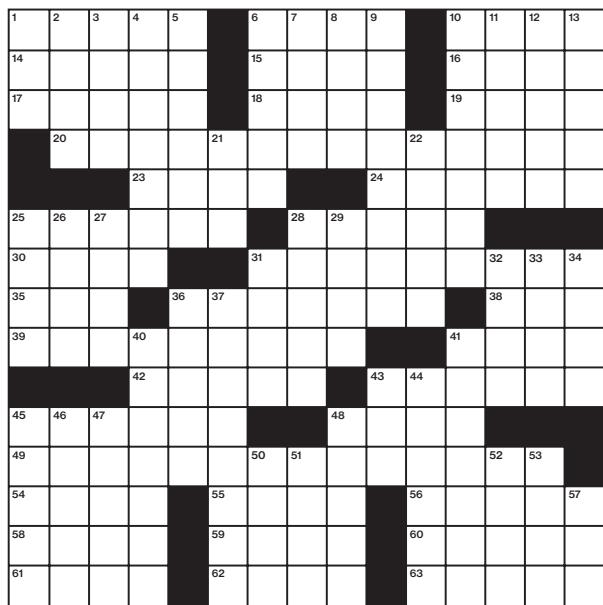


**D**on't be confused by our first problem. This is *MIT Technology Review*, not the *New York Times*. I expect *very* few crosswords in Puzzle Corner; Will Shortz can rest easy.

## Problems

**M/A 1.** Donna Levin and Denis Loring, SM '71, created a crossword puzzle they thought might amuse Puzzle Corner readers.



### Across

1. Public relations concern
6. Rippers of a sort
10. Identify
14. Nary a time
15. Snowstorm street-cleaner
16. Panache
17. "Goosebumps" author R.L.
18. On the bounding main
19. Ad lib
20. Quantity of molecules in a mole of guacamole?
23. Security interest that might be subprime (abbr.)
24. R2-D2 and C-3PO
25. Kitschy stuff
28. Barcelona bud
30. Struggles for words
31. Cardinality of all natural martini garnishes?
35. Beatrix's portrayer in "Kill Bill"
36. Secants' reciprocals
38. Cough up the cash
39. 1010\*\*100 works of Russian literature?
41. It's a real drag
42. Eunuch that's chicken?
43. Compounds having a basic nitrogen atom with a lone pair
45. Maiden name of FDR's mom
48. Words often accompanied by rolling eyes
49. Quantum of energy at a lumberyard?
54. Succotash bean
55. Symbol for an inclusion mapping
56. Four months before mayo
58. Pre-owned
59. Primes like 11 and 13
60. Prepare to compete for the Mr. Universe title
61. What "will be" will be, in Spain
62. Otherwise
63. Abnormal breath sounds

### Down

1. Helpful connections
2. Start to morph?
3. Tel \_\_\_
4. Molecular biologist's interest, maybe
5. Builds
6. One in a black suit?
7. Too
8. Troubles
9. Graceful leap from the high platform
10. First lunar phase
11. Exculpating excuse
12. Having leonine tresses
13. Many MIT alums
21. Get older
22. Motivating instincts
25. Down, as a brewski
26. Blood (prefix)
27. Online zine
28. Extra in a sci-fi flick, perhaps
29. Flirty coquette
31. Nobel laureate Lars Onsager's birthplace
32. "Once \_\_\_ a time ..."
33. Michigan or Mead
34. Very basic liquids
36. Metallic sound
37. Antonym
40. Start of a Toronto Blue Jays game
41. Oberon's mate
43. They might make up a six-pack
44. Fireball, for one
45. Grade that barely makes the grade
46. Woman für whom Beethoven composed a piece
47. Debussy composition
48. Inspid
50. Academic's hood
51. Elevator pioneer
52. Jodie Foster title role of 1994
53. Determined with reference to the Earth's axes
57. Photo finish?

**M/A 2.** Brian Cook likes to think big. He wished to merge  $N$  companies into one giant company and asks: If only one merger can be performed at a time and only pairwise mergers are allowed ( $2 \rightarrow 1$ ), how many distinct ways are there to form the giant company? For example, if  $N = 3$ , then there are only three possible orders in which to merge them: ((12)3), ((13)2), and (1(23)). For extra credit, try removing the restriction to pairwise mergers.

**M/A 3.** Joseph Horton has a triangle ABC with D, E, and F the midpoints of the sides opposite A, B, and C respectively. He draws DY and EX perpendicular to CF and wants you to prove DY = EX.

### Speed Department

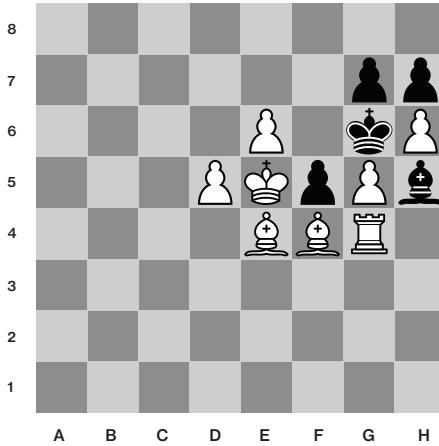
A speed problem from Sorab Vatcha: What great nation and educational institute in it are part of a catastrophic event?

### Solutions

**N/D 1.** John Astolfi wants you to find a valid chess position containing a legal move by White that gives a double check to Black, but the White piece that moves does not deliver a check.

Several readers gave solutions based on a pawn moving to the eighth rank and promoting, the claim being that the promoted piece is not the same as the pawn that moved. Maybe. However, the noncontroversial solution is another pawn oddity, en passant capture. I have chosen Steve Shalom's contribution since, as he points out, from his position it is fairly easy to see that Black's

previous move must have been the double pawn push and hence, from the picture alone, we can determine that an en passant capture is possible and we have the desired double check with neither check being delivered by the moving piece.



**N/D 2.** Donald Aucamp notes that hero Jack Reacher in Lee Child's *A Wanted Man* mulls over (but does not solve) the following problem (paraphrased).

Let  $f(y)$  be the reduction of the nonnegative integer  $y$ , which is formed by adding all the digits and repeating the process until only a single digit remains. For example,  $948 \rightarrow 9 + 4 + 8 = 21 \rightarrow 2 + 1 = 3$ , so  $f(948) = 3$ .

Now let  $y$  be the sum of three consecutive nonnegative integers  $n - 2$ ,  $n - 1$ , and  $n$ . Show that  $f(y) = 6$  if and only if  $n$  is divisible by 3.

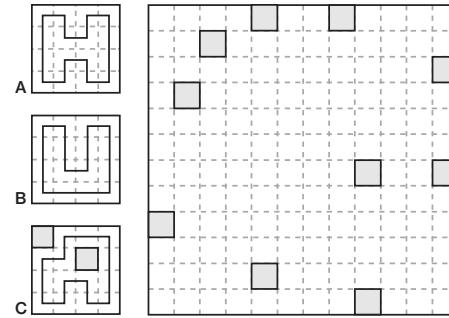
John Kramer shows that  $f(n) = \text{mod}_9(n)$  except that  $f(9n) = 9$  by illustrating it as follows for four-digit numbers and noting that analogous arguments apply for all numbers.

Let  $y = abcd = 1000a + 100b + 10c + d$ . Then  $y = 900a + 90(a + b) + 9(a + b + c) + (a + b + c + d)$ . If  $a + b + c + d < 10$  we are done; otherwise repeat the process.

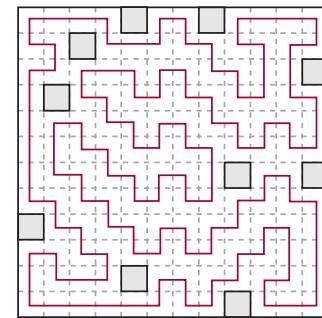
Having thus validated what several other readers remind us is called "casting out nines," Kramer then proceeds to the original problem of showing  $f(y) = f(3n - 3) = 6$  if and only if  $n$  is divisible by 3. If  $n = 3k$ ,  $f(y) = \text{mod}_9(9k - 3) = 6$ . If  $n = 3k + 1$  (resp.  $3k + 2$ ),  $f(y) = 9$  (resp. 3).

**N/D 3.** Nob Yoshigahara attributes the following problem to Kotani (who presumably spends a lot of time showing houses). In figures A and B, each of the 16 rooms is visited by a "grand tour" exactly once. In figure C, two rooms are "closed" and only one such grand tour is possible.

The large figure shows a 144-room house with 10 closed rooms. Find the unique grand tour.



So many beautiful diagrams—an embarrassment of riches. The following grand tour is from David Micheletti. See the Puzzle Corner website for Marc Strauss's partial "pictorial derivation."



### Better Late Than Never

**2015 J/A 3.** William Lemnios notes that a closed form for the probability that at least one employee out of 400 will not be tested is  $1 - (1 - 0.75^{40})^{4000} \approx 3.943\%$ .

### Other Responders

Responses have also been received from K. Aou, G. Benton, B. Bresnik, C. Brown, D. Brown, J. Chandler, N. Cohen, C. Connell, B. Edelman, J. Feil, E. Field, M. Foster, G. Gibian, R. Giovannello, P. Groot, J. Harmse, C. Kieronski, P. Kramer, F. Kuttner, P. Laferriere, I. Lai, J. La'O, B. Leibowitz, Z. Levine, M. Marinan, S. McGinnis, T. Mita, R. Morgen, Neltharion, A. Ornstein, G. Peters, J. Prussing, E. Sard, E. Signorelli, J. Sinnett, G. Smith, A. Stern, K. Terao, D. Turek, and T. Weiss.

### Proposer's Solution to Speed Problem

USA 'n' MIT (in "tsunami").

Send problems, solutions, and comments to Allan Gottlieb, New York University, 715 Broadway, Room 712, New York, NY 10003, or to [gottlieb@nyu.edu](mailto:gottlieb@nyu.edu). For other solutions and back issues, visit the Puzzle Corner website at [cs.nyu.edu/~gottlieb/tr](http://cs.nyu.edu/~gottlieb/tr).

Have a favorite puzzle from the last 50 years? Tell us which one and why at [PuzzleCorner@technologyreview.com](mailto:PuzzleCorner@technologyreview.com).