NUMBERS COUNT

An ill-defined problem in arithmetic, with apologies to the Channel 4 panel game Countdown, presented by Mike Mudge.

This month the area of investigation is believed to be that of ingenious interactive programming and requires no mathematical knowledge beyond the rules of basic arithmetic.

Does the mnemonic BODMAS mean anything to any *PCW* readers; in particular those who were confused in their early days of arithmetic by obtaining incorrect answers from non-scientific calculators?

An Ill-Defined Problem Given a finite set of integers called the base, a set of arithmetic operators (typically +, −, ×, ÷) and an unlimited number of brackets, construct (if possible) a given target integer.

Any readers who watch 'Countdown' on Channel 4 will realise that the numbers game played there is a special case of this problem; as indeed (usually with a very large set of operators) is the problem of construction of the natural numbers from 1 to N using 3 threes or 4 fours or 5 fives, etc. For example, construct the target integer 784 from (75, 11, 6, 4, 3, 1). A brief thought should yield a solution 784 = 75×(6+4)+11×3+1 . . . but how is that arrived at? Can all positive integers, less than some N, be constructed from the given base set?

With the base set as input, devise a program (probably interactive) to assist in the thought processes identified above particularly applicable to large base sets and associated targets.

Any attempt to rationalise the above nebulous problem may be sent to Mike Mudge, 1 Dolboeth, Cwm Mabws, Llanrhystud, Dyfed SY23 5BB, tel 0974-272548, to arrive by 1 February 1991. Any communications received will be judged, using subjective criteria, and a prize will be awarded by *PCW* to the 'best' contribution arriving by the closing date. It would be appreciated if such submissions contained a brief description of the hardware used, details of programs, run times and a summary of the results obtained; together with suggestions for further work in this area, all in a form suitable for publication in *PCW*.

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

Postscript Further to Numbers Count 86, April 1990: David Kirkby (prizewinner) of 5 Parkmead, Loughton, Essex IG10 3JW, will supply a listing of Carmichael Numbers up to at least 1.3 billion upon receipt of a suitable SAE.

Review, Harshad Numbers May 1990

The topics of Harshad Numbers and Stanbury Primes generated many prizeworthy responses, in addition to that of the prizewinner Richard Tobin discussed last month. Hugh Spence, using Turbo Pascal on a 10MHz Opus PCV, found all 408 NZH for 12 and smallest H-numbers for 10(1)296 except 165, 185, 200 & 275. Michael Rostron used compiled Quick Basic on an Amstrad 2386 to obtain results including H-numbers for bases 2 to 10 with digit sums from the base to 50. Ed Heron, using Forth on an RM Nimbus with an 80186 chip running at 8MHz, found the 408 NZH for 12 in 63 minutes: his investigation of Stanbury Primes found that 'the "formula" was very good up to around a=587 but subsequently deteriorated to about as good as random'! Arnold Bailson concentrated on the Stanbury Primes using HiSoft Modula-2 PC Development System on an RM Nimbus PC186 and found that the ratios No. of Stanbury Primes/No. of Stanbury Numbers and No. of primes/ No. of natural numbers were in 'remarkable' agreement up to 4275328913.

Is there a kind of 'uniform distribution' suggested here? Bruce Halsey found smallest H-numbers for 165:70(17×9's)5, 185:684(18×9's)5, 200:3(2×9's)800 & 275:34 (29×9's)25 and wonders about 297? Jos Pardo used an Olivetti XP9, an 80386 computer running at 33MHz, to investigate Stanbury Primes. Details are available on request.

Review, June 1990

The response to this article, the first of three parts due to Norman Meeres of Esher, suggests that the topic of quadratic partitions and cubic residues has much to commend it. Norman has advanced the concept of 'compatible pairs of primes', these being primes p & q, neither of the form $27a^2 + b^2$ but such that pq is of that form. Then a and b are cubic residues of both primes, for example:

$7 \times 13 = 91 = 27(1^2) + 8^2$
$13 \times 67 = 871 = 27(5^2) + 14^2$
$19 \times 73 + 1387 = 27(7^2) + 8^2$

A preliminary computer-aided survey suggests that about one sixth of the relevant prime pairs are 'compatible' in accordance with the above definition. The distribution of these 'compatible prime pairs' is a topic surely worthy of further investigation.

Frank Webster used BBC Basic on an Acorn Electron to investigate the 1610 primes of the form 6m+1 less than 30,000: A,B,C,D values were found in 33 minutes and projects B & C were then completed.

However, the prizewinner this month is Gareth Suggett of 31 Harrow Road, Worthing, Sussex BN11 4RB, who found that 'this problem didn't really inspire me to great heights' but nonetheless generated a program which, for each prime 6x+1, lists its complete set of cubic residues ('calculated by brute force'). The relevant A,B,C,D values were then obtained and all of the conditions discussed in the article verified.

An overview of this problem area can be expected in *PCW* for June 1991 when further responses, prompted by the articles for August and November 1990, have been analysed.

Mike Mudge welcomes correspondence on any subject within the areas of number theory and computational mathematics. Particularly welcome are suggestions for further Numbers Count articles.

LEISURE LINES

Brainteasers courtesy of JJ Clessa. Dec 90

Another year almost gone again. Here's a couple of puzzles to get you in the mood during the run-up to the holiday period.

This Month's Quickie

No answers, no prizes, for the quickie. A man smoked 100 cigarettes (shame on him) in five days, each day smoking six cigarettes more than the day before. How many cigarettes did he smoke on the first day?

Prize Puzzle

A certain 6-digit number, when multiplied by an integer less than 10, gives a product which is the original number with its digits reversed. There are only two 6-digit numbers which have this property (I hope!), although the integer multiplier is different in each case.

What are the numbers, and what are the respective integers? (Numbers with leading zeros not permitted.)

Answers on postcards or backs of sealed envelopes — no letters please. Send to: December Prize Puzzle, *PCW* Editorial, VNU House, 32–34 Broadwick Street, London W1A 2HG, to arrive not later than 31 December 1990. Good Luck!

Winner, September 1990

We had a record response to the September puzzle, with well over 200 entries coming in. It seems that the logic puzzles are quite popular with our readers. And, as with last month, our winning entry came from beyond these shores — from Mr PB Edmonds of Guernsey, Channel Islands. Not surprising, since we get quite a high percentage of overseas entries every month. Our congratulations go to you, Mr Edmonds, as well as your prize which you should receive shortly.

The correct solution was: the Norwegian drinks Whisky, the Japanese sport is swimming.

To all the also-rans, don't give up. It could be your turn next.