

THE OFFICIAL JOURNAL OF THE FIBONACCI ASSOCIATION

# **TABLE OF CONTENTS**

Sets in Which the Product of Any K Elements Increased by t Is a k <sup>th</sup> Power	98
Divergent Rats Sequences Steven Shattuck and Curtis Cooper	101
Derived Sequences, The Tribonacci Recurrence and Cubic Forms	107
Morgan-Voyce Polynomial Derivative Sequences	116
On the Frequency of Occurrence of $\alpha^i$ in the $\alpha$ -Expansions of the Positive Integers	123
New Problem Web Site	137
Some Properties of Partial Derivatives of Generalized Fibonacci and Lucas Polynomials	138
Generalizing Bailey's Generalization of the Catalan Numbers	142
On Irrational Valued Series Involving Generalized Fibonacci Numbers II	149
The Binet Formula and Representations of k-Generalized Fibonacci Numbers	158
Generalizations of Some Identities Involving the Fibonacci Numbers Fengzhen Zhao and Tianming Wang	165
Approximation of ∞-Generalized Fibonacci Sequences and Their Asymptotic Binet Formula	168
Author and Title Index	180
Elementary Problems and Solutions Edited by Russ Euler and Jawad Sadek	181
Advanced Problems and Solutions Edited by Raymond E. Whitney	187

**VOLUME 39** 

NUMBER 2

# PURPOSE

The primary function of **THE FIBONACCI QUARTERLY** is to serve as a focal point for widespread interest in the Fibonacci and related numbers, especially with respect to new results, research proposals, challenging problems, and innovative proofs of old ideas.

## **EDITORIAL POLICY**

THE FIBONACCI QUARTERLY seeks articles that are intelligible yet stimulating to its readers, most of whom are university teachers and students. These articles should be lively and well motivated, with new ideas that develop enthusiasm for number sequences or the exploration of number facts. Illustrations and tables should be wisely used to clarify the ideas of the manuscript. Unanswered questions are encouraged, and a complete list of references is absolutely necessary.

# SUBMITTING AN ARTICLE

Articles should be submitted using the format of articles in any current issues of **THE FIBONACCI QUARTERLY.** They should be typewritten or reproduced typewritten copies, that are clearly readable, double spaced with wide margins and on only one side of the paper. The full name and address of the author must appear at the beginning of the paper directly under the title. Illustrations should be carefully drawn in India ink on separate sheets of bond paper or vellum, approximately twice the size they are to appear in print. Since the Fibonacci Association has adopted  $F_1 = F_2 = 1$ ,  $F_n + i = F_n + F_n - i$ ,  $n \ge 2$  and  $L_1 = 1$ ,  $L_2 = 3$ ,  $L_n+i = L_n+L_n-i$ ,  $n \ge 2$  as the standard definitions for The Fibonacci and Lucas sequences, these definitions *should not* be a part of future papers. However, the notations *must* be used. One to three *complete* A.M.S. classification numbers *must* be given directly after references or on the bottom of the last page. **Papers not satisfying all of these criteria will be returned.** See the new worldwide web page at:

http://www.sdstate.edu/~wcsc/http/fibhome.html

for additional instructions.

#### Three copies of the manuscript should be submitted to: CURTIS COOPER, DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE, CENTRAL MISSOURI STATE UNIVERSITY, WARRENSBURG, MO 64093-5045.

Authors are encouraged to keep a copy of their manuscripts for their own files as protection against loss. The editor will give immediate acknowledgment of all manuscripts received.

The journal will now accept articles via electronic services. However, electronic manuscripts must be submitted using the typesetting mathematical wordprocessor AMS-TeX. Submitting manuscripts using AMS-TeX will speed up the refereeing process. AMS-TeX can be downloaded from the internet via the homepage of the American Mathematical Society.

## SUBSCRIPTIONS, ADDRESS CHANGE, AND REPRINT INFORMATION

Address all subscription correspondence, including notification of address change, to: PATTY SOLSAA, SUBSCRIPTIONS MANAGER, THE FIBONACCI ASSOCIATION, P.O. BOX 320, AURORA, SD 57002-0320. E-mail: solsaap@itctel.com.

Requests for reprint permission should be directed to the editor. However, general permission is granted to members of The Fibonacci Association for noncommercial reproduction of a limited quantity of individual articles (in whole or in part) provided complete reference is made to the source.

Annual domestic Fibonacci Association membership dues, which include a subscription to THE FIBONACCI QUARTERLY, are \$40 for Regular Membership, \$50 for Library, \$50 for Sustaining Membership, and \$80 for Institutional Membership; foreign rates, which are based on international mailing rates, are somewhat higher than domestic rates; please write for details. THE FIBONACCI QUARTERLY is published each February, May, August and November.

All back issues of **THE FIBONACCI QUARTERLY** are available in microfilm or hard copy format from **BELL & HOWELL INFORMATION & LEARNING, 300 NORTH ZEEB ROAD, P.O. BOX 1346, ANN ARBOR, MI 48106-1346.** Reprints can also be purchased from **BELL & HOWELL** at the same address.

> ©2001 by The Fibonacci Association All rights reserved, including rights to this journal issue as a whole and, except where otherwise noted, rights to each individual contribution.

# Ge Fibonacci Quarterly

Founded in 1963 by Verner E. Hoggatt, Jr. (1921-1980) and Br. Alfred Brousseau (1907-1988)

THE OFFICIAL JOURNAL OF THE FIBONACCI ASSOCIATION DEVOTED TO THE STUDY OF INTEGERS WITH SPECIAL PROPERTIES

#### EDITOR

PROFESSOR CURTIS COOPER, Department of Mathematics and Computer Science, Central Missouri State University, Warrensburg, MO 64093-5045 e-mail: cnc8851@cmsu2.cmsu.edu

#### **EDITORIAL BOARD**

DAVID M. BRESSOUD, Macalester College, St. Paul, MN 55105-1899 JOHN BURKE, Gonzaga University, Spokane, WA 99258-0001 BART GODDARD, East Texas State University, Commerce, TX 75429-3011 HENRY W. GOULD, West Virginia University, Morgantown, WV 26506-0001 HEIKO HARBORTH, Tech. Univ. Carolo Wilhelmina, Braunschweig, Germany A.F. HORADAM, University of New England, Armidale, N.S.W. 2351, Australia STEVE LIGH, Southeastern Louisiana University, Hammond, LA 70402 FLORIAN LUCA, Instituto de Mathematicas de la UNAM, Morelia, Michoacan, Mexico RICHARD MOLLIN, University of Calgary, Calgary T2N 1N4, Alberta, Canada GARY L. MULLEN, The Pennsylvania State University, University Park, PA 16802-6401 HARALD G. NIEDERREITER, National University of Singapore, Singapore 117543, Republic of Singapore SAMIH OBAID, San Jose State University, San Jose, CA 95192-0103 ANDREAS PHILIPPOU, University of Patras, 26100 Patras, Greece NEVILLE ROBBINS, San Francisco State University, San Francisco, CA 94132-1722 DONALD W. ROBINSON, Brigham Young University, Provo, UT 84602-6539 LAWRENCE SOMER, Catholic University of America, Washington, D.C. 20064-0001 M.N.S. SWAMY, Concordia University, Montreal H3G 1M8, Quebec, Canada ROBERT F. TICHY, Technical University, Graz, Austria ANNE LUDINGTON YOUNG, Loyola College in Maryland, Baltimore, MD 21210-2699

#### **BOARD OF DIRECTORS—THE FIBONACCI ASSOCIATION**

G.L. ALEXANDERSON, Emeritus Santa Clara University, Santa Clara, CA 95053-0001 CALVIN T. LONG, Emeritus Northern Arizona University, Flagstaff, AZ 86011 FRED T. HOWARD, President Wake Forest University, Winston-Salem, NC 27109 PETER G. ANDERSON. Treasurer Rochester Institute of Technology, Rochester, NY 14623-5608 GERALD E. BERGUM South Dakota State University, Brookings, SD 57007-1596 KARL DILCHER Dalhousie University, Halifax, Nova Scotia, Canada B3H 3J5 ANDREW GRANVILLE University of Georgia, Athens, GA 30601-3024 HELEN GRUNDMAN Bryn Mawr College, Bryn Mawr, PA 19101-2899 MARJORIE JOHNSON, Secretary 665 Fairlane Avenue, Santa Clara, CA 95051 CLARK KIMBERLING University of Evansville, Evansville, IN 47722-0001 JEFF LAGARIAS AT&T Labs-Research, Florham Park, NJ 07932-0971 WILLIAM WEBB, Vice-President Washington State University, Pullman, WA 99164-3113

Fibonacci Association Web Page Address: http://www.MSCS.dal.ca/Fibonacci/