media and the sundry other faults which can occur. To back up one's records every time a fresh appointment is made or one deleted from the 'book' would be counterproductive in terms of time even though it is essential if the possibility of either missing a vacant time slot or double-booking is to be avoided. An actual appointment book can be kept in a fire-proof safe for peace of mind.

In addition to this, the software available at present for this function will only display, at best, one day per VDU screen (some only half a day) per dentist. A good receptionist can keep a visual image in mind of the black spaces in an actual book and can turn a page to 'bring up' a whole week at a time much quicker than any software can on a screen.

To go back to the function of computerisation of clinical records, one has to realise that for this to be fully effective there has to be a terminal and screen in each surgery with central mass storage as well as a terminal, etc, at the front desk. This again raises the question of cost: even using micros for only two surgeries and reception on this basis with, say, 10Mb storage will put the cost towards the five-figure mark, which becomes very expensive in the context of a small dental practice. The actual storage figures for dental records with chartings for each patient may be in the range of 500-700 bytes per patient per course of treatment and this multiplied by approximately 3000 patients per dentist gives some idea of the basic storage needed to keep clinical records. Details of treatment have to be kept for at least two years after completing a course of treatment and this, allied with all the other office functions needed, suggests that the 10Mb mentioned above could be a conservative estimate for a practice containing three or more dentists.

The other main problem concerning dentists at the present time is the possible computerisation of the NHS claim form FP17. This is a complex form which has to be filled in accurately so the dentist can be paid by the NHS. It contains details of the patient; name, address, clinical charting grid, a minimum of seven different dates to be filled in and various other details. Software has been written to cope with this so it can be printed out after the data has been put in from the handwritten clinical notes. The problem with this is that the slightest change in the format of the grids, etc, on the FP17 would mean rewriting this software. A suggestion has been made that the central collating body for these forms could use 'light pens' to read any printed codes produced by any printer, enabling a dentist to use whatever internal record system is desired. This problem still has to be resolved and will depend on whatever change in method of remuneration of dentists may be applied in the future.

The only other main office function for which a computer is often used and not yet mentioned in connection with a dental practice is the use of word processing. This is not generally a great necessity in a dental practice. Recalling patients every six months is often a feature of a dental software package and would incorporate a print-out (hard copy) format.

In summation, one can state that the small system with a couple of disk drives, screen and printer (not necessarily of letter quality) with a good database software package at about £3000 is a viable proposition for even the single-handed practitioner. The limitation of use to office procedures only is still worthwhile, even solely on the basis of eliminating lots of pieces of paper. Clinical records require considerable mass storage, sophisticated software and even provision in the actual surgeries to accommodate the extra terminals needed.

END

NUMBERS COUNT

POWERFUL NUMBERS AND A PROBLEM OF STEINHAUS

Mike Mudge poses another problem for mathematical wizards.

The positive integers consist of 1,2,3,4,5···; these are each ordered sequences of the ten digits 0,1,2,···9. When n denotes a positive integer the product of n-factors each equal to x and called the n-th power of x is written x^n. Thus the fifth power of three is written $3^5 = 3x3x3x3x3 = 243$.

Given two positive integers n and k, a third positive integer, denoted by $p_n(k)$, may be defined as the sum of the n-th powers of the digits of k — eg, $p_3(271) = 2^3+7^3+1^3 = 352$.

A positive integer, k, which is equal to the sum of the n-th powers of its own digits is called a Powerful Number (PN) of degree n. It is defined by $p_n(k) = k$. Note: 1 is a trivial PN for all k since $1^k = 1$. For example, if n = 3 the PNs are given by

$153 = 1^3+5^3+3^3 = 1+125+27$
$370 = 3^3+7^3+0^3 = 27+343+0$
$371 = 3^3+7^3+1^3 = 27+343+1$
$407 = 4^3+0^3+7^3 = 64+0+343$

while if n = 10 there is known to be only one PN.

$467\ 930\ 7774 = 4^{10}+6^{10}+7^{10}+9^{10}+3^{10}+0^{10}+7^{10}+7^{10}+7^{10}+4^{10}$

The name 'Powerful Number' is due to J Randle, *The Mathematical Gazette,* Vol III No 382 December 1968, while the number of non-trivial PNs corresponding to each n <= 10 is reprinted here from M R Mudge, *Computer Bulletin,* II/33, September 1982.

n	3	4	5	6	7	8	9	10
Number of PNs	4	3	6	1	5	3	4	1

The Steinhaus Problem

Professor Hugo Steinhaus of Wroclaw, Poland has denied being the originator of the following problem, although it carries his name throughout the literature.

What pattern of digits is determined by repeating the operation of summation of the n-th powers of the digits from an arbitrary initial value k?

Special case n =2 (A Porges). A set of eight numbers, *American Mathematical Monthly* 52, 1945. From an arbitrary initial value k one either reaches the trivial PN 1 or enters the loop of length 8 given by 4 16 37 58 89 145 42 20.

Special Case n = 8 (I Takada). 'Computation of Cyclic Parts of Steinhaus Problem for Power 8', Mathematical Seminar Notes of Kobe University 7, 1979.

From an arbitrary initial value k one either reaches the trivial PN 1, one of the non-trivial PNs 24678050, 24678051 or 88593477, or enters the loop of length 3 given by 54642372 7973187 77124902 or a unique loop of length 25 or a unique loop length 154.

It should be noted that the total CPU time for analysis of this problem is quoted by I Takada as 216.6 seconds on the NEC ACOS-6 Fortran system at Kobe University.

Problem

Submit a program which investigates the pattern of digits determined by repeating the operation of summing the 8th powers of the digits from the initial values of 2 and 3 —these leading eventually to the Takada loops of length 25 and 125 respectively. Extend the knowledge of the Steinhaus Problem by commencing an investigation of the 9th powers in particular generating the four PNs referred to in the above table: each has nine digits.

All submissions should include program listings, hardware descriptions, run times and output; they will be judged for accuracy, originality and efficiency (not necessarily in that order). A prize of £10 will be awarded to the 'best' entry received within two months of the appearance of this article.

Submission to: Mr M R Mudge BSc, FIMA, FBCS, Room 560/A, Department of Mathematics, The University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET.

Submissions will only be returned if suitable stamped addressed envelopes are included.