国外经典教材·计算机科学与技术

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Fluency with Information Technology: Skills, Concepts,and Capabilities

新编信息技术导论

技能、概念和能力（影印版）

(美) Lawrence Snyder 著

清华大学出版社

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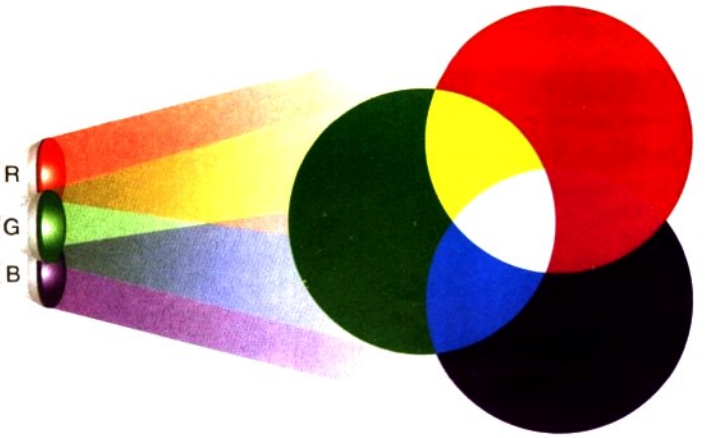


Figure 1.4. The RGB color scheme

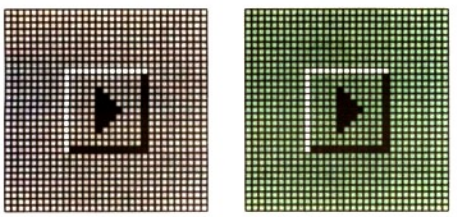


Figure 1.5. Two virtual buttons with different "feels"

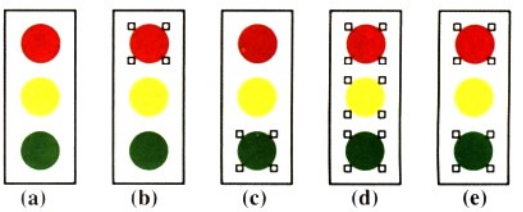


Figure 2.9. Examples of selection

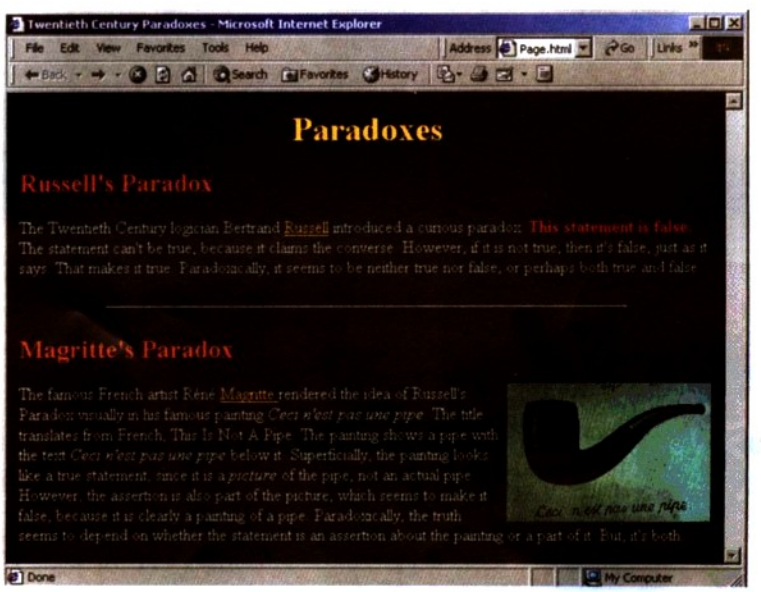


Figure 4.2. Completed Web page and the HTML source (continued next page).

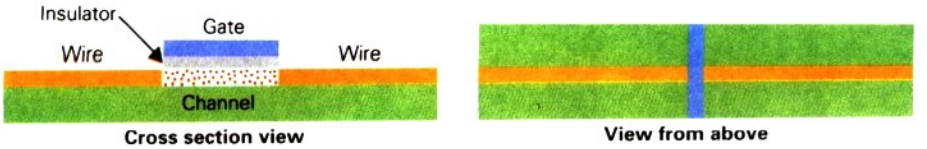


Figure 9.17. *A fiild-effect transistor. The channel is specially treated to improve its conducting/nonconducting properties.*

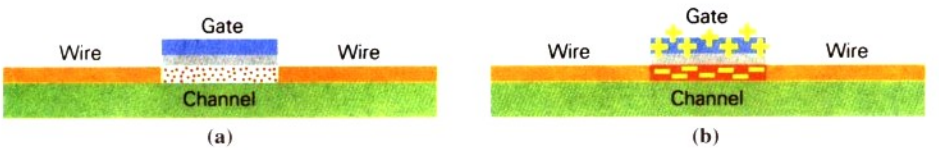


Figure 9.18. *Fiild effect transistor. (a) with the gate at neutral causing the channel not to conduct,isolating the wires, and (b) with the gate charged, causing the channel to conduct, connecting the wires.*

Figure 11.7. *Moon photographs. (a) The original black-and-white picture, (b) tinted version of original, (c) with boosted highlights.*

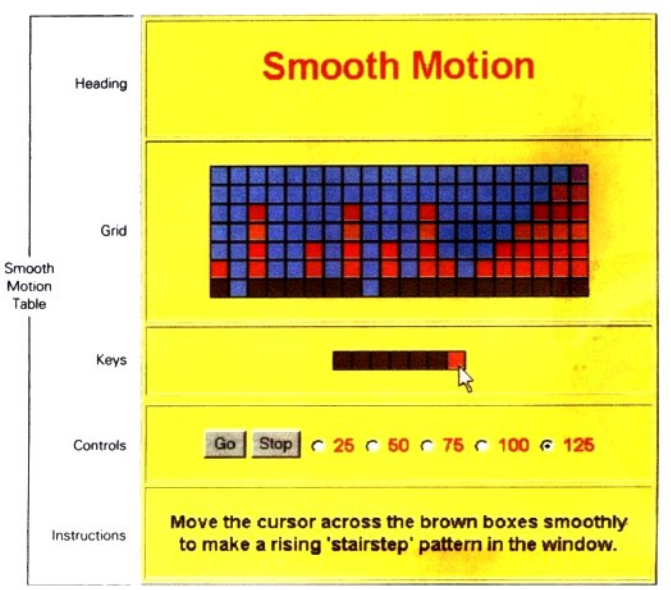


Figure 22.1. *The Smooth Motion application user interface. Try it* **www.aw.com/snyder.**

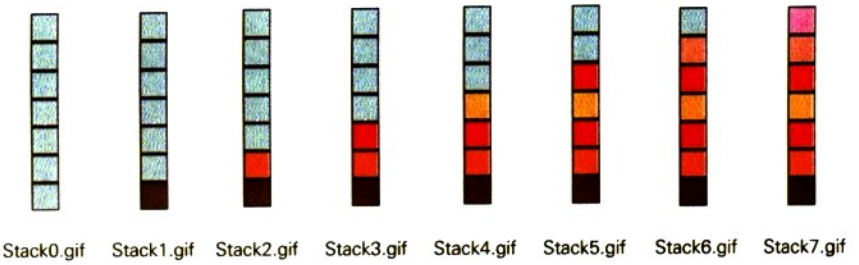


Figure 22.5. *The eight frames required for the Smooth Motion application*

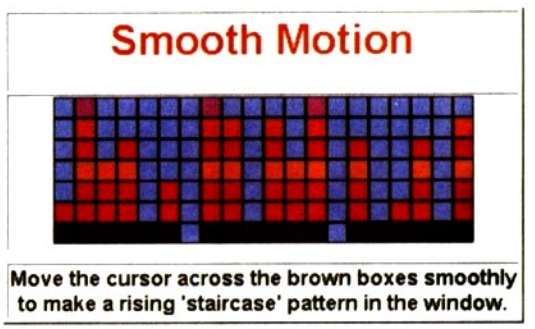


Figure 22.6. *Image, HTML,and JavaScript for the Smooth, Motion implementation after the completion of the Animate Grid task.*

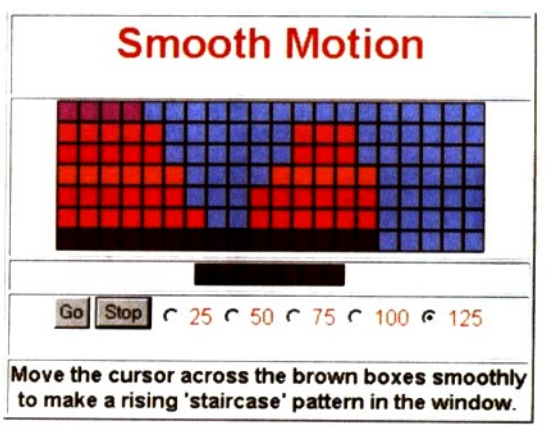
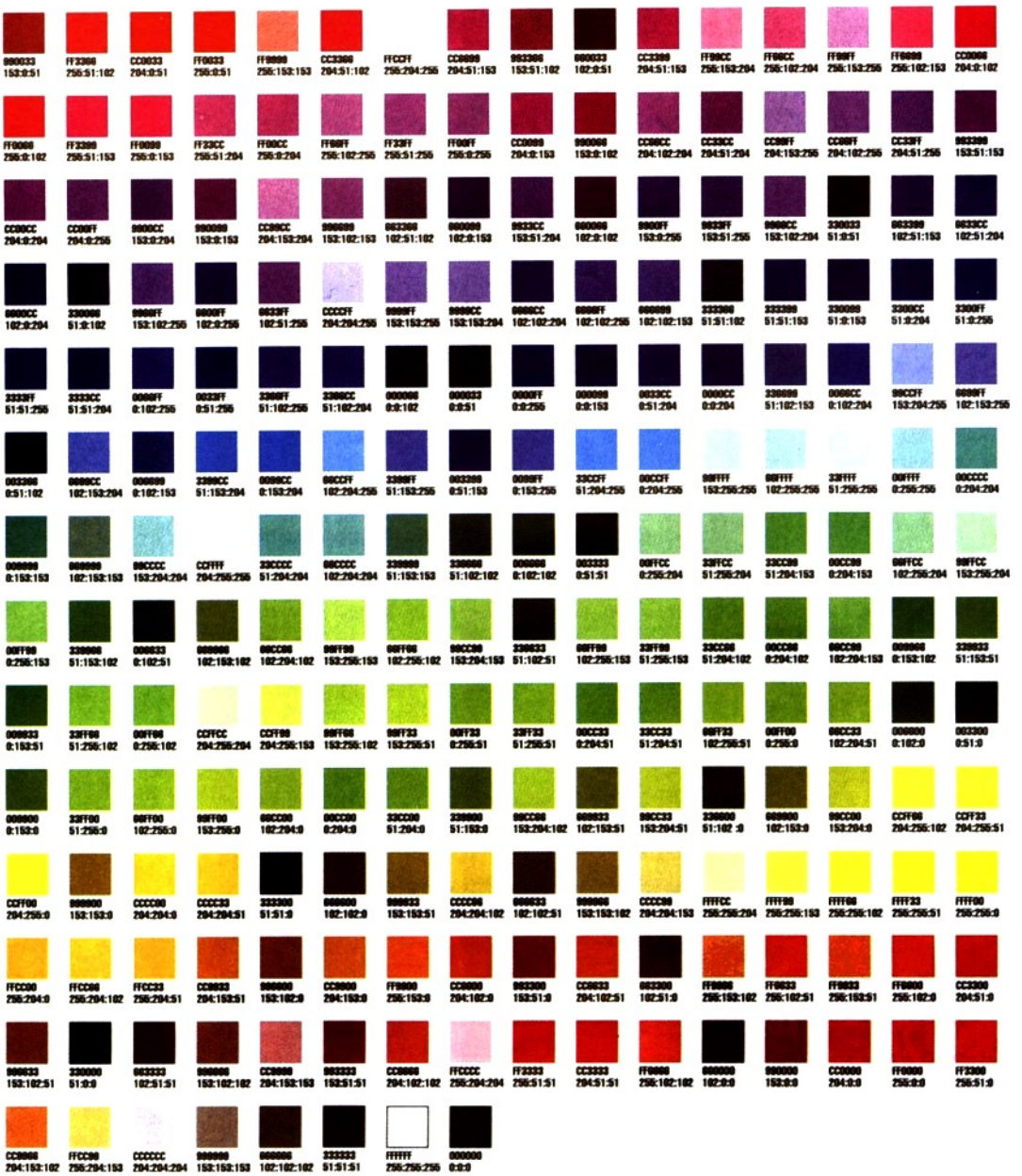


Figure 22.7. *JavaScript for the Sense Keys task; two declarations and the two event handlers, not shown.*

Table A.1 Web-Safe Colors for Web Page Design



出 版 说 明

近年来，我国的高等教育特别是计算机学科教育，进行了一系列大的调整和改革，急需一批门类齐全、具有国际先进水平的计算机经典教材，以适应当前我国计算机科学的教学需要。通过使用国外先进的经典教材，可以了解并吸收国际先进的教学思想和教学方法，使我国的计算机科学教育能够跟上国际计算机教育发展的步伐，从而培育出更多具有国际水准的计算机专业人才，增强我国计算机产业的核心竞争力。为此，我们从国外知名的出版集团 Pearson 引进这套“国外经典教材·计算机科学与技术”教材。

作为全球最大的图书出版机构，Pearson 在高等教育领域有着不凡的表现，其下属的 Prentice Hall 和 Addison Wesley 出版社是全球计算机高等教育的龙头出版机构。清华大学出版社与 Pearson 出版集团长期保持着紧密友好的合作关系，这次引进的“国外经典教材·计算机科学与技术”教材大部分出自 Prentice Hall 和 Addison Wesley 两家出版社。为了组织该套教材的出版，我们在国内聘请了一批知名的专家和教授，成立了一个专门的教材编审委员会。

教材编审委员会的运作从教材的选题阶段即开始启动，各位委员根据国内外高等院校计算机科学及相关专业的现有课程体系，并结合各个专业的培养方向，从 Pearson 出版的计算机系列教材中精心挑选针对性强的题材，以保证该套教材的优秀性和领先性，避免出现“低质重复引进”或“高质消化不良”的现象。

为了保证出版质量，我们为该套教材配备了一批经验丰富的编辑、排版、校对人员，制定了更加严格的出版流程。本套教材的译者，全部来自于对应专业的高校教师或拥有相关经验的 IT 专家。每本教材的责编在翻译伊始，就定期不间断地与该书的译者进行交流与反馈。为了尽可能地保留与发扬教材原著的精华，在经过翻译、排版和传统的三审三校之后，我们还请编审委员或相关的专家教授对文稿进行审读，以最大程度地弥补和修正在前面一系列加工过程中对教材造成的误差和瑕疵。

由于时间紧迫和受全体制作人员自身能力所限，该套教材在出版过程中很可能还存在一些遗憾，欢迎广大师生来电来信批评指正。同时，也欢迎读者朋友积极向我们推荐各类优秀的国外计算机教材，共同为我国高等院校计算机教育事业贡献力量。

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编审委员会

Preface

WELCOME to *Fluency with Information Technology: Skills, Concepts, and Capabilities*. I am delighted to introduce to you a book that moves beyond the click-here-click-there form of technology instruction to one firmly founded on ideas. The time is right for a new introduction to IT because today the majority of college and post-secondary students are already familiar with computers, the Internet, and the World Wide Web. They do not need rudimentary instruction in double-clicking and resizing windows. Rather, they need to be taught to be confident, in-control users of IT. They need to know how to navigate independently in the ever-changing worlds of information and technology, to solve their problems on their own, and to be capable of fully applying the power of IT tools in the service of their personal and career goals. They must be more than literate; they must be fluent with IT.

What's Fluency with Information Technology?

The inspiration for writing this book comes from a report by the National Research Council (NRC), *Being Fluent with Information Technology*. In that study, commissioned by the National Science Foundation, the committee asserted that traditional computer literacy does not have the "staying power" students need to keep pace with the rapid changes in IT. The study concluded that the educational "bar needs to be raised" if students' knowledge is to evolve and adapt to that change. The recommended alternative, dubbed *fluency with information technology*, or *FIT*, was a package of skills, concepts, and capabilities wrapped in a project-oriented learning approach that ensures that the content is fully integrated. The goal is to help people become effective users immediately, and to prepare them for lifelong learning.

The Vision

Because fluency with information technology—I usually shorten it to *Fluency*—is a new concept that largely implements the vision of the NRC committee, I'll introduce the main components: the three-part content, the integration mechanism of projects, and the role of programming.

Three-part Content

To make students immediately effective and launch them on the path of lifelong learning, they need to be taught three types of knowledge: Skills, Concepts, and Capabilities.

- *Skills* refers to proficiency with contemporary computer applications such as email, word processing, Web searching, etc. Skills make the technology immediately useful to students and give them practical experience on which to base other learning. The Skills component approximates traditional computer literacy content; that is, Fluency *includes* literacy.
- *Concepts* refers to the fundamental knowledge underpinning IT, such as how a computer works, digital representation of information, assessing information authenticity, etc. Concepts provide the principles on which students will build new understanding as IT evolves.
- *Capabilities* refers to higher-level thinking processes such as problem solving, reasoning, complexity management, troubleshooting, etc. Capabilities embody modes of thinking that are essential to exploiting IT, but they apply broadly. Reasoning, problem solving, etc. are standard components of education, their heavy use in IT makes them topics of emphasis in the Fluency approach.

For each component, the NRC report lists ten recommended items. These are shown in the accompanying table.

Projects

The Skills, Concepts, and Capabilities represent different kinds of knowledge that are co-equal in their contribution to IT fluency. They span separate dimensions of understanding. The overall strategy is to focus on the Skills instruction in the lab, the Concepts instruction in lecture/reading material, and the Capabilities instruction in lecture/lab demonstrations. The projects are the opportunity to use the three kinds of knowledge for a specific purpose. They illustrate IT as it is often applied in practice—to solve information processing tasks of a substantial nature.

A project is a multiweek assignment to achieve a specific IT goal. An example of a project is to create a database to track medical patients in a walk-in clinic, and to give a presentation to convince an audience that patient privacy has been preserved. Students apply a variety of Skills such as using database design software, Web searching, and presentation facilities. They rely on their understanding of Concepts such as database keys, table structure, and the Join query operator. And they use Capabilities such as reasoning, debugging, complexity management, testing, and others. The components are applied together to produce the final result, leading students to an integrated understanding of IT and preparing them for significant "real life" applications of IT. The labs can be found on the book's Web site.

The NRC's List of Top Ten Skills, Concepts, and Capabilities

Fluency with Information Technology

Skills

1. Set-up a personal computer
2. Use basic operating system facilities
3. Use a word processor to create a document
4. Use a graphics or artwork package to manipulate an image
5. Connect a computer to the Internet
6. Use the Internet to locate information
7. Use a computer to communicate with others
8. Use a spreadsheet to model a simple process
9. Use a database to access information
10. Use on-line help and instructional materials

Concepts

1. Fundamentals of computers
2. Organization of information systems
3. Fundamentals of networks
4. Digital representation of information
5. Structuring information
6. Modeling and abstraction
7. Algorithmic thinking and programming
8. Universality
9. Limitations of Information Technology
10. Social impact of computers and technology

Capabilities

1. Engage in sustained reasoning
2. Manage complexity
3. Test a solution
4. Find problems in a faulty use of IT
5. Navigate a collection and assess quality of the information
6. Collaborate using IT
7. Communicate using IT about IT
8. Expect the unexpected
9. Anticipate technological change
10. Think abstractly about Information Technology

The Programming Debate

Since the advent of computer literacy nearly three decades ago, there has been ongoing debate as to whether nonspecialists should be taught programming. Rational arguments have been offered on both sides, and thoughtful, well-intentioned adherents espouse each point of view. This book does *not* claim that one must be a professional programmer to be fluent. It sees programming's significance for the general population to be much more limited: to support algorithmic thinking, reasoning, debugging, and other components of fluency. And learning the NRC committee's modest set of basic programming ideas—variable, conditional, iteration, etc.—won't make anyone a programmer. In the discussion following the publication of the report, the committee's "some, but not much" compromise on the programming question seems to have been widely accepted.

Fluency with Information Technology treats only the recommended handful of basic programming concepts. Nevertheless, the perception that programming is a difficult topic suitable only for mathematically strong "techies" raises the question of whether even this small set of concepts can be taught to a general student population. The answer is that it can and the students find it rewarding!

The programming can be found in Chapters 18, 20, and 21 (with case studies in Chapters 19 and 22), and is optional for those who do not wish to cover it.

Audience

This book is designed for (second semester) freshmen "non-techies," students who will not be majoring in science, engineering, or math. ("Techies" benefit, too, but because "hot shots" can intimidate others, they should be discouraged from taking the class, or better, encouraged to join an accelerated track or honors section.) Except for one short paragraph about encryption, which can be skipped, no mathematical skills are required beyond arithmetic. There are no prerequisites.

Most students who take Fluency will have used email, surfed the Web, and perhaps word processed, and this is more than enough preparation to be successful. Students with no experience are advised to spend a few hours acquiring some exposure to IT prior to starting Fluency.

Chapter Dependencies

I have written *Fluency with Information Technology* so it can be taught in a variety of ways. In addition to the preliminary material in Chapters 1 and 2 and the wrap-up in Chapter 24, the overall structure of the book includes standalone chapters with few dependencies, as well as small chapter sequences devoted to a sustained topic. The sequences are:

- 3, 4, 5 networking, HTML, and information
- 8, 9, 10, 11 data representations, computers, and algorithms
- 13, 14, 15 database principles and design
- 18, 19, 20, 21 programming in JavaScript

One effective way to use this design is to present one of the chapter sequences as the basis for a project assignment. Then, while the students are working on the project—projects may span two or more weeks—material from standalone chapters is covered.

Though there are many sequences, three stand out to me as especially good ways to present the material:

> *Networking cycle.* The linear sequence of chapters is designed to begin with information and networking and progressively advance through computation and databases to JavaScript, where it returns to the networking theme. This is the basic Chapter 1 to Chapter 24 sequence, adjusted by local reordering to accommodate the timing of projects as needed.

> *Internet forward.* I teach Fluency in the 1–10, 18–22, 11–17, 23–24 order. This approach begins with information and HTML, progresses through to algorithms, then jumps to JavaScript to continue the Web page building theme, and finally wraps up with databases. The strategy is dictated to a large degree by the logistics of teaching the class in a quarter (10 weeks), and is recommended for that situation.

> *Traditional.* In this approach, the material is taught to parallel the time sequence of its creation. So, information representation and computers come well before networking. In this case, the order is 1–2, (23), 8–15, 3–7, 16–24. Chapter 23, which contains more philosophical content like the Turing test and Kasparov/Deep Blue chess tournament, might optionally be presented early for its foundational content.

Each of these strategies has a compelling pedagogical justification. Which is chosen depends more on instructor taste and class logistics than on any need to present material in a specific order.

Pedagogical Features

Learning Objectives: Each chapter opens with a list of the key concepts that readers should master after reading the chapter.

There are several boxed features that appear throughout the text to aid in your understanding of the material. These are:

FITtip: Practical hints and suggestions for every day computer use.
FITbyte: Interesting facts and statistics.
FITcaution: Warnings and explanations of common mistakes.
Try It: Short, in chapter exercises with solutions provided.
Checklists: A useful list of steps for completing a specific task.

Throughout the text, we also distinguish notable material by the following features:

FITlink: Here the author shows students a practical application of some of the abstract concepts presented in the text.
Great Moments: A historical look at some of the major milestones in computing.
Great Minds: This feature takes a closer look at some of the influential pioneers in technology.

Reference material includes the following:

Glossary: Important words and phrases appear in boldface type throughout the text. A glossary of these terms is included at the end of the book.
Answers: Solutions are provided to the odd numbered exercises for the multiple choice and short answer questions.
Appendix A: HTML reference including a chart of web safe colors.
Appendix B: JavaScript programming rules.
Appendix C: Bean Counter Program: A complete JavaScript & HTML example.
Appendix D: Memory Bank Program: A complete JavaScript & HTML example.

Supplements to Instruction

The companion Web site for *Fluency with Information Technology* is at **www.aw.com/snyder/**, where you can find the various HTML sources, database designs, and JavaScript programs used in the textbook examples. Students are encouraged to retrieve these files to explore along with the text.

Laboratory materials. Learning Fluency is a hands-on activity, and so 14 complete laboratory exercises are available at the Web site.

PowerPoint slides. A convenient resource for teaching Fluency is the collection of PowerPoint slides available at the site.

Fluency instructor bulletin board. Share tips and ask questions of other instructors involved in teaching Fluency with Information Technology.

Note to Students

Fluency is a somewhat unusual topic, making this a somewhat unusual book. There are two things that I think you should know about using this book.

> *Learn Skills in the lab.* Of the three kinds of knowledge that define Fluency—Skills, Concepts, and Capabilities—very little of the Skills material is included in this book. The Skills content, which is mostly about how to use contemporary computer applications, changes very rapidly, making it difficult to keep up to date. But the main reason few skills are included is that they are best learned in the lab, seated in front of a computer. The lab exercises, which are online and are up to date, provide an excellent introduction to contemporary applications. They provide great coverage of the Skills.

> *Study Fluency steadily.* If this book is successful, it will change the way you think, making you a better problem solver, better at reasoning, better at debugging, etc. These Capabilities are useful in IT and elsewhere in life, so they make learning Fluency really worthwhile. But changing how you think won't happen by just putting the book under your pillow. It'll take some studying. To learn Fluency you must apply good study habits: read the book, do the end of chapter exercises (answers to odd-number exercises are printed at the back of the book), start on your