

Cluster 5 (Biophysics) Sequence with Python (2017)

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)
- 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-ruin2_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]