CS 5 Today

Seems more like two-thirds term to me...

indefinitely nested structure...

from indefinitely nested loops

Homework 8  loops! due 1/1

CS Midterm

Tuesday, Apr. 2
In-class, written
Page of notes is OK
  - Recursion in Python
  - Function composition
  - Circuit design
  - Hmm, assembly code
  - Loops in Python
  - See online practice...

Accommodations...

Homework 8 preview

When Algorithms Discriminate...

#0

#1 ~ lab

#2

#3

#4

(Extra)

The Mandelbrot Set

Lots of loops!

Pi from Pie

TTS Securities

Thinking in Loops...

ASCII Art

Un-warnings:

Concerns? accom.? See me...

Five problems, written

worth 1 hw assignment

score worries? Extra extra-credit in hw9 and beyond

Suggestions:

Go over in-class exercises and hwk problems
Create a page of notes, 2-sided is OK

Consider small variations of the problems – and how they would change the solutions...

that’s our approach...
Thinking in loops

**for**

---

**while**

---

**definite iteration**

For a **known** list or # of iterations

**indefinite iteration**

For an **unknown** number of iterations

---

PythonBat loop practice...

google for “PythonBat” then...

---

What are the **design** differences between these two types of Python loops?
Loops: *for* or *while*?

\[
\begin{align*}
\text{pi\textunderscore one}(e) & : e = \text{how close to } \pi \text{ we need to get} \\
\text{pi\textunderscore two}(n) & : n = \text{number of darts to throw}
\end{align*}
\]

*Nested* loops are familiar, too!

\[
\begin{align*}
\text{for } mn \text{ in range}(60): \\
& \text{for } s \text{ in range}(60): \\
& \text{tick()}
\end{align*}
\]

Which function will use which kind of loop?

Pi from Pie?

Pizza is the universal constant, after all...

Hw8 Pr3

Estimating \(\pi\) from pie?

- (1) Suppose you throw 100 darts at the square (all of them hit the square).
- (2) Suppose 80 of the 100 hit inside the circle.
- (3) How could you estimate \(\pi\) from these throws?

\begin{align*}
\text{Pi\textunderscore design challenge...} & \\
\text{Name(s) } & \\
\text{Estimating } \pi \text{ from pie?} & \\
\text{Hints} & \\
\text{How big is a side of the square? Its area?} & \\
\text{How big is the radius of the circle? Its area?} & \\
\text{How do these help?} &
\end{align*}
Nested loops

```
for y in range(84):
    for m in range(12):
        for d in range(f(m,y)):
            for h in range(24):
                for mn in range(60):
                    for s in range(60):
                        tick()
```

Creating 2d structure

```
for row in range(3):
    for col in range(4):
        print("#", end='')
```

```
row =
col =
col =
col =
col =
col =
```

```
row =
col =
col =
col =
col =
col =
```

```
row =
col =
col =
col =
col =
col =
```

```
row =
col =
col =
col =
col =
col =
```
Python and images

```python
from cs5png import *

inputs are width and height

im = PNGImage(300, 200)

im.plotPixel(10, 100)
```

Nested loops' 2d structure

```python
for d in range(f(m)):
    for m in range(1, 13):
        num_bdays(m, d)
```

nested loops' 2d structure

```python
for r in range(3):
    for c in range(6):
        if c%2 == r%2:
            print('#', end='')
        else:
            print(' ', end='')
        print()
```

Match!

```python
for r in range(3):
    for c in range(6):
        if c >= r:
            print('#', end='')
        else:
            print(' ', end='')
        print()
```

Try it!

```python
for r in range(3):
    for c in range(6):
        if c%2 == 1:
            print('#', end='')
        else:
            print(' ', end='')
        print()
```

What trends appear in this birthday data?

How might we be suspicious of the fairness of this data?!

That's my type of alien!
Lab 8: *the Mandelbrot Set*

Consider an *update rule* for all complex numbers $c$

$$z_0 = 0$$
$$z_{n+1} = z_n^2 + c$$

from cs5png import *

def testImage():
    """ image demonstration ""
    WD = 300
    HT = 200
    im = PNGImage( WD, HT )

    for row in range(HT):
        for col in range(WD):

            if col == row:
                im.plotPoint( col, row )

    im.saveFile()

Imagining Images

Complex #s!

$\sqrt{-1} = i$

$1j * 1j == -1$

In[]: $c = -2+1j$

$$(-2+1j) * (-2+1j)$$

In[]: $c**2$

$(3-4j)$

Mandelbrot Definition

Consider an *update rule* for all complex numbers $c$

$$z_0 = 0$$
$$z_{n+1} = z_n^2 + c$$

Nothing's too complex for Python!
Lab 8: *the Mandelbrot Set*

Consider an *update rule* for all complex numbers $c$

$$ z_0 = 0 $$
$$ z_{n+1} = z_n^2 + c $$

Before the M. Set, complex things were made of simple parts:

This was a “*naturally occurring*” object where zooming uncovers *more* detail, not less:

Complex things always consisted of simple parts...

Higher-resolution M. Set

The black pixels are points that do *not* diverge for $z = z^2 + c$
Estimating $\pi$ from pie?

(1) Suppose you throw 100 darts at the square (all of them hit the square).

(2) Suppose 80 of the 100 hit inside the circle.

(3) How could you estimate $\pi$ from these throws?

Hints:
- How big is a side of the square? its area?
- How big is the radius of the circle? its area?

How do these help!?