General Advice on the Writing Projects

If your instructor assigns one or more of the writing projects, you are fortunate. Written communication skills are of utmost importance in today's world of information. By doing the research for such essays, you will become familiar with the literature in many areas of mathematics and computer science, and you will hone your library and information gathering skills. In this section, we offer some helpful advice and provide a list of information resources—including books, articles, and Internet resources—to get you started. At the end of the solutions section of each chapter in this *Guide*, we give specific suggestions of where you might look when working on the various writing projects. We do not guarantee that you will find exactly what you are looking for in the references we suggest, but at least our pointers will start you in the right direction. Tracking down the information is half the challenge!

Here are several ideas and points to bear in mind as you do the research for the writing projects:

- The *first* place to search for material on any of the writing projects is probably the World Wide Web. In fact, the Internet and search engines make it embarrassingly easy to find sources of information on any topic one desires. One particularly popular search engine is Google (`www.google.com`). To find primary sources, such as research papers, the academic search engine Google Scholar (`scholar.google.com`) is extremely useful. Keep in mind that many terms used in mathematics have other meanings as well. So it's a good idea to include a word or phrase describing the general topic in addition to specific keywords or phrases. For example, searching for `"association rules" databases`, rather than just `association rules`, will help ensure that you find results about how association rules are used in databases rather than websites about the rules of various condominium associations. The information on Boolean searches in Section 1.2 of the textbook can help you use search engines more effectively.

- You should definitely check the website for the textbook: `www.mhhe.com/rosen`. There, you will find many useful links that can get you started on researching the writing projects. Notice the various web icons throughout the textbook, which indicates relevant material on that website.

- Libraries have online search facilities that allow you to find books in their collection by keyword. You can also search for authors or titles, of course. The suggestions above and in the textbook for using Internet search engines apply to library collections as well. Ask a librarian for assistance, if necessary.

- One of the most important resources for finding mathematics publications is MathSciNet (`mathscinet.ams.org`). The website for MathSciNet includes a searchable database of scholarly articles and books in the mathematical sciences. In addition to searching titles, authors, abstracts, and keywords of mathematics publications, it also searches a comprehensive set of brief reviews of essentially every mathematical research paper and book written since 1940 (and being kept up-to-date at the rate of over 100,000 items per year). These reviews appear in a journal called *Mathematical Reviews*, published by the American Mathematical Society. The journal comes in electronic form on the web (MathSciNet) and in printed volumes (which few institutions subscribe to any longer). Ask your librarian whether your institution is a subscriber, and if so, you can usually use computers on campus to gain access.

- The following library research technique should come in handy. If the source you are looking at does not deal in enough detail with the topic you are investigating, then consult the references given in that source. Continue this process backwards as deeply and broadly as necessary. Of course this is particularly easy to do on the web.

- Wikipedia (`wikipedia.org`) is an obvious source of information about mathematics. The previous tip about consulting references cited by the source at hand is very useful in conjunction with Wikipedia. Two other useful websites are MathWorld (`mathworld.com`) and MathOverflow (`mathoverflow.net`). MathWorld is an encyclopedia-style site and is professionally overseen to ensure quality and accuracy. MathOverflow is an open question and answer site, and tens of thousands of questions have already been asked and answered, so there's a good chance that a search of the existing questions will turn up some useful information.

- Remember to do the obvious things, like using the index and table of contents of any book you consult. When looking up items in an index, don't forget to try possible variations of what you are looking for (e.g., you may find one of the entries "induction, mathematical" or "mathematical induction" but not the other).

- An excellent source for many of these writing projects is [MiRo] (see the bibliography that follows), which is published as a supplement to this textbook and is also available on the text's companion website (`www.mhhe.com/rosen`). It has articles covering various parts of pure and applied discrete mathematics, at levels varying from elementary to intermediate. It is worth browsing through this book, even if you do not find anything in it relevant to a project you are working on. It will give you a feeling for the breadth of the subject you are studying.

- Popular accounts of mathematical topics often make their way into *The New York Times*. This premier of American newspapers has a detailed index, which is available in most libraries that carry the newspaper; it can also be accessed from the web, at `www.nytimes.com/ref/membercenter/nytarchive.html`. One prolific writer of mathematical articles is Gina Kolata. The *Times* also produces on a regular basis a special edition of mathematics-related articles; ask your library or mathematics department whether they have a recent issue. The *Times* and most other major newspapers are also available on the web, sometimes for free or at reduced prices for students.

- Many of the essays assigned in this textbook deal with the history of mathematical topics. Most books on the general history of mathematics are filed under the call letters QA 21. See [Bo4] and [Ev3] for two good sources. There are also wonderful extensive collections of essays about mathematics, both historical and expository. A classic is the four-volume treatise [Ne]. A more recent one of high quality is [DaHe], and [GoBa] includes a good deal of history in its entries. Perhaps the best resource for the history of mathematics is the MacTutor History of Mathematics archive on the web; its URL is `www-history.mcs.st-and.ac.uk`. It has biographies of hundreds of mathematicians, as well as references, articles, links, and an unbelievable amount of information.

- The Mathematical Association of America (MAA) has a website with lots of interesting articles (updated monthly) and special sections for students. Its URL is `www.maa.org`.

- Some of these projects go into depth on various topics in discrete mathematics. There are several good, more advanced textbooks on combinatorics and graph theory, such as [Bo1], [BoMu], [Br2], [ChLe], [Ro1], and [Tu1]. The library classifications here are QA 164 and QA 166, where you will also find specialized books, research monographs, and conference proceedings. In addition, there are dozens of other discrete mathematics textbooks at a level comparable with or slightly more or less advanced than your textbook. An excellent one is [Gr2]. It has comprehensive discussions of most discrete mathematical topics and a wide variety of interesting problems, including some challenging and open-ended ones. It also has an extensive bibliography and a detailed index that will lead you to the right source for further reading. Another, slightly different, more advanced book to take a look at (if nothing else, for its style!) is [GrKn].

- There is an intimate relationship between discrete mathematics and computer science. Computer science books of all sorts, whether dealing with hardware and circuit issues, programming, data structures, algorithms, complexity, theoretical foundations, operating systems, compilers, artificial intelligence, or other topics, may well be relevant to many of these projects. QA 76 is where many such books are housed in the library, although specialized topics will have their own call numbers (e.g., Q 335 for artificial intelligence or the high TK 7800's for circuit design). Our list that follows includes several textbooks on data structures

and algorithms. Another lively source is [De2], a collection of essays on various aspects of computer science and related mathematics, each with references for further reading. You will find those essays relevant to a large number of the writing projects, and you should definitely try to have a look at this collection.

Here are several points to bear in mind about writing essays (whether in mathematics or in other subjects):

- All the rules and advice you have learned over the years about good writing apply to technical writing as well. It is often more difficult to express mathematical ideas clearly and precisely, so do not expect these writing projects to be easy.
- Know your reader! Keep in mind for whom you are writing, and pitch the level to that audience. Think about how much you will assume your reader knows and how much you will need to fill in. (When in doubt, do not assume the reader knows much.)
- Organize, organize, organize! Essays need to have an introduction, a body, and a conclusion. If the work is going to be long, it probably makes sense to have labeled sections covering the different points. Make an outline of what you plan to say, and think a lot about how to order it, both before you start writing and throughout the process.
- Use a word processor. This makes it much easier to revise and edit your work numerous times, until it is just the way you want it. Make sure to take advantage of special features like spelling and grammar checkers. Pay some attention to the format (fonts, spacing, layout, etc.); most word processors let you design a very pleasing document. Print your essay on a laser-quality printer if you can. If your essay will contain much mathematical symbolism, try to use a mathematical word processor or typesetter. The best of these is LaTeX, which it would definitely be worth your while to learn to use (although it is not easy). To give you an idea of how nice LaTeX can look, note that this solutions manual was produced using LaTeX.
- Finally, be careful to give credit to the sources you use. Plagiarism has become a major problem, and if you copy material from the web or other sources and present it as your own, you are stealing another person's property. The consequences can include suspension from your school. When in doubt, ask you instructor about proper procedures for citations.

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