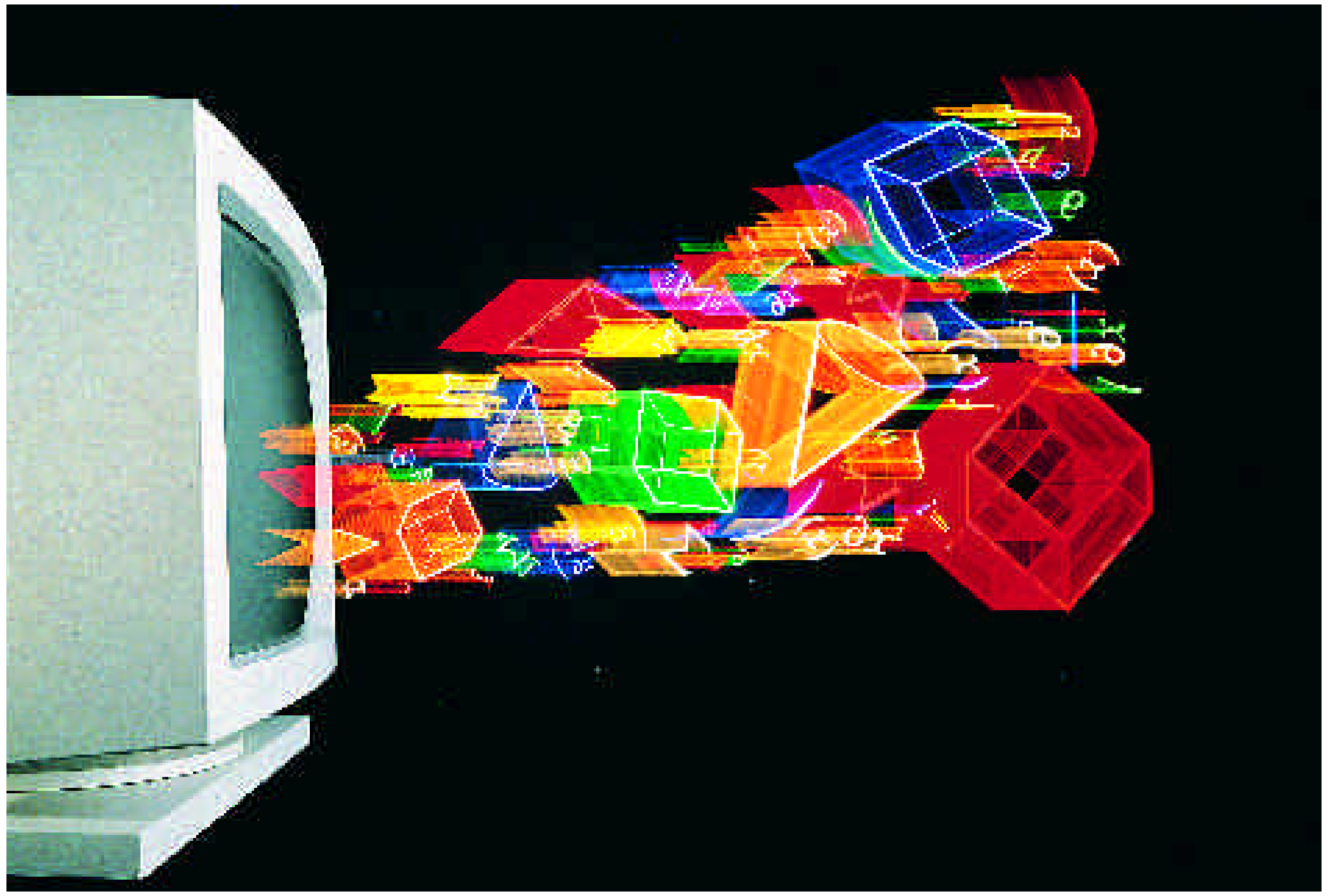
Morph code

Instead of dots and dashes, Mike Mudge checks his figures to find out whether numbers are nonamorphic or nonagonal. He also wonders why readers have been slow to respond.



Once upon a time... In the *Journal of Recreational Mathematics* Vol. 20(2), 1988, Charles W Trigg, of San Diego, addressed the problem of which primes had the sums of the squares of their digits also prime, e.g. if Prime (P) = 9431, then $9^2 + 4^2 + 3^2 + 1^2 = 107$ (Q) which is also prime. Among the 1229 prime numbers less than 10^4, Charles found 237 primes with this property… five two-digit, 47 three-digit and 185 four-digit primes. He observed that among the generating primes were the nine palindromes:

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11, 101, 131, 191, 313, 353, 373,
797 & 919
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The smallest of these is the sole prime repunit P = 11. For further study of repunits see *Repunits and Repetends* by Samuel Yates, Library of Congress Catalog Card Number 82-502451 (Star Publishing Co, Boiynton Beach, Florida 33435, in 1982).

There are also two near repunits, 223 and 8887. Among other structures present are members of the 25 reversal prime pairs such as 3169 and 9613. The smallest numbers of the pairs include

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113, 179, 199… 3389, 3583, 7187,
7457, 7949 and 9479.
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There are also some cases where the sums of the digits and the generating prime are equal, e.g. any prime permutation of 1136 giving 47 and 11, a prime permutation of 337, 1741 or 3037 giving 67 and 13, a prime permutation of 119 or 1019 giving 83 and 11. The most complex structure observed by Charles showed ten chains of primes wherein each Q is a P for the next link in the chain, e.g;

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191, 83, 73, :443, 41, 17, :463,
61, 37, :1699, 199, 163 :6599, 223,
17, : 6883, 173, 59, : 467, 101, 2,
:883, 137, 59 : 449, 113, 11, 2,:
797, 179, 131, 11, 2,:
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■ Problem CWT
Extend this analysis to both squares of digits of integers greater than 10^4, the cubes and higher powers of the digits of such prime numbers… and also address the problem to other "well-known" classes of integers like Fibonacci Numbers, Triangular Numbers, Tetrahedral Numbers etc. There may be underlying structures that deserve attention? Finally on this particular topic, the MM special: how do these results extend to other number bases? (Is there anything particular about base ten, from a number theoretic viewpoint? And if so, why?).

Nonamorphic numbers

Charles Trigg, the author cited above, introduced this terminology in the *Journal of Recreational Mathematics*, 13:1, pp 48-49 (1980-81). Definition: Nonagonal Numbers have the form N(n) = n(7n - 5)/2. A number is said to be nonamorphic if it teminates its nonagonal number.

Clearly, 1 is trivially nonamorphic in any number base. With this exception there are no nonamorphic numbers in bases two, three, four, five, eight and nine. In base ten there are five nonamorphic numbers less than 10^4, namely

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N(1)=1, N(5)=75, N(25)=2125,
N(625)=1365625 and
N(9376)=307659376.
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In base six there are five nonamorphic numbers less than 10^4, namely

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N(1)=1, N(4)=114, N(13)=1113,
N(213)=253213 and
N(5344)=302505344.
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Now, in base seven there are 42 such numbers!

■ Problem CWT nonamorph
Extend the above statistics to number bases greater than seven, and investigate any structure within these nonamorphs.

Finally, generate further "agonals" with associated "amorphs" and attempt to find an underlying general theory relating to their distributions within a given number base, and in particular the number bases in which non-trivial "amorphs" do not occur.

Can we consider "almost amorphs", where the termination differs from the input number in only one digit (by only one digit in that place)? Are we losing sight of number theory here and just playing with patterns? An underlying theory would say no.

Send any investigations of the above problems to Mike Mudge (see "PCW Contact", below) to arrive by 1st August, 1997. All material received will be judged using suitable subjective criteria and a prize will be awarded by *PCW* to the best entry arriving by the closing date (SAE for the return of entries, please). Each contribution should contain brief descriptions of the hardware and coding used, together with run times and a summary of the results obtained, and general comments on the topics. References to published or unpublished work in these areas would be appreciated.

Stop Press

In the March issue of *PCW* I requested a proof that $1^2 + 2^2 \dots + n^2 = N^2$ had no solutions other than n = 1 and n = 24. The reference has been supplied by Robin John Chapman of the University of Exeter to WS Anglin, The Square Pyramid Puzzle, *American Mathematical Monthly* Vol. 97, pp 120-124 (February 1990). Thanks, Robin.

George Sassoon has investigated $x^2 = ny^2 = p$ and has so far (10/2/97) found that the value p = 316234801 leads to integer solutions for n = 1(1)30. He wonders what percentage of possible n values give solutions and suggests that there is no upper bound on values for p yielding such solution sets? Your comments, please.

Review of "Prime candidate", (Numbers Count 162, Oct '96)

For reasons totally beyond my comprehension, this did not prove to be a popular hunting ground for *PCW* readers. The worthy prizewinner is therefore the originator of the problem: Jonathon Ayres, 59 Watson Road, Leeds LS14 6AE.

Are there any readers with at least partial results to Jonathon's questions? If so, please contact him directly. There is also a fourth question to consider: What happens if you use different functions such as the highest Alliott Hailstone function, so that HAHF = highest alliott function (a*x + b)?

PCW Contact

Mike Mudge welcomes correspondence from readers on any subject within the areas of number theory and computational maths, together with suggested subject areas or specific problems for future articles. Email numbers@pcw.vnu.co.uk or write to 22 Gors Fach, Pwll-Trap, St Clears, SA33 4AQ (tel 01994 231121).