Major League Eternity

This being the first issue of a calendar year, we again offer a "yearly problem" in which you are to express small integers in terms of the digits of the new year (1, 9, 9, and 2) and the arithmetic operators. The problem is formally stated in the "Problems" section, and the solution to the 1991 yearly problem is in the "Solutions" section.

Problems

Y1992. Form as many as possible of the integers from 1 to 100 using the digits 1, 9, 9, and 2 exactly once each and the operators +, -, x (multiplication), / (division), and exponentiation. We desire solutions containing the minimum number of operators; and, among solutions having a given number of operators, those using the digits in the order 1, 9, 9, and 2 are preferred. Parenthesis may be used for grouping; they do not count as operators. A leading minus sign *does* count as an operator.

JAN 1. Our "first" problem is a computer offering from Bob High. Write the first n numbers in alphabetical (dictionary) orders *as they are spelled out* (i.e., one, two, three,...one million,...). To avoid ambiguity, use no "ands" or hyphens, so 837,301 would be written "eight hundred thirty seven thousand three hundred one". 1,897 is "one thousand eight hundred ninety seven," not "eighteen hundred ninety seven." Define two functions, $F(m,n)$ and $G(m,n)$ as follows: $F(m,n)$ is m th number in the alphabetical list of the first n numbers; $G(m,n)$ is the position of the number m in this list. (For given n, F and G are inverses.) we ask:

(1) What is $F(1,000, 1,000,000)$? What is $G(1,000, 1,000,000)$?

(2) What is $F(1,000,000, 1,000,000)$? What is $G(1,000,000, 1,000,000)$?

(3) For what numbers n is $F(n,n) = G(n,n)=n$? List the first dozen.

JAN 2. Robert Bart offers the following extensions to an old problem from Nob. Yoshigahara. What is the smallest positive integer whose square root has a decimal expansion beginning with ten distinct digits? Now consider cube roots instead of square roots. Finally consider ith roots for i = 4,5, . . . ,10.

SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

Speed Department

Mark Astolfi wants you to use Major League rules (with no rainouts) and name five ways a baseball game can go on forever.

Solutions

Y1991. The following solution is from David Brahm, who writes that most of it was worked out by computer, which ran through the 6 possible number orderings, the 5 possible orders of operation, and the 7 possible operators (_, +, -, *, /, ^, and ^-) in each of the 3 positions.

1 = 1^991	20 = 19 + 1^9	80 = (1+9)*(9-1)
2 = 1^99 + 1	27 = 19 + 9 - 1	81 = 91 - 9 - 1
3 = 1 + 9/9 + 1	28 = 19 + 9*1	82 = 91 - 9*1
7 = 9 + 9 - 11	29 = 19 + 9 + 1	83 = 1 - 9 + 91
8 = 9 - 1^19	36 = (1+1)*(9+9)	88 = 99 - 11
9 = 99/11	38 = 19 + 19	89 = (1+9)*9 - 1
10 = 19 - 9*1	63 = 9*(9-1-1)	90 = 11*9 - 9
11 = 19 - 9 + 1	64 = (9-1)*(9-1)	91 = 1^9 * 91
12 = 11 + 9/9	70 = 9*9 - 11	92 = 1^9 + 91
16 = 9 + 9 - 1 - 1	71 = 9*(9-1) - 1	97 = 99 - 1 - 1
17 = 1*9 + 9 - 1	72 = 91 - 19	98 = 1*99 - 1
18 = 19 - 1^9	73 = 1 + 9*(9-1)	99 = 1 + 99 - 1
19 = 19*1^9	79 = 9*9 - 1 - 1	100 = 1 + 99*1

A/S 1. We begin with a bridge problem from Don Boynton who needs to make 7 Hearts against any defense with an opening lead of the Queen of Clubs.

North
♠ 2
♥ 3 2
♦ A K 2
♣ A K 7 6 5 4 3

West
♠ K 10 8
♥ 5
♦ Q J 10 9
♣ Q J 10 9 8

East
♠ 7 6 5 4 3
♥ Q 10 8 7
♦ 8 7 6
♣ 2

South
♠ A Q J 9
♥ A K J 9 6 4
♦ 5 4 3
♣ –

Bart Bramley notes that "this is the famous Vaniva problem, composed in 1928 by the great player Sidney Lenz for a contest sponsored by Vaniva shaving cream." David Gross felt this was a "nice problem with lots of blind alleys." His solution is to win the CA (discard D3) and play the CK. East has a choice of 1) spade discard, 2) diamond discard, 3) ruff. Each of these leads to a different ending.

1) After a spade discard play for a trump coup. Play a low TRUMP on the CK, play the SA and the SQ (and a 3rd spade if West does not cover) ruffing out the SK. Then play the heart double finesse, run the spades and the DA, take a club ruff with East discarding a diamond (best), and play the DK. Finally use a club for the coup and all the tricks.

2) After a diamond discard there is a repeating triple squeeze against West. Discard the S9 on the CK, take a heart finesse, the DA, a heart finesse, and run all the hearts. This will be the position with 1 heart to play:

North
♠ 2
♥ –
♦ K 2
♣ 7 6

West
♠ K 10
♥ –
♦ Q J
♣ J 10

East
♠ 7 6 5 4
♥ –
♦ 8
♣ –

South
♠ A Q J
♥ 4
♦ 5
♣ –

On the last heart West cannot discard a spade, so s/he discards a minor suit stopper while dummy discards C6. Now South cashes the DK and whichever minor suit card West has abandoned, squeezing West in spades and the other minor.

3) After a ruff South can set up the spades via a ruffing finesse and draw trumps. The play is: overruff, SA, SQ (ruffing this or the 3rd round of spades whenever West plays SK), heart finesse, draw trumps and claim.

A/S 2. Thomas Weiss wants you to find a crossword puzzle using as few squares as possible but satisfying:

(1) All 26 letters of the English alphabet are used at least once each.

(2) No proper nouns, abbreviations, contractions, acronyms, or foreign words are used.

(3) All letters are used to form words both horizontally and vertically.

(4) Radial symmetry about the center is achieved, as is common in American crossword puzzles.

I guess the winner is the following 7x7 solution from an anonymous reader who stayed at the Clarion Hotel in Cincinnati.

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

One might object to the use of a British dictionary as representing a foreign language (or using two scrabble dictionaries as representing two foreign

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ALUMNEWS

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the black astronaut who lost his life in the *Challenger* explosion.

•Stanley Rose, an MIT telethon volunteer in New York City for more than 15 years, has been remarkably effective in enlisting project support from his employer, Bankers Trust, notably in providing a site and catering the callers' dinner.

Presidential Citations honor unusual service to the Institute and the Alumni/ae body by its member organizations. This has been a blockbuster year, with citations going to six alumni/ae groups:

•The Class of 1950 Student Aid Fund, established at the class's 25th Reunion, now totals more than $2 million and is MIT's largest class-supported financial aid fund. The fund has helped hundreds of students and their families by providing scholarships and subsidizing loan interest.

•The MIT Club of Cape Cod, founded in 1976, has demonstrated the best that clubs can offer their members, through an annual directory, quarterly newsletter, broad range of speakers, and notable efforts to reach out to all members of the MIT community in the region.

•In the three short years that it has been in operation, the Young Alumni Steering Committee of Boston has done an exemplary job of organizing events tailored to the interests of graduates from the past 10 years.

•Since Greg Turner '74 led a revival of the MIT Club of South Texas seven years ago, the club has grown steadily and has established a positive MIT presence in Houston.

•The MIT Club of Boston was honored for its black-tie gala at the Boston Museum of Fine Arts to welcome President Charles Vest and Becky Vest. The event attracted 450 guests.

•The Productivity Commission "Road Show," a collaboration of the Alumni/ae Association staff, MIT clubs in eight cities, and the MIT Industrial Liaison Program, was honored for its success in bringing the *Made in America* report of the MIT Commission on Industrial Productivity to more than 1,600 attendees coast to coast. The Road Show attracted national media attention and demonstrated MIT's concern for the national agenda to a wide audience.—*Judith Norkin.* □

PUZZLE CORNER

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languages. Eugene Sard has a 9x9 solution but needed an unabridged dictionary for three words. The following 9x9 from the proposer used only *Webster's Students Dictionary* and *Random House College Dictionary.*

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

A/S 3. Our last regular problem is from Nob. Yoshigahara. Choose two digits excluding 0 and 1 and consider the set of numbers that contain each of the two digits at least once. For example, 4 and 8 gives 8848, 4884, 84 and infinitely many others. Now consider the smallest member of this set that is a multiple of the two original digits. Call this the LYM (least Yoshigahara multiple). In our example the LYM is 48; the LYM of 3 and 5 is 3555. Among the 28 pairs of digits, 4 lead to sets that do not contain a multiple of the digits and, for these pairs, the LYM is not defined. For example, all multiples of 2 and 5 end is 0 so are not in the set constructed from 2 and 5. The LYM of 2 and 4 is 24, which is the smallest of the LYMs. What is the largest?

Apparently considerable searching, guided by some heuristics such as "casting out nines," was needed for this problem. Farrel Powsner found this question to be a good exercise for teaching problem solving to high school students. Powsner's results were as follows.

23 - 2232	46 - 4464
24 - 24 (smallest)	47 - 44744
25 - none	48 - 48
26 - 2226	49 - 4,444,444,944
27 - 2772	56 - none
28 - 2888	57 - 5775
29 - 2,222,222,292	58 - none
34 - 3444	59 - 5,555,555,595
35 - 3555	67 - 76776
36 - 36	68 - 6888
37 - 37737	69 - 6696
38 - 3888	78 - 7,888,888
39 - 3339	79 - 77,777,779,779 (largest)
45 - none	89 - 8,888,889,888

Other Responders

Responses have also been received from R. Bart, D. Boynton, S. Bragg, B. Bramley, D. Church N. Cooke J. Cronin, C. Dale, L. Daley, J. Drumheller, S. Feldman, M. Fountain, J. Grossman, J. Harmse, W. Hartford, R. High, K. Kiesel, D. McMahon, A. Ornstein, D. Plass F. Powsner, G. Ropes, K. Rosato, J. Rudy, D. Savage, A. Tracht, and H. Zaremba,

Proposer's Solution to Speed Problem

One can have a never-ending tie, constant scoring (without making 3 outs), an infinite series of foul balls, an infinite series of unsuccessful pickoff attempts, or an eternal rundown.