KOENIG
step forward

Linux Kernel Programming

Duration: 4 Days (8 Hours per Day)

Prerequisites:
- C Language
- Linux Knowledge is Required

Module 1 – Introduction

What is Device Driver
What is Kernel Module
Device Drivers vs Kernel Modules
Types of Kernel Modules
Basic Commands
Hello World Kernel Module
Printfs vs Printk
Simplified Makefile
What happens when run insmod
What happens if we return -1 from Kernel Module Init Function
Give another name to Kernel Module
Kernel Module Span across Multiple C Files
Two Kernel Modules from Single Makefile
Dmesg in Deep
Dmesg Follow Option
Linux Kernel Module Example with module_init only
Linux Kernel Module Example with module_exit only
Two Line Linux Kernel Module
Cross Compilation

Module 2 – Linux Kernel Module Internals

From .c to .ko
Understanding Module.symvers and modules.order
Insmod vs Modprobe
How Modprobe Calculates Dependencies
Understanding module_init and module_exit functions
Examples of gcc Attribute Alias
Linux Kernel Module Example without module_init and module_exit Macro

Module 3 – Module Parameters

Passing Parameters to Linux Kernel Modules
What Happens if We Pass Incorrect Values to Module Parameters
How to Pass parameters to Builtin Modules
How to Pass String with Multiple Word as Parameter
Passing Zero to Permission Argument of module_param macro
Passing Array as Module Parameters
Inv Bool

Module 4 – Exporting Symbols

Symbol and Symbol Table
Exporting Symbol
System.map vs /proc/kallsyms
Linux Kernel Module Example of Exporting Function
Module Stacking

Linux Kernel Module Example of Exporting Variable
Version Magic

Module 5 – Module Licenses

What Happens if We Don't Specify MODULE_LICENSE macro
What is Tainted Kernel
How to Check Whether The Kernel is in Tainted State or Not
What Happens When you Specify Invalid License
What Happens When a Non-GPL Kernel Module Trying to Access GPL Module

Module 6 – Module Metadata

How to Find Out Kernel Version from a .ko
Module Metadata
MODULE_INFO macro
Objdump on Kernel Module

Module 7 – PrintK

What Happens if We Continuously Call PrintK
Printk Kernel Ring Buffer Size
PrintK Log Levels
Default PrintK Log Level
Kernel Messages on Console
Short PrintK Macros
Enable pr_debug Messages
Linux Kernel Module Example which Prints Floating Point Number
Why Floating Point Unit is OFF in Kernel Space
Limiting PrintK Messages – printk_rate_limit
Limiting PrintK Messages – printk_once
Avoiding Default New Linux Behaviour of PrintK
Printing Hex Dump – print_hex_dump
Printing Hex Dump – print_hex_dump_bytes
Dynamic Debug

Module 8 – System Call for Loading Module

What Happens if I Try to Load non-ko File with Insmod
Strace on Insmod Command
Find Out Name of Module from .ko

Module 9 – Kernel Panic, Oops, Bug

How to Dump Kernel Stack
What is Kernel Panic
Kernel Panic Example
What is Oops
Oops Example
What is BUG and Example
Can we Remove Module After Bug/Oops
How to Define Preprocessing Symbol in Makefile

Module 10 – Process Management in Linux Kernel

How to Find Out How Many CPU's are Present from User Space and Kernel Space
Process Representation in Linux Kernel and Process States
Linux Kernel Module Example Demonstrating Process Name, Process ID and Process
Linux Kernel Module Example Demonstrating Current Macro
Linux Kernel Module Which Accepts PID as Argument and prints Process and Parent
Process Memory Map
Linux Kernel Module Example for Printing Process Memory Map

Module 11 – Kernel Threads

Introduction to Kernel Threads
Kernel Thread Example – kthread_create
Kernel Thread Example – kthread_run
Two kernel Threads Example
Can We Have Two Kernel Threads with Same Name
What Happens If We Don't Use kthread_should_stop() in Thread Function
What Happens If We Don't Call kthread_stop() in module_exit
Print Process ID in Kernel Module
Linux Kernel Thread Example of Race Condition

Module 12 – Module Support for Multiple Kernels

LINUX_VERSION_CODE Macro
KERNEL_VERSION Macro
UTS_RELEASE
Linux Kernel Module Example Supporting Multiple Versions
Output of Pre-processed Stage