Behold Combinatorial Computation, the Missing Face of the Coins of Permutations and Combinations of Specified Set (N) and Selection (R)

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ABSTRACT

Statement of the Problem: In Mathematics (combinatorics in particular) discrete objects in sets are separated into two categories: one of similar objects and the other of dissimilar objects in case of deployment in multiplication only or multiplication accompanied by arrangement operations. Multiplication only applies to sets of similar objects, while multiplication accompanied by arrangement applies to sets of dissimilar objects. Both operations accomplish increase in quantity by number for their respective sets. Furthermore, multiplication accompanied by arrangement concerning sets of dissimilar objects is guided by one of two conditions; one where order of placement of the objects is important and the other the order of placement of objects is unnecessary. The arrangement of the set where order is important is called permutation and that where order is unimportant is called combination. Nevertheless, both permutation and combination go by specification of set (n) and selection (r), more or less in correspondence with the specification of multiplicand and multiplier terms applicable to the multiplication of objects that are similar, for proper performance in the determination of increase of quantity by number. In the case of determination of increase of quantity by number in combinatorics embracing permutations and combinations of specified set (n) and selection (r) calculation and computation operations come into play. Calculation offers the number of arrangements (factorials) using peculiar formulary, while computation using view mixing techniques presents the entire membership of the calculated factorials, individually. Calculation and computation are the two opposite faces of the coin of permutation and combination at work in the determination of increase of quantity by number via arrangement of set of dissimilar objects in combinatorics.

Methodology and Theoretical Orientation: This is a maiden presentation of the methodologies for computing permutations and combinations of specified set (n) and selection (r) involving two distinct schemes: one of Square Kinematics View Mixing for 4 from 4 i.e., $_4P_4$ for permutations only and the other, Solid State View Mixing for r from n i.e., $_nP_r$ for permutations and i.e., $_nC_r$ for combinations. The theoretical orientation of both methods is view mixing in two opposite directions along the axis of each array in the case of permutations and in one direction only in the case of combinations.

Findings: Square Kinematics View Mixing Scheme was used in producing 24 quadruplets for 4 from 4 permutation factorial i.e., $_4P_4 = 4! = 4 \times 3 \times 2 \times 1 = 24$ quadruplets. Also, Solid State View Mixing Scheme was used in computing 10 triplet combinations for 3 from 5 combinations.

Conclusion and Significance: Square Kinematics View Mixing Scheme and Solid-State View Mixing Scheme for computing permutations and combinations of specified set (n) and selection (r) represent breakthroughs in computational combinatorics in Mathematics in the 21st century.

Recommendations: The two techniques are recommended for wide publicity for relief to the world of computational combinatorics in Mathematics.

Keywords: Dissimilar, Permutation, Combination, Computation, View mixing

INTRODUCTION

Permutations and Combinations are twin themes in Combinatorics in Mathematics. Each of them has two faces like a coin; one face featuring Calculation and the other Computation. Permutations go by two specifications; one of fullset selection e.g., $_nP_n$, and other of subset selection e.g., $_nP_r$, where (n) is the set and (r) is the selection for r < n. Combinations, on the other hand, go by one specification only which is subset selection e.g., $_nC_r$ for r < n. The calculation face of Combinations of specified set (n) and

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subset selection

(r) concerning prediction of the number of factorial (arrangement) has been operational for long by reason of the formula, $nCr = \frac{nPr}{r!}$ established long ago in Mathematics Literature [1-4]. But the computation face of combinations of specified set (n) and selection (r) concerned with the presentation of the calculated factorials has remained blank till now for lack of technique(s) or scheme(s) for computing

the calculated factorials. Likewise, the computation face of the coin of permutations of specified set (n) and selection (r) has remained blank till now for lack of technique(s) or scheme(s) for computing the calculated factorials whether for full set selection or subset selection. But here comes Solid State View Mixing Scheme, a technique capable of computing the calculated factorials for all specified set (n) and selection (r) for both permutations and combinations alike.

This is a breakthrough in computational combinatorics in Mathematics! Thanks to Advances in Computational Combinatorics by this author.

Solid State View Mixing Scheme has two distinct input mixing procedures namely Place-Skipped Input (PSI) and Digit-Skipped Input (DSI) to work with three types of mixerhead viz: square mixerhead, polygonal mixerhead, and circular mixerhead. Given a common input set (n) and selection (r), the three different mixerheads using each of the two input mixing procedures at a time produce unique output sequences of the factorials of either permutations or combinations, wherein the input set is remarkably proliferated and diversified [5-7].

DEFINITIONS

Combinations: The number of ways in which (r) objects can be chosen from a set of (n) dissimilar objects without regard to the order of selection is called the number of combinations of (n) objects taken (r) at a time.

Permutations: The number of possible distinct arrangements of (r) objects chosen from a set of (n) dissimilar objects with regard to order of selection is called the number of permutations of (n) objects taken (r) at a time.

Isodigitation: Digitisms (multidigital numbers) bearing repetition of one or more digits.

De-isodigitation: The removal of digitisms bearing repetitions of one or more digits.

MATERIALS AND METHODOLOGY

Materials

Materials include the digits 1,2,3,4,5 and letters a, b, c, d, e and Solid-State View Mixing Scheme using two input types in square and circular mixer heads only, because of space constraint.

Methodology

Computation of factorials of Combinations of specified set (5) and selection (3) using each of Place-skipped Input Mixing (PSI) and Digit-skipped Input Mixing (DSI) in square mixer head.

Description

(A) Computation of factorials of permutations of specified set (4) and selection (4) PSI.

Fullest selection permutation computation

By fullest selection it is meant that the selection is equal to the set. We have come to one of the points at issue in the unfolding of the Solid-State Mixing Scheme as a technique for the computation of permutations. We intend to demonstrate the performance of the Scheme with fullset selection of 4 from 4, input mixing algorithms of PSI (Place-skipped input) for square digital mixer polygon.

Square Mixerhead: Square mixerhead is employed for the full set selection 4 from 4 **(Figure 1)**.

Permutation Computation for 4 from 4

(a) Pullulation – unleading by view mixing **(Table 1)**

(b) Displacement mixing for unleaded permutations using two rules is parallel, i.e. 2 – stream approach (Table 2).

Figure 1. Full set selection 4 from 4, PSI Loaded Mixer for Permutation Computation.

Table 1. Pullulation – unleading by view mixing.

Col. 1	up	adcb	. . . . . Line 1
" 1	down	bcda	. . . . " 2
Col. 2	up	badc	. . . . " 3
" 2	down	cdab	. . . . " 4
Col. 3	up	cbad	. . . . " 5
" 3	down	dabc	. . . . " 6
Col. 4	up	dcba	. . . . " 7
" 4	down	abcd	. . . . " 8
8			

Table 2. Stream approach.

Opd – Stream A					Core – excavation – Stream B				
Line 1	opd	lead	acdb	Line 9	Line 1	cex	F/cast	dcab	Line 9
" 1	opd	trail	dbac	" 10	" 1	"	B/cast	abdc	" 10
" 2	opd	l	bdca	" 11	" 2	"	F/cast	cdba	" 11
" 2	opd	t	cabd	" 12	" 2	"	B/cast	bacd	" 12
" 3	opd	l	bdac	" 13	" 3	"	F/cast	adbc	" 13
" 3	"	t	acbd	" 14	" 3	"	B/cast	bcad	" 14
" 4	"	l	cadb	" 15	" 4	"	F/cast	dacb	" 15
" 4	"	t	dbca	" 16	" 4	"	B/cast	cbda	" 16
" 5	"	l	cabd R12	" 17	" 5	"	F/cast	bacd R12	" 17
" 5	"	t	bdca R11	" 18	" 5	"	B "	cdba R11	" 18
" 6	"	l	dbac R10	" 19	" 6	"	F "	abdc R10	" 19
" 6	"	t	acdb R9	" 20	" 6	"	B "	dcab R9	" 20
" 7	"	l	dbca R16	" 21	" 7	"	F "	cbda R16	" 21
" 7	"	t	cadb R15	" 22	" 7	"	B "	dacb R15	" 22
" 8	"	l	acbd R14	" 23	" 8	"	F "	bcad R14	" 23
" 8	"	t	bdac R13	" 24	" 8	"	B "	adbc R13	" 24
8					**8**				

Key: R12 = Line 17 replicating Line 12. F = Front, B = Back

Summary of products

Chart 1   (a)   Line 1 – 8 =8 Permutation

Chart 1   (b)   Stream A Lines 9 – 16="

Chart 1   (b)   Stream B Lines 9 – 16=<u>8</u> Permutation

Total =<u>24</u> Permutations

Lines 17 – 18 invalidated by replications.

By factorial formula = 4x3x2x1 = 2<u>4</u>   **(a)**

Computation of factorials of Combinations of specified set (5) and selection (3) using Digit-skipped input mixing (DSI) in square mixerhead.

(a)   By factorial formula = 4x3x2x1   = 2<u>4</u>

Computation of factorials of Combinations of specified set (5) and selection (3) using Digit-skipped input mixing (DSI) in square mixer head.

DSI Loaded (Figure 2)

DSI loaded subset selection 3 from 5 for combination computation.

Combination computation for subset selection, 3 from 5 (DSI)

(a) Pullulation – Unloading by view mixing (one direction only) **(Table 3)**. View Mixing output.

(b) Pullulation continued – unloading by substitution view mixing one direction only **(Table 4)**.

Figure 2. DSI loaded.

Table 3. Combination computation for subset selection, 3 from 5 (DSI) Pullulation.

Col. 1	up	123	Line	1
" 2	up	234	"	2
" 3	"	345	"	3
" 4	"	451	"	4
" 5	"	512	"	5
		5		

Table 4. Pullulation continued – unloading by substitution view mixing one direction only.

Interserial 0	Col1/Col2	UVR 1	134	Line	6
	"	UVR 2	124	"	7
	Col2/Col13	UVR 1	245	"	8
	"	UVR 2	235	"	9
	Col3/Col4	UVR 1	351	"	10
	"	UVR 2	241 R6	"	11
	Col4/Col5	UVR 1	412 R7	"	12
	Col4/Col5	UVR 2	452 R8	"	13
	Col5/Col1	UVR 1	523 R9	"	14
	"	UVR 2	513 R10	"	15
		5			
Interserial 1	Col1/Col3	UVR 1	145 R4	"	16
	"	UVR 2	125 R5	"	17
	Col2/Col4	UVR 1	251 R5	"	18
	"	UVR 2	231 R1	"	19
	Col3/Col5	UVR 1	312 R1	"	20
	"	UVR 2	342 R2	"	21
	Col4/Col1	UVR 1	423 R2	"	22
	"	UVR 2	453 R3	"	23
	Col5/Col2	UVR 1	534 R3	"	24
	"	UVR 2	514 R4	"	25

Summary of products

(a)   View mixing Lines   1 – 5 = 5 combinations

(b)   Substitution view mixing Interserial 0 lines   6– 10 = 5 combinations

(c)   "Interserial 1 lines 16 – 25   = -

      Total = 10

      By factorial formula, $nCr = 5C_3 = \frac{5\times4\times3}{3\times2\times1} = 10$

RESULTS

(a)   Permutation of 4 from 4 (Table 5)

Notes:

(a)   Lee = Local exchange

(b)   Opd = Odd position digits

(a)   and (b) are examples of displacement mixing

(b)   Computation of 3 from 5 (Table 6)

(a)   View Mixing Lines 1 – 5   =5 Combinations

(b)   Substitution View Mixing

(i)   Interserial   0 Lines 6 – 10 = 5 Combinations

(ii)   Interserial   1 Lines 16 – 25 = Nil

=   <u>10 Combinations</u>

Combinations by factorial formula

$$nCr = 5C_3 = \frac{nPr}{r!} = \frac{5 \times 4 \times 3}{3 \times 2 \times 1} = \frac{5 \times 4 \times 3}{3 \times 2 \times 1} = 10 \text{ combinations}$$

(c) Hence computed factorials = calculated factorials = 10 combinations.

Table 5. Content of Computation Face of the Coin of Permutations of specified set 4 and selection 4 with input set in the sequence a,b,c,d, drawn from **Table 1**.

Technique	Solid State View Mixing Scheme			Remarks
Input mixing	**PSI**		**Location in Chart No. 1**	
	S/N			
	1	ACGU	Line 1	
	2	UGCA	" 2	
	3	UACG	" 3	Pullulation
	4	GCAU	" 4	(unloading by
	5	GUAC	" 5	view mixing)
	6	CAUG	" 6	
	7	CGUA	" 7	
	8	AUGC	" 8	
	9	CAGU	Stream A Line 1	
	10	ACUG	" " 2	
	11	GUCA	" " 3	
	12	UGAC	" " 4	Stream A Opd,
Output	13	AUCG	" " 5	displacement
	14	UAGC	" " 6	mixing
	15	CGAU	" " 7	
	16	GCUA	" " 8	
	17	AGCU	Stream B Line 1	
	18	CUAG	" " 2	
	19	UCGA	" " 3	
	20	GAUC	" " 4	Stream B Lee,
	21	UCAG	" " 5	displacement
	22	AGUC	" " 6	mixing
	23	GACU	" " 7	
	24	CUGA	" " 8	
Total Valid Output	24			

Table 6. Content of Computation Face of the Coin of Combinations of specified set 3 and selection 5 of input set sequence of 1, 2, 3, 4, 5.

Input Mixing	Solid State View Mixing Algorithm				Remarks
	DSI		**Location in Chart No. 2**		
Output	No. 1	123	Line	1	View mixing
	2	234	"	2	
	3	345	"	3	
	4	451	"	4	
	5	512	"	5	
	6	134	"	6	Substitution view mixing
	7	124	"	7	
	8	245	"	8	
	9	235	"	9	
	10	351	"	10	
Total valued output	10				

Note: Summary of Combinations under PSI and DSI in common

DISCUSSION

Solid State View Mixing Scheme is a versatile technique that has emerged recently from Numeration science literature in the making to keep the computation face of the coins of both permutations of fullset selection and subject selection operational likewise the computation face combinations of subset selection are made operational; by inchoate Solid State View Mixing Scheme. The number of factorials for any specified set (n) and selection (r) of permutations and combinations as calculated by formulary can also be computed henceforth by Solid State View Mixing Scheme.

Solid State Mixing Scheme is a great arrangement device for computation of permutations and combinations of specified set (n) and selection (r), being fully equipped with accessories such as (i) interserial numbering with or without circumferencing. (ii) view mixing with or without substitution, and (iii) displacement mixing with a variety of options as used in charts 2,3 and 4 in the text. Solid State View Mixing Scheme and Square Kinematics being arrangement devices in Numeration Science amply justify the designation of Numeration Science as Science of number and arrangement.

FINDINGS

(i) As the *calculation face* the coin of permutations and combinations of specified set (n) and selection (r) is operational by reason of formulary; likewise, the *computation faces* of the coin of permutations and combinations of specified set (n) and selection (r) is henceforth rendered operational by Solid State View Mixing Scheme(ii) Proliferation and diversification of the input set are two inseparable achievements of permutation worked by Solid State View Mixing Scheme.(iii) *Interserial numbering* operational in the computation of factorials of permutations of specified set (n) and selection (r) by the technique of Solid State View Mixing Scheme is a vital ingredient, and no less an innovation.

CONCLUSION AND SIGNIFICANCE

Computation of factorials of permutations and combinations of specified set (n)and selection (r) is a great theatre of digital arrangement hitherto asleep in academics but is now introduced for academic operations in computational combinatorics in Mathematics by Solid State View Mixing Scheme. The significance of this presentation is threefold Both Solid State View Mixing Scheme is applicable to the derivation of the genetic code, the workforce of strength 24 in protein synthesis. Competent techniques for computing factorials of specified set (n) and selection (r) are now available for the first time for confirmation of the calculated number of factorials and they excel in proliferation and diversification in the theatre of digital arrangement. Lastly a new numbering system, designated*, Interserialnumbering* operational in Solid State View Mixing Scheme is introduced to the world of computational combinatorics. The two arrangement devices qualify as algorithms in Numeration Science emerging as a study subject …. academic discipliner in this 21st Century.

RECOMMENDATIONS

Let this presentation be widely publicized for learning and use by the world of computational combinatorics in Mathematics.

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