

Reading and In-Class Problem

Reading

- Swaroop, Byte of Python: Ch.7,13
- Langtangen, Primer on Scientific Programming with Python: Ch. 2,3

Problem

Write a program that tests a users knowledge of multiplication.

- write function that randomly generates two integers and the product of the integers
- use this function to ask a user for the product of the two integers, tests to see is the user is correct, and provides the appropriate feedback to the user.
- generate a 100 by 100 nested list of numbers that represent elevations, such that the elevations represent a flat surface. Make the code flexible so that the orientation and grade of this surface can be changed easily within the script.

Exceptions

- errors raise exceptions
 - IndexError (tried to get index outside of list range)
 - NameError (variable not defined)
 - ValueError (using wrong value in function)
 - TypeError (using wrong type)
 - lots of others

Exceptions

```
a=range(3)
print a[4]

import math
math.log(-1.)

print b

c='1'
print c+1.
```

try and except

- instead of catching different situations that cause program to fail
- allow error and catch

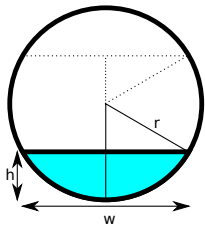
```
a=range(1000)
for i in a:
    if i!=0:
        a= 2./i
    else:
        a= 'undefined'
    print a
for i in a:
    try:
        a=2./i
    except ZeroDivisionError:
        a='undefined'
    print a
```

functions

- make commands
- pass arguments, return value, string, list...
- keyword arguments (default values)
- docstrings

functions

- What is area shaded portion?
- $\theta = \text{asin}(\frac{w}{2r})$
- $\text{Slice} = \frac{\theta}{2\pi} \cdot \pi \cdot r^2$
- $\text{triangle} = (r - h) \cdot \frac{w}{4}$
- $\text{shaded} = 2 \cdot \text{slice} - 2 \cdot \text{triangle}$
- $\text{shaded} = \theta \cdot r^2 - (r - h) \cdot w$
- $\frac{1}{2}w = \sqrt{r^2 - (r - h)^2}$



functions

```
import math
def culvert(r,h):
    """
    calculate saturated area of culvert
    r = radius of culvert
    w = width of water in culvert
    h = height of water in culvert
    """
    r=float(r)
    h=float(h)
    try:
        w=2*(r**2-(r-h)**2)**.5
        theta=math.asin(w/(2*r))
        if (h<r)and(h>0):
            #area if culvert less than half full
            area=theta*r**2-(r-h)*w/2.
        elif (h<=2*r):
            #area if culvert more than half full
            area=math.pi*r**2 - (theta*r**2-(h-r)*w/2.)
        return area
    except ValueError:
        print 'height not consistent with radii'

if __name__=='__main__':
    area1=culvert(10.,1.)
    print area1
```

List Comprehension

- List Comprehension, [i**2 for i in range(10)]
- using with functions
- lambda (eg. a=lambda x,y: x**2+y)
- zip (eg. a=[1,2,3];zip(a,a))

```
a=lambda x,y:x*y
b=[a(i,j) for i in range(7) for j in range(4)]
c=[[a(i,j) for i in range(7)] for j in range(4)]
d=[[a(i,j) for i in range(7)] for j in range(4) if j%2.==0]
e=[[a(i,j) for i in range(7) if i%2.==0] for j in range(4)]

f=[i*2 for i in range(7)]
g=[i+3 for i in range(4)]
## note difference in length
h=[i*j for i,j in zip(f,g)]
```

Formatting 'print'

- 'old' way
 - `print '1+1= %i'%(3)`
 - `print '1+1= %.2f'%(3)`
 - `print '1+1= %s'%('three')`
- 'new' way, python 3.x (back ported)
 - `print('1+1={0}'.format(11))`
 - `print('1+1={0:10}'.format(11))`
 - `print('1+1={0:10} or {1:.5}'.format(11,2.))`