
CYBRARY

Introduction to Assembly

Instructor Name: Dr. Matthew Miller

Course Creation Date: 01/23/2020

Instructor Contact: millermj@unk.edu

Course Description and Goals

Prerequisites: This course requires a background in basic programming concepts. Students should have access to a Linux system or setup a Linux virtual machine.

Course Description: This course will provide background and information related to programming in assembly. Assembly is the lowest level programming language which is useful in reverse engineering and malware analysis.

Course Goals: By the end of the course, students should be able to:

- a) Write assembly programs
 - i) x86
 - ii) ARM
- b) Read assembly programs
- c) Understand different data representations
 - i) Binary, hex, 2's complement
- d) Understand how the following work
 - i) Functions
 - ii) Stack
 - iii) Data storage

Course Resources

Labs Used: This course uses a free assembly template that can be downloaded to the students Linux environment.

Brought to you by:

CYBRARY | FOR BUSINESS

Develop your team with the **fastest growing catalog** in the cybersecurity industry. Enterprise-grade workforce development management, advanced training features and detailed skill gap and competency analytics.

CYBRARY

Course Outline

Module 1| Basic Assembly

Lesson 1: Assembly Intro

Lesson 1.1 Template and Setup (8:07)

Lesson 1.2 Assembly (7:49)

Lesson 1.3 Architecture, Registers, Protected Mode (13:02)

Lesson 1.4 Binary, 2's Complement and Hexadecimal (7:44)

Lesson 1.5 Assembly Template (7:01)

Lesson 2: Mnemonics and Instructions

Lesson 2.1 Instructions, Directives and Generating a Listing (14:57)

Lesson 2.2 Logical Operators and Memory Layout (15:16)

Lesson 2.3 Segments and Functions (9:58)

Lesson 3: Math and Extending Signs

Lesson 3.1 Sign Extend, Zero Extend, Multiply, Divide (11:43)

Lesson 3.2 Multiply and Divide Examples (6:55)

Lesson 4: Compare and Looping

Lesson 4.1 Compare, Conditionals and Jumps (11:03)

Lesson 4.2 If Skeleton and Loop Example (11:17)

Lesson 5: Shift and Rotate

Lesson 5.1 Shift Left and Right (9:13)

Lesson 5.2 Arithmetic Shift (10:35)

Lesson 5.3 Rotate/Rotate and Carry (8:56)

Lesson 5.3 Module 1 Review (5:12)

Module 2| Indirect Addressing, Stack, Arrays and Strings

Lesson 6: Indirect Addressing and Stack

Lesson 6.1 Indirect Addressing and Variables (9:11)

Lesson 6.2 Stack Intro (7:00)

Lesson 6.3 Stack Usage (7:39)

Lesson 6.4 Simple Function Example (11:17)

Brought to you by:

CYBRARY | FOR BUSINESS

Develop your team with the **fastest growing catalog** in the cybersecurity industry. Enterprise-grade workforce development management, advanced training features and detailed skill gap and competency analytics.

CYBRARY

- Lesson 6.5 Function Prologue (3:21)
- Lesson 6.6 Function Epilogue (8:17)
- Lesson 6.7 Function Arguments (8:40)
- Lesson 6.8 Saving Registers (9:33)
- Lesson 6.9 More Complicated Function (14:46)
- Lesson 6.10 Recursive Function (8:40)
- Lesson 7: Calling Conventions and Local Variables
 - Lesson 7.0: Calling Conventions (8:30)
 - Lesson 7.1: Local Variables (6:22)
 - Lesson 7.2: Local Variable Example (12:19)
 - Lesson 7.3: Enter and Leave (5:02)
 - Lesson 7.4: Enter and Leave Example Conversion (4:52)
- Lesson 8: Floating point
 - Lesson 8.1: Floating Point (7:10)
 - Lesson 8.2: Floating Point Circle Example (10:04)
 - Lesson 8.3: Floating Point Comparison (6:16)
 - Lesson 8.4: Floating Point Comparison Example (9:38)
- Lesson 9: Complex examples
 - Lesson 9.1: Max of Three Numbers (12:34)
 - Lesson 9.2: Conditional Move (8:17)
 - Lesson 9.3: Conditional Move Max Example (6:44)
- Lesson 10: Arrays and Strings
 - Lesson 10.1: Arrays (11:20)
 - Lesson 10.2: Array examples (6:20)
 - Lesson 10.3: String Instructions (7:11)
 - Lesson 10.4: String Uppercase Example (9:39)

Module 3 | ARM Architecture

- Lesson 11: ARM Intro
 - Lesson 11.1: ARM Intro (11:40)
 - Lesson 11.2: ARM Template (6:07)
 - Lesson 11.3: ARM Math and Data Movement (8:25)

Brought to you by:

CYBRARY | FOR BUSINESS

Develop your team with the **fastest growing catalog** in the cybersecurity industry. Enterprise-grade workforce development management, advanced training features and detailed skill gap and competency analytics.

CYBRARY

- Lesson 11.4: Branching, If, While, Shift (8:49)
- Lesson 11.5: Shift Example (7:21)
- Lesson 11.6: Memory Offsets, Debugging and Listing (10:53)
- Lesson 11.7: Pushing and Popping (5:34)
- Lesson 11.8: Push Example (5:29)
- Lesson 11.9: Array Indexing (8:30)
- Lesson 11.10: Array Indexing Example (4:56)
- Lesson 11.11: ARM Multiple Load and Store (5:57)
- Lesson 11.12: ARM Load and Store Multiple Example (6:00)

Lesson 12: Advanced ARM

- Lesson 12.1: VFP and Neon (15:23)
- Lesson 12.2: Neon Example (12:44)
- Lesson 12.3: Neon Floating Point (6:29)
- Lesson 12.4: Neon Floating Point Example (7:52)
- Lesson 12.5: SIMD Load and Store Data (8:33)
- Lesson 12.6: SIMD Process Data (8:49)
- Lesson 12.7: SIMD Encryption Example (11:35)
- Lesson 12.8: Thumb Mode (4:55)
- Lesson 12.9: Thumb Mode Example (14:51)
- Lesson 12.10: Conditional Execution (7:30)
- Lesson 12.11: Conditional Execution Example (8:53)
- Lesson 12.12: IT Block (5:10)
- Lesson 12.13: IT Block Example (7:32)

Module 4 | C Constructs and Interrupts

Lesson 13: Basic RE Lab

- Lesson 13.1: Tools for Code Reverse Engineering (8:46)
- Lesson 13.2: Reverse Engineering Process (7:41)
- Lesson 13.3: Setup Reverse Engineering Lab (8:08)

Lesson 14: C Constructs

- Lesson 14.1: Structures and Unions (5:36)
- Lesson 14.2: Structure Layout (5:10)

Brought to you by:

CYBRARY | FOR BUSINESS

Develop your team with the **fastest growing catalog** in the cybersecurity industry. Enterprise-grade workforce development management, advanced training features and detailed skill gap and competency analytics.

CYBRARY

- Lesson 14.3: Structure Creation/ Reverse Engineering (7:13)
- Lesson 14.4: Structures, Unions and Malloc (9:22)
- Lesson 14.5: Structures, Unions and Malloc Example (6:41)
- Lesson 14.6: Jump Tables and Switch Statements (5:43)
- Lesson 14.7: Jump Table Example (8:18)
- Lesson 14.8: Function Pointers (7:23)
- Lesson 14.9: Function Pointer Example (7:00)
- Lesson 14.10: Inline Assembly (9:38)
- Lesson 14.11: Inline Assembly Example (10:12)
- Lesson 14.12: Assembly with C (10:09)
- Lesson 14.13: SysCall and Interrupts (8:05)
- Lesson 14.14: Interrupt Example Using Fork(8:26)
- Lesson 14.15: Strings in C (5:44)
- Lesson 14.16: Integers in Assembly (7:37)
- Lesson 15: ARM Arrays and Repeat
 - Lesson 15.1: 64 Bit Assembly (10:10)
 - Lesson 15.2: MMX, SSE, AES-NI (9:49)
 - Lesson 15.3: AES Implementations (8:45)
 - Lesson 15.4: Implement Dump Registers (18:12)
 - Lesson 15.5: Static and Dynamic Linking (8:56)
 - Lesson 15.6: Shared Library (7:48)
 - Lesson 15.7: Shared Library Example (12:52)

Brought to you by:

CYBRARY | FOR BUSINESS

Develop your team with the **fastest growing catalog** in the cybersecurity industry. Enterprise-grade workforce development management, advanced training features and detailed skill gap and competency analytics.