Student's Guide to Python for Physical Modeling

Chapter 1: Introduction to Python for Scientific Computing A

1.1. Why Python for Scientific Computing?

- Briefly discuss the advantages of Python in scientific computing:
  - Open-source and free
  - Large and active community
  - Extensive libraries (NumPy, SciPy, Matplotlib, etc.)
  - Readability and ease of use

1.2. Basic Python Syntax

- Introduce fundamental Python concepts:
  - Variables and data types (integers, floats, strings, booleans)
  - Operators (arithmetic, comparison, logical)
  - Basic input and output (print, input)
  - Indentation and code blocks

1.3. Control Flow

- Explain conditional statements (if, else, elif)
- Discuss loops (for, while)
- Provide examples using code fragments: string_format.ipynb, string_percent.ipynb, for_loop.ipynb, while_loop.ipynb

1.4. Functions

- Define functions and their importance
- Explain function parameters, return values
- Introduce scope and namespaces (referencing scope.ipynb and name_collision.ipynb)

1.5. Introduction to NumPy

- Explain NumPy arrays and their advantages over Python lists
- Demonstrate basic array operations (creation, indexing, slicing)
- Introduce vectorization (using vectorize.ipynb)

Potential Additional Topics (Depending on Book's Scope)

- Basic plotting using Matplotlib (referencing simple_plot.ipynb)
- File I/O (referencing import_text.ipynb, save_load.ipynb, print_write.ipynb)

Chapter 2: Introduction to Python Programming

- string_format.ipynb
- string_percent.ipynb
- for_loop.ipynb
- while_loop.ipynb
- vectorize.ipynb

Chapter 3: Working with Arrays and Functions

- projectile.ipynb
- branching.ipynb
- nesting.ipynb

Chapter 4: Data Input and Output

- import_text.ipynb
- save_load.ipynb
- print_write.ipynb

Chapter 4: Visualization

- simple_plot.ipynb
- graph_modifications.ipynb
- line3d.ipynb
- subplot.ipynb
- subplots.ipynb

Chapter 6: Numerical Methods

- measurements.ipynb
- rotate.ipynb
- average.ipynb
- histogram.ipynb
- contour.ipynb
- matrix_inversion.ipynb
- quadrature.ipynb
- simple_oscillator.ipynb (used in solve_ode.ipynb)
- solve_ode.ipynb
- parametric_oscillator.ipynb
- ivp_comparison.ipynb
- vortex.ipynb
- gradient.ipynb
- streamlines.ipynb

Chapter 8: Advanced Topics

- data_images.ipynb
- walker.ipynb

- waves.ipynb (uses html_movie.py)

Chapter 9: Convolution

- convolution.ipynb

Chapter 10: Random Walks

- first_passage.ipynb
- data_dictionary.ipynb (requires first_passage.ipynb)
- nd_random_walks.ipynb

Epilogue

- surprise.ipynb

Appendix F: Scoping and Namespaces

- scope.ipynb
- name_collision.ipynb

Your Turn (Additional Exercises)

- fancy_plot.ipynb
- legend.ipynb
- measurements.ipynb (different from Chapter 6 version)
- random_walk.ipynb
- surface.ipynb
- regression.ipynb (requires first_passage.ipynb)

Additional Files

- bar3d.ipynb
- html_movie.py (used by waves.ipynb)
- perrin.ipynb (requires g26perrindata.npy)
- shading.ipynb
- sympy_examples.py (better suited for interactive use)