

**Rust for Python Developers**

**Course Number:** RUST-116  
**Duration:** 5 days

**Overview**

This Rust training course teaches Python developers how to master the Rust programming language by leveraging their knowledge of Python programming. By the end of the course, students confidently build efficient, safe, and concurrent applications in Rust.

**Prerequisites**

* Proficiency in Python programming
* Basic understanding of programming concepts such as variables, expressions, functions, and control flow

**Materials**

All students receive comprehensive courseware covering all topics in the course. Courseware is distributed via GitHub through documentation and extensive code samples.

**Software Needed on Each Student PC**

* A free, personal GitHub account to access the courseware
* Permission to install Rust and Visual Studio Code on their computers
* Permission to install Rust Crates and Visual Studio Extensions

If students cannot configure a local environment, a cloud-based environment can be provided.

**Objectives**

* Understand the Rust philosophy
* Set up and navigate the Rust environment
* Explore Rust within the context of Python
* Understand basic Rust syntax and semantics
* Use control flow and logic
* Understand ownership and borrowing concepts
* Use tuples, enums, structs, and vectors
* Employ pattern matching
* Implement Rust’s concurrency model
* Create custom macros
* Write Rust tests
* Create documentation with Rustdoc

**Outline**

* Introduction
* What is Rust?
  + Rust’s Philosophy and Goals
  + History and motivation
  + Rust vs Python
  + Rust Community
  + The Rust Playground
* Install Rust
  + Script
  + macOS Homebrew
  + Platform Installers
* Rust Editors
  + VSCode with Extensions
  + Rust Rover
  + Debug Rust in VSCode
  + GitHub Copilot
* Hello World
  + Create a new Project
  + Main Function
  + Print to the Console
  + Comments
* Cargo
  + What is Cargo?
  + How does Cargo compare to Pip and Conda?
  + Rust Crates compared to Python Packages
  + Run Command
  + Build Command
  + Build Release Command
  + Install Third-Party Crates
* Rust and Python Differences
  + Static Typing vs Dynamic Typing
  + Memory Management
  + Error Handling
  + Sequence, Selection, and Iteration
  + Structs vs Classes
  + Traits vs Protocols
  + Generics
  + Concurrency
* Scalar Types and Data
  + Rust Types vs Python Types
  + Constants
  + Immutable Variables
  + Mutable Variables
* Code Logic
  + If Statement
  + Loop with Break
  + While Loop
* Functions
  + Define a Function
  + Call a Function
  + Paramter Types
  + Return Types
  + Closure Functions
* Modules
  + Import Modules from Standard Library
  + Import Modules from Third-Party Crates
  + Define Custom Modules
  + Import Custom Modules
* Built-In Macros
  + print! and println!
  + format!
  + vec!
  + include\_str! and include\_bytes!
  + cfg! and env!
  + panic!
* Memory Management
  + Problems with Manual Management
  + Problems with Garbage Collection
  + Ownership & Borrowing
  + Rust vs Python
  + References
  + Lifetimes
* Strings
  + String Slices
  + String Objects
  + Convert Between Slices and Strings
  + Parse Number from String
  + Trim String
  + Print Strings with Interpolation
* Tuples
  + What is a Tuple?
  + Heterogeneous Elements
  + Access Elements
  + Destructuring
  + Immutable
* Enums
  + What is an Enum?
  + Define an Enum
  + Using Enums
  + Enum Variants
  + Enum Methods
  + Enums and Pattern Matching
  + Result Enum
  + Option Enum
  + Enums vs Structs
* Structs
  + What is a Struct?
  + Create Instance
  + Field Init Shorthand
  + Struct Update Syntax
  + Tuple Structs
  + Unit-Like Structs
  + Ownership of Struct Data
  + Function Implementation
  + Associated Functions
  + Stuct Methods
  + Constructor Pattern
* Vectors
  + What is a Vector?
  + Create a Vector
  + Add and Remove Elements
  + Access Elements
  + Iterate over Elements
  + Slicing, Length, and Capacity
  + Common Vector Operations
  + Understand Memory Management
  + Ownership and Borrowing Rules
* Collections and Iterators
  + Vectors, arrays, and slices
  + HashMaps and hash sets
  + Iteration and iterators
* Traits
  + What is a trait?
  + How does a trait related to traditional OOP interfaces?
  + Defining a trait
  + Implementing a trait
  + Default implementations
  + Traits as parameters
  + Traits as return types
  + Traits as bounds
* Generics
  + What is a generic?
  + How does a generic related to traditional OOP generics?
  + Defining a generic
  + Implementing a generic
  + Generic bounds
  + Multiple generic types
  + Where clauses
* Pattern Matching
  + What is Pattern Matching?
  + Match Statement
  + If Let Statement
  + While Let Statement
  + Destructuring Stucts and Tuples
  + Pattern Matching with Enums
  + Pattern Matching with Functions
  + Pattern Matching and Ownership
  + Refutability and Irrefutability
* Concurrent Programming
  + What is Concurrent Programming?
  + Using Multiple Threads
  + Mutex, RwLock, and Arc
  + Message Passing with Channels
  + Sync and Send Traits
  + Futures and Async/Await
* Unsafe Rust
  + What is Unsafe Rust?
  + Raw Pointers
  + Dereferencing Raw Pointers
  + Calling Unsafe Functions
  + Creating Safe Abstractions
  + Unsafe Traits
  + Unsafe Blocks
  + Unsafe Superpowers
* Macros and Metaprogramming
  + What is a Macro?
  + Define a Macro with macro\_rules!
  + Using Pattern Matching
  + Define Expansion
  + Use the Custom Macro
* Tests
  + What is a Test?
  + Test Functions
  + Test Organization
  + Test Attributes
  + Test Coverage
  + assert!, assert\_eq!, and assert\_ne!
* Documentation with Rustdoc
  + What is Rustdoc?
  + Add Documentation to Rust Code
  + Triple-Slash Comments and the #[doc] Attribute
  + Generate Documentation
  + Linking and Cross-Referencing Documentation
* Python Extension written in Rust (overview)
  + Why write Python Extensions in Rust?
  + Create a New Extensions
  + Compile, Run, and Debug a Rust Extension
  + Run Parallel Code outside of the GIL
  + GIL and Rust Lifetimes
  + Create Python Classes in Rust
* Conclusion