



THE COMPLETE GUIDE TO  
**BINARY ANALYSIS, DISASSEMBLY,  
AND ASSEMBLY**

# PRACTICAL **BINARY** ANALYSIS

WITH

**CAPSTONE & KEYSTONE**

## DISASSEMBLY (CAPSTONE)

```
0x00401000 55      push  rbp
0x00401001 48 89 e5  mov   rbp, rsp
0x00401004 48 83 ec 20 sub   rsp, 0x20
0x00401008 89 7d ec  mov   dword ptr [rbp-0x14], edi
0x0040100b 8b 45 ec  mov   eax, dword ptr [rbp-0x14]
0x0040100e 85 c0     test  eax, eax
0x00401010 74 05     je    0x401017
0x00401012 b8 01 00 00 00 mov   eax, 1
0x00401017 c9       leave
0x00401018 c3       ret
```

## ASSEMBLY (KEYSTONE)

```
push rbp          55
mov  rbp, rsp     48 89 E5
sub  rsp, 0x20    48 83 EC 20
mov  dword ptr [rbp-0x14], edi 89 7D EC
mov  eax, dword ptr [rbp-0x14] 8B 45 EC
test eax, eax     85 C0
je   0x401017     74 05
mov  eax, 1       B8 01 00 00 00
leave                               C9
ret                               C3
```



C



PYTHON



RUST



GO



JAVA



C#

- ✓ THEORY & FUNDAMENTALS
- ✓ MULTI-LANGUAGE API GUIDE
- ✓ REAL-WORLD CASE STUDIES
- ✓ COMPLETE SOURCE CODE
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MALWARE  
ANALYSIS



EXPLOIT  
DEVELOPMENT



BINARY  
PATCHING



SHELLCODE  
ANALYSIS



AUTOMATED  
REWRITING



COMPILER  
TOOLING

YURI HASHIMOTO

# Practical Binary Analysis with Capstone & Keystone

The Complete Guide to Binary Analysis, Disassembly, and Assembly

Steve T. Publications

This book is available at

<https://leanpub.com/practicalbinaryanalysiswithcapstonekeystone>

This version was published on 2026-07-07



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# The Complete Guide to Binary Analysis, Disassembly, and Assembly

**About this book:** This is a comprehensive, production-quality guide to two of the most important tools in binary analysis: the Capstone disassembler engine and the Keystone assembler engine. Written for readers ranging from curious beginners to seasoned reverse engineers, it covers theoretical foundations, practical implementation, API usage across multiple programming languages, and real-world applications including malware analysis, exploit development, compiler tooling, and automated binary rewriting. Every chapter includes complete, executable source code examples in C, Python, Rust, Go, Java, and C#, along with case studies, architecture diagrams, comparison tables, best practices, and troubleshooting guidance. By the end of this book, you will be able to build your own disassemblers, assemblers, binary patchers, shellcode analyzers, and reverse engineering automation tools from scratch.

# Introduction

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## Case Study: Real-World Malware Sample

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## Exercises

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# Chapter 12: Exploit Development and Binary Patching

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## Shellcode Analysis with Capstone

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## ROP Chain Construction and Validation

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## Binary Patching Fundamentals

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## Instruction Replacement and Size-Neutral Patches

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## Hot-Patching in Production

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## Exercises

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# Chapter 13: Compiler Tooling, Emulation, and Debugging

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## Compiler Backend Integration

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## Just-In-Time Compilation Support

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## Binary Instrumentation Frameworks

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## Emulation and Simulation

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## Debugging Tool Integration

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## Exercises

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# Chapter 14: Advanced Topics – Performance, Security, and Automation

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## Performance Benchmarking and Optimization

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## Memory Safety and Security Considerations

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## Testing Strategies for Binary Analysis Code

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## CI/CD Integration and Automation

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## Future Directions and Emerging Trends

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## Exercises

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# Conclusion

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## What You Have Gained

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## The Bigger Picture

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## What Comes Next

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## A Final Thought

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# Appendix A: Complete API Reference

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## Capstone C API

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## Keystone C API

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# Appendix B: Supported Architectures and Modes

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## Capstone Architectures

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## Keystone Architectures

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# Appendix C: Instruction Encoding Examples

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## x86-64 Common Instructions

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## ARM Common Instructions

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# Appendix D: Glossary

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# Appendix E: Further Learning Resources

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## Official Documentation

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## Source Code Repositories

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## Community Resources

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## Recommended Books

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## Conference Presentations

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## Online Tools

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