Linux
Kernel Debugging

Leverage proven tools and advanced techniques to effectively debug
Linux kernels and kernel modules

Kaiwan N Billimoria

[The Linux Kernel Debugging Computer Science](#)

Julia Schneider

The Linux Kernel Debugging Computer Science:

   Linux Kernel Debugging Kaiwan N. Billimoria,2022-08-05 Effectively debug kernel modules device drivers and the kernel itself by gaining a solid understanding of powerful open source tools and advanced kernel debugging techniques Key Features Fully understand how to use a variety of kernel and module debugging tools and techniques using examples Learn to expertly interpret a kernel Oops and identify underlying defect s Use easy to look up tables and clear explanations of kernel level defects to make this complex topic easy Book DescriptionThe Linux kernel is at the very core of arguably the world s best production quality OS Debugging it though can be a complex endeavor Linux Kernel Debugging is a comprehensive guide to learning all about advanced kernel debugging This book covers many areas in depth such as instrumentation based debugging techniques printk and the dynamic debug framework and shows you how to use Kprobes Memory related bugs tend to be a nightmare two chapters are packed with tools and techniques devoted to debugging them When the kernel gifts you an Oops how exactly do you interpret it to be able to debug the underlying issue We ve got you covered Concurrency tends to be an inherently complex topic so a chapter on lock debugging will help you to learn precisely what data races are including using KCSAN to detect them Some thorny issues both debug and performance wise require detailed kernel level tracing you ll learn to wield the impressive power of Ftrace and its frontends You ll also discover how to handle kernel lockups hangs and the dreaded kernel panic as well as leverage the venerable GDB tool within the kernel KGDB along with much more By the end of this book you will have at your disposal a wide range of powerful kernel debugging tools and techniques along with a keen sense of when to use which What you will learn Explore instrumentation based printk along with the powerful dynamic debug framework Use static and dynamic Kprobes to trap into kernel module functions Catch kernel memory defects with KASAN UBSAN SLUB debug and kmemleak Interpret an Oops in depth and precisely identify it s source location Understand data races and use KCSAN to catch evasive concurrency defects Leverage Ftrace and trace cmd to trace the kernel flow in great detail Write a custom kernel panic handler and detect kernel lockups and hangs Use KGDB to single step and debug kernel module source code Who this book is for This book is for Linux kernel developers module driver authors and testers interested in debugging and enhancing their Linux systems at the level of the kernel System administrators who want to understand and debug the internal infrastructure of their Linux kernels will also find this book useful A good grasp on C programming and the Linux command line is necessary Some experience with kernel module development will help you follow along   **Linux Kernel Development** Robert Love,2010 This practical guide helps programmers better understand the Linux kernel and to write and develop kernel code It provides in depth coverage of all the major subsystems and features of the Linux 2 6 kernel   **LF320 Linux Kernel Internals and Debugging** Linux Foundation,2010-04-29 Linux Kernel Internals and Debugging is designed to provide experienced programmers with a solid understanding of the Linux kernel Upon mastering this material you will have a basic understanding of the Linux architecture

kernel algorithms hardware and memory management modularization techniques and debugging   <u>The Linux Kernel Primer</u> Claudia Salzberg Rodriguez,Claudia Salzberg,Gordon Fischer,Steven Smolski,2006 Offers a comprehensive view of the underpinnings of the Linux kernel on the Intel x86 and the Power PC   *Memory Dump Analysis Anthology* Dmitry Vostokov,2008-04 This revised cross referenced and thematically organized volume of selected DumpAnalysis org blog posts targets software engineers developing and maintaining products on Windows platforms technical support and escalation engineers   **The Proceedings of the Thirtieth SIGCSE Technical Symposium on Computer Science Education** Jane Prey,SIGCSE99: The 30th ACM SIGCSE Technical Symposium,1999   <u>Linux Debugging and Performance Tuning</u> Steve Francis Best,2006 This is the definitive guide to Linux software debugging and performance optimization at both the kernel and application levels Using extensive Linux code examples Steve Best systematically introduces open source tools and best practice techniques for delivering bug free well tuned code BOOK JACKET   *The Proceedings of the Thirtieth SIGCSE Technical Symposium on Computer Science Education* Daniel T. Joyce,1999   **Debugging Linux Systems (Digital Short Cut)** Sreekrishnan Venkateswaran,2009-11-03 Debugging Linux Systems discusses the main tools available today to debug 2 6 Linux Kernels We start by exploring the seemingly esoteric operations of the Kernel Debugger KDB Kernel GNU DeBugger KGDB the plain GNU DeBugger GDB and JTAG debuggers We then investigate Kernel Probes a feature that lets you intrude into a kernel function and extract debug information or apply a medicated patch Analyzing a crash dump can yield clues for postmortem analysis of kernel crashes or hangs so we take a look at Kdump a serviceability tool that collects a system dump after spawning a new kernel Profiling points you to code regions that burn more CPU cycles so we learn to use the OProfile kernel profiler and the gprof application profiler to sense the presence of code bottlenecks Because tracing provides insight into behavioral problems that manifest during interactions between different code modules we delve into the Linux Trace Toolkit a system designed for high volume trace capture The section Debugging Embedded Linux takes a tour of the I O interfaces commonly found on embedded hardware such as flash memory serial port PCMCIA Secure Digital media USB RTC audio video touch screen and Bluetooth and provides pointers to debug the associated device drivers We also pick up some board level debugging skills with the help of a case study The section Debugging Network Throughput takes you through some device driver design issues and protocol implementation characteristics that can affect the horsepower of your network interface card We end the shortcut by examining several options available in the kernel configuration menu that can emit valuable debug information   **Computerworld** ,2005-07-18 For more than 40 years Computerworld has been the leading source of technology news and information for IT influencers worldwide Computerworld s award winning Web site Computerworld com twice monthly publication focused conference series and custom research form the hub of the world s largest global IT media network   *Computer Sciences Technical Report* ,2004   **Linux System Programming** Robert Love,2007-11-15 This book is about writing software that makes the most effective use of the system you re running on code

that interfaces directly with the kernel and core system libraries including the shell text editor compiler debugger core utilities and system daemons The majority of both Unix and Linux code is still written at the system level and Linux System Programming focuses on everything above the kernel where applications such as Apache bash cp vim Emacs gcc gdb glibc ls mv and X exist Written primarily for engineers looking to program better at the low level this book is an ideal teaching tool for any programmer Even with the trend toward high level development either through web software such as PHP or managed code C someone still has to write the PHP interpreter and the C virtual machine Linux System Programming gives you an understanding of core internals that makes for better code no matter where it appears in the stack Debugging high level code often requires you to understand the system calls and kernel behavior of your operating system too Key topics include An overview of Linux the kernel the C library and the C compiler Reading from and writing to files along with other basic file I O operations including how the Linux kernel implements and manages file I O Buffer size management including the Standard I O library Advanced I O interfaces memory mappings and optimization techniques The family of system calls for basic process management Advanced process management including real time processes File and directories creating moving copying deleting and managing them Memory management interfaces for allocating memory managing the memory you have and optimizing your memory access Signals and their role on a Unix system plus basic and advanced signal interfaces Time sleeping and clock management starting with the basics and continuing through POSIX clocks and high resolution timers With Linux System Programming you will be able to take an in depth look at Linux from both a theoretical and an applied perspective as you cover a wide range of programming topics *Algorithms and Architectures for Parallel Processing* Ting Hu,Feng Wang,Hongwei Li,Qian Wang,2018-12-29 This book constitutes the workshop proceedings of the 18th International Conference on Algorithms and Architectures for Parallel Processing ICA3PP 2018 held in Guangzhou China in November 2018 The 24 full papers presented were carefully selected and reviewed from numerous submissions to the two following workshops ICA3PP 2018 Workshop on Intelligent Algorithms for Large scale Complex Optimization Problems ICA3PP 2018 Workshop on Security and Privacy in Data Processing Linux Journal ,2005-07 *Information Security* Colin Boyd,Wenbo Mao,2003-12-12 The 2003 Information Security Conference was the sixth in a series that started with the InformationSecurity Workshopin 1997 A distinct feature of this series is the wide coverage of topics with the aim of encouraging interaction between researchers in di erent aspects of information security This trend continued in the program of this year s conference There were 133 paper submissions to ISC 2003 From these submissions the 31papersintheseproceedingswereselectedbytheprogramcommittee covering a wide range of technical areas These papers are supplemented by two invited papers athirdinvitedtalkwaspresentedattheconferencebutisnotrepresented by a written paper We would like to extend our sincere thanks to all the authors that submitted papers to ISC 2003 and we hope that those whose papers were declined will be able to nd an alternative forum for their work We are also very grateful to the three

eminent invited speakers at the conference Paul van Oorschot Carleton University Canada Ueli Maurer ETH Zur ich Switzerland and Andy Clark Inforenz Limited UK We were fortunate to have an energetic team of experts who took onthe task of the program committee Their names may be found overleaf and we thank them warmly for their considerable e orts This team was helped by an even larger number of individuals who reviewed papers in their particular areas of expertise A list of these names is also provided which we hope is complete *InfoWorld* ,2003-06-02 InfoWorld is targeted to Senior IT professionals Content is segmented into Channels and Topic Centers InfoWorld also celebrates people companies and projects *Linux Kernel Programming* THIERRY GAYET,2025-06-11 DESCRIPTION Linus Torvald released the first version of a kernel in 1991 inspired at the time by both proprietary Unix and the Minix system Thirty four years later this system has evolved with stability and robustness making it almost indispensable for the DevSecOps community The Linux kernel forms the robust core of countless systems from embedded devices to vast data centers driving unparalleled power and flexibility This book is your essential guide to deeply understanding this fundamental component and mastering the art of developing high performance kernel level code This book meticulously details the kernel s history architectural evolution and custom build processes You will master device driver fundamentals distinguishing user from kernel space and understanding the Linux Device Model LDM It explores Linux Security Modules intricate kernel memory management and various vital communication interfaces like I2C SPI SERIAL PCI and RTC The guide concludes with task process management real time concepts and essential kernel debugging and profiling By the end of this book you will be well equipped to confidently develop optimize and debug kernel level code This empowers you to build custom Linux systems craft efficient device drivers and troubleshoot complex issues ready to tackle advanced Linux system programming challenges You will also be able to better understand this system and develop your own drivers or low level developments for it WHAT YOU WILL LEARN GNU Linux kernel history feature evolution and licensing Understand and develop your character and block drivers Develop new file systems Manage your systems by communicating with the USB protocol Debug your drivers your kernel or any other module in the kernel space Understand the layout of the Linux device model Memory management in the kernel as well as via DMA or NUMA Implement Linux Security Modules LSM and Netfilter stack hooks WHO THIS BOOK IS FOR This book is for software engineers looking to understand the Linux kernel s architecture modify it and develop custom modules It also supports project managers team leaders and technical managers seeking a clear view of kernel development and capabilities CISOs and IT managers will benefit from insights into kernel limitations vulnerabilities and security measures such as Linux Security Modules LSMs TABLE OF CONTENTS 1 History of the GNU Linux Kernel 2 Introduction to the Linux Kernel 3 Introduction to Device Drivers 4 Linux Device Model 5 Character Device Drivers 6 Block Drivers and Virtual Filesystem 7 USB Drivers and libusb 8 Network Drivers 9 Linux Security Modules 10 Kernel Memory and DMA 11 Navigating Linux Communication Interfaces 12 Process Management 13 Debugging GNU Linux Kernel and Drivers **User Mode Linux** Jeff

Dike,2006 With User Mode Linux you can create virtual Linux machines within a Linux computer and use them to test and debug applications network services and even kernels This work covers almost everything from getting started through running enterprise class User Mode Linux servers It offers advice on bootup compilation administration and more *Linux NFS and Automounter Administration* Erez Zadok,2001 The Craig Hunt Linux Library provides the advanced information that Linux professionals and systems administrators need to keep their Linux servers up and running at maximum efficiency Developed by noted Linux and TCP IP guru Craig Hunt and written by acknowledged Linux experts these books dig deeper into each of the eight key Linux topics Samba Apache DHCP NFS and Automounter Sendmail DNS security and system administration than any other book on the market Erez Zadok creator of the latest release of Automounter Daemon Amd pens this comprehensive look inside the most popular Linux Unix distributed file system Learn how to install and configure Amd and NFS for optimum speed and reliability This addition to the popular Craig Hunt Linux Library gives you an in depth look at troubleshooting NFS access problems server side and client security plus using the Automounter query tool Amq

Linux Kernel Programming Kaiwan N Billimoria,2021-03-19 Learn how to write high quality kernel module code solve common Linux kernel programming issues and understand the fundamentals of Linux kernel internals Key Features Discover how to write kernel code using the Loadable Kernel Module framework Explore industry grade techniques to perform efficient memory allocation and data synchronization within the kernel Understand the essentials of key internals topics such as kernel architecture memory management CPU scheduling and kernel synchronization Book DescriptionLinux Kernel Programming is a comprehensive introduction for those new to Linux kernel and module development This easy to follow guide will have you up and running with writing kernel code in next to no time This book uses the latest 5 4 Long Term Support LTS Linux kernel which will be maintained from November 2019 through to December 2025 By working with the 5 4 LTS kernel throughout the book you can be confident that your knowledge will continue to be valid for years to come You ll start the journey by learning how to build the kernel from the source Next you ll write your first kernel module using the powerful Loadable Kernel Module LKM framework The following chapters will cover key kernel internals topics including Linux kernel architecture memory management and CPU scheduling During the course of this book you ll delve into the fairly complex topic of concurrency within the kernel understand the issues it can cause and learn how they can be addressed with various locking technologies mutexes spinlocks atomic and refcount operators You ll also benefit from more advanced material on cache effects a primer on lock free techniques within the kernel deadlock avoidance with lockdep and kernel lock debugging techniques By the end of this kernel book you ll have a detailed understanding of the fundamentals of writing Linux kernel module code for real world projects and products What you will learn Write high quality modular kernel code LKM framework for 5 x kernels Configure and build a kernel from source Explore the Linux kernel architecture Get to grips with key internals regarding memory management within the kernel Understand and work with various dynamic kernel

memory alloc dealloc APIs Discover key internals aspects regarding CPU scheduling within the kernel Gain an understanding of kernel concurrency issues Find out how to work with key kernel synchronization primitives Who this book is for This book is for Linux programmers beginning to find their way with Linux kernel development If you re a Linux kernel and driver developer looking to overcome frequent and common kernel development issues or understand kernel intervals you ll find plenty of useful information You ll need a solid foundation of Linux CLI and C programming before you can jump in

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