

EXPLORATIONS IN

COMPUTER SCIENCE

THIRD EDITION

R. MARK MEYER *and* MICHAEL VERDICCHIO



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Preface

Welcome to *Explorations in Computer Science*. The goal of this lab manual is to provide computer-based activities that will reinforce the concepts presented in a textbook and/or lectures for an introductory computer science course. Teachers can assign all of the labs or can pick and choose which ones to use in order to tailor the course to their needs and priorities.

ASSUMPTIONS

The activities in this lab manual assume that students have the skills necessary for a course at the CS-0 level. For instance, it is assumed that the students have no prior experience with programming, though they probably have basic skills with a computer. Therefore, this manual does not attempt to teach anyone how to turn on the computer, use a mouse, or drag a window. One of the essential skills that students may not yet have is that of capturing a picture of their computer's screen (often called a screenshot), and this process is explained in the first lab.

Another assumption is that students using this lab manual are not taking the course solely to learn a particular programming language, but rather to be exposed to the wide variety of topics within the realm of computer science. There are enough activities for students to get a good feeling for algorithms and programming, but these do not form the majority of the materials presented.

Detailed explanations of the core topics, such as what job scheduling is and how it is used in an operating system, are not recapitulated in this manual. Rather, the students are encouraged to reference textbooks, lecture notes, and other online materials. The lab manual commences with an explanation of how to use the apps provided on the Lab Manual website and how to interpret their behavior. In a few instances throughout the manual, the author couldn't help interjecting some historical or other material deemed of interest.

ORGANIZATION OF THE LABS

Each lab begins with succinct Objectives, References, and Background sections that briefly describe what is to be learned, what apps are to be used, and which topics can be consulted for further information. Next, the Activity section describes the software and shows how to use it. Students are expected to work through the Activity section, which guides them through starting the app, comparing what they see on their screens to the screenshots in the lab manual, and completing the activities. This interaction will prepare them to complete the Exercise sections. The teacher may assign one or more of the exercises to be handed in later.

The Deeper Investigation sections provide a stimulating coda for advanced students. A further activity is briefly described or a question posed. In most cases, the appropriate response would be a one-page written answer to the question. In other cases, the teacher may assign the task posed by the Deeper Investigation.

SOFTWARE

One very important goal of this manual is to ensure that students are able to do the activities on any computer. To meet this goal, we include a download with the lab manual, which has all of the referenced software in the form of executable Java JAR files (which we refer to as apps) that can be run on any modern computer.

All the apps were written using Java 1.2 and AWT graphical user interface components for maximum compatibility and widest audience availability. See the following section if you have trouble running the Java apps on your personal computer.

For one of the labs, we chose to use the spreadsheet program Microsoft Excel. Excel is a widely established program, available on both Windows and Macintosh. Students are also informed of alternative programs, including Numbers for Mac, Open Office Calc, and Google Sheets.

GETTING JAVA TO WORK

The apps and applications in this lab manual are all written in Java. Consequently, you will need Java's run-time environment (JRE) to run them. Any current versions should suffice, as will many older versions. The latest JRE can be downloaded from <http://java.oracle.com> by clicking on the download page for the latest Java SE. You may see downloads for the JDK, but this is much more than what is needed. The JDK is required to compile Java applications. To run existing executable JAR files, the JRE is much simpler and is all you will need. There is a version for every operating system.

RUNNING THE SOFTWARE

Students can download a ZIP file containing all the executable JAR files organized according to the app names given in this lab manual. It is recommended that each student download the ZIP archive and extract it to a place they can easily find on their personal computers. The contents can also be copied to a flash drive and run on any other computer with the JRE installed. Regardless of where the apps are stored, they need to be at the ready when students decide to complete the labs.

Apps are launched by double-clicking the .jar files. If any error messages appear, ensure that all installation instructions from Oracle were followed to install the JRE. Internet searches of verbatim error messages often reveal quick fixes.

Remember that Java apps are quite universal and can be used on almost any platform: Windows (in all its versions), Macs, Linux, Unix, and other systems. Java's graphics are also standard, so apps that are written on one platform usually look identical, or nearly identical, on widely different platforms. This uniformity cuts down on development time and costs, and assures that the largest possible number of students can use the software. However, apps are, of course, somewhat limited in what they can do in order to foil viruses, worms, and Trojan horses.

Like most textbooks and all computer software, this lab manual and its accompanying software are evolving creations. Software problems and design issues have been addressed in this new edition and will be addressed in future revisions. Comments, suggestions, and field spottings of perhaps not-rare-enough bugs are definitely welcome. We hope students enjoy the exercises as they wind their way through this vast and fascinating landscape called computer science!

Acknowledgments

Numerous people have motivated this work and also made it possible. The kind folks at Jones & Bartlett Learning set me on the path to writing this while we were visiting at SIGCSE '02 in Covington, Kentucky, and discussing the new textbook *Computer Science Illuminated*. However, this conversation would not have happened but for Dr. Jeffrey McConnell, chair of the Computer Science Department at Canisius College, who steered me toward the Jones & Bartlett booth. I sincerely thank him for this nudge that set a vast machine in motion.

A huge debt of thanks goes to Kelly Bucheger, who wrote two of the labs and fixed others. He has taught the CS-0 lab at Canisius for many years and is a popular teacher on campus. A saxophonist, composer, and writer on jazz by profession, he rounds out his days teaching computer science and web design at several area colleges, including Canisius College. While possessing all the other attributes of a great teacher, namely compassion, gentleness, clarity, and fairness, he brings an essential ingredient to the lab: humor. Kelly knows how to make the lab time fun while motivating learning. We all strive for this but he has accomplished it. Hopefully students across the country and the world who read this lab manual will feel this spirit of fun in their adventure into computer science!

R. Mark Meyer

I am first grateful for all of my students over the past 10 years and the opportunity I've been given to teach them. I am also grateful for those who have allowed me the responsibility of standing in front of a classroom. I grew up watching my parents set an example of compassionate teaching, and I now have the joy of coming home to love and encouragement every day from my wife Jacey. Many friends and family members seemed to believe in my pursuit of teaching in higher education before I ever believed in myself, and to each of them I remain grateful. Finally, I am grateful to work in an academic department without ego, with humble leadership, and with colleagues who genuinely want each other to succeed and to do better.

Michael P. Verdicchio