

ALGORITHM 72
COMPOSITION GENERATOR

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procedure comp (c, k); **value** k; **integer array** c;
integer k;

comment Given a k -part composition c of the positive integer n , comp generates a consequent composition if there is one. If comp operates on each consequent composition after it is found, all compositions will be generated, provided that $1, 1, \dots, 1, n-k+1$ is the initial c . If c is of the form $n-k+1, 1, 1, \dots, 1$, there is no consequent, and c will be replaced by a k vector of 0's. Reference: John Riordan, *An Introduction to Combinatorial Analysis*, John Wiley and Sons, Inc., New York, 1958, Chapter 6;

begin integer j; **integer array** d [1:k];
if k = 1 **then go to** last;
for j := 1 **step** 1 **until** k **do** d [j] := c [j] - 1;
test: **if** d[j] > 0 **then go to** set;
 j := j - 1;
 go to **if** j = 1 **then** last **else** test;
set: d [j] := 0;
 d [j - 1] := d [j - 1] + 1;
 d [k] := c [j] - 2;
 for j := 1 **step** 1 **until** k **do** c [j] := d[j] + 1;
 go to exit;
last: **for** j := 1 **step** 1 **until** k **do** c [j] := 0;
exit: **end** comp

CERTIFICATION OF ALGORITHM 42
INVERT (T. C. Wood, *Comm. ACM*, Apr., 1961)
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INVERT was hand-coded for the LGP-30 using machine language and the 24.0 floating-point interpretive system, which carries 24 bits of significance for the fractional part of a number and five bits for the exponent. The following changes were found necessary:

- (a) **if** j = n+1 **then** a[i, j] := 1.0 **else** a[i, j] := 0.0;
 should be
 if j = n+i **then** a[i, j] := 1.0 **else** a[i, j] := 0.0;
- (b) **for** k := j **step** 1 **until** 2 × n **do**
 a[i, k] := a[i, k]/a[i, j];
 should be
 for k := 2 × n **step** -1 **until** i **do**
 a[i, k] := a[i, k]/a[i, i];
- (c) **if** l ≠ i **then for** k := 1 **step** 1 **until** 2 × n **do**
 a[l, k] := a[l, k] - a[i, k] × a[l, j];
 should be
 if l ≠ i **then for** k := 2 × n **step** -1 **until** i **do**
 a[l, k] := a[l, k] - a[i, k] × a[l, i];

Given these changes, j becomes superfluous in the second i loop, and the other references to j may be changed to references to i.

INVERT obtained the following results:

The computer inverted a 17-by-17 matrix whose elements were integers less than ten in absolute value. When the matrix and its inverse were multiplied together, the largest nondiagonal element in the product was -.00003. Most nondiagonal elements were less than .00001 in absolute value.

INVERT was tested using finite segments of the Hilbert matrix. The following results were obtained in the 4 × 4 case:

16.005	-120.052	240.125	-140.082
-120.052	1200.584	-2701.407	1680.917
240.126	-2701.411	6483.401	-4202.217
-140.082	1680.920	-4202.219	2801.446

The exact inverse is:

16	-120	240	-140
-120	1200	-2700	1680
240	-2700	6480	-4200
-140	1680	-4200	2800

INVERT was also coded for the LGP-30 in machine language and the 24.1 extended range interpretive system. This system, which uses 30 significant bits for the fraction, obtained the following as the inverse of the 4 × 4 Hilbert matrix:

16.000	-120.001	240.001	-140.001
-120.001	1200.006	-2700.015	1680.010
240.001	-2700.016	6480.037	-4200.024
-140.001	1680.010	-4200.024	2800.016

The program coded in the 24.0 interpretive system successfully inverted a matrix consisting of ones on the minor diagonal and zeros everywhere else.

REMARK ON ALGORITHM 52
A SET OF TEST MATRICES (John R. Herndon, *Comm. ACM*, Apr. 1961)

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In the assignment statement

$c := t \times (t + 1) \times (t + t - 5) / 6;$ (a)

the t is undefined. A suitable definition would be provided by preceding (a) with $t := n;$

CERTIFICATION OF ALGORITHM 68
AUGMENTATION (H. G. Rice, *Comm. ACM*, Aug. 1961)

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AUGMENTATION was transliterated into BALGOL for the Burroughs 220, and proved successful in a number of test cases. However, the following algorithm has exactly the same effect and is considerably simpler:

real procedure Aug(x, y); **value** x, y; **integer** x, y;
begin if x < 0 **then** L : **go to** L **else** Aug := x + y **end** Aug

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