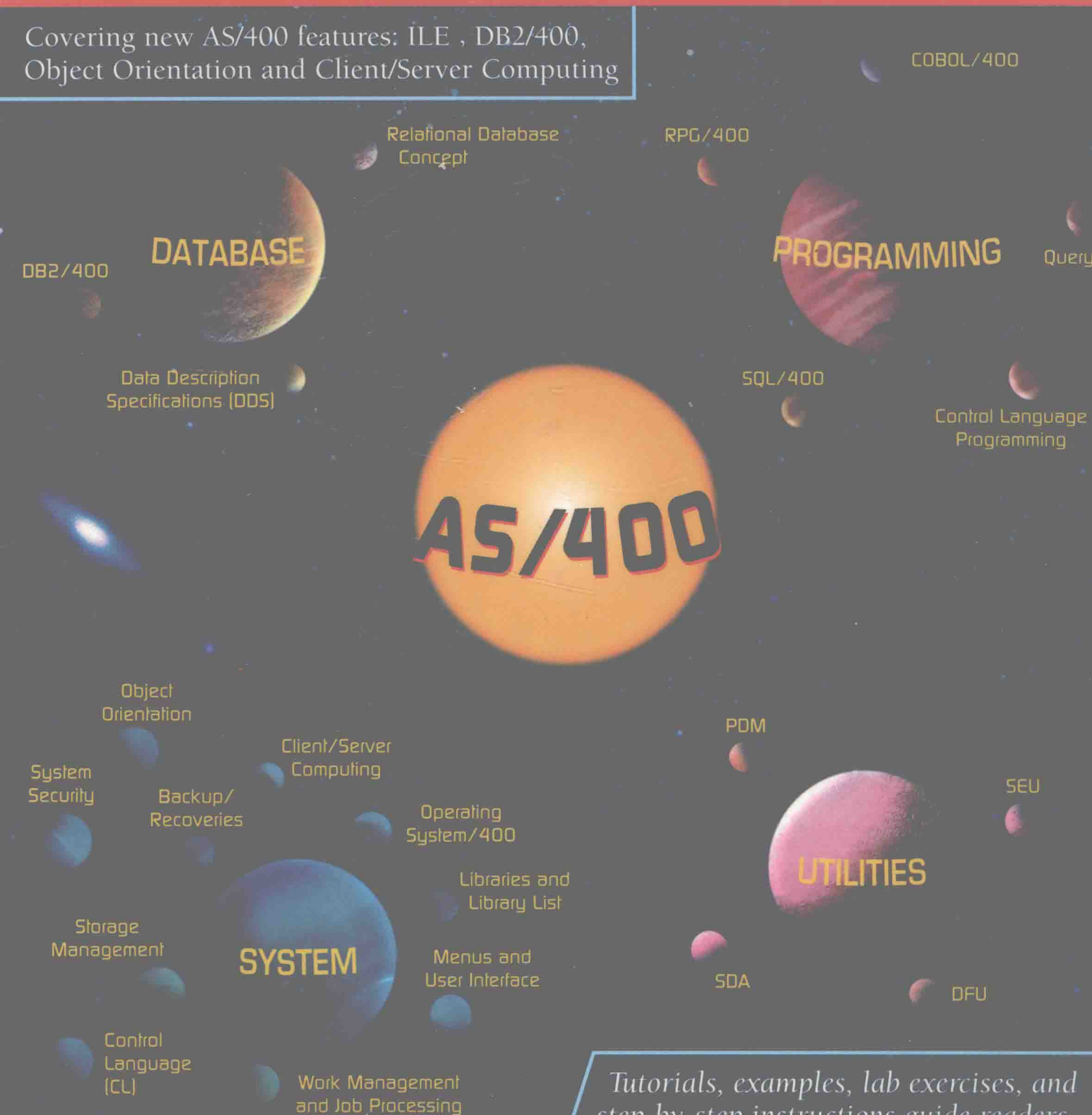
AS/400: System, Utilities, Database, and Programming

George Lin and Gayla Stewart

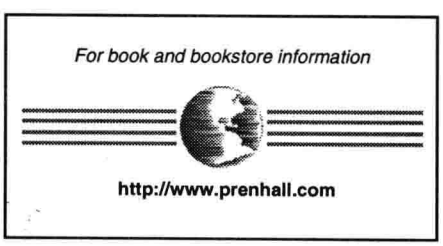
Covering new AS/400 features: ILE , DB2/400, Object Orientation and Client/Server Computing



Tutorials, examples, lab exercises, and step-by-step instructions guide readers through using the system and developing

AS/400
System, Utilities, Database, and Programming

George Lin
Gayla Stewart



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ABOUT THE AUTHORS

George Lin is a Software Engineer whose technical background spans all three major system platforms: AS/400, mainframe, and PC. For the last 15 years, he has worked on many system and application developments including client/server computing, object oriented architecture, relational database, graphical user interface, event-driven programming, and communication software applications. He has designed and implemented many business applications using various utilities, databases, and system development tools including those on the AS/400.

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Preface

The Application System/400 (AS/400) is IBM's new generation of full-range, general-purpose computers, which encompass a broad family of related models. This new system was an instant hit in the market when it was introduced in 1988. By most estimates, the AS/400 has been one of the most successful products ever introduced by IBM.

The popularity of the AS/400 is not confined to the mid-range computing segment where the AS/400 originated. In recent years, the AS/400 has become a favorable down-sizing and right-sizing alternative for many organizations that have decided to migrate from a mainframe to a more efficient and less costly system. It enjoys very high popularity among information systems professionals because of its advanced technologies and many distinct characteristics, which include object-oriented architecture, ease of use, a high level of integration, an integrated relational database, integrated application development tools, and client/server computing. Innovative as it is, the AS/400 is truly a product beyond tradition and comparison.

In This Book

This book is distinct in its breadth, completeness, depth, and ease of use. It engages readers in hands-on projects while using a combination of text, tutorials, and lab exercises. Detailed and step-by-step illustrations and instructions using graphics, screens, displays, tables, diagrams, and examples are employed throughout the book.

Chapters of this book are organized into five major parts:

System

Part 1 introduces the AS/400 system architecture and operating system. Tutorials and lab exercises are used to illustrate the AS/400 environment and to teach the use of AS/400 menus and various displays. AS/400 Control Language (CL), which is essential for performing various system and programming tasks, is introduced. The AS/400 work management structure and job processing are explained. Other topics include storage management, system security, and backup and recovery. In addition, object-oriented architecture and client/server computing, the two most explosive movements in today's computer industry and the focal points of the AS/400 in recent years, are explained.

Utilities

Part 2 teaches readers how to use the AS/400 utilities, commonly called programming development tools, to develop their applications. These tools include Source Entry Utility (SEU), Data File Utility (DFU), Screen Design Aid (SDA), and Programming Development Manager (PDM). In each of the chapters, tutorials, screen displays, and lab exercises are used to maximize the reader's learning experience.

Database

Part 3 discusses the concept and structure of the relational database in general and the AS/400 database, DB2/400, in particular. It uses a combination of forms, examples, and lab exercises to explain to readers the use of Data Description Specifications (DDS) in defining the AS/400 database files.

Programming

Part 4 introduces the AS/400 programming languages. The AS/400 Control Language Programming (CLP) is discussed through various examples. Tutorials are used to dissect other major programming languages, including RPG/400, COBOL/400, and SQL/400. A comparative perspective between RPG/400 and its predecessor, RPG II, is presented. Finally, Query/400, an AS/400 utility, which allows users to retrieve data and create reports without the knowledge of a specific programming language, is taught through the use of tutorials and lab exercises.

Project

Part 5 presents step-by-step instructions that guide readers through the development of an application project. It reconstructs and expands the procedures specified in lab exercises and lab assignments of the preceding chapters to create the Asset Master application project. The structured instructions in this section assist readers in learning to use the AS/400 database, utilities, query, and CL commands when coding and developing application and programming projects.

Tutorials, Lab Exercises, and Lab Assignments

The tutorials, lab exercises, and lab assignments in many of the chapters enable readers to develop application projects through hands-on activities using various AS/400 utilities, database, and programming languages. They include CL commands, DB2/400, DDS, SEU, PDM,

DFU, SDA, Query/400, and RPG/400. After the completion of these exercises and assignments, readers will have completed two major application projects: the Asset Master and Employee Master.

Who Can Use This Book

This is a technical book written for both novices and experienced computer professionals. AS/400 users and students can use this book to learn the ins and outs of the system and to acquire the basic knowledge of the AS/400. Programmers, system analysts, system administrators, database administrators, and operators can use this book to learn application development, system administration, database design, programming, and operation of the AS/400. Both beginning and experienced computer professionals will benefit from the detailed hands-on tutorials, graphical screen illustrations, step-by-step instructions, and lab exercises. The structured tutorials and practical knowledge offered by this book make it ideal material for technical reference, self-study, and classroom teaching and learning.

Suggested Studying and Teaching Agenda

Because of the structure and arrangement of tutorials and lab exercises in this book, certain topics and lab exercises must be completed before you can advance to the next topics. You are advised to follow the study sequence listed below for either self-study or classroom teaching.

Study Sequence	Chapter	Topic
1	1	Overview of the AS/400 System Architecture and Operating System
2	2	Menus and User Interface - A Tutorial
3	3	AS/400 Control Language (CL) - A Tutorial
4	4	Work Management and Job Processing
5	5	Object-oriented Architecture
6	6	Using Libraries and Library List - A Tutorial
7	7	Storage Management
8	8	System Security
9	9	Backup and Recovery
10	10	Client/Server Computing
11	11	Programmer Menu and Application Development Tools
12	15	Programming Development Manager (PDM) - A Tutorial
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21	20	Control Language Programming (CLP)
22	21	RPG/400
23	22	RPG/400 Versus RPG II
24	23	COBOL/400
25	24	SQL/400 - A Tutorial
26	26	AS/400 Integrated Language Environment (ILE), Modular Programming, and Object-oriented Programming (OOP)
27	27	Developing an Application Project Using DB2/400, DDS, SEU, PDM, DFU, SDA, Query/400, RPG/400, and CL Commands

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Chapter 1 Overview of the AS/400 System Architecture and Operating System

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1.3 AS/400 System Units

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1.1 AS/400 System Architecture

The AS/400 is a full-range, multiuser, and general-purpose computer system. It is renowned for its ease of use and high level of integration.

The AS/400 is IBM's new generation of full-range, multiuser, and general-purpose computer systems. Although it is generally considered a mid-range or mini system, the AS/400 is a mini in price and size only. The power and functionality of the AS/400 are far more advanced than its mid-range counterparts, such as System/36 and System/38.

The higher-end models of the AS/400 offer size and power comparable to traditional mainframes, although not with respect to cost. In fact, the AS/400 is easier to use and less costly to maintain because features of its system architecture and technology, such as object orientation and integrated database, have revolutionized the computer industry. More recently, the AS/400 has made significant inroads into networking and client/server computing with the introduction of models specifically designed for client/server applications. For these reasons, the AS/400 has become a product of choice as a server in enterprise-wide client/server environments.

The system architecture of the AS/400 provides many distinctive features that form this revolutionary system. These distinctive features include

The major characteristics of the AS/400 ---------->

- High level of integration
- Object orientation
- Relational and integrated database
- Data and program independence
- Single-level storage
- SAA conformance
- Client/server computing

1.1.1 High Level of Integration

The high level of integration reduces the cost of initial acquisition and subsequent maintenance. It also increases system efficiency and productivity.

One of the most distinctive features of the AS/400 system architecture is its high level of system integration. Unlike traditional systems that generally separate their database and application development tools from their operating system, the AS/400 offers a full-fledged operating system that integrates most aspects of the machine and user interface. On the AS/400, the work management, storage management, database, control language, query management, security management, and application development tools such as Data File Utility, Source Entry Utility, Programming Development Manager, and Screen Design Aid are all preloaded and integrated into the AS/400 operating system. This high

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