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**Dedication**

To my wonderful wife, Christine,

and my fine boys, Matthew, Luke, and Peter

*Bruce Momjian 2002-01-08*

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**Foreword**

Most research projects never leave the academic environment. Occasionally, exceptional ones survive the transition from the university to the real world and go on to become a phenomenon. POSTGRESQL is one of those projects. Its popularity and success are a testament to the dedication and hard work of the POSTGRESQL global development team. Although developing an advanced database system is no small feat, maintaining and enhancing an inherited code base are even more challenging. The POSTGRESQL team has managed to not only improve the quality and usability of the system, but also expand its use among the Internet user community. This book marks a major milestone in the history of the project.

Postgres95, later renamed POSTGRESQL, started as a small project to overhaul Postgres. Postgres was a novel and feature-rich database system created by the students and staff at the University of California at Berkeley . Our goal with Postgres95 was to keep the powerful and useful features of this system while trimming down the bloat caused by much experimentation and research. We had a lot of fun reworking the internals. At the time, we had no idea where we were going with the project. The Postgres95 exercise was not research, but simply a bit of engineering housecleaning. By the spring of 1995 however, it had occurred to us that the Internet user community really needed an open source, SQL-based multiuser database. Happily, our first release was met with great enthusiasm, and we are very pleased to see the project continuing.

Obtaining information about a complex system like POSTGRESQL is a great barrier to its adoption. This book fills a critical gap in the documentation of the project and provides an excellent overview of the system. It covers a wide range of topics, from the basics to the more advanced and unique features of POSTGRESQL.

In writing this book, Bruce Momjian has drawn on his experience in helping beginners with POSTGRESQL. The text is easy to understand and full of practical tips. Momjian captures database concepts using simple and easy-to-understand language. He also presents numerous real-life examples throughout the book. In addition, he does an outstanding job of covering many advanced POSTGRESQL topics. Enjoy reading the book and have fun exploring POSTGRESQL! It is our hope this book will not only teach you about using POSTGRESQL, but also inspire you to delve into its innards and contribute to the ongoing POSTGRESQL development effort.

Jolly Chen and Andrew Yu, co-authors of Postgres95

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**Preface**

This book is about POSTGRESQL, the most advanced open source database. From its origins in academia, POSTGRESQL has moved to the Internet with explosive growth. It is hard to believe the advances during the past four years under the guidance of a team of worldwide Internet developers. This book is a testament to their vision, and to the success that POSTGRESQL has become.

The book is designed to lead the reader from their first database query through the complex queries needed to solve real-world problems. No knowledge of database theory or practice is required. However, basic knowledge of operating system capabilities is expected, such as the ability to type at an operating system prompt.

Beginning with a short history of POSTGRESQL, the book moves from simple queries to the most important database commands. Common problems are covered early, which should prevent users from getting stuck with queries that fail. The author has seen many bug reports in the past few years and consequently has attempted to warn readers about the common pitfalls.

With a firm foundation established, additional commands are introduced. The later chapters outline complex topics like transactions and performance.

At each step, the purpose of each command is clearly illustrated. The goal is to have readers understand more than query syntax. They should know *why* each command is valuable, so they can use the proper commands in their real-world database applications.

A database novice should read the entire book, while skimming over the later chapters. The complex nature of database systems should not prevent readers from getting started. Test databases offer a safe way to try queries. As readers gain experience, later chapters will begin to make more sense. Experienced database users can skip the early chapters on basic SQL functionality. The cross-referencing of sections allows you to quickly move from general to more specific information.

Much information has been moved out of the main body of the book into appendices. Appendix

lists sources of additional information about POSTGRESQL. Appendix

provides information about installing POSTGRESQL. Appendix

lists the features of POSTGRESQL not found in other database systems. Appendix

contains a copy of the POSTGRESQL manual pages which should be consulted anytime you have trouble with query syntax. Also, do not overlook the excellent documentation that is part of POSTGRESQL. This documentation covers many complex topics, including much POSTGRESQL-

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specific functionality that cannot be covered in a book of this length. Sections of the documentation are referenced in this book where appropriate.

This book uses *italics* for identifiers, SMALLCAPS for SQL keywords, and a monospaced font for SQL queries. The Web site for this book is located at http://www.postgresql.org/docs/awbook.html.

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**Acknowledgments**

POSTGRESQL and this book would not be possible without the talented and hard-working members of the POSTGRESQL Global Development Team. They took source code that could have become just another abandoned project and transformed it into the open source alternative to commercial database systems. POSTGRESQL is a shining example of Internet software development.

**Steering**

q Fournier, Marc G., in Wolfville, Nova Scotia, Canada, coordinates the entire effort, provides the

server, and administers the primary Web site, mailing lists, ftp site, and source code repository. q Lane, Tom, in Pittsburgh, Pennsylvania, United States, is often seen working on the

planner/optimizer, but has left his fingerprints in many places. He specializes in bug fixes and performance improvements. q Lockhart, Thomas G., in Pasadena, California, United States, works on documentation, data types

(particularly date/time and geometric objects), and SQL standards compatibility. q Mikheev, Vadim B., in San Francisco, California, United States, does large projects, like vacuum,

subselects, triggers, and multi-version concurrency control (MVCC). q Momjian, Bruce, in Philadelphia, Pennsylvania, United States, maintains FAQ and TODO lists,

code cleanup, patch application, training materials, and some coding. q Wieck, Jan, near Hamburg, Germany, overhauled the query rewrite rule system, wrote our

procedural languages PL/PGSQL and PL/TCL, and added the NUMERIC type.

**Major Developers**

q Cain, D'Arcy, J. M., in Toronto, Ontario, Canada, worked on the TCL interface, PyGreSQL, and

the INET type. q Dal Zotto, Massimo, near Trento, Italy, created locking code and other improvements. q Eisentraut, Peter, in Uppsala, Sweden, has added many features, including an overhaul of psql. q Elphick, Oliver, in Newport, Isle of Wight, United Kingdom, maintains the POSTGRESQL

package for Debian Linux. q Horak, Daniel, near Pilzen, Czech Republic, did the WinNT port of POSTGRESQL (using the

Cygwin environment). q Inoue, Hiroshi, in Fukui, Japan, improved btree index access. q Ishii, Tatsuo, in Zushi, Kanagawa, Japan, handles multibyte foreign language support and porting

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