Subroutine for generating all permutations of N integers

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A permutation algorithm proves useful in many social science problems. It is not unusual to want to look at all possible orderings and determine which is "best" according to your own criteria. Since the advent of the computer, this has been relatively feasible. One problem with these programs has been to find one when you need it. Another problem is computer run time, since no

matter what method is used to generate permutations, run time increases factorially with length of permutation. This abstract attempts to aid in solving these two problems.

Language. The program is short (22 lines code, 50 lines with comments). It is written in BASIC but can be readily translated to FORTRAN.

Output. Runs through all $N!$ Permutations of N integers in 2 sec for $N = 7$, 15 sec for $N = 8$, and 140 sec for $N = 9$ on Dartmouth Time Sharing System. These are all a full order of magnitude faster than the next fastest program I have seen (see Table 1).

Availability. Requests for copies of the program should be sent to Richard Pechter, Dartmouth College, Hinman Box 358, Hanover, New Hampshire 03755.

Table 1

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10 ' THIS PROGRAM RUNS THROUGH ALL PERMUTATIONS OF N VARIABLES
20 ' IT ASSUMES THE VARIABLES HAVE BEEN ASSIGNED NUMBERS ONE TO N
30 ' AND THEN GENERATES IN THE I MATRIX ALL DIFFERENT POSSIBLE
40 ' ORDERINGS OF THESE N INTEGERS.
50 '
90 ' PRIMER PROGRAM
100 INPUT A
105 MAT I=ZER(A)
106 LET L=1
110 FOR I=1 TO A
130   LET I(I)=I
140   LET L=L*I
150 NEXT I
160 FOR C=0 TO L-1
170   GOSUB 200
180
190 NEXT C
195 STOP
196 '
197 ' SUBROUTINE TO GENERATE PERMUTATIONS
198 '
200 IF C=0 GOTO 500
210 IF C/2=INT(C/2) GOTO 300
220 LET T=I(A)
230 LET I(A)=I(A-1)
240 LET I(A-1)=T
250 GOTO 500
260 '
300 IF C/3=INT(C/3) GOTO 400
302 '   IF THIS IS AN EVEN TIME THROUGH, BUT NOT A MULTIPLE OF SIX
304 '   THEN REVERSE THE LAST AND THIRD TO LAST DIGITS.
310 LET T=I(A)
320 LET I(A)=I(A-2)
330 LET I(A-2)=T
340 GOTO 500
350 '
360 ' WHEN THE PROGRAM REACHES HERE WE KNOW C/Q! IS AN INTEGER FOR Q=3
400 LET B=6
410 FOR I=4 TO A
420   LET B=B*I
430   IF INT(C/B)<>C/B GOTO 450
440 NEXT I
450 FOR J=1 TO I/2
460   LET T=I(A+1-J)
470   LET I(A+1-J)=I(A+J-I)
480   LET I(A+J-I)=T
490 NEXT J
500 RETURN
510 END

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'NUMBER OF VARIABLES
'REDIMENSION I VECTOR TO EXACTLY FIT NO. OF VARIABLES
'INITIALIZE PERMUTATION VECTOR
'COMPUTE A! (THE NO. OF DIFFERENT PERMUTATIONS)
'GO GET A PERMUTATION
'DO WHAT YOU WANT TO WITH THE PERMUTATION.
'FIRST TIME THROUGH JUST SEND BACK INITIAL VECTOR
'IF THIS IS AN ODD TIME THROUGH REVERSE THE LAST TWO DIGITS
'THERE ARE 6 POSSIBLE PERMUTATIONS OF THE LAST THREE DIGIT
'I IS THAT SMALLEST Q. NOW REVERSE THE LAST I POSITIONS OF THE I MATRIX.