



OVERVIEW & INSTALL

Haskell modern, expressive programming language
Check version
haskell --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