MUSICAL INTERLUDE

END ZONE

Controlling your sampler

Innovative Software, which makes the IS Digitiser sampling board for the Atari ST, has released a new piece of software to run alongside the Digitiser, providing control of samples via the Atari's MIDI port. Multiple keyboard splits can be set up, which means that providing you have enough RAM, you can assign a different sample to every note on your MIDI keyboard. Remember, though, that the digitiser itself is a monophonic device, so you can only play one sample at a time.

The sampler, which retails for £99.95, includes variable sample rate from 4 to 25KHz, along with effects such as echo and reverb as well as a real-time oscilloscope and reasonable editing facilities. An unusual feature is that as well as outputting sampled sounds to your hi-fi, it can also send them to the monitor or TV loudspeaker, without necessarily using either the hardware interface or the main software package. The various source files supplied by Innovative allow you to play back samples from your own Basic, C or machine code programs.

The IS Digitiser and new MIDI software, which costs £19.95, are available from Chips Data Direct on (0903) 40509.

Hybrid Arts' ADAP SoundRack represents the ultimate 'add on' sampler. Besides some sophisticated software you get a 16-bit linear stereo sampler that runs at up to 44.1KHz, which is identical to the CD format, giving 10 seconds stereo (or 20 seconds mono) in 8-voice polyphony.

Being based around the Atari ST means that all editing, looping, and so on, is done in colour with your mouse. SoundRack is disk compatible with Akai S900, Emax, Ensoniq Mirage, Korg DDS1, Prophet 2000/2002 and the Roland Sampler.

It also boasts several real-time digital effects such as DDL, reverb, chorus, and so on, and with a 4Mbyte machine could give over a minute of sampling, dumping onto hard disk. Currently it's limited to a stereo output, but before long someone will hopefully offer a modification that routes the eight voices to separate outputs. At entry level SoundRrack will set you back £19.99. Further details from Syndromic Music on (01) 444 9126.

Roger Howorth is a freelance computer journalist and sound recording engineer who owns and experiments musically with an Atari ST. If you would like to share your musical experience with Roger or you would like to pass on any interesting snippets, why not write to him care of *PCW*, VNU House, 32-34 Broadwick Street, London W1.

NUMBERS COUNT

Mike Mudge juggles with positive integers, is spellbound by powerful numbers and wonders, is this a case for geometric analysis?

Consider the n-digit positive integer, N, expressed in base 10 in the conventional manner: that is, $N = a_0 + a_1 \times 10 + a_2 \times 10^2 .. + a_{n-1} \times 10^{n-1}$ where $0 \leqslant a_i \leqslant 9$.

Given N, the idea is to construct a related positive integer, $F(N) = P_r(N)$ where r = 2,3,4,5 . . . , defined to be the sum of the $r^{th.}$ powers of the digits of N.

Thus $P_2(123) = 1^2 + 2^2 + 3^3 =$ 14sp, while $P_4(423) = 4^4 + 2^4 + 3^4 =$ 353.

Now, if $P_r(N) = N$, then N is defined to be a 'powerful number' of degree r, to base N.

Some examples of powerful numbers to base 10:

Degree 3. $P_3(153) = 1^3 + 5^3 + 3^3 = 153$.

Degree 4. $P_4(1634) = 1^4 + 6^4 + 3^4 + 4^4 = 1634$.

Degree 5. $P_5(4150) = 4^5 + 1^5 + 5^5 + 0^5 = 4150$.

Degree 6. $P_6(548834) = 5^6 + 4^6 + 8^6 + 8^6 + 3^6 + 4^6 = 548834$.

Problem (i) Construct an efficient algorithm to 'dissect' a given positive integer, base 10, into its constituent digits base b.

Problem (ii) Generate all the powerful numbers of degree r to base 10 up to a given $N_{max.}$

Problem (iii) Provide a theoretical and/or empirical argument to define *all* the powerful numbers of degree r to base 10. Hint: how large can a powerful number of degree r to base 10 be? There are only finitely many for a given r. Is there always at least one?

Problem (iv) Generalise the results of (i) and (ii) to base b not equal to 10.

Is it possible to have a positive integer which is a powerful number (albeit with different degrees) in more than one number base? Furthermore, is there a possible geometrical interpretation of the above transformation?

If the two-digit integer, to base 10, a_1a_0, is regarded as representing (or being represented by) the point in the x,y-plane with coordinates $x = a_0$, $y = a_1$; and, similarly, in three-dimensional space for $a_2a_1a_0$ where $z = a_2$ is there a geometrical interpretation of the mapping defined by $P_r(N)$?

(1,5,3) is in some sense a 'fixed point' for the mapping defined by $P_3(N)$. The points (1,3,5), (3,5,1),(3,1,5),(5,1,3) and (5,3,1) can be regarded as joined to (1,5,3) by 'unit arrows' corresponding to one stage in the mapping: that is, geometrically $P_3(1,3,5) = (1,5,3)$.

Has this picture any physical significance?

When the numbers N involved have more than three digits, the geometry is in an n– dimensional hyperspace. Although this is difficult (if not impossible!) to visualise, the set of points associated with powerful numbers may be open to some interesting interpretation.

Readers are invited to suggest functions $F(N) = F([a_0, a_1, ... a_{n-1}])$ other than $P_r(N)$ that may generate interesting results when iterated on the set of positive integers base b. Reference to Numbers Count, *PCW* November 1983 ('The Persistence of an Integer') will provide one example of such an extension.

Send your attempts at this project to Mike Mudge, 'Square Acre', Stourbridge Road, Penn, Staffordshire WV4 5NF, tel: (0902) 892141, to arrive by 1 February 1988.

It would be appreciated if such submissions contained a brief summary of results obtained, in a form suitable for publication in *PCW*. These submissions will be judged using subjective criteria, and a prize will be awarded by *PCW* to the 'best' contribution received by the closing date.

Please note that submissions can only be returned if a stamped addressed envelope is provided.

Review: W-sequences, April

$$\begin{array}{ccccccc} & & & W_1 & & & \\ & W_2 & & & & W_3 & \\ W_4 & & W_5 & & W_6 & & W_7 \end{array}$$

The basic binary-tree structure exhibited by the terms of a W-sequence will interest programmers:

NUMBERS COUNT

This structure leads directly to certain generalisations concerning junction points: thus if Z is a junction point of $W(a,b,c,d_1,d_2)$ then all members of $W(a,b,z,d_1,d_2)$ are also junction points of that sequence.

Computation and counting of terms of W-sequence involves no essential difficulty, efficient sorting is merely needed at the final stage. Determination of a particular term, for example the 2157th in a particular W-sequence such as W(2,3,1,1,1), can be readily carried out by repeated division of 2157 by 2 noting the presence of a non-zero remainder. (Answer, 30646.)

Junction points for W(2,3,1,1,1) start with $Z_1 = w_{11} = w_{16} = 31$, $Z_2 = w_{22} = w_{32} = 63$, $Z_3 = w_{23} = w_{33} = 94 \ldots w_{271} = w_{191} = 2551., \ldots w_{383} = w_{543} = 7654 \ldots$

Some combinations of parameters which do not yield junction points were discovered, including (i) a & b both even, +(ii) d_1 and d_2 one odd and the other even.

An analysis of W(2,3,1) and W(2,3,2) shows that the terms are divided between the residue classes 3,1,2 and 0 modulo 4 in ratios 5:2:2:1 within 'very small' error.

Thus for the first 1303 terms of W(2,3,2) (those less than 20000) the ratios are 49.58:21.03:20.18:9.21. If this process is repeated for sets of terms within each interval of 20000 up to 680000, the corresponding intervals are (48.77-49.80):(20.86-21.23):(20.18-20.95):(8.65-9.21).

Note that apart from $c = w_1$ itself, all terms of W(2,3,c) are congruent to 1,3,4 or 5 modulo 6. Further, apart from $c = w_1$ and possibly w_2, w_3 and w_4, every term in W(6,9,c) is congruent to 7, 10, 37 or 43 modulo 54 (except when c is congruent to zero modulo 18, when W_n is congruent to 1 modulo 54).

This month prizes go to Gareth Suggett of 31 Harrow Road, Worthing, Sussex BN11 4RB for a combination of theoretical observations and computation, and also to Philip Newton Webb of 83 Sopwith Crescent, Merley, Wimborne, Dorset for considerable analysis and flow-charting relating to W-sequences.

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or particular, for future Numbers Count articles; all letters will be answered in due course.

Isolated readers can be put into contact with others sharing the same interests. However, greater efficiency regarding published problems should result from contacting the prizewinner directly.

USER GROUPS

Rupert Steele looks at a user group service, run on Prestel, and has news of a mini-revival among local clubs.

The sophistication of user groups is increasing. Many are sending me newsletters produced on laser printers, or distributing on disk — often with useful little utilities thrown in. Others are running bulletin boards or areas on Prestel. Perhaps the most important is ClubSpot 810, run by the Electronic Publications Committee of the Association of Computer Clubs.

This database has consistently been one of the most accessed areas on Prestel. It contains information on a variety of machines, as well as a general hobby area. You can see it on Prestel by keying *810# or using keyword search *clubspot# — although if you really want to get into the computer details, you will have to become a member of Prestel Microcomputing. This gives you access to the closed-off pages for a relatively modest fee. And while you are on Prestel, you can of course take advantage of its other facilities, such as the national electronic mail service. For more information, contact Andy Leeder, secretary of the Electronic Publishing Committee, ClubSpot 810, Church Farm, Stratton St Michael, Norwich NR15 2QB.

Directory enquiries

Recently I have received interesting letters from two directory stalwarts, the 1512 Independent Users' Group and BOOG.

The 1512 Group is taking an interest in Amstrad's PC1640, and has devised a part exchange scheme for members who want to upgrade. They can do so by selling their machine at a suitably low price to somebody outside the group who can't afford a mint condition 1512. Details are available from The 1512 Independent Users' Group, PO Box 55, Sevenoaks, Kent TN13 1AQ. Tel: (0732) 63157.

BOOG meanwhile has changed its contact point — you should now address enquiries to Jeremy Browne of BOOG Ltd, 102a Aldershot Road, Fleet, Hants GU13 9NY. Tel: (0252) 621745. He adds that the group is offering assistance not only for the Osborne machines, but also for other CP/M micros. Some BOOG members are also upgrading to MS-DOS machines, and they are being supplied with relevant material.

Local clubs latest

Local clubs were the backbone of the hobby computing movement before (almost) everybody could afford their own machine, but are now generally operating on a rather smaller scale. However, there are a few groups which continue to thrive, and the Association of Computer Clubs has sent me some details. The Harrow Computer Group, for instance, meets regularly in the Harrow Arts Centre; meetings alternate between the hardware subgroup and a general get-together, which often features a lecture. As with all Association of London Computer Clubs, membership of the Harrow Group entitles you to visit other ALCC groups. Contact Norman for details at 4 Tapley Court, St Johns Road, Harrow HA1 2HZ. Tel: (01) 863 5241. Harrow's activities are also available on Prestel page *81021254#.

Moving west, I have been contacted by the West Herts Micro Users Association, which meets fortnightly on Tuesday evenings at St Stephen's Parish Centre, Station Road, Bricket Wood, St Albans, Herts. Its special interest subjects are networking, hardware and computer-aided engineering. Details from Brian Larkin, 82 Church Street, Leighton Buzzard, Beds LU7 7BT, or call Terry Bradbury on (0727) 73633.

The Huntingdonshire Computer Club draws its members from the St Neots, Huntingdon and St Ives districts. It meets on the morning of the second Sunday of each month in the St Ives Centre, IVO Centre, St Ives, with an additional informal meeting on the evening of the last Thursday of the month in the lounge of the Horseshoes public house, Offord D'Arcy. John Childs is the secretary, at 57 Manor Gardens, Buckden, Huntingdon PE18 9TW.

If you would like your user group or club to have a mention in this column, or you wish to be considered for the Directory of User and Support Groups, please write to Rupert Steele, 12 Philbeach Gardens, London SW5 9DY.