

## Cluster 5 (Biophysics) Sequence with Python (2018)

Introduction to Python

- History/Background
- Interactive / Object-Oriented
- Comparison to C
- Python Environment: Basic navigation/Use

Basic python using Interactive tutorial (ipython environment )

- Variable assignments
- Operations: +, -, \*, /, power(\*\*), modulo(%)
- Variable type: integers, floats, boolean, arrays, strings
- Packages and modules numpy, sys
- Lists and array operations (indexing/slicing)
- Dictionaries
- Strings and string operations
- Simple plotting with matplotlib

Start-up python programs (using gedit):

- How to run/execute python in terminal-Add input and print functions[helloworld.py]
- Conditional logic: if-else, for loop, and range(n) list [odd\_even.py]
- Conditional logic: If-elif, while loop, import modules:sys,random [magic8ball.py]
- Intro to functions: factorial concept [factorial\_basic.py] [factorial\_function.py]
- Intro to numpy arrays, matplotlib/basic graphics [basic\_plot.py]

Warm-up programs exercises- putting it all together :

- Predator-Prey Model: Hare vs Lynx Competition [predator\_prey\_shell.py] [predator\_prey.py]\*\*
- Central Dogma Model: DNA to RNA to protein [RNA\_translation\_shell.py] [RNA\_translation.py]

\*\* includes graphics output

Introduction to probability and random numbers

- Discussion of probability concepts and random number generators
- Calculating "pi" with random numbers [calculate\_pi.py]
- Exploring random number generators [RNG\_program.py, mersenne\_twistor.py, random\_pairs.py]
- Introduction to Gamblers Ruin problem (Optional)
- Playing casino games [ gamblersruin1\_shell.py, gamblersruin1.py] [gambler\_sruin2\_shell.py, gamblersruin2.py] (Optional)

Introduction to random walks in one dimension

- Discuss diffusion and cellular transport mechanisms (concepts)
- Graph multiple 1d random walks [randwalk1d\_mult\_shell.py, randwalk1d\_mult.py]
- Discuss relationship between diffusion and random walks. Show how viable diffusion (random process) is for transporting material around a cell (based on cell size)
- Compute diffusion coefficient of 'x' position in 1d random walk [randwalk1d\_hist\_shell.py, randwalk1d\_hist.py]

Random walks in two dimensions

- Discussion of random walks in 2 dimensions - how to implement random steps

- Create simple 2d random walk with grid pattern [randwalk2d\_simple\_shell.py, randwalk2d\_simple.py]
- Create 2d random walk with box(rectangle) as confining boundary. Use random angle [randwalk2d\_box\_simple\_shell.py, randwalk2d\_box\_simple.py]
- Create 2d random walk with confining boundary. Introduce module approach( Discuss) [randwalk2d\_mod.py, randwalk2d\_box.py]
- Create 2d random walk with target within confining boundary (uses module) [randwalk2d\_target\_shell.py, randwalk2d\_target.py ]
- (Optional) Build histogram of random walks with target [randwalk2d\_target\_hist.py]