

9. Numeric and Mathematical Modules

The modules described in this chapter provide numeric and math-related functions and data types. The `numbers` module defines an abstract hierarchy of numeric types. The `math` and `cmath` modules contain various mathematical functions for floating-point and complex numbers. The `decimal` module supports exact representations of decimal numbers, using arbitrary precision arithmetic.

The following modules are documented in this chapter:

- 9.1. `numbers` — Numeric abstract base classes
 - 9.1.1. The numeric tower
 - 9.1.2. Notes for type implementors
 - 9.1.2.1. Adding More Numeric ABCs
 - 9.1.2.2. Implementing the arithmetic operations
- 9.2. `math` — Mathematical functions
 - 9.2.1. Number-theoretic and representation functions
 - 9.2.2. Power and logarithmic functions
 - 9.2.3. Trigonometric functions
 - 9.2.4. Angular conversion
 - 9.2.5. Hyperbolic functions
 - 9.2.6. Special functions
 - 9.2.7. Constants
- 9.3. `cmath` — Mathematical functions for complex numbers
 - 9.3.1. Conversions to and from polar coordinates
 - 9.3.2. Power and logarithmic functions
 - 9.3.3. Trigonometric functions
 - 9.3.4. Hyperbolic functions
 - 9.3.5. Classification functions
 - 9.3.6. Constants
- 9.4. `decimal` — Decimal fixed point and floating point arithmetic
 - 9.4.1. Quick-start Tutorial
 - 9.4.2. Decimal objects
 - 9.4.2.1. Logical operands
 - 9.4.3. Context objects
 - 9.4.4. Constants
 - 9.4.5. Rounding modes
 - 9.4.6. Signals
 - 9.4.7. Floating Point Notes
 - 9.4.7.1. Mitigating round-off error with increased precision
 - 9.4.7.2. Special values
 - 9.4.8. Working with threads
 - 9.4.9. Recipes
 - 9.4.10. Decimal FAQ

- 9.5. fractions — Rational numbers
- 9.6. random — Generate pseudo-random numbers
 - 9.6.1. Bookkeeping functions
 - 9.6.2. Functions for integers
 - 9.6.3. Functions for sequences
 - 9.6.4. Real-valued distributions
 - 9.6.5. Alternative Generator
 - 9.6.6. Notes on Reproducibility
 - 9.6.7. Examples and Recipes
- 9.7. statistics — Mathematical statistics functions
 - 9.7.1. Averages and measures of central location
 - 9.7.2. Measures of spread
 - 9.7.3. Function details
 - 9.7.4. Exceptions