Python for Physicist

Lecture Note - 3

Md. Enamul Hoque

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mjonyh@gmail.com or mjonyh-phy@sust.edu

Lecturer
Department of Physics, Shahjalal University of Science and Technology
Sylhet - 3114, Bangladesh

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Functions, Packages and Modules

- Functions:
  - sin, cos, tan, log etc in the package named 'math'
  - user defined f(x)
- Packages:
  - contain commonly used functions
  - math, numpy, scipy, pylab, matplotlib are commonly used packages
- Modules:
  - Some packages are used in such a way that they can be split into smaller sub-packages.
  - numpy.linalg for linear algebra
  - numpy.fft for fast fourier transform

Example of using packages

Converting polar coordinates

- Analyses:
  - Input: r and θ
  - Convert: $x = r\,cos\theta$ and $y = r\,sin\theta$
  - Print: x and y
- Code:

```
from math import sin, cos, pi
r = float(input("Enter r: "))
d = float(input("Enter angle (deg): "))
theta = d * pi / 180
x = r*cos(theta)
y = r * sin(theta)
print "x = ", x, " and y = ", y
```

Exercise: Write a program which is invert of the above program.

Exercise

A particle of mass m that encounters a one-dimensional potential step

- Initial:
  - Wavevector, $k_1 = \sqrt{2mE}/\hbar$ for the kinetic energy E
  - Potential V jump from 0 to V_0 at position x
- For $E > V$, there will be a transmission probability with $k_2 = \sqrt{2m(E-V)}/\hbar$
- Otherwise, there will be only reflection.
- The Coefficients are given by
  - $T = \frac{4k_1k_2}{(k_1+k_2)^2}$
  - $R = \left[\frac{k_1-k_2}{k_1+k_2}\right]^2$

Problem: Write a python program to compute and print out the transmission and reflection probabiities using those formulaes.

Using while statement

The Fibonacci Sequence

- First two numbers are 1 and 1.
- The sequence will be the sum of previous two numbers.

Code:

```
f1, f2 = 1, 1
while f1 < int(input("Enter an Integer: ")):
    print f1
    f1, f2 = f2, f1 + f2
```

Excercise while statement

The Catalan numbers

- Catalan numbers are used in the theory of disorder quantum mechanical systems.
- Represented by $C_{n+1} = \frac{4n+2}{n+2} C_n$
- Where $C_0 = 1$

Exercise: Write a program to find the Catalan number at a given integer number.