

## Fttth Handbook Fttth Council

Offers exhaustive research on collaborations in education, business, and the government and social sectors.

Nowadays, the Internet plays a vital role in our lives. It is currently one of the most effective media that is shifting to reach into all areas in today's society. While we move into the next decade, the future of many emerging technologies (IoT, cloud solutions, automation and AI, big data, 5G and mobile technologies, smart cities, etc.) is highly dependent on Internet connectivity and broadband communications. The demand for mobile and faster Internet connectivity is on the rise as the voice, video, and data continue to converge to speed up business operations and to improve every aspect of human life. As a result, the broadband communication networks that connect everything on the Internet are now considered a complete ecosystem routing all Internet traffic and delivering Internet data faster and more flexibly than ever before. This book gives an insight into the latest research and practical aspects of the broadband communication networks in support of many emerging paradigms/applications of global Internet from the traditional architecture to the incorporation of smart applications. This book includes a preface and introduction by the editors, followed by 20 chapters written by leading international researchers, arranged in three parts. This book is recommended for researchers and professionals in the field and may be used as a reference book on broadband communication networks

as well as on practical uses of wired/wireless broadband communications. It is also a concise guide for students and readers interested in studying Internet connectivity, mobile/optical broadband networks and concepts/applications of telecommunications engineering.

This Handbook provides a detailed and wide-ranging coverage of the key economic questions in South Africa, concentrating on the more recent economic challenges facing the country.

This comprehensive new resource demonstrates how to build smart grids utilizing the latest telecommunications technologies. Readers find practical coverage of PLC and wireless for smart grid and are given concise excerpts of the different technologies, networks, and services around it. Design and planning guidelines are shown through the combination of electricity grid and telecommunications technologies that support the reliability, performance and security requirements needed in smart grid applications. This book covers a wide range of critical topics, including telecommunications for power engineers, power engineering for telecommunications engineers, utility applications projecting in smart grids, technologies for smart grid networks, and telecommunications architecture. This practical reference is supported with in-depth case studies.

The 14 International Conference on Knowledge-Based and Intelligent Information and Engineering Systems was held during September 8–10, 2010 in Cardiff, UK. The conference was organized by the School of Engineering

at Cardiff University, UK and KES International. KES2010 provided an international scientific forum for the presentation of the - sults of high-quality research on a broad range of intelligent systems topics. The c-  
ference attracted over 360 submissions from 42 countries and 6 continents: Argentina, Australia, Belgium, Brazil, Bulgaria, Canada, Chile, China, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong ROC, Hungary, India, Iran, Ireland, Israel, Italy, Japan, Korea, Malaysia, Mexico, The Netherlands, New Zealand, Pakistan, Poland, Romania, Singapore, Slovenia, Spain, Sweden, Syria, Taiwan, -  
nesia, Turkey, UK, USA and Vietnam. The conference consisted of 6 keynote talks, 11 general tracks and 29 invited s- sions and workshops, on the applications and theory of intelligent systems and related areas. The distinguished keynote speakers were Christopher Bishop, UK, Nikola - sabov, New Zealand, Saeid Nahavandi, Australia, Tetsuo Sawaragi, Japan, Yuzuru Tanaka, Japan and Roger Whitaker, UK. Over 240 oral and poster presentations provided excellent opportunities for the presentation of interesting new research results and discussion about them, leading to knowledge transfer and generation of new ideas. Extended versions of selected papers were considered for publication in the Int- national Journal of Knowledge-Based and Intelligent Engineering Systems, Engine- ing Applications of Artificial Intelligence, Journal of Intelligent Manufacturing, and Neural Computing and Applications. This much-needed book describes the digital home networkingenvironment, its techniques, and the

challenges around its service architecture. It provides a broad introduction to state-of-the-art digital home standards and protocols, as well as in-depth coverage of service architectures for entertainment and domestic services involving digital home resources. Topics include networking, remote access, security, interoperability, scalability, and quality of service. Notably, the book describes the generic architecture that was proposed and developed in the context of the EUREKA/Celtic research project Feel@Home.

Written by some of the best known POF experts from Germany, one of the leading countries in POF technology, this is the most comprehensive introduction and survey of POF data communication systems currently available. Half a decade after it was first published, this second edition has been completely revised and updated; it has doubled in size. It features recent experimental results, and more than 1000 figures, 600 references and numerous tables complete the text. This guide identifies issues and challenges in broadband development, analyzing potential solutions to consider, and providing practical examples from countries that have addressed broadband-related matters.

This broad-ranging volume fundamentally covers all the variable factors of development and advancement of the promising technology of FTTH, which will be the key broadband telecom access technique to the end users of the future.

The second edition of this handbook provides a state-of-the-art overview on the various aspects in the rapidly developing field of robotics. Reaching for the human frontier, robotics is vigorously engaged in the growing challenges of new

emerging domains. Interacting, exploring, and working with humans, the new generation of robots will increasingly touch people and their lives. The credible prospect of practical robots among humans is the result of the scientific endeavour of a half a century of robotic developments that established robotics as a modern scientific discipline. The ongoing vibrant expansion and strong growth of the field during the last decade has fueled this second edition of the Springer Handbook of Robotics. The first edition of the handbook soon became a landmark in robotics publishing and won the American Association of Publishers PROSE Award for Excellence in Physical Sciences & Mathematics as well as the organization's Award for Engineering & Technology. The second edition of the handbook, edited by two internationally renowned scientists with the support of an outstanding team of seven part editors and more than 200 authors, continues to be an authoritative reference for robotics researchers, newcomers to the field, and scholars from related disciplines. The contents have been restructured to achieve four main objectives: the enlargement of foundational topics for robotics, the enlightenment of design of various types of robotic systems, the extension of the treatment on robots moving in the environment, and the enrichment of advanced robotics applications. Further to an extensive update, fifteen new chapters have been introduced on emerging topics, and a new generation of authors have joined the handbook's team. A novel addition to the second edition is a comprehensive collection of multimedia references to more than 700 videos, which bring valuable insight into the contents. The videos can be viewed directly augmented into the text with a smartphone or tablet using a unique and specially designed app. Springer Handbook of Robotics Multimedia Extension Portal: <http://handbookofrobotics.org/> This is a self-contained book on the foundations and

applications of optical and microwave technologies to telecommunication networks application, with an emphasis on access, local, road, cars, trains, vessels and airplanes, indoor and in-car data transmission as well as for long-distance fiber-systems and application in outer space and automation technology. The book provides a systematic discussion of physics/optics, electromagnetic wave theory, optical fibre technology, and the potential and limitations of optical and microwave transmission.

FTTH Handbook Digital Home Networking John Wiley & Sons  
This book contains a selection of refereed papers presented at the “International Conference on Operations Research (OR 2011)” which took place at the University of Zurich from August 30 to September 2, 2011. The conference was jointly organized by the German speaking OR societies from Austria (ÖGOR), Germany (GOR) and Switzerland (SVOR) under the patronage of SVOR. More than 840 scientists and students from over 50 countries attended OR 2011 and presented 620 papers in 16 parallel topical streams, as well as special award sessions. The conference was designed according to the understanding of Operations Research as an interdisciplinary science focusing on modeling complex socio-technical systems to gain insight into behavior under interventions by decision makers. Dealing with “organized complexity” lies in the core of OR and designing useful support systems to master the challenge of system management in complex environment is the ultimate goal of our professional societies. To this end, algorithmic techniques and system modeling are two fundamental competences which are also well-balanced in these proceedings.

Multimedia computing has emerged as a major area of research. Coupled with high-speed networks, multimedia computer systems have opened a spectrum of new applications by combining a variety of information sources,

such as voice, graphics, animation, images, audio, and video. Handbook on Multimedia Computing provides a comprehensive resource on advanced topics in this field, considered here as the integration of four industries: computer, communication, broadcasting/entertainment, and consumer electronics. This indispensable reference compiles contributions from 80 academic and industry leaders, examining all the major subsets of multimedia activity. Four parts divide the text: Basic Concepts and Standards introduces basic multimedia terminology, taxonomy, and concepts, including multimedia objects, user interfaces, and standards Multimedia Retrieval and Processing Techniques addresses various aspects of audio, image, and video retrieval; indexing; and processing techniques and systems Multimedia Systems and Techniques covers critical multimedia issues, such as multimedia synchronization, operating systems for multimedia, multimedia databases, storage organizations, and processor architectures Multimedia Communications and Networking discusses networking issues, such as quality of service, resource management, and video transport An indispensable reference, Handbook on Multimedia Computing covers every aspect of multimedia applications and technology. It gives you the tools you need to understand and work in this fast-paced, continuously changing field.

This book is a comprehensive contributed volume that aims to describe and explain the design, fabrication, operating characteristics, and specific applications of the most popular and useful types of specialty optical fibers. These “specialty fibers include any kind of optical fiber that has been architecturally manipulated to diverge from a conventional structure. For instance, metal-coated fibers can be utilized for bandwidth improvement, and hollow core fibers offer more controllable dispersion for sensitive medical procedures.

Applications for these specialty fibers abound in the biomedical, sensors, and industrial fields, as well as in more traditional communications capacities. This book will act as a specialty fiber “guided tour, hosted by the top names in the discipline. The globally renowned editors, Drs. Mendez and Morse, have extensive experience in research, academia, and industry. \*Completely covers biomedical and industrial sensor technology with emphasis on real world applications \*Comparative studies of pros and cons of all fiber types with relation to test and measurement, mechanical properties and strength, and reliability \*Easy to access essential facts and details at the beginning of each chapter

This new book is an introduction to modern communications networks that now rely far less on telephone services and more on cellular and IP networks. The resource is designed to provide answers to the fundamental questions concerning telecommunications networks and services. This includes the structure and main components of a modern telecommunications network; the importance of standardization; and how cellular mobile networks operate; among many others. In addition, you are provided with problems and review questions to work through and help you master the material.

This handbook provides a glimpse of the research that is underway in smart cities, with an examination of the relevant issues. It describes software infrastructures for smart cities, the role of 5G and Internet of things in future smart cities scenarios, the use of clouds and sensor-based devices for monitoring and managing smart city facilities, a variety of issues in the emerging field of urban informatics, and various smart city applications. Handbook of Smart Cities includes fifteen chapters from renowned worldwide researchers working on various

aspects of smart city scale cyber-physical systems. It is intended for researchers, developers of smart city technologies and advanced-level students in the fields of communication systems, computer science, and data science. This handbook is also designed for anyone wishing to find out more about the on-going research thrusts and deployment experiences in smart cities. It is meant to provide a snapshot of the state-of-the-art at the time of its writing in several software services and cyber infrastructures as pertinent to smart cities. This handbook presents application case studies in video surveillance, smart parking, and smart building management in the smart city context. Unique experiences in designing and implementing the applications or the issues involved in developing smart city level applications are described in these chapters. Integration of machine learning into several smart city application scenarios is also examined in some chapters of this handbook.

First in-depth analysis of broadband developments in Europe, combining qualitative and quantitative analysis, with chapter contributions provided by in-country experts. This book constitutes revised selected papers from the 7th International Conference on Operations Research and Enterprise Systems, ICORES 2018, held in Funchal, Madeira, Portugal, in January 2018. The 12 papers presented in this volume were carefully reviewed and selected from a total of 59 submissions. They are organized in topical sections named: methodologies and technologies; and applications.

As optical technologies move closer to the core of

modern computer architecture, there arise many challenges in building optical capabilities from the network to the motherboard. Rapid advances in integrated optics technologies are making this a reality. However, no comprehensive, up-to-date reference is available to the technologies and principles underlying the field. The Encyclopedic Handbook of Integrated Optics fills this void, collecting the work of 53 leading experts into a compilation of the most important concepts, phenomena, technologies, and terms covering all related fields. This unique book consists of two types of entries: the first is a detailed, full-length description; the other, a concise overview of the topic. Additionally, the coverage can be divided into four broad areas: A survey of the basics of integrated optics, exploring theory, practical concerns, and the fundamentals behind optical devices Focused discussion on devices and components such as arrayed waveguide grating, various types of lasers, optical amplifiers, and optoelectronic devices In-depth examination of subsystems including MEMS, optical pickup, and planar lightwave circuits Finally, systems considerations such as multiplexing, demultiplexing, 3R circuits, transmission, and reception Offering a broad and complete treatment of the field, the Encyclopedic Handbook of Integrated Optics is the complete guide to the fundamentals, principles, and applications of integrated optics technology. The Internet is connecting an increasing number of individuals, organizations, and devices into global networks of information flows. It is accelerating the dynamics of innovation in the digital economy, affecting

the nature and intensity of competition, and enabling private companies, governments, and the non-profit sector to develop new business models. In this new ecosystem many of the theoretical assumptions and historical observations upon which economics rests are altered and need critical reassessment.

Updated February 2014 This book is an guide to the design and installation of outside plant fiber optic cabling networks. It was written as a reference book for instructors and students in classes aimed at FOA CFOT and CFOS/O OSP specialist certification as well as a reference for anyone working in the field. This book offers expansive coverage on the components and processes of fiber optics as used in all outside plant applications and installation practices. Underground, buried, aerial and submarine/underwater installations are covered in detail as is specialized testing for extreme long distance networks. Fiber to the home is given special treatment in an appendix where these new generation networks are described in detail. Complete OSP curriculum materials are available from FOA. It's hard to think of the science and technology of electrical engineering without considering the one reference that has, for over 90 years, covered it like no other: the STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS. Every technical breakthrough, every industry standard, every trend and defining issue--all have been a part of what has made the HANDBOOK a watershed reference for generations of engineers and technicians. One look at this new edition, featuring the insights of over 60 expert contributors, and you'll see that

this authoritative tradition is alive and well. Now more than ever, this standard-setting reference continues to give you the definitive, 360 degree look at the world of electricity, covering its generation, transmission, distribution, measurement, and use--including all the technical aspects needed by engineers working with electrical systems.

Today, multimedia applications on the Internet are still in their infancy. They include personalized communications, such as Internet telephone and videophone, and interactive applications, such as video-on-demand, videoconferencing, distance learning, collaborative work, digital libraries, radio and television broadcasting, and others. Handbook of Internet and Multimedia Systems and Applications, a companion to the author's Handbook of Multimedia Computing probes the development of systems supporting Internet and multimedia applications. Part one introduces basic multimedia and Internet concepts, user interfaces, standards, authoring techniques and tools, and video browsing and retrieval techniques. Part two covers multimedia and communications systems, including distributed multimedia systems, visual information systems, multimedia messaging and news systems, conference systems, and many others. Part three presents contemporary Internet and multimedia applications including multimedia education, interactive movies, multimedia document systems, multimedia broadcasting over the Internet, and mobile multimedia. As the volume of global Internet traffic increases, the Internet is beginning to suffer from a broad spectrum of performance-

degrading infrastructural limitations that threaten to jeopardize the continued growth of new, innovative services. In answer to this challenge, computer scientists seek to maintain the original design principles of the Internet while allowing for a more dynamic approach to the manner in which networks are designed and operated. The Handbook of Research on Redesigning the Future of Internet Architectures covers some of the hottest topics currently being debated by the Internet community at large, including Internet governance, privacy issues, service delivery automation, advanced networking schemes, and new approaches to Internet traffic-forwarding and path-computation mechanics. Targeting students, network-engineers, and technical strategists, this book seeks to provide a broad and comprehensive look at the next wave of revolutionary ideas poised to reshape the very foundation of the Internet as we know it.

"This book provides the latest and most relevant research on the understanding, expansion, and solutions on technologies used for improvements in the health and social care field"--Provided by publisher.

Communications: Wireless in Developing Countries and Networks of the Future The present book contains the proceedings of two conferences held at the World Computer Congress 2010 in Brisbane, Australia (September 20–23) organized by the International Federation for Information Processing (IFIP): the Third IFIP TC 6 International Conference on Wireless Communications and Information Technology for Developing Countries (WCITD 2010) and the IFIP TC 6 International Network of the Future Conference (NF 2010). The main objective of these two IFIP conferences on communications is to provide a platform for the exchange of recent and original contributions in wireless networks in developing countries and networks of the future. There are many exciting trends and developments in the communications

industry, several of which are related to advances in wireless networks, and next-generation Internet. It is commonly believed in the communications industry that a new generation should appear in the next ten years. Yet there are a number of issues that are being worked on in various industry research and development labs and universities towards enabling wireless high-speed networks, virtualization techniques, smart networks, high-level security schemes, etc. We would like to thank the members of the Program Committees and the external reviewers and we hope these proceedings will be very useful to all researchers interested in the fields of wireless networks and future network technologies.

This handbook is an authoritative, comprehensive reference on optical networks, the backbone of today's communication and information society. The book reviews the many underlying technologies that enable the global optical communications infrastructure, but also explains current research trends targeted towards continued capacity scaling and enhanced networking flexibility in support of an unabated traffic growth fueled by ever-emerging new applications. The book is divided into four parts: Optical Subsystems for Transmission and Switching, Core Networks, Datacenter and Super-Computer Networking, and Optical Access and Wireless Networks. Each chapter is written by world-renown experts that represent academia, industry, and international government and regulatory agencies. Every chapter provides a complete picture of its field, from entry-level information to a snapshot of the respective state-of-the-art technologies to emerging research trends, providing something useful for the novice who wants to get familiar with the field to the expert who wants to get a concise view of future trends. Taking a coherent and logical approach, this book describes the potential use of co-ordinated multipoint systems

supported by radio over fiber. It covers an impressive breadth of topics, ranging from components, subsystem and system architecture, to network management and business perspectives. The authors show the importance of radio over fiber in eliminating or mitigating against the current, perceived barriers to the use of co-ordinated multipoint, and the drivers for standardisation activities in future mobile/wireless systems over the next few years. The book brings together the system concept for centralized processing, including what is required for co-existence with legacy wireless systems, the algorithms that can be used for improving wireless bandwidth utilization at physical and MAC layers and the radio over fiber network and link design necessary to support the wireless system. Other important research is also covered as the authors look at compensating for radio over fiber impairments and providing simple network management functions. A study of service provision and the business case for such a future wireless system is also fully considered. This book comes at an important time for future wireless systems with standardization of fourth generation wireless systems still ongoing. The content enables readers to make key decisions about future standardisation and their own research work. The business analysis also makes the book useful to those involved in deciding the future directions of telecoms organisations. This information will be core to their decision-making as it provides technical knowledge of the state-of-the-art but also system level assessments of what is possible in a business environment.

ICT is playing an increasingly important role in both business and individual's private life. It has increased international interconnectedness and speed up the process of globalization. But on the other side the total energy consumption by the communication and networking devices and the relevant global CO<sub>2</sub> emission is increasing

exponentially. ICT has, in many ways, a vital role to play. It accounts for about two percent of global CO2 emissions. Telecommunications applications can have a direct, tangible impact on lowering greenhouse gas emissions, power consumption, and achieve efficient recycling of equipment waste. This book is the outcome of the special session on Green Communications at 'The 12th International Symposium on Wireless Personal Multimedia Communications' (WPMC) held in Sendai, Japan in September 2009. To the best of the editors' knowledge this is the first book on the Green Information and Communication Technologies (ICT) and can be considered a milestone and a key-tool aimed at driving the industrial, scientific and academic efforts of the international community to guarantee a greener future to the whole planet. Part I of the book Towards Green ICT provides the necessary background and technical content to understand the vision and the role of green communication packed with details of the technologies like Zigbee and RFID in turning the planet earth greener. Part II covers a number of paradigm-shifting technical approaches including energy-efficient deployment through optimizations in the planning of ICT networks, energy-efficient wireless transmission techniques, reduced transmission power & reduced radiation, cross-layer optimization methods, and opportunistic spectrum sharing without causing harmful interference pollution. Part III covers the application of Intelligent WiMAX (I-WiMAX), a green radio technique able to support new maritime communication services and ICT based Business models. The coverage of new and upcoming issues on Green ICT makes it a good choice for educators, industry practitioners, regulators, researchers and students

The Routledge International Handbook of Globalization Studies offers students clear and informed chapters on the history of globalization and key theories that have considered

the causes and consequences of the globalization process. There are substantive sections looking at demographic, economic, technological, social and cultural changes in globalization. The handbook examines many negative aspects – new wars, slavery, illegal migration, pollution and inequality – but concludes with an examination of responses to these problems through human rights organizations, international labour law and the growth of cosmopolitanism. There is a strong emphasis on interdisciplinary approaches with essays covering sociology, demography, economics, politics, anthropology and history. The Handbook written in a clear and direct style will appeal to a wide audience. The extensive references and sources will direct students to areas of further study.

This is the sales professional's handbook to understanding IT technologies and mastering the concepts and needs of a network environment. Essential understanding of the technologies that sales representatives need to know for success is provided here with case studies and real-world examples.

Optical Networking Best Practices Handbook presents optical networking in a very comprehensive way for nonengineers needing to understand the fundamentals of fiber, high-capacity, high-speed equipment and networks, and upcoming carrier services. The book provides a practical understanding of fiber optics as a physical medium, sorting out single-mode versus multi-mode and the crucial concept of Dense Wave-Division Multiplexing.

Das Internet-Ökosystem ist gekennzeichnet durch eine starke Dynamik und ausgeprägte Evolutorik. Während sich das Spektrum an Inhalten und

Anwendungsdiensten, welche integriert über "General-Purpose"-Breitbandnetze bereitgestellt werden sollen, fortwährend wandelt, werden sowohl die Anforderungen an die Datenübermittlung als auch entsprechende Kapazitätsallokationsprobleme zunehmend komplexer. Die erwartete Rolle des Internets der Dinge, 5G oder Virtual-Reality-Anwendungen unterstreicht, wie wichtig es für Anbieter von breitbandigen Zugangsdiensten sein wird, diesen sich wandelnden Anforderungen in einer ökonomisch effizienten Weise gerecht werden zu können. Dieses Buch untersucht Evolution und den Wettbewerb im Internet-Ökosystem und führt eine netzökonomische Analyse effizienter Kapazitätsallokationen in All-IP-Netzen durch. In diesem Zusammenhang wird die Rolle von Netzneutralitätsregulierungen kritisch bewertet.

The 4th edition of this popular Handbook continues to provide an easy-to-use guide to the many exciting new developments in the field of optical fiber data communications. With 90% new content, this edition contains all new material describing the transformation of the modern data communications network, both within the data center and over extended distances between data centers, along with best practices for the design of highly virtualized, converged, energy efficient, secure, and flattened network infrastructures. Key topics include networks for cloud computing, software defined networking, integrated and embedded networking appliances, and low latency networks for financial trading or other time-sensitive applications. Network architectures from the leading vendors are outlined

(including Smart Analytic Solutions, Qfabric, FabricPath, and Exadata) as well as the latest revisions to industry standards for interoperable networks, including lossless Ethernet, 16G Fiber Channel, RoCE, FCoE, TRILL, IEEE 802.1Qbg, and more. Written by experts from IBM, HP, Dell, Cisco, Ciena, and Sun/ Oracle Case studies and ‘How to...’ demonstrations on a wide range of topics, including Optical Ethernet, next generation Internet, RDMA and Fiber Channel over Ethernet Quick reference tables of all the key optical network parameters for protocols like ESCON, FICON, and SONET/ATM and a glossary of technical terms and acronyms

A complete and in-depth introduction to computer networks and networking In this first volume of The Handbook of Computer Networks, readers will get a complete overview of the key concepts of computers networks, data transmission, and digital and optical networks. Providing a comprehensive examination of computer networks, the book is designed for both undergraduate students and professionals working in a variety of computer network-dependent industries. With input from over 270 experts in the field, the text offers an easy-to-follow progression through each topic and focuses on fields and technologies that have widespread application in the real world.

Telecommunications have underpinned social interaction and economic activity since the 19th century and have been increasingly reliant on optical fibers since their initial commercial deployment by BT in 1983. Today, mobile phone networks, data centers, and broadband services that facilitate our entertainment, commerce, and

increasingly health provision are built on hidden optical fiber networks. However, recently it emerged that the fiber network is beginning to fill up, leading to the talk of a capacity crunch where the capacity still grows but struggles to keep up with the increasing demand. This book, featuring contributions by the suppliers of widely deployed simulation software and academic authors, illustrates the origins of the limited performance of an optical fiber from the engineering, physics, and information theoretic viewpoints. Solutions are then discussed by pioneers in each of the respective fields, with near-term solutions discussed by industrially based authors, and more speculative high-potential solutions discussed by leading academic groups.

This book is based on both industrial and academic research efforts in which a number of recent advancements and rare insights into telecommunication systems are well presented. The volume is organized into four parts: "Telecommunication Protocol, Optimization, and Security Frameworks", "Next-Generation Optical Access Technologies", "Convergence of Wireless-Optical Networks" and "Advanced Relay and Antenna Systems for Smart Networks." Chapters within these parts are self-contained and cross-referenced to facilitate further study.

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