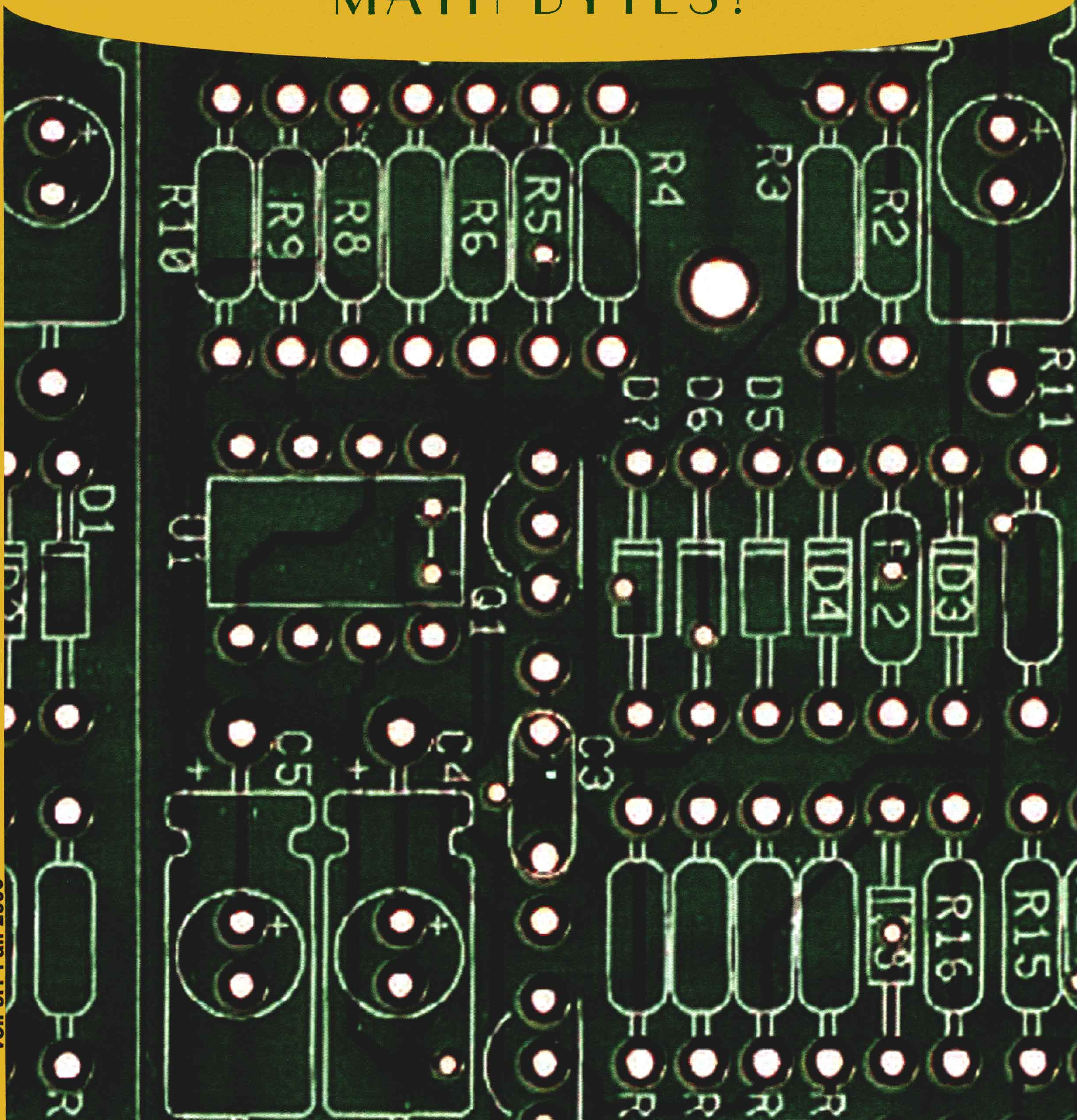
Math Reader

MATH BYTES!



Vol. 3.1 Fall 2000

Math Reader

Contents

Executive Editor: Hiroko K. Warshauer
Senior Editors: Terry McCabe, Max Warshauer, Eugene Curtin
Special Writers: Tivadar Divéki, Tatum Blunt, Laura Chavkin, Kevin Jones, Jeff Slomka, Cody Patterson
Design: Jennifer LeGrévellec, Amy Warshauer
Final Editing and Proofreading: David Nelson, Michael Kellerman
Administration: Lydia Carbuccia
Circulation: Kristi Carter
Webmaster: Peng Wu

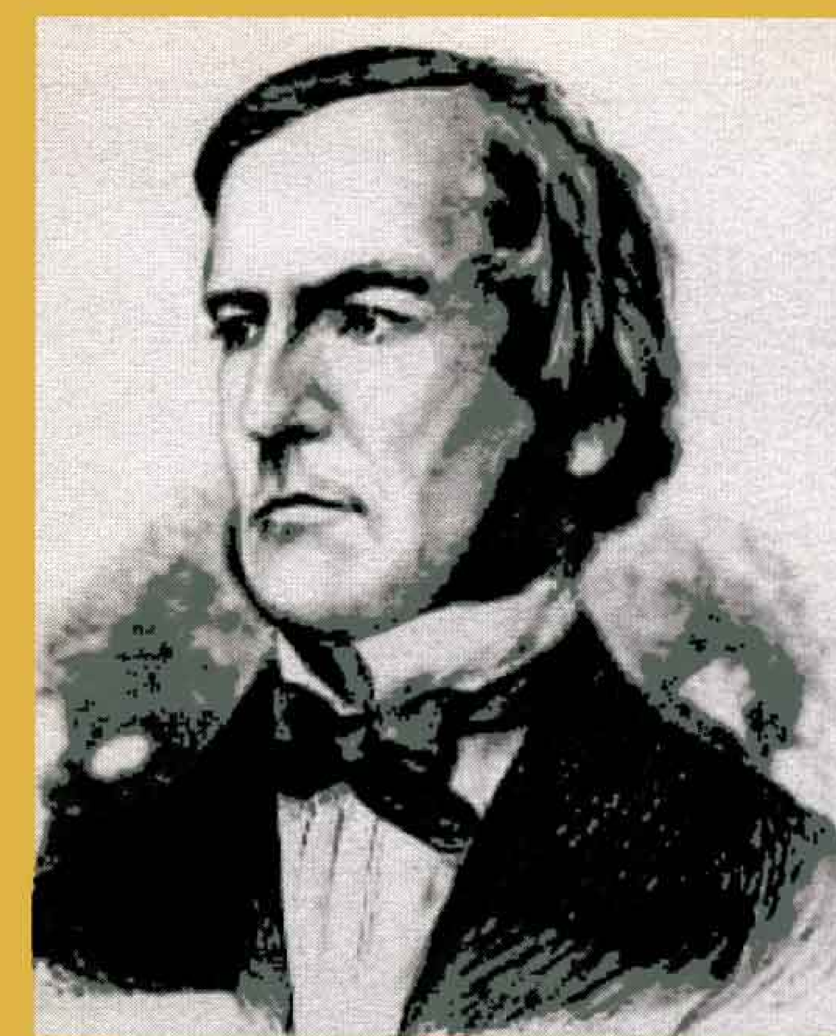
Math Reader
Southwest Texas State University
San Marcos, TX 78666
Phone: (512) 245-3439, Fax: (512) 245-1469
e-mail: mathexplorer@swt.edu.
Visit our website: www.mathexplorer.com

Math Explorer and **Math Reader** are published by Southwest Texas State University Math Institute for Talented Youth (MITY).

SWT

George Boole

By Tatum Blunt



George Boole was born on November 2, 1815, in the small town of Lincoln, England. Boole's father encouraged him to obtain an education in the classics, and languages such as Latin and Hebrew. In addition to excelling in Latin, Boole took a special interest in mathematics. His father loved the subject and passed on to George what knowledge he could from his own private studies. Boole later became interested in Algebra and Calculus. He was highly influenced by the works of Isaac Newton and Pierre Laplace.

By the late 1830's, Boole established contact with Duncan Gregory, a Scottish mathematician who edited the ***Cambridge Mathematical Journal***. Boole decided to share his mathematical ideas with Gregory, who in turn was impressed with his work and began publishing it. This marked the beginning of an extremely prominent career.

George Boole found ways to use algebraic symbols in logic. He devised a system of binary algebra, called **Boolean algebra,** that today has broad applications in the design of computer circuits and telephone switching. He made significant contributions to probability theory, the field of differential equations and the calculus of finite differences; he also had a reputation for being an outstanding and dedicated teacher. Boole died in 1864 but his contributions to mathematics are very much alive.

Reference:
http://www-groups.dcs.standrews.ac.uk/~history/Mathematicians/Boole.html

Tatum Blunt is an elementary education major at Southwest Texas State University.

PROBLEMS OF THE MONTH

1. The students in Ms. Brown's class were asked which food they liked the most: hamburgers, pizza or tacos. Each student was required to choose one (and only one) of these foods. One half of the class preferred hamburgers, one third preferred pizza and the other 5 students preferred tacos. How many students are in Ms. Brown's class?

2. Ricardo has two straight sticks which he uses to measure various objects. These sticks are 7 inches and 10 inches in length. Suppose that he wants to draw a line segment that is exactly 1 inch long. How can he do this using the sticks?

3. A rectangular garden has an area of 72 square meters and is enclosed by 44 meters of fence. What is the length and width of the garden?

4. Every 4 years is leap year. The rule is generally that if a year is divisible by 4, it is a leap year. If a year is divisible by 100, it is not a leap year unless it is divisible by 400, in which case it is a leap year. Thus 2000 is a leap year because it is divisible by 400 even though it is divisible by 100. How many leap years will occur in the millennium beginning January 1, 2001 and ending December 31, 3000?

5. Convert the following numbers to base 2: 12, 13, 14, 15, 16, 24, 36, 37

6. Convert the following base 2 numbers to base 10:
   a. 11_2, 111_2, 1111_2, 11111_2
   b. 101_2, 10101_2, 1010101_2, 101010101_2

Read the main article for problems 5, 6 and 7.

7. The largest number you can represent with 3 digits in base 2 is 7. What is the largest number you can represent with 4 digits in base 2? How about with 5 digits? Can you explain the pattern?

8. Computers perform many tasks by following a list of instructions called a program. Here is an example of a list of instructions. Pretend that you are a computer and perform these instructions. What is the result?
   a. Let A = 0, B = 0 and C = 0.
   b. Increase A by 1.
   c. If A is even, then increase B by 1. Otherwise, do nothing.
   d. If B is even, then increase C by 1. Otherwise, do nothing.
   e. If A is greater than 10, then go to step f. Otherwise, return to step b and perform the steps again.
   f. Write down the values of A, B and C.

9. Compute the next three terms of the following sequence: 4, 7, 13, 25, 49, 97, ___, ___ , ___

10. Compute the following sums: a. 1+2+1 b. 1+2+3+2+1 c. 1+2+3+4+3+2+1 d. 1+2+3+4+5+4+3+2+1
What pattern do you notice in the answers? Can you show why this pattern works? Use your pattern to figure out the sum: 1 + 2 + 3 + ...+ 98 + 99 + 100 + 99 + 98 + ...+ 3 + 2 + 1

Send us your solutions! Every month, we will publish the best solutions on our website: www.mathexplorer.com. If we print your solutions, we will send you and your teacher free **Math Reader** pens!

NUMBER SYSTEM

By Jeff Slomka

Jeff Slomka teaches computer science at Southwest Texas State University.

We are all familiar with the decimal number system. When we write 321, we know that this number represents 3 hundreds, 2 tens, and 1 one.

321 in **expanded notation** looks like

$$3 \times 100 + 2 \times 10 + 1.$$

In mathematics, we often write 10^2 to mean 10 x 10 and 10^3 to mean 10 x 10 x 10. We call the raised numbers 2 and 3 the **power** or **exponent** to which the **base**, 10, is raised. Though we usually write 10 for 10^1 and 10^0 equals 1, the expanded notation of 321 is formally written as

$$3 \times 10^2 + 2 \times 10^1 + 1 \times 10^0.$$

Our decimal system, sometimes referred to as "base 10," uses place values that are powers of 10. However, we also use other number systems daily. For example, our system for measuring time uses a system based on 60 (60 seconds in a minute, 60 minutes in an hour). For measuring small lengths or quantities, we use a system based on 12 (12 inches in a foot, 12 objects in a dozen).

All number systems work essentially the same way. Each digit, called the **face value**, has a value which is based on its place. The value of each place, called the **place value**, is a power of the base.

System	Decimal				Base 60 (seconds)		Base 12 (inches)	
Place	10^3	10^2	10^1	10^0	60^1	60^0	12^1	12^0
Place values	1000	100	10	1	60	1	12	1
Place meaning					Minutes	Seconds	Feet	Inches
Digits	0 - 9				0-59		0-11	

The Binary Number System

The decimal system was probably adopted because people have 10 fingers readily available for counting. While the decimal system is very convenient for people to use, a very different system for storing and manipulating numbers is used by computers. All modern computers store and manipulate data using the binary number system. The **binary number system** uses the number 2 as its base. The binary number system, like our decimal number system, uses place values that are powers of its base.

Place	2^5	2^4	2^3	2^2	2^1	2^0
Place value	32	16	8	4	2	1

The binary number system is the smallest number system that can be used. It has only two digits, 0 and 1. A binary number consists of a string of 0's and 1's such as 101101_2. The subscript 2 is used indicate that the number is a binary number rather than the decimal number 101,101.

To understand the meaning of a binary number we must convert it to our familiar decimal system. The procedure for converting a binary number to decimal is to multiply each binary digit by its place value and then to add all of the products.

MS

Place	2^5	2^4	2^3	2^2	2^1	2^0
Place value	32	16	8	4	2	1
Digit	1	0	1	1	0	1
Digit times place value	32	0	8	4	0	1

For example, the table above shows the procedure for converting 101101_2 to decimal:

$$32 + 0 + 8 + 4 + 0 + 1 = 45$$

Binary Numbers and the Computer

A computer's storage consists of a large number of **bits** (**bit** is short for **binary digit**). Each bit is a transistor, a device that can have only two conditions, or states, caused by either the presence or absence of electrical current. We could call these states "on" and "off", "true" or "false", or "yes" and "no", but by referring to the two states as 1 and 0, we have the basis for storing information using the binary number system.

Binary Codes

The binary number system could be used to directly store positive integers (1, 2, 3, ...). But computers must store many different types of data, including negative numbers (how could we store the '-'?), real numbers, characters (letters and punctuation marks), as well as sounds, images, and programs. All of these varied types of information must be stored in the computer using only 1's and 0's. To do so, we use codes.

Most of us at some time have invented a code, usually to keep information secret. The simplest kind of code is called a **substitution code**, where each letter in a message is coded using another letter. This is exactly the kind of code used for storing character information in a computer. The coding system for character information is called ASCII. In the ASCII system, each character is assigned a value in the range of 0 - 127. That value is then converted to binary using 8 bits (known as a **byte**) for storage in the computer. The decimal code values for letters are sequential, thus a (lower case a) is 97, b is 98, c is 99, A (capital A) is 65, B is 66, C is 67, and so on. In addition to letters, numbers, and punctuation marks, other characters too have ASCII codes.

So the sentence **Hi Mary!** would be stored in 8 bytes as:

01001000
01101001
00100000 space
01101101
01100001
01110010
01111001
00100001 exclamation point

A single bit can code 2 values "yes" or "no", "true" or "false" etc. By using several bits we can increase the number of values that can be coded. How might you develop a code for the compass points (North, South, East, and West)?

Real-world data is, of course, much more complex than the four compass directions. Coding systems for complex information will use large numbers of bits to encode the data.

Puzzle Page

Math Readers: We want to print your work! Send us original math games, puzzles, problems, and activities. If we print them, we'll send you and your math teacher free **Math Reader** pens.

Word Search

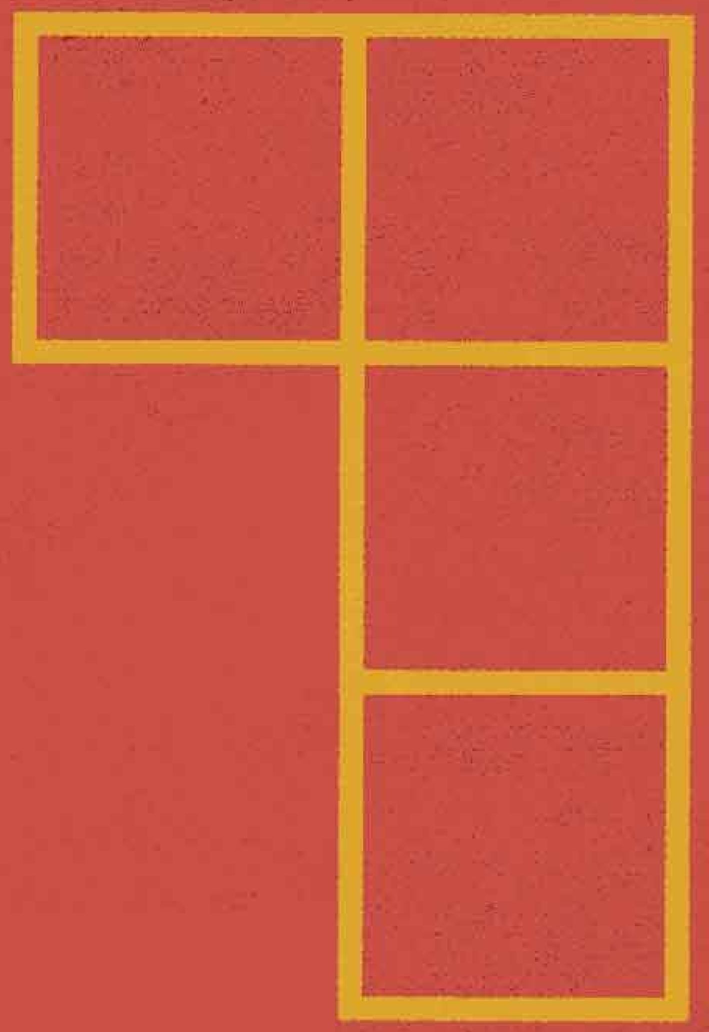
Forwards or backwards, up, slanted, or down.
Where can the words in this puzzle be found?

Binary
Algebra
Boole
Decimal
Base
Byte
Exponent
Digit
Mayan
Bits

X	Y	I	L	A	M	I	C	E	D	R	O	O	E
O	M	H	S	E	S	P	B	P	Q	N	B	N	A
N	D	I	G	I	T	E	W	U	I	O	T	E	F
Y	O	B	A	V	E	R	A	G	O	I	X	N	U
T	I	O	S	Q	N	C	C	L	A	S	A	E	N
R	T	F	E	T	Y	E	U	E	E	I	R	M	D
B	A	W	B	C	A	R	B	P	T	V	B	A	M
G	N	E	A	N	S	T	A	Y	E	I	E	Y	B
A	I	E	X	P	O	N	E	N	T	N	G	A	R
L	M	Z	L	X	H	G	B	S	I	E	L	N	R
L	I	G	C	O	Q	E	I	O	T	B	A	O	K
Q	L	U	G	L	M	A	T	H	A	I	A	T	C
U	E	V	I	T	U	C	S	S	N	O	C	R	S
J	U	E	L	O	O	B	I	E	R	O	C	S	P

Sarah wanted to measure out four quarts of water. She only had two cans, a five-quart and a three-quart can. How did she do it?

How many different ways can you join four squares side to side? Don't count the same way in a different position. Only count different shapes. Here is one example.



Bulletin Board

Check it Out!

Math Trading Cards: http://www.bulletproof.org/math/default.asp. Yes, you can get a picture of the most famous mathematicians through history and a short description of their works.

Did you hear this?

Q: Where do mathematicians go shopping?
A: At the deci mall

Grants for Camps

SWT Junior Summer Math Camps have received support from the Fund for the Improvement of Postsecondary Education (FIPSE), Eisenhower Grant, the American Mathematical Society (AMS) and the National Science Foundation. WOW!! Somebody knows math is important!

Math Camp Snapshots

The 2000 SWT Junior Summer Math Camp at Hernandez Elementary School in San Marcos had 200 students attend.

Yes! I want to subscribe.

Order Form (Please type or print), **Send to:**

Name:___

Address:___

City, State:___ Zip:___

School (optional):___

Phone: ( )___ E-mail:___

Amount of Payment: $___

__Math Reader (elementary), number of sub's___

__Math Explorer (intermediate), number of sub's___

Method of Payment:

__Check (payable to SWT Math Institute for Talented Youth)

__Purchase Order number:___

__Master Card __Visa

Card Number:___-___-___-___ Exp. date:__/__

Cardholder's Signature___

Type of Subscription: (Select one. All subscriptions include postage and handling for one year, 4 issues.)

__Individual ($8) __Group ($6, min. 25 subscriptions) __School ($4, min. 100 subscriptions)

Math Explorer (intermediate) and **Math Reader** (elementary) magazines are published four times a year. An annual subscription is $8.00 for individuals, $6.00 for group purchases of 25 or more, and $4.00 for school purchases of 100 or more. For subscriptions, fill out the order form above or contact *Math Explorer* at the address, phone, or e-mail on page 2.

MATH ODYSSEY

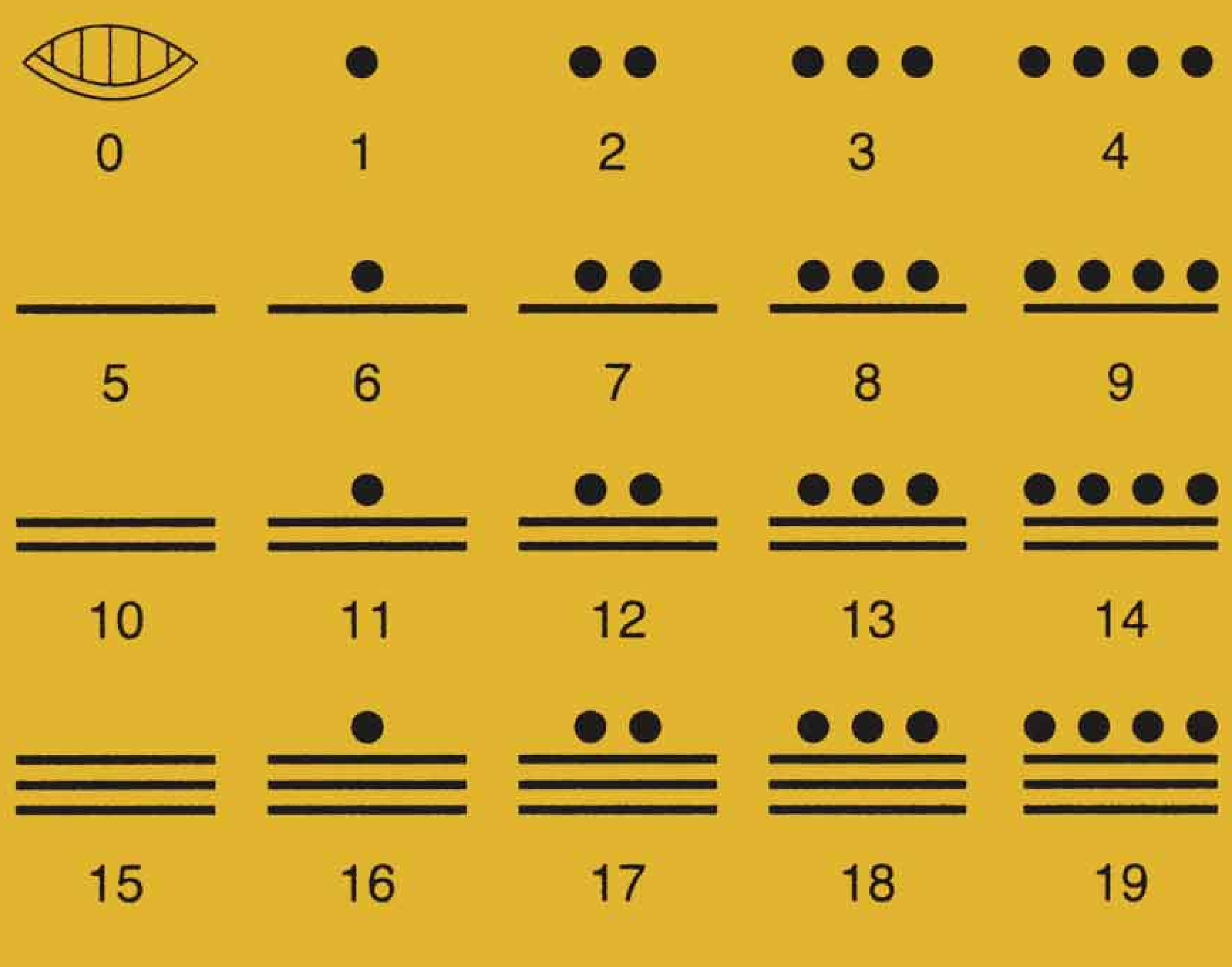
by Laura Chavkin and Hiroko Warshauer

Mayan Mathematics

Who were the Mayans? They were the largest group of American Indians north of Peru and they were centered in the Yucatan peninsula. If you find the area on a current map of Central America, the Mayans would have lived in southern Mexico, Belize, Guatemala, and the Yucatan peninsula. The Mayans were once a powerful empire with a population of nearly 50,000,000 people. By 800 AD, however, their civilization and population had diminished drastically.

The Mayans invented a number system that included three symbols, a **shell** for zero, a **dot** for one and a **bar** for five. Using a combination of these three symbols any whole number can be written. The place value is base 20 and then after 360 are multiples of 18. So the first place value is 1, the second, 20 and the third 18 x 20. The Mayans created a 360 day calendar.

You can see how this works in the table to the right and the example below.



Example: 32 in Mayan numerals looks like

Try writing your age and your birthday in Mayan numerals.

Can you represent the decimal number 321 in Mayan?

What is the decimal number for  ?

Reference: http:www.michielb.nl/maya/num/mayanum.zip

We at Math Reader welcome you to an exciting new year in math exploration. In the seasons ahead, we want to bring you fun articles to read, challenging problems to work and intriguing puzzles to solve.

Please share any solutions, ideas or comments with us. You can visit our website to access any past issues and see the solutions to the problems and puzzles. We hope you'll visit often!

Sincerely,

Hiroko K. Warshauer, editor