Student' own discoveries in information theory curriculum

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***Abstract* — A recent approach to learning Information and Coding Theory is suggested basing on power of modern computer science. Students willingly try to rediscover known and famous technologies by means of programming them. In order not to distract their attention, an 'easy programming' is suggested for what MATLAB seems to be the best tool. Collection of programs developed mutually by author and his students forms an 'Information Theory Digital Laboratory'.**

***Keywords* — Information Theory; educational curriculum; coding-decoding; error-correcting codes.**

I. INTRODUCTION

Information Theory is a discipline fundamental for many modern specialties. It is so important to educate students in accordance with recent methodology involving computer technologies. Author suggests an active educational approach called "Student's own discoveries". It includes suggestion to students a virtual repetition of fundamental inventions from this area by means their own programming. MATLAB seems to be one of most preferable tools for this because it allows to pay less attention to programming technology itself but more for essence of the problem in focus. Author wrote a textbook about [1]. It is his intention to present this material now.

II. STUDENT "DISCOVERIES"

Initial invitation for student's discoveries should be an overview of coding technologies of recent days unlikely to meet in classical textbooks yet, and a Gallery of Information Era Heroes; they may prepare essays about them. Simple coding programs like Morse (Fig. 1) or Bodo codes (Fig. 2), variable length coding and/or constant-length one as well as other similar ones may be suggested next [2, 3]. Any language may be used here to understand the problem deeper, but MATLAB seems to be the most easy one. Another useful research programming task for them may be an analysis of a literature text for frequency of its characters [2, 3]; such work required several years in the past but few minutes today. Having determined such probabilities, a vector p=[p1, p2, p3, . . , pn], MATLAB allows to get entropy of corresponding alphabet in one simple line:

>> *H=-sum*(*p* .* *log*2(*p*))

Similar, programs for channel entropies from three points of view (i.e. Receiver vs. Sender, Sender vs. Receiver and their mutual entropy) are worth to be prepared and analyzed by students. Channel noise may be easily simulated in any programming language by probabilities for 1 to being changed to 0, and vice versa, 0 to 1.

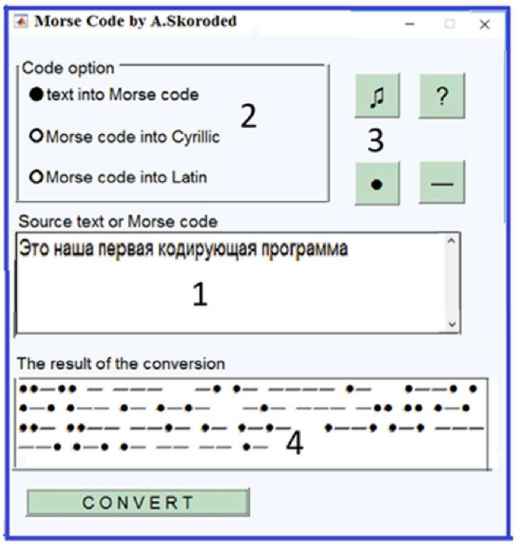

Figure. 1. GUI-program for coding and decoding by Morse alphabet: 1 – input window, 2, 3 – options acoustic reproduction, getting help etc., 4 – window for encoded text

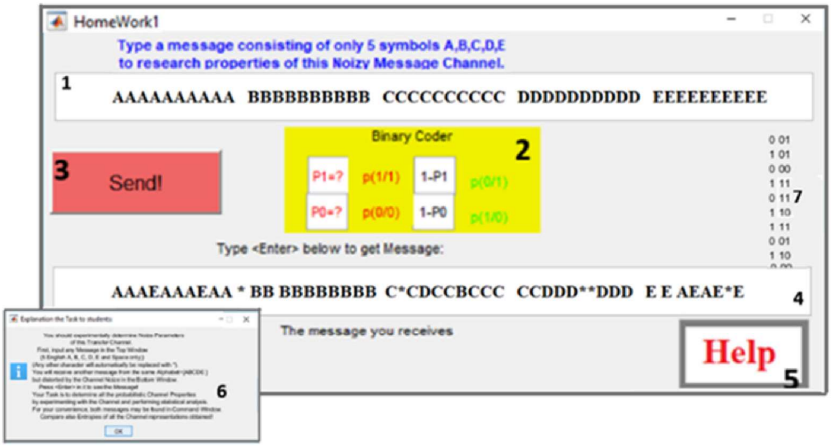

Figure. 2. GUI-program HomeWork1 for laboratory work on determining probability parameters of an information transfer channel: 1 – window for input messages; 2 – hidden parameters of binary noise; 6 – Help, instruction to work

One of the most challenging problems in information theory and technology is development of 'smart codes' able to correct transfer errors. Redundancy is to be used for them but as minimized as possible. Application of theory is suggested to students to develop such coding technology with supplementing programs [4, 5].

Having developed them allows to get statistical analysis how these technologies reduce percentage of errors. All these constitute Digital Laboratory for virtual examination of information transfer technologies.

III. CONCLUSIONS

It is up-to-date to suggest an innovative educational method of 'Own student' discoveries' to learn actively and research problems in Information and Coding Theory curriculum. It means developing student's own computer programs that allow to focus more deeper on the problem. It is advised to apply an 'easy' programming for doing this. MATLAB seems to be the most preferable language [6].

'Digital laboratory' of Information Theory may be constantly developed further by educators and student's mutual efforts.

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REFERENCES

[1] Є. О. Гаєв. Теорія інформаційних процесів методом відкриттів з MATLAB і Java. Навчально-дослідницька робота. К. : НАУ, 2021. 140 с. (in Ukrainian)

[2] Ye. A. Gayev et all. Digital Laboratory of Information Processes Theory: an innovative educational approach. Матеріали XIII Міжнародної науково-технічної конференції "Авіа-2017". 19–21 квітня, Київ : НАУ, 2017. 9.42, p. 638–641. URL: http://avia.nau.edu.ua/doc/avia-2017/AVIA_2017.pdf

[3] Ye. A. Gayev and V. M. Azarskov. Educational "Own Discoveries" Method by an easy MATLAB-Programming for Engineers. URL: http://proceedings2018.caeconference.com/posteraward/PosterAward_2018_finalists%2038.pdf

[4] O. O. Boiko, Digital laboratory for information process theory. Java-realization. Batchelor Thesis. Kyiv : NAU, 2018. 85 pp.

[5] A. V. Baboryga, Digital laboratory for information process theory. MATLAB-realization. Batchelor Thesis. Kyiv : NAU, 2018. 90 pp.

[6] Гаєв Є. А., Азарсков В. Н. Сучасне програмування для інженерів : навч. посіб. *Програмування та математика з MATLAB*. 2019. Ч. 1. 300 с. *Складні типи даних та алгоритми, інтелектуальні програми*. 2016. Ч. 2. 198 с.