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多媒体技术教程

（英文版）

Fundamentals of Multimedia

Ze-Nian Li · Mark S. Drew

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A 15 second clip of music from a compact disc was digitized at three different sampling rates (11 kHz, 22 kHz, and 44 kHz) with 8-bit precision. The effects of the different sampling rates are clearly audible. This is a demonstration of the *Nyquist Theorem.*

Press Button to Play 8-bit Audio Clip

Music 11 kHz
Music 22 kHz
Music 44 kHz

Nyquist Theorem:

The minimum sampling frequency of an A/D converter should be at least twice the frequency of the signal being measured.

Close

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Music 11 kHz
Music 22 kHz
Music 44 kHz

Nyquist Theorem:

The minimum sampling frequency of an A/D converter should be at least twice the frequency of the signal being measured.

Close

▲ FIGURE 2.4: Colors and fonts. *Courtesy of Ron Vetter.*
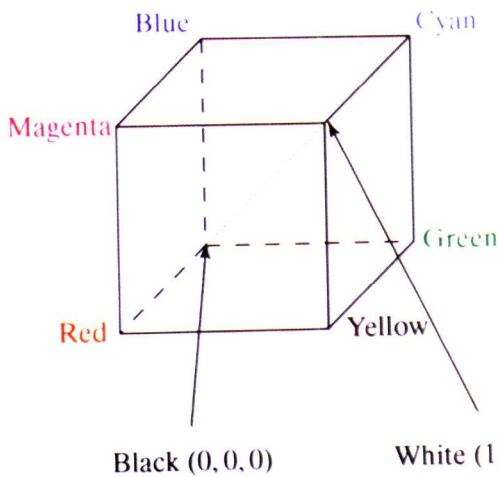

▶ FIGURE 2.6: Color wheel.
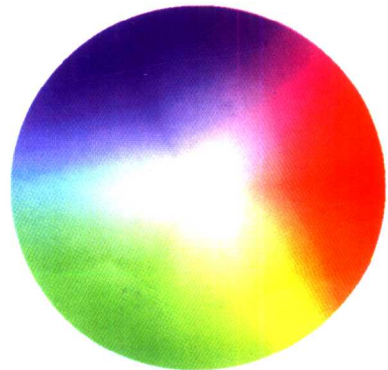
▲ FIGURE 3.5: High-resolution color and separate R, G, B color channel images. (a) example of 24-bit color image forestfire.bmp. (b, c, d) R, G, and B color channels for this image.
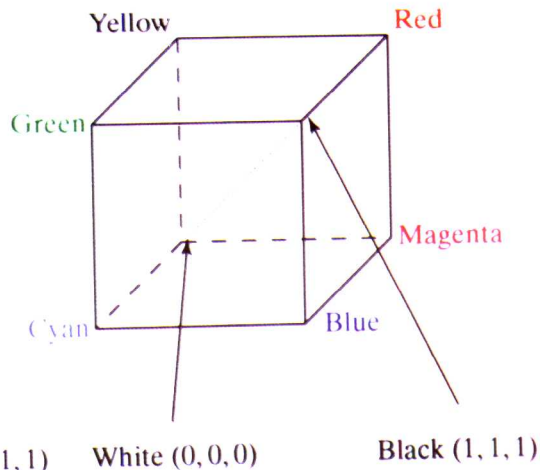

▲ FIGURE 3.7: Example of 8-bit color image.

▲ FIGURE 3.17: JPEG image with low quality specified by user.

The RGB Cube

The CMY Cube

▲ FIGURE 4.15: RGB and CMY color cubes.

(a)

(b)
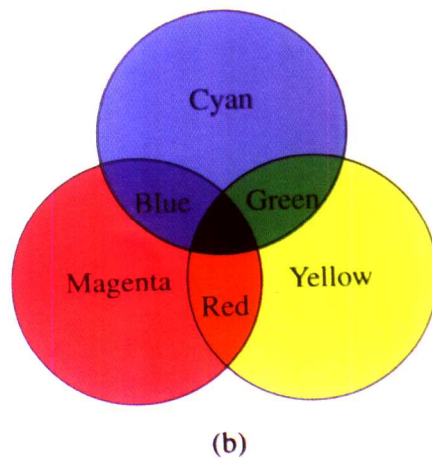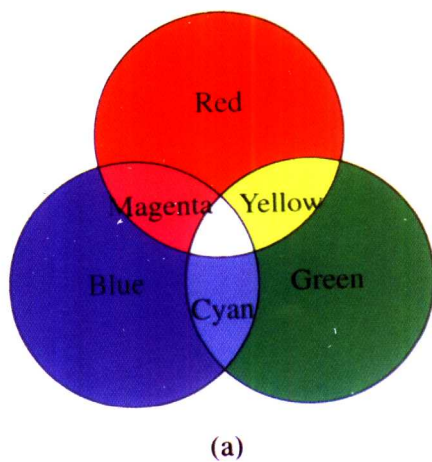
▲ FIGURE 4.16: Additive and subtractive color: (a) RGB is used to specify additive color; (b) CMY is used to specify subtractive color.

(a)

(b)

(c)

(d)
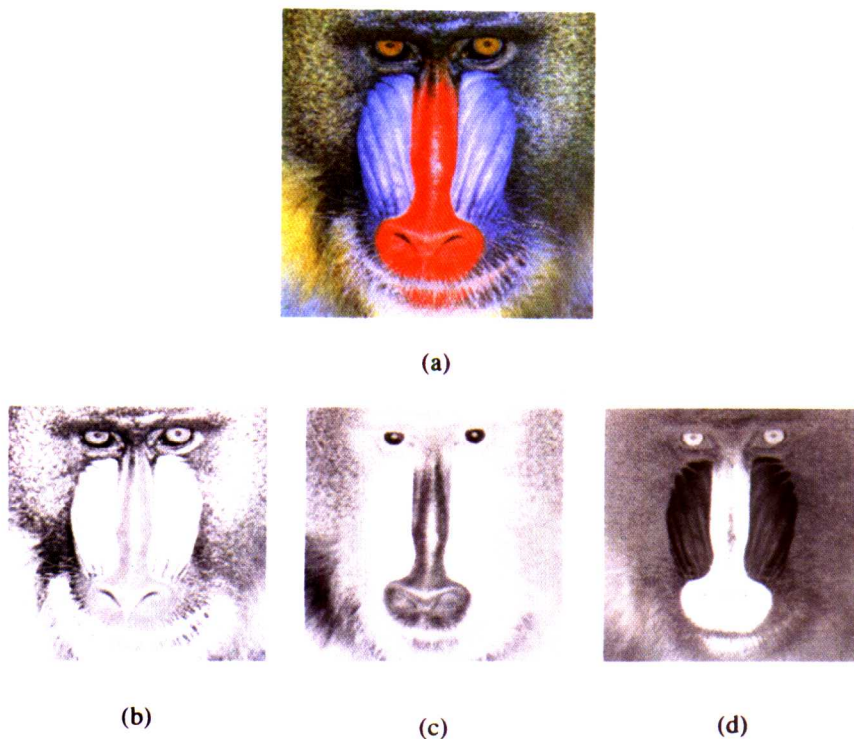
▲ **FIGURE 4.18:** $Y'UV$ decomposition of color image. Top image (a) is original color image; (b) is Y'; (c) is U; (d) is V.

$L = 100$
White

Green: $a < 0$ Yellow: $b > 0$

Blue: $b < 0$ Red: $a > 0$

Black
$L = 0$
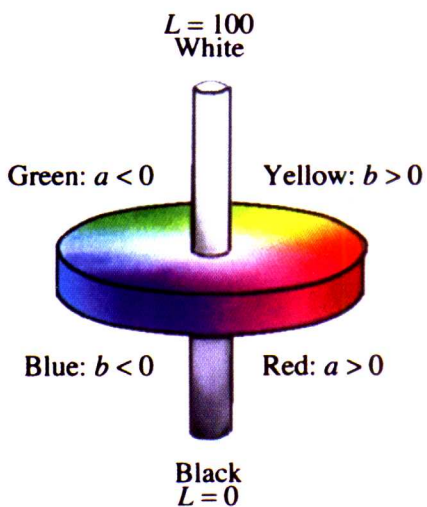
▲ **FIGURE 4.14:** CIELAB model.

▲ **FIGURE 4.21:** SMPTE Monitor gamut.

▲ FIGURE 9.13: Comparison of JPEG and JPEG2000: (a) Original image; (b) JPEG (left) and JPEG2000 (right) images compressed at 0.75 bpp; (c) JPEG (left) and JPEG2000 (right) images compressed at 0.25 bpp.

(a)

(b)

(c)
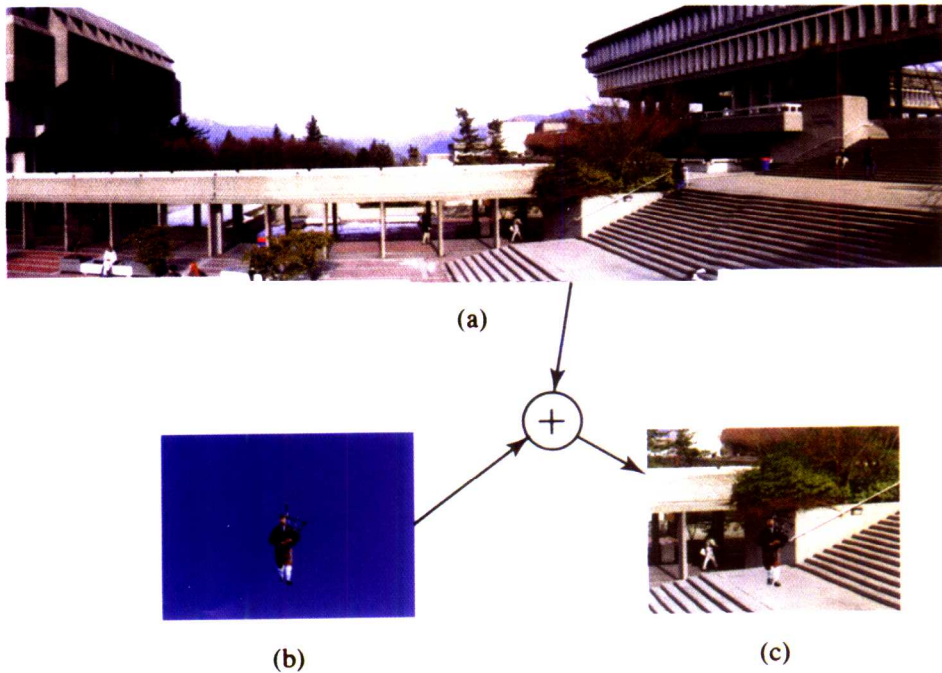
▲ **FIGURE 12.10:** Sprite Coding. (a) The the foreground object (piper) in a blue-screen image; (b) the foreground object (piper) in a bluescreen image; (c) the composed video scene. *Piper image courtesy of Simon Fraser University Pipe Band.*

Moving region: helicopter

Moving region: person

Moving region: boat
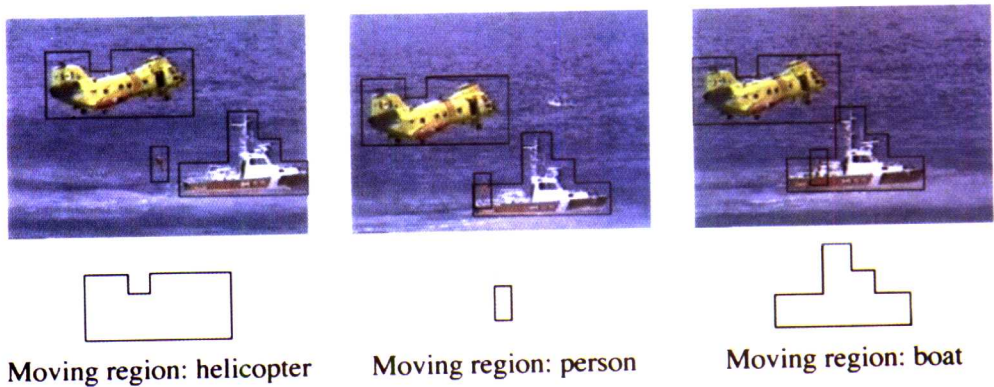
▲ **FIGURE 12.19:** MPEG-7 Video segments.
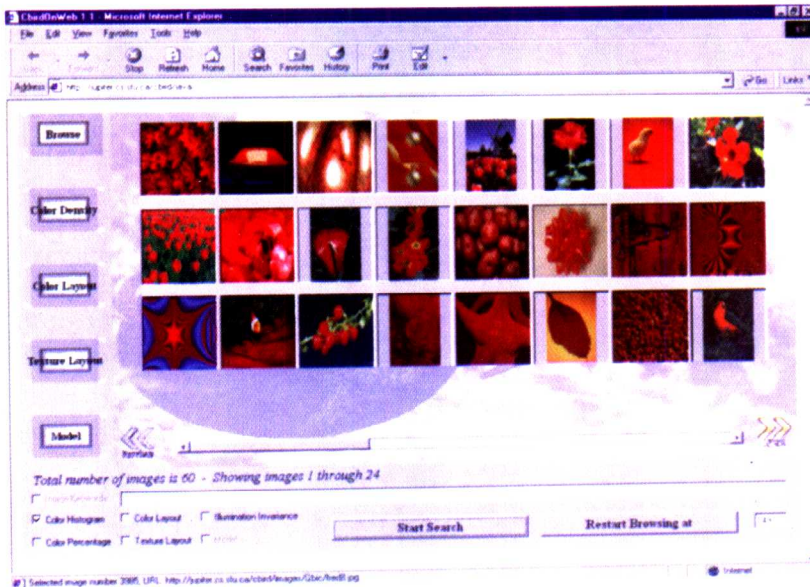
▲ **FIGURE 18.3:** Search by color histogram results. *Some thumbnail images are from the Corel Gallery and are copyright Corel. All rights reserved.*
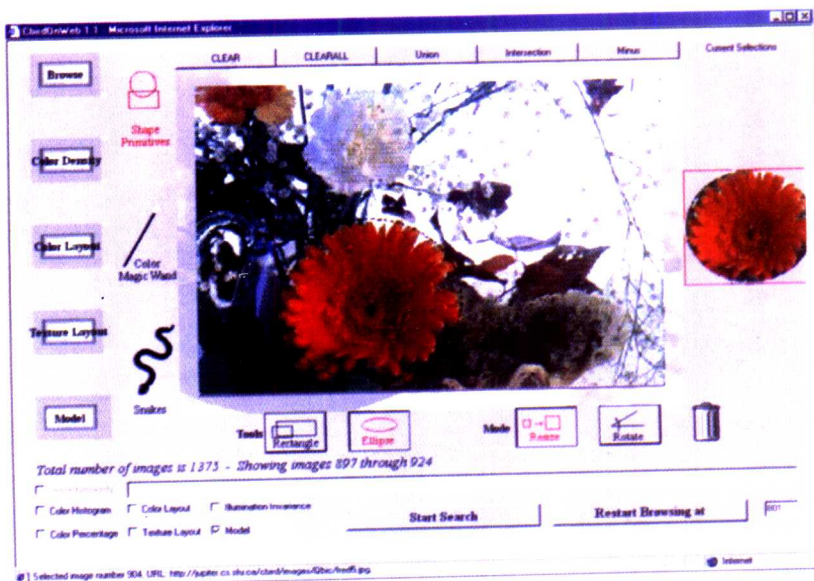
▲ **FIGURE 18.8:** C-BIRD interface showing object selection using an ellipse primitive. *Image is from the Corel Gallery and is copyright Corel. All rights reserved.*
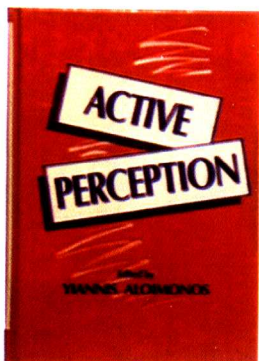
◀ **FIGURE 18.10:** Model and target images. (a) Sample model image; (b) sample database image containing the model book. *Active Perception textbook cover courtesy Lawrence Erlbaum Associates, Inc.*

(a) (b)

▶ **FIGURE 18.13:** Color locales. (a) Color locales for the model image; (b) color locales for a database image.

(a)

(b)

此为试读，需要完整PDF请访问：www.ertongbook.com
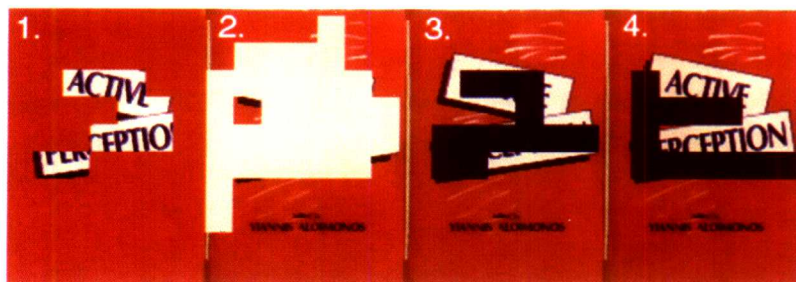
出版者的话

文艺复兴以降，源远流长的科学精神和逐步形成的学术规范，使西方国家在自然科学的各个领域取得了垄断性的优势；也正是这样的传统，使美国在信息技术发展的六十多年间名家辈出、独领风骚。在商业化的进程中，美国的产业界与教育界越来越紧密地结合，计算机学科中的许多泰山北斗同时身处科研和教学的最前线，由此而产生的经典科学著作，不仅擘划了研究的范畴，还揭橥了学术的源变，既遵循学术规范，又自有学者个性，其价值并不会因年月的流逝而减退。

近年，在全球信息化大潮的推动下，我国的计算机产业发展迅猛，对专业人才的需求日益迫切。这对计算机教育界和出版界都既是机遇，也是挑战；而专业教材的建设在教育战略上显得举足轻重。在我国信息技术发展时间较短、从业人员较少的现状下，美国等发达国家在其计算机科学发展的几十年间积淀的经典教材仍有许多值得借鉴之处。因此，引进一批国外优秀计算机教材将对我国计算机教育事业的发展起积极的推动作用，也是与世界接轨、建设真正的世界一流大学的必由之路。

机械工业出版社华章图文信息有限公司较早意识到"出版要为教育服务"。自1998年开始，华章公司就将工作重点放在了遴选、移译国外优秀教材上。经过几年的不懈努力，我们与Prentice Hall，Addison-Wesley，McGraw-Hill，Morgan Kaufmann 等世界著名出版公司建立了良好的合作关系，从它们现有的数百种教材中甄选出Tanenbaum，Stroustrup，Kernighan，Jim Gray 等大师名家的一批经典作品，以"计算机科学丛书"为总称出版，供读者学习、研究及庋藏。大理石纹理的封面，也正体现了这套丛书的品位和格调。

"计算机科学丛书"的出版工作得到了国内外学者的鼎力襄助，国内的专家不仅提供了中肯的选题指导，还不辞劳苦地担任了翻译和审校的工作；而原书的作者也相当关注其作品在中国的传播，有的还专诚为其书的中译本作序。迄今，"计算机科学丛书"已经出版了近百个品种，这些书籍在读者中树立了良好的口碑，并被许多高校采用为正式教材和参考书籍，为进一步推广与发展打下了坚实的基础。

随着学科建设的初步完善和教材改革的逐渐深化，教育界对国外计算机教材的需求和应用都步入一个新的阶段。为此，华章公司将加大引进教材的力度，在"华章教育"的总规划之下出版三个系列的计算机教材：除"计算机科学丛书"之外，对影印版的教材，则单独开辟出"经典原版书库"；同时，引进全美通行的教学辅导书"Schaum's Outlines"系列组成"全美经典学习指导系列"。为了保证这三套丛书的权威性，同时也为了更好地为学校和老师们服务，华章公司聘请了中国科学院、北京大学、清华大学、国防科技大学、复旦大学、上海交通大学、南京大学、浙江大学、中国科技大学、哈尔滨工业大学、西安交通大学、中国人民大学、北京航空航天大学、北京邮电大学、中山大学、解放军理工大学、郑州大学、湖北工学院、中国国

家信息安全测评认证中心等国内重点大学和科研机构在计算机的各个领域的著名学者组成"专家指导委员会",为我们提供选题意见和出版监督。

　　这三套丛书是响应教育部提出的使用外版教材的号召,为国内高校的计算机及相关专业的教学度身订造的。其中许多教材均已为M. I. T.,Stanford,U.C. Berkeley,C. M. U. 等世界名牌大学所采用。不仅涵盖了程序设计、数据结构、操作系统、计算机体系结构、数据库、编译原理、软件工程、图形学、通信与网络、离散数学等国内大学计算机专业普遍开设的核心课程,而且各具特色——有的出自语言设计者之手、有的历经三十年而不衰、有的已被全世界的几百所高校采用。在这些圆熟通博的名师大作的指引之下,读者必将在计算机科学的宫殿中由登堂而入室。

　　权威的作者、经典的教材、一流的译者、严格的审校、精细的编辑,这些因素使我们的图书有了质量的保证,但我们的目标是尽善尽美,而反馈的意见正是我们达到这一终极目标的重要帮助。教材的出版只是我们的后续服务的起点。华章公司欢迎老师和读者对我们的工作提出建议或给予指正,我们的联系方法如下:

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To my mom, and my wife Yansin.

Ze-Nian

To Noah, James (Ira), Eva, and, especially, to Jenna.

Mark

Preface

A course in multimedia is rapidly becoming a necessity in computer science and engineering curricula, especially now that multimedia touches most aspects of these fields. Multimedia was originally seen as a vertical application area; that is, a niche application with methods that belong only to itself. However, like pervasive computing, multimedia is now essentially a horizontal application area and forms an important component of the study of computer graphics, image processing, databases, real-time systems, operating systems, information retrieval, computer networks, computer vision, and so on. Multimedia is no longer just a toy but forms part of the technological environment in which we work and think. This book fills the need for a university-level text that examines a good deal of the core agenda computer science sees as belonging to this subject area. Multimedia has become associated with a certain set of issues in computer science and engineering, and we address those here.

The book is not an introduction to simple design issues—it serves a more advanced audience than that. On the other hand, it is not a reference work — it is more a traditional textbook. While we perforce discuss multimedia tools, we would like to give a sense of the underlying principles in the tasks those tools carry out. Students who undertake and succeed in a course based on this text can be said to really understand fundamental matters in regard to this material; hence the title of the text.

In conjunction with this text, a full-fledged course should also allow students to make use of this knowledge to carry out interesting or even wonderful practical projects in multimedia, interactive projects that engage and sometimes amuse and, perhaps, even teach these same concepts.

Who Should Read This Book?

This text aims at introducing the basic ideas in multimedia to an audience comfortable with technical applications—that is, computer science and engineering students. It aims to cover an upper-level undergraduate multimedia course but could also be used in more advanced courses and would be a good reference for anyone, including those in industry, interested in current multimedia technologies. Graduate students needing a solid grounding in materials they may not have seen before would undoubtedly benefit from reading it.

The text mainly presents concepts, not applications. A multimedia course, on the other hand, teaches these concepts and tests them but also allows students to use coding and presentation skills they already know to address problems in multimedia. The accompanying web site shows some of the code for multimedia applications, along with some of the better projects students have developed in such a course and other useful materials best presented electronically.

The ideas in the text drive the results shown in student projects. We assume the reader knows how to program and is also completely comfortable learning yet another tool. Instead of concentrating on tools, however, we emphasize what students do not already know.

Using the methods and ideas collected here, students are also able to learn more themselves, sometimes in a job setting. It is not unusual for students who take the type of multimedia course this text aims at to go on to jobs in a multimedia-related industry immediately after their senior year, and sometimes before.

The selection of material in the text addresses real issues these learners will face as soon as they show up in the workplace. Some topics are simple but new to the students; some are more complex but unavoidable in this emerging area.

Have the Authors Used This Material in a Real Class?

Since 1996, we have taught a third-year undergraduate course in multimedia systems based on the introductory materials set out in this book. A one-semester course could very likely not include all the material covered in this text, but we have usually managed to consider a good many of the topics addressed and to mention a select number of issues in Part III within that time frame.

Over the same time period as an introduction to more advanced materials, we have also taught a one-semester graduate-level course using notes covering topics similar to the ground covered by this text. A fourth-year or graduate course would do well to consider material from Parts I and II of the book and then some material from Part III, perhaps in conjunction with some of the original research references included here and results presented at topical conferences.

We have attempted to fill both needs, concentrating on an undergraduate audience but including more advanced material as well. Sections that can safely be omitted on a first reading are marked with an asterisk.

What is Covered in This Text?

In Part I, Multimedia Authoring and Data Representations, we introduce some of the notions included in the term *multimedia* and look at its history as well as its present. Practically speaking, we carry out multimedia projects using software tools, so in addition to an overview of these tools, we get down to some of the nuts and bolts of multimedia authoring. Representing data is critical in multimedia, and we look at the most important data representations for multimedia applications, examining image data, video data, and audio data in detail. Since color is vitally important in multimedia programs, we see how this important area impacts multimedia issues.

In Part II, Multimedia Data Compression, we consider how we can make all this data fly onto the screen and speakers. Data compression turns out to be an important enabling technology that makes modern multimedia systems possible, so we look at lossless and lossy compression methods. For the latter category, JPEG still-image compression standards, including JPEG2000, are arguably the most important, so we consider these in detail. But since a picture is worth a thousand words and video is worth more than a million words per minute, we examine the ideas behind MPEG standards MPEG-1, MPEG-2, MPEG-4, MPEG-7, and beyond. Separately, we consider some basic audio compression techniques and take a look at MPEG Audio, including MP3.

In Part III, Multimedia Communication and Retrieval, we consider the great demands multimedia places on networks and systems. We go on to consider network technologies