An Upscale Weight Problem

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 4) and the arithmetic operators. The problem is formally stated in the "Problems" section, and the solution to the 1993 yearly problem is in the "Solutions" section.

Problems

Y1994. Form as many as possible of the integers from 1 to 100 using the digits 1, 9, 9, and 4 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 4 are preferred. Parentheses may be used for grouping; they do not count as operators. A leading minus sign does count as an operator.

JAN 1. Theodore Hoffman is dismayed to realize that he gains weight just by moving his scales. He writes:

The puzzle surfaced when I moved my bathroom "Detecto" scales from a section of bare wood floor to a rug. Imagine my surprise when I found that, according to the scales, I had gained 10 pounds in the process of moving them. So, I made a few readings under varied conditions. Here they are:

Object	Scales Location/Reading on Scales			
	On floor or wood	On 3/8" foam pad	On 5/8" pile rug	On 3/4" wood on top of rug or foam
Scales alone	0	0	0	0
Me	145	153	155	145
2 weights	181/2	191/2	193/4	181/2

(The Detecto scales register from 0 to 255. The overhang of the weight-carrying top platform clears all surfaces by 3/8")

My curiosity abounds as to the explanation.

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

JAN 2. Donald Savage asks: The present U.S. flag has 50 stars arranged in alternate rows of 6 and 5. If Puerto Rico were to become a state, what would be an appropriate arrangement of the stars on the revised U.S. flag?

Speed Department

Speedy Jim Landau wants to know what is the matter with the function

$$f(\lambda) = \frac{1}{\lambda + \sin(\lambda)}$$

where L is the latitude?

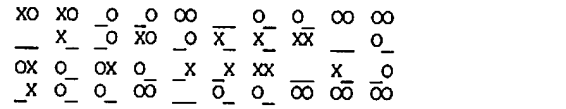
Solutions

Y1993. The following solution is from John Drumheller:

1 1^{993}	30 (19-9)*3	59 -
2 93-91	31 19+9+3	60 (1+9)*(9-3)
3 1^{99}*3	32 (9/9)+31	61 -
4 1^{99}+3	33 (1*99)/3	62 -
5 9-13+9	34 1+(99/3)	63 (9-3+1)*9
6 ((1*9)+9)/3	35 (9*3)-1+9	64 91-(9*3)
7 19-9+3	36 (13-9)*9	65 -
8 (9*3)-19	37 1+9+(9*3)	66 9+(3*19)
9 1^{93}*9	38 39-1^9	67 -
10 1^{93}+9	39 1^9*39	68 99-31
11 (9/3)-1+9	40 1^9+39	69 ((9-1)*9)-3
12 13-(9/9)	41 -	70 -
13 19-9+3	42 -	71 -
14 13+(9/9)	43 -	72 (9+9)*(3+1)
15 (1*9)+9-3	44 -	73 -
16 19-(9/3)	45 ((3+1)*9)+9	74 93-19
17 (9*3)-1-9	46 19+(9*3)	75 3-((1-9)*9)
18 (9*3*1)-9	47 9+39-1	76 -
19 1-9+(9*3)	48 (1*9)+39	77 (9*9)-3+1
20 39-19	49 31+9+9	78 (1*9*9)-3
21 (1*9)+9+3	50 (9*9)-31	79 91-9+3
22 19+(9/3)	51 (9-1+9)*3	80 (9*9)-1^3
23 -	52 91-39	81 (1/9)*9^3
24 ((9-1)*9)/3	53 ((9+9)*3)-1	82 (9*9)+1^3
25 19+9-3	54 ((1*9)+9)*3	83 93-1+9
26 ((9*9)/3)-1	55 1+((9+9)*3)	84 (19+9)*3
27 (1*9*9)/3	56 -	85 1-9+93
28 1+(9*9/3)	57 (19*9)/3	86 99-13
29 39-1+9	58 19+39	87 ((1+9)*9)-3
		88 91-(9/3)
		89 -
		90 $9^{(3-1)}$+9
		91 -
		92 93-1^9
		93 1^9*93
		94 1^9+93
		95 99-1+3
		96 (1*99)-3
		97 1+99-3
		98 99-1^3
		99 -1^3*99
		100 1^3+99

A/S 1. The late Bob High wanted to know the longest legal go game on a 2x2 board with no passes.

The following solution was from the proposer himself: Note that by the "ko" rule, a legal game cannot repeat a game position with the same player to move. The longest legal game on a 2 x 2 board without passes is 23 moves (24 positions); it is given by:



(There are a total of 57 legal positions on the 2 x 2 board; 8 if we all take symmetries into account. The longest legal game *with passes* I've been able to construct has over 50 moves, and traverses 44 of the legal positions!)

A/S 2. Thurston Sydnor wonders where, in the first quadrant, the curve $x^y = y^x$ intersects itself.

Al Cangahuala writes that one solution to the equation is clearly $x=y$. One can find where the second solution intersects this line by performing the substitution $y=kx$. Then $x^{kx}=(xk)^x$ and thus $x=k^{1/(k-1)}$. We get the x-coordinate of the intersection by taking the limit as k approaches 1 (since the intersection occurs at the $x=y$ line. But, letting $n=1/(k-1)$ we get that

$$\lim_{k\to 1} k^{1/(k-1)} = \lim_{n\to\infty} (1/n+1)^n = e$$

So the point of intersection is (e,e).

A/S 3. Dave Mohr has noticed that the temperature sign in his bank alternates integer readings expressing Fahrenheit and Celsius. Assuming that the readings are perfect (and perfectly rounded), for what temperature(s) is one's uncertainty of the precise temperature at a minimum?

The following solution is from Eric Lund: Let F be the thermometer reading in degrees Fahrenheit and C be the thermometer reading in degrees Celsius. Let F_{nom} and C_{nom} be the exact temperature, i.e., $F_{nom}=1.8\ C_{nom}+32$. If (F,C) is a solution to this problem, then for all integers n, $(F+9n, C=5n)$ is also a solution. Therefore we need only consider the range $32 \le F \le 41$, $0 \le C \le 5$. Construct the following table:

C	F	F_{min}	F_{max}
0	32	31.5	32.5
0	33	32.5	32.9
1	33	32.9	33.5
1	34	33.5	34.5
1	35	34.5	34.7
2	35	34.7	35.5
2	36	35.5	36.5
3	37	36.5	37.5
3	38	37.5	38.3
4	38	38.3	38.5
4	39	38.5	39.5
4	40	39.5	40.1'
5	40	40.1	40.5
5	41	40.5	41.5

From the table we see that for any integer n, the combinations $F=9n+35$, $C=5n+1$ and $F=9n+38$, $C=5n+4$ give the temperature to within 0.2 degrees Fahrenheit.

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A scary police lineup at best, according to the bride and groom (all suspects not otherwise classed are from '92). From left, standing: Seth Cohen, Adam Riess, Iren Chow, Henry Chung, '93, Dawn Watkins Chow (the bride), who covers the lower half of the face of Marc Wisnudel, '91, John Watkins Chow (the groom), Dan Green, Ellen Shen, '91, Mike Gull, Kate Bergeron, '93, Brian Lu, '91, who is obscuring almost entirely—save for a bit of forehead—Ashley Shih, '91), Enrique Herrera, '91, Sue Katz, Brian Katz, '91, Amelia Lapeña, '94, and Jeff Falkowsky. From left, kneeling: Henry Houh, '89, Albert Cheng, Mohsin Ansari, Mike Rizen, '91, and Theresa Derderian.

And the list keeps going. . . . Congratulations to Jennifer Hill, who was married to Rice graduate Brian West in San Marino, Calif., on June 26. The reception was held at the Athenaeum at Cal Tech. Amy Anderson Chang ('91) and her husband Andrew Chang ('88) traveled to California for the wedding. Currently, Jennifer and Brian are living in Austin, Tex., while Jennifer pursues a PhD in biomedical engineering at University of Texas. Jennifer recently patented a photopolymerized hydrogel material used to prevent thrombosis and hyperplasia following balloon angioplasty. Congratulations on the patent, too! I'm happy to spread such exciting news to our peers.

Navy ensign Robert B. Pember recently passed the midway point in a six-month deployment aboard the guided missile frigate USS *Hawes*, home-ported in Charleston, S.C., as part of the aircraft carrier USS *Theodore Roosevelt* Battley Group. In August, elements of the battle group were in the Red Sea, where they were enforcing the U.N.-imposed "no-fly" zone over southern Iraq. USS *Hawes*, Standing Naval Force Mediterranean, is working with NATO allies to enforce the U.N.-imposed "no-fly" zone over Boznia-Herzegovina. While on station in the Adriatic Sea, the 445-foot-long Oliver Hazard Perry-class frigate participated in Operation Provide Promise, which provides relief supplies to war-torn former Yugoslavia and performed a medical evacuation of two Italian fisherman whose ship was fired upon by the Serbo-Mongtenegro Navy when it sailed into Montenegro's coastal waters. Be well, Ben, and be careful.

Ramon Cajina wrote from Prague in August telling me that he just finished getting a graduate degree in fluid mechanics in Belgium. After graduating, he interrailed around Europe—visiting Prague, Poland, Hungary, Austria, Switzerland, Italy, and Greece. Malee Lucas ('93) did some traveling with him. Ramon writes that he attended Melanie Lazaro and Trinidad Flores's wedding in Florida in July. Congratulations to Melanie and Trinidad. . . . Joanne Gutierrez also send word about Melanie and Trinidad, as well as filling me in on her life. Joanne finished a master's degree in Course VI at MIT last spring and has moved to Phoenix to work in the rotational program for Motorola's Semiconductor Products Sector. During her first three months, she chose to work on zener diode development (zener diodes are special diodes that also operate in the reverse breakdown). Thanks for the explanation, but I still don't get it. The weather in Phoenix was mostly in the 100s over the summer, reports Joanne. She says that the Valley of the Sun (Phoenix is surrounded by mountains) is beautiful and offers plenty of great terrain and breathtaking views for hiking and camping. Lately, Joanne has seen a bunch of MIT alums including Kiet Van, Paul Duran, Pablo Rodriguez, Kathy Nelson, and Evaristo Gonzales, who is working for Ford.

Alexandre Witze spent last academic year at UC/Santa Cruz in a graduate program for science journalism, directing herself away from geology and all the research that goes with it. After UCSC, Alex started doing a required internship, writing for the weekly science section of the *Dallas Morning News*. When she has completed her internship, Alex hopes to contribute to national magazines and newspapers as a freelance writer. She will be based in south Lake Tahoe, Calif., and may be looking for skiing lessons. Alex has also ventured to the land down under a few times this year as her parents have moved from New Jersey to Sydney, Australia. Alex mentions that Debbie Wells was working at the seismological laboratory at Caltech and last she heard, Debbie was thinking about going back to grad school this past fall.

Emilio Mayorga went back to Nicaragua after graduation from MIT to see his folks and to look for an environmental job, but the economy there is quite devastated, making it difficult to find work. After nine months he returned to the States "to the safety and warmth of graduate school." Emilio is in Seattle at University of Washington's School of Oceanography. He says that his research will actually deal with the Amazon, and next summer he may go to Brazil to start doing field research. In Nicaragua, Emilio became an educational counselor (EC) and is planning to continue with it in Seattle. He has heard from another EC enthusiast, Glorybell Silhy, who went back to El Salvador after graduation and was recently married.

Jonah Benton moved back to New York City this summer after working in Hartford, Conn., for eight months at Travelers Insurance. Jonah is consulting and writing software with a friend of his. He is working long hours but still finds time to go to Fairway Market on 74th and Broadway. Fairway Market, Jonah describes, is "reason enough to move to New York: mushrooms alone occupy nine square feet. Their fruit is wonderful and they have the best bagels in the city. I love food and cooking and Fairway is about the closest to an ideal supermarket that I've ever seen. When I get to heaven I want to be able to shop there, only without the crowds. Great place."

Don't fret classmates. The class gift—the Program for the Encouragement of Technology (PET)—is still under way. There will be a workshop at MIT in January 1994. It will be the first time that our program is being implemented. Junior high school students from the Cambridge/Boston area will be participating. If you would like to get involved, please call me @ (303) 920-7769 or try Maryglenn Vincens in the Alumni/ae Association office (617) 253-5489. Sorry for the short notice, but get in touch with us ASAP. Also, don't forget to send in your pledges. Thanks so much.

I'm still in Aspen, so keep writing.—**Leslie Barnett**, secretary, P.O. Box 7604, Aspen, CO 81612-7604, (303) 920-7769 (home), (303) 925-1961 (work)

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Please send news for this column to: **Mari Madsen**, secretary, 12-16 Ellery St. #405, Cambridge, MA 02138

PUZZLE CORNER

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Other Responders

Responses have also been received from S. Altchuler, L. Antinarelli, M. Archambault, S. Balbus, J. Banerjee, R. Banerjee, L. Beckett, B. Benulis, L. Bernacki, S. Booker, S. Boylan, F. Carbin, E. Chaglassian, C. Coltharp, N. Cosman, C. Counselman, S. Cram, C. Dale, K. Doniger, M. Driscoll, P. Duffy, A. Egler, A. Elsworth, A. Eurdolian, S. Feldman, A. Flemming, M. Foley, M. Fountain, J. Friedman, L. Gowan, M. Hailperin, W. Hartford, W. Hartford, R. Hedrick, R. Hess, D. Hopkins, J. Keilin, J. Kelleher, C. Kelly, R. King, N. Ko, T. Lawsonk, H. Ma, C. Meissner, A. Ornstein, B. Parry, R. Pena, N. Petite, J. Prussing, H. Reynolds, K. Rosato, J. Rudy, M. Samuelson, J. Solman, K. Thorpe, A. Tracht, N. Ulman, L. Vogel,

Proposer's Solution to Speed Problem

It has a pole at the equator.