My beautiful wife Alice has accepted a position at Tufts–New England Medical Center, where she will serve as dermatologist-in-chief as well as chair of the dermatology department at Tufts University School of Medicine. Although I will remain at NYU, I look forward to again seeing Boston much more frequently. Go Tufts-NEMC!

As you know, the print edition of *Technology Review* has changed its frequency from (almost) monthly to bimonthly. As a result, Puzzle Corner, which appears six times per year, will now be included in each issue.

This being the first issue of a calendar year (the December/January issue came out in 2005, after all, and there was no February issue), we again offer a "yearly problem" in which you are to express small integers in terms of the digits of the new year (2, 0, 0, and 6) and the arithmetic operators. The problem is formally stated in the "Problems" section, and the solution to the 2005 yearly problem is in the "Solutions" section.

Problems

Y2006. How many integers from 1 to 100 can you form using the digits 2, 0, 0, and 6 exactly once each, and the operators +, -, × (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 2, 0, 0, and 6 are preferred. Parentheses may be used for grouping; they do not count as operators. A leading minus sign does count as an operator.

M/A 1. Larry Kells wonders what the odds are that you get a bridge hand in which you are guaranteed to be able to make a slam in a suit, independent of the contents of the other three hands. For grand slams this is easy: you need all 13 trumps. Your challenge is to answer this for small slams as well.

M/A 2. Ermano Signorelli sent us a cute problem from George Skoda but was "surprised that Marilyn [vos Savant] allowed this sexist puzzle in her column with no comment."

The king's daughter had three suitors and couldn't decide which one to marry. So the king said, "I have three gold crowns and two silver ones. I will put either a gold or silver crown on each of your heads. The suitor who can tell me which crown he has will marry my daughter." The first suitor looked around and said he could not tell. The second suitor did the same. The third suitor said, "I have a gold crown." He was correct, but the daughter was puzzled: this suitor was blind. How did he know?

Speed Department

SD. A musical quickie from Richard Cartwright, who wants you to match the songs in the left column with the integer sequences in the right column.

1. "Auld Lang Syne"	a.	-3,	-4,	+4
2. "Happy Birthday"	b.	-3,	+2,	-2
3. "The Star-Spangled Banner"	c.	0,	+2,	-2
4. "Tea for Two"	d.	0,	+2,	+2
5. "Yankee Doodle"	e.	+5,	-1,	+1

Solutions

Y2005. The solution below is from Joel Karnofsky, who sent us a Mathematica program as well as a graph showing the number of expressible integers from 1 to 100 for each year of the present century. The deleterious effect of a second (or third!) zero in the year is very apparent from the graph. The full Karnofsky contribution can be found at cs.nyu.edu/~gottlieb/tr/2006-jan-y2005.

1 = 205^0	15 = (20+0)-5	48 = 0-2+50
2 = 0^50+2	19 = 20-5^0	49 = 50-2^0
3 = 2+50^0	20 = 20+0^5	50 = 0^2+50
4 = (20+0)/5	21 = 20+5^0	51 = 2^0+50
5 = 20^0×5	25 = 20+0+5	52 = 0+0+52
6 = 20^0+5	30 = 50-20	70 = 20+50
7 = 2+0+0+5	32 = (2+0)^(0+5)	100 = (20+0)×5
10 = (2+0+0)×5	40 = 200/5	

SEP 1. Jorgen Harmse notes that the easiest way to be sure of defeating a trump grand slam is to have a trump trick in every suit, and this also works for no trump. So A-JT98-JT98-JT98, which has only seven points, will defeat any grand slam, and no one has found a solution with six points.

Recall that the problem also asks for a hand that cannot be certain of defeating a grand slam in any suit, or in no trump. Harmse notes that with five or more high points in one suit, you are sure to defeat a grand slam in that suit. Hence no hand with more than 16 points can qualify. Harmse then shows *(see below)* that the 16-point hand KJ65-KJ65-KJ9-KJ does indeed qualify and hence is maximal, as required. He writes,

"To prove this, consider minor-suit and no-trump and major-suit contracts separately.

	♠ A ♥ A ♦ 87654 ♣ T98765	
♠ QT98743 ♥ QT9874 ♦ - ♣ -		♠ KJ65 ♥ KJ65 ♦ KJ9 ♣ KJ
	♠ 2 ♥ 32 ♦ AQT32 ♣ AQ432	

"In a minor suit, declarer uses dummy's aces as entries to establish trumps and then uses trumps as entries to establish the other minor. Seven no trump is made by the same play.

♠ T982
♠ A
♠ A32
♠ 98762

♠ -	♠ KJ65
♥ QT9874	♥ KJ65
♦ QT8765	♦ KJ9
♣ T	♣ KJ

♠ AQ743
♠ 32
♦ 4
♣ AQ543

"At seven spades, declarer uses the red aces to lead trump honors from dummy. If you cover the ten and the nine, then your KJ are picked up in two rounds. If you let one go, then declarer finesses three times. After the trump finesses, a heart ruff allows declarer to finesse in clubs. Declarer then draws the remaining trump(s) and cashes clubs. The opponents make seven hearts on a similar deal."

SEP 2. I received several "pragmatic" solutions, such as "take a taxi" or "cover his head with his hands." However, I believe Stephen Judd's solution below is more in the spirit of the problem. Judd also takes us to task for using miles per hour rather than metric units, believing that in this regard, "If science and technology people don't lead, no one else will follow." Judd writes,

"I puzzled out the question about MIT students getting 'all wet.' The wording is quirky (read "humorous"); getting 'all wet' is not the issue. My interpretation is that we are to minimize water contacted and disregard runoff and surface area soaked.

"My solution is this: her effective area collecting water is her horizontal surface plus her vertical surface times the tangent of the angle to the rain. The tangent is her apparent horizontal wind speed over the vertical rainfall speed. The total effective area collecting rain is thus $1 + |s\text{-}h|/H$, where $H = 17.3/6$, s is her walking speed forward ($s > 0$), and h is the wind speed from behind.

"Her total water collected is this area times the amount of time she spends in the rain, which is inversely proportional to s: $w(s) = (1 + |s\text{-}h|/H)/s$. Now minimize total water by taking the derivative with respect to s: $w'(s) = -1/s^2\ (1 - h/H)$, if $s > h$ and $w'(s) = -1/s^2\ (1 + h/H)$, if $0 < s < h$ and setting it equal to zero. The first case reduces to $h = H$; the second has no positive solution.

"When $h < H$, $w'(s) < 0$; so $w(s)$ is minimized as $s \to \infty$. When $h > H$, $w'(s) < 0$ for $0 < s < h$, and $w'(s) > 0$ for $s > h$; so w has a minimum at $s = H$. Curiously, when $h = H$, all solutions $s \geq H$ are equivalent.

"To answer your particular questions: (1) $h = 17.3/\sqrt{3} > H$, so she should walk at speed $h \approx 9.998$. (2) $h = 0 < H$, so she should walk as fast as possible. (3) $h = -17.3/\sqrt{3} < H$, so she should walk as fast as possible.

"I have wondered about this problem for years; your column gave me the initiative to finally understand it. Thanks."

SEP 3. The results here were interesting. The proposer used a "continuous approximation," i.e., produced the analogous differential equations and obtained 14 percent. He ran simulations for small numbers of initial pills to validate the continuous approximation,but did not simulate 1,000 initial pills. David Kazdan did simulate 1,000 initial pills and obtained "about 16 percent." (He remarked as well on the medical inadvisability of keeping aspirins for so long a time, especially when breaking them and thereby increasing their surface area.) Loren Kohnfelder also did simulations, but he got "13 percent (approx.); when I run the simulation 1,000 times or more, it varies from around 12.5 to 13.5 percent." He sent me a URL where I could try the simulation, and my thousand runs yielded 13.2 percent. Don Miller got 14.4 percent, but I am not sure if this was a simulation.

Better Late than Never

2005 MAY 2. Tom Terwilliger believes a complete solution should have mentioned that the angles in a regular tetrahedron are of size arccos(1/3) ≈ 109.47 degrees. Hence, if one lamppost is at the North Pole, the others are at 19.47 south latitude and at longitudes (among others) of 0, 120 east, and 120 west.

2005 MAY SD. In the September issue, I printed a "correction" stating that there are no Friday the 13ths for certain years. A number of readers have pointed out that, in fact, the original answer was correct.

Other Responders

Responses have also been received from R. Ackerberg, C. Baudoin, A. Bowen, H. Braunisch, M. Braunstein, J. Cutcher-Gershenfeld, C. Dale, B. Deitrick, M. Gilman, R. Giovanniello, M. Godin, R. Hess, L. Hurd, H. Ingraham, P. Lawes, W. Lemkios, E. Lubell, T. Mita, L. Mullin, A. Ornstein, J. Podolsky, J. Prussing, R. Ragni, K. Rosato, L. Rosenbaum, N. Sabi, J. Serrao, E. Signorelli, A. Taylor, and E. Underrinder.

Proposer's Solution to Speed Problem

1-e, 2-c, 3-a, 4-b, 5-d. The ith number in each sequence is the size of the interval, in half-steps, between notes i and i+1 of the song.

Send problems, solutions, and comments to Allan Gottlieb, New York University, 715 Broadway, Room 712, New York NY 10003, or to gottlieb@nyu.edu.