

MIND-BLOWING SIMILARITIES IN THE WAY THAT INFORMATION IS STORED, TRANSFERRED, AND USED IN THE RESPECTIVE WORLDS OF SILICON AND CARBON

Text bracketted in quotes “ “ comes from, Leventhal, L. and Walsh, C. “Microcomputer Experimentation with the Intel SDK-85”, Prentice Hall 1980.

1. “Most I/O devices transfer data serially rather than in parallel. Serial data transmission greatly reduces hardware requirements since only one data line is needed.”

Information is stored in DNA as a linear array of units called “nucleotides”. Instead of using 0’s and 1’s to encode information, DNA uses 4 nucleotides, namely, A, G, C, and T. The information in DNA is accessed, copied, or transmitted serially

2. “However, since computers handle data in parallel, conversion is necessary on both input and output to interface a serial communication line.”

Since the information in DNA is utilized in parallel, conversion is necessary at the output from the serial communication line.

Serial to parallel (SP) conversion in the computer utilizes 256 ($=2^8$) possible 8-bit-containing bytes; SP conversion of the information in DNA utilizes 64 ($=4^3$) possible 3-bit triplets. In the computer, the byte specifies either an operation or data; in DNA the triplet specifies an amino acid (1 of 20) selected by a lookup table. A series of triplets in DNA ultimately is translated into a linear array of sequential covalently attached amino acids called proteins; The 20 amino acids are the units from which proteins are assembled.

256 possible bytes exceeds the requirements needed to specify the 128 ASCII character dataset; 64 possible triplets exceeds the requirements needed to specify the 20 amino acid dataset.

3. “.....we must have some way to determine when data is (sic) available and to identify the beginning and ending of transmission. One simple way of doing this is to place start and stop bits around the actual data.”

The series nucleotide triplets which specify the sequence of amino acids in a protein are bracketted by two sets of start and stop signals. One set of signals, the outer one, specifies where to start and stop compiling the DNA sequence for use; the other set, the inner one, specifies where to start and stop the SP conversion for translation into protein.

DNA serves as a repository of genetic information, and can be thought of as the hard drive where genetic information is stored in a stable but not used form. In order to use the information in DNA to synthesize protein, it must be downloaded into the functional equivalent of RAM, known as messenger RNA. Just like the information in RAM which evaporates when the program is QUIT, messenger RNA is degraded when it is no longer needed. Messenger RNA contains a linear working image of the gene which also linear.

In the computer, information can be transferred between RAM and the hard drive and vice versa; in the cell, information can be transferred between RNA and DNA and vice versa. The transfer of information from DNA to RNA creates a working image of a gene and is called “transcription”. The transfer of information from RNA to DNA creates a stable inheritable copy of the image of a gene and is called “reverse transcription” Reverse transcription is the less commonly used, but not less important pathway for information transfer, e.g., by retroviruses (HIV is one) when they cause cancer or leukemia.

Recall computer viruses which replicate themselves and metastasize to other systems.

4. “Many errors can occur in data communications, particularly if the connections are noisy or if the distances are long. One potential problem is noise that looks like a start bit to the receiver.”

Addition or deletion of a single bit to a byte in a program can cause the transmission of the byte or the execution of the program to which it belongs to crash. Similarly, the addition or deletion of a single nucleotide from one of approximately 300 triplets in the average protein can cause the reading of the genetic message to get out of register, resulting in the premature termination of the protein which it encodes.

In summary, the CENTRAL DOGMA of molecular biology: “DNA makes RNA makes PROTEIN (makes MONEY)”

5. DNA chips and more, as time permits.

Bernard Weisblum
University of Wisconsin Medical School
Pharmacology Department
1300 University Avenue
Madison, WI 53706

+ (608)-262-0972 (desk)
+ (608)-262-1733 (dept)
+ (608)-263-2490 (lab)
+ (608)-238-6663 (home)
+ (608)-262-1257 (fax)
weisblum@facstaff.wisc.edu
Antibiotics class notes: <<http://weisblumlab.pharmacology.wisc.edu>>
