University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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MASc (University of Victoria, 2012)
BEng (University of Victoria, 2007)

"Counting Prime Polynomials and Measuring Complexity and Similarity of Information via Necklace Factorizations"

Department of Electrical and Computer Engineering

Wednesday April 20, 2016
4:00 P.M.
Engineering and Computer Science Building
Room 468

Supervisory Committee:
Dr. Stephen Neville, Department of Electrical and Computer Engineering, University of Victoria (Co-Supervisor)
Dr. T. Aaron Gulliver, Department of Electrical and Computer Engineering, UVic (Co-Supervisor)
Dr. Venkatesh Srinivasan, Department of Computer Science, UVic (Outside Member)

External Examiner:
Dr. Hirosuke Yamamoto, Department of Complexity Science and Engineering, University of Tokyo

Chair of Oral Examination:
Dr. Ahmed Sourour, Department of Math, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

This thesis explores an analogue of the prime number theorem for polynomials over finite fields as well as its connection to the necklace factorization algorithm T-transform and the string complexity measure T-complexity. Specifically, a precise asymptotic expansion for the prime polynomial counting function is derived. The approximation given is more accurate than previous results in the literature while requiring very little computational effort. In this context asymptotic series expansions for Lerch transcendent, Eulerian polynomials, truncated polylogarithm, and polylogarithms of negative integer order are also provided. The expansion formulas developed are general and have applications in numerous areas other than the enumeration of prime polynomials.

In particular, an isomorphism between the equivalence classes of aperiodic necklaces and monic prime polynomials is utilized to derive an asymptotic bound on the maximal T-complexity value of a string. Furthermore, the statistical behaviour of uniform random sequences that are factored via the T-transform are investigated, and an accurate probabilistic model for short necklace factors is presented.

Finally, a T-complexity based conditional string complexity measure is proposed and used to define the normalized T-complexity distance that measures similarity between strings. The T-complexity distance is proven not to be a metric. However, the measure computes in linear time and space making it a suitable choice for big data sets.