



OVERVIEW & INSTALL

C modern, expressive programming language

```
# Check version
c --version
```

Install via official installer, package manager, or version manager

Popular package managers: cargo, pip, gem, npm, brew

BASIC SYNTAX

Variables, control flow, expressions

```
// Variable declaration
let x = 10;
// Conditional
if x > 5 { ... } else { ... }
// Loop
for item in collection { ... }
```

DATA TYPES

Primitive: integers, floats, booleans, strings

Composite: arrays, maps, tuples, structs

```
// Typed declaration
let name: String = "Alice";
let numbers: Vec<i32> = vec![1, 2, 3];
```

Strong typing prevents common runtime errors

FUNCTIONS

```
fn greet(name: &str) -> String {
    format!("Hello, {}!", name)
}
let result = greet("World");
```

First-class functions; lambdas/closures supported

```
let double = |x| x * 2;
```

OOP / MODULES

Structs, classes, or records with methods

```
struct User { name: String, age: u32 }
impl User {
    fn new(name: &str) -> Self { ... }
    fn greet(&self) -> String { ... }
}
```

Interfaces / traits / protocols for polymorphism

COLLECTIONS

```
// Array / slice
let arr = [1, 2, 3];
// Dynamic list
let mut list = Vec::new();
list.push(42);
// Map / dictionary
let mut map = HashMap::new();
map.insert("key", "value");
```

ERROR HANDLING

Result/Option types or exceptions

```
fn read_file(path: &str) ->
Result<String, Error> {
    Ok(std::fs::read_to_string(path)?)
}
match result {
    Ok(data) => process(data),
    Err(e) => eprintln!("Error: {}", e),
}
```

CONCURRENCY / ASYNC

Threads, async/await, or actor model

```
async fn fetch_data(url: &str) ->
Result<String> {
    let resp = client.get(url).await?;
    resp.text().await
}
tokio::main / async_std / smol
```

Green threads or OS threads depending on runtime

TESTING

Built-in or framework test support

```
#[test]
fn test_greet() {
    assert_eq!(greet("Alice"), "Hello, Alice!");
}
cargo test / run test suite
```

Unit tests co-located with source code

ECOSYSTEM & PACKAGES

Package registry and dependency management

```
# Add dependency
cargo add serde
# In Cargo.toml:
[dependencies]
serde = { version = "1.0", features = ["derive"] }
```

Curated ecosystem with popular libraries for HTTP, JSON, DB

CLI & BUILD TOOLS

cargo build	compile project
cargo run	build and run
cargo test	run tests
cargo fmt	format code
cargo clippy	linting
cargo doc	generate documentation

Integrated toolchain for build, test, and docs

COMMON GOTCHAS

Follow language-specific naming conventions

Understand ownership/borrowing/GC model for this language

Use idiomatic patterns don't port code from other languages

Check community guidelines for error handling approach

Profile before optimizing correctness first