

Project 2. . Available

Project dates: **November 1th to June 30th**

Project Title: **DNA Codes**

Adviser: **Vyacheslav Rykov**

Abstract:

DNA nanotechnology often requires collections of oligonucleotides called DNA free energy gap codes. We will use new theoretical results for designing new DNA codes. In this project we will study how to design these codes to accomplish a desired amount of work within an acceptable error rate. Using a statistical thermodynamic and probabilistic model of DNA code fidelity and mathematical random coding theory methods, we will find DNA code design parameters, e.g., strand number, strand length and sequence composition, needed to achieve experimental goals.

In this project we propose that the participating student engages in the following activities:

A. Study the theoretical aspects of the problem by using following sources:

1. A.G. D'yachkov, A.J. Macula_, W.K. Pogożelski, T.E. Renz, V.V. Rykov, and D.C. Torney, A Weighted Insertion-Deletion Stacked Pair Thermodynamic Metric for DNA Codes. The Tenth International Meeting on DNA Computing. Milano-Bicocca, Italy 2004
2. .G. D'yachkov, A.J. Macula_, V.V. Rykov, "Random Coding Bounds for DNA Codes Based on Fibonacci Ensembles of DNA Sequences", 2007, be published.
3. M.A. Bishop, A.G. D'yachkov, A.J. Macula, T.E. Renz, V.V. Rykov. Free Energy Gap and Statistical Thermodynamic Fidelity of DNA Codes, 2007, be published
4. A. Serfling, "Approximation Theorems of Mathematical Statistics", *John Wiley*, 1985.
6. F.J. MacWilliams, N.J.A. Sloan, "The Theory of Error-Correcting Codes", *Amsterdam, The Netherlands: North Holland*, 1977.

This will help her/him understand the research topic and serve as an introduction to the final, written, research report.

B. Develop algorithms for generating new DNA codes.

C. Write computer programs for generating random strings, and generating DNA codes.

D. Run the programs and help the adviser to generate new DNA codes, and develop web-site with generated codes.

E. Put together her/his findings, written software, significant graphs, tables, and so on in the final research report to be presented at the MAM Symposium.

OTHER REQUIREMENTS: The students interested in the project above are expected to have taken and passed with maximal grades or close MATH 1950(Calc I), MATH 1960(Calc II), MATH 4050 (Linear Algebra) and MATH 4740 (Introduction to Probability and Statistics). They should be familiar with computers and MAPLE. The student is also expected to meet with the adviser a couple of times a week, (or communicate actively by e-mail) for discussions, guidance, and progress reports during the preparation period of the project.