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Periodic table as a Binary table for Drug Encryption

M. Yamuna*

K. Karthika

SAS, VIT University, Vellore, Tamilnadu, India, 632 014.

Corresponding Authors:
M. Yamuna
myamuna@vit.ac.in

Abstract:
Modern living styles and change is food habits have lead to new diseases and this number is getting multiplied. Research regarding finding medicines for these diseases is in active process and new drugs get released in market frequent. In developing these new drugs communicating details of these findings cannot be avoided. Any drug is best represented using its molecular formula. In this paper we have developed a new binary periodic table and hence use this for encrypting details about any drug.

Keywords: periodic table, molecular formula, binary string, encryption.

Introduction

In cryptography, encryption is the process of encoding messages or information in such a way that only authorized parties can read it. Encryption doesn't prevent hacking but it reduces the likelihood that the hacker will be able to read the data that is encrypted. In an encryption scheme, the message or information, referred to as plaintext, is encrypted using an encryption algorithm, turning it into an unreadable ciphertext. This is usually done with the use of an encryption key, which specifies how the message is to be encoded. Any adversary that can see the ciphertext should not be able to determine anything about the original message. An authorized party, however, is able to decode the ciphertext using a decryption algorithm, that usually requires a secret decryption key, that adversaries do not have access to. For technical reasons, an encryption scheme usually needs a key – generation algorithm to randomly produce keys (1).

The periodic table of the chemical elements is a table that displays all known chemical elements in a systematic way. The elements in the periodic table are ordered by their atomic number (Z) and are arranged in periods (horizontal rows) and groups (vertical columns). The layout of the periodic table is designed to illustrate periodic trends, similarities and differences in the properties of the elements (2).

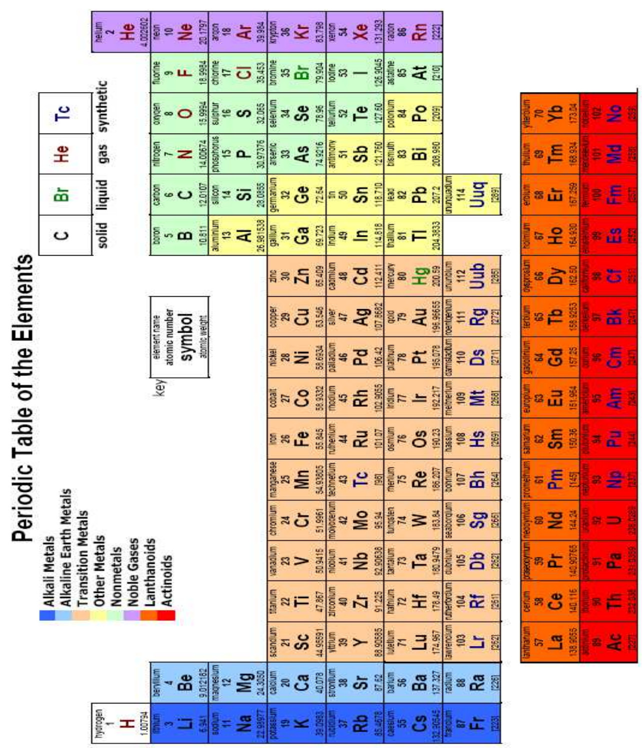


Table 1

Materials and Methods

Insertion Method

In (3), H.J. Shiu et al introduced the insertion method, which is wide use now. A snapshot (3) of insertion method is given below.

Method 1: The Insertion Method

To simplify the discussion, the most basic version is outlined and a simple example is given. The more complicated version of the method will be presented after the basic one is explained. All of the methods use a reference sequence s suppose the secret message M is 01001100. Let S be ACGGTTCCAATGC. The method works as follows:

Step 1: Code S into a binary sequence by using the binary coding rule. Thus the sequence s will now become 00011010111110101000011 1001.

Step 2: Divide S into segments, whereby each segment contains k bits. Suppose k is 3. Then there are the following segments: 0000, 110, 101, 111, 010, 100, 001, 110, 01.

Step 3: Inserts bits from M, one at a time, into the beginning of segments of S. The result is as follows: 000, 1110, 0101, 0111, 1010, 1100, 0001, 0110, 01. Those segments without any secret message inserted should be ignored. Thus, there are the following binary sequence: 000011100101011110101100000 10110.

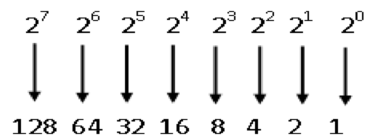
Step 4: Use the inverse function of the binary coding rule to produce the following faked DNA sequence: S′=AATGCCCTGGTAACCG. As the reader can see, this sequence is quite different from S.

Step 5: Send the above sequence S′ to the receiver.

Binary Conversion

In mathematics and digital electronics, a binary number is a number expressed in the binary numeral system, or base – 2 numeral system, which represents numeric values using two different symbols: typically 0 (zero) and 1 (one). More specifically, the usual base - 2 system is a positional notation with a radix of 2. Because of its straightforward implementation in digital electronic circuitry using logic gates, the binary system is used internally by almost all modern computers and computer-based devices such as mobile phones (4).

Replace each atomic number into binary representation.



Results and Discussion

In this section we have provide a construction of binary table and hence use it for encrypting details about any exiting drug or any new finding.

Construction of Binary Periodic Table

We can use any one of the values either atomic number or atomic weight of the chemical elements for binary conversion. We shall construct a table based on the chemical element’s atomic numbers. Using the usual periodic table 1 as the base table we generate the following binary table.

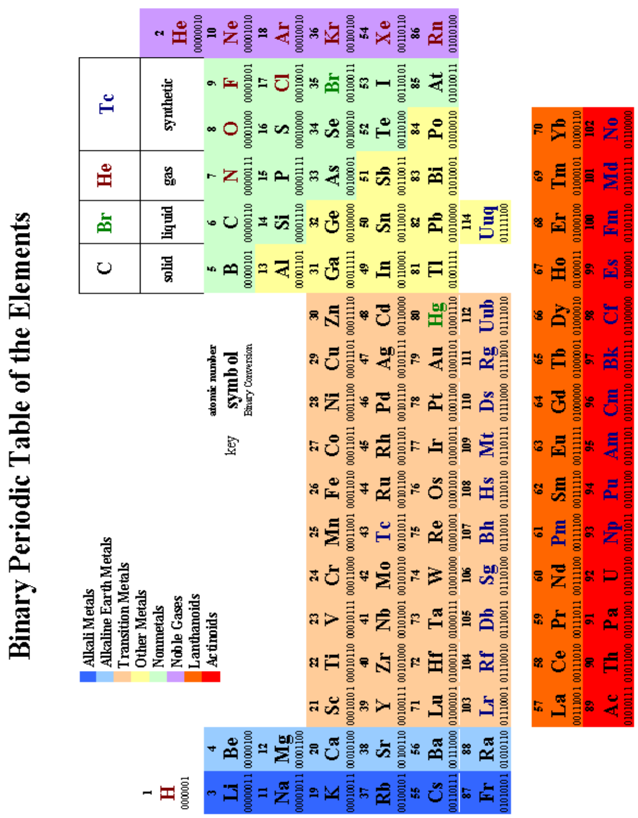


Table 2

Converting Molecular Formula to Binary String

Any molecular formula is a combination of chemical elements and numbers. We use this molecular formula for generating a binary string of the drug. A numerical value in the chemical formula represents the number of times the chemical element occurs in the drug. We replace the numbers by the original chemical elements itself. For example Na_3Cl_2 is replaced by NaNaNaClCl. Then we replace each elements by its corresponding 8 bit code. In the above example from Table 2 Na is replaced by 11 11 11 and Cl by 17 17 17 to obtain the binary string 00001011 00001011 00001011 00010001 00010001.

Encryption algorithm

Step 1: Let S be the molecular formula for any drug.

Step 2: Convert S into S_1 as explained in section3.2

Step 3: Replace each chemical element by its corresponding binary string S_2 using Table – 2.

Step 4: Obtain a new binary string S_3 using the insertion method explained in section 2.1.

Step 5: Send S_3 to the receiver.

By reversing the procedure we can decrypt the binary string into its corresponding chemical formula for the particular drug.

Example:

Consider a random binary string

M:

0000011101101101011101010101101000000111000110011000000111110101010110000101111111000000110101010010011011011100001000000011110110110001111011010100000011010101101101010101010100000111000000110111101110000000001111000000000.

Consider a chemical formula of Aciclovir: $C_8H_{11}N_5O_3$ to be encoded. Rewrite the chemical formula as follows

S: CCCCCCCCHHHHHHHHHHHNNNNNOOO

Convert each chemical element into its corresponding atomic numbers.

S1: 6 6 6 6 6 6 1 1 1 1 1 1 1 1 1 1 1 7 7 7 7 7 8 8 8

By using Table 2 convert S1 into S2

S2:

00000110 00000110 00000110 00000110 00000110 00000110 00000110 00000110 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000111 00000111 00000111 00000111 00000111 00001000 00001000 00001000

We now use the insertion method to insert string S2 into M. We divide M into segments of length k = 1 and insert S2.

0000000000111110001010001011011000101010001101100010001010011100000000000001111100000001010010110100000000000111101010100010011100100010100000000001100010101010101011000000000000001011

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00100010001000110000000101000101101010101000000
00011000000000000010111010001010001011000000 1
0101010011010001000100001000000000101000 11001
0001010011111001000100011011100100010000 1010
1001010100001010100101000101111110010101 0010
000000 000000011101010 000000000010000000.

Note that the red color numbers represents the original one.

So the given drug can be encrypted as follows and send S3 to the receiver

S3:

000000000011111000101000101101100010101000 11
0110001000101001110000000000000111111000000010
1001011010000000000011110101010001001110 01000
10100000000011000101010101011000000000000001011
00100010001000110000000101000101101010101000000
00011000000000000010111010001010001011000000 1
0101010011010001000100001000000000101000 11001
0001010011111001000100011011100100010000 1010
1001010100001010100101000101111110010101 0010
000000 000000011101010 000000000010000000.

Suppose the received message is

10000010101111110101010101001010000000000000001
01101010000000001111000000100000111111010001000
10011100000001010001101100000010001011111100000
00000011111010100010001101100000010101001 1110
10101010100000001000000000000000001000010101010
101100100000010000011001000000100010011010001 0
1010100100001000000100001101010101010000 10000
1010101000011010000001000000110001010100000001
10001000100010010010101010101001000010001010
000100100000000100001100000010000111011010000 0
110000100000010000011010100

Collect only red color numbers alone

000001100000001100000001100000001100000001100000
011000000011000000011000000011000000011000000110
000000001000000001000000001000000001000000010000
000100000000100000000100000000100000000100000001
0000000010000000010000000010000000010000001110000
100000001000

Split the binary string into 8 bit string

00000110 00000110 00000110 00000110 00000110 00000110 00000110 00000110 00000110 00000110 00000110 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000111 00001000 00001000

By using Table 2 convert each bit into atomic numbers.

6 6 6 6 6 6 6 6 6 6 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 7 8 8

Again by using Table 2, convert atomic numbers into its corresponding chemical elements

CCCCCCCCCCCHHHHHHHHHHHHHHHNOO

Obtain the required chemical formula

$C_{11}H_{15}NO_2$

From this we can obtain the original chemical formula for MDMA (3,4-methylenedioxy-N-methylamphetamine.

Conclusion

A binary string can be of any length and numerous binary strings are available in public domain. So it is difficult to find the difference between a fake binary string and the encrypted one. We have used insertion method. So all the advantages of encrypting a message using this method applies here also. Moreover since each chemical element is converted into a binary string, it is difficult for anyone to guess this as a chemical formula since a periodic table using binary string is not in use.

References

1) http://en.wikipedia.org/wiki/Encryption.

2) http://www.webqc.org/periodictable.php

3) Shiu H.J, Ng K.L, Fang J.F, Lee R.C.T, Huang C.H. Data hiding methods based upon DNA sequences, Information Sciences 2010; 180: 2196 – 2208.

4) http://en.wikipedia.org/wiki/Binary_number.

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