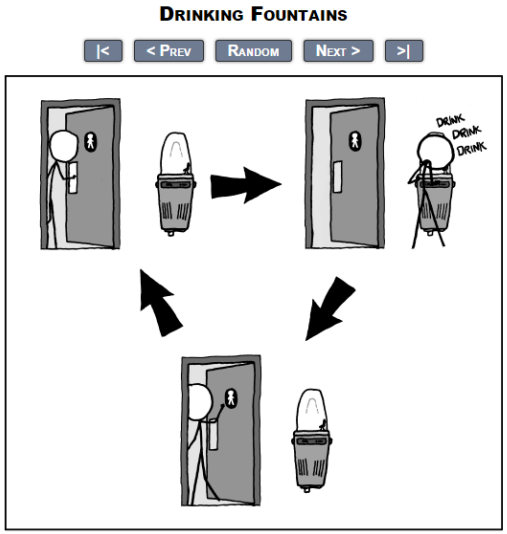
CompSci 101
Introduction to Computer Science

Oct. 25 , 2016

Prof. Rodger

from xkcd



Grace Hopper Celebration of Women in Computing Conference

Latanya Sweeney

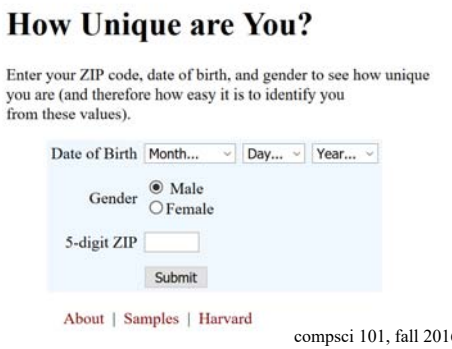
Chief Technologist at FTC. I am a computer scientist with a long history of weaving technology and policy together to remove stakeholder barriers to technology adoption. My focus is on "computational policy" and I term myself a "computer (cross) policy" scientist. I have enjoyed success at creating technology that weaves with policy to resolve real-world technology-privacy clashes.

http://latanyasweeney.org/

Identify 87% of US population using (dob,zip,gender). Director of Harvard Data Privacy Lab, instrumental in HIPAA because of *de-identification* work

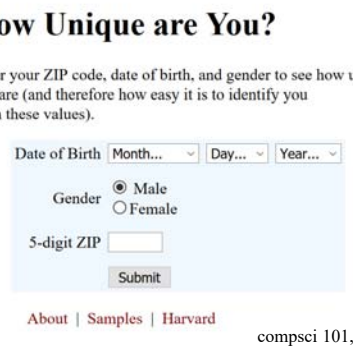
aboutmyinfo.org

- Entered my data



aboutmyinfo.org

- Entered my data
- Easily identifiable by birth date (about 1)
- Lots with my birth year (about 273)
- Lots of people in my age range (of four years) – (1,365)



Announcements

- Reading and RQ14 due next time
- Assignment 5 due Thursday
- APT 5 due today, APT 6 out

- This week:
  - Nested loops, tuples, images and more with sets

Problem: Given list of words, find word with most vowels

- Example:
  - Given [‘dog’, ‘cat’, ‘gerbil’, ‘elephant’]
  - ‘elephant’ has 3 vowels, the most
- To solve – nested loops:
  - Loop over words in list
    - For each word: Loop over characters in word

Bit.ly/101f16-1025-1

```
def wordWithMostVowels(words):
    maxcnt = 0
    maxword = ""
    cnt = 0
    for word in words:
        for letter in word:
            if isVowel(letter):
                cnt += 1
        if cnt > maxcnt:
            maxcnt = cnt
            maxword = word
    return maxword
```


Problem 2 – Given two lists of names, print a list of pairs of names in which the two names are the same length

- A = [‘mo’,’ted’,’bill’]
- B = [‘billie’, ‘jes’, ‘bo’]

mo, bo

ted jes

- To solve
  - for name in A:

    for name in B:

    Check length

    print pair

bitly/101f16-1025-2

```
for aname in A:
    for bname in B:
        if len(aname) == len(bname):
            print aname + ", " + bname
print
for bname in B:
    for aname in A:
        if len(aname) == len(bname):
            print aname + ", " + bname
```


Tuples

- Like a list, but cannot change them
  - Define them with “,”

    (5, 7, 8) or 5, 7, 8
- Use most list operations on them
  - they are a type of list
  - But immutable
- Examples

Example

```
x = (4, 6, 8)
y = 9, 5, 6
print x
print y
print x[1]
print y[1]
y[0] = 2
z = ([5,6], [7,8])
print z
z[0][1] = 12
print z
z[0].append(4)
print z
z[0].remove(5)
z[0].remove(12)
z[0].remove(4)
print z
```


Crossword Plagiarism

bit.ly/crossword-0308 - from fivethirtyeight.com

EXAMPLE OF "SHADY"

Answers in white are the same.

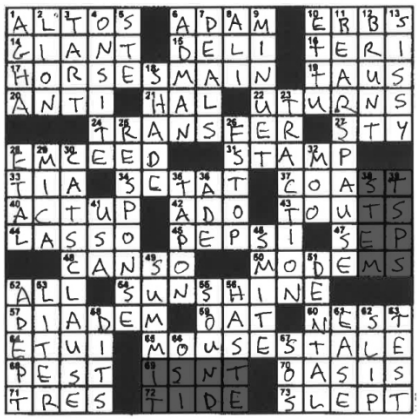
PUBLICATION	The New York Times
PUBLISH DATE	January 8, 2001
BYLINE	Gregory E. Paul
EDITED BY	Will Shortz

PUBLICATION	USA Today
PUBLISH DATE	June 4, 2010
BYLINE	Mark Howard
EDITED BY	Timothy Parker

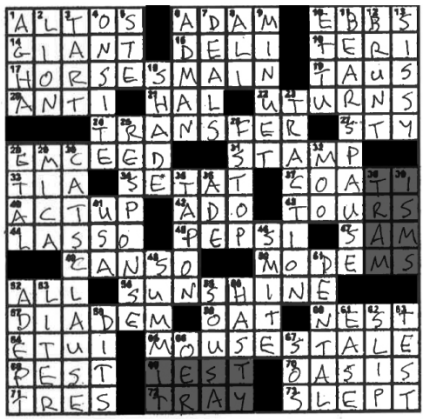
Crossword Plagiarism

EXAMPLE OF "SHODDY"

Answers in white are the same.



PUBLICATION	USA Today
PUBLISH DATE	November 30, 2004
BYLINE	Kendall Twigg
EDITED BY	Timothy Parker



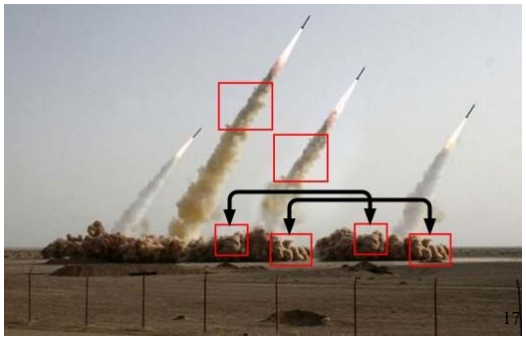
PUBLICATION	USA Today
PUBLISH DATE	November 9, 2011
BYLINE	Harper Dantley
EDITED BY	Timothy Parker

Puzzles with at least 25% similarity to previous puzzle since May 2003

		PUBLICATION
ORIGINAL	REPEATER	NO. OF PUZZLES
Universal	USA Today	537
USA Today	Universal	162
New York Times	Universal	64
New York Times	USA Today	28
Chicago Tribune	Universal	15
Los Angeles Times	USA Today	14
Los Angeles Times	Universal	12

Image Processing

- What's real, what's Photoshopped
  - http://bit.ly/1Kj0Kn6 from 2008
  - Learn more at http://bit.ly/1Psi0hG, we'll do very basic stuff in class and lab, next assignment too!



Example: convert color to gray scale

Process each pixel
Convert to gray

Example: convert blue to green

Process each pixel
Convert blue ones to green

Is this like red-eye removal?

Need new concepts and Image library

- Red, Green, Blue color model
  - Triples of (R,G,B) are processed as Python tuples.
  - *Let's study tuples!*
- Images can be very big, what's 4K display?
  - 4,096 x 2,160 = 8,847,360 pixels, 8Mb at least
  - Creating huge lists takes up memory
  - Sometimes only need one pixel at-a-time
  - *Let's study generators!*

Need new concepts and Image library

- Red, Green, Blue color model
  - Additive model, each pixel specified by (r,g,b) triple, values of each between 0-255
  - https://en.wikipedia.org/wiki/RGB_color_model
  - White is (255,255,255) and Black is (0,0,0)
- Images stored as sequence of (r,g,b) tuples, typically with more data/information too
  - 256 values, represented as 8 bits, $2^8 = 256$
  - 32 bits per pixel (with alpha channel)
  - In Python we can largely ignore these details!

Image library: Two ways to get pixels

- Each pixel is a *tuple* in both models
  - Like a list, indexable, but *immutable*
  - `pix = (255,0,0)`
    - What is `pix?`, `pix[0]?` What is `pix[5]`?
- Invert a pixel: by subscript or named tuple
  - Access by assignment to variables!

```
npx = (255-pix[0],255-pix[1],255-pix[2])
```

```
(r,g,b) = pix
npx = (255-r,255-g,255-b)
```


Let's look at GrayScale.py

- Key features we see
  - Import Image library, use API by example
  - Image.open creates an image object
- Image functions for Image object im
  - `im.show()`, displays image on screen
  - `im.save("xy")`, saves with filename
  - `im.copy()`, returns image that's a copy
  - `im.load()`, [x,y] indexable pixel collection
  - `im.getdata()`, iterable pixel collection
- Let's look at two ways to process pixels!

Image Library: open, modify, save

- `Image.open` can open most image files
  - .png, .jpg, .gif, and more
  - Returns an image object, so store in variable of type Image instance
  - Get pixels with `im.getdata()` or `im.load()`
- `Image.new` can create a new image, specify color model "RGB" and size of image
  - Add pixels with `im.putdata()`
- These belong to Image package

`im.getdata()`, accessing pixels

- Returns something *like* a list
  - Use: `for pix in im.getdata():`
  - Generates pixels on-the-fly, can't slice or index unless you use `list(im.getdata())`
  - Structure is called a Python generator!
  - Saves on storing all pixels in memory if only accessed one-at-a-time
- See usage in GrayScale.py, note how used in list comprehension, like a list!

Alternate : Still Tuples and Pixels

- The `im.getdata()` function returns list-like iterable
  - Can use in list comprehension, see code
  - Use `.putdata()` to store again in image

```
pixels = [makeGray(pix) for pix in im.getdata()]
```

```
def makeGray(pixel):
    r,g,b = pixel
    gray = (r+g+b)/3
    return (gray,gray,gray)
```


Making Tuples and Generators

- Overuse and abuse of parentheses
  - To create a tuple, use parentheses

```
for pix in im.getdata():
    (r,g,b) = pix
    npx = (255-r,255-g,255-b)
```

  - To create a generator use parentheses as though creating a list comprehension!

```
[2*n for n in range(10000)]
(2*n for n in range(10000))
```

- See this in PyDev console

Questions about Image Code

bit.ly/101f16-1025-3

`im.load()`, accessing pixels

- Returns something that can be indexed [x,y]
  - Only useful for accessing pixels by x,y coords
- Object returned by `im.load()` is …
  - Use pix[x,y] to read and write pixel values
- Note: this is NOT a generator

```
pix = im.load()
tup = pix[0,0]
pix[1,1] = (255,255,0)
```


Lab 7

- You'll create new images
  - Invert
  - Solarize
  - Darken
  - Brighten
  - etc

NC State Fair

- Experience it!