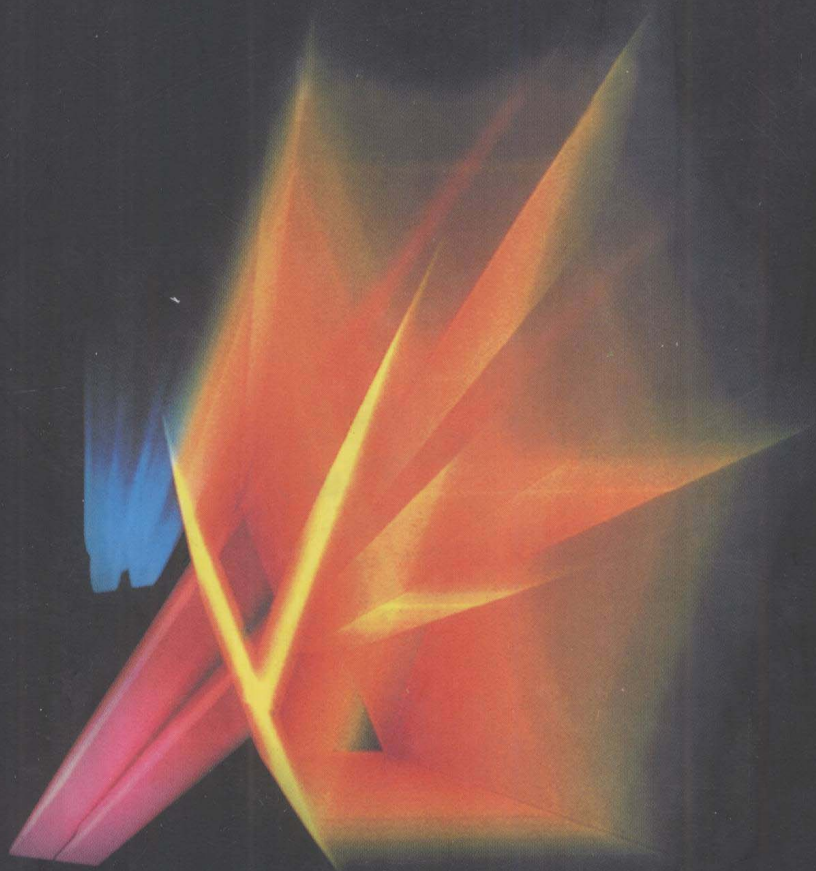


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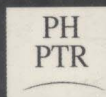
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Multimedia: Computing, Communications,
and Applications



Ralf Steinmetz Klara Nahrstedt

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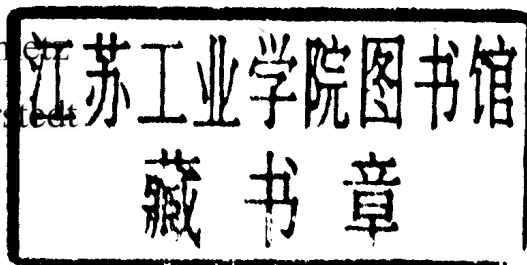
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By Ralf Steinmetz, Klara Nahrstedt

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内 容 提 要

本书从多媒体部件、系统和应用三个主要方面来阐述，内容系统、丰富、全面，从操作系统和硬件到用户界面、应用和编程采样，覆盖了包括新领域在内的许多重要的主题。本书由 18 章构成：前 5 章介绍了多媒体、媒体等概念及数据流的特点，具体讲述了声音/音频、图像和图形、视频和动画的基本概念、构成和表示方法；第 6 章概括了对音频和视频数据的存储，进行数据压缩的原因及实现数据压缩的编码方法（如 DCT 等）；第 7、8 章介绍了光存储介质和计算机技术；第 9 章详细讲述了资源和进程管理，给出了大量实时处理的主要算法；第 10 章概述了网络系统的层、协议、服务及网络的分类，也介绍了局域网、广域网和城域网的特点、分类和组成；第 11 章论述了在教育层子系统和传输层子系统中如何实现多媒体通信，如何实现 QoS 和资源管理；第 12 章简单描述了多媒体数据库的组成和管理；第 13 章通过利用 ODA、SGML、超文本和超媒体及 MHEG 对文档体系结构进行了分析；第 14 章引入了多媒体的一个重要内容，即多媒体交互界面的设计；第 15 章较为详细地描述了多媒体系统的核心——多媒体同步问题，包括同步的构想、要求以及一个多媒体同步的参考模型等；第 16 章的内容是编程抽象，详细概述了诸如库、系统软件、高级过程编程语言和面向对象方法的抽象层次；最后在第 17、18 章，讲述了多媒体在媒体成分制作与合成、媒体通信及娱乐等方面的应用和多媒体未来的发展方向。

本书既可作为高校相关专业多媒体课程的教材，又可作为在此领域工作的各类人员的参考资料。

出版说明

2001 年,教育部印发了《关于“十五”期间普通高等教育教材建设与改革的意见》。该文件明确指出,“九五”期间原国家教委在“抓好重点教材,全面提高质量”方针指导下,调动了各方面的积极性,产生了一大批具有改革特色的新教材。然而随着科学技术的飞速发展,目前高校教材建设工作仍滞后于教学改革的实践,一些教材内容陈旧,不能满足按新的专业目录修订的教学计划和课程设置的需要。为此该文件明确强调,要加强国外教材的引进工作。当前,引进的重点是信息科学与技术 and 生物科学与技术两大学科的教材。要根据专业(课程)建设的需要,通过深入调查、专家论证,引进国外优秀教材。要注意引进教材的系统配套,加强对引进教材的宣传,促进引进教材的使用和推广。

邓小平同志早在 1977 年就明确指出:“要引进外国教材,吸收外国教材中有益的东西。”随着我国加入 WTO,信息产业的国际竞争将日趋激烈,我们必须尽快培养出大批具有国际竞争能力的高水平信息技术人才。教材是一个很关键的问题,国外的一些优秀教材不但内容新,而且还提供了很多新的研究方法和思考方式。引进国外原版教材,可以促进我国教学水平的提高,提高学生的英语水平和学习能力,保证我们培养出的学生具有国际水准。

为了贯彻中央“科教兴国”的方针,配合国内高等教育教材建设的需要,人民邮电出版社约请有关专家反复论证,与国外知名的教材出版公司合作,陆续引进一些信息科学与技术优秀教材。第一批教材针对计算机专业的主干核心课程,是国外著名高等院校所采用的教材,教材的作者都是在相关领域享有盛名的专家教授。这些教材内容新,反映了计算机科学技术的最发展,对全面提高我国信息科学与技术的教学水平必将起到巨大的推动作用。

出版国外著名高等院校信息科学与技术优秀教材的工作将是一个长期的、坚持不懈的过程,我社网站(www.pptph.com.cn)上介绍了我们首批陆续推出的图书的详细情况,后续教材的引进和出版情况我们会及时在网上发布,敬请关注。希望广大教师和学生将使用中的意见和建议及时反馈给我们,我们将根据您的反馈不断改进我们的工作,推出更多更好的引进版信息科学与技术教材。

人民邮电出版社

2001 年 12 月

序 言

多媒体技术是 20 世纪 90 年代计算机的又一场革命。21 世纪的人类社会将是信息化社会，以信息技术为主要标志的高新技术产业在整个经济中的比重不断增长，多媒体技术及其产品是当今计算机产业发展的新领域。多媒体计算、通信及应用是人们如今最感兴趣的领域之一，在建筑、商业及教育等许多行业中得到了飞速的发展。计算机和网络应用现在传送和处理的已不仅仅是文本和图像，而是包括视频、音频和其他的连续媒体数据和附加的不连续媒体数据在内的多媒体数据。多媒体标准化组织正在积极为此领域制定许多新的标准，以符合多媒体技术发展的需要。

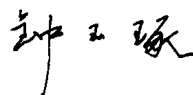
这本书从多媒体部件、系统和应用三个主要方面来阐述，其内容系统、丰富、全面，从操作系统和硬件到用户界面、应用和编程采样，覆盖了包括新领域在内的许多重要的主题，介绍了多媒体新兴领域方面的知识，有独到之处。

本书由 18 章构成，章节内容非常丰富和必需。各章主要内容大致如下：

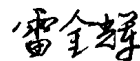
前 5 章介绍了多媒体、媒体等概念及数据流的特点，具体讲述了声音/音频、图像和图形、视频和动画的基本概念、构成和表示方法。第 6 章概括了对音频和视频数据的存储、进行数据压缩的原因及实现数据压缩的编码方法（如 DCT 等），详细介绍和描述了 H.261、JPEG、MPEG-1 和 MPEG-2 等标准中所使用的编码原理、算法和数据流和 DVI（交互式数字视频系统）的音频和静态图像编码、视频编码和数据流。第 7、8 章的内容是光存储媒介和计算机技术，介绍了 CD-DA、CD-ROM、CD-WO、CD-MO 等 CD 的体系结构和基本原理，通信体系结构和多媒体工作站的组成。关于多媒体操作系统的第 9 章中的论点是这本书比较独特的地方，该章详细讲述了资源和进程管理，给出了大量实时处理（速率单调，EDF 等）的主要算法。同时还详细讨论了文件系统管理，对多媒体操作系统的未来进行了展望。第 10 章概述了网络系统的层、协议、服务及网络的分类，也介绍了局域网、广域网和城域网的特点、分类和组成。第 11 章论述了 in 应用层子系统和传输层子系统中如何实现多媒体通信，如何实现 QoS 和资源管理。第 12 章简单描述

了多媒体数据库的组成和管理。第 13 章通过利用 ODA、SGML、超文本和超媒体及 MHEG 对文档体系结构进行了分析。做好以上准备后，第 14 章引入了多媒体的一个重要内容，即多媒体交互界面的设计。第 15 章较为详细地描述了多媒体系统的核心——多媒体同步问题，包括同步的构想、要求以及一个多媒体同步的参考模型等，这些内容在其他书中论述较少，是本书的又一特色之处。第 16 章的内容是编程抽象，详细概述了诸如库、系统软件、高级过程编程语言和面向对象方法的抽象层次。最后在第 17、18 章，讲述了多媒体在媒体成分制作与合成、媒体通信及娱乐等方面的应用和多媒体未来的发展方向。

本书既可作为高校相关专业多媒体课程的教材，又可作为在此领域工作的各类人员的参考资料。希望读者通过学习本书，对多媒体领域的相关知识有一个比较透彻的理解，在多媒体领域取得更大的成功。



清华大学 计算机科学与技术系 教授
中国计算机学会 多媒体专业委员会 主任



昆明理工大学 计算机系 副教授

Foreword

Multimedia computing and communications are areas of intense current interest, software and hardware development, and future promise. Residential, institutional and business applications are emerging at a fast pace. Multimedia standards organizations are actively producing new standards for the field. Yet, the term "multimedia" and the subject areas it covers remain, to many people who hear, read and even use the term, clouded in mystery. Some recent books have attempted to define the essential elements of this fascinating area with various degrees of success.

This book is fully successful in its enterprise; it will certainly fill a void in the emerging field of multimedia. The book covers all the important topics involved in the new area, from the operating system and hardware aspects to the user interface, the applications and the programming abstractions. Such a wealth of information is not found in any of the few other books published thus far in the field.

The book is organized in 18 chapters, all of which are very informative and essential. The first five chapters define multimedia terminology and review the fundamentals of sound/audio, images and graphics, video and animation. An excellent treatise on image and video data compression follows, introducing and describing in detail such important standards as H.261, JPEG, MPEG-1 and MPEG-2. Chapters in optical storage media and computer technology give the reader up-to-date information about CD standards and pertinent hardware technology.

The chapter on operating system issues really makes this book unique. Resource and process management are covered in detail. All the important algorithms for real-time scheduling (rate monotonic, earliest-deadline-first and so on) are given.

File systems management is discussed in detail, and future aspects of multimedia operating systems are also covered.

Networking systems are the subject of another chapter. All the technologies relevant to multimedia networking are described. A chapter on protocols and quality of service issues follows, giving an overview of important multimedia protocols.

A brief description of multimedia databases is followed by a complete treatment of document architectures and standards such as ODA, SGML, hypertext and MHEG. Important design issues concerning multimedia interfaces are then presented. A very rich chapter on multimedia synchronization describes the heart of a multimedia system. This treatment is another major contribution of the authors that cannot be found in other books. A discussion of important programming abstractions follows, and the book concludes with an interesting chapter on multimedia applications and one on future directions.

We expect that this book will become a standard text in multimedia courses as well as a standard reference for all people working in the field. We congratulate the authors for their laborious but worthwhile and successful endeavor, and wish the readers a most pleasant journey into the field of multimedia!

Nicolas D. Georganas, University of Ottawa

Domenico Ferrari, University of California at Berkeley

February 1995

Preface

There has been an explosive growth of multimedia computing, communication and applications during the last decade. Computers and networks process and transmit currently more than just text and images. Video, audio and other continuous media data, as well as additional discrete media such as graphics became part of integrated computer applications. In the future, all computers and networks will support multimedia computing and communication to provide appropriate services for multimedia applications.

This book aims to achieve a complete and balanced view on the multimedia field covering three main domains: *devices*, *systems* and *applications*. In the device domain, basic concepts for processing of video, audio, graphics and images are presented (Chapters 2 through 5). Because of the currently available technology and quality requirements, the original data rates of these media demand compression methods. The corresponding approaches are described in Chapter 6. Chapter 7 presents the optical storage media which have contributed significantly to the current development of computer-based multimedia systems. On the other hand, the high-speed networks, described in Chapter 10, with their higher bandwidth and transmission possibilities of all media kinds, have led to networked multimedia systems. In the system domain, Chapters 8 through 12 provide information on *computer technology* as an interface between the device and the system domain, *operating system*, *communication system* and *database system*. The application domain includes topics such as *programming abstractions* (Chapter 16), which represent the interface between the application and the system domain, *document handling* (Chapter 13), *tools and applications* (Chapter 17), and *user interfaces* through which the document handling, tools and applications are made accessible to humans. To all three

domains, one area is common: the *synchronization* of multimedia. This topic is covered separately in Chapter 15.

This book has the character of a *reference book*, covering a wide scope. It has evolved from the first multimedia technology book, published in German in 1993 [Ste93b] (Figures from this book were reused with permission of the Springer Verlag.). However, substantial areas have changed and enhancements have been made. The results, presented in this book, serve as groundwork for the development of individual components of a multimedia system. The book can be used by computer professionals who are interested in multimedia systems and applications. The book can also be used as a text for beginning or advanced graduate students in computer science, and related disciplines, although the absence of exercises for each chapter may put more load on the instructor. All discussions present the handling of multimedia in the corresponding domains and assume that the reader is familiar with the basic concepts of the systems: for example, scheduling in operating systems, layering in communication systems, etc. Since the amount of material in the book is too much for a one-semester course, it can be taught during two or more semesters. For example, the instructor could choose to emphasize the multimedia computing or communication aspect, including synchronization and application issues.

Many people have helped us with the preparation of this book. We would especially like to thank David Farber, Jonathan Smith, Ruzena Bajcsy, Craig Reynolds, Gerold Blakowski, Andreas Mauthe and Doris Meschzan. We would also like to thank Klara's colleagues from the Distributed System Laboratory for their comments and discussions during the writing process. Special thanks go to John Shaffer, Brendan Traw, Jean McManus and Anshul Kantawala. Acknowledgment is also due the National Science Foundation and the Defense Advanced Research Projects Agency (#NCR-8919038) for supporting Klara's research reported here.

Last but not least, we would like to thank our families for their support and patience.

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