

Linux Device Driver Development Programming Workshop

Course Duration: Two Full Days

Course Fee: Rs. 3500/- (+ Tax)

Pre-Requisites:

Linux Kernel Internals & Advanced Programming Workshop

Course Outline:

Linux Device Driver Programming

- **An introduction to device drivers**
 - User space vs Kernel space
 - Kernel Architecture or Model
 - Splitting the kernel
 - Kernel modules
 - Kernel Module vs Applications
 - Role of the Device Drivers
 - Classes of devices and modules

- **Kernel Module Programming Basics**
 - Modules Defined
 - Data Type in the Kernel
 - Version dependency
 - Building and Running Modules
 - Types of Modules in the kernel
 - Writing your first kernel module
 - Module Related Commands
 - Statically linked vs dynamically linked drivers/modules
 - The kernel symbol table
 - Exporting symbols from modules
 - Module Parameters
 - Lab exercises for above mentioned topics

- **Kernel Debugging Techniques**
 - Kernel Debugging: dmesg, printk
 - Lab exercises for above mentioned topics

- **Accessing Hardware Mechanisms**
 - System Memory
 - Device Memory
 - I/O Ports
 - I/O ports vs. memory mapping
 - Allocating and mapping I/O space
 - Functions for reading and writing I/O ports
 - Side effects and compiler optimization
 - Accessing hardware from User Space
 - Example: the Parallel Port
 - Driver example
 - Barriers
 - User-Mode Access to Devices
 - open, close, read, write
 - ioctl
 - ioperm, iopl, inb, outb
 - mmap, munmap

- **The proc file system programming**
 - Using /proc
 - Creating proc file system entries
 - Registration
 - Reading from /proc
 - Writing to /proc
 - Lab exercises

- **Hardware and Interrupt Handling**
 - Installing and implementing an interrupt handler
 - Restrictions of kernel code running in interrupt context
 - IRQs & their Registration
 - IRQ Handling & Control
 - Top & Bottom Halves
 - Enabling and Disabling Interrupts
 - Lab exercises

- **Tasklets and Bottom halves**
 - Task queues
 - Lab exercises

- **Kernel Threads**
 - Lab exercises

- **Sleep and wakeup (wait queues)**

- **Memory Management**
 - Allocating Memory
 - Accessing Memory
 - Get Some Space (kmalloc()), kfree(), various flags
 - Get Some Pages (get_free_page())
 - Get Some Virtual Memory - vmalloc()
 - Get Some Boot-time Space

- **Concurrency and Race Conditions**
 - Combating Race Conditions
 - Atomic Operations
 - Semaphores
 - Spin Locks

- **Time, Delays and Deferred Work**
 - Kernel Timers
 - Timer handling
 - HZ and Jiffies
 - Time of Day
 - Delayed Execution
 - Kernel Timers
 - Current time

- **The Linux Device Model**

- **Character Device Drivers**
 - Registering a character device driver
 - The file structure
 - Major and minor numbers
 - Character Device Methods open(), release(), read(), write()
 - Data Transfers between User Process and Driver
 - copy_from_user(), copy_to_user()
 - Making a Device File
 - Memory Access in Kernel Space
 - Programming with ioctl(), mmap()
 - devfs / lseek / ioctl
 - Lab exercises

- **Writing various Character Drivers**
 - Memory Based Driver
 - IO PORT (Hardware) Based Driver

- **Programming with ioctl()**
 - writing device driver with ioctl()
 - Adding ioctl's in an existing device driver
 - Lab exercises

- **Netlink socket interface**
 - point to point, multicast and broadcast
 - UDP, TCP and Raw sockets
 - Writed kernel module and userspace applilications using Netlink sockets
 - Lab exercises
- **Network Drivers**
 - The net_device structure in detail
 - Packet transmission
 - Packet reception
 - Simulating a network device
 - Lab exercises
- **Adding a Driver to the Kernel Tree**
- **Sample Hardware based device driver projects**

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