row: if "Malaysia" in row['COUNTRY']: ...



• CSV: comma separated values



• CSV: comma separated values

• FASTA: sequence data > Rosalind.1289 ACGTTTAATTATATAAAA > Rosalind.1988 GCGAAGGTATTTGGSAAAA

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- CSV: comma separated values
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 Portable Network Graphics (PNG): stores images pixel by pixel.

Image: Image:

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- CSV: comma separated values
- FASTA: sequence data > Rosalind.1289 ACGTTTAATATATAAAA > Rosalind.1988 GCGAAGGTATTTGGSAAAA

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- Portable Network Graphics (PNG): stores images pixel by pixel.
- Structured Query Language (SQL): used to access/modify relational databases.

Color By Numbers...









• Images are a grid of pixels.

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Color By Numbers...









- Images are a grid of pixels.
- Can access color value for pixel (row, col): print "Red: ", img[row,col,0]
 print "Green:", img[row,col,1]
 print "Blue: ", img[row,col,2]

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Color By Numbers...









- Images are a grid of pixels.
- Can access color value for pixel (row, col): print "Red: ", img[row, col,0] print "Green:", img[row, col,1] print "Blue: ", img[row, col,2]
 Challenges: manipulate images, pixel by pixel.

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Code Review



```
#Sample image processing file for BridgeUp: STEM
#Assumes a input file called: bfl.png is in the same directory
import matplotlib.pyplot as plt #Import plotting and numbers libraries
import numpy as np
img = plt.imread('bf1.png')
                              #Read in first butterfly image
plt.imshow(img)
                              #Load image into matplotlib
plt.show()
                              #Open window to show image (close to continue
height = img.shape[0]
width = img.shape[1]
newImg = np.zeros((height,width,3))
for i in range(height):
     for j in range(width):
          newImg[i,j,0] = img[i,j,0]
                                      #Line to change!
          newImg[i,j,1] = 0
          newImg[i, j, 2] = 0
plt.imshow(newImg)
plt.show()
plt.imsave('roque.png', newImg)
```

Ln: 24 Col: 0

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Code Review



K. St. John (CUNY & AMNH)

Algorithms #12

2 March 2016 10 / 13







• Display the green channel, the blue channel, and in black and white.







- Display the green channel, the blue channel, and in black and white.
- Starting with a monochromatic butterfly (e.g. bflyBlue.png), display only the butterfly.







- Display the green channel, the blue channel, and in black and white.
- Starting with a monochromatic butterfly (e.g. bflyBlue.png), display only the butterfly.
- Make a white butterfly appear purple (e.g. bflyGreen.png).







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- Starting with a monochromatic butterfly (e.g. bflyBlue.png), display only the butterfly.
- Make a white butterfly appear purple (e.g. bflyGreen.png).
- Display the image upside down.







- Display the green channel, the blue channel, and in black and white.
- Starting with a monochromatic butterfly (e.g. bflyBlue.png), display only the butterfly.
- Make a white butterfly appear purple (e.g. bflyGreen.png).
- Display the image upside down.
- Subtract two similar images and display pixels that differ by more than 30%.



• Using matplotlib & numpy in lab today.

Image: A match a ma

3. 3



- Using matplotlib & numpy in lab today.
- Email lab reports to kstjohn@amnh.org



- Using matplotlib & numpy in lab today.
- Email lab reports to kstjohn@amnh.org
- Challenges available at rosalind.info