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# SOFTWARE ENGINEERING

## A PRACTITIONER'S APPROACH

### FIFTH EDITION

# 软件工程

## 实践者之路 (第5版)



Roger S. Pressman 著



清华大学出版社

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北 京

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**Software Engineering: A Practitioner's Approach, Fifth Edition**

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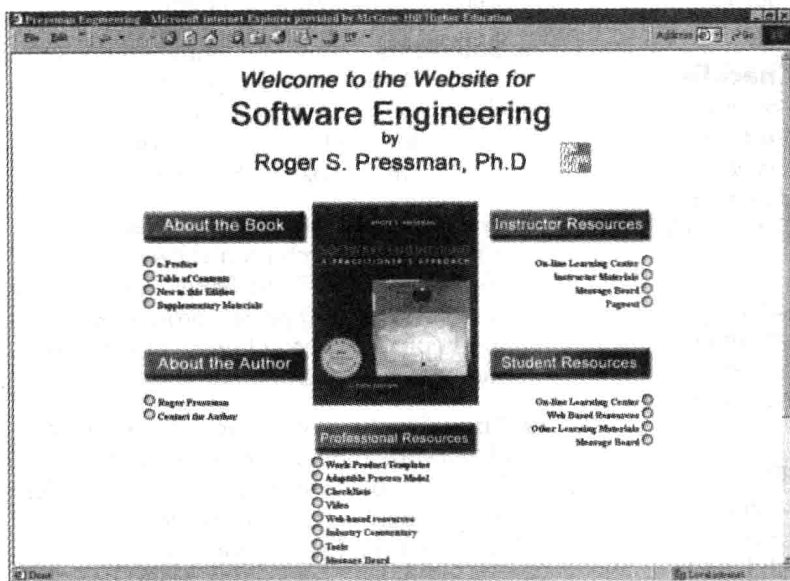
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# SOFTWARE ENGINEERING

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Visit the SEPA, 5/e, website at <http://www.mhhe.com/engcs/compSci/pressman>

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### ▲ Supplementary Content -

Need even more information? The site contains a collection of supplementary materials that expand on topics presented within the book.

### ▲ Message Board -

Want to talk with other readers? The message board allows Q&A among students and others and provides a useful mechanism for informal communication.

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清华大学出版社从 1996 年开始,与国外著名出版公司合作,影印出版了“大学计算机教育丛书(影印版)”等一系列引进图书,受到了国内读者的欢迎和支持。跨入 21 世纪,我们本着为我国高等教育教材建设服务的初衷,在已有的基础上,进一步扩大选题内容,改变图书开本尺寸,一如既往地请有关专家挑选适用于我国高校本科及研究生计算机教育的国外经典教材或著名教材,组成本套“大学计算机教育国外著名教材系列(影印版)”,以飨读者。深切期盼读者及时将使用本系列教材的效果和意见反馈给我们。更希望国内专家、教授积极向我们推荐国外计算机教育的优秀教材,以利我们把“大学计算机教育国外著名教材系列(影印版)”做得更好,更适合高校师生的需要。

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## ABOUT THE AUTHOR

**R**oger S. Pressman is an internationally recognized authority in software process improvement and software engineering technologies. For over three decades, he has worked as a software engineer, a manager, a professor, an author, and a consultant, focusing on software engineering issues.

As an industry practitioner and manager, Dr. Pressman worked on the development of CAD/CAM systems for advanced engineering and manufacturing applications. He has also held positions with responsibility for scientific and systems programming.

After receiving a Ph.D. in engineering from the University of Connecticut, Dr. Pressman moved to academia where he became Bullard Associate Professor of Computer Engineering at the University of Bridgeport and director of the university's Computer-Aided Design and Manufacturing Center.

Dr. Pressman is currently president of R.S. Pressman & Associates, Inc., a consulting firm specializing in software engineering methods and training. He serves as principle consultant, helping companies establish effective software engineering practices. He also designed and developed the company's software engineering training and process improvement products—*Essential Software Engineering*, a complete video curriculum that is among the industry's most comprehensive treatments of the subject, and *Process Advisor*, a self-directed system for software engineering process improvement. Both products are used by hundreds of companies worldwide.

Dr. Pressman has written many technical papers, is a regular contributor to industry periodicals, and is author of six books. In addition to *Software Engineering: A Practitioner's Approach*, he has written *A Manager's Guide to Software Engineering* (McGraw-Hill), an award-winning book that uses a unique Q&A format to present management guidelines for instituting and understanding software engineering technology; *Making Software Engineering Happen* (Prentice-Hall), the first book to address the critical management problems associated with software process improvement; and *Software Shock* (Dorset House), a treatment that focuses on software and its impact on business and society. Dr. Pressman is on the Editorial Boards of *IEEE Software* and the *Cutter IT Journal*, and for many years, was editor of the "Manager" column in *IEEE Software*.

Dr. Pressman is a well-known speaker, keynoting a number of major industry conferences. He has presented tutorials at the International Conference on Software Engineering and at many other industry meetings. He is a member of the ACM, IEEE, and Tau Beta Pi, Phi Kappa Phi, Eta Kappa Nu, and Pi Tau Sigma.



## PREFACE

**W**hen a computer software succeeds—when it meets the needs of the people who use it, when it performs flawlessly over a long period of time, when it is easy to modify and even easier to use—it can and does change things for the better. But when software fails—when its users are dissatisfied, when it is error prone, when it is difficult to change and even harder to use—bad things can and do happen. We all want to build software that makes things better, avoiding the bad things that lurk in the shadow of failed efforts. To succeed, we need discipline when software is designed and built. We need an engineering approach.

In the 20 years since the first edition of this book was written, software engineering has evolved from an obscure idea practiced by a relatively small number of zealots to a legitimate engineering discipline. Today, it is recognized as a subject worthy of serious research, conscientious study, and tumultuous debate. Throughout the industry, *software engineer* has replaced *programmer* as the job title of preference. Software process models, software engineering methods, and software tools have been adopted successfully across a broad spectrum of industry applications.

Although managers and practitioners alike recognize the need for a more disciplined approach to software, they continue to debate the manner in which discipline is to be applied. Many individuals and companies still develop software haphazardly, even as they build systems to service the most advanced technologies of the day. Many professionals and students are unaware of modern methods. And as a result, the quality of the software that we produce suffers and bad things happen. In addition, debate and controversy about the true nature of the software engineering approach continue. The status of software engineering is a study in contrasts. Attitudes have changed, progress has been made, but much remains to be done before the discipline reaches full maturity.

The fifth edition of *Software Engineering: A Practitioner's Approach* is intended to serve as a guide to a maturing engineering discipline. The fifth edition, like the four editions that preceded it, is intended for both students and practitioners, retaining its appeal as a guide to the industry professional and a comprehensive introduction to the student at the upper level undergraduate or first year graduate level. The format and style of the fifth edition have undergone significant change, making the presentation more reader-friendly and the content more easily accessible.

The fifth edition is considerably more than a simple update. The book has been revised to accommodate the dramatic growth in the field and to emphasize new and important software engineering practices. In addition, a comprehensive Web site has been developed to complement the content of the book. The Web site, which I call



*SepaWeb*, can be found at <http://www.mhhe.com/pressman>. Designed to be used in conjunction with the fifth edition of *Software Engineering: A Practitioner's Approach*, *SepaWeb* provides a broad array of software engineering resources that will benefit instructors, students, and industry professionals.

Like all Web sites, *SepaWeb* will evolve over time, but the following major content areas will always be present: (1) a broad array of *instructor resources* including a comprehensive on-line *Instructor's Guide* and supplementary teaching materials (e.g., slide presentations to supplement lectures, video-based instructional aids); (2) a wide variety of *student resources* including an extensive on-line learning center (encompassing study guides, Web-based resources, and self-tests), an evolving collection of "tiny tools," a case study, and additional supplementary content; and (3) a detailed collection of *professional resources* including outlines (and samples of) software engineering documents and other work products, a useful set of software engineering checklists, a catalog of software engineering (CASE) tools, a comprehensive collection of Web-based resources, and an "adaptable process model" that provides a detailed task breakdown of the software engineering process. In addition, *SepaWeb* will contain other goodies that are currently in development.

The 32 chapters of the fifth edition have been organized into five parts. This has been done to compartmentalize topics and assist instructors who may not have the time to complete the entire book in one term. Part One, *The Product and the Process*, presents an introduction to the software engineering milieu. It is intended to introduce the subject matter, and more important, to present concepts that will be necessary for later chapters. Part Two, *Managing Software Projects*, presents topics that are relevant to those who plan, manage, and control a software development project. Part Three, *Conventional Methods for Software Engineering*, presents the classical analysis, design, and testing methods that some view as the "conventional" school of software engineering. Part Four, *Object-Oriented Software Engineering*, presents object-oriented methods across the entire software engineering process, including analysis, design, and testing. Part Five, *Advanced Software Engineering Topics*, presents dedicated chapters that address formal methods, cleanroom software engineering, component-based software engineering, client/server software engineering, Web engineering, reengineering, and CASE.

The five-part organization of the fifth edition enables an instructor to "cluster" topics based on available time and student need. An entire one-term course can be built around one or more of the five parts. For example, a "design course" might emphasize only Part Three or Part Four; a "methods course" might present selected chapters in Parts Three, Four, and Five. A "management course" would stress Parts One and Two. By organizing the fifth edition in this way, I attempted to provide an instructor with a number of teaching options. *SepaWeb* can and should be used to supplement the content that is chosen from the book.

An *Instructor's Guide for Software Engineering: A Practitioner's Approach* is available from *SepaWeb*. The *Instructor's Guide* presents suggestions for conducting var-

ious types of software engineering courses, recommendations for a variety of software projects to be conducted in conjunction with a course, solutions to selected problems, and a number of teaching aids.

A comprehensive video curriculum, *Essential Software Engineering*, is available to complement this book. The video curriculum has been designed for industry training and has been modularized to enable individual software engineering topics to be presented on an as-needed, when-needed basis. Further information on the video can be obtained by mailing the request card at the back of this book.<sup>1</sup>

My work on the five editions of *Software Engineering: A Practitioner's Approach* has been the longest continuing technical project of my life. Even when the writing stops, information extracted from the technical literature continues to be assimilated and organized. For this reason, my thanks to the many authors of books, papers, and articles as well as a new generation of contributors to electronic media (newsgroups, e-newsletters, and the World Wide Web) who have provided me with additional insight, ideas, and commentary over the past 20 years. Many have been referenced within the pages of each chapter. All deserve credit for their contribution to this rapidly evolving field. I also wish to thank the reviewers of the fifth edition: Donald H. Kraft, Louisiana State University; Panos E. Livadas, University of Florida; Joseph Lambert, Pennsylvania State University; Kenneth L. Modesitt, University of Michigan—Dearborn; and, James Purtilo, University of Maryland. Their comments and criticism have been invaluable. Special thanks and acknowledgement also go to Bruce Maxim of the University of Michigan—Dearborn, who assisted me in developing the Web site that accompanies this book. Bruce is responsible for much of its design and pedagogical content.

The content of the fifth edition of *Software Engineering: A Practitioner's Approach* has been shaped by industry professionals, university professors, and students who have used earlier editions of the book and have taken the time to communicate their suggestions, criticisms, and ideas. My thanks to each of you. In addition, my personal thanks go to our many industry clients worldwide, who certainly teach me as much or more than I can teach them.

As the editions of this book have evolved, my sons, Mathew and Michael, have grown from boys to men. Their maturity, character, and success in the real world have been an inspiration to me. Nothing has filled me with more pride. And finally, to Barbara, my love and thanks for encouraging still another edition of "the book."

Roger S. Pressman

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<sup>1</sup> If the request card is missing, please visit the R. S. Pressman & Associates, Inc. Web site at <http://www.rspa.com/ese> or e-mail a request for information to [info@rspa.com](mailto:info@rspa.com).

## USING THIS BOOK

The fifth edition of *Software Engineering: A Practitioner's Approach* (SEPA) has been redesigned to enhance your reading experience and to provide integrated links to the SEPA Web site, <http://www.mhhe.com/pressman/>. SepaWeb contains a wealth of useful supplementary information for readers of the book and a broad array of resources (e.g., an *Instructor's Guide*, classroom slides, and video supplements) for instructors who have adopted SEPA for classroom use.

A comprehensive video curriculum, *Essential Software Engineering*, is available to complement this book. The video curriculum has been designed for industry training and has been modularized to enable individual software engineering topics to be presented on an as-needed, when-needed basis. Further information on the video can be obtained by mailing the request card at the back of this book.<sup>1</sup>

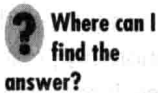
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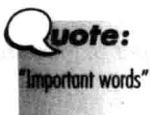
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The **WebRef** icon provides direct pointers to important software engineering related Web sites.

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The **SepaWeb.checklists** icon points you to detailed checklists that will help you to assess the software engineering work you're doing and the work products you produce.



The **SepaWeb.documents** icon points you to detailed document outlines, descriptions and examples contained within the SEPA Web site.

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