<<分析方法>>

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前言

Do not ask permission to understand.Do not wait for the word of authority.Seize reason in your own hand.With your own teeth savor the fruit.Mathematics is more than a collection of theorems, definitions,problems and techniques; it is a way of thought. The same can be said about an individual branch of mathematics, such as analysis. Analysis has its roots in the work of Archimedes and other ancient Greek ge-ometers, who developed techniques to find areas, volumes, centers of gravity, arc lengths, and tangents to curves. In the seventeenth century these techniques were further developed, culminating in the invention of the calculus of Newton and Leibniz. During the eighteenth centu-ry the calculus was fashioned into a tool of bold computational power and applied to diverse problems of practical and theoretical interest.At the same time the foundation of analysis——the logical justification for the success of the methods——was left in limbo. This had practical consequences: for example, Euler——the leading mathematician of the eighteenth century——developed all the techniques needed for the study of Fourier series, but he never carried out the project. On the contrary,he argued in print against the possibility of representing functions as Fourier series, when this proposal was put forth by Daniel Bernoulli,and his argument was based on fundamental misconceptions concerning the nature of functions and infinite series.In the nineteenth century, the problem of the foundation of anal-ysis was faced squarely and resolved. The theory that was developed forms most of the content of this book. We will describe it in its logical order, starting from the most basic concepts such as sets and numbers and building up to the more involved concepts of limits, continuity,derivative, and integral. The actual historical order of discovery was almost the reverse; much like peeling a cabbage, mathematicians be-gan with the outermost layers and worked their way inward. Cauchy and Bolzano began the process in the 1820s by developing the theo-ry of functions without defining the real numbers. The first rigorous definition of the real number system came in the work of Dedekind,Weierstrass, and Heine in the 1860s. Set theory came later in the work of Cantor, Peano, and Frege.The consequences of the nineteenth century foundational work were enormous and are still being felt today. Perhaps the least important consequence was the establishment of a logically valid explanation of the calculus. More important, with the clearing away of the concep-tual murk, new problems emerged with clarity and were developed into important theories. We will give some illustrations of these new nineteenth century discoveries in our discussions of differential equa-tions, Fourier series, higher dimensional calculus, and manifolds. Most important of all, however, the nineteenth century foundational work paved the way for the work of the twentieth century. Analysis today is a subject of vast scope and beauty, ranging from the abstract to the concrete, characterized both by the bold computational power of the eighteenth century and the logical subtlety of the nineteenth century.Most of these developments are beyond the scope of this book or at best merely hinted at. Still, it is my hope that the reader, after hav-ing entered so deeply along the way of analysis, will be encouraged to continue the study.My goal in writing this book is to communicate the mathematical ideas of the subject to the reader. I have tried to be generous with ex-planations. Perhaps there will be places where I belabor the obvious,nevertheless, I think there is enough truly challenging material here to inspire even the strongest students. On the other hand, there will inevitably be places where each reader will find difficulties in follow-ing the arguments. When this happens, I suggest that you write your questions in the margins. Later, when you go over the material, you may find that you can answer the question. If not, be sure to ask your instructor or another student; often, it is a minor misunderstanding that causes confusion and can easily be cleared up. Sometimes, the in-herent difficulty of the material will demand considerable effort on your part to attain understanding. I hope you will not become frustrated in the process; it is something which all students of mathematics must confront. I believe that what you learn through a process of struggle is more likely to stick with you than what you learn without effort.Understanding mathematics is a complex process. It involves not only following the details of an argument and verifying its correctness,but seeing the overall strategy of the argument, the role played by every hypothesis, and understanding how different theorems and definitions fit together to create the whole. It is a long-term process; in a sense,you cannot appreciate the significance of the first theorem until you have learned the last theorem. So please be sure to review old mate-rial; you may find the chapter summaries useful for this purpose. The mathematical ideas presented in this book are of fundamental impor-tance, and you are sure to encounter them again in further studies in both pure and applied mathematics. Learn them well and they will serve you well in the future. It may not be an easy task, but it is a worthy one.

内容概要

数学主要讲述思想的方法，深入理解数学比掌握一大堆的定理、定义、问题和技术显得更为重要。理论和定义共同作用，本书在介绍实分析的时候结合详尽、广泛的阐释，使得读者完全理解分析基础和方法。
目次：基础；实数体系结构；实线拓扑；连续函数；微分学；积分学；序列和函数级数；超函数；欧拉空间和矩阵空间；欧拉空间上的微分计算；常微分方程；傅里叶级数；隐函数、曲线和曲面；勒贝格积分；多重积分。
读者对象：数学专业的研究生以及相关的科研人员。

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