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THE MAIN TASKS OF CODING AND WAYS TO FIND THE OPTIMAL CODE

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When we talk about the transfer of information between objects, we usually mean a complex of information about the object as a whole or about the state of its individual elements. Specific information received about the object (source of information) is called news. News is transmitted with the help of signals. A signal is a carrier of information in time and space. There are several types of signals:

- visible signal (television images)
- sound signal (call)
- electrical signal (positive and negative impulses)
- radio signal and i.a.

One signal can lead to another signal. Signals can be related to each other both spatially and temporally. A signal is the result of a change in the state of the object. The laws of changing the state of the object in the process of information transmission are called code.

Uploading news to signals goes through the following stages:

- a) conversion (improving the message according to coding);
- b) coding (construction of news elements according to a certain law);
- v) modulation (affecting the transmission medium to convert the coded message into a signal).

Signals are static and dynamic according to their state in time. A static signal indicates a permanent change in the state of the object. A dynamic signal reflects the continuous change of the state of the object.

The sequence of letters, signs and quality marks at the input of the communication channel is called the input code word, and those at the output are called the output code word. News compiled from input code words is called primary, and news compiled from output code words is called secondary news. In this case, coding is viewed as a transition from primary messages to secondary messages, where code is conceived as an algorithm for making that transition.

News and signals are divided into 2 types according to their structure: continuous and discrete. If the signal (message) takes an arbitrary value in a finite interval of amplitudes, it is continuous, if it takes a finite number of values, it is discrete.

Compared to continuous signals, discrete signals are more widely used in information transmission. Because discrete signals are more resistant to interference in the communication channel, errors are easy to detect and most importantly, easy on the computer is processed. Discontinuous signals are discrete by the quantization method since signals can be introduced, we only focus on discrete signals we will deliver.

Discrete news units are called discrete broadcasts. These show has different physical properties including quality are called symptoms. From quality features: polarity, amplitude, examples are time, frequency and frequency-time signs.

Since the polarity sign is based on negative and positive impulses, the number of qualities is $m=2$.

Although the amplitude sign is theoretically infinite, in practice only two signs are used: signal present, signal absent.

The number of time signatures is $m \geq 2$. Elementary program extension is a common means of protection against obstacles.

When we say frequency sign, we mean the frequency of data completion is held.

Often the joint use of several quality marks is done. This allows to increase the reliability of transmission.

Such a code is a fixed-length, multi-frequency data set is organized. Elementary data is sorted by time. This kind the number of qualities is $k = m_t + m_z$. Here: m_t and m_z – suitable is the number of frequency and time signatures.

Depending on the selected encoding method, news programs are grouped in the ensemble.

Since each message transmitted is the result of a random selection from the original ensemble of messages, the reception of each message is certain is a probable random event.

The main task of the "theory of information and coding" is to develop such a communication system that its power, frequency band, transmission time, etc. ensure the necessary transmission accuracy at the minimum value of such parameters.

The following properties are important for the code to be optimal:

- a) abundance in each code word must be minimum or zero;
 - b) the codewords of the optimal code are independent of the same probability
- must be built from symbols.

So the first principle of optimal coding is in the code maximization of information, and the second principle is highly probable code word is short.

Based on these principles, M news ensemble to encode optimally:

- 1) arrange the news in descending order of probability;
- 2) divide the ensemble of news into 2 groups with the same probability;
- 3) mark the first group with 0 and the second with 1;

- 4) divide each group into 2 subgroups with the same probability;
- 5) marking subgroups with 0 and 1;
- 6) work should be continued until 1 element remains in each group.

Let us show from the beginning that the news with equal probability is optimal
the code becomes a complete code.

For the code to be an optimal code, the Haffman method is used. So, the code built with this method is optimal. For example, given the following P_i probabilities. Let's write P_i in the first column, P_i 's are written starting from zero and in descending order.

0,20	0,20	0,23	0,37	0,40	0,60	0	1	00	01	10	10
0,20	0,20	0,20	0,23	0,37	0,40	1	00	01	10	11	11
0,19	0,19	0,20	0,20	0,23			01	10	11	000	000
0,12	0,18	0,19	0,20					11	000	001	010
0,11	0,12	0,18							001	010	011
0,09	0,11									011	0010
0,09											0011
$S \rightarrow 4$	$S \rightarrow 1$	$S \rightarrow 1$	$S \rightarrow 1$	$S \rightarrow 1$		$1 \rightarrow S$	$1 \rightarrow S$	$1 \rightarrow S$	$1 \rightarrow S$	$4 \rightarrow S$	

The smallest probabilities are written in the last 2 lines, and $0.09+0.09=0.18$, by comparison, the number 0.18 moves to the 4th place, and let's note it in the last line. Again, the sum of the last 2 lines $0.12+0.11=0.23$ goes to the 1st place. The sum of the last numbers goes back to the first line. If we fight this process, then it will happen. The operation was completed. Let's do the opposite and find the codes. Let's write 0 above and 1 below. Let's move along the last line of the straight table, reverse the arrows. In this operation, instead of 1 code, 2 codes are generated.

The process ends when the first given P_i number of codes is received, that is, the flat table is 100% executed.

References

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