Code Generation Models and the Enigmatic Code

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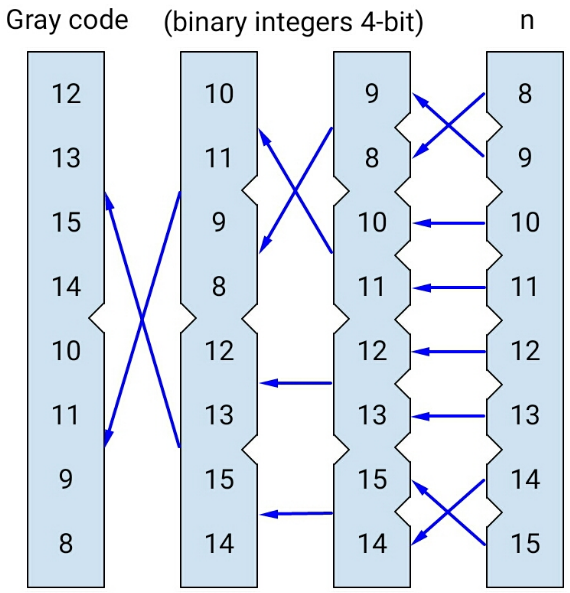
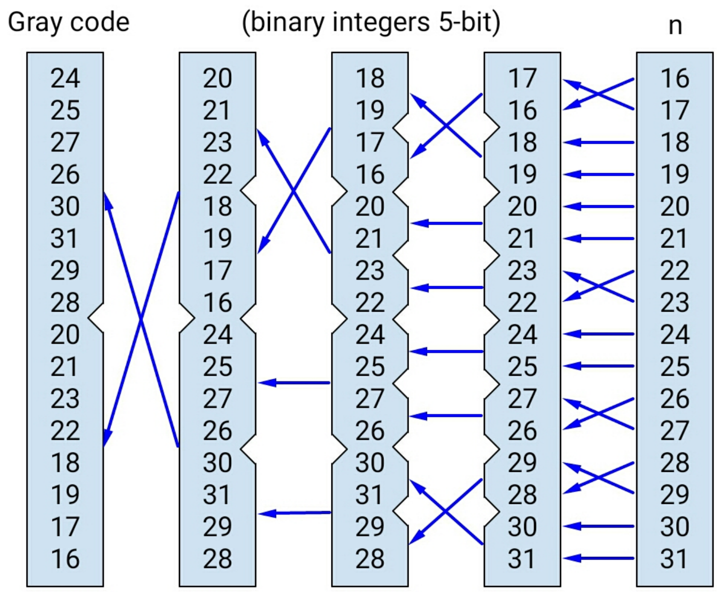
Abstract

Models are presented that describe the process of creating the Gray code and other similar codes without any calculation. These models are based on simple and rigid rules. Of the codes obtained in this way, only one does not correspond to a sequence of OEIS, and it remains unknown whether it can be used somewhere.

Below we see the model for creating the Gray code (in decimal) for all integers that have a length of four and five digits in their binary expressions.





The numbers arranged in the last column are rearranged in gray code in the first column by transferring groups of numbers from column to column, in the way the arrows show. There are only two types of paired arrows for carrying numbers, crosswise (×) and parallel (=). The number of columns is always equal to the length of the binary expressions of the numbers to be encoded. The patterns formed in the columns of the arrows are the same in both tables.

The rules for the arrangement of arrows are defined by the Thue Morse sequence:

01101001100101101001011001101001, ...

We omit the first digit and divide the sequence into groups of 1, 2, 4, 8, ... digits:

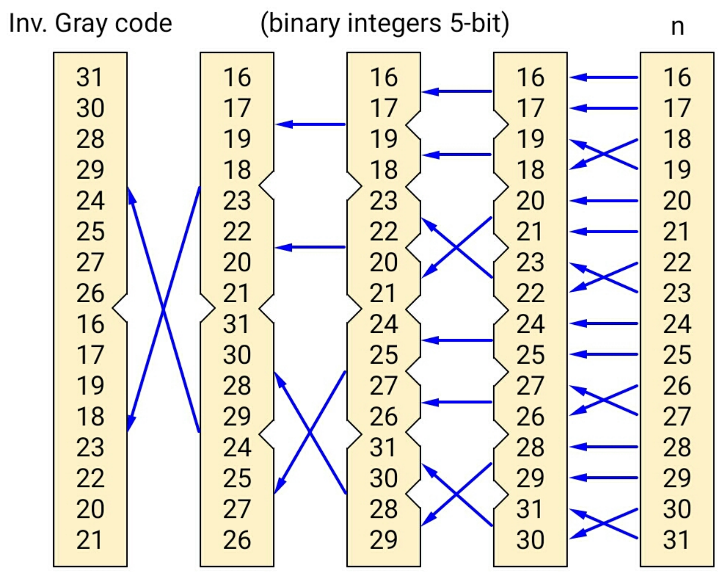
1, 10, 1001, 10010110, 1001011001101001, ...

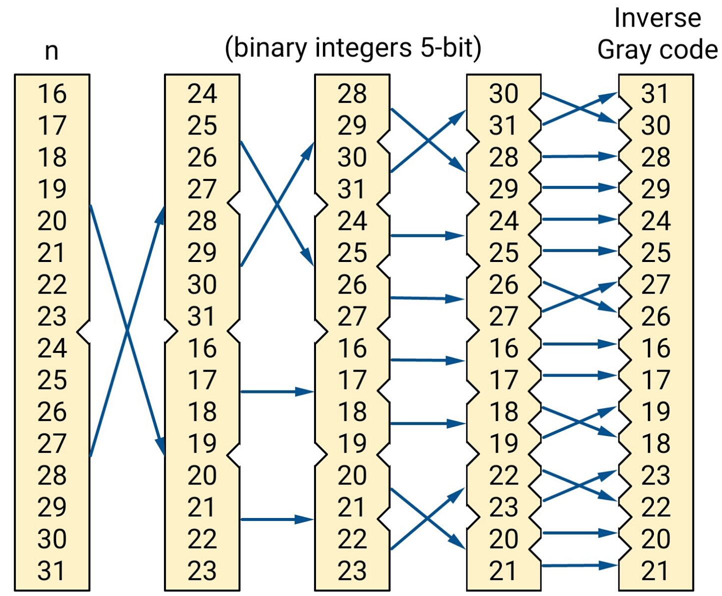
Each term in this sequence is a double copy of the previous term, but the digits of the copy placed on the right side are reversed. We now set "=" = 0, "×" = 1 and replace with these symbols the digits of the last sequence. So we will have

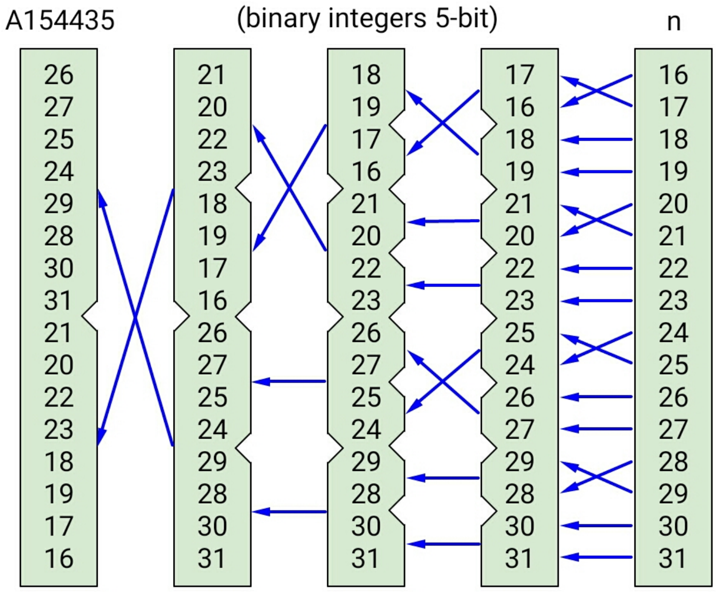
×, × =, × = = ×, × = = × = × × =, ...

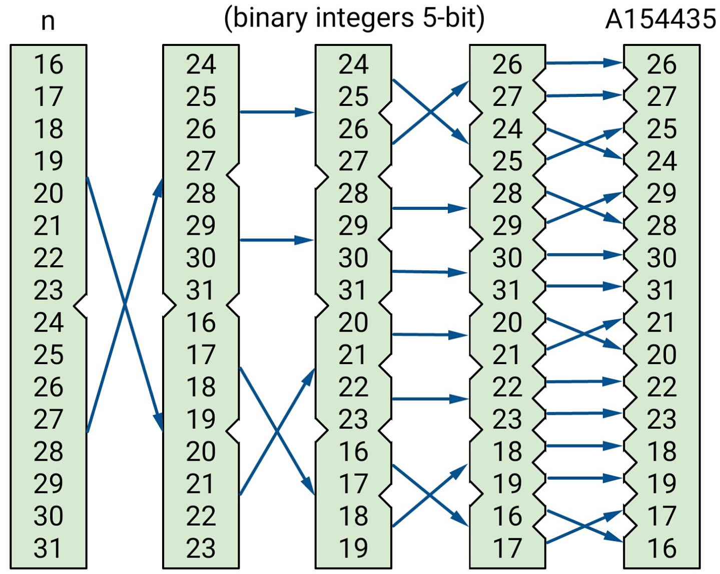
Then we place in this order the symbols in the successive columns of the arrows of the above table so that they are read from top to bottom.

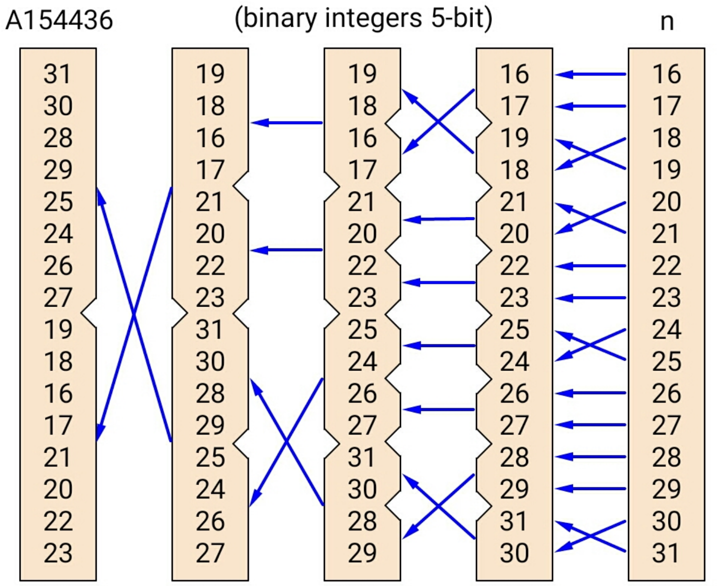
A similar procedure applies to the following models, with the difference that in place of the Thue Morse sequence the binary sequence 101010... is also used.

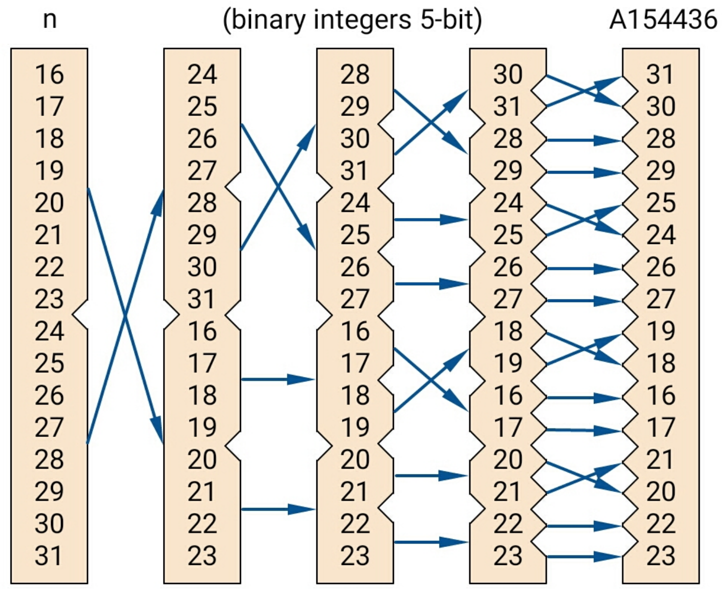



n
(binary integers 5-bit)
Inverse
Gray code
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
24 25 26 27 28 29 30 31 16 17 18 19 20 21 22 23
28 29 30 31 24 25 26 27 16 17 18 19 20 21 22 23
30 31 28 29 24 25 26 27 16 17 18 19 22 23 20 21
31 30 28 29 24 25 27 26 16 17 19 18 23 22 20 21


A154435
(binary integers 5-bit)
n
26 27 25 24 29 28 30 31 21 20 22 23 18 19 17 16
21 20 22 23 18 19 17 16 26 27 25 24 29 28 30 31
18 19 17 16 21 20 22 23 26 27 25 24 29 28 30 31
17 16 18 19 21 20 22 23 25 24 26 27 29 28 30 31
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


n
(binary integers 5-bit)
A154435
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
24 25 26 27 28 29 30 31 16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31 20 21 22 23 16 17 18 19
26 27 24 25 28 29 30 31 20 21 22 23 18 19 16 17
26 27 25 24 29 28 30 31 21 20 22 23 18 19 17 16





We observe the following.

1. Each column after the first contains the same number of pairs of arrows of the type "=" and "×".

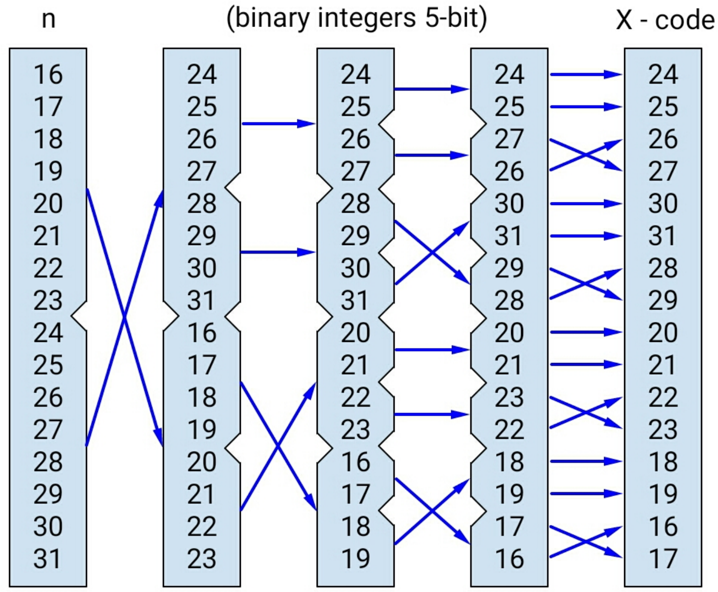
2. The number of these pairs is doubled in each subsequent column.

3. The rules for arranging pairs in each column are determined by the arrangement of the pairs in the previous column.

4. In each diagram, all the vertices or all the bottoms of the columns are occupied by pairs of "×" type arrows.

Violation of these rules leads to insignificant sequences.

We also notice that each code sequence is created in two ways, except for the Gray code and the unknown x code. These two sequences do not coincide with each other as would be expected based on the above.



The relevant sequences and their definitions, by OEIS

A003188

Decimal equivalent of Gray code for n.

0, 1, 3, 2, 6, 7, 5, 4, 12, 13, 15, 14, 10, 11, 9, 8, 24, 25, 27, 26, 30, 31, 29, 28, 20, 21, 23, 22, 18, 19, 17, 16, ...

A006068

a(n) is Gray-coded into n (inverse Gray code).

0, 1, 3, 2, 7, 6, 4, 5, 15, 14, 12, 13, 8, 9, 11, 10, 31, 30, 28, 29, 24, 25, 27, 26, 16, 17, 19, 18, 23, 22, 20, 21, ...

A154435

Permutation of nonnegative integers induced by Lamplighter group generating wreath recursion, variant 3: a = s(b,a), b = (a,b), starting from the state a.

0, 1, 3, 2, 6, 7, 5, 4, 13, 12, 14, 15, 10, 11, 9, 8, 26, 27, 25, 24, 29, 28, 30, 31, 21, 20, 22, 23, 18, 19, 17, 16, ...

A154436

Permutation of nonnegative integers induced by Lamplighter group generating wreath recursion, variant 1: a = s(a,b), b = (a,b), starting from the state a.

0, 1, 3, 2, 7, 6, 4, 5, 15, 14, 12, 13, 9, 8, 10, 11, 31, 30, 28, 29, 25, 24, 26, 27, 19, 18, 16, 17, 21, 20, 22, 23, ...

A010060

Thue-Morse sequence: let A_k denote the first 2^k terms; then A_0 = 0 and for k >= 0, A_{k+1} = A_k B_k, where B_k is obtained from A_k by interchanging 0's and 1's.

0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, ...

A133468

A080814 complemented, then interpreted as binary and then re-expressed in decimal form (e.g., "1221" = "0110"). Alternately, view as A080814 with "1" mapped to "1" and "2" mapped to "0".

1, 2, 9, 150, 38505, 2523490710, ...

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